

CFRC MAINTENANCE OF WAY INSTRUCTIONS - PHASE 2 SOUTH

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TYP DWG	2508	132RE, 136RE and 141RE Rail Sections
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TYP DWG	2527	Heavy Duty Road Crossing, Full Width Concrete on Wood Ties
TYP DWG	2536	Normal Duty Road Crossing, Timber and Asphalt Crossing
TYP DWG	2537	7 3/4" x 14 3/4" Tie Plate for 6" Base Rail Sections
TYP DWG	2540	7 3/4" x 14" Tie Plate for 5-1/2" Base Rail Sections
TYP DWG	2601	Roadbed Sections
TYP DWG	2602	Ballast Sections
TYP DWG	2604	Clearance Diagrams
TYP DWG	2605	Clearance Matrix
TYP DWG	2607	Bridge Approach Ties
TYP DWG	2609	Inner Guard Rail
TYP DWG	2613	Typical Layout at Highway Crossing with Active Warning Device
COMMON DWG	130005	6" Track Spike
COMMON DWG	130800	Rectangular Head Timber Coach Screw
COMMON DWG	135010	Bar Stock Anchor for 5-1/2" and 6" Base Rail



MWI 301-04

Ballast and Sub-Ballast

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Revised: 3/6/15

Page 1 of 6

PURPOSE: To provide uniform Ballast and Sub-ballast.

SAFETY: Observe all applicable Safety and Operating Rules and Regulations and Safe Job Procedures.

LOCATION: All CFRC tracks.

ENVIRONMENTAL: Observe all applicable Federal, State, and Local Environmental Rules and Regulations.

I. DISCUSSION

The CFRC Requirements for Prepared Railroad Track Ballast and Sub-ballast were developed by a team from the Engineering Department.

II. PROCEDURE

- A. The detailed requirements follow:
- B. These requirements will be used for the purchase of all Track Ballast and Sub-ballast installed on CFRC.

Prepared by: RMW

Approved by: 
Miguel Torres - CFRC Chief Operating Officer

CFRC TRANSPORTATION

PREPARED RAILROAD TRACK BALLAST and SUB-BALLAST

Approved: December 9, 2013

Revised: March 6, 2015

CFRC

PREPARED RAILROAD TRACK BALLAST AND SUB-BALLAST

(1) SCOPE:

These are the requirements for grading and other significant physical properties of mineral aggregates for prepared track ballast and sub-ballast. The suppliers governed by this requirement, shall have or establish a quality system that complies with DOT, AAR Specification for Quality Assurance, M1003 (AAR M-1003), or International Quality Standard ANSI 9000 Series (ISO 9001).

(2) TYPES OF BALLAST:

Quarried Granite and Trap Rock, produced in a crushing-screening plant designed to satisfy the requirements listed herein.

(3) GENERAL REQUIREMENTS:

The type and sizes of prepared ballast shall be designated by the Railroad. The mineral aggregate shall be clean, hard, durable, free from any frozen lumps, deleterious matter and harmful adherent coatings. No materials subject to regulation as hazardous wastes as defined in the administrative code of the state where the material will be used shall be allowed.

(4) HANDLING:

Processed ballast shall be handled at the producing plant in such a manner that it is kept free from segregation. It shall be loaded only into cars which are clean and free from rubbish or any substance that would foul or damage the ballast. The producer should not make repeated passes of equipment over the same levels in stock piled ballast.

Track ballast shall be washed prior to loading in railcars.

(5) INSPECTION:

The Railroad reserves the right to reject any car of ballast arriving at the site for unloading that does not conform to the requirements as determined by methods of test.

If material loaded does not conform to these requirements, the Railroad must notify the supplier to stop loading until the fault has been corrected and to dispose of all defective material without cost to the Railroad.

(6) TESTING:

(A) Determinations of deleterious substances, resistance to abrasion, soundness, bulk specific gravity, absorption, and flat and/or elongated particles shall be made at a testing laboratory approved by the Railroad. These tests will be conducted when adding a new supplier, renewing contract, opening a new quarry or strata, and at least annually. It is the supplier's responsibility to furnish copies of the annual test results and AAR M-1003, ISO 9001, or DOT certification to CFRC Maintenance of Way Manager.

- (B) Visual inspections and gradation test shall be made at the place of production prior to shipment as often as considered necessary. (Minimum of 1 sample per 1000 tons of ballast produced but may be reduced if material consistently meets requirements.) Gradation test results will be transmitted by e-mail to CFRC Maintenance of Way Manager. The reports shall be forwarded in a consolidated monthly summary of tests in an electronic format such as Excel. The supplier shall retain the details of gradation for a minimum of one year after the test is performed.
- (C) CFRC retains the right to conduct on-site inspection for compliance to this requirement. Deviation from these requirements will require the supplier to utilize a CFRC prescribed five step corrective action process designed to identify and permanently eliminate the root cause(s) of the problem.

- Define the problem.
- Fix the problem.
- Identify the root cause of the problem.
- Implement corrective action to eliminate the root cause.
- Establish a follow-up plan to assess effectiveness and permanence.

Ineffective corrective action plans can result in the supplier being removed from the CFRC approved supplier list.

- (D) Samples of the finished product for all tests shall be representative and of sufficient weight for testing.

(7) QUALITY REQUIREMENTS:

- (A) Deleterious substances shall not be present in prepared ballast in excess of the following amounts:

Material finer than No. 200 sieve (Track ballast only) = 1.0%

Clay lumps and Soft or Friable pieces = 0.5%

(If clay lumps and soft or friable pieces exceeds 0.5%, the supplier must test and certify that clay lumps do not exceed 0.5% and soft or friable pieces do not exceed 2%. Action plan must be submitted to reduce this material.)

- (B) The percentage of wear of prepared ballast tested in the Los Angeles Machine shall not be greater than:

Granite = 32.0%

- (C) Granite ballast is predominately considered the CFRC preference. Any deviation must be approved by the CFRC Maintenance of Way Manager.

- (D) The soundness of prepared ballast for use in regions where freezing temperatures are expected shall be such that when tested:

1. in the sodium sulfate soundness test, the weighted average loss shall not be in excess of 7.0% after 5 cycles.

or

2. in the magnesium sulfate soundness test, the weighted average loss shall not be in excess of 11.0% after 5 cycles.

- (E) The bulk specific gravity of granite ballast shall be a minimum of 2.60.

- (F) The maximum percentage of absorption of granite ballast shall be 1.0%.

- (G) The maximum percentage of flat and/or elongated particles of granite ballast shall be 5.0%

(8) SUB-BALLAST REQUIREMENTS:

Sub-ballast shall be crusher-run stone or general aggregate base (dense graded aggregate), granite or limestone material that shall meet the requirements as set out in Chapter 1, Part 2, Article 2.11, "SUB-BALLAST SPECIFICATIONS" of the American Railway Engineering and Maintenance-of-Way Association (AREMA) Manual for Railway Engineering and relevant sections of this Maintenance of Way Instruction

(A) Testing: For new materials and new quarries not previously approved by CFRC, testing shall be accomplished to meet the requirements as set out in Chapter 1, Part 2, Article 2.11, Paragraph 2.11.3 "Testing" and Table 1-2-4 of the American Railway Engineering and Maintenance-of-Way Association (AREMA) Manual for Railway Engineering. Properties testing limits shall be the same as the testing limits for base aggregates as governed by the state or province the project is in. Test results shall be submitted to CFRC Maintenance of Way Manager.

(B) Sub-ballast shall be placed in three inch maximum lifts and compacted to 95% of the maximum dry unit weight as determined by the Modified Proctor Density Test ASTM D1557.

(9) GRADING REQUIREMENTS:

The grading of prepared track ballast and sub-ballast shall be determined by test with laboratory sieves having square openings and conforming to current ASTM Specifications, Designation E-11.

(10) PREPARED RAILROAD TRACK BALLAST AND SUB-BALLAST FOR CFRC SHALL CONFORM TO THE FOLLOWING GRADING REQUIREMENTS:

BALLAST & SUBBALLAST GRADATIONS - % PASSING				
SCREEN SIZE	MAINLINE AREMA #4A	YARD AREMA #5	SUBBALLAST	
			OPTIMUM	ALLOWABLE RANGE
2-1/2"	100%			
2"	90 100%		100%	100%
1-1/2"	60 – 90%	100%		
1"	10 – 30%	90 – 100%	95%	90 – 100%
3/4"	0 – 10%	40 – 75%		
1/2"		15 – 35%		
3/8"	0 – 2%	0 – 15%	67%	50 – 84%
NO. 4		0 – 15%		
NO. 8				
NO. 10			38%	26 – 50%
NO. 40			21%	12 – 30%
NO. 60				
NO. 200			7%	0 – 10%

(11) METHODS OF TEST:

The supplier shall certify the ballast delivered to the Railroad is typical of that upon which specified tests have been made.

Samples shall be secured in accordance with the current ASTM methods of sampling, Designation D-75. Test samples shall be reduced from field samples by means of ASTM C 702

Sieve analysis shall be made in accordance with current ASTM method of test, Designation C 136.

Material finer than the No. 200 sieve shall be determined in accordance with the current ASTM of test, Designation C-117.

The bulk specific gravity and percentage of absorption shall be determined in accordance with the ASTM Method of Test, designation C 127.

The percentage of clay lumps and soft particles shall be determined in accordance with the current ASTM method of test, Designation C-142.

The resistance to abrasion shall be determined in accordance with the current ASTM method of test, Designation C-131, or C-535, using the grading most nearly representative of the size of ballast specified.

Soundness test shall be made in accordance with the current ASTM method of test, Designation C-88.

The weight per cubic foot shall be determined in accordance with the current ASTM method of test, Designation C-29.



MWI 401-02

Timber Crosstie and
Switch Tie Requirements

Issued: 12/9/13

Revised: 3/6/15

Page 1 of 1

PURPOSE: To provide uniform Timber Crosstie and Switch Requirements.

LOCATION: All CFRC tracks.

I. DISCUSSION

The CFRC Timber Crosstie and Switch Tie Requirements have been revised and redesigned as MW-99001 and attached.

Prepared by: RMW

Approved by: Miguel Torres
Miguel Torres - CFRC Chief Operating Officer

Timber Crosstie and Switch Tie

Procurement Requirement

- 1.0 **Scope** – This procurement requirement establishes the minimum detailed technical requirements for Timber Crossties and Timber Switch Ties for use by the Department. It is the Department’s desire to enter into a long-term contract with suppliers of quality timber crossties and timber switch ties. The suppliers governed by this requirement, shall have or establish a quality system that complies with and is certified to the requirements set forth in the AAR Specification for Quality Assurance, M1003 (AAR M-1003), or International Quality Standard ANSI 9000 Series (ISO 9001).
- 1.1 **Crosstie & Switch Tie Description** – Timber crossties and switch ties are used to secure, anchor and support rail, switch, and other track equipment. As such, the consistent quality of crossties and switch ties is of the utmost importance to the Department for safety and track reliability. The crossties and switch ties acquired under this requirement shall be used to meet CFRC field requirements for initial installation at new construction locations, replacement at existing sites, and also for modification at existing locations. Crossties and switch ties acquired for use by the Department shall as a minimum meet the material quality, dimensional, and processing requirements of sections 3, 4, and 5 of this requirement as directed and applied by the contract.
- 1.2 **Requirements Rating Criteria** – Assignment of requirement importance shall be designated by one of the following:
- (C) – Critical Characteristic
 - (M) – Major Characteristic
 - (I) – Incidental Characteristic

This requirement covers two types of ties, timber crossties and timber switch ties. As such, in certain instances, functional requirements specified herein may not be applicable to a particular product. In those cases, the supplier shall respond to the requirement as being not applicable, and explain why it is not. In other instances, in lieu of a defined requirement, this requirement may ask for data, or a description for relative comparison.

2.0 **Applicable Documents** – The latest issue of the following document forms a part of this requirement to the extent specified herein:

- Applicable Federal, State, and local Regulations

In the event of a conflict between the document referenced here and the detailed content of section 3, 4, and 5, the detail requirements of sections 3, 4, and 5, shall be considered the superseding requirements.

3.0 **Requirements (C)** –

3.1 **General (D)** – The information and requirements included in this section are applicable to timber crossties and switch ties as specified in sections 3.2 and 3.3 respectively of this document.

3.1.1 **Definitions** –

- a) **Decay** – Decay is the disintegration of wood substance material due to the action of destroying fungi. “Blue Stain” shall not be considered as decay and is permissible in any wood used for ties.
- b) **Rot** – Is the decomposition of wood, which occurs due to age, decay, or chemical disintegration.
- c) **Holes** – Within the rail bearing area, a large hole is one more than 1/2 inch in diameter and 3 inches deep. Outside the rail bearing area, a large hole is one which is 1/4 the width of the surface on which it appears and 3 inches deep. Numerous holes are any number equaling a large hole in damaging effect. Such holes may be caused in manufacture or otherwise.
- d) **Knots** – Within the rail bearing area, a large knot is one having an average diameter more than 1/3 the width of the surface on which it appears; but such a knot will be allowed if it is located outside the rail bearing area. Numerous small knots equaling the diameter of a large knot in damaging effect shall equate to a large knot and shall have the same limitations.
- e) **Shake** – A shake is a separation along the grain, most of which occurs between the rings of annual growth (see Figures A, B, & C below).

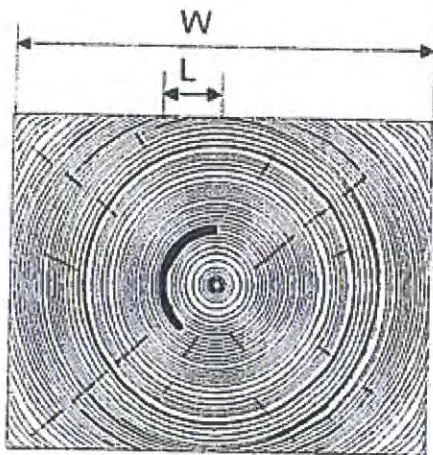


Fig. A

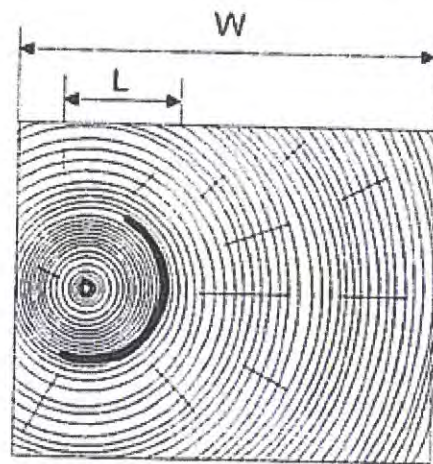


Fig. B

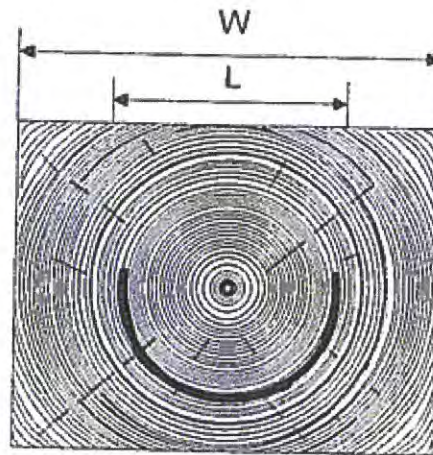


Fig. C

The procedure illustrated in the above diagrams shall be used in determining the length of the shake. One which is not more than $\frac{1}{3}$ the width of the tie shall be allowed, provided it does not extend nearer than 1 inch to any surface. Multiple ring shakes shall not be allowed.

- f) **Split** – A split is a separation of the wood extending from one surface to an opposite or adjacent surface.
- 1) In unseasoned ties, a split no more than $\frac{1}{8}$ inch wide and/or 4 inches long is acceptable when antisplitting devices have been applied and the tie is brought back to its original sawn dimensions.
 - 2) In a seasoned tie, a split no more than $\frac{1}{4}$ inch wide and/or longer than the width of the face across which it occurs is acceptable when antisplitting devices have been applied and the tie is brought back to its original sawn dimensions.

- 3) Multiple splits of no more than a three way split are acceptable.
 - 4) In no instance will a tie be considered acceptable when a split extends into the rail bearing area.
- g) **Checks** –
- 1) **For procurement of seasoned ties:** A check is a “V” shape groove in a tie similar to a cut made with an ax. A check is acceptable provided it is not more than 3/8 inch wide, the depth not greater than 1/2 the thickness of the tie, and does not extend into the rail bearing area.
 - 2) **For treatment of seasoned ties:** A check is acceptable provided it is not more than 1/2 inch wide, the depth not greater than 1/2 the thickness of the tie, and does not extend into the rail bearing area.
- h) **Bark Seams** – Bark seams will not be acceptable if they appear in the rail bearing area. A bark seam or pocket is a patch of bark partially or wholly enclosed in the wood. Bark seams will be allowed provided they are not more than 2 inches below the surface and/or 10 inches long.
- i) **Wood Destroying Insect Infestation** – A wood destroying insect infestation is the presence of insects known to destroy wood and other cellulose materials, such as termites, carpenter ants, etc. If an infestation exists, the type of insect will be identified. If termites are detected, the identification must distinguish between Formosan Subterranean termites, and other termite species.
- 1) All ties shall be inspected for and protected from infestation.
 - 2) If an infestation is found, the tie is not acceptable for use on CFRC.
 - 3) Ties infected with other than Formosan Subterranean Termites will be disposed of in an appropriate manner determined by the supplier.
 - 4) Ties infested with Formosan Subterranean Termites shall be treated to kill the termites and disposed by burning in an environmentally appropriate facility.
- j) **Slanting Grain** – Except in woods with interlocking grain, a slant in grain in excess of 1 in 15 will not be permitted, and/or if present in rail bearing area.
- k) **Excessive Wane** – Examples of this defect have been

termed in the industry as "Saddlebacks" and "Sledruners". These conditions in ties shall not be considered acceptable and are illustrated and further defined below.

- 1) **Saddlebacks** – Saddlebacks between the rail base area will not be accepted if lack of face is more than 1/2 the width (see Fig. D, below).
- 2) **Sledrunner** – A sledrunner appearing on the end of a tie will not be accepted if lack of face is more than 1/2 the thickness and more than 3 inches from end of tie (see Fig. E, below).

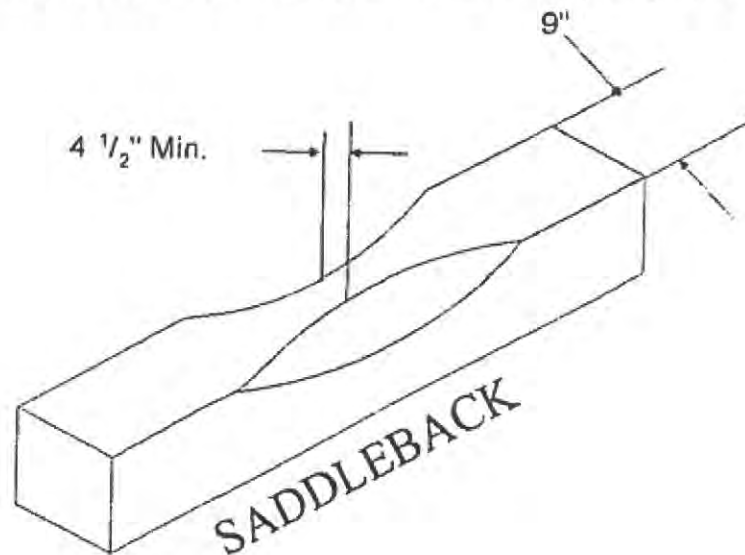


Fig. D

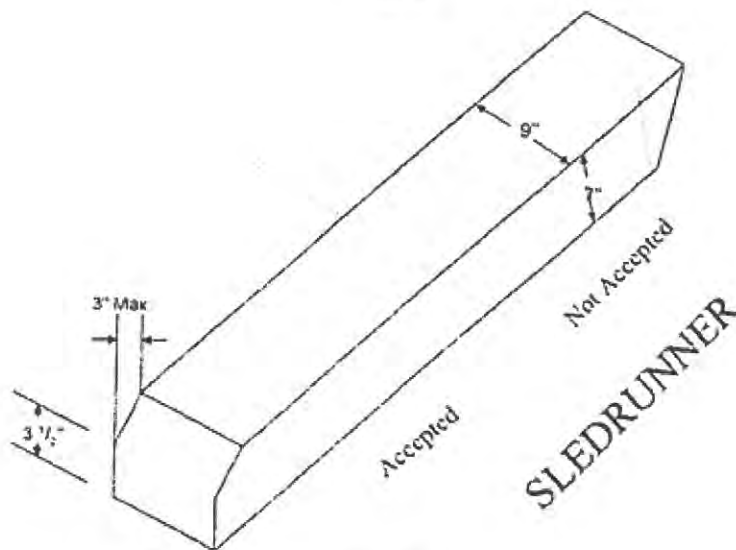


Fig. E

3.2 **Timber Crossties Requirements (C)** –

3.2.1 **Acceptable Materials (C)** - The following types of wood shall be acceptable for the manufacture of timber crossties:

- a) Ash
- b) Beech
- c) Birch
- d) Cherry
- e) Elm
- f) Gum
- g) Hackberry
- h) Hickory
- i) Locust
- j) Maple
- k) Mulberry
- l) Oak {see 3.4.1, b) , 5) }
- m) Sassafras
- n) Walnut

3.2.2 **Physical Requirements(C)** – Except as hereinafter provided, all crossties shall be free from any defects that may impair their strength or durability as crossties, such as decay, rot, large splits, large shakes, slanting grain, large or numerous holes, or knots.

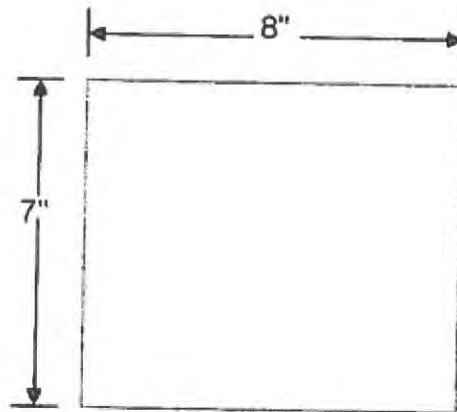
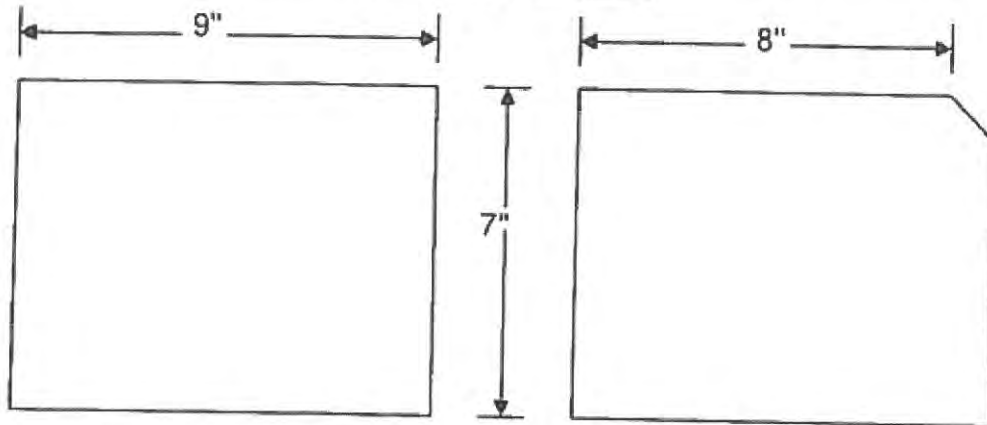
3.2.2.1 **Manufacture** –

- a) All timber crossties shall be straight, well hewed or sawed, cut square at the ends, have bottom and top parallel and the bark entirely removed.
- b) All timber crossties (see 3.2.2.2 for normal dimensions) shall be considered straight when:
 - 1) A straight line along the top from the middle of one end to the middle of the other end lies more than two inches from either side, **and**
 - 2) A straight line along a side from the middle of one end to the middle of the other end lies more than two inches from the top and the bottom of the tie.
- c) A tie is not well hewed or sawed when its surfaces are cut into with score marks more than 1/2 inch deep or when its surfaces are not even.
- d) The top and bottom of a tie will be considered parallel

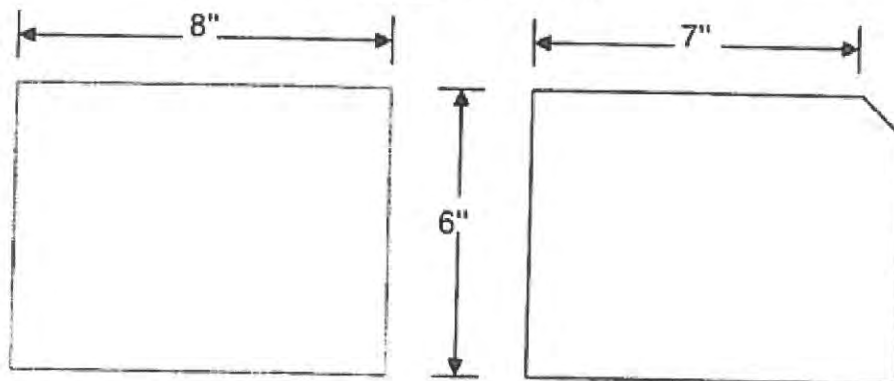
if any difference in the thickness at the ends does not exceed 1/2 inch.

e) The following size categories shall apply for 7" and 6" crossies :

7" GRADE CROSSIES



6" GRADE CROSSIES



1" OF WANE ALLOWED - 20% SQUARE

7" X 8" ALLOWED

3.2.2.2 **Dimensions** –

- a) Except as hereinafter provided, crossties shall measure as follows throughout the rail bearing area. The rail bearing areas as used here and hereafter are defined as those sections of the tie between 20" and 40" from the middle (11" and 31" from its end):
 - 1) Grade 5 – 7" x 9" x 8' 6" Minimum 8" face
 - 2) Grade 4 – 7" x 9" x 8' 6" Minimum 7" face
 - 3) Grade 4 – 7" x 8" x 8' 6" Minimum 7 – 1/2" face – Maximum 2 %
 - 4) Grade 3 – 6" x 8" x 8' 6" Minimum 7" face
- b) Ties more than 1 inch longer or shorter than required shall be rejected.
- c) The thickness and widths specified are minimums for the required sizes.
- d) Ties over 1 inch longer, thicker, or wider than the required size ordered shall be rejected.
- e) All thickness and widths shall apply to the sections of the tie between 20 inches and 40 inches from the middle of the tie.
- f) All determinations of widths shall be made on the top of the tie, which is the narrower of the horizontal surfaces, or the one with no heartwood if both horizontal surfaces are of the same width.
- g) In seasoned ties, thickness and width requirements shall be considered met if not more than 1/4" scant of those specified.

3.2.2.3 **Malformation Tolerances** –

- 3.2.2.3.1 **Decay** – Crossties with decay shall not be acceptable for use or purchase by the Department (See para. 3.1.1, a).
- 3.2.2.3.2 **Rot** – Crossties with rot shall not be acceptable for use or purchase by the Department (see para. 3.1.1, b).
- 3.2.2.3.3 **Holes** – Crossties with large holes or several small holes with diameters equaling a large hole shall not be acceptable for use or purchase by the Department (see para. 3.1.1, c).
- 3.2.2.3.4 **Knots** – Crossties with large knots or several small knots equaling to a large knot within the rail bearing area shall not be acceptable by the Department (see para. 3.1.1, d).
- 3.2.2.3.5 **Shakes** – Crossties with a shake no greater than 1/3 the width of the tie and not nearer than 1 inch to any surface shall be allowed. Multiple ring shakes shall not be allowed (see para 3.1.1, e).

- 3.2.2.3.6 **Splits** – Crossties with acceptable splits as defined in para. 3.1.1, f) shall be allowed.
- 3.2.2.3.7 **Checks** – Crossties with acceptable splits as defined in para. 3.1.1, g) shall be allowed.
- 3.2.2.3.8 **Bark Seams** – Crossties with acceptable bark seams as defined in para. 3.1.1, h) shall be allowed.
- 3.2.2.3.9 **Slanting Grain** – Crossties with acceptable slanting grain as defined in para. 3.1.1, i) shall be allowed.
- 3.2.2.3.10 **Excessive Wane** – Crossties with acceptable saddlebacks as defined in para. 3.1.1, j) shall be allowed.
Crossties with acceptable sledrunners as defined in para. 3.1.1, j) shall be allowed.
- 3.2.2.3.11 **Wood Destroying Insect Infestation** – Crossties with wood destroying insect infestation shall **not** be acceptable for use or purchase by the Department. See para. 3.1.1, i) for disposition instructions.

3.3 **Timber Switch Tie Requirements (C)** –

3.3.1 **Acceptable Materials (C)** – The acceptable types of wood for switch ties are:

- a) Oak {see 3.4.1, b), 5)}
- b) Black gum
- c) Red gum – provided heartwood does not exceed 50%.

3.3.2 **Physical Requirements (C)** – Except as hereinafter provided, all switch ties shall be free from any defects that may impair their strength or durability as switch ties, such as decay, rot, large splits, large shakes, slanting grain, large or numerous holes, or knots.

3.3.2.1 **Manufacturing -**

- a) All timber switch ties shall be straight, clean sawed, cut square at the ends, have bottom and top parallel, and the bark entirely removed except as hereinafter provided.
- b) A timber switch tie less than 15 foot long shall be considered straight:
 - 1) When a straight line along the top from the middle of one end to the middle of the other end lies more than two inches from either side, and
 - 2) When a straight line along a side from the middle of one end to the middle of the other end lies more than two inches from the top and the bottom of the tie.

- c) A timber switch tie 15 foot long or more shall be considered straight:
 - 1) When a straight line along the top from the middle of one end to the middle of the other end is entirely within the tie, and
 - 2) When a straight line along a side from the middle of one end to the middle of the other end lies more than two inches from the top and the bottom of the tie.
- d) A timber switch tie is not well hewed or sawed when its surfaces are cut into with score marks more than 1/2 inch deep or when its surfaces are not even.
- e) The top and bottom of a timber switch tie will be considered parallel if any difference in the thickness at the ends does not exceed 1/2 inch.
- f) Timber switch ties shall be sawed on four sides.
- g) Except as hereinafter provided, timber switch ties shall not be less than 9 inches wide throughout the section between 12 inches from each end of the tie.

3.3.2.2 **Dimensions** –

- a) Switch ties shall be 7 inches thick.
- b) Switch ties shall be provided in the quantities ordered from the following lengths:
 - 1) 9'–0"
 - 2) 10'–0"
 - 3) 11'–0"
 - 4) 12'–0"
 - 5) 13'–0"
 - 6) 14'–0"
 - 7) 15'–0"
 - 8) 16'–0"
 - 9) 16'–6"
 - 10) 23'–0"
- c) The rail bearing area shall be defined as “the section of the switch tie between 12” from each end of the tie.”
- d) The lengths, thickness and widths specified are minimums for the required sizes.
- e) Switch ties over 1 inch longer, thicker, or wider than the required size ordered shall be rejected.

- f) All thickness and widths requirements are minima and apply to the rail bearing area, which is that section of the tie between 12 inches from each end of the tie.
- g) A maximum of 1 inch wane is allowed in the rail bearing area on top or bottom of the tie.
- h) All determinations of widths shall be made on the top of the tie, which is the narrower of the horizontal surfaces, or the one with no heartwood if both horizontal surfaces are of the same width.
- i) In seasoned ties, thickness and width requirements shall be considered met if not more than 1/4" scant of those specified.

3.3.2.3 **Malformation Tolerances** –

3.3.2.3.1 **Decay** – Switch ties with decay shall not be acceptable for use or purchase by the Department (See para. 3.1.1, a).

3.3.2.3.2 **Rot** – Switch ties with rot shall not be acceptable for use or purchase by the Department (see para. 3.1.1, b).

3.3.2.3.3 **Holes** – Switch ties with large holes or several small holes with diameters equaling a large hole shall not be acceptable for use or purchase by the Department (see para. 3.1.1, c).

3.3.2.3.4 **Knots** – Switch ties with large knots or several small knots equaling to a large knot within the rail bearing area shall not be acceptable by the Department (see para. 3.1.1, d).

3.3.2.3.5 **Shakes** – Switch ties with a shake no greater than 1/3 the width of the tie and not nearer than 1 inch to any surface shall be allowed. Multiple ring shakes shall not be allowed (see para 3.1.1, e).

3.3.2.3.6 **Splits** – Switch ties with acceptable splits as defined in para. 3.1.1, f), shall be allowed.

3.3.2.3.7 **Checks** – Switch ties with acceptable splits as defined in para. 3.1.1, g), shall be allowed.

3.3.2.3.8 **Bark Seams** – Switch ties with acceptable bark seams as defined in para. 3.1.1, h), shall be allowed.

3.3.2.3.9 **Slanting Grain** – Switch ties with acceptable slanting grain as defined in para. 3.1.1, i), shall be allowed.

3.3.2.3.10 **Wood Destroying Insect Infestation** – Switch ties with wood destroying insect infestation shall **not** be acceptable for use or purchase by the Department. See para. 3.1.1, i) for disposition instructions.

3.4 **Tie Processing (C)** –

3.4.1 **Unloading and Inspection (I)** – Ties shall be unloaded and passed through a double-end trim saw, which shall expose

interior defects and assures uniform length for mechanical handling at the plant and subsequently in the field.

- a) The inspection shall include both ends and all four sides for possible defects.
- b) Either a manual or semi-automatic unloading/ inspection system shall record the grade and specie and route the ties into bays designated as follows:
 - 1) Oak Main Line {see 3.4.1, b), 5)}
 - 2) Oak Branch Line {see 3.4.1, b), 5)}
 - 3) Mixed Hardwood Main Line {see 3.4.1, b), 5)}
 - 4) Mixed Hardwood Branch Line {see 3.4.1, b), 5)}
 - 5) White Oak – It is the intent of the Department to prohibit the use of white oak ties for both Crosstie and Switch Tie application. This prohibition is being made to minimize and eliminate the occurrence of accelerated deterioration of ties made of white oak in this region. Either mixed hardwood ties or red oak ties shall be shipped to those locations. Red oaks shall be separated from mixed oaks in quantities as directed by the Department.
 - 6) Culls – All ties not meeting minimum requirements for mainline or branchline ties.
- c) Ties, which do not meet this requirement, are separated as rejects or culls and handled as directed by the Department.

3.4.2 Incising (I) –

- a) Ties shall be incised on four sides not less than $1/2$ inch in depth.
- b) Incising shall cover from **end-to-end** on each side of the tie.
- c) At least 90% of the teeth contacting the tie shall be in place in each incisor head.
- d) **All** ties shall be incised.

3.4.3 Stacking (I) – Grade ties shall be stacked to provide proper air seasoning.

- a) Two to four inches of space shall be left between the ties so as to make continuous flues through the pile or stack.
- b) The foundation shall be stacked a minimum of 14” off the ground on treated or other suitable material to prevent transfer of decay.

- c) No more than ten stacks or piles shall be placed side by side in a continuous row.
- d) A space of at least three feet shall be left between the rows of ties, except where shed drying is used.
- e) Firebreaks shall be maintained in accordance with the fire protection plan as established by plant management and approved by local government.
- f) The grounds and storage area shall be clear of debris, vegetation, and well drained (No standing water).
- g) When possible, rows shall be placed with the open side in the general direction of the prevailing wind.
- h) Each row shall carry information painted on the outside of the stack for the purpose of inventory record. Information shall include:
 - 1) pile or row number
 - 2) quantity
 - 3) specie
 - 4) date
 - 5) ownership

3.4.4 **Seasoning (C)** – Ties being air seasoned shall be held in stack until the amount of moisture in the wood will permit acceptable penetration and retention of preservative. In general, oak seasons in ten months and mixed hardwoods in six months.

- a) The maximum acceptable moisture content in oak shall be 50% using two inch increment borings.
- b) The maximum acceptable moisture content in mixed hardwood shall be 40% using two inch increment borings.

3.4.5 **Boring and Branding (C)** –

- a) Seasoned ties to be treated shall be re-inspected before treatment.
- b) Ties that are damaged or split beyond the limitations of this requirement shall be removed.
- c) Ties shall be branded for identification using 1 1/2 inch lettering, having cutting edges 1/8 inch wide, and impregnated 1/4 inch into the end of each tie.
- d) Branding shall include ownership, origin and year treated.
- e) Ties shall have a visible saw kerf mark or some other approved marking to designate the sap side of the crosstie. For creosote only treated ties, apply one kerf mark. For dual treated boron/creosote ties, apply two kerf marks.

3.4.6 Selective End Plates (C) –

- a) Seasoned ties which are split no more than $\frac{1}{4}$ inch wide and with the split extending from one surface to another, shall be clamped and end-plated back to its original sawn dimensions, then returned to the material flow.
- b) Unseasoned ties, which are split no more than $\frac{1}{8}$ inch wide and/or 4 inches long, shall be clamped and end plated back to its original dimensions, then returned to the material flow.
- c) Ties, which cannot be returned to acceptable dimensions, shall be rejected.

3.4.1 Trimming (I) –

- a) Prepared ties shall be loaded on trams and secured with wire banding or chains and counted.
- b) The number of ties on each tram shall be counted, verified, and recorded on a tram ticket or plant order.

3.4.8 Treatment (C) – Ties shall be dual treated with Boron and Creosote, in accordance with American Wood Preservers' Association (AWPA) Standard U1, Commodity Specification C, to the requirements of Use Category 4C (UC4C). Use SBX Pre-Treatment or Creosote SBX-O One Step Treatment with appropriate creosote preservatives as required by the specification. Governing treating requirements are as follows :

3.4.8.1 Rueping Process (AWPA-C-6) (C) – Properly air seasoned ties (crossties, switch ties, and crossing panels) that meet the moisture content requirements shall be treated using the Rueping process.

- a) The creosote shall be maintained at a minimum average of 180° F during the pressure period and pressurized to a maximum of 200 psi for mixed hardwood and 220 psi for oak.
- b) The specific treating parameters will vary with the age and construction of the treating plant. The supplier shall have available for the Department's inspection the parameters for his operations. For acceptance the set up parameters must comply with the following:

1) Hot Oil Treatment:	Oak 180° F/6 hour minimum MHW 180° F/4 $\frac{1}{2}$ hour minimum
2) Creosote Pressure:	180 - 220 PSI
3) Temperature:	180 ° - 210 ° F
4) Vacuum:	Not less than 22"

3.4.8.2 **Boulton Drying (C)** – This process shall only be used for ties produced from trees felled within the previous ninety days (three months) and do not meet the moisture content specified in 3, 4, 4 above.

- a) Ties shall be trammed with each layer separated by 3/8 inch minimum sticker placed at each end of the ties.
- b) The ties shall be heated and boiled in oil under vacuum in the treating cylinder until the moisture content of the wood is low enough to allow proper treatment and meet the requirements of AWPA Standard U1.

3.4.8.3 **Inspection of Treating Sheets and Graph (C)** –

- a) When the ties are being treated, the plant operator shall maintain a log and a graph, or a graph only if treating controls are automatic, of the following parameters :
 - 1) time (no greater than 15 minute intervals)
 - 2) temperature
 - 3) pressure
 - 4) vacuum
 - 5) creosote tank contents

In the event graph equipment becomes inoperable, inaccurate, or graph becomes illegible, Contractor must cease treatment of ties for the Department until equipment is repaired.

- b) The contractor shall upon request from the Department provide the log and graph, and the tram ticket for review and inspection.
- c) For all crossties, switch ties, and crossing timbers, a net retention meeting the requirements of AWPA Standard U1, unless refusal takes place.

3.5 **Nail Plates (C)** – Nail Plates shall be the approved method used to control splitting in ties for the Department.

3.5.1 **Nail Plate application** –

- a) Ties shall be selectively nail plated prior to treatment.
- b) Nail plates shall be applied to both ends of any tie plated.

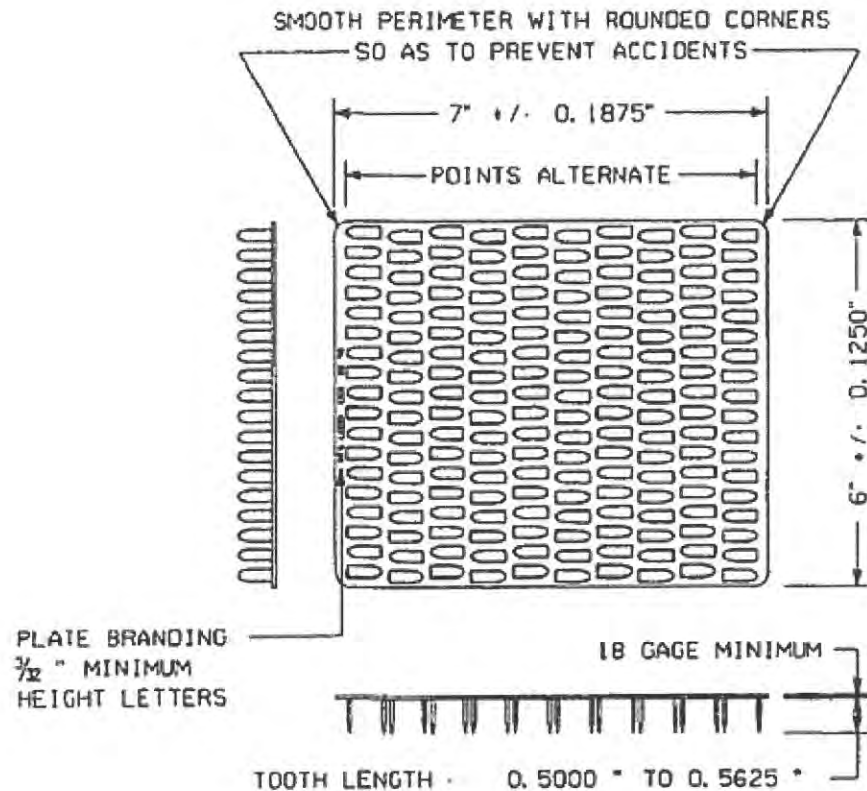
- c) Application of nail plates shall be subject and limited to ties with the maximum split dimension per paragraph 3.1.1, f), of this requirement.
- d) Ties to be end plated shall have flat, smooth, sawn ends with no spurs.
- e) Nail end plates shall be applied by a mechanical device capable of exerting sufficient pressure to close splits bringing the tie back to its original sawn dimensions and with capacity to drive a nail end plate into the end of the tie using a pressure plate.
- f) Nail end plates shall be centered on the split (s) as practicable and securely applied against the end of the tie .
- g) No part of the nail end plate shall protrude beyond the edge of the tie. The nail end plate shall be positioned to avoid projecting over the edge of tie having the maximum permissible wane. If this is not practical, the protruding edge of the nail end plate shall be ground off, bent over and hammered into the tie, or otherwise treated to remove the potential for hand injuries.
- h) Exposed edges of installed nail end plates shall be checked for any burrs and snags made during application, and if found, removed by grinding, filing, or other means to eliminate potential hand injuries when installing the ties.

3.5.2 **Nail Plate Design (C)** – (see Figures 3.5.2-1 and 3.5.2-2).

- a) The material for nail plates shall be structural steel, ASTM A653, grade 40, 18-gage minimum and hot dipped galvanized, ASTM A924, coating designation G60.
- b) The size of the plates and number of teeth per plate shall be as shown on the attached drawings, “Nail Plates for Main Track Ties” and “Nail Plates for Side Track Ties”.
- c) Nail end plates shall be branded in 3/32 inch minimum height letters to include plate manufacturers name or symbol, CFRC, plant (two letters), and year (two digits).

Examples of Plant Location Designations:

<i>Florence</i>	<i>CFRC</i>	<i>FL</i>	<i>99</i>
<i>Green Springs</i>	<i>CFRC</i>	<i>GS</i>	<i>99</i>
<i>Guthrie</i>	<i>CFRC</i>	<i>GU</i>	<i>99</i>
<i>Montgomery</i>	<i>CFRC</i>	<i>MO</i>	<i>99</i>



NOTES.

MATERIAL REQUIREMENTS, STRUCTURAL STEEL. ASTM A653, GRADE 4, 18 GAGE MINIMUM. AND HOT DIPPED GALVANIZED IN ACCORDANCE WITH ASTM A924. COATING DESIGNATION G60.

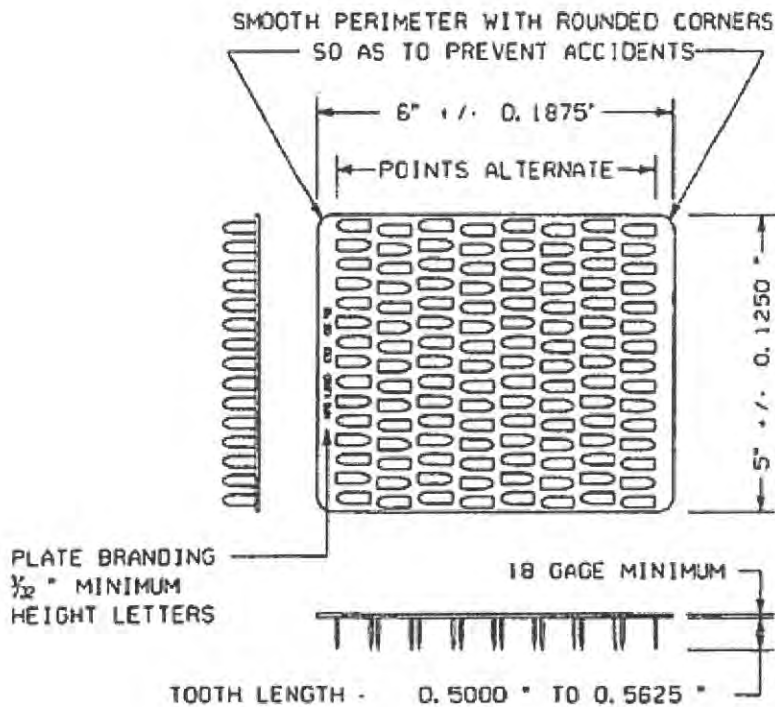
NUMBER AND ALIGNMENT OF ROWS TO BE DETERMINED BY THE PLATE MANUFACTURER. A MINIMUM OF 180 TEETH OR A MINIMUM DENSITY OF 4.1 TEETH PER SQUARE INCH OF MEASURED PLATE AREA. WHICHEVER PROVIDES THE GREATEST NUMBER OF TEETH, IS REQUIRED.

PLATE FLATNESS, CONCAVITY OR CONVEXITY MEASURED WITH A STRAIGHT EDGE AND TAPER GAGE ACROSS EITHER THE WIDTH, LENGTH OR DIAGONALS ON THE TOOTHLESS SIDE SHALL NOT EXCEED 0.03125".

BRAND LOCATION TO BE SELECTED BY MANUFACTURER OF PLATE.

NAIL PLATE
FOR MAIN TRACK TIES

Figure 3.5.2-1



NOTES.

MATERIAL REQUIREMENTS, STRUCTURAL STEEL, ASTM A653, GRADE 4, 18 GAGE MINIMUM, AND HOT DIPPED GALVANIZED IN ACCORDANCE WITH ASTM A924, COATING DESIGNATION G60.

NUMBER AND ALIGNMENT OF ROWS TO BE DETERMINED BY THE PLATE MANUFACTURER. A MINIMUM OF 120 TEETH OR A MINIMUM DENSITY OF 4.0 TEETH PER SQUARE INCH OF MEASURED PLATE AREA, WHICHEVER PROVIDES THE GREATEST NUMBER OF TEETH, IS REQUIRED.

PLATE FLATNESS, CONCAVITY OR CONVEXITY MEASURED WITH A STRAIGHT EDGE AND TAPER GAGE ACROSS EITHER THE WIDTH, LENGTH OR DIAGONALS ON THE TOOTHLESS SIDE SHALL NOT EXCEED 0.03125".

BRAND LOCATION TO BE SELECTED BY MANUFACTURER OF PLATE.

NAIL PLATE
FOR SIDE TRACK TIES

Figure 3.5.2-2

3.6 **Environmental (C)** –

3.6.1 **Environmental Regulations** – All material shall comply with current environmental regulations.

3.6.2 **Disposal Hazards** – Material posing a possible disposal hazard, such as preservatives, insecticides or other sensitive disposables, shall be indicated in documentation and presented at the supplier vendor forum.

3.7 **Safety (C)** – The supplier shall observe all applicable Federal, State, and Local safety and operating rules and regulations.

3.8 **Workmanship (C)** – All ties and related components shall be manufactured, finished and comply with all AAR, and FRA standards for workmanship and/or certification.

4.0 **Quality Assurance Provisions (C)** –

- a) The supplier shall be responsible for insuring that the delivered ties meet the requirements as identified in the applicable paragraphs of this requirement and as directed in the contract agreement.
- b) The Department also reserves the right to perform ad-hoc no notice inspections at the manufacturing plant or in the field to evaluate ties for quality and conformance with this requirement.
- c) Final acceptance of ties shall be based on destination inspection by the Department at the location designated by the Department in the agreement.

5.0 **Transportation (M)** – The Department shall provide transportation direction with each order. The supplier shall ship via truck or rail to destinations as directed by the Department with each order.

6.0 **Notes** – This section not used.

Prepared by: RMW

Approved by: Miguel Torres
Miguel Torres –
CFRC Chief Operating Officer



MWI 403-02

Requirements and Use of Nail
Plates for Cross and Switch Ties

Issued: 12/9/13

Revised: 3/6/15

Page 1 of 1

PURPOSE: To establish the requirements for Nail Plates used to control splitting in Cross Ties and the procedure for their installation.

LOCATION: All CFRC tracks.

I. DISCUSSION

The CFRC Requirements and Use of Nail Plates for Cross and Switch Ties has been now included in MW-99001 and is attached to MWI 401-02.

Prepared by: RMW

Approved by: 
Miguel Torres - CFRC Chief Operating Officer



PURPOSE:	To establish uniform instructions governing the use of Transition and Compromise Rails.
SAFETY:	Observe all applicable Safety and Operating Rules and Regulations and Safe Job Procedures.
LOCATION:	All CFRC tracks.
ENVIRONMENTAL:	Observe all applicable Federal, State and Local Environmental Rules and Regulations.

I. DISCUSSION

- A. Transition and compromise rails are specially manufactured track components that allow the safe and efficient connection of two different rail sections. **Transition rails** are fabricated from one rail section with the railhead planed or machined to conform to the worn rail section. **Compromise rails** are fabricated from two rail sections with a special forging joining the two rail sections. Transition and compromise rails are used to replace both compromise welds and bolted compromise joints in CWR territory.
- B. Transition and compromise rails may be required in programmed rail maintenance, such as curve patch and out of face rail relays or other project and maintenance activities such as turnout or road crossing replacement. The decision of where transition or compromise rails will be used should be made during the pre-installation inspection / planning trip as described in MWI 1101. The criteria used to determine if a transition rail is required is when all of the following are met:
1. Class 2 or higher track *and*
 2. 5 MGT or higher *and*
 3. When the total rail height difference is greater than 1/4" if rails to be joined by thermite welding and 1/8" if rails to be joined by flash-butt welding.

Example: Joining new 141RE to 136 RE with 3/16" wear. The total difference is 5/16" and the universal transition rail would be cut to approximately 16'-2" long.

- C. Transition and compromise rails should be used in other maintenance activities at locations that have high tonnage or a history of continuing compromise weld / bolted joint failures. The criteria in paragraph B should be used as a guide.

- D. [Removed]
- E. Transition and compromise rails, if made from relay rail, will be certified to be free of defects per MWI 508.
- F. Center of gravity lift point will be marked for transition and compromise rails.
- G. All flash butt welds will be magnaflux tested.

II. PROCEDURE

- A. Installation procedure for transition and compromise rails.
 - 1. Use all the required PPE and ensure that a proper job briefing is conducted before beginning this work.
 - 2. Identify the area of the compromise between the rail sections. Keep in mind that:
 - a) The forged transition zone (normally 10 ½" long) on compromise rails must be centered between ties to ensure that regular tie plates can be used.
 - b) The transition zone of compromise rails should not be located on open deck bridges or within a turnout on the long ties.
 - c) Where possible, the field welds in the adjacent rail should not be opposite each other.
 - d) It is normally desirable to remove as much of the smaller rail section as possible.
 - 3. Examine the compromise area for wear and determine the height of the rail.
 - 4. The smaller rail section end of the transition or compromise rail will have a rail height that varies from 1/4" worn at the end to full rail height near the center. Mark the location on the transition or compromise rail where the rail height equals the existing rail height. This will be your saw cut location on the transition rail.
 - 5. NOTE: The minimum length plug rail permitted in track will be as described in MWI 801 (*Welding Manual*). A shorter length is acceptable if a Flash Butt welder is utilized.
 - 6. Compromise rails from 115RE to larger rails are handed left or right because of the different head widths. The gage side should be straight in the line between the two rail sections. To identify a left or right handed compromise rail:

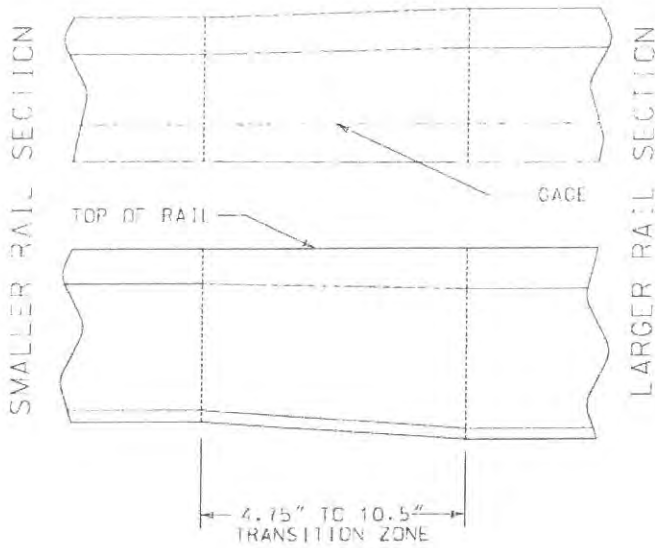
- A. Stand along outside the gage of the track, facing the gage (straight) side of far rail.
 - B. The larger rail section will be on the end corresponding to its hand.
 - C. See figure in Appendix B. It is a right hand compromise rail.
7. Mark the saw cut locations on the existing rail. The cut locations should be in a crib to facilitate welding. The cut must be at least 18 inches from the plant weld used by the manufacturer in the fabrication of the transition or compromise rail. Refer to MWI 801, *Welder's Manual*, for minimum weld to weld distance on the existing rail.
 8. Check to see that the shortened transition or compromise rail will still fit properly.
 9. Cut the rails and place the transition or compromise rail in the gap.
 10. Weld the transition rail or compromise in place using either the in-track welder or thermite welding. Be sure to follow the proper procedures for the welding method selected. See MWI 801, *Welding Manual*.
- B. Transition rails will be requisitioned electronically through the Purchasing and Materials Department. At the present time, the following designs have been approved:

<i>Stock Control #</i>	<i>Description</i>
013.1321150.1	Rail, Compromise, 132RE (new) / 115RE (1/4" worn) RH, 19'-4"
013.1151150.1	Rail, Transition, 115RE (new) / 115RE (3/8" worn) 20'
013.1321151.1	Rail, Compromise, 132RE (new) / 115RE (1/4" worn) LH, 19'-4"
013.1321220.1	Rail, Compromise, 132RE (new) / 122CB (1/4" worn) 19'-4"
013.1361150.1	Rail, Compromise, 136RE (new) / 115RE (1/4" worn) RH, 19'-4"
013.1361151.1	Rail, Compromise, 136RE (new) / 115RE (1/4" worn) LH, 19'-4"
013.1361220.1	Rail, Compromise, 136RE (new) / 122CB (1/4" worn) 19'-4"
013.1361320.1	Rail, Transition, 136RE (new) / 132RE (1/4" worn) 20'
013.1411150.1	Rail, Compromise, 141RE (new) / 115RE (1/4" worn) RH, 19'-4"
013.1411151.1	Rail, Compromise, 141RE (new) / 115RE (1/4" worn) LH, 19'-4"
013.1411220.1	Rail, Compromise, 141RE (new) / 122CB (1/4" worn) 19'-4"
013.1411270.1	Rail, Compromise, 141RE (new) / 127DY (1/4" worn) 19' -4
013.1411320.1	Rail, Transition, Universal, 141RE (new) / 136RE (new) / 132RE (new) / 132RE (1/4" worn) 26'-8"
013.1411360.1	Rail, Transition, 141RE (new) / 136RE (1/4" worn) 19' -4"
013.1411401.1	Rail, Transition, 141RE (new) / 140RE (1/4" worn) 20'

Prepared by: RMW

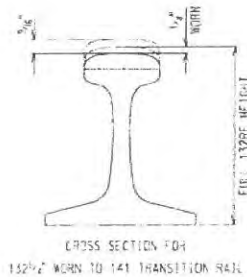
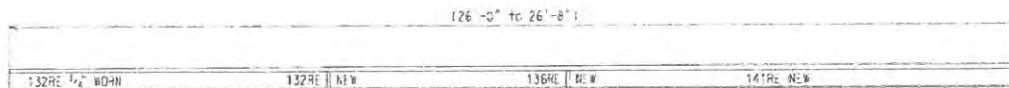
Approved by: Miguel Torres
Miguel Torres - CFRC Chief Operating Officer

APPENDIX A



NOTES:
 WEBS TO BE SMOOTH AND
 FREE OF DISCONTINUITIES
 LENGTH PER PURCHASE ORDER
 IF WORN SECTION ORDERED,
 MACHINING TO BE APPLIED
 GRADUALLY AND UNIFORMLY.

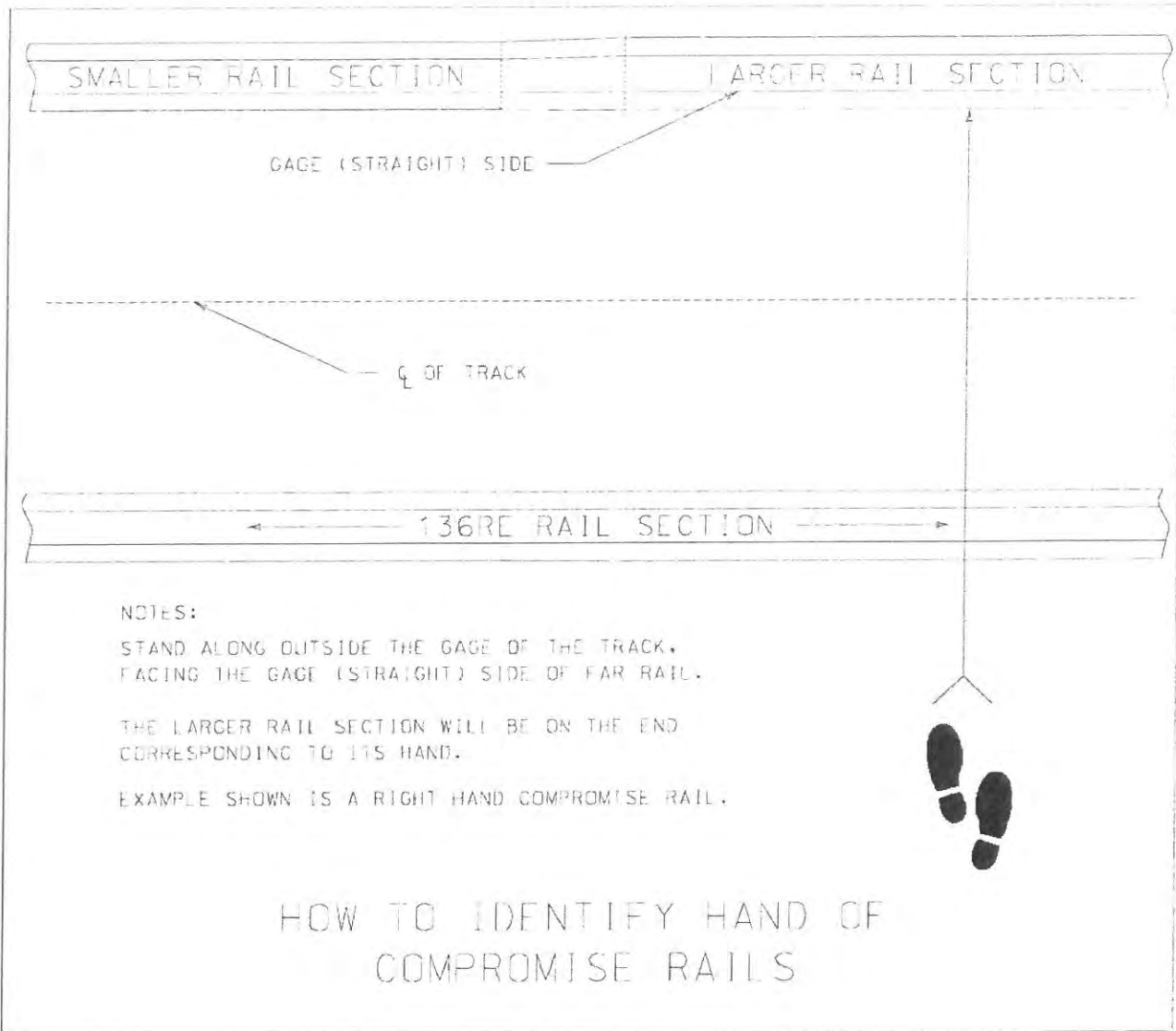
GENERAL ARRANGEMENT FOR
 COMPROMISE RAILS



NOTES:
 TRANSITION TO BE SMOOTH AND CONSISTENT
 LENGTH PER PURCHASE ORDER
 MACHINING TO BE APPLIED
 GRADUALLY AND UNIFORMLY.

GENERAL ARRANGEMENT FOR
 TRANSITION RAILS

APPENDIX B





PURPOSE:	To provide uniform instructions for Anchoring the Track Structure.
SAFETY:	Observe all applicable Safety and Operating Rules and Regulations and Safe Job Procedures.
LOCATION:	All CFRC tracks.
ENVIRONMENTAL:	Observe all applicable Federal, State and Local Environmental Rules and Regulations.

I. DISCUSSION

- A. Rail anchors are essential in achieving a stable track structure. They are designed to prevent longitudinal movement of the rail and work together with the other components of the track structure to prevent buckling.
- B. Rail anchors are required on both jointed and continuously welded rail tracks. They will be applied before the track is returned to service.
- C. All tracks, which are not in compliance with this rail anchoring policy, will be brought up to policy during the next Rail Laying, Curve Patch, or Bridge Timbering operation. During Timbering operations, missing anchors will be replaced to match the pattern currently in track. Tracks, that have a history of buckling or excessive rail movement, will be reviewed by the Chief Engineer on a case-by-case basis to establish a date for compliance. If the next cycle is too far away, a schedule for compliance will be prepared by the Chief Engineer and approved by the CFRC Maintenance of Way Manager.
- D. New rail anchors will be manufactured from mill certified steel.
- E. Relay rail anchors will not be used on main tracks or passing sidings when laying new rail by rail teams. Rail anchors removed to perform other maintenance activities may be reinstalled if effective.

II. PROCEDURE

A. All Track

1. To avoid tie skewing, anchors should be applied against the same tie on opposite rails.
(Opposite rails should be anchored the same)
2. Definition: Box Anchor – Anchors applied against both sides of the tie on opposite rails to restrain longitudinal rail movement in both directions. [Four (4) rail anchors per tie.]

B. Jointed Rail Territory

The track will have 16 rail anchors per 39 ft. rail. Box anchor 8 ties per rail length spaced in accordance with Rail Anchor Pattern Sketch shown on page 5, where practical.

C. Continuous Welded Rail Territory

1. Definition: Continuous Welded Rail (CWR) – A number of rails welded together into lengths exceeding 400 feet.
2. When laying continuous welded rail (CWR), it will be box anchored on every other tie throughout the entire section of CWR. Additional rail anchors are required at the following locations:
 - a. Joints installed in CWR will be box anchored on every tie for 130 consecutive ties in each direction within 60 days except ties supporting rail joints.
 - b. Curves 3 degrees and greater on main track and sidings – CWR being installed will be anchored on every tie. (Anchors applied against both sides of each tie.)
 - c. Turnouts - CWR will be box anchored on every tie for 130 consecutive ties in each direction from the long ties of the turnout.
 - d. Railroad Crossings - CWR will be box anchored on every tie for 130 consecutive ties in each direction from the railroad crossing.
 - e. Road Crossings - CWR will not be anchored within the road crossing unless required by the design of the road crossing surface material. If the road crossing is 50 ft. wide or greater, CWR will be box anchored on every tie for 130 consecutive ties in each direction from the road crossing.
 - f. All Open Deck Bridge Approaches - CWR will be box anchored on every tie for 130 consecutive ties in each direction from the backwall of the bridge.
 - g. Epoxy Bonded Insulated Joints - Structurally sound epoxy bonded insulated joints do not require additional anchors.
3. CWR laid across bridges will be anchored as follows:
 - a. Ballast Deck Bridges - CWR will use the anchor pattern as described in paragraph II.C.2.

- b. Open Deck Bridges with total length 100 ft or less - CWR will be box anchored on every tie that is fastened to the bridge span.
 - c. Open Deck Bridges with total length between 100 ft. and 500 ft. with an alignment of 2 degrees or less:
 - 1) CWR will be box anchored on every tie that is fastened to the bridge span, throughout all spans less than 100 ft.
 - 2) CWR will be box anchored on every tie that is fastened to the bridge span, for the first 100 ft. from the fixed end of individual spans with length greater than 100 ft.
 - d. Rail anchor pattern will be specified by the CFRC Maintenance of Way Manager when any of the following conditions exist:
 - 1) Open Deck Bridges with a total length greater than 500 feet
 - 2) Alignment is greater than 2 degrees
 - 3) Bridges with existing rail expansion joints
 - 4) Other special situations
4. Turnouts within CWR territory will have every tie box anchored, where anchors can be applied, on both the straight side and diverging side of the turnout. Care must be taken to ensure that anchors do not interfere with the movable portion of the switch. Ensure that the requirements in paragraph II.C.2.d. are met. Ties with positive restraint rail fasteners are considered to be anchored.
 5. Ties that have a positive restraint fastener on one end only should be box anchored on the other end. MWI 701, *Use of Premium Rail Fasteners in CWR*, details the use of these fasteners.
 6. At some locations, there may be two or more of the above situations present. In that case the requirements will be additive.

For example: A turnout located 100 ft. from an open deck bridge (75 ft. long). In this example, the CWR will be box anchored on every tie between the backwall at the end of the bridge and the turnout. The turnout will be box anchored on every tie, where anchors can be applied, on both the straight side and diverging side of the turnout. The CWR will be box anchored on every tie for 130 ties beyond long ties of the turnout.
 7. Rail Anchor Patterns are illustrated on attached plans.

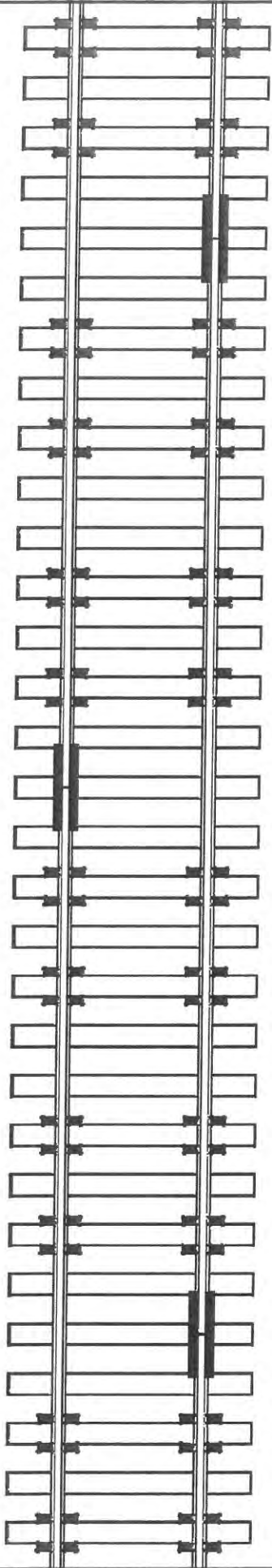
MWI 703-07

3/6/15

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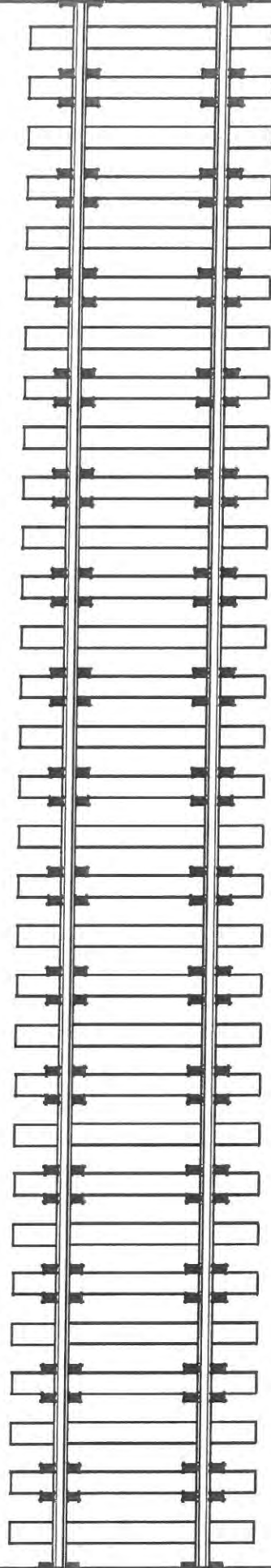
Prepared by: RMW

Approved by: *Miguel Torres*
Miguel Torres - CFRC Chief Operating Officer



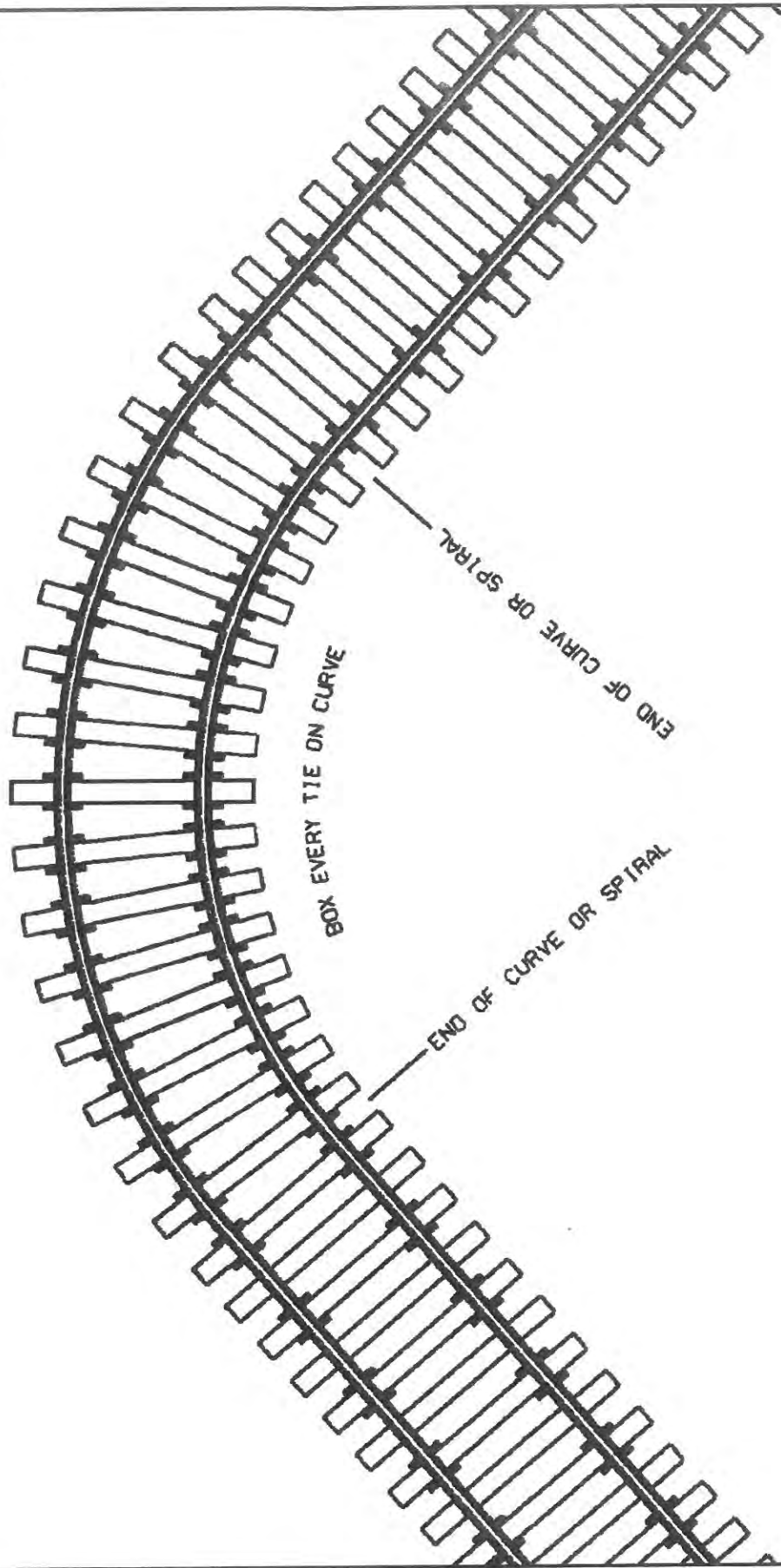
JOINED RAIL - 16 ANCHORS PER 39 FOOT RAIL. BOX ANCHOR 8 TIES.

RAIL ANCHOR PATTERNS



WELDED RAIL - TANGENTS AND CURVES LESS THAN 3 DEGREES - BOX ANCHOR EVERY OTHER TIE.
 SAME PATTERN FOR BALLAST DECK BRIDGES.

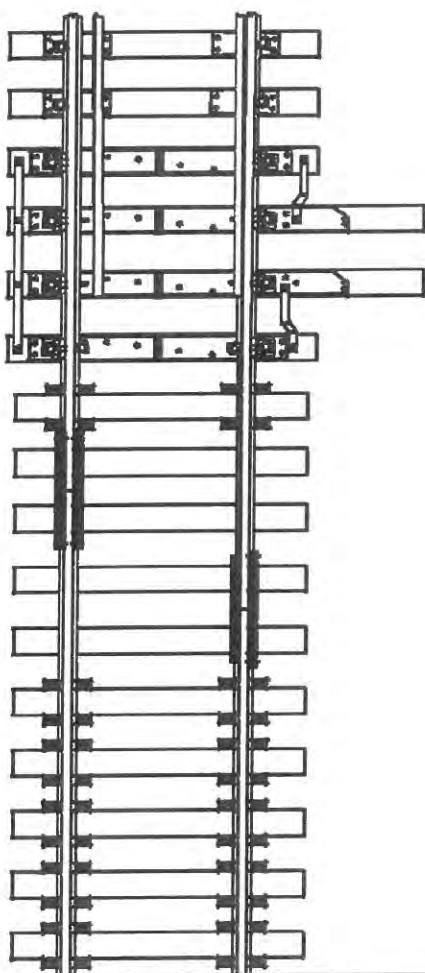
RAIL ANCHOR PATTERNS



WELDED RAIL - CURVES, 3 DEGREES AND GREATER
BOX ANCHOR EVERY TIE ON CURVE AND SPIRALS
RAIL ANCHOR PATTERNS

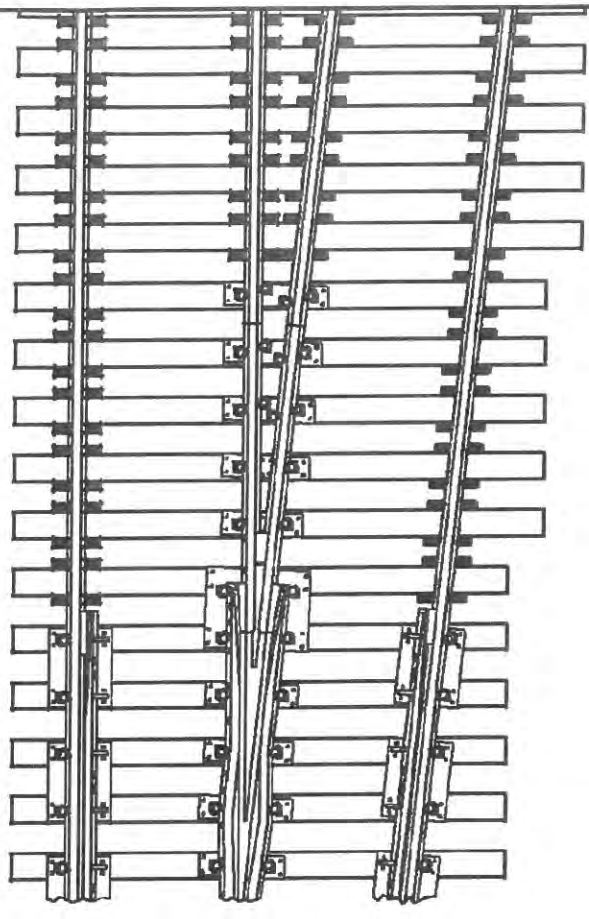
AHEAD OF SWITCH POINT :

- BOX ANCHOR EVERY TIE FOR 130 TIES. COUNT FROM FURTHEST JOINT FROM SWITCH POINT OR FROM TIE AHEAD OF BRACE PLATES IF STOCK RAILS ARE WELDED INTO TRACK.
- IF JOINT BARS ARE PERMANENT, DO NOT APPLY ANCHORS OPPOSITE BARS



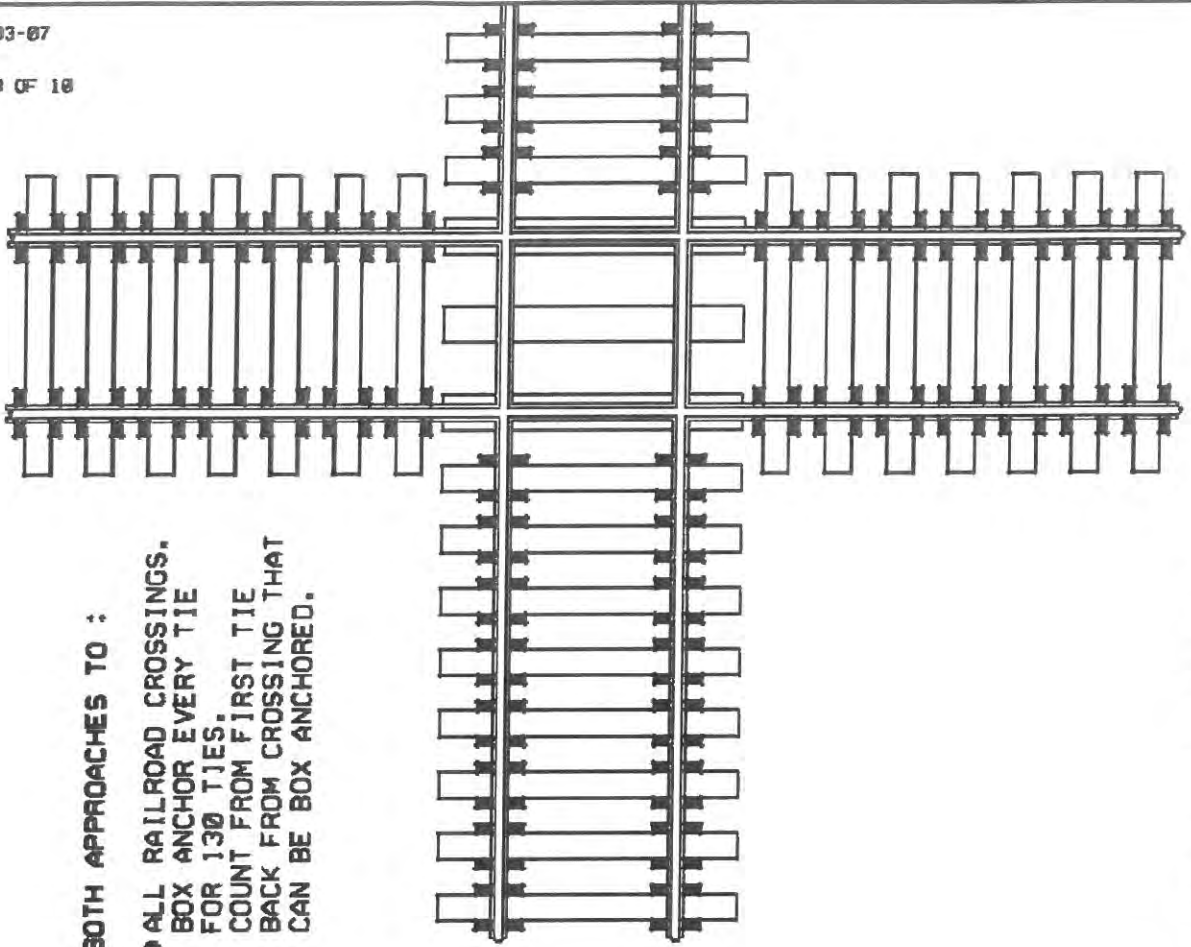
BEHIND HEEL OF FROG :

- BOX ANCHOR EVERY TIE FOR 130 TIES ON BOTH THE THROUGH TRACK AND TURNOUT TRACK. COUNT FROM THE LAST LONG TIE.
- BOX ANCHOR EVERY TIE TO END OF GUARD RAIL.



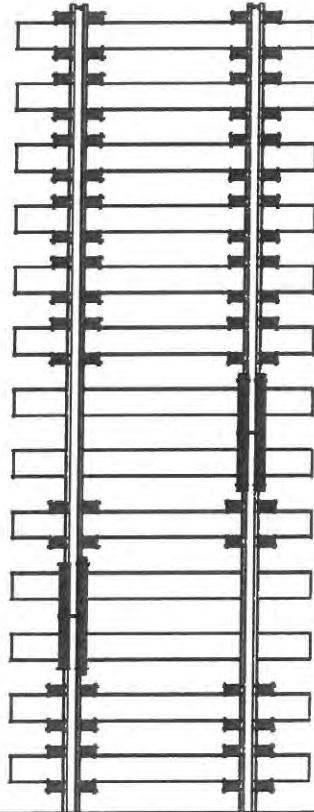
- BETWEEN SWITCH HEEL AND TOE OF FROG, BOX ANCHOR EVERY TIE THAT CAN BE ANCHORED ON AS MANY RAILS AS POSSIBLE. (REFER TO APPLICABLE STANDARD DRAWINGS)

WELDED RAIL ANCHOR PATTERN ADDITIONS



BOTH SIDES OF RAIL JOINTS :

- BOX ANCHOR EVERY TIE FOR 130 TIES.
- USE NORMAL ANCHOR PATTERN FOR :
- EPOXY GLUED INSULATED JOINTS.
- JOINTS WHICH ARE TO BE WELDED AS THE RAIL IS BEING LAID OR IMMEDIATELY AFTER IT IS LAID.



BOTH APPROACHES TO :

- ALL RAILROAD CROSSINGS, BOX ANCHOR EVERY TIE FOR 130 TIES.
- COUNT FROM FIRST TIE BACK FROM CROSSING THAT CAN BE BOX ANCHORED.

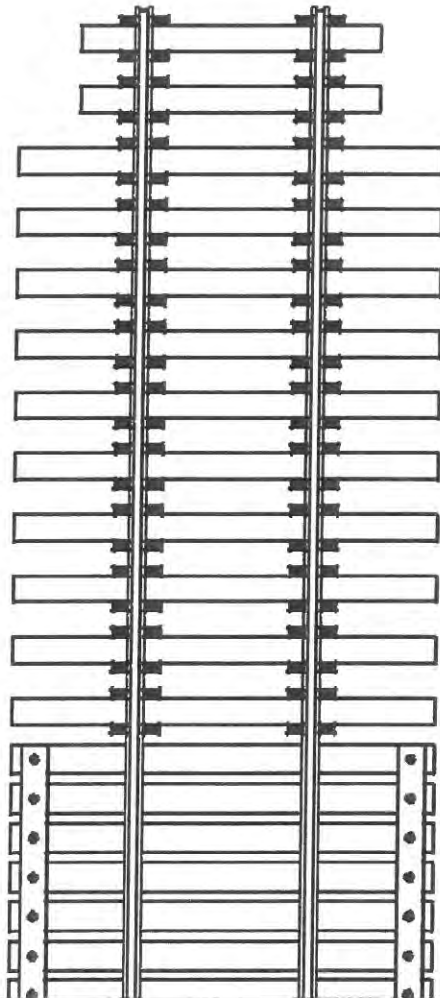
WELDED RAIL ANCHOR PATTERN ADDITIONS

BOTH APPROACHES TO :

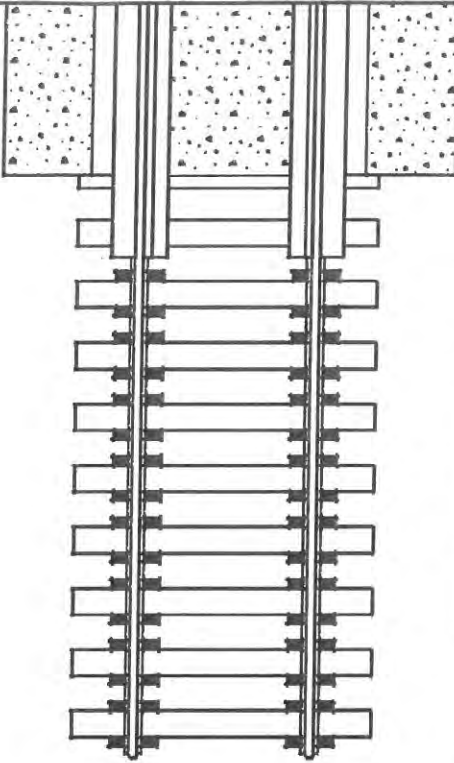
- ALL OPEN DECK BRIDGES.
BOX ANCHOR EVERY TIE FOR 130 TIES.

BOTH APPROACHES TO :

- ROAD CROSSINGS 50 FOOT OR GREATER.
BOX ANCHOR EVERY TIE FOR 130 TIES.
- ROAD CROSSINGS UNDER 50 FOOT.
USE NORMAL ANCHOR PATTERN.



COUNT FROM BACKWALL OF BRIDGE.

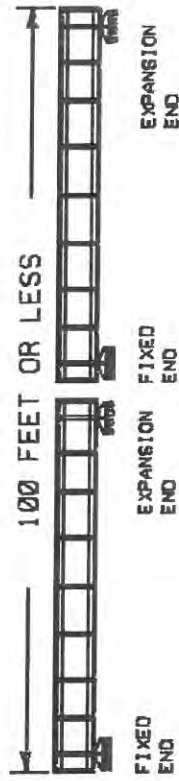


COUNT FROM FIRST TIE BACK FROM END OF CROSSING OR FROM JOINTS FOR CROSSING WARNING IF NOT EPOXY GLUED JOINTS.

WELDED RAIL ANCHOR PATTERN ADDITIONS

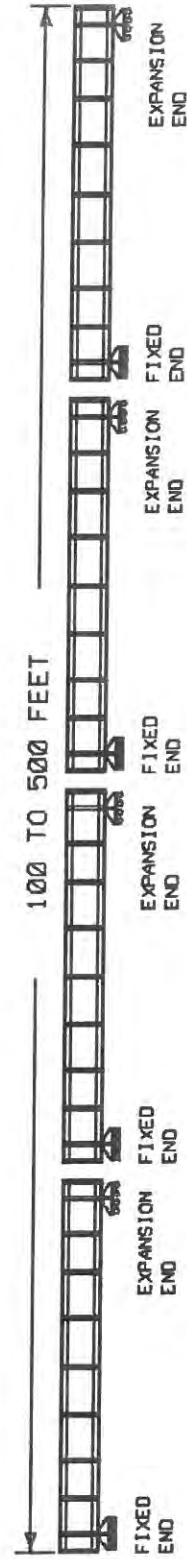
OPEN DECK BRIDGES WITH A TOTAL LENGTH OF 100 FEET OR LESS :

- RAIL ANCHORS WILL BE APPLIED ON ALL TIES FASTENED TO THE BRIDGE SPAN.



OPEN DECK BRIDGES WITH TOTAL LENGTH BETWEEN 100 FEET AND 500 FEET :

- RAIL ANCHORS WILL BE APPLIED WITHIN THE LENGTH DESIGNATED ON ALL TIES FASTENED TO THE BRIDGE SPAN.
- RAIL ANCHORS WILL BE APPLIED THROUGHOUT ALL SPANS LESS THAN 100 FEET.
- RAIL ANCHORS WILL BE APPLIED FOR THE FIRST 100 FEET MEASURED FROM THE FIXED END FOR INDIVIDUAL SPANS WITH LENGTH GREATER THAN 100 FEET.



WELDED RAIL ANCHORING ON OPEN DECK BRIDGES

PURPOSE:	To establish a policy governing the Selection and Installation of Insulated Joints.
SAFETY:	Observe all applicable Safety and Operating Rules and Regulations and Safe Job Procedures.
LOCATION:	All CFRC tracks.
ENVIRONMENTAL:	Observe all applicable Federal, State and Local Environmental Rules and Regulations.
RELATED DOCUMENTS:	MWI 705, Insulated Joint Escalation Plan Drawing 2505, Epoxy Bonded Insulated Joint for 132RE, 136RE and 141RE Rail.

I. DISCUSSION

- A. Insulated Joints are necessary for the safe operation of signal systems and some road crossing warning devices.
- B. Insulated Joints are to be inspected and maintained according to MWI 705.
- C. These joints are manufactured in a variety of designs. The optimal joint should be used based on track tonnage according to this policy.
- D. All tracks, which are not in compliance with the criteria described below, will be brought into compliance during the next curve patch or rail laying project or during maintenance when insulated joint is replaced. Exceptions to this policy must be approved by the Chief Engineer

II. PROCEDURE

- A. Insulated Joints will be classified as three general types as described below:
 - 1. Premium insulated joints are joints such as Portec Center Liner or LB Foster Kevlar.
 - 2. Regular duty insulated joints are bonded insulated joints.
 - 3. Light duty joints are the encapsulated design or fiberglass bars.

- B. Insulated joints should be installed as follows:
 - 1. All tracks 20 MGT and greater – Premium Insulated Joints.
 - 2. Turnouts and all other tracks – Regular Duty Insulated Joints.
- C. Any deviation to these requirements must have written approval from the CFRC Maintenance of Way Manager.
- D. The end post of an insulated joint is to be suspended between the ties unless an insulated steel or composite plate is used. Rubber tie plates under the joint are not to be used when installing a new or replacement joint.
- E. Bonded insulated joints are not drilled on the ends by the manufacturer. They should be positioned or cut to facilitate welding.
- F. Ordering information for commonly used Premium and Regular Insulated Joints is contained in Appendix I. Ordering information for commonly used Encapsulated Insulated Joints is contained in Appendix II.

Prepared by: RMW

Approved by:



Miguel Torres - CFRC Chief Operating Officer

Appendix I. Matrix of Bonded Insulated Joints—Regular and Premium

PREMIUM

Rail	Length	Stagger
115RE	20'	13'-4" X 6'-8"
	40'	23'-4" X 16'-8"
122CB	20'	13'-4" X 6'-8"
	40'	23'-4" X 16'-8"
132RE	20'	13'-4" X 6'-8"
	40'	23'-4" X 16'-8"
136RE	20'	13'-4" X 6'-8"
	40'	23'-4" X 16'-8"
141RE	20'	13'-4" X 6'-8"
	40'	23'-4" X 16'-8"

REGULAR

Rail	Length	Stagger
115RE	20'	13'-4" X 6'-8"
	40'	23'-4" X 16'-8"
122CB	20'	13'-4" X 6'-8"
	40'	23'-4" X 16'-8"
132RE	20'	13'-4" X 6'-8"
	40'	23'-4" X 16'-8"
136RE	20'	13'-4" X 6'-8"
	40'	23'-4" X 16'-8"
141RE	20'	13'-4" X 6'-8"
	40'	23'-4" X 16'-8"

* Note – only most common joint configurations shown.

Appendix II. Encapsulated Insulated Joints

ENCAPSULATED

Section	Hole Spacing
115RE	6"x6"x7-3/8"x6"x6"
	6-1/2"x6-1/2"x5-3/8"x6-1/2"x6-1/2"
122CB	6"x6"x7-3/8"x6"x6"
132RE	6"x6"x7-3/8"x6"x6"
136RE	6-1/2"x6-1/2"x5-3/8"x6-1/2"x6-1/2"
141RE	6-1/2"x6-1/2"x5-3/8"x6-1/2"x6-1/2"

* Note – only most common joint configurations shown.



Maintenance of Way

Welding Manual

ISSUED: December 9, 2013
REVISED: March 6, 2015



MWI 801-06

CFRC Welding Manual

Issued: 12/9/13

Revised: 3/6/15

Page 1 of 2

- PURPOSE:** To establish uniform procedures for all welders performing work for the Engineering Department on track appliances, buildings, bridges or other structures using the thermite, oxy-propane, or electric-arc methods of welding.
- SAFETY:** Observe all applicable Safety and Operating Rules and Regulations and Safe Job Procedures.
- LOCATION:** All CFRC tracks and property.
- ENVIRONMENTAL:** Observe all applicable Federal, State and Local Environmental Rules and Regulations.

I. DISCUSSION

- A. The *Welding Manual* is prepared and issued to you for your benefit. It is your duty to study and understand it and perform your work in accordance with these instructions.
- B. This manual should always be considered jointly with the other Rules, Regulations, and Instructions affecting the employees of the Engineering Department.

II. PROCEDURE

The *Welding Manual* follows:

MWI 801-06

3/6/15

Page 2 of 2

Prepared by: RMW

Approved by: *Miguel Torres*
Miguel Torres - CFRC Chief Operating Officer



Welding Manual

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A. SAFETY

GENERAL

1. Safety is of the first importance in the discharge of duty.
2. The title Welder, as used in this Manual, is intended to include Welding Forman, Welder, Welder Helper, and those individuals specifically qualified by the Chief Engineer to operate a burning torch.
3. The Welder is responsible for compliance with this *Welding Manual*, and all other CFRC policies. If the meaning of a rule or policy is uncertain or any conflicts between rules or policies exist, it must be brought to the attention of the Chief Engineer for explanation and resolution.
4. Job Briefings that cover welding, cutting, and grinding activities must include a fire prevention and response plan. Before stepping off the ballast line, check area for plants that may cause an allergic reaction and have insect spray applied.
5. Welding, cutting, and grinding will be done only by or under the direct supervision of a qualified employee. There are several categories of welding used by the Engineering Department. Employees must not do or supervise work in any category that the Chief Engineer has not qualified them for.
6. Protective clothing, shoes, and gloves, which will give the full body protection, must be worn during all welding, cutting, and grinding operations.
 - a. Aluminum leggings must be worn for surface grinding with plate mounted or cup wheels. When combination leggings (welding leggings) are available, they may be used for all grinding, sawing, and torch cutting procedures. Aluminum or leather leggings must be used for other grinding work.
 - b. Clothing must be kept free of grease, oil, and other flammable materials. When performing these operations, employees must keep shirt sleeves rolled down and collar fastened. Caution must be exercised at all times to keep sparks or slag from being caught in cuffs, pockets, sleeves, under gloves, and out of shoes, eyes, and ears. Frayed clothing must never be worn. Synthetic fabrics that are readily combustible must never be worn.
 - c. Welding gloves must be worn during any welding or grinding procedure.
7. Safety glasses must be worn at all times. Employees observing, working near, or performing any grinding, welding, or cutting operations must wear necessary approved face shields, helmets, goggles with approved lenses, and cover glasses.
8. When possible, welding and/or cutting should not be done near combustible material. Either the work or the combustible material should be moved to a safe place.

9. The use of cutting or welding equipment to perform maintenance work on or in a structure without authorization by or without the knowledge of the person in charge of the structure is prohibited.
10. When welding or cutting close to wooden beams, partitions, flooring, or scaffolding, a guard of sheet metal or other non-combustible material should be used. Fire resistant guard curtains (not tarpaulins) should be large enough, tight, and weighted down to prevent sparks rolling underneath or through openings. Every precaution must be taken to provide suitable protection against flying sparks. Before work is started, all surfaces in the area should be carefully cleaned of any readily ignitable material, and combustible surfaces, such as floors, partitions, etc., should be wetted down before the operation is started, and constantly wetted while the work is going on.
11. An employee should be assigned as a “fire watch” to extinguish fires started by sparks, molten metal, or hot slag. A careful inspection of the area, where hot work has been performed, must be made before leaving the work area to detect and extinguish any live sparks or smoldering fires.
12. Suitable fire extinguishers, readily accessible, in ample numbers in close proximity of where the equipment is being used, to provide a quick response. Before beginning grinding, if a water hose is provided, off track area must be dampened with plain water and have hose at the ready for possible pop up fires. Beware of smoke and avoid being in line of smoke so as not to breathe it in. If available on the welding truck in use, the 12 volt pump sprayer must be kept in good working order. If the 12 volt pump sprayer is not available, the 5 gallon Indian pump water sprayer is the best substitute. Always spray from the ballast line when possible.
13. The use of cutting and/or welding equipment, in the performance of maintenance work in structures containing combustible materials, should be avoided. Where the use of welding or cutting equipment is permitted in these facilities, every precaution must be taken to minimize the risk of fire. The Roadmaster will be contacted to assign someone to patrol the area for several hours after the hot work ceases as a “fire watch.”
14. Welding equipment must be positioned so that flames and sparks do not fall on cylinders, hoses, electric welding cables, hydraulic hoses, and other equipment.
15. Welders working on bridges, scaffolds, platforms, and other such work areas higher than the surrounding ground will comply with FRA and other governmental regulations in the use of lifelines, safety belts, or other safeguards as protection against falling.
16. Welding or cutting must not be done from any platform suspended by rope subject to burning or damage by fire.
17. Welding or cutting in “confined spaces” may only be performed by employees qualified to enter confined spaces.

- a. Welding or cutting in a closed or confined space rapidly burns up breathable oxygen. Adequate ventilation must be provided when working in closed or confined spaces. Equipment must be tested for leaks prior to entering confined area. A person must be in position to see the Welder and near welding equipment to turn it off in case of emergency. Oxygen, propane, or other fuel tanks must not be taken into a confined space.
 - b. When the welder must enter a confined space through a small opening such as a manhole, a lifeline and safety belt are required. The welder is to adjust the lifeline and safety belt in such a manner that will allow the welder to be pulled from the confined area without having the welder's body jam in the opening.
 - c. One cannot enter a confined space without a trained rescue team. A life line and safety belt alone is not a suitable extraction plan.
18. Adequate ventilation must be provided when welding or cutting certain metals or using certain welding rods or fluxes as toxic fumes may be produced. Among the metals or items that may produce toxic fumes are beryllium, brass, bronze, cadmium, chromium, fluxes containing fluorides, galvanized iron, lead, lead based paint, manganese, mercury, and zinc. It is mandatory when welding or grinding on manganese to use a power blower. If electricity is available, a power blower is recommended for any welding or grinding operation. If adequate ventilation cannot be provided, a suitable metal fume or HEPA filter respirator must be used.
19. When necessary to obstruct the track(s), the welder must first **know** that full protection is provided in accordance with Operating Rules.
20. The Welder is to report equipment defects or safety hazards to their Roadmaster. The equipment should not be used until it has been checked for safety. Only qualified personnel will make repairs to welding equipment.
21. Hands, whether gloved or otherwise, must not be used to brush slag or metal from material being welded or cut.

OXY-PROPANE WELDING AND CUTTING

1. Refer to propane as “propane” not “gas”. The word “gas” is a general term and confusion is dangerous.
2. Welding and cutting equipment must be kept clean, free of oil and grease, and in good condition. This equipment will be equipped with flash back arrestors and reverse flow check valves to ensure that the gasses mix at the torch. Exception: If using a Victor HD310C torch handle, add on reverse flow check valves must **not** be used, as they are built in this torch handle.

3. Daily inspection must be made on all equipment. Leaky cylinders, hoses, or connections must not be used. Any odor must be traced and all precautions taken against sparks.
4. The use of SNOOP is the preferred method and the only approved liquid for locating leaks. Where SNOOP is not available the following pressure loss method may be used to detect leaks:
 - a. Connect equipment.
 - b. Open cylinder valves, set pressures, and purge hoses.
 - c. Close torch and cylinder valves.
 - d. Watch gauges for approximately one minute.
 - e. If the pressure indicated by the gauges remains the same, there are no leaks.
 - f. If the gauge indicating tank pressure shows a drop, there is a leak between the cylinder and the regulator.
 - g. If the gauge indicating hose pressure shows a drop, there is a leak between the torch and the regulator.
 - h. If a leak is indicated, check the fittings and hose in the appropriate area.
5. Keep oil and grease away from cylinders, cylinder valves, and hoses. Grease and oxygen is a highly explosive mixture.
6. Open cylinder valves slowly.
7. Purge oxygen and propane lines and hoses before lighting the torch.
8. Cylinders must not be roughly handled and must never be handled with a magnet. Cylinders must be transported, stored, and used in a vertical position. A special cradle can be used to ensure proper cylinder positioning.
9. Never use a cylinder or its contents for other than their intended purpose.
10. Protect cylinder valves from bumps, falls, falling objects, heat, and the weather. Use cylinder safety caps when moving any cylinder.
11. It is a CFRC, OSHA, and DOT requirement that all compressed gas cylinders **MUST** have safety caps protecting the valves when they are transported over public roadways. The **APPROVED** protector cylinder valve caps will fulfill this requirement and the regulators may be left on the cylinders. Some state and local laws may vary so always follow the most restrictive laws. If the protective valve caps are not available, the solid safety cap must to be used. Propane cylinders must have a screw-in safety plug in the valve outlet when being transported unless the solid safety cap design does not provide adequate room to accommodate the safety plug.

Description

Protector Cylinder Valve Cap – Oxygen

Protector Cylinder Valve Cap – Propane

Safety Plug – Propane

12. Before moving the cylinders, purge the hoses by closing the cylinder valves, opening the torch valves to release pressure on the gauges, and release the regulator valve screw.
13. **Gauges must be removed from the cylinder at the end of every work day.**
14. Mark empty cylinders ‘empty’ or ‘M.T.’ with a removable material, such as chalk or crayon. Do not place marking on top of numbers stamped into or stenciled onto cylinders.
15. Send empty cylinders back to supplier promptly. Never attempt to refill any cylinders.
16. Storage of cylinders.
 - a. Cylinders shall be kept away from radiators and other sources of heat.
 - b. Inside of buildings, cylinders shall be stored in a well protected, well ventilated, dry location, at least 20 feet from highly combustible materials. Cylinders should be stored in definitely assigned places away from elevators, stairs, or gangways. Assigned storage places shall be located where cylinders will not be knocked over or damaged by passing or falling objects, or subject to tampering by unauthorized persons. Cylinders shall not be kept in unventilated enclosures such as lockers and cupboards.
 - c. Inside a building, cylinders except those in actual use or attached ready for use shall be limited to a total gas capacity of 2,000 cubic feet or 300 pounds of liquefied petroleum gas.
 - d. Oxygen cylinders in **storage** shall be separated from propane cylinders or combustible materials (especially oil or grease), a minimum distance of 20 feet or by a noncombustible barrier at least 5 feet high having a fire resistance rating of at least one-half hour.
 - e. In vehicles, if the cylinders are kept in a locker or cabinet, the locker or cabinet must be ventilated. Openings both top and bottom must be provided or the locker or cabinet fitted with a louvered door that will permit any oxygen or propane leaking from a cylinder to disperse freely.
17. Keep valves closed on empty cylinders.
18. Use only approved wrenches for opening cylinder valves not equipped with handles.
19. Never use oxygen for any purpose other than welding. Oxygen is not a substitute for compressed air and should never be used to blow off clothing.
20. Cylinders must be fitted with twin Grade “T” hoses for propane and oxygen with an inside diameter of ¼” or 3/8”. Hoses with an

inside diameter of 3/8” must be used to preheat the rail ends when making field welds with a length not to exceed 100’.

21. Flashback arrestors and reverse flow check valves

- a. Hoses for propane and oxygen will be fitted with combination flashback arrestors and reverse flow check valves at the regulator end.
- b. Hoses for propane and oxygen will be fitted with reverse flow check valves at the torch end, unless using a Victor HD310C torch handle. Note that the placement of additional external reverse flow check valves on the Victor HD310C torch handle can cause fuel starvation and a possible blowout of the mixer assembly.
- c. Flashback arrestors and reverse flow check valves must be inspected in accordance with manufacturer’s instructions at least every six months unless required more often by the manufacturer.
 - i. In the absence of manufacturer’s instructions for testing flashback arrestors and reverse flow check valves, the following procedure must be followed.
 - ii. Turn off both regulator adjusting valves. Remove the reverse flow valves from the torch and the flashback arrestors from the regulators.
 - iii. Attach the reverse flow valves onto the regulators. Pay particular attention to attach the oxygen valve to the oxygen regulator and the propane valve to the propane regulator.
 - iv. Turn on each cylinder with the “T” handle until the pressure reaches 65 psi for oxygen and 15 psi for propane. If either valve allows their respective gases to flow, the valves are defective and must be immediately replaced before proceeding.
 - v. Remove the reverse flow valves from the regulators and attach only the hoses to the regulators.
 - vi. Attach the flashback arrestor to the torch end of the hose (with the torch not attached). Pay particular attention to attach the oxygen flashback arrestor to the oxygen hose and the fuel gas flashback arrestor to the fuel gas hose.
 - vii. Turn on each cylinder with the “T” handle until the pressure reaches 65 psi for oxygen and 15 psi for propane. If either flashback arrestor allows their respective gases to flow the flashback arrestor is defective and must be immediately replaced before proceeding.
- d. Victor HD310C torch handles will be checked for reverse flow using the following procedure.
 - i. Turn off both regulator adjusting valves.
 - ii. Disconnect one hose from one of the regulators.
 - iii. Open all torch control valves.

- iv. Plug the tip end.
 - v. Turn on the regulator that is NOT DISCONNECTED until a 2 to 5 psi reading appears.
 - vi. Put the end of the hose that is DISCONNECTED from the regulator under water or cover the end of the hose with an approved leak detector solution such as SNOOP.
 - vii. Bubbles will appear if the check valve is leaking. There should be no more than two bubbles in 10 seconds.
 - viii. If the check valve leaks, reconnect the hose to the regulator and unplug the cutting tip. Flush for 3 to 5 seconds with 10 psi of propane or 30 psi of oxygen (depending on the valve being tested).
 - ix. Retest the check valve using steps i. thru vii. above. If there is still a leak, replace or repair the torch before proceeding.
 - x. Reconnect the hose that was disconnected for the first test. Repeat steps i. through ix. with the other hose.
 - xi. After both check valves test good, purge both the oxygen and propane lines before lighting the torch. Test all hose connections for leaks.
22. Quick disconnect hose couplings are **not** to be used.
23. Repair hoses and connections **only** with crimp style welding hose repair kit and perform Snoop test prior to use.
- a. Never attempt to repair hoses with friction tape, or other types of tape or with wire.
 - b. Do not use Teflon tape or pipe dope on any of the system's compression fittings. (eg. Regulator to cylinder valve, flashback arrestors, reverse flow check valves, test gauges, hose connections, etc.)
24. Before cutting through sheet metal, plate, or other material, employees must be certain that no persons are in a position to be burned or injured from falling material.
25. Do not use wooden or flammable material to support work for welding and cutting.
26. Only approved vendors will perform other than routine adjustments and maintenance to regulators.

ELECTRIC ARC WELDING

Mandatory use of wire feeder.

Any welding repair to frogs, switch points, engine burns, rail ends, etc. that require more than a 30 minute repair (minor repair) will be done with a wire feeder,

All welding teams, other than a dedicated thermite Welding Team, that have a wire feeder are required to use it. If a team does not have a wire feeder, or it is broke down, the Chief Engineer for that area is to be contacted and he will handle accordingly.

This instruction applies to sections:

C. Repair of Engine Burns

- D. Repair of Rail Ends
- E. Repair of Rail Ends for Glued Bonded Insulated Joints
- F. Repair of Switch Points
- G. Repair of Frogs and Railroad Crossings

1. Avoidance of electric shock is largely within the control of the Welder. Most welding voltages are not high enough to cause severe injury by electric shock; however, a mild shock from normal working voltages may cause involuntary muscular action that might cause a person to lose balance. Wet clothing reduces the resistance of cloth and increases the effect of a normally small shock. Notwithstanding, under certain conditions, the voltages produced by an electric welder can be dangerous to one's life.
2. Live metal parts of an electrode holder must not be allowed to touch bare skin or wet clothing.
3. An electrode holder must not be permitted to touch any metal that contacts the welding ground. This will cause a dead short circuit on the welding generator resulting in damage to the equipment.
4. The jaws of the electrode holder must be kept clean.
5. Welding Cables:
 - a. Cable capacity must be matched to the welding machine.
 - b. The normal length of cables connected to the welding machine is 50 feet. Shorter or longer lengths may be used with permission of the Chief Engineer.
 - c. On territories where track access is limited by terrain, an additional 50 feet of cable may be added using insulated cable connectors.
6. Always be sure that the cables are in good condition and all cable connections are tight.
7. Cable splices must be 10 feet or greater from the electrode holder.
8. Cable is to be uncoiled before welding. It should be strung out on the ground without crossing itself. Do not leave cable coiled up and hanging from a hook or coiled up one layer upon another while welding.
9. Do not coil or loop electrode cable around the body while welding.
10. All ground connections must be mechanically strong, close to the work, and of adequate size electrically. Never attach ground clamp to the rail base. Use of a magnetic ground clamp that attaches to the ball of the rail is recommended. (Item # 280.0859924.1)
11. Never operate a gasoline or diesel powered welder in a confined space or without adequate ventilation.

12. Never strike an arc on, or touch an electrode against oxygen, propane, or other cylinders used for the storage of compressed gas.
13. Electrodes must be removed from holders when not in use. Electrode stubs should be disposed of into a metal container.
14. Other than routine maintenance, only qualified individuals or vendors will make repairs to welding machines.
15. Where practical, the work should be enclosed with a fire proof screen to protect the eyes of others from the glare of welding rays. Welders working along the line of road must take precautions to protect the public and others employees not involved in the welding process from glare.
16. When the use of a wire feeder is complete, both the 15 feet welding gun and the roll of wire must be removed from the feeder.

ELECTRIC ARC WELDING IN TRACK CIRCUIT TERRITORY

1. High amperage current (100 to 300 amperes) used for welder operation, which flows through a section of rail during the arc welding process, has a tendency to leak to earth and unbalance the track circuit.
2. Stray electrical current could damage sensitive signal equipment that is used for train operation and active grade crossing warning devices.
3. Unbalancing of the track circuit may affect the operation of track relays resulting in signal interruptions.
4. Sufficient stray current could flow through the track relay to hold it energized with the track circuit occupied if the return current of the welding outfit is allowed to flow through only a short section of rail.
5. Operation of the electric arc welder on bridge guard rails, or on non-bonded tracks, such as sidings or non-signaled running tracks, running parallel to or in close proximity to main tracks equipped with track circuits, will also affect the proper operation of the track circuit. The following instructions must be followed when using electric arc welding equipment on any track or guard rail in track circuited territory.
6. Before proceeding with the use of an electric welder on tracks in track circuited territory, the Signal Maintainer must be notified a sufficient time in advance to install circuit fuses to protect signal equipment.
7. The location of insulated joints must be ascertained before any work is undertaken. If there is a question as to the limits of any track circuit, a signal employee must identify the limits

prior to the start of work.

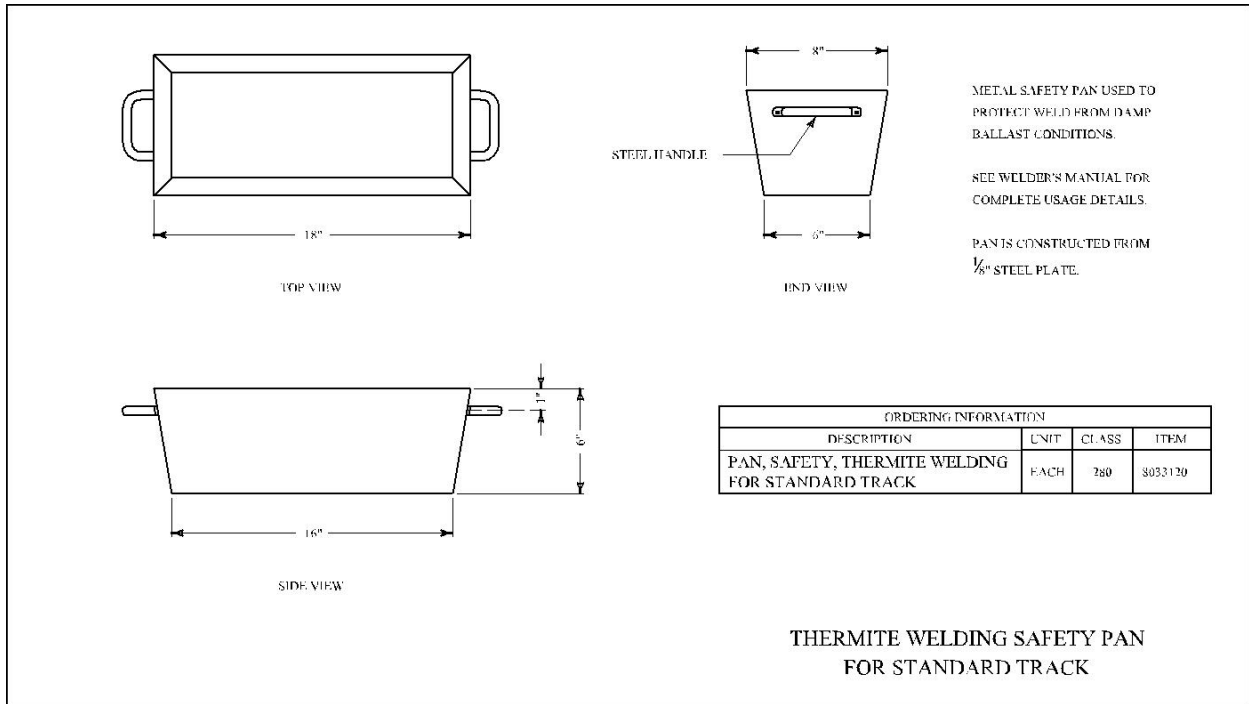
8. Electric arc welders (generators) must be properly insulated, and insulation kept in good condition.
 - a. All electrical equipment must be grounded at the source, and all connections must be clean and tight.
 - b. The ground clamp must be clean, fit well, and make full contact without any current resistance. Use of a magnetic ground clamp is recommended.
9. Do not disturb the ground clamp while welding. Welders equipped with mechanical ground bars must not be moved during welding, nor stopped with the ground spanning an insulated joint.
10. Care must be exercised to see that the ground plates are never allowed to touch the opposite rail of the track on which welding is performed as this will cause serious damage to signal apparatus.
11. The welding electrode and ground plates must never be dropped in the ballast or be permitted to come in contact with the ground while the generator is running. When the welder is not in operation, they should be carefully laid on the end of a tie.
12. At points where the wires are run under or over the rails of any track, additional protection of the insulation must be provided by sliding a short section of rubber hose or placing an insulating mat between the wire and rail.
13. When performing electric arc welding operations on or about bridge structures, the use of guard rails or bridge members for completing the "Hot" side of the circuit between generator and welding electrode must be avoided. An insulated cable conductor must be used for this purpose. When welding guard rails or bridge members, extreme care must be taken to prevent tools, tie plates, or other metallic objects from making contact between main track rails and the member on which welding is performed.
14. Equipment such as grinders, slotters, push cars, and hi-rail vehicles must be properly insulated to prevent shorting the track circuit.
15. In track circuit territory, multiple operator welding systems where two or more welding circuits are connected electrically to the same source must not be operated.
16. No more than two single arc-welding machines may be operated within the limits of any track circuit. This applies to territory having one or multiple tracks.
17. Automatic and semi-automatic wire feed systems must be fully insulated from the unit frame.
18. For the welding of conventional insulated joints, joint bars shall be applied on only one joint at a time. (When the insulated joint is on the closure rail, the installation of

joint bars may short the track circuit.)

19. Protect bond wires during preheating, post heating, welding heat, surface grinding, and cross slotting.
20. The polarity switch must be in the “OFF” position while traveling or when removing the welding machine from the track. Some welding machines do not have a polarity switch with an “OFF” position. These welding units must be turned off while traveling or when removing the machine from the track.

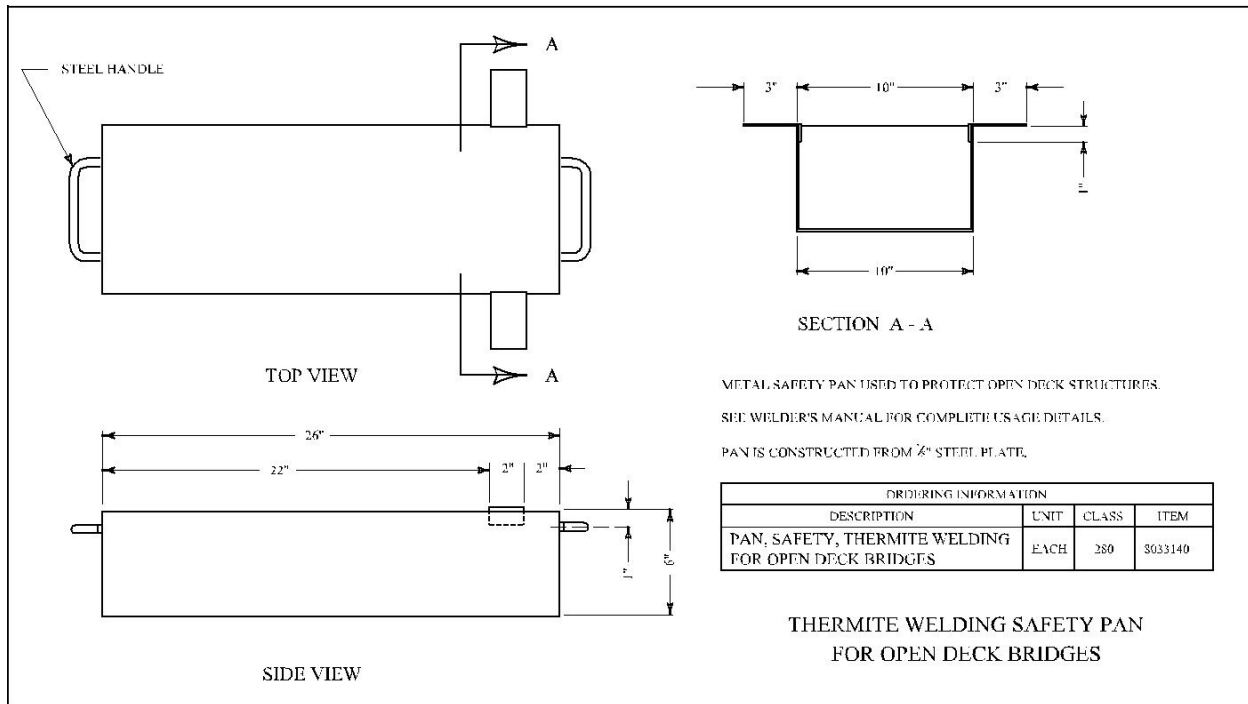
THERMITE WELDING

1. Daily inspection must be made of all equipment to ensure that the equipment is kept clean and in good condition.
2. All equipment and personnel, not directly involved in making the weld, will be moved to a safe distance of 20 feet (30 feet if snow on the track) during the weld reaction and pour, as well as during the grinding operations. In particular, equipment will be far enough from the work to ensure that it is not showered with sparks from these operations.
3. The slag basin shall have 3/4” of dry sand placed in the bottom of the basin during the preheat process.
4. At any time the ballast or surface under a field weld is wet, a safety pan will be placed directly under the weld. The safety pan is a metal container approximately 8” x 18” x 6” with 3” of dry sand in the bottom as illustrated in Sketch A-1.
5. When a weld must be made on an open deck bridge: A safety pan will be placed directly under the weld. The safety pan is a metal container approximately 10” x 26” x 6” with 3” of dry sand in the bottom as illustrated in Sketch A-2.
6. A full face shield, welding gloves and long sleeves are required when handling hot slag basins and during the tear down process of a poured weld. This face shield and welding gloves are required during the shearing process.
7. Do not move the slag basins until five minutes (six minutes for wide gap welds) have passed since the pour. After five minutes, move the slag basin fifteen to twenty feet (eight to ten ties) and place on level ballast. After twenty additional minutes have passed, empty slag basin in designated location.
8. Never throw hot metal or slag into water, snow, or ice because an explosion may occur.
9. The contents in the slag basin(s) and safety pans should be dumped only after they have completely solidified, and in a dry place where it will not cause a fire or personal injury.



Sketch A-1

10. One method for removing weld risers is the weld riser removal tool. Insert the tool vertically with the large opening over the riser and the notch toward the weld. Pull the end of the tool smoothly to the desired angle in accordance with the welding procedure. When breaking of a riser, completely insert the tool onto the riser and use the tool defensively due to the snapping effect. After breaking off a riser, the riser may be handled with the tool and placed in the disposal area.
11. If using a hammer to remove the weld risers, a full face shield and welding leggings must be worn. Always stand on the opposite side of the rail from the riser that is being struck. A hot cut chisel can be used to gently remove the sand mold from around the base of the risers to allow for cooling. The risers should not be removed until approximately 25 minutes after the end of the pour. Be sure to clear the "red zone" before striking the risers and use only light taps with the hammer.



Sketch A-2

HAND TOOLS

Using Hot Cut Chisel:

1. Hot cut chisel may be used for clean up of sand mold debris around base risers and side of weld areas, but will not be struck doing this clean up task. Employee must stand on opposite side of rail to be cleaned and with light downward strokes, remove sand away from risers. When done cleaning on first side, step over the rail to clean other side of rail. All required PPE is stated below.
2. In case of emergency, such as weld shear failure, the hot cut chisel will be used to cut risers from side of ball and clean up top of ball after torching off head. This will be done only after the hot cut chisel has been inspected as explained below.
3. Hot cut chisel handle will be inspected for cracks, the chip protector will be removed, and head of hot cut chisel will be inspected for cracks, overflow, or missing pieces.
4. The tool will be ground if not found in compliance and if pieces are missing, the hot cut chisel will be removed from service.
5. After the head of the hot cut chisel has been inspected and corrected, the chip protector will be put back in place.

6. The cutting edge of the hot cut chisel is to be properly sharpened using the procedure outlined in MWI 1702.

Chip Protector – 3 lbs. Hot Cut Chisel
Chip Protector – 5 lbs. Hot Cut Chisel

Note: When using a hot cut chisel to cut away excess metal from the sides of the railhead, the following procedure must be followed:

1. Head of the hot cut chisel must be turned to a perpendicular angle between 10 to 15 degrees away from vertical in relation to the ball of rail. See photo A-1.
2. Cutting point of chisel must not strike risers squarely rather at an angle. See photo A-2.
3. Head of chisel must be hit squarely. See photo A-3.
4. Chip protector is correctly sized. See photo A-4.

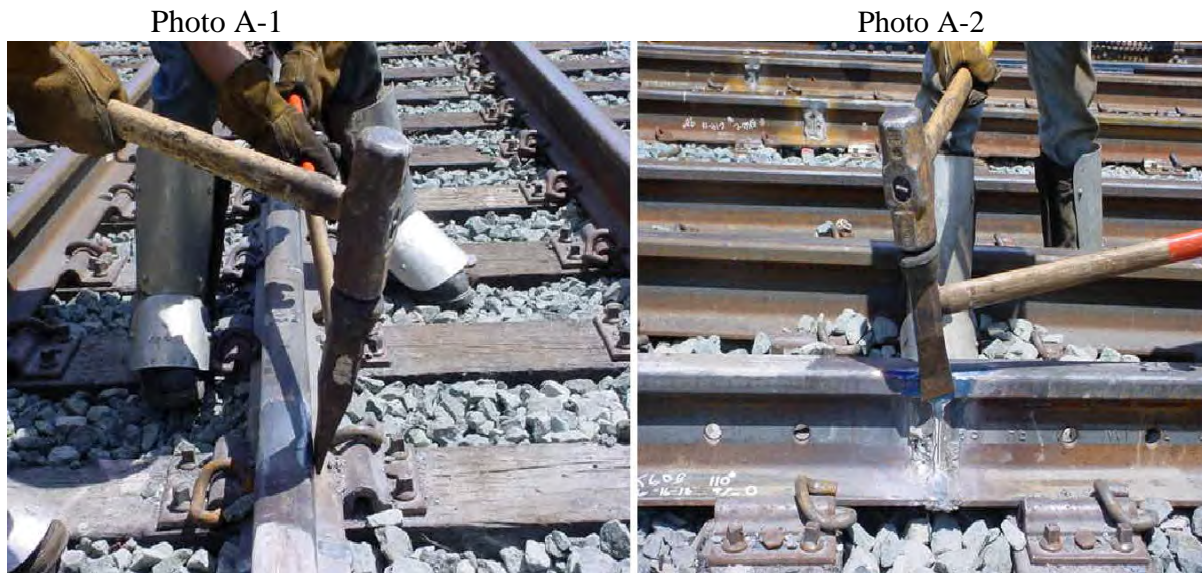


Photo A-3

Photo A-4



Required PPE:

If the hot cut chisel does have to be used due to weld shear failure, the following PPE will be worn by both holder and striker:

- Hardhat,
- Safety Glasses,
- Face Shield with chin guard,
- Welder's Gloves and,
- Leather/Metal Metatarsal Leggings

1. Handles must be maintained tight on all hammers, sledges, mauls, chisels, etc.
2. Ensure everyone is standing clear of the red zone before swinging any wide arching sledge or maul.
3. All burrs, chips, and battered metal must be ground off all hand hammer driven tools, such as sledges, spike mauls, hot cut chisels, wedges, drift pins, etc.
The use of a dead blow hammer is required when striking alignment wedges to crown rail ends for welding.
4. When striking and struck tools are repaired, they must be ground to an approved contour, checked with an approved template and fitted with a chip protector. See MWI 1702 for more information on repairing hand tools.

CUTTING RAIL AND TRACK BOLTS AT DERAILMENT SITES

1. Do not use welding or cutting equipment at the scene of a derailment until the person in charge of re-railing operations advises that it is safe to do so. Material leaking from damaged cars may be explosive or highly flammable and the use of open flames must be controlled.
2. Twisted and bent rails may shift to a new position with little or no warning when cut. Before making the cut, all personnel not involved in making the cut shall be clear of the Red Zone. Use heavy equipment to stabilize the rail before cutting and during the entire cut. The torch must be at least 36 inches or longer. The welder must be positioned in order to not become caught between the rail and other objects if the rail does shift.
3. Joint bars on twisted and bent rails may be propelled a considerable distance when the bolts are cut. A chain loosely wrapped several times around the joint will restrain the joint bars when the bolts are cut. If the bolts are under pressure, they may also fly when cut. If in doubt, cut the rail first and then remove the joint bars.

B. QUALIFICATIONS FOR CFRC ENGINEERING DEPARTMENT WELDERS

GENERAL:

1. All Welders performing work for the Engineering Department on track appliances, buildings, bridges, or other structures using the Thermite, Oxy-propane, or Electric-arc methods of welding must be qualified by a Welding Instructor or Manager–Welding.
2. The qualification test will consist of actual welding and grinding, as well as a written or oral examination on safety precautions and welding procedures. The test will be specified by the Chief Engineer.
3. The Chief Engineer will maintain a record of each person who qualifies as Welder. The record will indicate:
 - a. The welding category(s) in which an individual is qualified,
 - b. The date each qualification was granted,
 - c. Qualification as a Welder, and
 - d. The person who qualified the individual
4. No person will perform any welding without being qualified. **Exception:** Persons in training to become Welders may perform work specified by a Welding Instructor or Manager–Welding under the direct supervision of a qualified Welder.
5. It is understood that when an employee accepts the position of Welder Helper, they will progress toward becoming qualified as a Welder.

QUALIFICATIONS CATEGORIES:

1. Welding work performed for the Engineering Department will be divided into the following categories:
 - a. Structural; Electric-Arc Method
 - b. Track Appliance; Electric-Arc Method; Using Electrodes
 - 1) Repair engine burns
 - 2) Repair battered rail ends, regular and insulated joints
 - 3) Repair switch points
 - 4) Repair frogs and crossings
 - c. Track Appliance; Electric-Arc Method; Using Wire Feed
 - 1) Repair engine burns
 - 2) Repair battered rail ends, regular and insulated joints
 - 3) Repair switch points
 - 4) Repair frogs and crossings
 - d. Field Welding of Rail Ends; Thermite Method

- 1) 1" Gap Welds
 - a) Boutet
 - b) Orgo-Thermit
- 2) 2 ¾" Gap Welds
 - a) Boutet
 - b) Orgo-Thermit
- e. Rail piling; Electric-Arc Method Welding
- f. Air arc metal removal
- g. In track electric flash-butt welding of joints
- h. Slice
- i. Basic cutting with burning torch

ACCEPTABLE TRAINING INCLUDES:

1. Work under a qualified CFRC Welder.
2. Class room training directed by a Welding Instructor or Manager–Welding.
3. Commercial Trade School

AWARDING OF WELDER POSITIONS:

1. To be awarded a bid position of welder, a person must qualify under these rules prior to the expiration of qualification time as called for in the appropriate Labor Agreement.

**QUALIFICATION REQUIREMENTS:
KNOWLEDGE AND UNDERSTANDING RAILROAD RULES**

1. A person must obtain a copy of the Engineering Department *Welding Manual* and must demonstrate to a Welding Instructor or Chief Engineer a general knowledge of its contents.
2. A person must obtain a copy of the *CFRC MofW Field Manual* and demonstrate to the Chief Engineer, or designee, a general knowledge of the rules.
3. A person must obtain a copy of the *CFRC Operating Rules* and must be examined and qualified as required by these rules.

5. A person must obtain a copy of the *FRA Track Safety Standards* and become qualified in accordance with §213.7.
6. **A person must submit a welding report on Maximo at the completion of each work day.**

QUALIFICATION REQUIREMENTS: DEMONSTRATION OF WELDING SKILLS

1. The qualification will be based on actual work performed under the personal observation of a Welding Instructor or Chief Engineer for all track appliances and structural welding. Qualification for bridge welding will also comply with American Welding Society Bridge Welding Code (AWS D1.5).
2. Certain welding procedures require that test samples, made in accordance with American Welding Society specifications, be prepared for qualification. Test material will be mild steel plate (ASTM A36 structural steel or equal) 3/8" to 1" thick. A test sample will qualify a person only for the welding process used to make the test sample.
3. Test samples may be required in the flat and vertical positions for track appliance. For structural welding, the person will be required to have vertical and overhead weld samples.
4. The Welding Instructor or Chief Engineer may require qualified Welders in structural or track appliance to make additional test samples if steel plates 3/4" thick or greater, or high strength steel are required. Test samples will be made with the welding process and the type and thickness of steel to be used. The Welding Instructor or Chief Engineer will specify the welding positions.
5. The Welding Instructor or Chief Engineer may require qualified Welders who have not performed welding for the Railroad for a period of one (1) year or longer to make test samples in one or more positions to demonstrate that they have retained their welding skills.
6. The Welding Instructor or Chief Engineer will provide materials for the test samples and see that the samples are tested in accordance with American Welding Society's Specification for Compliance (Structural D1.1, Bridge D1.5), maintain records of results, and maintain a list of qualified Welders by welding categories.
7. The Welding Instructor or Chief Engineer will observe the person requesting qualification under actual work conditions to verify the welder's work habits and methods are consistent with safe welding practices. Proper welding procedure is a requirement for qualification.
8. The Welding Instructor or Chief Engineer will examine welds for durability made by a person requesting qualification after they have been subjected to service for a period of time; however, the period of time must not exceed the time referred to in Labor Agreements. Durable welds are a requirement for qualification.

9. Persons that have successfully completed a commercial trade school course in welding which required the preparation and examination of test welds in accordance with American Welding Society's Specification may be relieved by a Welding Instructor or Chief Engineer from making similar test samples for the Railroad, provided the following conditions are met:
 - a. The person desiring to be qualified has a written statement from the instructor of the course stating the welds met proper requirements.
 - b. A copy of the laboratory examination of the test samples showing they met American Welding Society's specifications.
 - c. Not over one (1) year has passed since the samples were made and tested.

C. REPAIR OF ENGINE BURNS.

GENERAL

1. Engine burns in carbon steel rails will be repaired through the use of the electric-arc welding process with the mandatory use of either heating blocks or a Teleweld heater.
2. Engine burns in alloy rail will not be repaired. For description of alloy rail, see page H-2.
3. Engine burns should be repaired as soon as practicable. The impact of wheels on the defect will increase the metal flow, secondary batter, and thermal cracking.
4. The size and number of engine burns, that may be repaired in a given rail, depend upon the weight and condition of rail to be repaired and the availability of replacement rails. Generally, defects, which will be deeper than 3/8" after grinding, should not be repaired (See Sketch C-1). Also, engine burns requiring a weld longer than 10" should not be repaired.
5. Engine burns will not be repaired:
 - In a rail with shelly spots in the burn area.
 - In a switch point.
 - In a stock rail.
 - In the guardrail area of a turnout.
 - Within three (3) feet of a plant or thermite weld.
6. When repairs are necessary in cold weather, the heated area must be protected to prevent rapid cooling, as follows.

<i>Rail Temperature</i>	<i>Weather Conditions</i>	
	<i>Clear</i>	<i>Wind, light rain, or snow</i>
40°F or greater	Air Cool Weld Cooling Cover is not required	Apply Weld Cooling Cover immediately after shearing. Leave cover in place until weld is cooled below 800°F (about 35 minutes).
Between 40°F and 0°F	Prior to installation of molds, preheat railhead and base to 100°F (hand hot) for a distance of 3 feet on both sides of the weld gap. Complete weld and unmold normally. Apply Weld Cooling Cover immediately after shearing. Leave cover in place until weld is cooled below 800°F (about 35 minutes).	
0°F and less	Welding is not recommended	

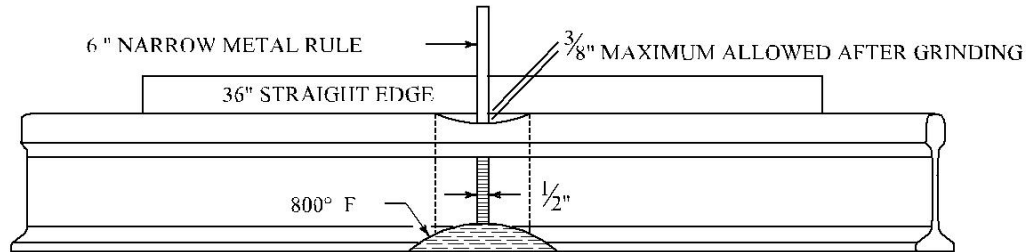
7. The Signal Maintainer will be notified in advance whenever welding is to be performed in track circuit territory.

8. See *Section "A", Safety*, for instructions for electric arc welding in track circuit territory.

PROCEDURE FOR REPAIRING ENGINE BURNS:

1. Check to see if rail can be repaired with a weld less than 10" long.
2. Before welding, three (3) ties on each side of the repair area will be inspected to determine if the rail can expand during the repair. Nip spikes and remove rail anchors if necessary.
3. Shim rail with a crown of 1/8" at the center of the engine burn using a 36" straight edge. See sketch in Section "I", Thermite Welding.
4. Mark the limits of the repair. The repair limits should be marked at an angle across the railhead so that the length of repair on the gage side will be approximately one inch (1") longer than on the field side on each side of the repair.
5. Grind out all damaged metal down to sound, clean parent metal. The removal shall not be accomplished through the use of a torch. Special care must be used to remove enough metal to eliminate all shatter cracks.
6. If during the repair work, it is found that the rail requires removal of more than 3/8 inch in depth of damaged metal by grinding; it will be repaired, protected by joint bars, and removed from track as soon as possible.
7. Preheating
 - a. Orgo-Thermit Heating Blocks - Before welding, the heating blocks are to be secured on each side of the rail in the web area and ignited. After the rail is heated to 800°F, carefully examine the rail for cracks. Cracks will appear as dark hair lines in the heated area. If cracks are present, further grinding is required. Heating blocks must remain in place until the repair has been completed.
 - 1) Heat block for 90# to 119# rail
 - 2) Heat block for 122# to 140# rail
 - 3) Heat block are not currently available for 141# rail or greater

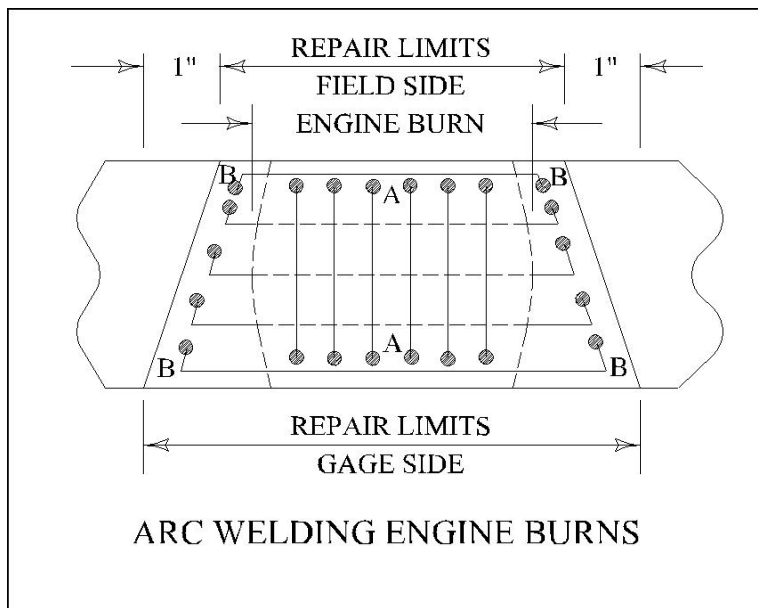
HEAT BASE AFTER WELDING THE SAME LENGTH AS THE WELD AND 1/2 INCH IN WEB
FROM BASE TO BALL TO APPROXIMATELY 800° F.



ENGINE BURN REPAIR SKETCH
DEPTH MEASUREMENT AND HEATING PATTERN

Sketch C-1

- b. Other Heating Devices – An approved heater must be used to heat the rail to 800°F. The temperature will be verified using a Tempilstick or digital thermometer. Position the heater so that the pre-heated area includes the repair and four inches (4") to both sides of the repair. One approved heater is the Teleweld Single Propane heater.
8. Repair of the engine burn must start immediately after the ground out area has been inspected for cracks and must continue without stopping until all weld material has been deposited.
9. Approved welding rods and wires for the electric-arc process are listed on page N-2.
10. Welding of engine burns should start on the gage side (not gage corner) and proceed to the field side in beads deposited lengthwise according to Sketch C-2.



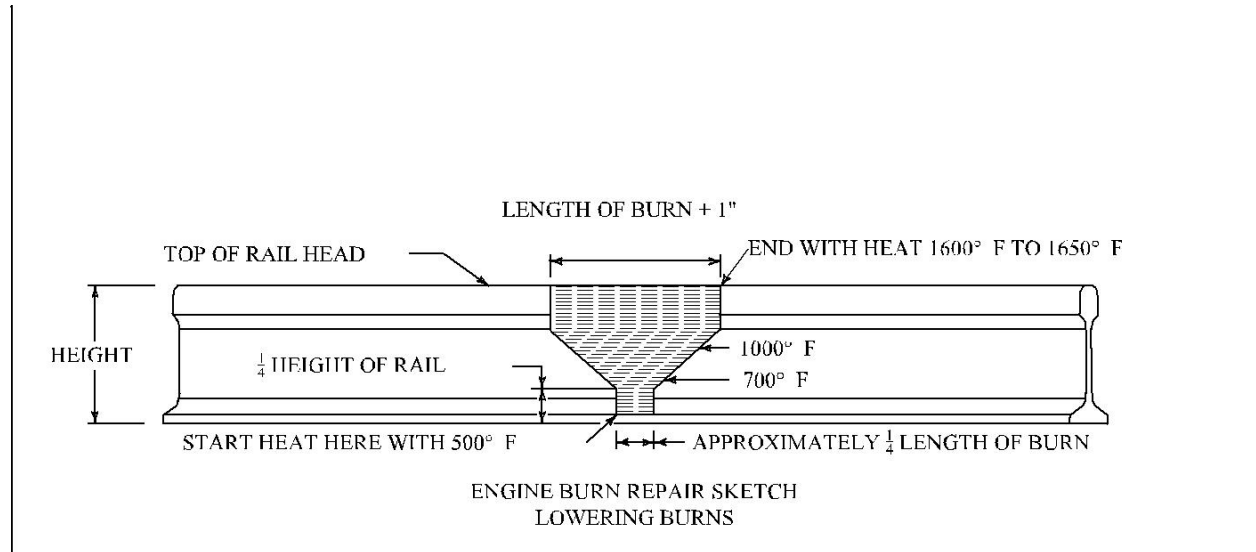
- A. First few beads are 90° across the rail head to fill the deepest area ground.
- B. All finish beads are run length wise with the rail between repair limits.

Sketch C-2

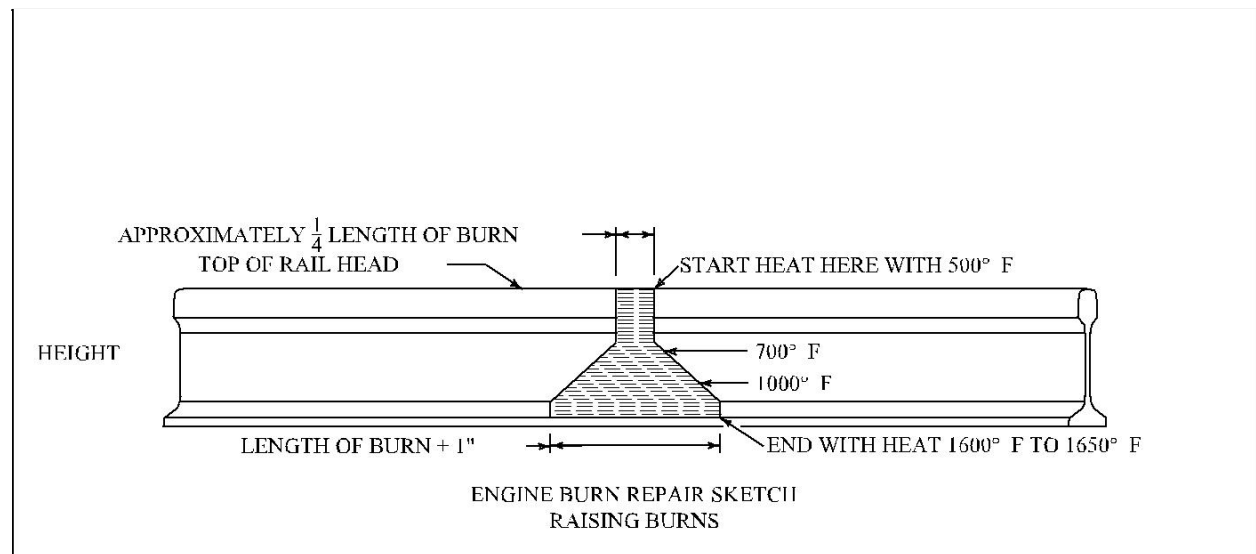
11. Each bead must be peened while the deposit is hot to relieve welding stresses that can cause cracking. Enough weld material should be deposited so that the un-ground surface will be higher than the rail and that the grinding will eliminate the visible welding marks and seams.
12. The weld area must be protected against rain, snow, etc., and be allowed to cool as slowly as possible. Leave heating blocks in place until rail temperature is below 500 F. Verify by using a digital thermometer or a Tempilstick.
13. Use the surface grinding attachment to grind the weld area to a smooth surface and true rail contour.
14. After the welds are made and allowed to cool, an inspection must be made to determine the straightness of the running surface of the rail. Use an approved 36" straightedge. Surface tolerance is $-0'' / +0.030''$ (crown).
15. Remove shims from one tie and tamp that tie before removing the shims from the next tie. Replace any rail anchors that were removed.

CORRECTING VERTICAL DISTORTION:

If the repair has caused a dip, the rail alignment can be corrected by heating the rail as shown in the Sketches C-3 and C-4. Allow the repair area to cool slowly.



Sketch C-3



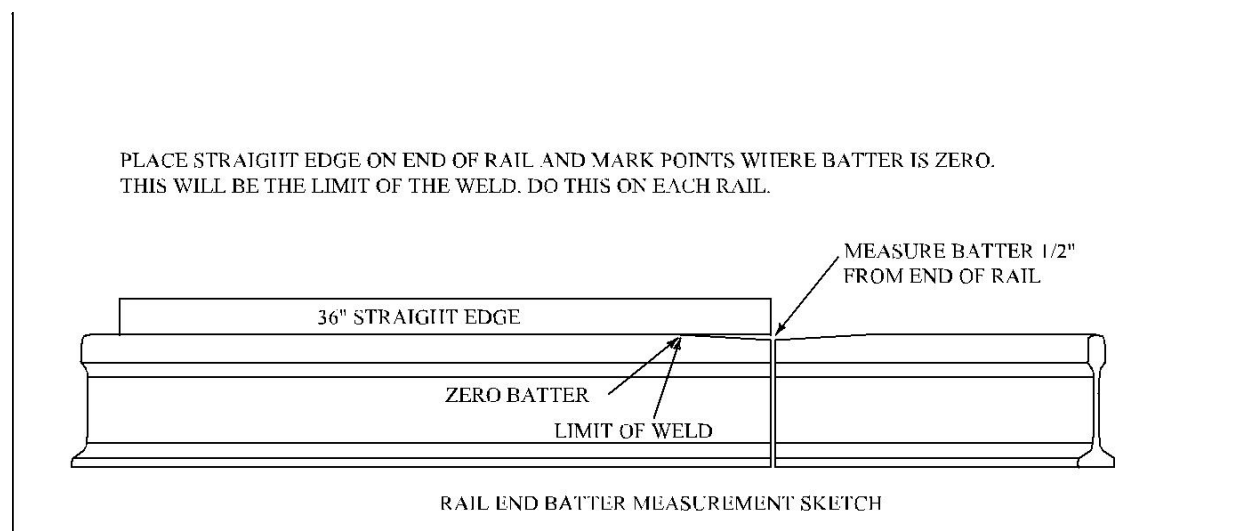
Sketch C-4

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D. REPAIR OF RAIL ENDS

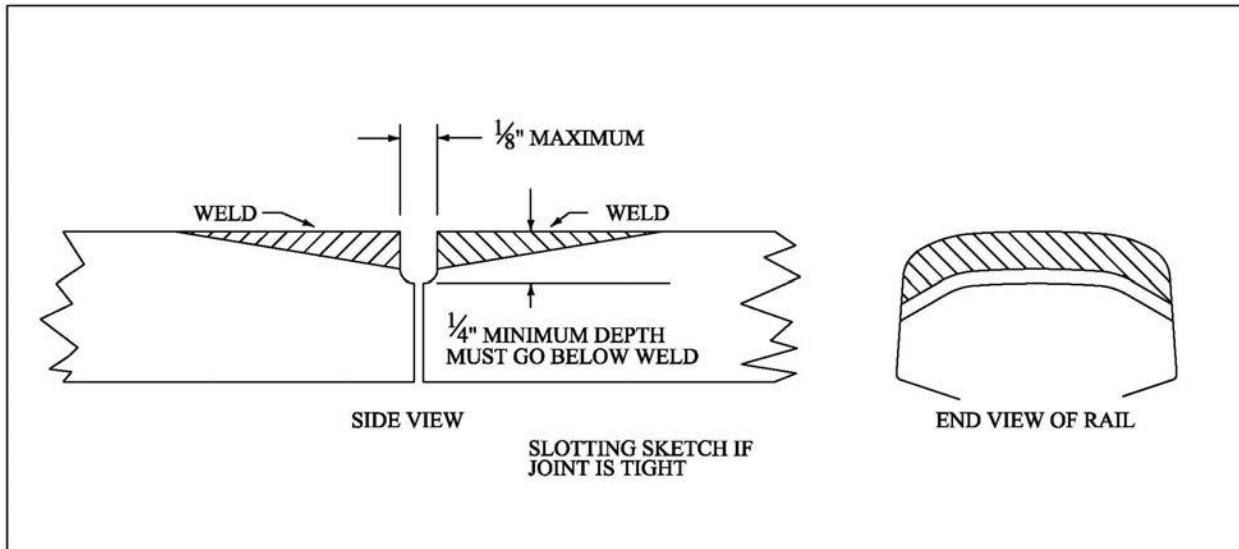
GENERAL

1. Rail end batter in carbon steel rails will be repaired through the use of the electric-arc welding process.
2. Rail ends that have been repaired by welding will not be thermite welded until the rail end has been cropped to remove the entire previously repaired area.
3. Rail ends, that are battered, chipped or spalled, should be repaired to prevent further damage to the rail ends and accelerated deterioration of the other track components.
4. Rail end repairs should be made when the batter reaches the limits as listed below:
 - 1/8 inch (0.125") where freight train speed exceeds 60 MPH
 - 1/4 inch (0.250") where freight train speed exceeds 40 MPH
 - 3/8 inch (0.375") where freight train speed exceeds 10 MPH
 - 1/2 inch (0.500") where freight train speed is 10 MPH or on excepted track.
5. Batter is the distance, measured in thousandths of an inch, between an approved 36" straightedge and the top of rail 1/2 inch in from the end of the rail as shown in Sketch D-1.

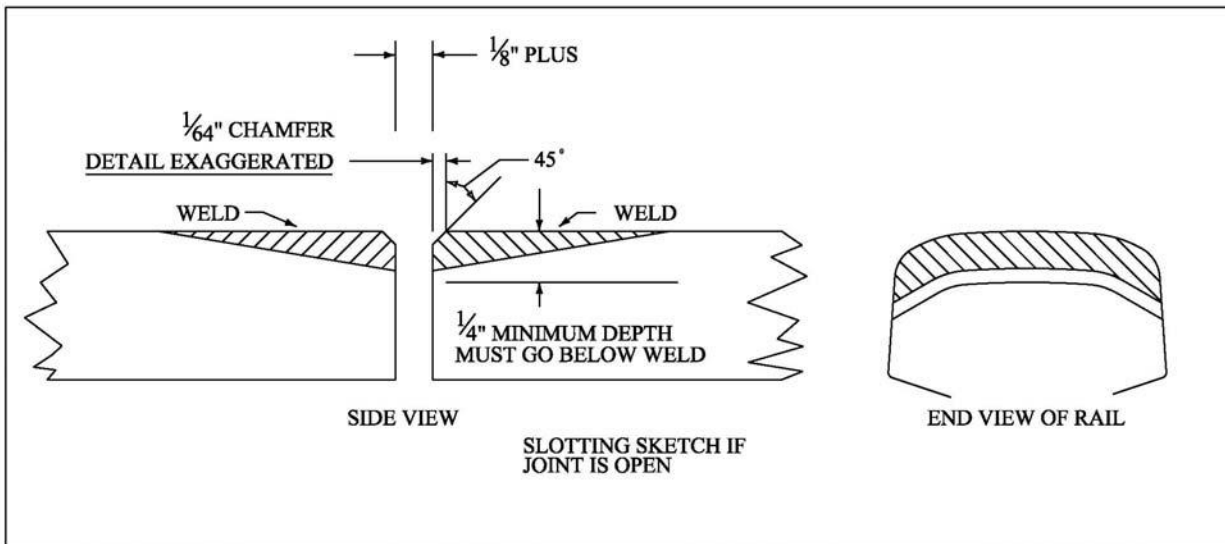


Sketch D-1

6. Rail ends will be slotted by grinding to prevent chipping due to overflow. For rail gaps of $\frac{1}{8}$ " or less see Sketch D-2. For rail gaps greater than $\frac{1}{8}$ " see Sketch D-2A.



Sketch D-2



Sketch D-2A

7. Before repairing the rail ends, the track near the repair should be inspected for excessive expansion at the rail ends, joint bar condition, ties in the joint area, ballast in the joint area and surface. Tamp the joint as necessary.
8. The Signal Maintainer will be notified in advance whenever welding is to be performed in track circuit territory.
9. See *Section "A", Safety*, for instructions for electric arc welding in track circuit territory.

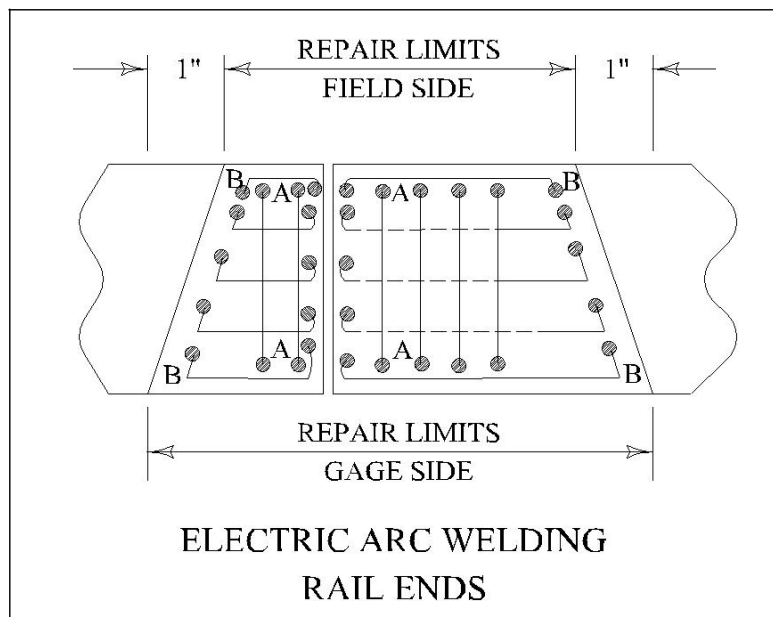
PRELIMINARY WORK

1. Use an approved 36" straightedge to mark the limits of the repair. The repair limits should be marked at an angle across the top of rail so that the length of the repair on the gage side will be approximately one inch (1") longer than on the field side.
2. Rail ends to be repaired must be clean, free from dirt, dust, oil, grease or other foreign substance. Grind out all damaged metal down to sound and clean parent metal. The removal will not be accomplished through the use of a torch.
3. Before welding, preheat the ground railhead to approximately 800°F for a distance of 8" beyond the weld area in each rail requiring repair. Carefully examine it for cracks. Cracks will appear as dark hairlines in the heated area. If cracks are present, further grinding is required.
4. During welding, excessive heat must be avoided, especially near manganese castings. Heat in excess of 500°F could be transferred to and damage manganese castings.

PROCEDURE FOR REPAIRING RAIL ENDS:

ELECTRIC ARC PROCESS

1. Approved welding rods and wires for welding of rail ends are shown on page N-2.
2. Welding must begin immediately after preheating and the 800°F preheat maintained in the area surrounding the repair.
3. First welds are to be made across the railhead until level and then lengthwise from the gage to field side. See Sketch D-3.
4. The welding should proceed lengthwise with the railhead. Each pass must be peened while the deposit is hot to relieve welding stresses. The weld should be extended beyond the rail end and the excess metal removed by slotting after the weld is completed.



- A. First few beads are 90° across the rail head to fill the deepest area ground.
- B. All finish beads are run length wise with the rail between repair limits.

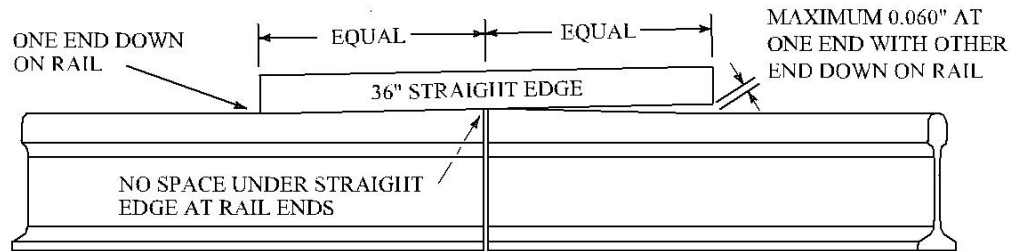
Sketch D-3

5. Enough weld material should be deposited so that the unground surface will be higher than the rail and that the grinding will eliminate the visible welding marks and seams.
6. With carbon steel rail, post-heat the welded area to approximately 800°F immediately after the welding operations. After post-heating, the weld area must be allowed to cool as slowly as possible and protected against rain, snow, etc.
7. With fully heat treated and head hardened rails, post-heat the welded area to approximately 800°F immediately after the welding operations. After post-heating, it is most important that the rail cool slowly to 200°F. It may be necessary to protect the weld area with insulation, such as an insulated blanket to obtain the desired slow cooling and against rain, snow, etc.
8. **It is very important that preheating and post-heating be diligently performed to obtain a quality repair weld.**

GRINDING

1. Use the surface grinding attachment to grind the weld area to a smooth surface and true rail contour.
2. After the welds are made and allowed to cool, an inspection must be made to determine the straightness of the rail. Use an approved 36" straightedge. Surface tolerance is -0 IN./+0.030 IN. See Sketch D-4.

PLACE STRAIGHT EDGE EQUALLY OVER THE JOINT. RAIL ENDS SHOULD BE STRAIGHT OR WITH SLIGHT CROWN, MAXIMUM 0.030" HIGH. DO NOT OVERGRIND.
NOTE - SURFACE GRINDING WILL BE DONE WITH SURFACE GRINDING ATTACHMENT. FREEHAND GRINDING WILL NOT BE DONE EXCEPT TO DRESS UP CORNERS OF RAIL HEAD AFTER SURFACE GRINDING HAS BEEN COMPLETED.



FINISH GRINDING SKETCH

Sketch D-4

3. If the rail ends are of different heights and are being built up to match surfaces, there should be a 10 inch runoff from each 1/4 inch difference in height but the runoff must not extend beyond the furthest bolt hole from end of rail.

Note: It is preferable to build up the low rail end in a permanent joint, instead of grinding the high rail end, unless a thermite weld is to be made.

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E. REPAIR OF RAIL ENDS IN GLUE-BONDED INSULATED JOINTS

GENERAL

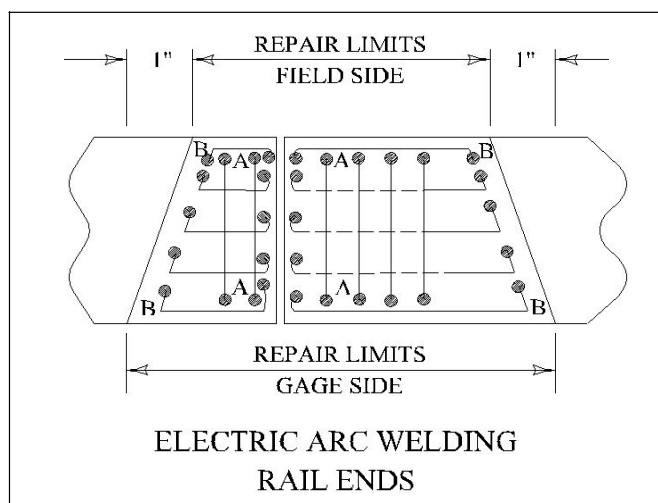
1. Glue-bonded insulated joints will be repaired through the use of the electric-arc welding process.
2. Before repairing the rail ends, the track near the repair should be inspected for ties in the joint area, ballast in the joint area and surface. Tamp the joint as necessary.
3. Glue-bonded insulated joints are structural units that are composed of rail, insulated bars, end post, bolts, and adhesive. As a structural unit, they must be treated differently from individual rail ends. Therefore, some differences exist between these techniques and those used for rail ends.
4. Approved welding rods and wires for the repair of glue-bonded insulated joints are listed on page N-2.
5. Care must be taken to ensure that the welding ground cable clamp is securely grounded to the running surface of the rail being repaired. Use of a magnetic ground clamp is recommended.
6. The Signal Maintainer will be notified in advance whenever welding is to be performed on glued-bonded insulated joints.
7. See *Section "A", Safety*, for instructions for electric arc welding in track circuit territory.

PROCEDURE FOR REPAIRING GLUE-BONDED INSULATED JOINTS

1. Use an approved 36" straightedge to mark the limits of the repair. The repair limits should be marked at an angle across the top of rail so that the length of the repair on the gage side will be approximately one inch (1") longer than on the field side.
2. Rail ends to be repaired must be clean, free from dirt, dust, oil, grease, or other foreign substance. Grind out all damaged metal down to sound and clean parent metal. The removal will not be accomplished through the use of a torch.
3. Before welding, preheat the rail end not to exceed 150°F. The preheat torch flame should be applied in a uniform circular motion on the rail end, beginning at a point two inches (2") from the rail end and proceeding to a point two inches (2") beyond the repair limits. Welding must commence immediately after preheating. If welding is interrupted, allow the rail to cool, then preheat must be repeated.
4. The area to be repaired should be welded in multiple layers. Each welding bead must be peened and enough time allowed between beads to keep the rail end within the allowable

maximum temperature of 300°F degrees in the glue-bonded insulated area. A Tempilstik or other approved temperature measuring device must be used on both sides of the railhead to check the temperature.

5. The final layer of welded material will be deposited as follows:
 - a. Start the weld bead on the field side one inch (1") from the rail end.
 - b. Progress the weld to the rail end and across the end of the rail to the gage side.
 - c. Continue to bead parallel to the gage line to a point one inch (1") beyond the visible end hardened area.
 - d. Turn diagonally and return toward the field, slightly overlapping the first bead.
 - e. Continue this pattern, diagonally turning each bead just short of the previous bead at the weld limit, with as many beads as necessary to cover the welded area of the railhead.
6. When the weld is completed, the arc should be broken by crossing back into the welded surface.



- A. First few beads are 90° across the rail head to fill the deepest area ground.
- B. All finish beads are run length wise with the rail between repair limits.

Sketch E-1

7. The completed weld pattern should be such that it will provide a gradual transition for the car wheels from the parent metal to the welded surface.
8. Grind the repaired area to a smooth surface and a true rail contour immediately after completing the weld. Use an approved 36" straightedge to check the surface. The tolerance is - 0 IN /+ 0.030 IN (See Sketch D-4 for reference).
9. The rail ends should be slotted and cleaned of all charred end post material and grinding dust. Then the gap between the rails filled with a clear 100% silicone caulking.

F. REPAIR OF SWITCH POINTS:

GENERAL

1. Switch points will be maintained and repaired through the use of grinding and the electric-arc welding process.
2. **Main track switch points are not to be repaired by any welding process.** In the event that it becomes necessary to repair a switch point in an emergency situation, a 10 MPH temporary speed restriction must be placed on the turnout with speed boards posted until the point is replaced. The speed restriction will only pertain to the route affected by the repaired point.
3. Switch points are made from either carbon steel rails or fully heat treated steel rails (former requirement with many still in use), deep head hardened steel rails (current requirement), or may have manganese steel tips installed on the point. A magnet or magnetic rail thermometer may be used to differentiate between steel rails and manganese insofar as the magnet will not stick to manganese.
4. New switch points and stock rails should be inspected frequently in the first few months after installation. When the metal flow starts to form a lip, it should be removed by grinding. This grinding must be done several times until the top surface has work hardened to the maximum hardness and flowing has stopped. The time to reach maximum hardness depends on the tonnage passing over the track component.
5. The wearing and mating surfaces of switch points and stock rails **must be ground periodically** to remove flowed metal which may cause the switch point to chip or cause an improper fit between the switch point and stock rail.
6. **Before** beginning repairs to the switch point, the stock rail must be inspected to ensure that the undercut or recess is correct, that there is no overflow material present and the switch is adjusted properly. **If any item is out of tolerance, it must be corrected.**
7. **Arc or torch cutting is not permitted.**
8. Generally yard and non-mainline switch points should not be repaired in the field by welding if the repair would be greater than about 24" in length. Switch points requiring more repair should be replaced and sent to the designated location for repair if the switch point is not scrap. The availability of replacement points will influence the decision also. If no replacements are available, the point may be repaired but arrangement should be made to replace the repaired point in a reasonable time period.
9. Any knife blade switch that has not been recessed into the stock rail will be recessed prior to repairing the switch point.
10. Sketches F-1 through F-5 (located at the end of this section) depict details of the switch

point, stock rail, and stock rail recess for both Samson and knife type switch points.

11. Approved welding rods and wires for rail steel switch point repairs are on Page N-2 and manganese steel tip insert repairs are on Page N-1.
12. The Signal Maintainer will be notified in advance whenever welding is to be performed in track circuit territory.
13. See *Section "A", Safety*, for instructions for electric arc welding in track circuit territory.

PRELIMINARY WORK

1. Inspect condition of complete switch.
 - a. Check to see that switch stand is firmly fastened to ties; a loose stand may allow points to move into the path of the wheel flange and be chipped.
 - b. Check condition of connecting rods, switch rods, rod bolts, and other switch parts for wear that could cause play in the switch points. Make sure that moving parts do not bind on switch ties. All bolts designed for cotter pins must have cotter pins in place.
 - c. Check heel block for missing or worn bolts and thimbles, worn bolt holes, and condition of switch ties. Vertical play of the switch heel could allow the switch point to rock under traffic exposing the point end to contact with the wheel flange.
 - d. Check to see that the base of the stock rail is seated in the switch plates and wedges are tight.
 - e. Check to see that the switch point is not twisted and rests flat on the switch plates.
2. All cracked, chipped, work hardened, spongy, fatigued, spalled, or otherwise defective metal will be removed by grinding to clean parent metal. Special care must be taken to ensure that all cracks and breaks are removed.

PROCEDURE FOR REPAIRING SWITCH POINTS:

1. Preheat and maintain the weld zone for at least 8" beyond the weld area to a temperature of 800°F as determined by a Tempilstik or other approved device.

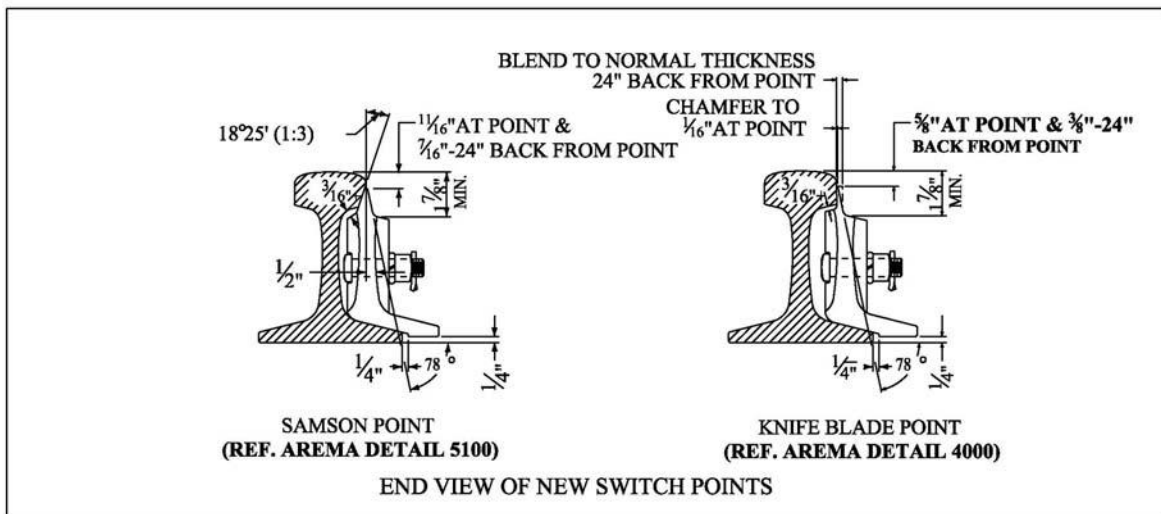
Exception: Do not preheat switch points with manganese steel tip inserts.

2. Weld the switch point in the open position, starting at the point and working toward the heel. A copper plate (1/8" thickness or 1/4" thickness) may be placed between the point and stock rail to help protect against overflow. This copper backing plate must be 1/16" off of the point to allow sufficient weld for grinding in order to eliminate seams.

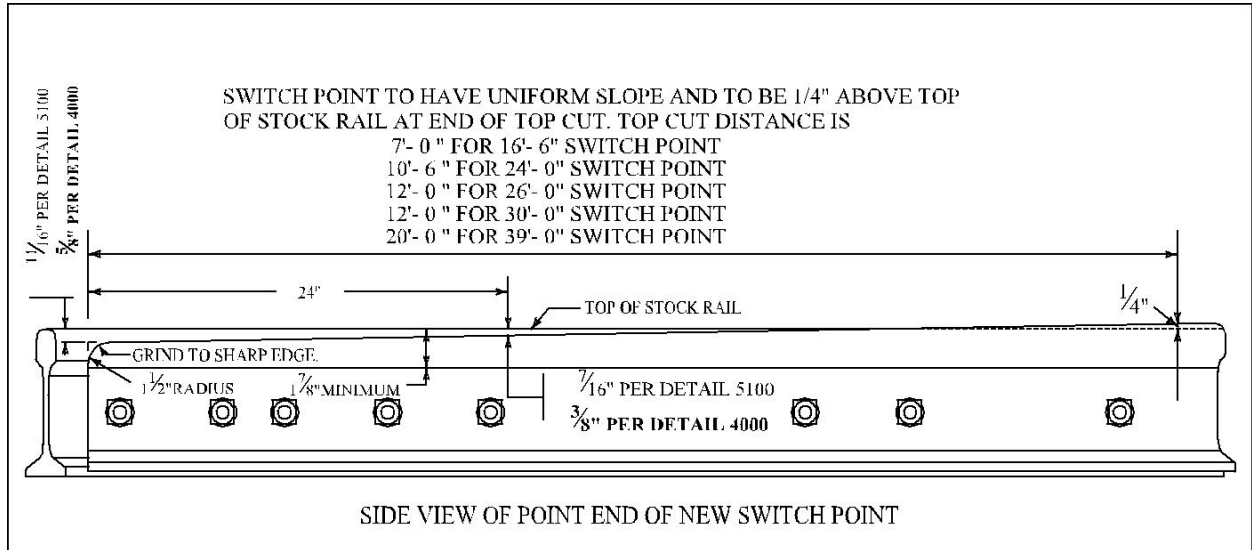
3. The contour of the weld should be kept uniform. The switch point should be built up slightly in excess of the dimensions required by the typical plans, then ground to final size and shape. Do not leave any seams between the welding beads and the parent metal.
4. After the weld repair is completed but before grinding, post heat the repaired area to a temperature of approximately 800°F for 8" beyond the welded area. Heat the base and back of the point an equal amount to prevent the point from warping.

Exception: Do not post heat switch points with manganese steel tip inserts.

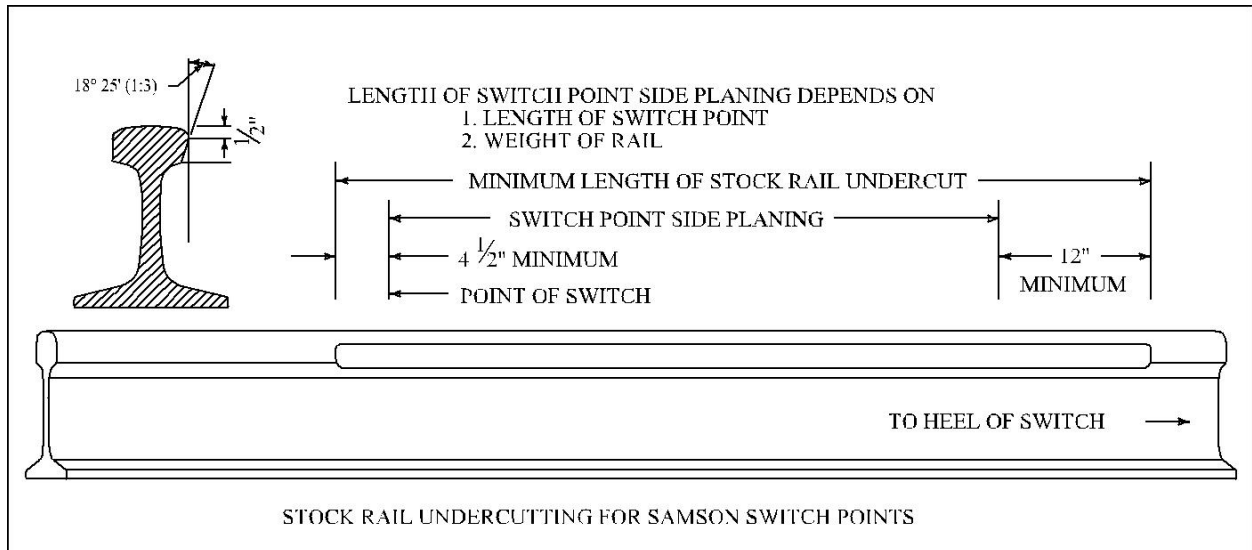
5. Grinding procedures.
 - a. First, grind the back side of the point. Check with a 36" straightedge after grinding. Check for proper fit with the stock rail by throwing the switch.
 - b. Second, grind the gage face of the point. Check with a 36" straightedge after grinding.
 - c. Third, grind the top of the point. Check with a 36" straightedge after grinding. The end of the switch point should be ground to a thin edge 5/8" lower than the top of the stock rail. See Sketch F-1.
 - d. Fourth, finish grind at the end of the switch point. At the point, all sharp edges should be slightly rounded toward the stock rail. There should be a radius of about 5/8" between the top and gage face of the point starting where the point becomes 5/8" thick.
 - e. Fifth, check the gage face alignment. With the switch point closed, place one end of a 36" straightedge on the gage face of the switch point at the end of the welding and the other end on the stock rail ahead of the point. Check to see that the point is not sticking out into the flangeway.
6. Protect the point from cooling too rapidly.
7. Traffic must not be allowed to use the switch until the switch point temperature is below 200°F.



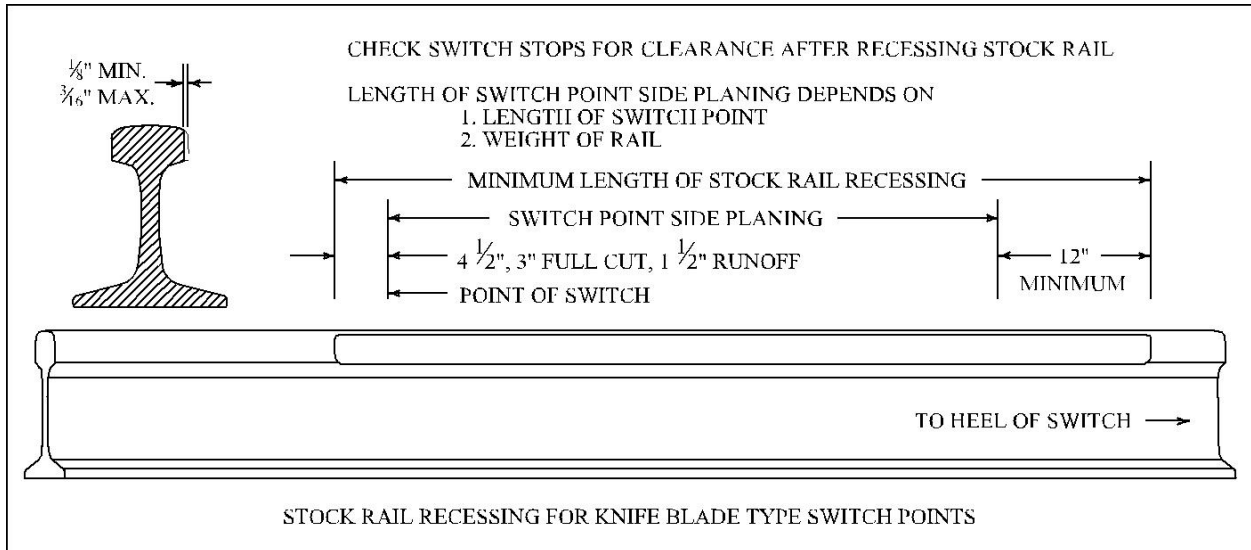
Sketch F-1



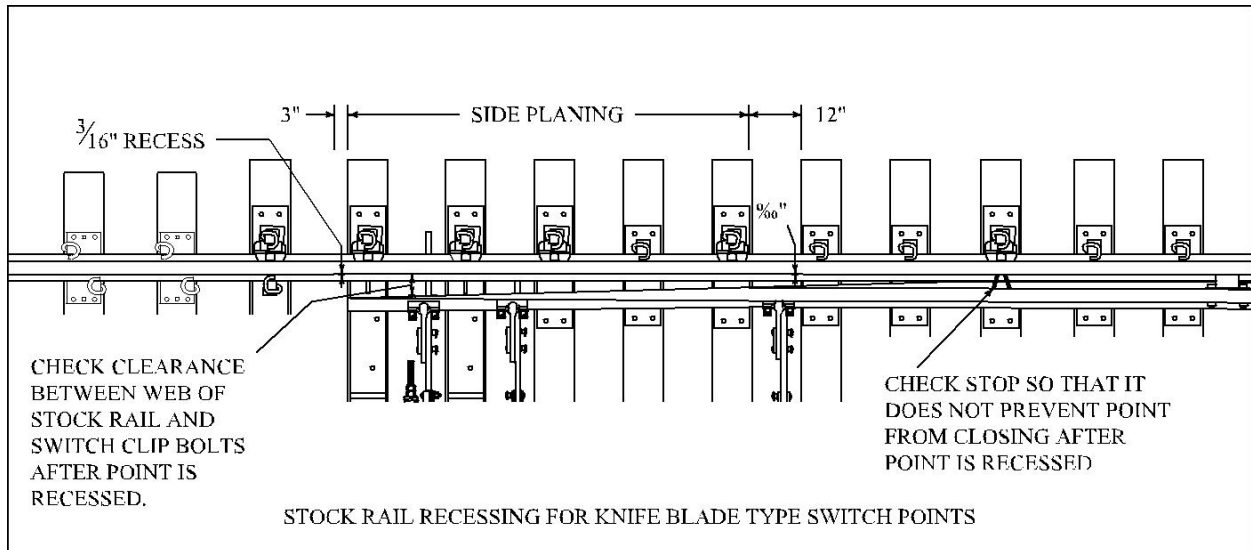
Sketch F-2



Sketch F-3



Sketch F-4



Sketch F-5

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G. REPAIR OF FROGS AND RAILROAD CROSSINGS:

TECHNICAL NOTES ABOUT MANGANESE CASTINGS

1. Manganese steel track components are comparatively soft (approximately 200 - 220 Brinell) when produced. Most items including frog castings are hardened (approximately 352 Brinell) before being placed in service. Other items are allowed to work harden.
2. Manganese steel work hardens by plastic flow of the metal grain structure under rolling wheel loads and impacts. This flow or deformation of the relatively soft metal results in a bead or ridge forming on the top edges of the frog points and wings usually on both sides of the flangeway and on the gage side of the flangeway in railroad crossings. The flow or deformation will slow as the hardness of the top surface increases by cold rolling under traffic.
3. Formation of this bead or ridge may narrow the flangeway opening. If this bead is allowed to form to the maximum, it can cause the frog to fail. The bead will become extremely hard. The wheel flanges will cause the bead to chip or spall, often very deeply into the casting. This is the reason some frogs, crossings, and other track components may need grinding or welding shortly after installation.
4. New manganese track components should be inspected frequently in the first few months after installation. When the bead starts to form, it should be removed by grinding. This grinding must be done several times until the top surface has work hardened to the maximum hardness and flowing has stopped. The time to reach maximum hardness depends on the tonnage passing over the track component.
5. Grinding should be confined to the top edges where overflow has occurred. No grinding should be done on the top surface, other than what is necessary to correct a mismatch or dress temporary wear ramp pads, as this will remove work hardened material.
6. A radius of 3/8" to 5/8" between the top and gage face should be ground on the wings and point. There should be no sharp edges. Sharp edges become hard and brittle under wheel loads and may spall, crack, or chip when contacted by the wheel flange.
7. Welding should not be done on practically new castings except to correct conditions that cannot be eliminated by grinding.
8. A thorough examination should be made of an older frog before a decision is made to weld the frog as grinding can correct many problems. Excessive heat can reduce the strength of manganese steel.
9. Slot grinding should be done at regular intervals to reduce chipping and spalling. The areas to be ground are those where the manganese casting is in rigid contact with wing and heel rails, the heel of the frog casting, and rail joints if the frog is not welded into track.

GENERAL

1. The manganese steel components of frogs and railroad crossings will be repaired through the use of the electric-arc welding process. The rail components will be repaired using the techniques described in the appropriate rail repair section.
2. In the repair of manganese steel castings, it is of great importance to keep the heat build up caused by the welding process as low as possible. Manganese steel castings are heat treated at the foundry. Lack of attention to heat build-up will permanently destroy this heat treatment and will cause the casting to become brittle. The area of the casting being repaired must be kept less than 500°F at all times.
3. Where compressed air is available, it is to be used to cool the area worked on manganese steel castings.
4. Water-cooling is also an acceptable option for cooling the area worked on manganese steel. If water cooling techniques are employed, remove the carbon block if used, then use a spray bottle (like a garden sprayer) or a bottle with a hole in its top to douse the weld with water until the water stops boiling on the weld. Use compressed air or a wire brush to remove excess water from the flangeway. The flangeway may be left damp, but the carbon block should never be applied in freestanding water. (Note: Only water (no additive) is to be used for the purpose of water-cooling. If an additive (windshield washer fluid, RV anti-freeze, etc.) is used in the water storage system to prevent freezing, this treated water CANNOT be used to control the heat build up in manganese steel.
5. When it becomes necessary to weld frogs there are certain practices that must be followed. These are:
 - a. Weld only on clean, sound, non-work-hardened metal.
 - b. Apply minimum heat to the base metal.
 - c. Use welding procedures that produce the minimum thermal stress in the weld deposit.
 - d. Use of a power blower is mandatory when welding or grinding manganese.
 - e. Power blower

USE OF AIR CIRCULATOR FAN

DO'S

- a. Fan may be used by Thermite (field) Welding Team while make field welds to circulate air for cooling personnel in warm or hot temperatures.
- b. Fan should be placed far enough from ongoing work as not to cause a tripping hazard, (suggested 10'), never in the fowl of any track and should be placed on a level surface as not to turn over.

- c. Fan must be plugged into a Ground Fault Circuit Interrupter (GFCI) receptacle or a portable GFCI must be used if power source doesn't have one provided.
- d. Fan should be used in fair weather conditions.
- e. When storing fan, it should be covered with a tarp, or some type of covering as to keep dry as much as possible. (Some teams have used grill covers to suffice for this).
- f. Fan also may be used to blow smoke fumes away while welding on manganese frogs, or any type of weld repair.

DONT'S

- a. Fan will not to be used in inclement weather conditions, such as rain, snow, sleet, etc.
 - b. Fan is not to be placed in a wet location or puddles, even if the weather conditions are dry, such as a mud location in track. Move to a dry area.
 - c. Fan will not be used if any portion of the grilling, cord or safety guard area is damaged or missing. Authorized repairs must be made or the fan replaced.
 - d. If an extension cord is used for powering the fan, it must be rated to match or exceed that of the fan.
 - e. If the fan is placed in track, the power cord is to either be run under rail in center of check not touching any metal portion of rail, rail anchor or tie plate. If it isn't run under the rail, it must have a rubber pad or some type insulator between power cord and rail. (A round pipe insulator works well for this application)
6. There are usually three reasons that a frog must be welded.
- a. Cracks have developed to the point where a weld repair is necessary to make the frog safe and prevent further damage.
 - b. The point needs to be built up because of wear or depression.
 - c. Large sections have broken out, or deep sections are to be removed to correct spalling, chipping, or cracking.
7. Turnout and railroad crossing frogs must be rebuilt before the point is chipped, broken, or worn more than 5/8" down and 6" back, which is the FRA 10 MPH Slow Order Limit (FRA §213.137 (B)).
8. Turnout and railroad crossing frogs should be rebuilt when the tread surface has worn 1/4" below the original surface, but must be rebuilt before the tread wear exceeds 3/8", which is the FRA 10 MPH Slow Order Limit (FRA §213.137 (C)).

9. Self-guarded frogs should be rebuilt when the raised guard has worn ¼” from the original contour, but must be rebuilt before the wear exceeds 3/8” (FRA §213.141 (A)).
10. Conformal frogs with wrap rails and boltless conformal frogs (WBM) must be repaired before the point is chipped, broken, or worn more than 5/8” down and 6” back, which is the FRA 10 MPH Slow Order Limit (FRA 213.137 (B)). The notched straight edge gauge designed to determine the depth of wear or damage on conformal frogs must be used. The correct notched gauge for measurement is dependent on the type of conformal frog being inspected. They are not interchangeable.
11. Approved welding rods and wires for manganese steel frog repairs are on page N-1.
12. The Signal Maintainer will be notified in advance whenever welding is to be performed in track circuit territory.
13. Frogs will be marked with a “hash mark” on the top of heel end of the wing rail of frog, each time it is repaired by welding.
14. See *Section "A", Safety*, for instructions for electric arc welding in track circuit territory.

PRELIMINARY WORK

1. Prior to welding, frogs and railroad crossings must be inspected in the following areas and corrections made as required.
 - a. Good surface and crosslevel from ahead of the toe joint to past the heel joint. Defective ties should be replaced and tamped.
 - b. Measure guard check gage and guard face gage and correct, if necessary.
 - c. Check and tighten frog, guardrail, and joint bolts. Torque bolts in compliance with MWI 707 to equalize wear on bolts.
2. The running surface of the casting usually has areas that are not greatly worn. By using a 36” straight edge in these areas, low spots and the amount of build up can be determined. Lightly grind the entire running surface of the casting and inspect for cracks. More grinding will be required at high impact points which are at the frog point, the wings next to the point, and at the rail joints.
3. Manganese steel work hardens under impact. Grind out all loose, deteriorated, cracked, and work hardened material to clean parent metal. All cracks must be “veed” their full length and depth. Cracks will be sealed and a buffer pad of 2 layers of an approved stainless rod will be applied. Do not deposit any stainless closer than ¾” to a running surface. Care must be taken to ensure that all defective material is removed. **NEVER** use a torch to prepare manganese steel components. A grinding depth of 1/8” is usually sufficient but 3/16” may be required in high impact areas. Sharp edges along the flangeway are to be removed.

4. If the Welder has been specifically trained in the use of air-arc metal removal or the use of a slice torch, it may be used. Air or water may be used to assist in cooling the manganese steel casting, following the manufacturer's recommendations.

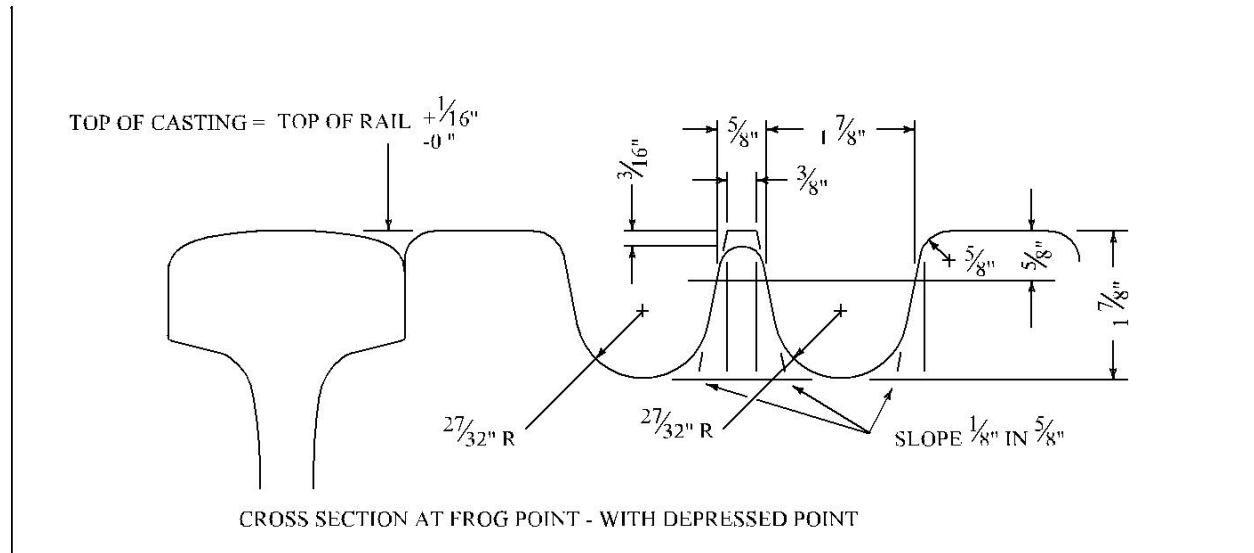
The Welder must monitor the temperature of the casting during the repair by using an approved thermometer or a 500°F Tempilstik. To use the Tempilstik, mark the component approximately ½" below the surface on which the weld metal will be deposited. If the Tempilstik mark melts during the welding process, the welding must be stopped. Welding at another location on the component is advisable, while the original location is allowed to cool.

PROCEDURE FOR REPAIRING RAILBOUND MANGANESE FROGS AND RAILROAD CROSSINGS

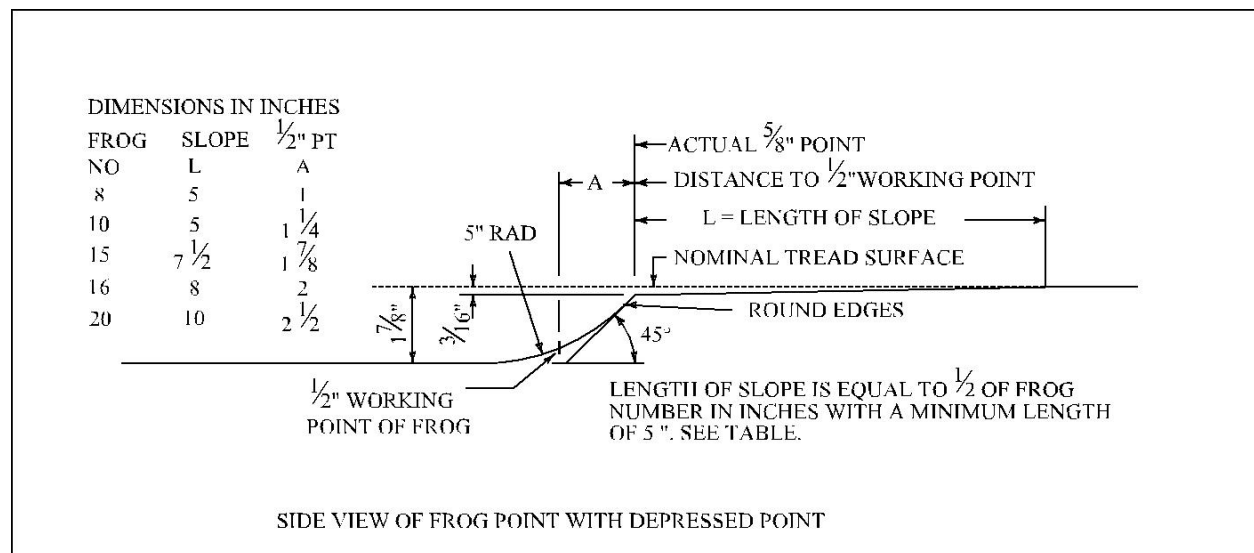
1. Be sure that the ground connection is securely attached to the component.
2. Use an approved wire or 3/16" welding rod for the electric-arc process. The type electrode to be used depends on the depth of the metal that must be laid down.
3. Use a flangeway gauge or a conformal frog gauge to check the flangeway opening and riser slope as welding progresses.
4. **Never** preheat manganese steel. If below 32° F, take the chill out of the casting.
5. Proper amperage, as required by the work being done and the size and type of rod being applied, will be used. Make the weld at such a rate that the bead will not be wider than 5/8" nor higher than 3/16".
6. The wider the bead, the slower the welding travel speed. The slower the travel speed, the hotter the casting gets. Travel as fast as possible and skip weld whenever possible.
7. Beads should not start or stop at the edge of the casting.
8. Every bead must be cleaned and peened to relieve stresses before depositing the next bead.
NOTE: Weld beads making up the stainless buffer pad should NOT be peened.
9. The final deposits should be built up high enough, so that when the grinding is completed, there will be no welding marks or seams visible and the finished surface will be smooth. In the wheel transition area of the frog, the point and the wing rails must be finished to the same level, even if the repair is not completed at this time. Plans must be made to return and complete the repair.
10. The built-up casting should be carefully ground and contoured. Special attention must be given to restoring a smooth and even running surface and to restoring the corner radii. Do not leave sharp corners. Use the flangeway gauge often during grinding to check openings

and radii.

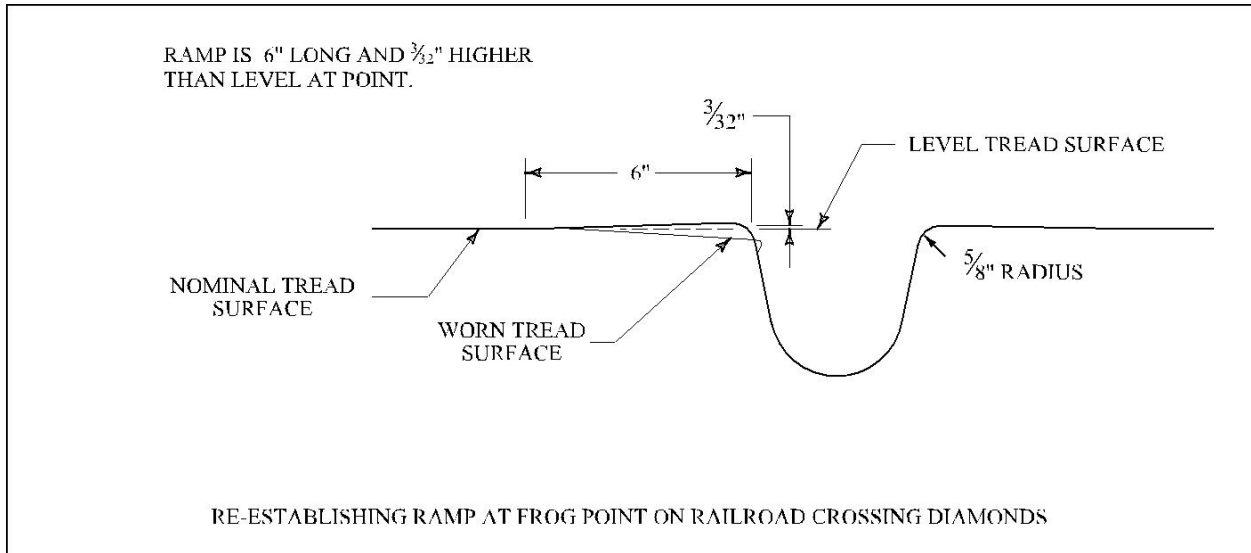
- After grinding, check the casting using a 36" straightedge and frog flangeway gauge. The surface tolerance is 0" low and 0.030" high. The top of the frog point will be low at the point and taper up to zero, as shown on Sketches G-1 and G-2. Ramped diamonds should be built up as shown in Sketch G-3. The flangeway will conform with the flangeway gauge, as shown on Sketch G-4.



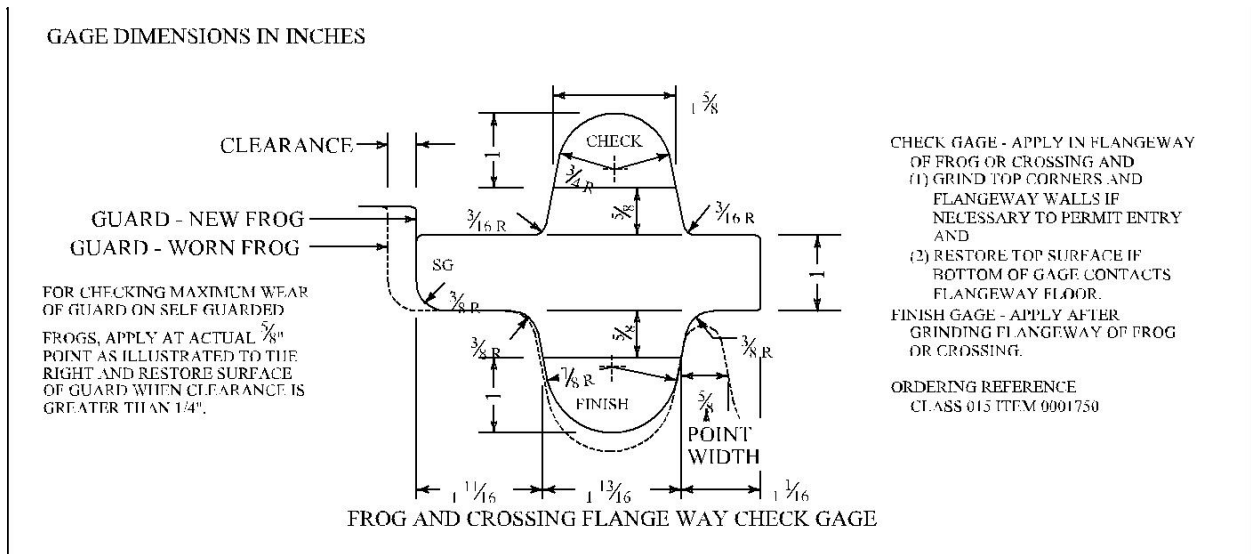
Sketch G-1



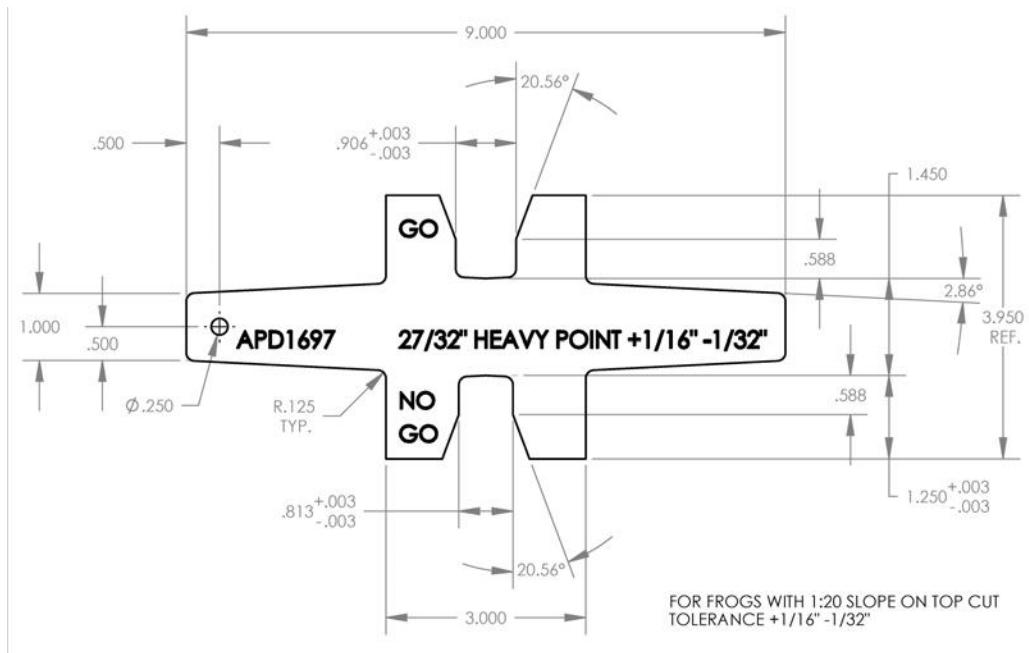
Sketch G-2



Sketch G-3



Sketch G-4A



Sketch G4-B

12. The junction between the castings and rail components will be slotted 1/8" wide and 1/4" deep to prevent chipping and spalling of the metal.
13. Measure the guard check gage and the guard face gage after grinding is completed to be sure it has not been changed (See Sketches G-5 and G-6).
14. After each welding repair to a frog is completed, a short weld bead or "hash mark" will be placed on the top of the heel end of the wing rail. These marks will indicate the number of repairs each frog has required.

PROCEDURE FOR REPAIRING SELF GUARDED MANGANESE STEEL FROGS

1. The procedures specified for railbound manganese steel frogs are to be used for self guarded frogs.
2. Additional requirements for self-guarded frogs:
 - a. The guards on self-guarded frogs must be welded and ground to contour prior to welding the point and wings of the frog.
 - b. Check the amount of wear on the raised guard by placing the gauge in the flangeway at the actual point (5/8" Point). It may necessary to remove the flow from the flangeway to permit entry of the gauge. If the clearance between the "SG" end of the gauge is more than 1/4", the guarding face should be repaired. It must be repaired before the clearance exceeds 3/8".
 - c. To repair the guarding face of a frog under traffic, first place a 1/4" bead at the top of the guard to ensure that the frog point is protected. Then begin at the bottom and build toward the top. After all welds have been made and ground, use the gauge to check the work.
 - d. Check the point, wings and flangeway of the frog by placing the gauge, "check" side down, into the flangeway. If the gauge contacts the flangeway floor, the running surface of the frog must be built up and ground to a true surface using the same repair techniques employed on other manganese steel frogs and railroad crossings.
 - e. Build up the point if required.
 - f. After the point, wings and flangeway repairs are completed recheck the guard by using the gauge. If the clearance between the gauge and the guard is too tight, further grinding should be done on the point, not the guard, to provide the correct clearance.

PROCEDURE FOR REPAIRING SPRING FROGS

1. Inspect frog for rail flow, broken bolts, proper clearance between horns and housing, welds or bolts securing housing to plates, spring tension for wing rail, chipping or other damage to point and other frog parts. See MWI 609 Inspection and Maintenance of Spring Frogs.
2. Rail ends on frogs will be repaired using the appropriate techniques for repairing fully heat-treated rail or head hardened rail described in this manual. Any additional welding repairs on spring frogs will not be made until the welding manager is contacted.

PROCEDURE FOR REPAIRING BOLTED RAIL FROGS AND RAILROAD CROSSINGS

General

1. Rail end batter in fully heat treated rails, head hardened rails and rails in contact with manganese steel castings will be repaired through the use of the electric-arc welding process.
2. Rail ends, that are battered, chipped or spalled, should be repaired to prevent further damage to the rail ends and accelerated deterioration of the other track components.
3. Rail end repairs should be made when the batter reaches the limits as listed below:
 - 1/8 inch (0.125") where freight train speed exceeds 60 MPH
 - 1/4 inch (0.250") where freight train speed exceeds 40 MPH
 - 3/8 inch (0.375") where freight train speed exceeds 10 MPH
 - 1/2 inch (0.500") where freight train speed is 10 MPH or on excepted track.
4. Batter is the distance, measured in thousandths of an inch, between an approved 36" straightedge and the top of rail 1/2 inch in from the end of the rail as shown in Sketch D-1.
5. Slot grinding to prevent chipping due to overflow will performed on rail ends and the area between parallel rails.

Preliminary Work

Prior to welding, frogs and railroad crossings must be inspected in the following areas and corrections made as required.

1. Good surface and cross level from ahead of the toe joint to past the heel joint. Defective ties should be replaced and tamped.
2. Measure guard check gage and guard face gage and correct, if necessary.

PROCEDURE FOR REPAIRING BOLTED RAIL FROGS AND RAILROAD CROSSINGS

1. Be sure that the ground connection is securely attached to the component. Use of a magnetic ground clamp is recommended.
2. Approved welding rods and wire for welding the rail ends of frogs are listed on Page N-2.
3. Use a flangeway gauge to check the flangeway opening as welding progresses (See Sketch G-4).

4. Use an approved 36" straightedge to mark the limits of the repair. The repair limits should be marked at an angle across the top of rail so that the length of the repair on the gage side will be approximately one inch (1") longer than on the field side.
5. Rail ends to be repaired must be clean, free from dirt, dust, oil, grease or other foreign substance. Grind out all damaged metal down to sound and clean parent metal. The removal must not be accomplished through the use of a torch.
6. Before welding, preheat the ground railhead to approximately 800°F for a distance of 8" beyond the weld area in each rail requiring repair. Carefully examine it for cracks. Cracks will appear as dark hair lines in the heated area. If cracks are present, further grinding is required.
7. Welding must begin immediately after preheating and the 800°F preheat maintained in the area surrounding the repair.
8. The welding should proceed as beads across the railhead. Each bead must be peened while the deposit is hot to relieve welding stresses. The weld should be extended beyond the rail end and the excess metal removed by slotting after the weld is completed.
9. Enough weld material should be deposited so that the unground surface will be higher than the rail and that grinding will eliminate the visible welding marks and seams.
10. With fully heat treated and head hardened rails, post-heat the welded area to approximately 800°F immediately after the welding operations. After post-heating, it is most important that the rail cool slowly to 200°F. It may be necessary to protect the weld area with a welding blanket to obtain the desired slow cooling and against rain, snow, etc.
11. It is very important that preheating and post-heating be diligently performed to obtain a quality repair weld.
12. Use the surface grinding attachment to grind the weld area to a smooth surface and true rail contour.
13. After the welds are made and allowed to cool, an inspection must be made to determine the straightness of the rail. Use an approved 36" straightedge. Surface tolerance is -0.000 inch/+0.030 inch

PROCEDURE FOR REPAIRING CONFORMAL FROGS

The conformal frog design protects the frog point and permits longer life before the first weld repair is required as compared to older RBM flat frogs. To ensure the correct methodology of inspecting and repairing of conformal frogs is used, the following procedure is adopted.

The point tread is contoured at a 1:20 ratio of slope (3 degrees) as well as the wing tread or riser portion of the casting to meet the contour of new wheels on the trucks. It is normal for a wear pattern to form in a conformal frog on the wing tread portion. See photos G-1 and G-2.

This section addresses the maintenance and repair of conformal frogs with wrap rails and boltless (WBM) frogs. The weld repair of a Boltless Conformal (WBM) frog is the same as for the conformal frogs with wrap rails, however do not use the same gauges for a wrap rail conformal frog on the boltless conformal frog.



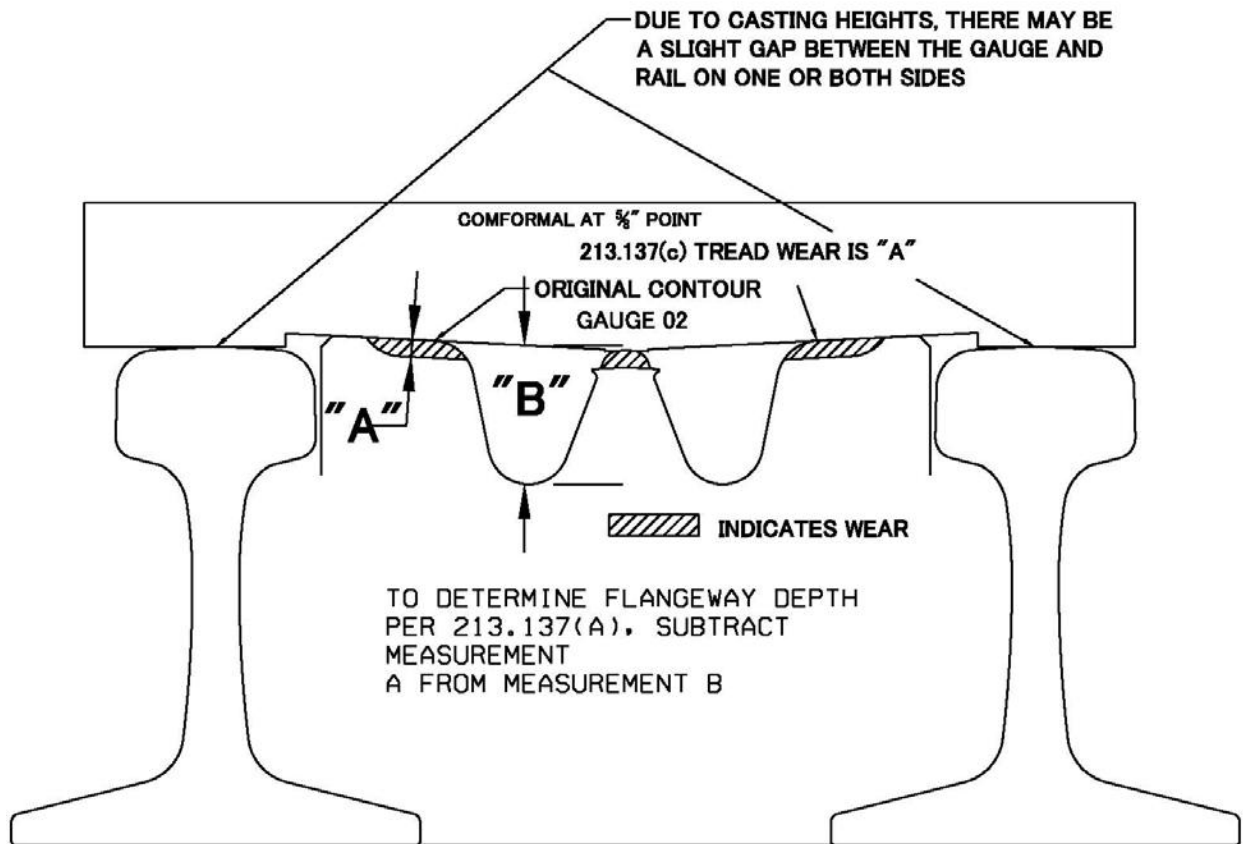
Photo G-1



Photo G-2

After the frog has been in service for a period of 60 days, the “humped” up metal left on the wing tread portion of the frog should be removed by grinding from the point of where the second gauge (shown later) is placed on the frog (where the point is $1 \frac{9}{16}$ ” spread) to a height level with a straight edge. The humped up metal is caused by excess metal flow. The location of the second gauge is dependent on the frog size. See Table 1 on page 6 for the proper location of the second gauge. This will help determine true wear on the frog. A welding manager should be contacted to help ensure this is done correctly.

During routine inspections, place the conformal frog gauge #02 along the top of the wrap rail. See Sketch G-7 below on the following page. For boltless conformal frogs, use gauge #1. If the tread wear exceeds $\frac{3}{8}$ ” below wrap rail height, the wing tread must be repaired or slow order to 10 mph.

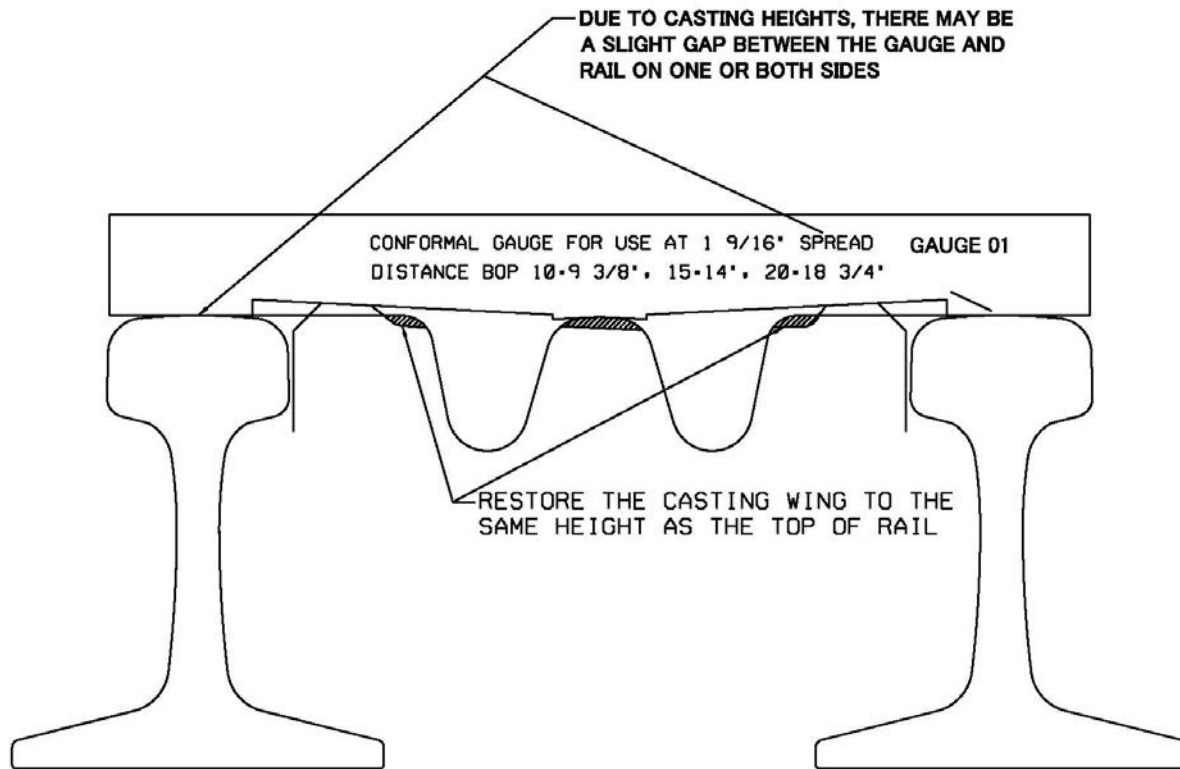


CONFORMAL GAUGE FOR CHECKING TREAD WEAR AND FLANGEWAY DEPTH AT POINT

Sketch G-7

The wing tread portion of the casting must be repaired when the wear exceeds 3/8" below the wrap rails top surface when using the conformal frog gauge #01.

If repairs are required on the wing tread portion of the casting, the repair area should be brought up to even with undamaged portions of adjacent tread or even with the height of the wrap rails after finish grinding is complete. See Sketch G-8 below on the next page. The repair must be checked using a conformal frog gauge #01 for frogs with wrap rails and #2 for boltless frogs and taper gauge



CONFORMAL GAUGE FOR WELD REPAIR OF THE WING AND POINT AT 1 9/16" SPREAD

Sketch G-8

Note: The height of the wing tread in the original casting on a conformal frog is 3/16" greater than the height of the top surface of the wrap rails. When repairing the wing tread, the 3/16" measurement should not be included in the repair. Check the height of the repair by placing a conformal frog gauge across the casting and using a taper gauge to ensure the repaired area is the same height as the wrap rails. Table 1 below gives the proper distance to place the #01 conformal frog gauge from the 5/8" frog point (actual point) for frogs with wrap rails. Table 2 provides the proper distance to place the #02 conformal frog gauge from the 5/8" frog point for boltless frogs. No weld repair will be made beyond the location of the second gauge on the wing tread.

Frog No.	Distance from #01 gauge
10	9 - 3/8"
15	14 - 0"
20	18 - 3/4"

Table 1 – For Conformal frogs with wrap rails

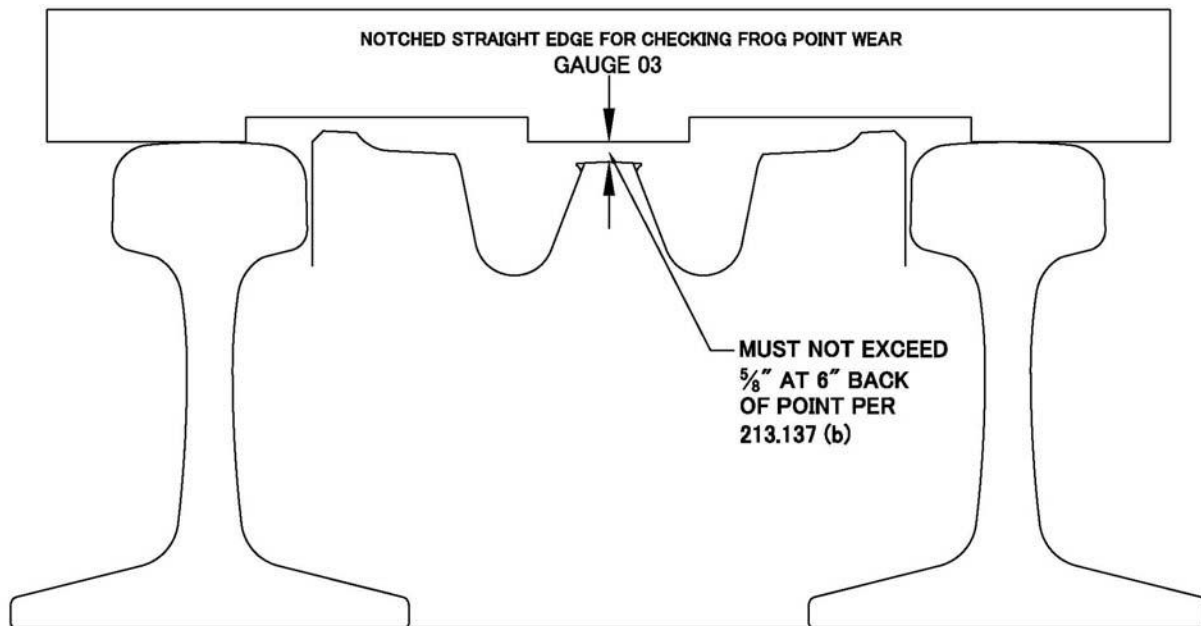
Frog No.	Distance from #01 gauge
10	7 - 13/32"
15	11 - 9/32"
20	14 - 29/32"

Table 2 – For Boltless Conformal frogs

To check the frog point, use the notched straight edge (gauge #03) for frogs with wrap rails. For boltless conformal frogs, use gauge #01. If the frog point is worn, broken, or chipped down more than 5/8" and back 6 inches, the frog point must be repaired or slow order to 10 mph. The frog point area is one-half the frog number. For example, for a No. 20 turnout, the point area extends 10" back from the actual point. See Sketch G-9. Photo G-3 provides an example of the boltless conformal frog gauges on a #20 frog.



Photo G-3

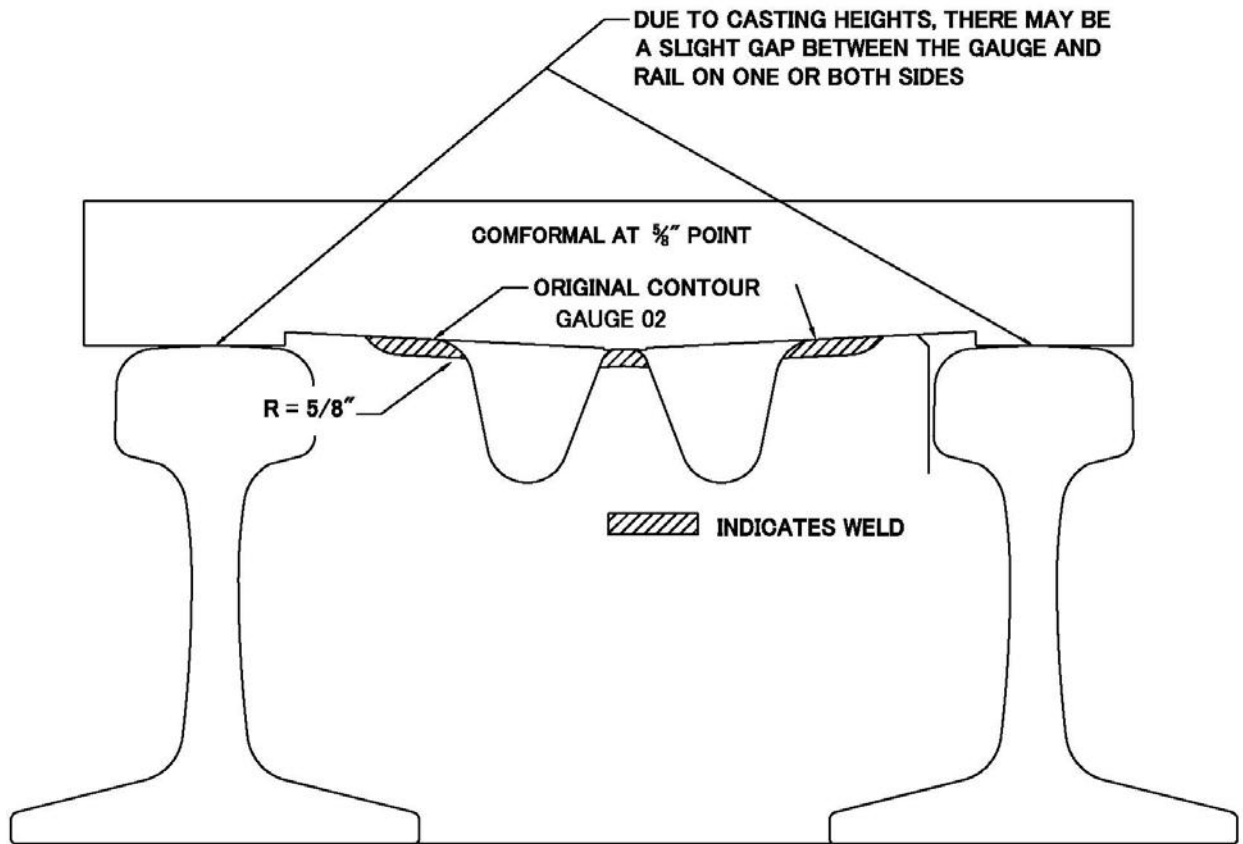


GAUGE TO CHECK 5/8" POINT WEAR ON CONFORMAL FROGS

Sketch G-9

Maintenance grinding of the overflow should be performed when needed.

When repairs are required on the tread area of the point, the area of the point should be brought up to a height that is level with the existing point after finish grinding, with the repaired area being brought up high enough to ensure no welding seams exist after grinding is complete. The repair must be checked using a 36" straight edge.



CONFORMAL GAUGE FOR WELD REPAIR OF WING AND POINT.

Sketch G-10

Proper grinding for the point repair should be contoured to the 1:20 slope (3 degrees) matching the existing contour left on the point. See Sketch G-10. The existing casting includes the 1:20 slope which may or may not be present. Finish grinding may include the bevel; however, where the weld repair area meets the original casting, the contour should be blended in to allow for a smooth transition from the repair area to the original casting. Figure 4 shows how the finished weld should appear at the $\frac{5}{8}$ " point.

Note: The point of the conformal frog DOES NOT contain a slope as a traditional RBM flat frog. When repair welding to the wrap rail level, a point slope should be made so the point is below the wing rail tread.

H. CUTTING RAIL

GENERAL

1. The FRA *Track Safety Standards* have two subparts that specifically address torch cut rails. In general, the FRA states: “Except as a temporary repair in emergency situations, no rail having a torch cut end shall be used in Classes 3 through 5 track” and above track. “When a rail end is torch cut, train speed over that rail end shall not exceed the maximum allowable for Class 2.”
2. All rail ends must be cut square and straight.
3. Cutting rail on timber structures or open deck bridges is not permitted without specific approval of the Chief Engineer or their designated representative. If rail is to be cut on a structure, a fire prevention and response plan must be developed and implemented.
4. All rail ends that will be used for thermite welding will be saw cut. The only exception is a mechanical failure of the saw during a cut and then an oxy propane torch may be used to complete that cut. No other welds will be made until an operational saw is available. Rail ends torch cut for thermite welding must be welded into the track within one (1) hour. This includes cutting rail to make field weld closures when laying rail or plugging out defects.
5. If rail is to be cut with a torch, the Welder must be sure that the rail is not alloy rail. Torch cut rail ends must be square and straight.
6. All torch cut rail ends will be protected by a 10 MPH Temporary Speed Restriction until the thermite weld is made, or the end has been sawed and joint bars installed.
7. To remove torch cut ends on regular or alloy rails for thermite welding or installing joint bars, a minimum of 3/8 inches of rail will be removed by making a saw cut. If the torch cut is not square to the rail end, the saw cut is to be made at the point that will make the rail end square and the piece cut off 3/8 inch thick at its thinnest point. The thickness of the saw blade may be considered to be part of the 3/8 inch minimum to be removed. Visually inspect the rail end for defects after the cut has been made. If more than one (1) hour has elapsed since the torch cut was made, then a minimum of 6 inches of rail will be removed by a saw cut.

ALLOY RAIL

1. Alloy rail will be saw cut only. If it becomes necessary to torch cut an alloy rail, the torch cut rail end will be removed before the track is returned to service.
2. At the present time there are only three types of alloy rail on CFRC. These are “Chromalloy”

manufactured by Colorado Fuel and Iron (CFI), "Wear Resistant" manufactured by Wheeling-Pittsburgh (WP) and "Super Rail" manufactured by Nippon Steel. In the field, the alloy rail may be identified in the following manner:

- a. CFI "Chromalloy" Rail - letters "CRO" will be included in the brand near the rail section identification.
- b. WP "Wear Resistant" Rail - letters "WWR" will be included in the heat identification.

CUTTING RAIL UNDER COMPRESSION

The following steps should be taken to safely, and properly relieve rail that is in compression.

1. Select a location to cut rail with torch in center of crib, not less than 10' from any existing weld in same rail. Select location on both rails with a minimum of a four tie stagger. Both rails will be cut when adjusting tight track.
2. Make a paint mark 2' on field side of rail on each end of location where cut will be made, (overall 4' distance) this will be measured again after rail is adjusted to determine amount of rail removed.
3. Remove ballast out of check where cut will be made to accommodate saw when used to remove torched rail ends.
4. Remove anchors for 10 ties on each side of area to be cut. (This will keep ties from shifting around when rail starts to come in).
5. Use torch to make a straight, complete cut through the rail in the center of the crib. (Use torch cutting guide if available) Start cut from base and cut upward in web area toward ball of rail, switch to opposite side of rail and cut remaining base section, once this is done, cut across the top of ball directly above previous cut to ensure straightness. (Using this process will keep you from having to remove slag from base area to be cut if you were to cut the ball first).
6. Move torch over 1 ½" and start at base of rail and cut within 1" of web area and cut across to previous cut. Move to opposite side of rail and start cut 1 ½" from previous cut and cut within 1" of web and cut across to previous cut through rail. Remove the base cuts with hammer and track punch. (Use of face shield is mandatory)
7. Use torch and start in previous complete cut 2" above base in web of rail and cut across 1 ½" and cut up web area to bottom of ball of rail. Cut ball of rail directly above cut and ensure straightness. Remove ball and web of cut rail with hammer and track punch. (Use of face shield is mandatory)

8. At this time the only area left is the web-base area, now the torch will be used to slowly, safely cut through the center of the remaining rail in the area. Use torch to continue as many passes needed until rail is relieved. If rail runs back tight together follow steps 6 and 7 again, but take caution to only remove in ½” increments at this time.
9. Once rail has quit running, the rail saw should be used to remove a minimum of 3/8” of rail off the torch cut portion of rail, (The saw blade width should be used in the measurement). Both rail ends are to be saw cut with the second rail gap cut a total of 1”. (Use of saw at this point will cut down on amount of heat in rail to be considered after adjustment is made to make the field weld).
10. Remainder of anchors will be removed for 200 ties each side of the cut rail. (Anchor removal will start at the cut and work outward from cut to remove the chance of rail bunching between end of 200 ties and cut).
11. The tie plates should be struck with sledge hammer to allow the rail to move, never strike the rail.
12. As the rail comes together, the rail saw should be used to remove rail, not to exceed a 1” gap at any time due to not knowing how far the rail will run and this will allow for a weld to be made when the rail stops running.
13. Steps 1 through 12 are to be followed for the opposite rail to be adjusted.
14. When rail has stopped running, the anchors are to be replaced starting at the end of the 200 ties and work toward the area of rail that was cut, this will allow for any remaining movement of rail. This will be done on both sides of the cut rail. The same procedure will be followed for the opposite rail.
15. After all anchors are replaced a field weld should be made, if for unknown reason a weld can't be made, drill rail and apply joint bars.
16. Fill crib areas back in with ballast.
17. Replace any spikes that were removed to make field welds.
18. Re-measure rail reference marks to determine amount of rail removed from each rail.
19. Write weld information in web of rail per CFRC Welding Manual.
20. Clean work area.
21. Fill out track disturbance record online.

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I. THERMITE WELDING

GENERAL

1. Only qualified Welders will make field welds.
2. Welds require a high degree of compliance with procedures and attention to detail, therefore, specific equipment is required. Some equipment required includes a stopwatch and a taper gauge that must be used during the welding process.
3. Thermite welding equipment and supplies must be kept dry at all times. The molds, portions, etc. must be kept in the original containers until ready to use. Thermite welding materials must be used within three years from the date of manufacture. This date is stamped on each box. Store only the supplies needed for one day's work on the truck. If the situation requires large quantities of supplies, they may be stored on the truck after ensuring that the materials can be kept dry and damage free.

USE OF AIR CIRCULATOR FAN

DO'S

- a. Fan may be used by Thermite (field) Welding Team while make field welds to circulate air for cooling personnel in warm or hot temperatures.
- b. Fan should be placed far enough from ongoing work as not to cause a tripping hazard, (suggested 10'), never in the foul of any track and should be placed on a level surface as not to turn over.
- c. Fan must be plugged into a GFCI receptacle or a portable GFCI must be used if power source doesn't have one provided.
- d. Fan should be used in fair weather conditions.
- e. When storing fan, it should be covered with a tarp, or some type of covering as to keep dry as much as possible. (Some teams have used grill covers to suffice for this).
- f. Fan also may be used to blow smoke fumes away while welding on manganese frogs, or any type of weld repair.
- g. Inspect power cord and plug before each use.

DONT'S

- a. Fan will not to be used in inclement weather conditions, such as rain, snow, sleet, etc.

- b. Fan is not to be placed in a wet location like a puddle, even if the weather conditions are dry, such as a mud location in track. Move to a dry area.
 - c. Fan will not be used if any portion of the grilling, cord or safety guard area is damaged or missing. Authorized repairs must be made or the fan replaced.
 - d. If an extension cord is used for powering the fan, it must be rated to match or exceed that of the fan.
 - e. If the fan is placed in track, the power cord is to either be run under rail in center of check not touching any metal portion of rail, rail anchor or tie plate. If it isn't run under the rail, it must have a rubber pad or some type insulator between power cord and rail. (A round pipe insulator works well for this application).
4. Making thermite welds in rainy weather should be avoided wherever possible. If this is not possible:
- a. All precautions must be taken to ensure that the weld is protected from the rain, including the use of umbrellas. Thermite welds must not be made in blowing rain.
 - b. All precautions must be taken to ensure that the weld is protected from the large temperature drop that rainfall can cause. The rail must be positively anchored against movement.
5. Unless in an emergency, thermite welds should not be made if the gauge of track is filled with snow. If the weld must be made:
- a. Clear snow around the weld area for a minimum 10' radius. When not practical due to embankment constrains, snow must be cleared to the edge of the ballast section.
 - b. Use a metal safety pan as described in item 18 of this section.
 - c. A hydraulic puller must be used for all closure welds. The puller must not be released until the weld has cooled below 700°F.
 - d. Just prior to igniting the charge, ensure that everyone is clear of the weld area red zone by at 30' and remain at this distance until the reaction and pour is complete.
6. Thermite welds, especially non-closure welds, can be made successfully at most temperatures provided the proper procedures are followed. The rails must be positively anchored against movement. For closure welds when the rail temperature is less than Desired Rail Neutral Temperature, a rail puller must be used, and a track disturbance record must be made indicating the amount of rail removed during the closure weld.
7. Thermite welds will not be made closer than ten feet (10') from any existing field weld or any closer than three feet (3') from any existing plant weld in the same rail.
- a. When installing an Insulated Glued Joint (IJ), thermite welds can not be made closer than 18" from the insulated joint bar.

8. Thermite welds will not be made over a tie. Rail should be cut so that the weld will be made between ties. This will eliminate the need to move cross ties.
9. A waste disposal area must be prepared prior to demolding the weld. This area must be free of any moisture, standing water, snow, ice, and/or frozen ballast. A clear walking path to this area must be maintained. All of the hot demolding debris must be placed in this prepared waste disposal area prior to welders departing the weld area.
10. Ensure that area around where weld is to be made, as well as walking paths for slag basin disposal, are kept clear of obstructions and hazards such as equipment, hydraulic lines, oxygen/propane lines, hand tools, jumper wires, etc. Walking areas should be kept clear at all times during the welding process.
11. When laying rail out of face, thermite welds will be made no closer than the height of the rail from the near edge of a bolt hole. When installing a maintenance plug, the distance from the end of the rail to the near edge of the bolt hole may be less than the height of the rail but it cannot be less than 4”.

Exception for yard tracks: the distance from the end of the rail to the near edge of the bolt hole may not be less than 1 1/2”. Any rail cuts, closer than 6” from the edge of a bolt hole, must be made with a saw to eliminate the heat affected zone that would be caused by a torch cut.

12. Thermite welds will not be made opposite any weld (in same crib) in the other rail. A Thermite weld should be staggered four (4) ties from any weld in the opposite rail, but must not be made any closer than one (1) tie stagger from any weld in the opposite rail (except when designed in special trackwork).
13. When installing a plug rail, the minimum plug length will be twelve (12) feet in tangent track and sixteen (16) feet in curved track. **Exception:** Plant welds made by either the electric flash or the oxy-acetylene method and marked by a rail defect detector car as having a transverse defect may be repaired by cutting out 1” of rail on both sides of the center of the weld (total of 2”) and making a thermite weld. These may also be repaired with the Electric Flash Butt Welding process, see section M. This may be done only if the weld is not excessively battered and the proper welding gap is obtained without adversely affecting the adjustment temperature of the rail.
14. All thermite welds must be ground before the heat leaves the weld. Do not re-introduce heat into the sides of the weld where it will be ground.
15. An ultrasonic test device will be used to test thermite welds as shown below:
 - a. An O&M firm representative, will randomly test thermite welds on their territory to ensure the weld quality.

- b. Thermite Welds made in FRA Class 6 and above tracks – The *FRA Track Safety Standards*, §213.341 (d), identifies the requirement to test these welds. The welds will be tested not more than two (2) days after the weld is made. If the welds are not tested within this time period, a temporary speed restriction of 30 MPH will be placed.
 - c. If the thermite weld does not test satisfactorily, it must be removed from the track and replaced by an appropriate length plug or removed with a wide gap weld.
 - d. The ultrasonic test device may also be used during the qualification of a Welder.
16. All thermite welds will be identified with the following paint stick markings on the web of the rail:
- a. Specific Mile Post Designation
 - b. Date of weld (MM/DD/YY).
 - c. Thermite weld batch/serial numbers will be recorded in Maximo.
 - d. Welder's initials or Team number.
 - e. Number of weld, by welder, for year.
 - f. Rail temperature (°F).
 - g. Amount of rail added or removed. (+ or -)
 - h. Additional information as may be required, such as **TC** for torch cut rail, **C** for closure weld, **P** if rail puller is used, and on track class 6 and above the **date the weld is tested** and the **testers initials**.
17. The welder will submit a Welding Report on Maximo at the completion of each work day. A Track Disturbance Report must also be completed for every thermite weld made in the track structure. Welds made Out Of Track do not require a Track Disturbance Report.
18. Molten steel and slag can explode upon contact with snow, ice, standing water, frozen ballast or soil, and wet ballast or soil. When the ballast or soil under a weld is wet, a metal safety pan containing at least three inches of dry sand should be placed directly under the weld. This will allow any leakage to fall in dry sand. The bridge safety pan will also provide some protection against fire for timber bridge members, and against heat damage to steel beams. The pans may be reviewed in Sketches A-1 and A-2.
- Track Safety Pan
Bridge Safety Pan
19. During the time the weld is reacting or is being ground, personnel and equipment must be located at a safe distance from the weld (minimum 20 feet unless snow on track, then 30 feet). In particular, vehicles shall be located far enough away from the work to ensure that they cannot be showered by the sparks.
20. No thermite welding on timber structures or open deck bridges is permitted without specific approval of the Manager - Bridge or his designated representative. The following minimum safety instructions must have been implemented:

- a. A fire prevention and response plan must be developed and implemented.
- b. An adequate source of pressurized water must be available and accessible.
- c. The entire area, where the weld will be made, will be wetted before commencing work. Any area, which may be showered with sparks, must be kept wet and protected.
- d. A metal safety pan will be used under the weld.
- e. After the weld is completed, the bridge ties will be wetted again. The work area should be inspected again several hours after the work is completed.
- f. Care must be taken to ensure that the rail and weld do not contact water until the weld has cooled.
- g. These are bare minimum requirements. Good judgment must be exercised to ensure that the structure is properly protected.

20. When making a weld in concrete tie track, the tie pads and insulators must be removed for one or more ties on each side of the weld before the weld is made. This will prevent scorching and deformation of these items. They must be replaced before allowing a train to pass after the weld has been made.

21. Heating rail by using rail heaters or cellulose/rope will not be used to make field welds.

22. Maintenance of Way jumper wires may only be used where appropriate. See MWI 1704 and **Standard** Drawing CFRC 2906 for complete details of the use of jumper wires for Maintenance of Way purposes.

23. Temperature and weather must be considered when making a thermite weld. Conditions that increase the cooling rate of the weld must be mitigated so that the weld does not cool too rapidly. See the chart below:

<i>Rail Temperature</i>	<i>Weather Conditions</i>	
	<i>Clear</i>	<i>Wind, light rain, or snow</i>
40°F or greater	Air Cool Weld Cooling Cover is not required	Apply Weld Cooling Cover immediately after shearing. Leave cover in place until weld is cooled below 800°F (about 35 minutes).
Between 40°F and 0°F	Prior to installation of molds, preheat railhead and base to 100°F (hand hot) for a distance of 3 feet on both sides of the weld gap. Complete weld and unmold normally. Apply Weld Cooling Cover immediately after shearing. Leave cover in place until weld is cooled below 800°F (about 35 minutes).	
0°F and less	Welding is not recommended	

24. Check the pressures at the torch by installing test gauges between the torch end check valves and the torch at the beginning of each week, or anytime there is a change in regulators, hoses, flash back arrestors, check valves, or hose reel using the following procedure.
 - a. **Install the test gauges between the torch end check valves and the torch.**
 - b. Set the regulators at the tanks to the proper Propane and Oxygen pressure.
 - c. Light the torch and adjust the propane valve so that the blue flame tips are of even length and 7/8" long.
 - d. Check the oxygen and propane gas pressures at the test gauges at the torch.
 - e. Adjust regulators at the tanks, if necessary, to get the proper Propane and Oxygen pressures at the test gauge.
 - f. Record the regulator settings for use in preheating the rail ends. The test gauges should be left in-place to ensure that proper delivery point pressures are maintained throughout the entire preheating process. Care must be taken to protect the test gauges from damage.

25. There are two (2) approved thermit weld manufacturers on CFRC. The two (2) approved manufacturers are Orgo-Thermit and Railtech-Boutet. Each manufacturer's process uses different equipment and procedures. A section detailing each of the welding processes follows.

WHEN WELDING ON A BRIDGE USING A HYDRAULIC RAIL PULLER TO MAKE WELDS ON THE OUTSIDE RAIL WHERE NO WALKWAY EXISTS

If the employee has greater than 6 feet in width for a walkway or a working platform on the outside rail, the employee must use personal fall arrest. When the walkway or working platform is 6 feet or less, the following will be met:

- o The employee working on the outside of the hydraulic rail puller must have a walkway or a working platform meeting FRA regulation § 214.109 part 3, "Top edge height of top rails, or equivalent guardrail system member, shall be 42 inches, plus or minus three inches. Supports shall be at intervals not to exceed eight feet. Toeboards shall be a minimum of four inches in height".

STRIPPED JOINTS

When fixing stripped joints, bolts on the gage side can be tightened with a track wrench, then the rail puller removed and the field side bolts can be tightened with an impact wrench following all fall protection guidelines.

ALL CASES

All other FALL PROTECTION guidelines must be adhered to which means the required written Fall Retrieval Rescue Plan must be used. Refer to M 074 for further guidance.

1. Team will have a written Retrieval Plan which includes a list of equipment necessary for the retrieval.
2. Employees will have a coworker that is responsible for knowing their safety partner's location at all times.
3. During the operation of the hydraulic rail puller, each end of the hydraulic rail puller is in the line of movement. This means the hydraulic rail puller can move in either direction along the rail while in operation.
4. In all cases when using a hydraulic rail puller, employees must not stand inside hydraulic rail puller area.

HYDRAULIC RAIL PULLER PROCEDURES FOR GEISMAR MODEL TH-120-STP

Before operating puller, be in compliance with CFRC Operating Rules and procedures.

1. Read and understand operating instructions and maintenance manual supplied with rail puller. If not available, ask welding manager for a copy.
2. Locate joint or defective weld to be removed.
3. **Before starting, surface the joint or defective weld by tamping necessary ties. This should be done if using the puller or not.**
4. Before tear down or saw cuts are made, check for marks on rail if plug was put in during cold Weather, and then pull according to winter track buckling procedures. If not, place reference marks each side of joint on rail, six to seven ties away from joint. This should be done on the field side with paint stick to watch and measure movement of rail, **just like the winter track buckling procedures. Do not add rail.**
5. Take off joint bars and or make saw cuts to achieve proper gap for weld. **Check rail laying charts to see how much rail is to be removed to reach the neutral rail temp.** Obtain proper gap for weld (1") for regular or (2 ¾") for wide gap weld.
6. If Rail moves widening the gap, the resulting gap **must not** be used for the weld. One inch (1") or (2 ¾") for wide gap must be cut out of the rail, plus pulling the gap that is needed to reach the proper Neutral Rail Temperature. **DO NOT ADD RAIL.**
7. Remove tie plates at joint and place alignment plates. Remove anchors where puller is to set on rail and knock down any high spikes.
8. Pre align rail to proper crown and gage with alignment plates. To insure puller will set level on rail and not slip, check web of rail for dirt, grease or obstructions. If grease or moisture is

present, burn off with torch and grind the web of the rail where puller jaws will make contact. (Roughly 3 feet to the open end and 4 feet to the intensifier end from the rail ends of the joint.)

9. Set puller on rail. Make sure puller is centered to get maximum working area, using centering arrow on beam.
10. Ensure the area to be gripped is clean and dry and any rust or mill scale and raised lettering has been ground flat.
11. Follow operating instructions for clamping and pulling rail. (OPERATING MANUAL)
12. Remove hoisting cable from the lifting beam. **NEVER OPERATE PULLER WITH CABLE ATTACHED.**
13. Connect puller to hydraulic power source set to 5gpm. Turn directional valve to the retract position and draw the jaws up to the web of the rail. Once all four jaws make contact with the rail, return the directional valve to the lock position.
14. Pull the four pins holding the lifting beam to the puller and pick up the lifting beam with the supplied handles and set in the gauge of the track out of the way.

EVERYONE MUST STAY CLEAR OF THE PULLER RED ZONE DURING PULL AND WHILE UNDER LOAD. THE RED ZONE IS DEFINED AS 15' FROM THE ENDS OF THE TOOL ALONG THE RAIL WHERE IT COULD POSSIBLY SLIP.

15. Begin pull by turning the directional valve to the retract position to get the proper gap (1" or 2³/₄" for wide gap). **DO NOT ADD RAIL.**
16. If proper gap cannot be achieved when puller is at maximum operating pressure of 120 tons, puller must be unclamped by using instructions in line 20 – 21 and 22 and anchors must be removed.
17. When proper gap is achieved, return directional valve to the center lock position, turn locking valve on control panel clockwise locking pressures in puller to hold in place. Shut the hydraulic power source off, and with the locking valve turned to the closed position, move the directional valve back and forth to relieve pressure at the hose connection. Disconnect hydraulic lines to use grinding tools and shear while the weld is cooling to 700°F.
18. Check rail alignment and adjust if needed.
19. Rail Alignment Plates must be used when using puller.

IMPORTANT:

DO NOT STRIKE ANY PART OF PULLER OR TRACK STRUCTURE WHILE PULLER IS UNDER LOAD. DO NOT REMOVE OR APPLY ANY RAIL ANCHORS WHILE THE PULLER IS UNDER LOAD. WHEN USING PULLER AROUND SWITCHES, CAUTION SHOULD BE USED TO KEEP FROM MISSALIGNING. A 200-FOOT DISTANCE OR OUT OF SOLID ANCHORS, IS A GOOD RULE TO FOLLOW.

20. Begin making weld by using MWI 801 Thermite welding procedures. (ORG. or BOUTET Wide Gap).
21. **Rail puller cannot be removed until weld has cooled to 700°F or below.** At the end of the finish grinding, a temperature of 700°F is generally reached. **CHECK WELD TEMPERATURE.**

BEFORE REMOVING PULLER

22. Remove rail puller by hooking hydraulic lines to puller. **(DO NOT START UNIT OR PTO).** Open lock valve by turning it counter clockwise. With Locking valve open slowly turn the directional valve to the extend position to release the pressure on the puller.
23. Once the pressure is released off the puller and the gauge reads zero tons, pick up lifting beam with handles and place it back in the cradles and install the four pins.
24. Turn power source on and turn directional valve to the extend position until the jaws on both ends have opened and are clear of the head of the rail.
25. Hydraulics can now be turned off. Do NOT remove hoses yet. **MOVE DIRECTIONAL VALVE BACK AND FORTH TO RELIEVE TRAPPED PRESSURE.** Check pressure gauge to make sure it is on zero and then remove hoses.
26. Hook up lifting cable from crane, lining up cable to get a straight lift. Make sure tagline is connected. Now puller can be lifted off the rail. If more work is to be done, move puller to the clear and put on ground or load in truck.
27. Remove alignment plates, and put tie plates on using proper tool. **Never put fingers under plates.** Spike and apply all anchors and dress work area in compliance with CFRC requirements.
28. All field welds must be marked with a Paint Marker. If puller was used, web of rail must be marked – PULL WELD or PW.
29. Move to the next weld and follow instructions again.

HYDRAULIC RAIL PULLER PROCEDURES FOR SIMPLEX RP 120

1. Read and understand operating instructions and maintenance manual supplied with puller. If not available, ask welding supervisor for copy.
2. Locate joint or defective weld to be removed.
3. **Before starting, surface the joint or defective weld by tamping necessary ties. This should be done if using the puller or not.**
4. Before tear down or saw cuts are made, check for marks on rail if plug was put in during cold weather, then pull according to winter track buckling procedures. If not, place reference marks each side of joint on rail, two feet each side of joint. This should be done on the field side with paint stick to watch and measure movement of rail, just like the winter track buckling procedures. DO NOT ADD RAIL.
5. Take off joint bars and or make saw cuts to achieve proper gap for weld. **Check rail laying chart to see how much rail is to be removed to reach the neutral rail temp. Obtain proper gap for weld(1") for regular or (2 3/4" wide gap weld).**
6. If Rail jumps open, this gap **must not** be used to make the weld. You must still cut (1") or (2 3/4" for wide gap) out of the rail. Plus pulling the gap that is needed to reach the proper rail temp. DO NOT ADD RAIL.
7. Remove tie plates at joint and place alignment plates under rail if available or wedges. Remove anchors where puller is to set on rail and knock down any high spikes.
8. Pre align rail to proper crown and gauge with alignment plates. To insure puller will set level on rail and not slip, check web of rail for dirt, grease or obstructions.
9. Set puller on rail. Make sure puller is centered to get maximum working area, using centering arrow on beam. Run pull cylinders ahead 2 inches before clamping to the rail.
10. If grease or moisture is present, burn off with torch and grind the web of the rail where puller jaws will make contact. (Roughly 3 feet to the open end and 4 feet to the intensifier end from the rail end of the joint.)
11. Follow operating instructions for clamping and pulling rail. (OPERATING MANUAL).
12. Remove lifting cable on crane and move it out of work area. **NEVER OPERATE PULLER WITH CABLE ATTACHED.**
13. Connect puller to hydraulic power source, setting to 5gpm. On puller control panel, extend lifting beam to clamp puller to rail. DO NOT STAND OVER BEAM WHEN IT IS BEING

MOVED. If beam does not move, the speed control knob must be turned clockwise to send more hydraulic pressure to beam. Now you can remove beam locking pin and retract beam till it is fully contracted. **DO NOT STAND OVER BEAM WHEN IT IS BEING MOVED.** If beam does not move, the speed control knob must be turned clockwise to send more hydraulic pressure to beam. Lift beam up out of working area and use the lock pin to lock in place (**THIS IS THE ONLY TIME THIS PIN IS TO BE REMOVED**). This is to provide enough work area to make field welds.

14. Now you can start your pull by using pull lever in the pull mode to get the proper gap (1" or 2 3/4" for wide gap). You can turn speed control knob to speed up (clockwise) or slow down (counter clockwise) the speed of the pull. **DO NOT ADD RAIL.**
15. If proper gap cannot be achieved when puller is at maximum operating pressure 120 tons, puller must be unclamped by using instructions in line 20 – 21 and 22 and anchors must be removed.
16. When proper gap is achieved, turn lock valve on control panel clockwise locking pressures in puller to hold in place and turn speed control knob counter clockwise completely.
17. Disconnect hydraulic lines to use grinding tools and shear while the weld is cooling to 700°F.
18. Check rail alignment and adjust if needed.
19. Rail Alignment Plates **must** be used when using puller. Pandrol and concrete must be pre-aligned with jacks and crowned .020 higher before puller is placed on rail. More clips must be removed.

IMPORTANT:

DO NOT STRIKE ANY PART OF PULLER OR TRACK STRUCTURE WHILE PULLER IS UNDER LOAD. DO NOT REMOVE OR APPLY ANY RAIL ANCHORS WHILE THE PULLER IS UNDER LOAD. WHEN USING PULLER AROUND SWITCHES, CAUTION SHOULD BE USED TO KEEP FROM MISSALIGNING. A 200-FOOT DISTANCE OR OUT OF SOLID ANCHORS, IS A GOOD RULE TO A FOLLOW.

20. Begin making weld by using MWI 801 Thermit welding procedures. (ORGO-THERMIT. or BOUTET Wide Gap).
21. **Rail puller cannot be removed until weld has cooled to 700°F or below.** At the end of the finish grinding, a temperature of 700°F is generally reached. **CHECK WELD TEMPERATURE.**

BEFORE REMOVING PULLER

22. Remove rail puller by hooking hydraulic lines to puller. **(DO NOT START UNIT OR PTO)**. Open lock valve by turning it counter clockwise. Move both valve handles to left and right to dump pressure in puller back to tank. The gauge should read 0. Start power source for hydraulics.
23. Pull pin and lower lifting beam to rail, making sure guide on bottom of beam is on rail to guide into place. Extend beam slowly until lock pin can be replaced. Replace pin when holes line up. If beam does not move then use speed control knob to help.
24. **REMOVING PULLER After beam lock pin is replaced, retract lifting beam and extend pull cylinders at the same time**, turning speed control knob all the way open, clockwise until puller is completely open. You must visually look to verify puller is open and will clear railhead. Return speed control valve to full counter clockwise position.
25. Hydraulics can now be turned off. **MOVE BOTH BEAM CONTROL HANDLE AND PULL CONTROL HANDLE BACK AND FORTH TO RELEVE ANY TRAPPED PRESURE IN SYSTEM**. Check pressure gauge to make sure it is on zero and then remove hoses.
26. Hook up lifting cable from crane, lining up cable to get a straight lift. Make sure tagline is connected, if it was removed. Now puller can be lifted off the rail. If more work is to be done, move puller to the clear and put on ground or load in truck.
27. Remove alignment plates, and put tie plates on using proper tool. **Never put fingers under plates. Spike and apply all anchors and dress work area in compliance with CFRC and FRA requirements.**
28. All field welds must be marked with proper name plate provided, or Paint Marker. If puller was used, web of rail must be marked – PULL WELD or PW.
29. Move to next weld and use instructions again. If using other model numbers or other manufacturers' brand of puller, refer to the manufacturer's written instructions.

THERMITE WELDING PROCEDURES

1" Gap, Orgo-Thermit Weld with Degradable Crucible

1. PREPARATION OF RAIL ENDS AND GAP

- a. Prior to removing bars or cutting rail tighten rail anchors at least 40' in either direction of weld location.
- b. The rail is to be saw cut. The Welder must have a rail saw in operating condition prior to making a weld.

- c. Examine the rail ends to see if they have rail end damage (chips, nicks, and surface deformation) or were previously repaired by welding to remove rail end batter. Do not make a field weld to a rail that has rail end damage or was previously welded unless the rail end is cropped to remove all the damaged area or welded-on material. Also completely remove signal bond wires, if present, by grinding.
- d. In an emergency, such as the mechanical failure of the rail saw during the cut, the rail may be torch cut. If a torch is used, **care** must be used to ensure a straight cut. All slag must be removed from the face of a torch cut rail. The weld must be made within one (1) hour of the torch cut. Also, the Welder will mark "TC" on the rail if a torch cut rail is welded into track.
- e. Clean the rails for a distance of 4" to 6" from each end with a burner and wire brush until the area is free of grease, rust, mill scale, paint and other foreign matter.

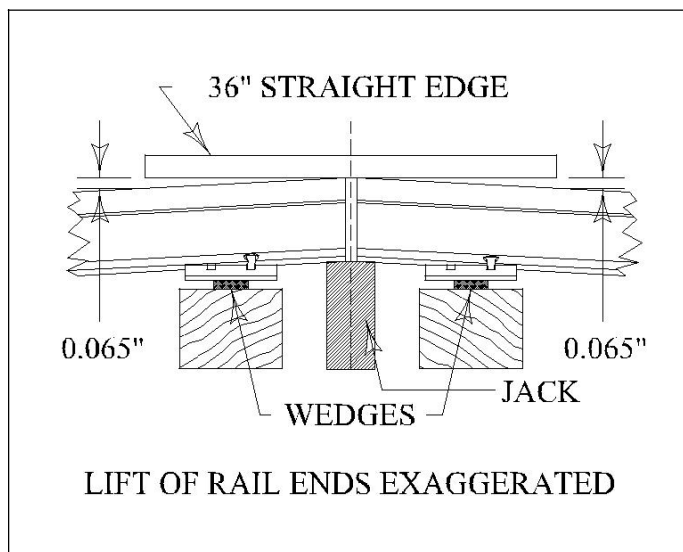
2. ALIGNMENT OF THE RAILS

- a. There are four parameters to be considered in aligning the rails for welding: gap, horizontal alignment, vertical alignment, and twist. The strongest weld is produced when the same section has no mismatch in the elevation of the rail bases, the webs are not twisted in relationship to each other, and any rail head mismatch is removed by grinding after the weld is made.
- b. With some worn rails, it may not be possible to have the rail bases at the same elevation without having to perform considerable grinding on the rail heads to obtain a smooth transition between rails. In these instances, a limited amount of rail base mismatch is permitted. As the amount of rail base mismatch increases, it becomes harder to align the webs of rail with a straightedge to eliminate twist. As the rail base mismatch increases, the strength of the weld decreases.
- c. Remove or loosen rail fastening from two or three ties (or whatever is necessary) on each side of the weld location.
- d. To position rail ends to be welded, use:
 - 1. alignment plates if available, or
 - 2. use a mechanical or hydraulic jack under the center of the two rail ends, and lift them slightly. Place the four wedges under each side of the tie plate on both ties to nearly the desired height. Then remove the jack. A few light hits with a dead blow hammer should be all that is required to reach the desired crown and alignment.

- e. **Ensure that the correct gap is obtained.** The correct gap for all rail sections is 1" with a tolerance of 1/16" (1" to 1 1/16" permitted). The gap will be measured on both sides of the head and web (4 measurements) to confirm the proper gap has been established.
- f. If the gap between rail ends is too small, the ends may be cut to give the proper gap.
- g. All rails should be eye aligned 40' from where the weld is being made.

h. Then use a 36" steel straightedge at the rail ends. The horizontal alignment along the web must be perfect with the straightedge. Check the web from the rail base to the rail head to insure that the two rails are not twisted in relationship to each other.

i. The vertical alignment should have a 1/8" crown at the joint. Using a 36" straightedge, there will be 0.065" between the straightedge and the rail at each end. See Sketch I-1.



Sketch I-1

- j. If necessary, use gage rods, one on each side of the joint, to hold the alignment. Additional gage rods may be required in curved track. Use of a "Canting Tool" (015.0003178.1) is very helpful in removing twist from the rail.
- k. When welding top worn rail to new rail, it may be necessary to have the bases of the two rails mismatched. Transition Rails have been developed to address this problem (See MWI 507). If transition rails are not used, it is preferable that the base mismatch does not exceed 1/8" but up to 1/4" is permitted. If the rail height difference is greater than 1/4", the weld will be made with the running surfaces of the rails mismatched and no more than a 1/4" base mismatch. The molds will have to be filed to fit. After the weld is completed, the higher rail will be ground off to match the lower rail.
- l. When making compromise welds, the rails will be aligned in a manner similar to that used for worn rail to new rail. Visually check the alignment of the webs to insure that the two rails are not canted in relationship to each other. Railhead mismatch should be

corrected by grinding rather than by a major alteration of the molds.

- m. If it is necessary to make a compromise weld from rail sections 122# and heavier to rail sections 100# and lighter, a 112# or 115# intermediate rail will be inserted between the heavier and lighter rail sections. Transition rails should be used in main tracks. See MWI 507 for details.
- n. When welding in a plug, joint bars should be installed on the end which will be field welded last, in order to hold the plug in true alignment while the first weld is being installed. When placing the plug in track, it should be of proper length to provide 1-inch gaps at each end for welding.
- o. Secure the rails. When the desired rail gap has been established, clamp the rails to secure the position so that sudden temperature changes or sudden jolts will not disturb the gap opening. Mark the rails and tie plates on either side of the gap so any longitudinal rail movement can be detected during welding.

3. INSTALLATION OF THE MOLDS

- a. Before installation, check the molds for damage. The pouring channels and risers must be clear. Verify that the molds are the correct size for the rails being welded. Some molds may be used for more than one rail section, such as 132 # on 131# rail and 115# on 112# rail. Place each mold in the mold shoe. The sides of the mold shoe must fit the mold tightly. If they do not, adjust the shoes by straightening the angle to 90°.

NOTE: The shoes are designed with structures at the top of the walls, which are used to support and position the single-use crucible above the molds.

- b. Apply one mold half on the rail, central to the gap, checking for fit. Match the other mold half to it. If the two halves do not fit tightly together due to a rail mismatch, one or both molds may have to be filed for proper fit. It is preferable that this filing does not exceed 1/8" but up to 1/4" is permitted. File the outer edges only where necessary. Wherever the outer edge is filed, the collar in the same area is also to be filed.
- c. Apply one mold half in the mold shoe centrally on the gap and slightly tighten the swivel arm screw of the clamping device while lifting the mold shoe upwards. Match the other mold half to it and slightly tighten the other swivel arm while lifting the mold shoe upwards. Tap both shoes under the bottom and tighten each swivel arm screw firmly with one hand. Recheck to ensure both molds are flush and fitting tightly together.
- d. Cover the mold top with plexiglass or cardboard before starting luting to keep the inside of the mold clean.
- e. When welding in curves, the top of the diverting plug is to be filed so that it fits horizontally into the mold. This will achieve a more even flow of the thermite steel into

the mold halves.

- f. Before luting, pack any gaps between the molds and rails with toilet paper flush with the outside of the mold. Tear a piece of paper to the width of the rail heads, fold into a “Z” shape, and slide along the top of the rail under the mold. A vertical tab will prevent luting sand from falling on the rail head.
- g. Ready-to-use luting material is available in 10 pound plastic bags from Orgo-Thermit, Inc. and is shipped with each kit.
- h. Fill the luting grooves surrounding the rail and under the rail base with luting sand and pack it firmly into place to prevent leakage of the molten metal when the mold is filled. Take care when luting under the rail base, to make sure the luting sand is placed on the correct side of the luting groove. After luting is completed, check the molds for foreign material, and re-cover.

NOTE: Preheating must begin within ten (10) minutes after molds have been luted. In the event that preheating does not commence within this time, the existing molds may be used, but new luting sand must be applied.

- i. Place three-quarter (3/4) inch of dry sand in the slag basin and fit the slag basin to the lugs on the sides of the mold shoes. Place the rail head protecting sheet on the rail heads next to the mold shoes. Carefully place additional luting sand on the rail head between the mold shoes and the rail head protecting sheets.
- j. When making welds in turnouts, the Left Handed Hinged Shoe can be used to prevent the slag basin from coming in contact with adjacent rails. This will replace the Turnout Kit was previously used.

4. PREHEATING

- a. Ensure that the preheating burner has been tested as detailed in Section I--Thermite Welding, General, paragraph 22.
- b. Set the propane and oxygen regulators to deliver the proper pressures to the burner.
- c. Place the burner saddle assembly on the universal clamp, turn the saddle adjustment knobs to center the burner head over the rail gap, and remove the burner saddle assembly. Open the oxygen valve completely and open the propane valve 1/4 turn. Adjust the oxygen and propane regulators to the proper pressures. Light the burner with a flint type lighter. Adjust the torch propane valve so that the blue flame tips are of even length at 7/8” long. Check the burner for clogged holes, and clean if necessary.

d. SKV-Extended (5-minute) data using SKV 5 minute preheating burner.

Propane:	14 PSI
Oxygen:	65 PSI
Burner Hgt:	1 3/8"

Victor or Smith 5 minute preheat burners are also authorized for preheating the SKV process. Use these pressure settings for Victor or Smith Preheaters:

Propane:	15 PSI
Oxygen:	65 PSI
Burner Hgt:	1 3/8"

- e. Pressures are measured at the burner when using 3/8" inside diameter hoses with flashback arrestors behind the burner bodies. Burner height is measured from the top of the lower rail if the rail ends are mismatched in height.
- f. Briefly preheat both slag basins to ensure that they are dry. Position the preheating burner on the universal clamp and adjust the knobs so that the flame is directed down the center of the rail gap. Ensure that the burner saddle is contacting the height adjustment ring. Verify that the burner tip does not touch the sand mold. Tighten the burner saddle clamp.
- g. During preheating, ensure that the preheating burner is in the center of the one (1") gap in the rail. Make certain that it is also aligned in the center across the head.
- h. Recheck the gauge pressures, and adjust if necessary. On a windless day the burner flame should rise about 18" from the outside risers. The diverting plug should be dried before placing it in the mold. Wave the diverting plug with the fire tong over the riser flame for approximately 1 to 2 minutes.

CAUTION: Do not hold the diverting plug in the flame until it turns white. The plug will become brittle.

- i. At the end of the 5 minute preheating time, the rail ends should show good orange/yellow color in the web and the base. If the rail ends do not show good orange/yellow color, continue to preheat until the color is obtained. When making a compromise weld, the base of the heavier rail section must have an orange/yellow color.
- j. Upon completion of preheating, remove the universal clamp and burner saddle assembly and insert the diverting plug into the mold, making sure it seats properly

NOTE: The welding charge must be ignited within fifteen (15) seconds after the preheating burner has been removed.

5. CRUCIBLE PREPARATION AND CHARGING

- a. These procedures may be accomplished while the rail ends are being preheated.
- b. The crucible is a Degradable Crucible (a beta set process crucible), which is equipped with a self-tapping device. A refractory cap is supplied with each crucible.
- c. Remove the lid on the crucible. Gently remove the crucible cap, which is shipped upside-down inside the crucible. Inspect both the cap and crucible for damage. **CAUTION:** If there are signs of damage, do not use the crucible.
- d. Turn the crucible upside-down and dump out any loose liner material. Inspect the tap hole area to ensure that the refractory discs (white color discs) are in place and nothing is covering them.
- e. Place the crucible on a level, clean and dry surface. Place the crucible on cardboard at a dry location near the working area. Pour in the portion, level the surface and install the cap.

CAUTION: Use only the portions designed for the single-use crucible. They are packed in orange bags. Never mix components from different kits.

6. REACTION AND POUR

- a. The welder will clear all individuals from the welding area prior to igniting the welding portion. All track equipment working in the area will be stopped if vibrations can be felt in the rail being welded or roadbed until the weld has been poured and solidified.
- b. Place the charged crucible on top of the mold shoes. Ensure that it is properly seated.
- c. The welder, using a gloved hand, will insert a lit igniter through the top of the crucible cap until it contacts the center of the welding portion. As soon as the igniter is inserted, the Welder will move away from the crucible to a safe position (approximately 20 ft, 30 feet if snow on track) while the reaction takes place.
- d. The tapping time, which is the time from when the portion ignites until the time the portion begins to flow, will be timed for each weld. The normal tapping time is from 23 to 28 seconds. If the tapping time is less than 15 seconds or more than 35 seconds, the weld is to be considered defective and immediately removed from track.

CAUTION: If the crucible's secondary tap does not tap within 1 minute, remain at a safe distance for 20 minutes. The heat from the reaction will slowly transfer through the refractory material. The crucible walls will become red hot.

7. REMOVING THE MOLDS

- a. Note that a full face shield, long sleeves and welding gloves are required during the tear down process. This includes shearing of the weld.
- b. Stand clear of the assembly for five minutes after the pour.
- c. After five minutes have passed, remove the crucible and the slag basins from the mold shoes. Set the crucible aside in a safe location. Carry the slag basins level staying on the level portion of the track. Do not step over the rail while carrying a hot slag basin. Take the slag basin fifteen to twenty feet (eight to ten ties) away from the weld. Place the slag basin on level ballast between the ties. Note that this area must be level and dry. Do not flip over the slag basin at this time; allow time for the slag to cool in the basin.
- d. After removing the crucible and slag basins, remove the universal clamp and mold shoes.
- e. Score the mold on both sides about 1 ½” above the rail head. Hold a shovel against the score mark on one side of the mold and carefully push the head of the mold from the opposite side until the mold is partially broken. If molten metal leaks out, return the mold to its original position and wait 15 to 30 seconds. Repeat until no leakage occurs; then push the mold head onto the shovel.
- f. While the weld is still at red heat, use the power shears to remove the excess metal from the sides and top of the rail head. The power shears must be a type of “Safety Shear”, one having a metal shroud completely covering all the hydraulic hoses which will prevent accidental damage to the hydraulic lines from hot material or from being struck by any tool. The safety shear shroud also helps prevent a “flare up” if a hose or fitting should fail during the shearing process. Shears with exposed flexible hydraulic lines will not be used. Operate the shears at a slow and consistent speed. Careful operation of the shears will decrease the likelihood of “hot tears”. Leave enough of the weld to permit proper grinding. If power shears are not available, a sledge hammer and hot cut chisel, or a propane torch may be used.

NOTE: When cutting away the excess metal from the top and sides of the ball, the chisel must be turned at an angle to the perpendicular, and not vertical to the ground.

- g. Base risers may be bent out slightly to make room for rough grinding. The angle between the riser and the rail head should be approximately 45° degrees. Care must be taken during bending to ensure that a hot tear is not created in the top of the base of the rail.
- h. The wedges may be removed after the weld cools to 700°F.

- i. After cooling for 20 minutes, the slag basin may be moved to the selected waste area and emptied. The preferred method for handling the debris produced during the welding process is to place it in the used crucible “can” and move it to a normal trash disposal container. If this is not possible, bury the hot debris in a shallow hole. Make sure that the hole is dry. If the ground is wet, let the debris cool before burying. Be careful of underground facilities on the right-of-way, such as signal cables, fiber optic cables, etc.

CAUTION: Do NOT throw debris into water or snow.

- j. The site should be left in a neat and orderly condition. All released track materials will be taken to the local material storage site.

THERMITE WELDING PROCEDURES

1” Gap, Railtech Boutet Weld with CJ Crucible (One-Shot):

1. PREPARATION OF RAIL ENDS

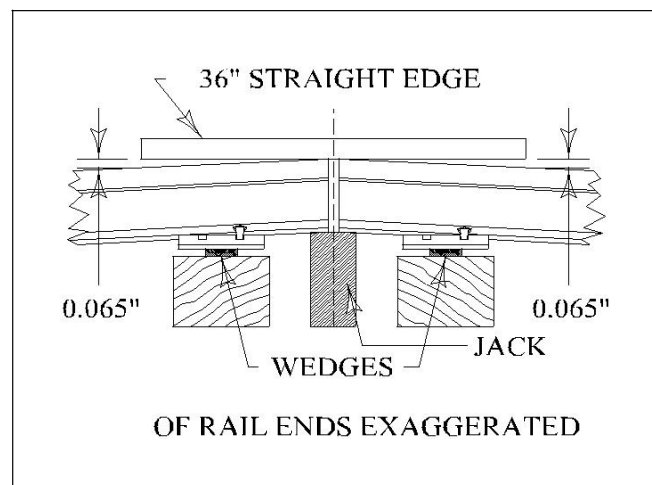
- a. The rail is to be saw cut. The Welder must have a rail saw in operating condition prior to making a weld and it must be used.
- b. Examine the rail ends to see if they have rail end damage (chips, nicks, bolt hole cracks and surface deformation) or were previously repaired by welding to remove rail end batter. Do not make a field weld to a rail that has rail end damage or was previously welded unless the rail end is cropped to remove all the damaged area or welded-on material. Also completely remove signal bond wires, if present, **by grinding**. To relieve tension on the rail with a torch, refer to Section H (Cutting Rail) on page H-2.
- c. Only in an emergency, such as the mechanical failure of the rail saw during the cut, may the rail be torch cut. If a torch is used, care must be used to ensure a straight cut. All slag must be removed from the face of a torch cut rail. The weld must be made within one (1) hour of the torch cut. Also, “TC” will be marked on the rail.
- d. Flame clean the rails for a distance of 4” to 6” from each end with the pre-heater and wire brush until area is free of grease, rust, mill scale, paint and other foreign matter.

2. ALIGNMENT OF THE RAILS

- a. There are four parameters to be considered in aligning the rails for welding: gap, horizontal alignment, vertical alignment and twist. The strongest weld is produced when the same section has no mismatch in the elevation of the rail bases, the webs are not twisted in relationship to each other, and any rail head mismatch is removed by grinding after the weld is made.
- b. With some worn rails, it may not be possible to have the rail bases at the same elevation without having to perform considerable grinding on the rail heads to obtain a smooth

transition between rails. In these instances, a limited amount of rail base mismatch is permitted. As the amount of rail base mismatch increases, it becomes harder to align the webs of rail with a straightedge to eliminate twist. As the rail base mismatch increases, the strength of the weld decreases.

- c. Remove or loosen rail fastening from two or three ties (or whatever is necessary) on each side of the weld location.
- d. To position rail ends to be welded, use:
 1. alignment plates if available, or
 2. use a mechanical or hydraulic jack under the center of the two rail ends, and lift them slightly. Place the four wedges under each side of the tie plate on both ties to nearly the desired height. Then remove the jack. A few light hits with a dead blow hammer should be all that is required to reach the desired crown and alignment.
- e. **Ensure that the correct gap is obtained.** The correct gap for all rail sections is 1" with a tolerance of 1/16" (1" to 1 1/16" permitted). The gap will be measured on both sides of the head and web (4 measurements) to confirm the proper gap has been established.
- f. If the gap between rail ends is too small, the ends may be cut to give the proper gap.
- g. All rails should be eye aligned 40 feet from where the weld is being made.
- h. Then use a 36" steel straightedge at the rail ends. The horizontal alignment along the web must be perfect with the straightedge. Check the web from the rail base to the rail head to insure that the two rails are not twisted in relationship to each other.
- i. The vertical alignment should have a 1/8" crown at the joint. Using a 36" straightedge, there will be 0.065" between the straightedge and the rail at each end. See Sketch I-2 below.
- j. If necessary, use gage rods, one on each side of the joint, to hold the alignment. Additional gage rods may be required in curved track. Use of a "Canting Tool" is very helpful in removing twist from the rail.



Sketch I-2

- k. When welding top worn rail to new rail, it may be necessary to have the bases of the two rails mismatched. Transition Rails have been developed to address this problem (See MWI 507). If transition rails are not used, it is preferable that the base mismatch does not exceed 1/8" but up to 1/4" is permitted. If the rail height difference is greater than 1/4", the weld will be made with the running surfaces of the rails mismatched and no more than a 1/4" base mismatch. The molds will have to be filed to fit. After the weld is completed, the higher rail will be ground off to match the lower rail.
- l. When making compromise welds, the rails will be aligned in a manner similar to that used for worn rail to new rail. Visually check the alignment of the webs to insure that the two rails are not twisted or canted in relationship to each other. Rail head mismatch should be corrected by grinding rather than by a major alteration of the molds.
- m. If it is necessary to make a compromise weld from rail sections 122# and heavier to rail sections 100# and lighter, a 112# or a 115# intermediate rail will be inserted between the heavier and lighter rail sections. Transition rails should be used in the main track. See MWI 507 for details.
- n. When welding in a plug, joint bars should be installed on the end which will be field welded last in order to hold the plug in true alignment while the first weld is being installed. When placing the plug in track it should be of the proper length to provide 1" gaps at each end for welding.
- o. Secure the rails. When the desired rail gap has been established, clamp the rails to secure the position so that sudden temperature changes or sudden jolts will not disturb the gap opening. Mark the rails and tie plates on either side of the gap so any longitudinal rail movement can be detected during welding.

3. INSTALLATION OF THE MOLDS

- a. Before installation, check the molds and base briquette for damage. The pouring channels and risers must be clear. Verify that the molds and base briquette are the correct size for the rails being welded. Place each mold in a mold jacket and the base briquette in the base plate. Plan placement of the mold such that the pour side of the mold is in the gage of the track on tangent track or to the low side of a curve on curved track; this will place the slag basin on the same side as the pour.
- b. Test fit the molds to the rail. The molds must be centered over the rail end gap with equal amount of rail exposed in the mold cavity. Vertical mold mismatch should not exceed 1/8". Grind off any rail flow that will prevent the molds from fitting tightly against the rail.
- c. Test the base briquette fit and alignment on the base of rail before applying the refractory paste. Apply a bead of refractory paste (the diameter of a pencil) in the recess on the

base briquette. Do not allow any paste in the middle depression of the base briquette.

- d. Install the base plate to the base of rail. Make sure that equal amounts of rail are exposed in the depression of the base briquette. Ensure that the thumbscrews are on the field side. Hand tighten the thumbscrews, and then give $\frac{1}{4}$ turn with a wrench. Recheck the crown after installing the base plate.
- e. Place one mold half on the rail. Center it in relation to the gap and the base plate. The pouring spout and mold clamp handle should be on the gage side on tangent track or on the low side of curved track. Put the second mold half in place. Center it in relation to the gap and the base plate. Re-adjust the mold halves, if necessary, to achieve a perfect fit.
- f. Final adjustment and control is achieved by positioning the mold clamp. Be careful not to break the molds by over-tightening the mold clamp. After clamping cover the mold top with Plexiglas or cardboard before starting luting to keep the inside of the mold clean.

CAUTION: Over-tightening of the base plate or the mold clamp may cause cracking of the molds or base briquette, which could lead to leakage of molten steel and personal injury.

- g. The luting process is designed to form a seal between the rail and the molds to prevent leakage of the molten metal when the mold is filled. Poorly aligned rail and/or molds make this process more difficult and increase the chance of leakage.
- h. Evenly apply by hand a thin layer of the pre-mixed luting sand to seal the gap between the rail and the mold; follow this thin layer by another to fill completely around the entire profile of the rail, including the bottom of the rail base. After luting the molds, place the slag basin on the mold clamp under the pour spout of the pour mold jacket. Apply a small amount of the luting sand on the lip of the pour spout and place three-quarter ($\frac{3}{4}$) inch of dry sand in the slag basin. After luting is completed, check the molds for foreign material, and re-cover.
- i. Do NOT let completed molds sit idle longer than ten (10) minutes before beginning preheating. In the event that preheating does not commence within this time, the existing molds may be used, but new luting sand must be applied.

CAUTION: If moisture is present under the weld, place a container of dry sand on the ballast under the weld to catch any leakage. Molten steel and slag can cause serious explosions upon coming into contact with snow, ice, standing water and/or frozen ballast/soil.

4. PREHEATING

- a. The preheating operation has a major influence on the quality of the finished weld. It must remove the residual moisture from the molds and bring the rail ends to the proper temperature range.
- b. Always check the Oxygen and Propane before beginning each preheat. Ensure that there is enough of each to complete the weld procedure and that the pressures are proper.
- c. Ensure that the preheating burner has been tested as detailed in Thermite Welding, General, paragraph 22.
- d. Set the propane and oxygen regulators to deliver the proper pressures to the burner.

- e. The proper preheat working pressures are:

Smith, Victor or Hessa Equipment

Propane: 15 PSI
Oxygen: 65 PSI
Burner Hgt.: 1 1/2"

Pressures are measured at the burner when using Grade T 3/8" inside diameter hoses with reverse flow check valves behind burner body. Burner height is measured from the top of the lower rail if the rail ends are mismatched in height.

- f. Position the preheating burner stand on the rail. Attach the unlit burner and align it so that the burner is centered in the one (1") gap in the rail. Make certain that it is also aligned in the center across the head and the burner tip is 1 1/2" above the head of the rail. Remove the burner from the stand. Light the burner, replace it on the stand and adjust the flame.
- g. Preheating time starts after the flame has been adjusted and the burner alignment has been "fine tuned". A stopwatch is the easiest and most accurate way to measure the preheat time. The proper preheat times are:

<i>Rail Size</i>	<i>Duration</i>
122 # rail and above	6 minutes minimum
below 122# rail	5 minutes minimum

- h. On a windless day the burner flame should rise about 18" from the outside risers. The diverting plug should be dried before placing it in the mold. Place the diverting plug on the edge of the mold next to the riser flame for approximately 1 to 2 minutes. Do not block the flame from the riser hole with the diverter brick.

- i. At the end of the preheating time, the rail ends should show good orange/yellow color in the web and the base. If the rail ends do not show good orange/yellow color, continue to preheat until the color is obtained. When making a compromise weld, the base of the heavier rail section must have an orange/yellow color.
- j. Upon completion of preheating, remove the burner and burner stand. Insert the diverting plug into the mold, making sure it seats properly.

NOTE: The welding charge must be ignited within fifteen (15) seconds after the preheating burner has been removed.

5. CJ CRUCIBLE

- a. The CJ Crucible (One-shot) is made from a refractory compound combined with a resin. The CJ Welding Charge must be used with the CJ Crucible, ie. only use the welding charge shipped in the field welding kit.

CAUTION: Never use a welding charge that has lost material or has a hole in the bag. Never mix two welding charges or add anything to the charge.

- b. Preparing the crucible for use may be done before or during the preheat process. Inspect the crucible for cracks or other damage. Clean out any loose sand. Open and pour the welding charge into the crucible. Place the crucible on cardboard at a dry location near the working area. Get an igniter ready. Place the CJ fork near the crucible. Ensure that the slag basins contain 3/4" of dry sand.

6. REACTION AND POUR

- a. The welder will clear all individuals from the welding area prior to igniting the welding portion. All track equipment working in the area will be stopped if vibrations can be felt in the rail being welded or roadbed until the weld has been poured and solidified.
- b. As soon as the preheating is complete and the diverter plug is in place, place the crucible on top of the molds. Ensure that it is centered by using the two large outside riser holes as a reference.
- c. The welder, using a gloved hand, will insert a lit igniter into the center of the welding charge to a depth of 1/2". Gently place the cover on the crucible, and move to a safe position.

CAUTION: During the reaction and pouring of the weld material, all personnel must move away from the crucible and remain a minimum of 20' (30 feet if snow on track) away while the reaction takes place. Do not return to the weld until you are certain that all molten material is contained.

- d. The tapping time, which is the time from when the portion ignites until the time the portion begins to flow, will be timed for each weld. The normal tapping time is from 23 to 28 seconds. If the tapping time is less than 15 seconds or more than 35 seconds, the weld is to be considered defective and immediately removed from track. The CJ Crucible is designed with a by-pass feature. In the event that the molten material does not discharge within the normal tapping time, the bypass will pour into the large riser hole at approximately 90 seconds after ignition. If the by-pass tap does not function remain a safe distance away for 20 minutes.
- e. When the crucible taps, the molten material will flow into the molds and the excess material and slag will flow into the slag basin. After the flow of molten material has stopped, start the solidification time. Do not place dry sand on top of molds and slag basins until five minutes have passed from the pour.

7. REMOVING THE MOLDS

- a. Note that a full face shield, long sleeves and welding gloves are required during the tear down process. This includes shearing of the weld.
- b. Following the pour, and after 5 minutes have elapsed, sprinkle dry sand on top of the molds and slag basin and remove the slag basin. Carry the slag basin level staying on the level part of the track. Do not step over a rail while carrying the hot slag basin. Take the slag basin fifteen to twenty feet (eight to ten ties) away from the weld. Place the slag basin on level ballast between the ties. Note that this area must be level and dry. Do not flip over the slag basin at this time; allow time for the slag to cool in the basin.
- c. After removing the slag basin, the CJ Crucible may be gently removed from the weld using the CJ Crucible Fork. The crucible will be lifted straight up and leveled. Pause momentarily to ensure that all molten material has drained into the mold. Carry the crucible level and set it down level in the “waste disposal” area.

CAUTION: Hot metal or slag coming in contact with moisture can cause an explosion.

- d. Six (6) minutes after the finish of the pour, score the mold on both sides 1 ½” above railhead. Hold a shovel against the score mark on one side of mold and carefully push the head of the mold from the opposite side until mold is partially broken. A demolding tool may also be used if available. If molten metal leaks out, return the mold to its original position and wait 15 to 30 seconds. Repeat until no leakage occurs. Then push the mold head onto the shovel or remove with the demolder.
- e. While the weld is still at red heat, use the power shears to remove the excess metal from the sides and top of the railhead. The power shears must be a type of “Safety Shear”, one

having a metal shroud completely covering all the hydraulic hoses which will prevent accidental damage to the hydraulic lines from hot material or from being struck by any tool. The safety shear shroud also helps prevent a “flare up” if a hose or fitting should fail during the shearing process. Shears with exposed flexible hydraulic lines will not be used. Operate the shears at a slow and consistent speed. Careful operation of the shears will decrease the likelihood of “hot tears”. Leave enough of the weld to permit proper grinding. If power shears are not available or in case of a weld shear failure, excess top railhead material may be removed by torch and excess railhead side material may be removed by hot cut chisel.

NOTE: When cutting away the excess metal from the sides of the railhead, the hot cut chisel must be turned at an angle to the perpendicular, and not vertical to the ground.

- f. Base risers may be bent out slightly to make room for rough grinding. The angle between the riser and the rail head should not exceed 45° . Care must be taken during bending to ensure that a hot tear is not created in the top of the base of the rail.
- g. The wedges and weld base plate may be removed after 20 minutes.
- h. After cooling for 20 minutes, the slag basin may be moved to the selected waste area and emptied. Bury the hot debris in a shallow hole, making sure there is no water in the hole. If the ground is wet or covered in snow, let the debris cool before burying. Be careful of underground facilities on the right-of-way, such as signal cables, fiber optic cables, etc.

CAUTION: Do NOT throw debris into water or snow.

- i. The site should be left in a neat and orderly condition. All released track materials will be taken to the local material storage site.

THERMITE WELDING PROCEDURES

2 3/4" Wide Gap Weld using Boutet CJ Crucible (One-shot)

1. GENERAL

Wide Gap Thermite Welds have been approved to be used in the field to replace defective electric flash butt plant welds, oxygen-acetylene plant welds, thermite welds and in-track welder welds. Wide Gap Welds may also be used when changing out a frog that is field welded in track with a frog of the same size, to eliminate installation of additional rails on each leg of the frog.

2. PREPARATION OF RAIL ENDS

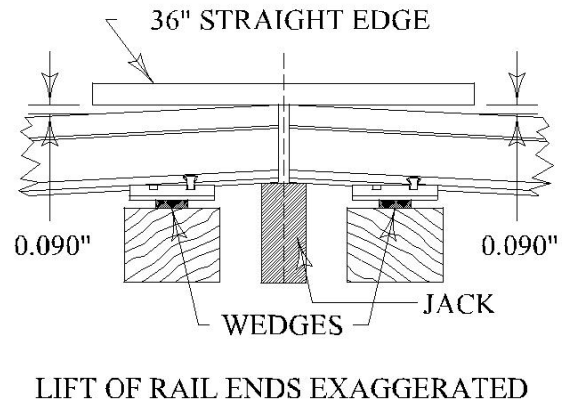
- a. Locate the defective plant/field weld. The area of the defective weld, that contains the defect, will be indicated by a vertical line on the field side head of the rail. Mark the "cut marks" on the rail head, ensuring that the existing weld and the defect area is completely removed. Also place "reference marks" on the field side of the rail head. The "reference marks" will be 24" apart and centered on the "cut marks".
- b. Wide gap welds will not be made on a tie. The weld should be no closer than 4" to the edge of a tie. If tie re-spacing is required, it should be done before the rail is cut.
- c. Prior to saw cutting the rail, ensure that all anchors 40' to either side of the cut are installed and tight. The rail is to be saw cut. The Welder must have a rail saw in operating condition prior to making a weld and it must be used.
- d. Examine the rail ends to see if they have rail end damage (chips, nicks, and surface deformation) or were previously repaired by welding to remove rail end batter. Do not make a field weld to a rail that has rail end damage or was previously welded unless the rail end is cropped to remove all the damaged area or welded-on material. If signal bond wires are present, remove them by grinding.
- e. Flame clean the rails for a distance of 4" to 6" from each end with the preheater and wire brush until area is free of grease, rust, mill scale, paint and other foreign matter.

3. ALIGNMENT OF THE RAILS

- a. There are four parameters to be considered in aligning the rails for welding: horizontal alignment, vertical alignment, twist and gap width. The strongest weld is produced when there is no mismatch in the elevation of the rail bases, the webs are not twisted in relationship to each other, and any rail head mismatch is removed by grinding after the weld is made.

- b. With some worn rails, it may not be possible to have the rail bases at the same elevation without having to perform considerable grinding on the rail heads to obtain a smooth transition between rails. In these instances, a maximum of 1/8" rail base mismatch is permitted. As the amount of rail base mismatch increases, the strength of the weld decreases.
- c. Remove or loosen rail fastening from two or three ties (or whatever is necessary) on each side of the weld location.
- d. To position rail ends to be welded, use:
 - 1. alignment plates if available, or
 - 2. use a mechanical or hydraulic jack under the center of the two rail ends, and lift them slightly. Place the four wedges under each side of the tie plate on both ties to nearly the desired height. Then remove the jack. A few light hits with a dead blow hammer (451.1100250.1) should be all that is required to reach the desired crown and alignment.
- e. **Ensure that the correct gap is obtained.** The correct gap for all rail sections is 2 3/4" with a tolerance of 1/16" (2 3/4" to 2 13/16" permitted). The gap will be measured on both sides of the head and web in the base fillet area to confirm the proper gap has been established. This gap must be maintained throughout the welding process. Use a rail puller when the rail temperature is less than Desired Rail Neutral Temperature.
- f. If the gap between rail ends is too small, the ends may be trimmed with a saw to give the proper gap.
- g. All rails should be eye aligned 40 feet from where the weld is being made.
- h. Then use a 36" steel straightedge at the rail ends. The horizontal alignment along the gage side of the web must be perfect with the straightedge. Check the web from the rail base to the rail head to insure that the two rails are not twisted in relationship to each other.
- i. The vertical alignment must be crowned at the joint. Determine the crown by placing a 36" straightedge on the rail, so that it is centered on the gap. Then measure between the straightedge and the rail at each end. This measurement will be 0.090 (+/- 0.005). See Sketch I-3 below.

- j. When welding top worn rail to new rail, it may be necessary to have the bases of the two rails mismatched. The base mismatch must not exceed 1/8". (If the rail height difference is greater than 1/8", do not use a wide gap weld.) The molds will have to be filed to fit. After the weld is completed, the higher rail will be ground off to match the lower rail. A wide gap weld is not designed to be used in place of a compromise weld. Therefore, use the existing compromise welds where appropriate.



Sketch I-3

- k. If necessary, use gage rods, one on each side of the joint, to hold the alignment. Additional gage rods may be required in curved track. Use of a "Canting Tool" is very helpful in removing twist from the rail.
- l. Secure the rails. When the desired rail gap has been established, tighten or add rail anchors to secure the rail position so that sudden temperature changes or sudden jolts will not disturb the gap opening. The "reference marks" will be checked to ensure that no rail is added to the track. The rails and tie plates on either side of the gap should also be marked so any longitudinal rail movement can be detected during welding. If the temperature is less than Desired Rail Neutral Temperature a hydraulic rail puller must be used to hold the rail from any movement during the solidification of the weld.

4. INSTALLATION OF THE MOLDS

- a. Before installation, check the molds and base briquette for damage. The pouring channels and risers must be clear. Verify that the molds and base briquette are the correct size for the rails being welded. Place each mold in a mold jacket and the base briquette in the base plate. Plan placement of the mold such that the pour side of the mold is in the gage of the track on tangent track or to the low side of a curve on curved track; this will place the slag basin on the same side as the pour.
- b. Test fit the molds to the rail. The molds must be centered over the rail end gap with equal amount of rail exposed in the mold cavity. Vertical mold mismatch should not exceed 1/8". Grind off any rail flow that will prevent the molds from fitting tightly against the rail.
- c. Test the base briquette fit and alignment on the base of rail before applying the refractory paste. Apply a bead of refractory paste (the diameter of a pencil) in the recess on the base briquette. Do not allow any paste in the middle depression of the base briquette.

- d. Install the base plate to the base of rail. Make sure that equal amounts of rail are exposed in the depression of the base briquette. Ensure that the thumb screws are on the field side. Hand tighten the thumbscrews, and then give $\frac{1}{4}$ turn with a wrench. Recheck the crown after installing the base plate.
- e. Place one mold half on the rail. Center it in relation to the gap and the base plate. The pouring spout and mold clamp handle should be on the gage side on tangent track or on the low side of curved track. Put the second mold half in place. Center it in relation to the gap and the base plate. Re-adjust the mold halves, if necessary, to achieve a perfect fit.
- f. Final adjustment and control is achieved by positioning the mold clamp. Be careful not to break the molds by over-tightening the mold clamp. After clamping, cover the mold top with Plexiglas or cardboard before starting luting to keep the inside of the mold clean.

CAUTION: Over-tightening of the base plate or the mold clamp may cause cracking of the base briquette or molds, which could lead to leakage of molten steel and personal injury.

- g. The luting process is designed to form a seal between the rail and the molds to prevent leakage of the molten metal when the mold is filled. Poorly aligned rail and/or molds make this process more difficult and increases the chance of leakage.
- h. Evenly apply by hand the pre-mixed luting sand around the entire profile of the rail, including the bottom of the rail base. After luting the molds, place the slag basin on the mold clamp under the pour spout of the pour mold jacket. Apply a small amount of the luting sand on the lip of the pour spout and place three quarter ($\frac{3}{4}$) inch of dry sand in the slag basin. After luting is completed, check the molds for foreign material, and recover.
- i. Do NOT let packed molds sit idle longer than ten (10) minutes before beginning preheating. In the event that preheating does not commence within this time, the existing molds may be used, but new luting sand must be applied.

CAUTION: If moisture is present under the weld, use a safety pan with dry sand between the ties to catch any leakage. Molten steel and slag can cause serious explosions upon coming into contact with snow, ice, standing water and/or frozen ballast/soil.

5. PREHEATING

- a. The preheating operation has a major influence on the quality of the finished weld. It must remove the residual moisture from the molds and bring the rail ends and the molds to the proper temperature range.
- b. Always check the Oxygen and Propane before beginning each preheat. Ensure that there is enough of each to complete the weld procedure and that the pressures are proper.
- c. Ensure that the preheating burner has been tested as detailed in Thermite Welding, General, paragraph 22.
- d. Set the propane and oxygen regulators to deliver the proper pressures to the burner.
- e. The proper preheating equipment and working pressures are:

Preheating Equipment

Torch Body

Manufacturer	Victor	Hessa	Smith
Model	HD310C	U. S. Thread	WH200

Preheating Burner 22 Orifice

Manufacturer	Victor	Hessa	Smith
Model	TWN-5	SKV-5	VNG-15674

Preheating Operating Pressures at the Torch Handle

Propane:	15 PSI
Oxygen:	60 PSI

Preheating Time

All rail sections: 6 1/2 minutes

Inline Test Gauges must be used when making Wide Gap Welds. Pressures are measured at the burner when using 3/8" inside diameter hoses with reverse flow check valves behind burner body. Burner height is measured from the top of the lower rail if the rail ends are mismatched in height.

- f. Position the preheating burner stand on the rail. Attach the unlit burner and align it so that the burner is centered in the gap between the rail ends. Make certain that it is also aligned in the center across the head and the burner tip is 2 3/8" above the head of the rail. Remove the burner from the stand. Light the burner, replace it on the stand and adjust the flame. On a windless day, the burner flame should rise about 12" to 14" from the outside risers.

- g. Preheating time starts after the flame has been adjusted to a slight crackle and the burner alignment has been “fine-tuned”. A stopwatch is the easiest and most accurate way to measure the preheat time. The proper preheat time is 6 1/2 minutes for all rail sections.
- h. The diverting plug must be dried before placing it in the mold. This is accomplished by placing the diverting plug on the end of the mold next to the riser flame for approximately 1 to 2 minutes. Do not block the flame from the riser hole with the diverter plug.
- i. At the end of preheating time, remove the burner and burner stand. Insert the diverting plug into the mold, making sure it seats properly.

NOTE: The welding charge must be ignited within fifteen (15) seconds after the preheating burner has been removed.

6. CJ CRUCIBLE

- a. The CJ Crucible (One-shot) is made from a refractory compound combined with a resin. The CJ Welding Charge must be used with the CJ Crucible, ie. only use the welding charge shipped in the field welding kit.

CAUTION: Never use a welding charge that has lost material or has a hole in the bag. Never mix two welding charges or add anything to the charge.

- b. Preparing the crucible for use may be done before or during the preheat process. Inspect the crucible for cracks or other damage. Clean out any loose sand. Open and pour the welding charge into the crucible. Place the crucible on cardboard at a dry location near the working area. Get an igniter ready. Place the CJ fork near the crucible. Ensure that the slag basin contains 1” of dry sand.

7. REACTION AND POUR

- a. The welder will clear all individuals from the welding area prior to igniting the welding portion. All track equipment working in the area or vehicular traffic (if adjacent to a road crossing) will be stopped if vibrations can be felt in the rail being welded or roadbed until the weld has been poured and solidified.
- b. As soon as the preheating is complete and the diverting plug is in place, place the crucible on top of the molds. Ensure that crucible is perpendicular and flush with side molds as rise holes are not visible as a reference on wide gap welds.
- c. The welder, using a gloved hand, will insert a lit igniter into the center of the welding charge to a depth of 1”. He will gently place the cover on the crucible, and move to a safe position.

CAUTION: During the reaction and pouring of the weld material, all personnel must

move away from the crucible and remain a minimum of 20 feet (30 feet if snow on track) away while the reaction takes place. Do not return to the weld until you are certain that all molten material is contained.

- d. The tapping time, which is the time from when the igniter is inserted until the time the portion begins to flow, will be timed for each weld. The normal tapping time is from 23 to 28 seconds. If the tapping time is less than 15 seconds or more than 35 seconds, the weld is to be considered defective and immediately removed from track. The CJ Crucible is designed with a by-pass feature. In the event that the molten material does not discharge within the normal tapping time, the bypass will pour into the large riser hole at approximately 90 seconds after ignition.
- e. When the crucible taps, the molten material will flow into the molds and the excess material and slag will flow into the slag basin. After the flow of molten material has stopped, start the solidification time. Do not place dry sand on top of molds and slag basins until six minutes have passed from the pour.

8. REMOVING THE MOLDS

- a. Note that a full face shield, long sleeves and welding gloves are required during the tear down process. This includes shearing of the weld
- b. Following the pour and after 6 minutes have passed, sprinkle dry sand on top of molds and slag basin. Now the CJ Crucible may be gently removed from the weld using the CJ Crucible Fork. The crucible will be lifted straight up and leveled. Pause momentarily to ensure that all molten material has drained into the mold. Carry the crucible level and set it down level in the “waste disposal area”. Remove the slag basin. Carry the slag basin level staying on the level area of the track. Take the slag basin fifteen to twenty feet (eight to ten ties) away from the weld. Place the slag basin on level ballast between the ties. Note that this area must be level and dry. Do not flip over the slag basin at this time; allow time for the slag to cool in the basin.

CAUTION: The “waste disposal location” should be selected before removing the slag basin. It must be dry, and out of the way. **Hot metal or slag coming in contact with moisture can cause an explosion.**

- c. After 10 minutes, remove the mold jackets.
- d. After 10 1/2 minutes, remove the mold top using the Boutet de-molding tool.
- e. After 11 1/2 minutes, use the power shears and shear the weld through the molds. The power shears must be a type of “Safety Shear”, one having a metal shroud completely covering all the hydraulic hoses which will prevent accidental damage to the hydraulic lines from hot material or from being struck by any tool. The safety shear shroud also helps prevent a “flare up” if a hose or fitting should fail during the shearing process. Shears with exposed flexible hydraulic lines will not be used.

- f. Operate the shears at a slow and consistent speed. Careful operation of the shears will decrease the likelihood of “hot tears”.
- g. If the air temperature is below 40° F, or it is windy, raining or snowing, cover the weld with a cooling retarding material immediately after shearing. Remove the cover after the weld cools to 700° F.
- h. Base risers may be bent out slightly to make room for rough grinding. The angle between the riser and the rail head should not exceed 45°. Care must be taken during bending to ensure that a hot tear is not created in the top of the base of the rail.
- i. The wedges and weld base plate may be removed after 20 minutes in tangent track or 30 minutes in curved track.
- j. After cooling for 20 minutes, the slag basin may be moved to the selected waste area and emptied. Bury the hot debris in a shallow hole, making sure there is no water in the hole. If the ground is wet or covered in snow, let the debris cool before burying. Be careful of underground facilities on the right-of-way, such as signal cables, fiber optic cables, pipes, etc.

CAUTION: Do NOT throw debris into water or snow.

9. REPORTING

A welding report on Maximo must be submitted at the completion of each work day, as well as a Track Disturbance Record for any Thermite weld made in the track structure. Be sure to use “WG” as the weld type instead of “BU” so that proper credit will be recorded when making Wide Gap Welds. Also record the thermite weld batch/serial numbers in TIMRS.

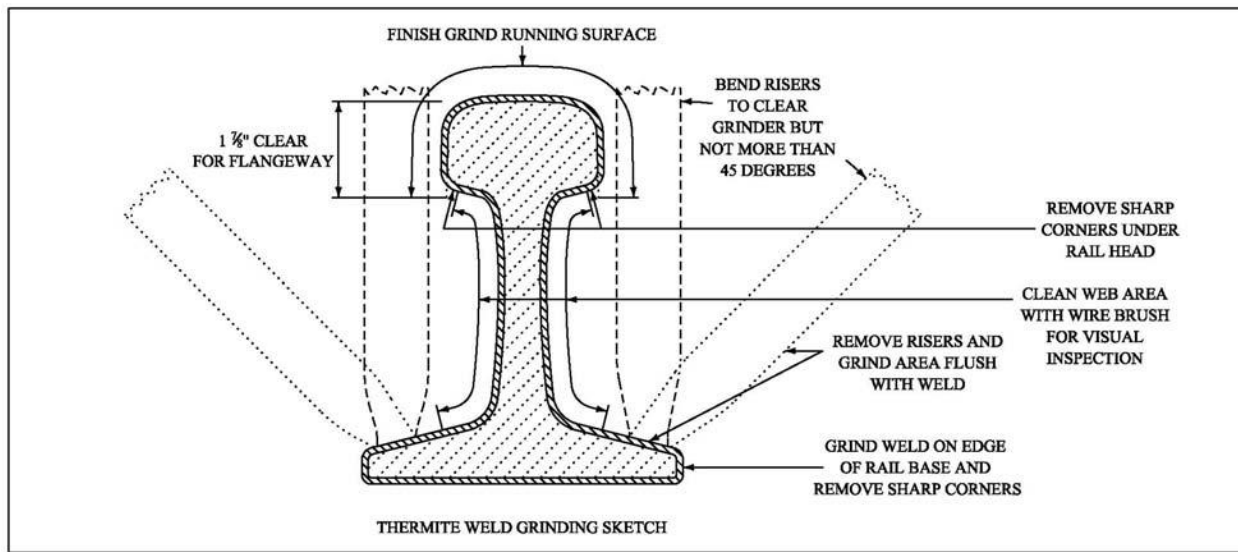
GRINDING OF THERMITE WELDS

1. ROUGH GRINDING THE WELD

- a. Rough grinding can be performed immediately after shearing.
- b. Prior to rough grinding, the base risers may be bent away from the rail head to provide clearance for the grinder. However, to avoid hot tears in the base, the risers should be bent the minimum distance that is required for clearance but not more than 45° from the vertical. The riser removal tool is available for this task.
- c. The rough grinding is finished when the top surface of the railhead is about 0.030" high and the gage side has been ground.

2. FINISH GRINDING THE WELD

- a. All thermite welds must be ground before the heat leaves the weld. Do not re-introduce heat into the sides of the weld where it will be ground. **Do not finish grind the rail head freehand.**
- b. Finish grinding may be performed while the weld is hot. The weld must be left high to compensate for the reduction in crown that will occur during the cooling to ambient temperature. Leave the weld about 0.030" high if finish grinding is done at 800°F, or about 0.015" high if finish grinding is done at 500°F.
- c. If the weld is at ambient temperature, the running surface will be ground within a tolerance of 0.000" low, 0.015" high. Check the final contour of the rail head with the 36" straightedge.
- d. For most welds, finish grinding in the following sequence will require the least handling of the grinding equipment:
 - 1) Sides of the railhead,
 - 2) Edges of the rail base and base riser area,
 - 3) Top of the railhead,
 - 4) Rounding off of sharp corners under the rail head and at the rail base.



Sketch I-4

- e. If the weld was made with a rail head mismatch, the higher rail will be runoff at the minimum rate of:
12" for each 1/16" difference in rail height for speeds of 40 MPH and less, and
18" for each 1/16" difference in rail height for speeds greater than 40 MPH.

If the weld was made with a gage face mismatch, the gage face will be ground to provide a gradual change. Check both surfaces with a 36" straightedge for any undesirable alignment.

- f. Remove the base risers by bending them back toward the rail. After removing the base risers, grind the riser area flush with the top of the weld metal leaving a smooth surface to avoid any notch effect stresses.
- g. The web and base are to be cleaned by hand with a wire brush for inspection.
- h. Grinding below the rail head should be done only where necessary to remove sharp edges and to grind the weld on the outside edges of the rail base.
- i. After finish grinding and wire brushing, a visual inspection must be made on every weld for hairline cracks and other visible defects. Use a 36" straight edge to verify proper crown.
- j. Tamp up the ties on each side of the weld. Re-install any spikes, clips, or anchors removed or missing. On track with concrete ties, replace any clips, tie pads, or insulators.
- k. The weld must have been completed for 20 minutes, ties tamped, the surface and gage side grinding completed, and the weld temperature below 500°F (check with a Templestik or a digital thermometer before allowing a train to pass over.

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J. GRINDING EQUIPMENT

GENERAL

1. When operating power grinding machines and abrasive rail saws, the proper hand, leg, and eye protection must be worn. The operator must not place himself or allow others to be in a hazardous position while the machine is in operation.
2. An approved type of metal foot and shin protection or combination welding leggings must be worn when surface grinding, or when doing free hand grinding with plate mounted or cup wheels. Leather leggings must be worn for all other grinding.
3. All grinders and saws must be provided with suitable guards that must be maintained in the correct position for the protection of the operator.
4. When grinding wheels and abrasive blades are stored, they should be left in the original containers until used, and the oldest wheel received will be used first. Containers should be marked with manufacture date in large numbers so proper stock rotation can take place. The manufacturing date is also shown on wheels. **Wheels and blades that are older than 2 years or more specifically 24 months from the date of manufacture must not be used.**
5. For other than temporary storage, straight wheels should be stored on edge and thin wheels should be laid flat to prevent warping. Plate mounted, cylinder, and cup wheels should be stored on their flat sides with cushioning material, such as corrugated paper, between them.
6. Only enough grinding wheels for two or three days use should be kept in welding team trucks or equipment, and a specific place in the truck or equipment shall be provided for storage.
7. Wheels should be tested occasionally during use for balance, and if found out of balance, destroyed.
8. Grinding wheels and abrasive blades absorb moisture. They should not be exposed to rain, dew, or fog, or placed on damp or wet ground. Moisture will throw the wheel out of balance, causing excessive vibration while operating at high speeds, and may result in the breaking of the wheel, which may lead to injury.
9. Extreme care must be used in the mounting of grinding wheels and abrasive blades. Blotters must be used. Wheels must not be forced on the spindles or be too loose. When tightening spindle nuts, care must be taken to tighten them only enough to hold the grinding wheels firmly. Ends of spindles must be so threaded that the nuts on both ends will tend to tighten as the spindles revolve. Ensure that the same size mounting flanges are used on both sides.
10. Grinding wheels and abrasive blades are to be removed from equipment at the end of each days work and stored in original box in a dry location to protect the wheels and blades from moisture.

OPERATING GRINDING WHEELS AND ABRASIVE BLADES

1. Extreme care must be exercised in the use of grinding wheels and abrasive blades.
2. The operator must know that the spindle speed of his grinder or abrasive saw is not greater than the maximum operating speed shown on the grinding wheel or abrasive blade.
3. Grinding wheels and abrasive blades not plainly marked with the maximum operating speed will not be used. The Chief Engineer and Roadmaster will promptly be notified of receipt of unmarked wheels and blades.
4. Each wheel must be closely inspected before mounting to make sure it has not been damaged in any way.
5. Grinding wheels and abrasive blades have a date of manufacture on the label. **Wheels and blades that are older than 2 years or more specifically 24 months from the date of manufacture must not be used.** Undated wheels and abrasive blades will not be used.
6. The operator will check and record the speed of their grinder or abrasive saw with a tachometer daily or prior to use if not used daily. Enter speed, on daily RPM Form, and retain for 30 days. If necessary, adjustments will be made in the speed of the wheel spindle prior to use. It is mandatory to use a power blower when grinding manganese. If electricity is available, it is recommended to use a power blower for all grinding operations.
7. Roadway Mechanics are authorized to make adjustments in the speed of the wheel spindle with the Welder present. The Welder's tachometer will be checked at this time by comparing readings with the Mechanic's tachometer, and if found to vary by more than 5%, will be reported to the Roadmaster for adjustment or replacement.
8. Slotting of frogs may be accomplished by use of straight grinders, or electric grinders. Rail end slotting should be accomplished by use of an electric grinder, or slotting attachment.

TACHOMETERS

1. The present tachometer for Engineering Department use is a four digit non-contact optical model. Previously approved mechanical tachometers may be used until they require replacement.
2. The method of operation of an optical tachometer may vary among manufacturers but is typically as follows:
 - a. The piece of equipment that is to have its rotational speed checked must be stopped and a piece of adhesive backed reflective tape is stuck to the spindle.

- b. The equipment is started and brought up to a stable operating speed.
 - c. The tachometer is aimed at the reflective tape. Some models have aiming bars or other aids for aligning the tachometer with the tape.
 - d. The power button is pressed and a light parallel to the aiming bars comes from the tachometer as a visual aid in positioning the tachometer on the reflective tape while the reading is taken.
 - e. The power button is held on until the reading stabilizes. The speed recording is obtained and recorded. This step is repeated three or four times and compared to the speeds obtained from each reading.
 - f. The speeds obtained should be the same for each reading if the equipment is running at a constant speed, but a variation of a few RPM between readings is not unusual.
 - g. The speed obtained must be less than that permitted by CFRC rules or the speed shown on the grinding wheel, grinding disk, or abrasive blade, whichever speed is slower.
 - h. Most optical tachometers can be calibrated by aiming at a single tube fluorescent light and comparing the reading obtained with the reading given in the operating instructions of the tachometer.
3. Grinding on the flat sides of straight wheels is hazardous, and must be avoided.
 4. If a grinding wheel or abrasive blade should break during operation, notify the Roadmaster. An inspection must be made to ensure that the hood, flanges, and nuts have not been damaged and that the spindle has not been bent or sprung out of balance. Also, the speed of the machine must be checked. Wheel fragments, mounting plates, and label should be collected in the event the manufacturer desires to perform laboratory tests.
 5. Unless grinding equipment is permanently attached to a vehicle, the equipment must be removed from the vehicle before starting to grind.
 6. Grinding wheels and abrasive blades must be stopped when a grinding machine is being moved. Care must be taken when moving a grinder so that the wheel does not strike anything that may crack it.
 7. Operators must periodically inspect grinding machines and saws that are in use and report to their supervisory officer anything unusual in the operation of the saws or grinders such as peculiar noises, apparent increase in engine or spindle speed, vibration, wheels out of balance or badly worn, etc.

IN-TRACK ELECTRIC FLASH BUTT WELD GRINDING

1. Grinding precautions that are required for thermite welding are also applicable for in-track electric flash butt welding.
2. Due to limited space created by the machinery when rail puller is in place, grinding with a hand held disc grinder to prep the rail is not permitted.

K MISCELLANEOUS WELDING

MANGANESE COMPONENTS

1. Other manganese components, such as, manganese switch point tips and switch point guards, can be repaired in the field only when qualified to do so by O&M management. Use the electric-arc method and the techniques described in the “Repair of Frogs and Railroad Crossings” section.

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L AIR ARC METAL REMOVAL

GENERAL

1. The exact air quantity and pressure requirements vary with the specific torch used. In general, the compressed air required will vary from 80 to 100 PSI and 26 to 33 CFM for torches.
2. The amperage needed depends upon the electrode diameter. Best results are usually obtained when maximum amperage is used. The recommended current is:

Electrode Size :	3/16"	1/4" and greater
Recommended Amp.	300	400

3. Carbon, stainless, and manganese steels should be cut and gouged with the electrode on DC reverse polarity.
4. The initial rod position should be about 6" out from the holder and the length adjusted as required.
5. The Signal Maintainer will be notified in advance whenever welding is to be performed in track circuit territory.
6. See *Section "A", Safety*, for instructions for electric arc welding in track circuit territory.

PROCEDURE

1. The welding machine should be set at the desired amperage.
2. The air should be on before starting to cut or gouge. The air should also be used to cool the cut.
3. The torch should be held so that the electrode slopes back from the direction of travel with the air blast below the electrode.
4. An electrode angle of approximately 45° is recommended.
5. The initial rod position should be about 6" out from the holder and the length adjusted as required by the work.
6. If the air blast is above (in front of) the electrode, the metal will not be properly removed and the cut surface will be covered with oxide (dull appearance).
7. Use only a straightforward motion.

8. The depth and contour of the groove is controlled by the electrode angle and travel speed. For a narrow and deep groove, the electrode should be held at a steep angle and used at a slow travel speed. For a shallow groove, the electrode should be held at a flat angle and used at a fast travel speed.
9. The width of the groove is controlled by the size of the electrode. Generally the groove will be approximately 1/8" wider than the electrode diameter.
10. The travel speed should be uniform. The proper speed will produce a good, clean cut without appreciable oxide.
11. During gouging, a short arc must be maintained by progressing in the direction of the cut, fast enough to keep up with the metal removal.
12. Low amperage and/or a bad ground will result in a sputtering arc and intermittent, skimpy cuts.
13. Irregular gouging action is a result of too slow a travel speed.
14. If the electrode is the wrong polarity, it will heat up rapidly and the arc will sputter.
15. If any slag is adhering to the edges of the cut, the air pressure is too low.
16. The cut surface should be ground to remove all traces of oxide, slag, and any other irregularities. The finished cut surface should be clean and smooth.

OPERATION OF SLICE TORCH

CAUTION: Don't use constant voltage power supplies. They may damage the torch. Only the slice torch is made for continuous cutting with power. Don't use the battery model torch or striker with a welding power supply. Electrical cables are smaller gauge, will overheat, and can possibly catch fire. The amperage setting on the welding machine should be set to around 195 to 200 amps.

WARNING: When cutting with power, be sure to use a welding helmet that has a number 10 or greater welding lens. The arc will damage the eyes and burn the skin if proper safety equipment is not used.

1. Ignition when using power and grounded work piece.

WARNING: If any part of the cutting rod touches a grounded surface, the rod can ignite and the rest of the cutting rod may blow off. The rod will continue to burn as long as oxygen is supplied. If grounding occurs, release the oxygen lever immediately and remove the cutting rod from the work. The cutting rod is electrically “hot”. Do not touch it unless the power is off. Electrical shock can injure. Know where the cut pieces may fall. Both sides of a cut should be adequately supported. When they can’t be, clear the area where the cut pieces will fall. Do not aim the cutting rod at any hot surface when applying oxygen flow. This cutting rod should never be ignited on anything but the grounded work piece.

2. Procedure:

- a) Starting Oxygen Flow: - Start oxygen flow by squeezing oxygen lever in the torch handle. Be sure the hand is covered by the shield on the torch.

NOTE: Oxygen pressure should be between 80 and 90 psi. The oxygen line must have a combination backflash arrestor/ reverse flow check valve on the regulator and a reverse flow check valve on the end that the slice torch line connects to. The apparatus will be checked for leaks the same as an oxy-propane outfit would be.

- b) Starting The Arc: - Touch the cutting rod to the grounded work piece. The resulting arc will ignite the cutting rod.
- c) Stopping the cutting rod: - Release the oxygen lever while removing the rod from the grounded work piece. The rod will continue to burn as long as oxygen is supplied and will continue to arc while touching the grounded work piece.
- d) Cutting Rod Fails To Ignite or Goes Out: - If the cutting rod doesn’t ignite or if it goes out while in use, move the torch away from the work piece. Do not touch the hot tip of the cutting rod! Check to be sure the rod is getting enough oxygen. Try igniting the rod again. If the rod still doesn’t ignite or if the rod continues to go out, check the oxygen flow, and also check to make sure the rod is not clogged nor have a hole in it.

3. Cutting Technique:

- a) Once the rod is burning, use the following technique: - Normal cutting is done by using a drag technique. Once the rod is in contact with the piece to be cut, drag the rod in the direction of the cut. If the operator can’t see the kerf, the speed of cut is too fast. If the rod is being used too rapidly, the progress of the cut is too slow and the rod is being used without cutting. Remember, the cutting rods consume as long as the oxygen is flowing.

Maintain the proper travel speed at all times.

NOTE: Use a sawing motion when material to be cut is thicker than 1 ½ to 2 inches to ensure a complete melt through.

- b) Use a smooth motion to complete the cut. Be careful not to hit nearby material with the rod when cutting in “close quarters”. After completing the cut, release the oxygen control lever in the handle. Hold the rod away from your body until it cools. Once use of the slice torch is completed, shut down power supply, close the oxygen valve off at the cylinder and purge as with a regular torch outfit. Place rods, and slice torch in the storage area.
- c) The slice torch is to be used only on removal of defective material in manganese components such as frogs, etc. Do NOT exceed 500°F. It will not be used to remove material from switch points, or rail ends. After the material has been removed with the slice torch, the grinder should be used to clean all torched surfaces. Areas unable to be ground will be cleaned with a chipping hammer or chisel, and a wire brush.

M. IN TRACK ELECTRIC FLASH BUTT WELDING

GENERAL

1. Rail Preparation Requirements

- a. All rails used for electric flash butt welds will have the scale removed down to bright metal 27" from each end of the rails where the welding current carrying electrodes contact the rail. Also, any raised mill marking in the web of the rail will be ground smooth.
- b. Rail ends will be clean of all foreign matter.
- c. Rail will be cut by using a rail saw. A weld may also be cut out by using an oxy-propane torch, but only if the new weld is made within 30 minutes of cutting. Torch cut rails, with cuts older than 30 minutes, will have the torch cuts removed by trimming 6 inches from each end with a rail saw before welding.
- d. Electric flash butt welds should not be located on a tie. If the weld location falls on a tie, reposition the tie off the weld.
- e. Electric flash butt welds will be marked on the field side web of the rail near the weld with an identifying marking. This marking will include the following information
 - 1) The vender or CFRC equipment making the weld.
 - 2) Holland Co.= HW
 - 3) CFRC Plasser = PW
 - 4) CFRC Truck = TW
 - 5) The equipment number of the machine/truck making the weld.
 - 6) Was this a closure weld?
 - a. If it was, insert a "C" before the sequence number.
 - b. If not, leave blank.
 - 7) The weld sequence number.
 - 8) The date the weld was made.

A sample marking for a closure weld made by the Holland Co., using their truck #406 follows:

HW 406 C 1234 1/18/06

2. Parameters For Continuous Welded Rail

- a. Preheating of rail ends for the welding cycle will be done by pulsed flashing.
- b. When using a continuous flash welder, no interruption of platen travel or flashing current within 1/2 inch of final flashing is allowed with a minimum of 5/8" upset required.

- c. Upset Current: Must be a minimum of one second in duration.
- d. Upset Blow: Upset to refusal within 5/8" is normal. Minimum upset required is 1/2". When using puller, holding pressure until the weld has cooled to 700°F or less (approximately seven (7) minutes after upset) is mandatory for closure welds. No clamp slippage is allowed.
- e. Weld Rejection: Welds rejected will be cut down through the middle of the weld with a rail saw or, if torch cut, re-weld within 30 minutes.

3. Welding Machine Setup

The following procedure is to be used in the preparation of the welding machine for welding a specific rail section.

- a. Upsetting pressure will be adjusted to the proper setting for the rail section and metallurgy being welded.
- b. Flashing time will be lengthened or shortened until the required 5/8 inch upset is achieved.

4. Upsetting Pressure for any Rail Section

The minimum upset pressure is 40 metric tons or 44.1 US tons.

5. Chart Recorder

A chart recorder approved by CFRC is to be used to monitor welding current, platen displacement and hydraulic pressure.

6. Weld Finishing Requirements

- a. All notches resulting from offsetting and shearing operations will be eliminated by grinding.
- b. A finishing deviation of 0.015" will not be exceeded on the rail running surface.
- c. A finishing deviation of 0.010" will not be exceeded on the gage and field sides of the rail head.
- d. The web zone (underside of rail head, web, and top of base) will be finished to within 1/8" of parent metal but not deeper than parent section. Care must be exercised to insure that finished grinding on the underside of the rail head and head to web fillets

removes all sharp notches and leaves a smooth transition zone.

7. Weld Inspection

- a. The electrode contact area will be visually inspected for electrode burns. Electrode burns may appear as small deposits of copper electrode on the rail or there may be evidence of metal flow of the parent rail steel.
- b. After finished grinding, a visual inspection is required.
- c. When the external stripper or shear is used for removing the upset, the clamp area in the web will be inspected on every weld for gouges or slippage. Any excessive gouge in the parent metal will be rejected.
- d. Any weld not meeting the specified tolerances and tests will be cut out and re-welded.

8. Weld Tolerance Measurement

- a. Tools: A 36" straightedge and a taper gauge will be used to take measurements from the finished weld.
- b. Procedure: Center the 36" straightedge over the weld against the high side. Gently slip the taper gauge under the extreme end of the straightedge lengthwise, reading the amount of variation from the taper gauge for offset and crown camber measurements.
- c. The following tolerances were developed, assuming that like class rail is being welded; i.e. New to New, Class 1 to Class 1, etc.

9. Weld Tolerance Offset Limits for New, Class 1, 2 and 3 Relay Rail.

a. Rail Height Mismatch:

Maximum Height Differential 0.250"

b. Rail Head:

Vertical offset:	0.125"
Gage side horizontal offset:	0.050"
Horizontal kink:	0.025"

c. Rail Base:

Vertical offset:	0.125"
Horizontal offset:	0.100"

10. Surface Misalignment after Grinding:

Combined offset and crown camber: 0.015”
Combined offset and dip camber: 0.000”

11. Gage Misalignment after Grinding:

Combined offset and kink: 0.020”

REPAIR WELDING PROCEDURE

This procedure is designed to produce a quality rail weld and adjust the rail at the same time. It is based on 1 ½” rail consumption per weld. In this procedure the following terms have been adopted to avoid confusion:

- Defect Plug - The piece of rail to be removed from the track. The normal length of a defect plug is 19’-0”. This length has been selected to balance the physical characteristics of the various In-Track Welding Equipment and track surface and alignment requirements. When using CFRC Plasser In-track welder, minimum plug length must be 27 ft.
- Replacement Plug - The piece of rail to be installed into the track. The normal replacement plug length is 19’-1-1/2” This length is determined by adding 1-1/2” to the length of the defect plug.
- Current Rail Temperature - The rail temperature measured at the work site.
- Adjusted Rail Temperature - The desired rail laying temperature. It is location dependent and is specified in MWI 1125.
- Temperature Measuring Device - The In-Track Welding Team is normally equipped with a Fluke Digital Model 51 thermometer with a model 80PK-7, Industrial Surface Probe. It read instantly and temperature measurements can be made quickly.
- Match Marks - Marks precisely measured and placed on tie plate and base of the existing rail that will remain in track after the defect plug is removed. They are normally 25’ apart and are used for quality control purposes in this procedure.
- Plug Weld - The first weld made with the replacement plug, both ends are free.
- Closure Weld - The second weld made with the replacement plug, one end free. This weld restores the track’s integrity.

- Closure Weld Release Temperature - The maximum temperature (700^o F) at which the puller can be released without damaging a closure weld.
1. Mark the cut marks for the length of the Defect Plug on the top of the existing rail. The marks should be approximately centered in cribs to expedite the welding process. The normal length of a defect plug is 19'-0".
 2. Make Match Marks on the top of the existing rail exactly 25' apart. The witness marks should be approximately centered around the defect plug cut marks. Enter the measurement on the *Record of In-Track Welding* form.
 3. Measure the Current Rail Temperature with the digital thermometer. Enter the measurement on the *Record of In-Track Welding* form.
 4. Identify the proper Adjusted Rail Temperature from MWI 1125. Enter the temperature on the *Record of In-Track Welding* form.
 5. Determine the Temperature Difference by subtracting the from the Adjusted Rail Temperature and enter on the *Record of In-Track Welding* form.
 6. Find the value in Temperature Difference column of the *Repair Welding - Table 1* (column A). Read the Free Rail Length (in feet) from column B, the 10^o F Variation from column C, and the Nominal Closure Force from the proper column (column D-I) of *Repair Welding - Table 1*. Enter the values on the *Record of In-Track Welding* form.
 7. Remove rail anchors and loosen any tight spikes for the Free Rail Length determined above. Ideally the Defect Plug should be in the center of the freed rail. However when installing plugs near fixed objects, such as bridges, turnouts, road crossings, railroad crossings, etc., the length of freed rail can be moved to location that encompasses the Defect Plug. If possible, there should be at least 234' between the fixed object and the beginning of the freed rail.
 8. The length of free rail must be examined for anything that would cause the rail to bind or restrict the movement of the rail in the direction of the weld. The weld process cannot be initiated until the closest point between the possible obstruction and the adjacent tie/tie plate in the direction of the pull is 2" or greater. Reposition ties as necessary.
 9. Polish the webs of the existing rails for electrical contact. Polish both sides of the webs for a distance of 27" from the weld location. Remove any branding in this area.
 10. At the completion of the initial saw cut a gap of 1 1/2" should open in the rail.
 11. If a gap of at least 1 1/2" did not open, the free rail should be vibrated to break the friction bond between the rail and the tie plates.

12. The Team Supervisor evaluate the following conditions and determine the proper course of action:
 - a) A 1 ½” gap was obtained, continue with step #13.
 - b) A gap less than 1 ½” was obtained, go to step # 24.
 - c) A gap more than 1 ½” was obtained, go to step # 25.
13. Make the second cut to free the Defect Plug.
14. The preparation team moves to next location and the welding team moves into place. The In-Track Welder moves over the Defect Plug, beyond both weld locations.
15. The existing rail at the closure weld location is barred out of the tie plates to the field side. The Defect Plug is removed.
16. Place the Replacement Plug in the rail seats of the tie plates. Re-spike the center portion of the Replacement Plug to aid in weld alignment.
17. Align the rail ends nearest the In-Track Welder and complete the Plug Weld. During the upsetting of this weld the rail ends at the Closure Weld location will pass each other. Return the existing rail to the tie plate seats.
18. While the Plug Weld is cooling to the required Closure Weld Release Temperature, profile grind the Plug Weld, place and clamp the puller at the Closure Weld location.
19. After the Plug Weld has cooled below the Closure Weld Release Temperature, pull closed any gap. Release the puller and measure the gap. Pull the gap closed and read the puller force. Enter the reading on the *Record of In-Track Welding* form.
20. Check puller force required to close the gap, determine in step #19 above, against the *Rail Gap vs Puller Force Limitation* chart for the puller you are using. Using this chart, determine if the puller has adequate capacity to complete the weld. Enter the OK/No on the *Record of In-Track Welding* form. If no, the closure weld can not be made.
21. Align the rail ends and complete the Closure Weld. At the completion of the Closure Weld, record the puller force on the *Record of In-Track Welding* form.
22. While the weld is cooling to the Closure Weld Release Temperature, re-spike and re-anchor the track. Begin at the Replacement Plug location and work away from it.
23. After the weld has cooled below the Closure Weld Release Temperature, release the puller, move the In-Track Welder to next location and profile grind the weld. Go to step #26.

24. If the gap is **less than 1 ½"**, then the temperature difference and the free rail length are not correct.
- a) Re-measure the Current Rail Temperature and compare to the initial Current Rail Temperature measurement. If the Current Rail Temperature has increased, go to step #5.
 - b) If the Current Rail Temperature has not changed, then the Adjusted Rail Temperature has fallen below the requirement. If the Current Rail Temperature has decreased, then the temperature difference is not correct. In either case additional rail will need to be removed from the track. Relocate the remaining Defect Plug cut mark on the existing rail to a point that will provide 1 ½" overlap between the existing rail and the Replacement Plug. Go to step #13.
25. If the gap is **greater than 1 ½"**, then the temperature difference and the free rail length are not correct.
- a) Re-measure the Current Rail Temperature and compare to the initial Current Rail Temperature measurement. If the Current Rail Temperature has decreased, go to step #13.
 - b) If the Current Rail Temperature has not changed, then the Adjusted Rail Temperature has risen above the requirement. If the Current Rail Temperature has increased, then the temperature difference is not correct. In either case additional rail will need to be added to the track. Relocate the remaining Defect Plug cut mark on the existing rail to a point that will provide 1 ½" overlap between the existing rail and the Replacement Plug. Go to step #13.
26. Measure the distance between the Match Marks. Record the final distance between the Witness Marks on the *Record of In-Track Welding* form. Determine the amount of rail added/removed during the welding process.
27. Compare the puller tonnage recorded in step #21 with the Nominal Closure Force. If the puller force exceeds the Nominal Closure Force by more than 15 tons, it is likely that something prevented free movement of the rail in the direction of the weld. Walk the free rail and look for evidence of longitudinal restraint (bunched ballast, skewed ties, humped etc.) in the track. Repair as necessary.
28. Compare the final and original Match Mark measurements. The difference should be less than the 10° F Variation to ensure that the Actual Adjusted Rail Temperature is within 10° F of the Desired Adjusted Rail Temperature. If it is not, complete a *Track Disturbance Report*.

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N. APPROVED WELDING ELECTRODES AND WIRES

FOR USE WITH MANGANESE FROGS.

<i>Name</i>	<i>Size</i>	<i>Polarity</i>	<i>Description</i>	<i>Use</i>
Lincoln Frogmang	3/16" Electrode	<i>DCRP</i>	Coated 22% manganese alloy.	Build-up and repair of manganese components in frogs and crossings.
ED026101 60 Pounds Lincoln Frogmang	1/16" Wire	<i>DCRP</i>	Flux core, self shielded 25% manganese alloy.	Build-up and repair of manganese components in frogs and crossings.
ED026106 25 Pounds Lincoln Frogmang	5/64" Wire	<i>DCRP</i>	Flux core, self shielded 25% manganese alloy.	Build-up and repair of manganese components in frogs and crossings.
ED026105 25 Pounds Inweld Frog-Spec	5/32" 3/16" Electrode	<i>DCRP</i>	Coated CR NI MG alloy. Deposit hardness 200 BHN. Work hardens to 470 BHN.	Build-up and repair of manganese components in frogs and crossings.
60 Pounds	5/64" 1/16" Wire			Peened as deposited except first and last pass.
TrackWeld 912	5/32"	<i>DCRP</i>	Coated High Strength joining electrode. As deposited 160 BHN.	Repairing flangeway cracks and defects in manganese frogs and crossings, and starter pads for manganese
TrackWeld 912 Matweld 900	3/16" Electrode	<i>DCRP</i>	Work hardens to 450 BHN.	build-up. Keep 3/8" below running surface.
TrackWeld 570W	1/16" 5/64" Wire	<i>DCRP</i>	Flux core, self shielded Austenitic Manganese 11% to 14% - As deposited 220 BHN. Work Hardens to 530 BHN.	Build-up and repair of manganese components in frogs and crossings. Peened as deposited except first and last pass.

For use with
 Rails

<i>Name</i>	<i>Size</i>	<i>Polarity</i>	<i>Description</i>	<i>Use</i>
Trackweld 540 40 Pounds	3/16" Electrode	DCRP	Coated Carbon Steel Alloy. Deposit hardness 208 BHN Work hardens to 390 BHN	Build-up and repair of carbon steel components; rail ends, switch points engine burns, and rail, bolted frogs and crossings Use approximately 180 amps..
Trackweld 540W 30 Pounds	1/16" 5/64"Wire	DCRP	Coated Carbon Steel Alloy. Deposit hardness 208 BHN Work hardens to 390 BHN	Build-up and repair of carbon steel components; rail ends, switch points engine burns, and rail, bolted frogs and crossings
540W - 10 lbs. 540W – 10 lbs.	1/16"Wire 5/64" Wire			Use approximately 28 Vo
Frogalloy/M1 22 10 pounds	1/8" 3/16" Electrode	DCRP	Coated Carbon Steel Alloy. Deposit hardness 208 BHN Work hardens to 390 BHN	Build-up and repair of carbon steel components; rail ends, switch points engine burns, and rail, bolted frogs and crossings Use approximately 180 amps
McKay M-932	1/8" 5/32" 3/16" Rod	DCRP	Hardalloy	Build-up and repair of carbon steel components; rail ends, switch points engine burns, and rail, bolted frogs and crossings
Inweld Railspec-O	1/16" 5/64" Wire	DCRP	Carbon Steel Alloy	Build-up and repair of carbon steel components; rail ends, switch points engine burns, and rail, bolted frogs and crossings Use approximately 28 Vo
Inweld Railspec	1/8" 5/32" 3/16" 1/4" Rod	DCRP		Use 1/4" only with machines capable of 300+ amps

Other Rods.

<i>Name</i>	<i>Size</i>	<i>Polarity</i>	<i>Description</i>	<i>Use</i>
Slice Torch	1/4" x 22" 1/4" x 44"	<i>DCRP</i>	Tubular metal rod	For removal of defective material from manganese components
Arc Air Pack of 50 rods	5/32" x 12" 3/16" x 12" 1/4" x 12" 5/16" x 12" 3/8" x 12" 3/8" x 5/32" X12" 5/8" x 3/16" x 12" 3/8" x 12"	<i>DCRP</i>	Copper coated carbon arc	For removal of defective material by gouging.
AWS 7018 10 lb packs	1/8" 5/32" 3/16" 3/32" 1/4"x18" Electrode	<i>DCRP</i>	Electrode made to AWS E7018E specifications.	Welding structural steel, repairing roadway machines, frames, etc.

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O. WELDING SUPPLIES

Item Number	Description
	ELECTRIC WELDING MATERIALS AND EQUIPMENT
	Cable, welding, number 2/0 AWG, 375 amp, 600 volt, neoprene jacket, Mylar separator.
	Cable, welding, number 3/0 AWG, 450 amp, 600 volt, neoprene jacket, Mylar separator.
	Connector, cable, male. Tweeco 4MPC-1 for 3/0 - 4/0 cable
	Connector, cable, female. Tweeco 4MBP-2 for 3/0 - 4/0 cable
	Connector, cable, ball point with neoprene cover, TWECO 9405-1100, model 1-MPB.
	Clamp, welding, ground, TWECO model TW GC-500.
	Ground Clamp - Magnetic - 600 Amp.
	Holder, Electrode, 400 Amp, 1/4" capacity, Tweco Model A-14HD.
	Holder, Electrode, 500 Amp, 3/8" capacity, Tweco Model A-38HD.
	Block, carbon, box of 4. Use in flangeway to repair frog.
	Brush, wire, metal cleaning, 1" X 13-3/4" curved hardwood handle.
	Gauge, flangeway check, frog and railroad crossing, AREMA Plan 790-55
	Gauge - Frog - use to check POINT of CONFORMAL Heavy Point. Drawing APD 1697
	Gauge - Frog - Use on repair of Conformal Heavy Point Frog. Set of 3 gauges - IRS728
	Gauge - Frog - Use on repair of Boltless Conformal Heavy Point Frog. Set of 2 gauges
	Grinder - W/Guard, 9" - 3 HP - 5000 RPM - 115 V. - 5/8"X11 Spindle.Dewalt
	Grinder - W/Guard, 4-1/2" 8500 RPM - 115 V. - 5/8"X11 Spindle. Dewalt
	Needle Scaler Model 182LNA1 - Ingersol Rand - Requires Comp. Air 100 psi.
	Needles for Scaler - U/M = Set - 19 needles per set
	Helmet - Welding - Lincoln Electric Viking
	Filter - Auto Darkening - Replacement for Lincoln Electric Viking Helmet
	Lens - Cover External - for Lincoln Electric Viking Weld Helmet - Min. Order = 5
	Lens - Cover INTERNAL - for Lincoln Electric Viking Weld Helmet - Min. Order = 5
	Lens - Magnification X 1.25 - for Lincoln Electric Viking Weld Helmet
	Lens - Magnification X 1.50 - for Lincoln Electric Viking Weld Helmet
	Liner - Sweatband - for Lincoln Electric Viking Weld Helmet
	Helmet - Welding - Jackson Truesight - Digital Auto Darkening
	Filter - Auto Darkening - Replacement for Jackson Truesight Helmet.
	Lens - Cover External - for Jackson Truesight Weld Helmet - Min. Order = 10
	Lens - Cover INTERNAL - for Jackson Truesight Weld Helmet - Min. Order = 10
	Speedglas Welding Helmet - complete.
	Replacement batteries for Speedglas welding helmet.
	Speedglas Kit, inner & outer clear shield and batteries.
	Protection plate - inside - clear - for Speedglas Welding Helmet.
	Protection plate - outside - clear - for Speedglas Welding Helmet.
	Copper Plate - 24"L X 2"W X 1/4"T - For Welding Switch Points.
	Copper Plate - 24"L X 2"W X 1/8"T - For Welding Switch Points.
	Hammer - Ball Pein - 32 oz. Grade B Steel W/Fiberglass Handle.
	Hammer - Dead Blow - Vaughn -W / Replaceable Striking Surfaces.

Item Number	Description
	Replaceable Striking Surfaces for Vaughn Dead Blow Hammer - White Need 2 ea.
	Hammer - Slag - Wooden Handle - Vaughn.
	Hammer - Chipping - Vaughn
	Wire Feeder - Lincoln - LN-25 PRO. - Does NOT include Mig Gun.
	Mig Gun - Lincoln - K-126-12 - Fits LN-25 and LN-25 PRO Feeders.
	Liner, Replacement - Mig Gun - Lincoln - K-126-12
	Seat - Track Welders W/3 Adj. legs and back support. Eidos Track Master Model 110
	Seat - Track Welders W/Three way air splitter - fold down back rest. Model BRET17
	Shield - Heat - Fits Lincoln K-126 Mig. Gun.
	Gun Tube (Goose Neck) - Lincoln - 62 degree - Fits K-126 Mig Gun.
	Insulator - Contact Tip - Lincoln - Fits K-126 Mig Gun.
	Contact Tip - Lincoln - 1/16th dia. Fits K-126 Mig Gun.
	Contact Tip - Lincoln - 5/64th dia. Fits K-126 Mig Gun.
	Drive Roller Kit - Lincoln - 1/16th dia. - Fits LN-25 Feeder.
	Drive Roller Kit - Lincoln - 5/64th dia. - Fits LN-25 Feeder.
	Drive Roller Kit - Lincoln - 1/16th dia. - Fits LN-25 PRO Feeder.
	Drive Roller Kit - Lincoln - 5/64th dia. - Fits LN-25 PRO Feeder.
	Wire - Grounding - Lincoln - Connects K-126 Mig Gun to LN-25 Wire Feeder.
	Pliers - Mig Welding - Welper 8 in 1 Pliers.
	Blower, Utility, Portable 12" Electric - Outdoor Rated 120V. Global Ind. Sourced to IRS. Mandatory use when Welding or Grinding of Manganese.
	WELDING PPE
	Glasses - Cutting - Shade 5 (Clear face shield must be worn also)
	Gloves, welding, leather with aluminized back.
	Gloves, welding, leather. Size Small.
	Gloves, welding, leather. Size Medium.
	Gloves, welding, leather. Size Large.
	Gloves, welding, leather. Size X-Large.
	Jacket, Welding 30" length SMALL - Orange Flame Retardant - W/Reflective Stripes.
	Jacket, Welding 30" length MEDIUM - Orange Flame Retardant - W/Reflective Stripes.
	Jacket, Welding 30" length LARGE - Orange Flame Retardant - W/Reflective Stripes.
	Jacket, Welding 30" length X- LARGE - Orange Flame Retardant - W/Reflective Stripes.
	Jacket, Welding 30" length 2X- LARGE - Orange Flame Retardant - W/Reflective Stripes.
	Jacket, Welding 30" length 3X- LARGE - Orange Flame Retardant - W/Reflective Stripes.
	Jacket, Welding 30" length 4X- LARGE - Orange Flame Retardant - W/Reflective Stripes.
	Jacket, Welding 30" length 5X- LARGE - Orange Flame Retardant - W/Reflective Stripes.
	Leggings - New Combination Leather and Metal - full wrap around Velcro Flap.
	CUTTING TORCH EQUIPMENT
	Torch, Arc-Air Electric - Model H-3 with 7 ft. Swivel Cable. Carbon Arc Gouging.
	Torch, SLICE - Metal Removal.

Item Number	Description
	Long Torch, Cutting, 36 inches long - Airco - 822-9555, 75 deg. Head.
	Torch, Cutting, 1 Pc.- 75 deg. Head - Airco 822-9515 - 21" 2 finger trigger - mid torch body.
	Tip, Cutting, Propane - Size # 3 - Airco Type 229.
	Tip, Cutting, Propane - Size # 4 - Airco Type 229.
	Tip, Cutting, Propane - Size # 5 - Airco Type 229.
	Tip, Cutting, Propane - Size # 6 - Airco Type 229.
	Tip, Cutting, Propane - Size # 7 - Airco Type 229.
	Torch, Cutting Attachment, Victor - CA-2460, 90 deg. Head.
	Torch, Cutting Attachment, Victor - CA-2461, 75 deg. Head.
	Tip, Cutting, Propane - Size # 3 HPN - Victor # 033-0325.
	Tip, Cutting, Propane - Size # 4 HPN - Victor # 033-0326.
	Tip, Cutting, Propane - Size # 5 HPN - Victor # 033-0327.
	Torch, Handle, Victor - HD 310C Note: Has Rev. Flow Check Valves Built-in. D0 NOT ADD.
	Preheating Head, Victor - Flathead - TWINB-5 (for preheating field welds)
	Torch, Cutting Attachment - SMITH 90 Degree Head VNG - DG209 Fits WH200 Handle
	Torch, Cutting Attachment - SMITH 75 Degree Head VNG - SC205 Fits WH200 Handle
	Tip, Cutting, Propane - Size # 3 - SMITH - VNG SC50A-3
	Tip, Cutting, Propane - Size # 4 - SMITH - VNG SC50A-4
	Tip, Cutting, Propane - Size # 5 - SMITH - VNG SC50A-5
	Torch Handle - SMITH - VNG WH200
	Preheating Head - SMITH Thermite Railroad VNG - 15674
	Mount - Oxygen-Propane Gauge Assembly Holder
	Regulator, Oxygen, VICTOR, two stage W/Guards - Smaller Design.
	Regulator, Propane, VICTOR, two stage W/Guards - Smaller Design.
	Flashback Arrestor, Oxygen Regulator Model.
	Flashback Arrestor, Propane Regulator Model.
	Reverse Flow Check Valve, Torch End, for fuel gas.
	Reverse Flow Check Valve, Torch End, for oxygen.
	Test Gauges - Railtech - SET = 1 Oxygen + 1 Propane Dial Protected
	Plug - Safety - Propane Tank - Brass With Chain & Ring.
	Protector, Cylinder Non-Rotating Valve - Oxygen, Wesco Model WES-010
	Protector, Cylinder Non- Rotating Valve - Propane, Wesco Model WES-008
	Igniter, torch, three flint, Shurelite Model 4501.
	Flint, renewal, for Shurlite Model 4501 igniter.
	Cleaner, tip, Wypo Number 1 Set.
	Wrench, Cylinder, 10 Way combination. Forged steel, not stamped.
	Detector, external leak, SNOOP, 8 oz. bottle. Not for use to mounting hoses to fittings.
	Hose Reel - 1/4" ID - 100' Twin Hose Capacity.
	Hose Reel - 3/8" ID - 75' Capacity.
	Hose - welding, Grade T - 100' twin 1/4" dia. W/Fittings. Requires verbal approval of Weld. Manager.

Item Number	Description
	Hose - welding, Grade T - 100' twin 3/8" dia. W/Fittings. Requires verbal approval of Weld. Manager.
	Hose, welding, Grade T - 50' twin 1/4" dia. with fittings.
	Hose, welding, Grade T - 50' twin 3/8" dia. with fittings.
	Kit, welding hose repair, with crimper and fittings.
	BOUTET WELD FIELD KITS & ACCESSORIES
	Boutet Weld Field Kit 85 lb.
	Boutet Weld Field Kit 115 lb.1/4" Worn Both Sides.
	Boutet Weld Field Kit 115 lb.New to 1/4" Worn.
	Boutet Weld Field Kit 115 lb.3/8" Worn Both Sides.
	Boutet Weld Field Kit 115 lb.New to 3/8" Worn.
	Boutet Weld Field Kit 132 lb.1/4" Worn Both Sides.
	Boutet Weld Field Kit 132 lb.New to 1/4" Worn.
	Boutet Weld Field Kit 132 lb.3/8" Worn Both Sides.
	Boutet Weld Field Kit 132 lb.New to 3/8" Worn.
	Boutet Weld Field Kit 133 lb.3/8" Worn Both Sides.
	Boutet Weld Field Kit 133 lb.New to 1/4" Worn.
	Boutet Weld Field Kit 136 lb.New to 1/4" Worn.
	Boutet Weld Field Kit 136 lb.New to 3/8" Worn.
	Boutet Weld Field Kit 136 lb.New to 1/4" Worn.
	Boutet Weld Field Kit 136 lb. 3/8" Worn Both Sides.
	Boutet Weld Field Kit 100RA / 105 DUDLEY
	Boutet Weld Field Kit 100RE
	Boutet Weld Field Kit 100RB
	Boutet Weld Field Kit 110RE
	Boutet Weld Field Kit 115RE
	Boutet Weld Field Kit 122CB
	Boutet Weld Field Kit 127 DUDLEY
	Boutet Weld Field Kit 155#
	Boutet Weld Field Kit 132RE
	Boutet Weld Field Kit 136RE
	Boutet Weld Field Kit 140RE
	Boutet Weld Field Kit 141RE
	Boutet Weld Comp. Field Weld Kit 100RE/85
	Boutet Weld Comp. Field Weld Kit 100RE/90RA
	Boutet Weld Comp. Field Weld Kit 100RE/90RB
	Boutet Weld Comp. Field Weld Kit 100RE/100RB
	Boutet Weld Comp. Field Weld Kit 115RE/90RA Right Hand.
	Boutet Weld Comp. Field Weld Kit 115RE/90RA Left Hand.
	Boutet Weld Comp. Field Weld Kit 115RE/100RA
	Boutet Weld Comp. Field Weld Kit 115RE/100RE
	Boutet Weld Comp. Field Weld Kit 115RE/100NW Left Hand.
	Boutet Weld Comp. Field Weld Kit 115RE/100NW Right Hand.
	Boutet Weld Comp. Field Weld Kit 119/100 Left Hand.
	Boutet Weld Comp. Field Weld Kit 119/100 Right Hand.

Item Number	Description
	Boutet Weld Comp. Field Weld Kit 119/115
	Boutet Weld Comp. Field Weld Kit 127/115 Left Hand.
	Boutet Weld Comp. Field Weld Kit 127/115 Right Hand.
	Boutet Weld Comp. Field Weld Kit 122CB/100RB
	Boutet Weld Comp. Field Weld Kit 122CB/100RE
	Boutet Weld Comp. Field Weld Kit 122CB/115RE Right Hand.
	Boutet Weld Comp. Field Weld Kit 122CB/115RE Left Hand.
	Boutet Weld Comp. Field Weld Kit 132RE/122CB
	Boutet Weld Comp. Field Weld Kit 132RE/127
	Boutet Weld Comp. Field Weld Kit 132RE/115RE Left Hand.
	Boutet Weld Comp. Field Weld Kit 132RE/115RE Left Hand.
	Boutet Weld Comp. Field Weld Kit 136RE/115RE Right Hand.
	Boutet Weld Comp. Field Weld Kit 133RE/115RE Left Hand.
	Boutet Weld Comp. Field Weld Kit 133RE/115RE Right Hand.
	Boutet Weld Comp. Field Weld Kit 136RE/115RE Left Hand.
	Boutet Weld Comp. Field Weld Kit 136-141RE/122CB
	Boutet Weld Comp. Field Weld Kit 136RE/119RE Left Hand.
	Boutet Weld Comp. Field Weld Kit 136RE/119RE Right Hand.
	Boutet Weld Comp. Field Weld Kit 136-141RE/132RE
	Boutet Weld Comp. Field Weld Kit 136RE/133RE
	Boutet Weld Comp. Field Weld Kit 140RE/127RE
	Boutet Weld Comp. Field Weld Kit 140RE/132RE Left Hand.
	Boutet Weld Comp. Field Weld Kit 140RE/132RE Right Hand.
	Boutet Wide Gap Weld Kit 115RE.
	Boutet Wide Gap Weld Kit 119RE.
	Boutet Wide Gap Weld Kit 122CB.
	Boutet Wide Gap Weld Kit 132RE.
	Boutet Wide Gap Weld Kit 133RE.
	Boutet Wide Gap Weld Kit 136RE.
	Boutet Wide Gap Weld Kit 141RE.
	Boutet Crucible - CJ One Shot - Single Crucible Only.
	Boutet Refractory Paste
	Boutet Packing Felt
	Boutet Packing Sand (MUD) 8 lb. Individual Brick. (5 per case).
	Boutet Ignitor (Sparkler) U/M = each. Come 20 Ignitors per tube.
	Dry Sand - 50 lb. Bag
	Dry Sand - 1 lb. Bag.
	BOUTET HARDWARE
	Boutet Mold Jacket 110-141#
	Boutet Base Plate 107-141#
	Boutet Mold Clamp
	Boutet Slag Pan
	Boutet Crucible Fork W/Extention Guard
	Railtech Torch Stand - New Style - Fully Adjustable.
	Boutet Comp. Mold Jacket

Item Number	Description
	Boutet Base Plate - Small Rail - 85-105#
	Boutet Mold Jacket - Small Rail - 85-105#
	Boutet Base Plate Wide Gap Weld 110-141#
	Boutet Mold Jacket - Wide Gap Weld 110-141#
	Boutet Base Plate Compromise - 4 Ear Adjustable
	Boutet Cooling Retarder Cap
	Boutet Close Quarters Mold Jackets
	Boutet Close Quarters Base Plate with Detachable Ears.
	BOUTET WELD HAND TOOLS
	Hot Cut Chisel with 36" Handle
	Wedge - 6"L X 1- 3/8"W X 1"H. Grade B. Use in close quarters around switches.
	Wedge - Curved - 12" X 1- 1/8" With Strike Protection Installed.
	Protector - Chip - Rubber - Large
	Protector - Chip - Rubber - X-Large
	Alignment Plates - Rail - Thermite Welding - IRS # LMT02R - U/M = Pair.
	Canting Tool - Ratcheting tool to remove rail twist.
	Boutet Weld Demolder - Fits Normal and WGW's.
	Boutet Riser Removal Tool
	Firetong - To remove mold jackets from molds
	Removal Tool – Base plate and mold jackets
	Gap Gauge - 1" - Setting Gauge
	Straight Edge - Railtech Magnetic Adjustable
	Tool Set - Welders - Includes Tool Box.
	Fork - Garden - Narrow - D-Handle 8 Tine
	Hammer - Sledge 8 lb. Tampo W/36" Handle
	Maul - Spike - 10 lb. Grade B W/36" Handle
	Shovel - Size 2 - Square Point W/48" Handle
	Shovel Trenching Round Nose
	Punch - Track Grade B W/36" Handle
	Bar - Claw - per AREMA Drawing 11-97
	Mattock Pick W/Handle 6 lb.
	Lifter - Spike - W/Chip protector
	Protector - Spike Lifter Cover Kit.
	Ball Ratchet tool insulated
	Base Ratchet tool insulated
	Blanket, Silica Welding - control heat loss.
	Jumper Wire - 50 ft. With Orange Flags - attaches to ball of rail only.
	File - 14" Carbide Grit X-Course - No rubber handle - Used for filing Thermite Weld Molds.
	File - 14"- Carbide Grit Course -W/Rubber handle - Used for filing Thermite Weld Molds.
	Puller - Hyd. Rail - 120 TN. Simplex Model RP-120B
	Rail Grips - Replacement for Simplex Puller.
	Puller - Hyd. Rail - 120 TN. Geismar (Modern Track) Model TH-120
	Rail Grips - Replacement for Geismar (Modern Track) Puller.

	Description
	Hydraulic Quick Disconnect Fitting (Female)
	Hydraulic Quick Disconnect Fitting (Male)
	Cushion, KNEELMATE, 24" X 30" Orange Vinyl.
	MISCELLANEOUS
	Organizer - Tool - for bucket - 61 compartments - yellow/black - Grainger 4ZB46
	Bucket - Plastic 5 gal. - to be used with bucket organizer above.
	Umbrella - 9 ft.-3 inches.- Wide coverage - With Stake.
	Stopwatch - Digital W/Breakaway Lanyard.
	Fire Extinguisher - 2-1/2 Gal.- Stainless Steel - Fill with Water - Pressurize with Air. Comp.
	Sprayer - Water Tank - 5 Gal. Indian. IRS
	Sprayer - Water Tank - 15 Gal. Plastic tank with 12 Volt pump.
	Lube, Graphite, 12 oz. spray cans, 12 per case. Lube Hyd. Rail Puller Swingarms.
	Knife - Penguin HD P900C
	Knife - Cutter - EasyCut
	Replacement Blades for EasyCut Knife.
	Thermometer - Infrared - Laser Pointing with Case and batteries. IRS.
	Thermometer, Rail - Magnetic - Part # Dwg 34 -2.
	Tempilstik Marker - 300 Degree F., Box of 12.
	Tempilstik Marker - 450 Degree F., Box of 12.
	Tempilstik Marker - 500 Degree F., Box of 12.
	Tempilstik Marker - 700 Degree F., Box of 12.
	Tempilstik Marker - 800 Degree F., Box of 12.
	Spill Kit
	Red Box - Storage for aerosol cans.
	Hand cleaner - pop up dispenser
	Hand Towels - Blue - Disposable - Roll.
	Tachometer, optical, digital readout, non- contact, instructions, case, batteries, tape.
	Reflective Tape for optical tachometer, 5 ft. roll.
	Sling, cylinder, nylon, 1000 lb. capacity. Liftex CG10A
	Tag Line - 3/8" X 30FT. Snap Lock End - Nylon Rope
	Tag Line - 1/2" X 30FT. Snap Lock End - Nylon Rope
	Marker - Valve Action - For Marking Rail - White
	Marker - Valve Action - For Marking Rail - Yellow
	Marker - White - For Marking Rail.- Pump Style
	Marker - Green - For Marking Rail.- Pump Style
	Box - Saw Blade Storage 14" Dia. Blades
	Box - Saw Blade Storage 16" Dia. Blades
	Ratchet Strap 2" X18' long 3,330 lb.Load limit, D-ring hooks.To Secure Hyd.Rail Puller
	Ratchet Strap 1" X 12'- S-Hooks Load Limit = 1,000 lbs. Secure Welding Cylinders
	Spark Shield (Little Sparky) Shield for Grinding
	Straight Edge W/ Frog Ruler
	Straight Edge, 18" long, Starrett Number 385-18
	Straight Edge, 36" long, Starrett Number 385-36

Item Number	Description
	Gauge, taper, 6-1/4" long X 0.150" thick, Starrett Number 270.
	Gauge, step gauge up to 7/8" H (in 1/8" increments). Use with conformal frog guage.
	Ground Fault Circuit Interrupter, 2' Cord

APPROVED ABRASIVE BLADES AND WHEELS

Item Number	Description
CUTTING RAIL	
	14" X 1/8" X 1" Abrasive saw blade, fully reinforced, Maximum 5400 RPM
	16" X 1/8" X 1" Abrasive saw blade, fully reinforced, Maximum 4800 RPM
	26" X 7/32" X 1-3/4" Abrasive saw blade, fully reinforced, Maximum 2090 RPM
	14" X 1/8" X 1" Abrasive saw blade, aluminum oxide, double reinforced, Max 5400 RPM
	14" X 1/8" X 1" Abrasive saw blade, premium grade, double reinforced, Max 5400 RPM
	14" X 1/8" X 1" Abrasive saw blade, superior grade, double reinforced, Max 5400 RPM
	16" X 1/8" X 1" Abrasive saw blade, aluminum oxide, double reinforced, Max 4800 RPM
	16" X 1/8" X 1" Abrasive saw blade, premium oxide, double reinforced, Max 4800 RPM
	16" X 1/8" X 1" Abrasive saw blade, superior oxide, double reinforced, Max 4800 RPM
	26" X 7/32" X 1-3/4" Abrasive saw blade, double reinforced, Maximum 2100 RPM

SLOTTING RAIL	
	8" X 5/32" X 5/8" Abrasive grinding wheel, fully reinforced, Maximum 7640 RPM.
	8" X 1/8" X 5/8" Abrasive slotting wheel, fully reinforced, Maximum 7640 RPM.

GENERAL GRINDING	
	4-1/2" X 1/4" X 5/8"-11 Abrasive Grinding - MINI Disk.
	8" X 1" X 5/8" Abrasive grinding wheel, fully reinforced, Maximum 4535 RPM
	8" X 1/4" X 5/8"-11 Abrasive grinding wheel, fully reinforced, Type 27, Max 6600 RPM.
	9" X 1/8" X 5/8"-11 Abrasive grinding wheel, fully reinforced, Type 27, Maximum 6600 RPM.

SURFACE GRINDING	
	8" X 2" X 1 1/2" Type-6 abrasive grinding wheel, fully reinforced, tape wound, Maximum 5250 RPM
	8" X 2" X 2" Plate mounted, 4 bolt grinding wheel, tape wound, Maximum 4500 RPM
	6-3/4" X 2" X 5/8" -11 Flaring cup abrasive grinding wheel, Maximum 6000 RPM
	9" X 1/4" X 7/8" Abrasive grinding wheel, fully reinforced, Max 6600 RPM

STOCK RAIL & SWITCH POINT GRINDING MACHINE	
	10" X 1-1/2" X 1" Recess one side 6" X 1/2", abrasive grinding wheel, fully reinforced, Maximum 3630 RPM.

WEB GRINDING	
	6" X 2-1/4" X 1" Recess one side 2-3/8" X 1", abrasive grinding wheel, fully reinforced , Maximum 6050 RPM.
	8" X 1/2" X 5/8" Wire brush wheel, Maximum 6000 RPM

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PURPOSE:	To establish uniform procedure governing the construction and rehabilitation of Road Crossings and the selection of Road Crossing Surface Materials.
SAFETY:	Observe all applicable Safety and Operating Rules and Regulations and Safe Job Procedures.
LOCATION:	All CFRC owned or maintained tracks.
ENVIRONMENTAL:	Observe all applicable Federal, State and Local Environmental Rules and Regulations.
REFERENCES	CFRC Track Works – Road Crossing Installation. Typical Drawings: 2521, 2522, 2524, 2527, 2535, 2536, 2538, 2539, 2602 and 2613.

I. DISCUSSION

- A. Many crossings are covered by contracts. A review for contractual obligations should be made to ensure CFRC constructs the crossing as required and is reimbursed accordingly.
- B. Coordination with the proper governmental agency or outside party responsible for the crossing is essential.
 - 1. All street and road closures must be coordinated prior to closing.
 - 2. Proper barricades must be placed at all crossings during the time that they are closed to prohibit vehicles from entering the work zone. All state and local regulations must be met in the erection and installation of these barricades.
 - 3. Many States highway and local road departments have policies, which allow them to assist in providing barricades, detour routing, and/or paving at no cost to CFRC. In the initial contact with the governmental agency, arrangements must be made to obtain this assistance where available.
 - 4. A review of the highway traffic density, both current and projected, must be made during the planning for the project.
 - 5. In some cases the crossing to be repaired may be the only access and special arrangements must be made such as:

- a. Coordination with local resident/residents to leave their vehicle on the opposite side of the crossing.
 - b. Having material readily available to place in quickly to allow emergency vehicles access.
 - c. Constructing a temporary crossing.
 - d. Adjust work hours if necessary to accommodate special needs.
6. See Planning and Installation Checklist attached to this instruction and provided as a separate document.
- C. The horizontal and vertical geometrics of highway crossings require special attention. Highway crossing areas are usually areas that have multiple ownership and that alignments may be dictated by the governmental organization that controls the highway. The following design concepts were extracted from the *Policy on Geometric Design of Highways and Streets*, published by the American Association of State Highway and Transportation Officials. They should be considered where appropriate.
1. Horizontal Alignment – If practical, the highway should intersect the track at right angle with no nearby intersections or driveways. This layout will enhance the vehicle driver’s and locomotive operator’s view of the crossing area, reduces conflicting vehicular movements from crossroads and driveways, and is preferred for two wheeled vehicles. To the extent practical, crossings should not be located on railroad or highway curves.
 2. Vertical Alignment – It is desirable from the standpoint of sight distance, ride ability, braking and acceleration distances that the crossing be made as level as practical. Vertical curves should be of sufficient length to ensure an adequate view of the crossing. In some instances, the roadway vertical alignment may not meet acceptable geometrics for a given design speed because of restrictive topography or limitations of right-of-way. As a recommended guideline, the crossing surface should be on the same plane as the top of rail for a distance of 30 inches outside the rails¹. The surface of the highway should also not be more than 3 inches higher or lower than the top of the nearest rail at a point 30 feet from the rail unless superelevation makes a different level appropriate. Tracks that are superelevated or a roadway approach that is not level, require site specific analysis.

II. CRITERIA REQUIRED FOR A QUALITY CROSSING

Road crossing construction and rehabilitation is resource intensive and disruptive to rail and highway traffic, therefore special care must be taken to ensure that the crossing is properly installed. The entire “Crossing Zone” requires special care and maintenance practices. The “Crossing Zone” is the crossing surface including all new required pavement and the track / right of way approaching the crossing for 50 feet each side of the crossing.

A. DRAINAGE

¹ High speed roadways (50MPH and greater) with considerable truck traffic (20% and greater) should have the level distance increased to 20 feet.

1. If the crossing is well drained and shows no signs of subgrade problems, extra care must be taken to ensure that drainage facilities and “hard pan” are not damaged. “Hard pan” is a densely compacted layer of ballast and other materials lying beneath the ties. It is relatively impervious and acts like a subballast layer. This layer must be located at a depth that will promote drainage and not pool water.
2. Good drainage must be provided from all four quadrants of the crossing and crossing zone. Ditches, pipes and/or French drains should be installed, if necessary, to obtain the adequate drainage. Check and maintain all existing pipes and ditches on the right-of-way that drain the crossing zone.
3. A level granular working area must be provided around highway crossing warning devices. If this area is excavated for drainage, it should be filled with free draining size #5 ballast (see MWI 301). Provisions must be made to protect buried cables. Normally a level area 6 feet to the front / side and 2 feet to the rear of the mast foundation is required for maintenance of gate or flasher mechanisms. Refer to drawing 2613 for details.
4. Roadway approaches and ditches should be sloped or diverted away from the crossing.
5. In cases where roadway descends to the crossing, other drainage mechanisms such as slot drains should be considered to divert as much water away from the crossing as possible.
6. If there is evidence of sub-grade problems, the stability must be improved. Consider using asphalt (HMA) underlayment, geogrids, or geotextiles. When these materials are used, they must be installed in accordance with the instructions contained in MWI 1003 or MWI 1004.

B. BALLAST

1. Ballast in the crossing must be granite or trap rock meeting CFRC Requirements (MWI 301).
2. **Ballast must be clean and free draining** both in cribs and under ties within the crossing. Tracks that have ties replaced or surfaced must have a minimum of 4 inches of ballast below bottom of tie after tamping is complete. Tracks that are renewed by panel method will comply with typical drawings (12 inches of ballast under the tie). Engineering judgment may be used to reduce the depth of ballast required under a panel based on existing site conditions; at no time should the depth of ballast be reduced to less than 4 inches under the crossties.
3. Ballast within the entire crossing zone must be clean. Ballast that is fouled with mud or debris can degrade the proper operation of crossing warning devices.
4. If ties are replaced in the crossing, the ballast must be renewed.
5. A sufficient quantity of ballast to perform crossing renewal and planned track raise must

be available on site to prevent delay in restoring the track upon crossing installation.

6. Ballast cross section below bottom of tie which supports the track must be compacted solidly before the crossing surface and pavement approaches are placed. Preferred methods of compaction are:
 - a. Vibratory roller
 - b. Train traffic (4 tonnage trains or 20,000 tons accumulated minimum)
 - c. Dynamic Stabilizer
 - Cribs must be filled with ballast during operation.
 - 2 to 3 passes but shall not violate manufacturer's operating instructions.
7. The finished ballast cross-section in the crossing zone approaching the crossing must comply with Typical Drawing 2602. Care must be taken to ensure that no surplus ballast is present to impede drainage except as noted in paragraph II.A.3 above. Additional drainpipe may be required.

C. CROSSTIES

1. The old pavement should be saw cut three (3) feet from the rail. If ties are to be inserted, locate the saw cut on one side approximately six (6) feet from the rail or the minimum needed to install the ties. This will vary depending on site conditions and material used (panel installation, 8 foot 6 inch vs. 10 foot ties).
2. All ties through the entire crossing must be in a like new condition, wood, and provide consistent support. If any single tie needs to be replaced, it will be replaced with a new tie and all remaining ties through the entire crossing and the 5 approach ties must be in like new condition. If multiple locations of consecutive ties need to be replaced, then all ties within the crossing will be replaced. Branch line ties and relay ties will not be installed within the crossing.
3. If ties removed from the crossing are still sound, they may be reinstalled in tangent track.
4. Ten-foot wood ties are required for all full width concrete road crossing surfaces. These 10-foot wood ties must extend for a minimum of 10 ties beyond each end of crossing
5. Crossings in concrete tie territory are to be constructed on 10-foot long wood ties with positive restraint fasteners and plates. These 10-foot wood ties must extend for a minimum of 10 ties beyond each end of crossing as a transition to concrete ties. The use of clips with corrosion prevention coating should be considered.
6. Ties should be installed using the most appropriate method for the particular crossing. Normal methods include:
 - a. Mechanized tie installation equipment
 - b. Pre-plated ties (see drawing 2532)
 - c. Tie packs (see drawing 2526)
 - d. Track Panels (see drawing 2515)

7. During tie replacement or track panel construction, the ties will be placed on 19 - ½ inch centers for rubber interface and timber crossings. For concrete and full depth rubber crossings, comply with manufacturer's requirements for tie spacing.
8. Tie plates / fasteners should prevent rail movement and rotation. Tie plates must be replaced if worn beyond the limits shown below:

• Shoulder height	1 1/32 inch minimum
• Rail seat width (6 in. base rail)	6-1/4 inches maximum
• Rail seat width (5-1/2 in. base rail)	5-3/4 inches maximum
• Spike hole size	27/32 inch maximum
• Plate thickness at edge	1 1/32 inch minimum
• Rail seat flatness	1/16 inch maximum convex
• Plate bottom flatness	1/8 inch maximum convex
9. All ties in the crossing are to be spiked with two rail-holding spikes on the gage side and two on the field side. If the plates do not have the rail holding positions then plates will be replaced. Positive restraint fastener plates will be installed per typical drawing 2512.

D. RAIL

1. Rail should be replaced if existing rail:
 - a. has surface imperfections
 - b. is surface bent
 - c. has less than 9 years of expected life
 - d. is programmed for renewal within the crossings expected service life
 - e. has excessive base wear or nicks (limits are)

• base width (6" base rail)	5-7/8 inches minimum
• base width (5-1/2" base rail)	5-3/8 inches minimum
• notching in base	not visible
2. No bolted rail joints are allowed in the crossing.
3. Thermite welds may not be located within the crossing on main tracks and sidings and should not be located within crossings on other tracks.
4. No bolted rail joints are allowed within the Crossing Zone on main, branch or siding tracks, where the rail is greater than 110 lbs/yd. They may be closer to the crossing on other tracks at the discretion of the Chief Engineer.
5. Only bonded insulated joints are permitted in the Crossing Zone on main, branch or siding tracks.
6. Bolted joints within the Crossing Zone must be welded out as soon as possible.
7. Thermite welds in the crossing zone due to rail replacement or panel installation must be

made within 3 days.

8. Thermite welds in the crossing zone should be staggered and at least 10 feet away from the edge of the crossing, and supported by good ties.
9. Ensure that the rail anchoring pattern is correct. See MWI 703.

E. SURFACING

1. If practicable in multiple track crossings, all tops of rail should be brought to the same plane.
2. The minimum practical track raise should be used to limit its effect on the highway profile. Coordinate with the proper governmental agency or outside party responsible for the crossing as necessary.
3. Crossings should be surfaced so that at least one future surfacing cycle can be performed without the crossing being left lower than the surrounding track. The track runoff will be located outside the crossing zone.
4. Solid tamping is important. The tamper must use double insertions and, if capable, tamp the total length of the tie. Care must be taken to avoid center binding of the tie.
5. When track is tamped, ballast **MUST** be compacted before the crossing surface and pavement are placed. Preferred methods of compaction are:
 - a. Train traffic overnight (4 tonnage trains or 20,000 tons minimum)
 - b. Dynamic Stabilizer (2 to 3 passes for 50 feet each side of crossing but shall not violate manufacturer's operating instructions)
6. The finished ballast cross-section in the crossing zone approaching the crossing must comply with Typical Drawing 2602 with no surplus ballast to impede drainage except as noted in paragraph II.A.3. Permitted cross-section tolerances for track maintenance work are given in MWI 1113, section H.

F. TEMPORARY CROSSING

1. Ballast & Cold Mix
 - a. Must be of sufficient quantity and strength to support the expected road traffic.
 - b. Cold mix must be removed from the track as soon as it is not needed. Use a double or triple layer of filter fabric to aide in removing cold mix while keeping ballast clean.
 - c. Ballast must be per CFRC requirements for main track. Other materials are not permitted.
2. Modular Temporary Crossing
 - a. Must be of sufficient size and strength to support the expected road traffic.
 - b. Must be secured to track.

G. CROSSING SURFACE MATERIAL AND INSTALLATION

1. Material:
 - a. There are several CFRC Typical Road Crossing designs. Unless the crossing is covered by an agreement/contract, the Typical design will be determined during the preplanning inspection. The Chief Engineer will select the appropriate Typical design for other projects.
 - b. A heavy duty crossing surface is justified on heavy vehicular traffic roads.
 - c. See Section III for details on available crossing surface materials.
2. General installation:
 - a. The ends of rubber interface sections, located in traffic lanes, must be supported on a tie.
 - b. Concrete and other crossing surface materials should be installed according to the manufacturer's instructions.
 - c. Where truck traffic is considerable (20% and greater), a concrete header or apron may be considered. This is placed adjacent to the concrete crossing surface to absorb impact.
 - d. Spike at end of crossing on both sides should be heeled over to secure wood filler blocks or rubber interface from sliding out. The wood filler blocks or rubber interface will most likely move in the direction with the greatest traffic.
 - e. For concrete crossing panels, comply with MWI 901A, as attached.

H. ASPHALT PAVEMENT

1. The paving contractor will saw cut the existing pavement before the reconstruction. See Section II.C.1 for location criteria.
2. The crossing surface will extend a minimum of two (2) feet beyond the edge of the existing roadway / sidewalk or comply with state regulations, whichever is greater. Other widths must have the approval of the Chief Engineer.
3. Estimated quantity of asphalt pavement should be accurate to ensure quality and minimize waste. Saw cutting of asphalt prevents unintentional removal of material; therefore cut asphalt for tie replacement approximately 6 feet from the edge of rail on tie installation side and 3 feet on the opposite side. For this kind of work, estimate 0.9 ton per linear track foot. For routine surface work through crossing saw cut at 3 feet from the rail on both sides. For this kind of work, estimate 0.7 ton per linear track foot.
4. Ballast under the asphalt pavement must fill in the cribs including under the rubber or timber flangeway and field interface sections. Shoulder ballast must be level with top of tie and compacted with vibratory equipment by the asphalt-paving contractor prior to paving.

5. Asphalt pavement should be full depth between top of tie and road surface except for farm / residential crossings. Compacted pavement must be thick enough to lock into the rubber interface material.
6. Tack coat must be used where new asphalt meets old pavement. The Tack must meet the FDOT standard specifications.
7. Asphalt (bituminous concrete) pavement used must be a dense-graded mix, which meets the FDOT standard specification 334 for asphalt pavement construction. Certificates must be given to the Roadmaster.
 - a. Asphalt shall be superpave (Type SP) traffic level C with a spread rate of 110 lbs/SY per inch. Thickness shall equal the height of rail.
 - b. The asphalt pavement must be placed and compacted in a minimum of 2 lifts (4 inch maximum per lift).
8. Asphalt pavement material must be sufficiently hot (minimum 200°F) for proper compaction. Optimal temperature is greater than 250°F.
9. The roller used to compact the asphalt should be a steel-wheeled vibratory type. It must be narrow enough to fit between the gage side flangeway interface material and between the outside of the crossing and old pavement. It should exert a minimum force of 12,000 lb/roll at 2400 vpm and operated at a speed of less than 3 ft/sec. Normally, a 36-inch vibratory roller will meet these criteria. A roller with equivalent compaction force but less than 26" wide must be used between the rails on a Rubber / Asphalt / Timber (RAT) or Timber / Asphalt type crossing.
10. The roller must be operated parallel to the rail and up against the rubber, concrete, or timber surface material to ensure good asphalt compaction. Use caution not to dislodge rubber interface sections or the clamps / spikes that secure the rubber.
11. Asphalt should be compacted to at least 91% of maximum theoretical density (air voids less than 5% in the compacted mix). For quality assurance, asphalt core borings may be taken to verify compliance.
12. Paved road surface should be level with the top of rail for 30 inches from the field side of each rail unless there is a conflict with State regulations. In case of a conflict, the State regulations will govern. For new construction, highway surface should not be more than 3 inches higher or lower than the top of the near rail 30 feet from the rail along the road centerline, unless track superelevation dictates otherwise. If practicable, slope the pavement 1 inch in 10 feet to meet existing highway surface. On high speed roads (50MPH and greater), the surface may have to be even smoother to reduce impacts on the crossing surface. High speed roadways with considerable truck traffic (20% and greater) should have the level distance increased to 20 feet.

13. On unpaved roads, the asphalt pavement on the field side of the rail must be of sufficient volume so it does not move or slip away from the rail under the expected roadway traffic. State regulations may require a minimum length “apron”.
14. The crossing should be closed to highway traffic long enough for the hot asphalt pavement to cool (hand touchable) and stiffen to support loads without rutting.
15. The old pavement removed may not always be the same amount that was delivered for the current paving project. For example, the maximum thickness should be approximately 8” for any paving project. Depending on rail height, the *average* crossing timber is 8”. If a previous paving project had a thicker pavement section due to insufficient fill material (e.g. ballast), the amount of pavement removed will be greater than what was delivered if done correctly with sufficient fill material. This should be noted on the paving invoice.
16. Old pavement, ballast, and surface material must be disposed of in a proper manner complying with CFRC policies. Refer to Environmental Guidelines manual.
 - a. Different materials must be handled separately for removal or stockpile at CFRC designated sites.
 - b. Asphalt pavement with only some ballast stuck to the bottom may be a recyclable material so keep it as clean as possible.

I. QUALITY ASSURANCE

1. Crossing rehabilitation or construction is to be performed to meet these instructions. Failure of rail, track surface and gage, or roadway surface should not occur within the intended maintenance cycle. Engineering may direct or perform sample inspections of the following activities or materials:
 - Drainage
 - Ballast
 - Ties
 - Crossing material
 - Pavement (asphalt may be cored to verify material characteristics and density)
 - Rail and welding
2. If a crossing fails before its intended maintenance cycle and it requires a speed restriction for rail traffic or a detour for vehicular traffic, a report will be made by the Chief Engineer to the CFRC Maintenance of Way Manager.

Typical

The report should describe the problem and contain photographs.

J. POSITIVE TRAIN CONTROL

1. It is best practice to reference the end of an existing road crossing surface with marking the rail with paint before removing the existing material. If multiple tracks (e.g. double main line) are being worked on, mark the location of the end of each road crossing using paint for both rails.
2. Any road crossing whose length changes greater than one foot (1') must enter a change request per MWI 2114.

III. MATERIAL SELECTION

(Also refer to drawings 2521, 2522, 2524, 2527, 2535, 2536, 2538 and 2539)

CFRC has six (6) typical crossing surfaces for wood tie installations. There are 4 basic levels of service based on the amount and severity of the highway crossing traffic. They are:

1. Heavy Duty (1 design, drawing 2527)
2. Normal Duty (3 designs, drawings 2535, 2536, and 2538)
3. Light Duty (1 design, drawing 2521)
4. Farm / Residential Use (2 designs, drawings 2522 and 2536)

There is no specific criteria as to which crossing design should be used, and discretion should be exercised on a case by case basis, but generally, the heavier the truck traffic, the faster the highway speed, or the higher the railroad tonnage is, the more durable the crossing should be. Consideration should be given to consider the recommendation of state and local authorities if they have expressed it. Refer to the paragraphs below for more information. Factors to consider are:

1. Severity of interrupting the railroad
2. Severity of interrupting the highway
3. Railroad tonnage and speed
4. Highway vehicle traffic count
5. Highway vehicle weights
6. Highway vehicle speed

Many Highway Departments measure traffic or vehicle count as AADT (Average Annual Daily Traffic) and Truck AADT (Truck Average Annual Daily Traffic). If this data is available, use it in conjunction with the following chart. When using this method, one truck equals 100 cars.

The governmental agency or outside party responsible for the road at the crossing should be contacted to determine vehicle count. For light duty, private, farm and residential crossings, gather information from the person contacted to close the crossing.

The type of crossing material selected should generally follow the chart below:

**HIGHWAY
 TRAFFIC**

RAILROAD TRAFFIC

<u>Cars per Day*</u>	<u>0 – 10 MGT / year</u>	<u>10+ MGT / year</u>
0 – 50,000	Normal Duty (Rubber / Asphalt / Timber) See paragraph A2 Normal Duty (Timber / Asphalt) A3 [1] Light Duty (Rubber / Asphalt) A4 [2] Farm Duty (Rubber / Asphalt) A5 [2] Farm Duty (Timber / Asphalt) A6	Normal Duty (Rubber / Asphalt / Timber) See paragraph A2 Normal Duty (Timber / Asphalt) A3 [2] Farm Duty (Timber / Asphalt) A6
50,000 – 100,000	Normal Duty (Rubber / Asphalt / Timber) A2 Normal Duty (Timber / Asphalt) A3	Heavy Duty (Concrete on 10' wood ties) A1 Normal Duty (Rubber / Asphalt / Timber) A2 Normal Duty (Timber / Asphalt) A3
100,000+	Heavy Duty (Concrete on 10' wood ties) A1	Heavy Duty (Concrete on 10' wood ties) A1

*** When calculating cars per day, multiply each truck by 100.**

[1] Crossing must handle less than 5000 cars per day.

[2] Crossing must handle less than 500 cars per day.

If track warrants Positive Restraint Fasteners (Pandrol or NorFast Plates), use Heavy Duty Concrete (A1) or Light Duty Rubber / Asphalt (A4) as appropriate.

A. WOOD TIE INSTALLATIONS – CFRC has designs for heavy, normal, light duty and farm / residential duty applications for crossings. These designs use various combinations of concrete, timber, or rubber interface and asphalt pavement material.

1. Heavy Duty Highway Crossings (Concrete) – Shown on CFRC Typical Drawing number 2527. This crossing material consists of 9 ft. long concrete center (gage) and field panels. They must be installed on 10 ft. ties. Concrete crossings shall comply with MWI 901A, as attached.

The crossing information follows:

<i>Rail Weight</i>	<i>Description</i>
115 – 122	Crossing Concrete Panels, Heavy Duty, for 10-foot wood ties. Order by “Track Feet” in approximately . 8-ft. increments. Each 8-ft. 1-1/2 in. section incl. 1 concrete center panel and 2 concrete field panels with rubber flangeway fillers.
132 – 136	
141	

Approximate weights of these panels are:

Center Panel, 115 – 122 lb. rail	2850 pounds
Field Panel, 115 – 122 lb. rail	1550 pounds
Center Panel, 132 – 141 lb. rail	3125 pounds
Field Panel, 132 – 141 lb. rail	1675 pounds

The heavy duty concrete crossing design should be used where the preponderance of the highway traffic is composed of trucks, where the environmental or other concerns for the disposal of asphalt must be minimized and/or where maintenance history indicates a need for its use.

2. Normal Duty Highway Crossing (Rubber / Asphalt / Timber) (RAT) – Shown on CFRC Typical Drawing number 2535. This design uses 10 inch wide by 8 ft. 1-1/2 in. long wooden timbers that are placed against rubber interface material adjacent to the rails. The timbers are attached to the ties with timber screws. Use equipment, such as a backhoe arm, to handle crossing timbers. **Do not** use hands to handle crossing timbers. This will give the crossing more strength. Clamps for the rubber interface are not needed. Full depth compacted asphalt pavement is used for the remaining road surface area. The information for the RAT crossing timber follows:

Rail Weight	Description
115 – 122	Crossing Timbers 7-1/2" thick 8' 1-1/2" long per CFRC drawing 2535. Four timbers per bundle (2 gage, 2 field). Use with rubber rail seal. Order by "Track Feet" in 8-ft. increments.
132	Crossing Timbers 8" thick 8' 1-1/2" long per CFRC drawing 2535. Four timbers per bundle (2 gage, 2 field). Use with rubber rail seal. Order by "Track Feet" in 8-ft. increments.
136 – 141	Crossing Timbers 8-3/8" thick 8' 1-1/2" long per CFRC drawing 2535. Four timbers per bundle (2 gage, 2 field). Use with rubber rail seal. Order by "Track Feet" in 8-ft. increments.
all	Screw Timber 5/8" X 12" with Torx square washer head.

3. Normal Duty Highway Crossing (Timber / Asphalt) – Shown on CFRC Typical Drawing number 2536. This design uses 10 inch wide by 8 ft. 1-1/2 in. long wooden

timbers with wooden filler blocks adjacent to the rails. The timbers are attached to the ties with timber screws. Use equipment, such as a backhoe arm, to handle crossing timbers. **Do not** use hands to handle crossing timbers. Full depth compacted asphalt pavement is used for the remaining road surface area. The information for this timber follows:

<i>Rail Weight</i>	<i>Description</i>
115	Crossing Timbers 7-1/2" thick 8' 1-1/2" long with wood filler blocks per CFRC drawing 2536. Four timbers per bundle. Order by "Track Feet" in 8-ft. increments.
122	Crossing Timbers 7-1/2" thick 8' 1-1/2" long with wood filler blocks per CFRC drawing 2536. Four timbers per bundle. Order by "Track Feet" in 8-ft. increments.
132	Crossing Timbers 8" thick 8' 1-1/2" long with wood filler blocks per CFRC drawing 2536. Four timbers per bundle. Order by "Track Feet" in 8-ft. increments.
136	Crossing Timbers 8-3/8" thick 8' 1-1/2" long with wood filler blocks per CFRC drawing 2536. Four timbers per bundle. Order by "Track Feet" in 8-ft. increments.
140	Crossing Timbers 8-3/8" thick 8' 1-1/2" long with wood filler blocks per CFRC drawing 2536. Four timbers per bundle. Order by "Track Feet" in 8-ft. increments.
141	Crossing Timbers 8-3/8" thick 8' 1-1/2" long with wood filler blocks per CFRC drawing 2536. Four timbers per bundle. Order by "Track Feet" in 8-ft. increments.
all	Screw Timber 5/8" X 12" with Torx square washer head.
all	Counterbore diameter 1/2" double flute to be added to step drill (015.0001283.1) & attached with set screw.
all	Socket Adapter 1" Drive for 5/8" hex insert Torx bit.
all	Socket Retainer for 1" Drive impact.

4. Normal Duty Highway Crossing (Timber/Asphalt) for use with 18" tie plates-- – Shown on CFRC Typical Drawing number 2538. This design uses a 10 inch wide by 6 ft. 8-1/2 inch. long wooden timber with wooden filler blocks adjacent to the rails for the gage side and a 16-1/2 inch wide by 6 ft. 8-1/2 inch long wooden timber with wooden filler block

for the field side. The timbers are attached to the ties with timber screws. Use equipment, such as a backhoe arm, to handle crossing timbers. **Do not** use hands to handle crossing timbers. Full depth compacted asphalt pavement is used for the remaining road surface area. The information for this timber follows:

<i>Rail Weight</i>	<i>Description</i>
122	Crossing Timbers 7-1/2" thick 6.75' long with wood filler blocks per CFRC drawing 2538. Four timbers per bundle. Order by "Track Feet" in 6.75-ft. increments.
132	Crossing Timbers 8" thick 6.75' long with wood filler blocks per CFRC drawing 2538. Four timbers per bundle. Order by "Track Feet" in 6.75-ft. increments.
136	Crossing Timbers 8-3/8" thick 6.75' long with wood filler blocks per CFRC drawing 2538. Four timbers per bundle. Order by "Track Feet" in 6.75-ft. increments.
140	Crossing Timbers 8-3/8" thick 6.75' long with wood filler blocks per CFRC drawing 2538. Four timbers per bundle. Order by "Track Feet" in 6.75-ft. increments.
141	Crossing Timbers 8-3/8" thick 6.75' long with wood filler blocks per CFRC drawing 2538. Four timbers per bundle. Order by "Track Feet" in 6.75-ft. increments.
all	Bit Drill Step 11/16" With 3/8" Pilot 18" Overall Length
all	Screw Timber 5/8" X 12" with Torx square washer head.
all	Bit Torx adapter Insert 5/8" Impact 1" Drive
all	Counterbore diameter 1/2" double flute to be added to step drill (015.0001283.1) & attached with set screw.
all	Socket Adapter 1" Drive for 5/8" hex insert Torx bit.
all	Socket Retainer for 1" Drive impact.

5. Light Duty Highway Crossings (Rubber / Asphalt) – Shown on CFRC Typical Drawing numbered 2521. This design uses rubber interface material with full depth compacted asphalt pavement on the both sides of the rails. It is only permitted on tracks with less than 10 annual MGTs and highways less than 5,000 Cars per Day. Existing rubber interface material should be used where available.

The information follows:

<i>Rail Weight</i>	<i>Description</i>
90 – 100	
115	Crossing, Rubber Interface Light duty,
122	for wood ties.
132	Order by “Track feet” in 8 ft. increments.
136	Each “Track foot” includes 2 gage side
140	and 2 field side sections.
141	
90 – 141	Clip/Clamp which may be used to
	secure rubber. Use in each crib.
132 – 136	Crossing, Rubber Interface Light duty
141	for Pandrol plates on wood ties.
132 – 141	Clip/Clamp which should be used to
	secure
	rubber interface on Pandrol plates.
	Installation tool for Clip/Clamps

6. Farm / Residential Road Crossings (Rubber / Asphalt) – These very light duty road crossings are defined as private roads, city streets and with vehicular traffic speeds of 25 MPH and lower and with less than 500 Cars per day. This design is not permitted if trucks use the crossing. If the road will be handling trucks, use one of the previous designs. It is only permitted on tracks less than 10 annual MGTs. See CFRC Typical Drawing number 2522. This design uses lighter weight virgin rubber or used rubber field and flangeway interface material, with a minimum of four (4) inches of compacted asphalt.
7. Farm / Residential Crossings (Timber / Asphalt) – These are private crossings that conform to very light duty traffic criteria, and serve a limited number of users. Examples would be a road connecting two farm fields, a road providing access to an individual home, or an infrequently used access to a commercial site, such as a billboard or pumping station. The limited service requirements of these crossings allow the use of cascaded materials and minimization of asphalt quantities. Use equipment, such as a backhoe arm, to handle crossing timbers. **Do not** use hands to handle crossing timbers. Crossing material should be economized at these locations. The design is similar to the T / A crossing (Drawing 2536) but uses less asphalt pavement. Use the following guidelines:
- Use second hand wood material if available or order material described for Typical Duty crossings.

- b. In crossings not susceptible to frost heave such as areas below TN & NC, compacted asphalt pavement thickness to be 3 inches minimum to 4 inches maximum.
- 8. Former Normal Duty Highway Crossing (Concrete / Rubber / Asphalt) – This former typical design, shown on CFRC Typical Drawing number 2524 uses a concrete panel with rubber flangeway filler between the rails and rubber interface material with full depth compacted asphalt pavement on the field sides of the rails. If the crossing material is in good condition and the crossing has performed satisfactorily, it may be reinstalled. If the material is in good condition but the asphalt pavement broke up, use the crossing material in a lower duty crossing or add timbers against the rubber like the RAT crossing design for added strength.
- B. Private crossings will be considered the same as a public crossing with similar traffic volumes. Some private crossings, such as concrete plant entrances, will usually have heavy truck traffic. These industrial crossings should use normal or heavy duty material.
- C. Care must be taken to ensure that the correct type of rubber interface material is installed. Manufacturer's warranty (minimum of 10-year life) can only be honored if the rubber interface material is properly matched to the highway traffic conditions.
- D. All other crossing other crossing materials installed on CFRC owned and/or maintained tracks must be approved by the CFRC Maintenance of Way Manager. Road crossings, which are funded by Outside Parties, may be constructed with concrete slab or full depth rubber if specified by the Outside Party.

Platform (tieless, modular, or tub) type crossings are approved where track speeds do not exceed 15 MPH and tonnage does not exceed 10 MGT. These types of crossings should have 10 each 10' wood crossties on both approaches to transition to open track. Other applications of platform crossings must include a feasibility analysis with arrangements for inspection and approval from the CFRC Maintenance of Way Manager prior to installation.

Refer to drawing 2539 for additional requirements. If the outside party desires to use another premium crossing, prior arrangements and approval must be obtained from the CFRC Maintenance of Way Manager.

- E. Other crossing designs or materials such as composites, if approved by the CFRC Maintenance of Way Manager, may be considered on an individual location basis.
- F. Field side grinding relief is not required in any crossing surface.
- G. Rubber interface material is to be ordered by the track foot for a specific crossing and installed at that location.
- H. When material is ordered for crossings with positive restraint fasteners on wood ties, care must be taken to order material specifically designed to accommodate these fastening systems. The use of clips with corrosion prevention coating should be considered.

Prepared by: RMW

Approved by: *Miguel Torres*
Miguel Torres - CFRC Chief Operating Officer

PROJECT MILEPOST: _____ SUBDIVISION: _____

PROPOSED DATE OF INSTALLATION: _____

PROJECT PLANNING

Six (6) Weeks Prior To Project Work

- ___ Determine scope of project and crossings to be replaced with the Chief Engineer. Look for impediments such as drainage, utilities, and warning devices. Assess impact of raising track on roadway surface.

- ___ Review project scope, timeline, and who will furnish barricades with highway officials. Determine type of crossing surface. Same or different? Consider requests from local highway officials

- ___ Contact CFRC Maintenance of Way Manager to determine contribution by local agency

- ___ Order crossing materials necessary to complete road crossing project

___ Crossing material	___ Crossties	___ Spikes/screws/clips
___ Rail	___ Tie Plates	___ Ballast
___ Drainage material		

- ___ Notice of intent to contract (if applicable)

- ___ Contact agency responsible for road to arrange for road crossing closure.

- ___ Arrange for detour signing and barricading

- ___ Arrange for paving contractor or equipment for CFRC use to deliver and place asphalt in finished crossing

- ___ Arrange to have crossing saw cut and filled with ballast.

- ___ Clear out old ballast from crossing area for a 12" depth below cross tie or to hardpan depending on actual conditions.
 - ___ Install HMA underlayment if required by project
 - ___ Install geotextile fabric if required by project
 - ___ Install drainage pipe if required by project
 - ___ Pre-ballast panel area. Use vibratory roller to compact ballast.
 - ___ Install panel (including 10 new approach ties both sides)
 - ___ Fill in cribs
 - ___ Tamp and regulate track. Run track stabilizer if present.
- ___ If replacing crossties:
- ___ Remove and reinstall the necessary number of crossties
 - ___ Ensure that remaining crossties are in a new condition
 - ___ Ensure that crossties are arranged and spiked pursuant to the new crossing material
 - ___ Ensure that 4" of clean ballast is under each new tie
 - ___ Fill in ballast around crossties.
 - ___ Tamp and regulate track. Run track stabilizer if present.
- ___ Ensure track is inspected and safe for movement.
- ___ Ensure that applicable slow orders are in place.
- ___ Allow track to run appropriate amount of time/traffic to ensure consolidated ballast conditions.

REINSTALLATION OF ROAD CROSSING

- ___ Conduct a daily review of which crossing(s) are properly barricaded and scheduled for maintenance with crossing renewal team.
- ___ Install new road crossing material by following instructions for each type of road crossing.
- ___ Conduct a daily review of which crossing(s) have been serviced by crossing renewal team
- ___ Ensure crossing renewal team notifies paving contractor of which crossings need to be paved and have debris removed.
- ___ Restore asphalt pavement in and around road crossing
 - ___ Ensure cribs are full of ballast. Compact ballast with vibratory equipment.
 - ___ Ensure asphalt is at proper temperature at placement (>250°F).
 - ___ Place in lifts to not exceed 4 inches per lift for the base courses and not more than 2 inches for the wearing course.
 - ___ Ensure proper vibrator roller is used during asphalt placement.
 - ___ Ensure roller is operated parallel to the rails/crossing surface to ensure good compacting along edges of crossing.
- ___ Wait until asphalt is "hand cool" to open roadway for traffic.

- ___ Restore drainage away from the crossing zone.
- ___ Remove barricades and remove or cover all traffic control devices or detour signs.
- ___ Ensure track is inspected and safe for movement.
- ___ Ensure that applicable slow orders are in place.
- ___ Arrange for any track joints left in the track to be welded.

AFTER CROSSING IS COMPLETE

- ___ Ensure slow orders are not left on crossing an excessive amount of time.
- ___ Reclaim left over and released company material. Arrange for timely removal
- ___ Ensure that old asphalt is removed by paving contractor within 7 days of completion of road crossing.
- ___ Ensure that drainage in the crossing is not impeded by final cleanup work.
- ___ Contact local 911 center, fire, police, ambulance, rescue, post office, school district, television and radio station, and newspapers to notify them of crossing completion and re-opening it to public.

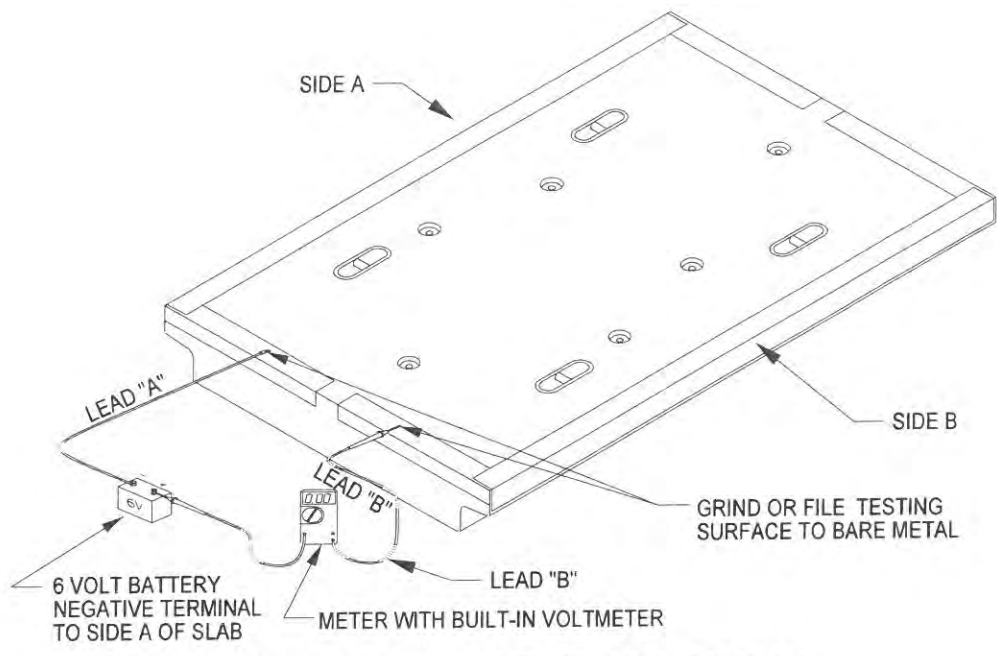
MWI 901A

Requirements for 9' Lagtype Shunt Resistant Concrete Grade Crossing Panels On 10' Timber Crossties

1. Each panel shall be manufactured using 6000 psi minimum concrete and American Grade 72 reinforcement. Manufacturer must supply mill certificates documenting reinforcement calculations, etc...
2. Each panel shall have a 3" x 3" x 1/4" angle surround. The angle surround shall have a 3 ml. rust inhibitive coating.
3. Each panel shall be manufactured to meet HS20-44 loading in accordance with AASHTO standard specifications for highway bridges, with a 30% impact increment. Loadings shall be based on single axle loads of 32,000 lbs. - 16,000 lbs. per side. Design calculations shall be certified by a registered professional engineer and submitted to owner, as requested.
4. Each panel shall have a non-skid surface and be protected from freeze/thaw cycles, deicers and other contaminants using 4 to 6 percent air entrainment.
5. Each gauge panel shall be 50-1/2" wide x 108" in length and manufactured to the correct height for size rail specified. Gauge panels shall have a 3" gap at each end of the frame with a non-conductive polyethylene insulator. The gauge panels at each end of the grade crossing shall have a deflector shield as depicted in the drawings.
6. Each field panel shall be 26 1/4" x 108" in length and manufactured for the correct height to size rail specified. The field panels at each end of the grade crossing shall have a deflector shield as depicted in the drawings.
7. Crossing panels shall be manufactured to be compatible with all rail fastening hardware and rail anchors.
8. Each field and gauge panel shall have recessed timber screw holes to protect timber screw heads from vehicular wheel impact as per locations specified in drawings.
9. Each panel shall have two (2) galvanized recessed lifting eyes with 4000 lbs. lifting capacity each. Each lifting eye shall be recessed below the surface of the panels to eliminate vehicular wheel impact.
10. Design of the crossing surface shall include provisions for filling in depressions and holes created by timber screws and lifting points. All depressions and holes shall be filled with a removable insert at all pedestrian crossings and within the limits of sidewalk on highway crossings. The removable insert shall be flush with crossing surface. Sand/grout type fill in depressions and holes will not be permitted.
11. Dimensional tolerance of grade crossing panels shall be +/- 1/4".
12. Each crossing shall be supplied with a 1/8" elastomeric bearing pad which shall be placed between the top of the crosstie and the bottom of the concrete panels.

MWI 901A
Requirements for 9 foot Lagtype Shunt Resistant
Concrete Grade Crossing Panels
On 10 foot Timber Crossties
Page2

13. If track is in a curve greater than 3°, panels shall be custom manufactured to fit radius. Use of filler plates will not be allowed and panels must abut one to the other. Manufacturer shall supply shop drawings detailing crosstie spacing and placement prior to installation
14. Any grade crossing panels which are located within the limits of a turnout shall be field measured and custom manufactured to fit. Manufacturer shall submit shop drawings within fourteen (14) working days after onsite field measurements are taken by manufacturer, indicating crosstie alignment and panel configuration prior to manufacture and installation.
15. At the owner's request, the supplier shall submit client references and shop drawings of the grade crossing panels for approval within fourteen (14) days after award of contract.
16. At a minimum the shop drawings shall include a full cross section view of panels on crossties, a plan view of panels in the track, and a detail drawing of the flangeways. The drawing should also indicate data on panel weights, loading requirements, lifting eye requirements and any other applicable information helpful to the engineer and/or client.
17. Manufacturer shall provide an onsite representative to assist at grade crossing installation, provided that notification of installation date is given well enough in advance (minimum two weeks) to allow scheduling.
18. Manufacturer must submit a copy of their Quality Assurance/ Quality Control Program. Manufacturer must batch/mix their own concrete. No ready mix concrete will be acceptable. Manufacturer QA/QC Program should address all areas in QA/QC of raw materials, production, curing, personnel training, testing, inspections, product tracking, shipping, requirements and certifications, etc...
19. Manufacturer shall verify that they have been actively involved in the manufacture of full depth precast concrete grade crossings for a minimum of seven (7) years. Manufacturer shall have product that is being bid in service under heavy traffic, high tonnage with positive results for seven (7) years and supply verification upon engineer's request.
20. Manufacturer shall provide owner and engineer with a one (1) year manufacturer's limited warranty from date of delivery.
21. Manufacturer shall supply high resistivity elastomeric flangeway filler. Flangeway fillers shall meet ADA requirements.
22. Contractor shall test all concrete crossing panels on site prior to installation according to the attached standard electrical test drawing. Document test results for each panel and submit results to the Engineer.



TYPICAL ELECTRICAL TEST

ELECTRICAL TEST STEPS:

1. BATTERY SHALL BE 5.0 (FIVE) AMPS OR GREATER.
2. SLABS ARE READY FOR TESTING WHEN 72 HOURS HAVE ELAPSED FROM CASTING OF CONCRETE.
3. MUST BE LESS THAN 2.0 (TWO) AMPS TO PASS THE TEST. RE-TEST AFTER TWO (2) DAYS IF GREATER THAN 2.0 (TWO) AMPS. REJECT IF AMPERAGE REMAINS ABOVE 2.0 (TWO) AMPS.
4. 0.3-0.4 AMPS IS A NORMAL READING. 2.0 (TWO) AMPS OR LESS PASS THE TEST.

COMMON DRAWINGS	
SHUNT RESISTANCE TEST FOR CONCRETE PANELS	
FILE OWNER: CFRC	DATE: 03/06/2015
REV. NO.: 0	DWG NO: 200903



MWI 1003-02

Uses and Installation of
Geotextiles and Geogrids

Issued: 12/9/13

Revised: 3/6/15

Page 1 of 5

PURPOSE:	To establish uniform instructions for the Use of Geotextiles and Geogrids.
SAFETY:	Observe all applicable Safety and Operating Rules and Regulations and Safe Job Procedures.
LOCATION:	All CFRC tracks.
ENVIRONMENTAL:	Observe all applicable Federal, State, Local and CFRC Environmental Rules and Regulations. Care must be exercised when disposing of Geotextiles and Geogrids removed from the roadbed. Contaminated matting must be staged on plastic and covered with plastic. Contact local Environmental Specialist to arrange for proper disposal of soiled material.

I. DISCUSSION

Geotextiles

- A. Geotextiles, also known as filter fabric, are permeable textiles manufactured from plastics in either woven or non-woven form. When used within the track structure, geotextiles have four potential functions: separation, transmission, filtration and reinforcement.
1. *Separation* provides a barrier to prevent subgrade fines from being pumped up into the ballast.
 2. *Transmission* supplies a horizontal, lateral conduit to drain water away from the center of the track.
 3. *Filtration* allows water to pass through the fabric while soil particles are retained.
 4. *Reinforcement* produces additional tensile strength to distribute wheel loads over the roadbed. However, geogrids are the more appropriate material to perform this function.
- B. Geotextiles will not correct line and surface problems caused by soft subgrade conditions. Geotextiles are neither a substitute for maintaining good roadbed drainage, nor a replacement for subballast in new construction.

- C. Within the track structure, geotextiles can be an economical solution to problems caused by poorly drained ballast. Geotextiles may be installed at locations such as road crossings, turnouts, railroad crossings and insulated joints where wet subgrade and contaminated ballast have been a continuing or recurring problem. For new construction, geotextiles may be used if justified by unfavorable subgrade conditions.
- D. Geotextiles may be used in earthwork, such as retaining structures and erosion control. Such applications must be designed and constructed on an individual basis and are not included in these instructions.
- E. Geotextiles are not to be used to prevent contamination of the ballast from work activities, such as dumping fill material and digging close to the track. Black plastic is a more economical material for this purpose.
- F. Geotextiles may deteriorate if continuously exposed to sunlight. Protection must be provided unless the material is scheduled for immediate use. It should be covered the same day it is placed. The original packaging should be retained to protect the remnants.

Geogrids

- A. Geogrids are plastic sheets in the form of a grid having relatively large, uniform openings. The grids interlock with the soil to create tensile reinforcement.
- B. Geogrids can be installed alone to strengthen the roadbed or in conjunction with geotextiles in severe service conditions where shallow stabilization is desired. For example, geogrids (with or without geotextiles) could be used at road crossings, turnouts, bridge approaches, railroad crossings, tunnels and tunnel approaches, retarders and sink areas.

II. PROCEDURE

Ordering Geotextiles

- A. The guidelines for the selection of the weight of geotextiles follows:
 - 1. Regular Duty (10 to 12 ounces per yard) is used for tangent track and light curves where drainage from the track is poor, but there is not a severe muddy or pumping problem.
 - 2. Heavy Duty (12 to 16 ounces per yard) is used for heavy tonnage lines and any location where muddy, pumping track is a continuing problem.
 - 3. Extra Heavy Duty (16 to 20 ounces per yard) is used for Railroad crossings, heavy traffic road crossings, bridge approaches and other extremely severe locations.

4. Turnout Packs, precut to fit the varying widths of turnouts and reinforced with extra thickness under the switch and frog areas, are available. These packs should be used to eliminate need to cut turnout sections from normal rolls.
- B. Requisitions for geotextiles are to be submitted in the normal manner and must include the following information:
1. Service requirements:
Regular Duty, Heavy Duty, Extra Heavy Duty or Turnout.
 2. Width required:
The normal width is 15'-0", but other widths can be obtained. Some mechanical placement systems used with undercutters use 11'-6" rolls.
 3. Length required:
Rolls are normally manufactured in 300 ft. lengths, but may be ordered in other lengths. Include extra material to cover overlaps at the end of each roll. A 150 ft. roll of 12 ounce fabric 15'-0" wide has a gross weight of approximately 200 pounds.
 4. Turnouts Packs:
State the frog number: 8, 10, 16 or 20. For number 16 turnouts, give the switch length: 24'-0" or 30'-0".

Ordering Geogrids

- A. Requisitions for geogrids will be submitted in the normal manner.
- B. The requirements for the geogrid must be based on the individual project requirements.
- C. It is recommended that the manufacturer's representative be consulted to determine the proper geogrid for the installation.

Installation of Geotextiles

- A. If underground cables are located in the work area, the proper agency must be notified. Communication companies, such as MCI, AT&T, US Sprint and Wiltel/WTG, the Signal Supervisor and/or other underground utility companies must be notified **prior** to installing geotextiles.

- B. To function properly, the geotextile **must be installed correctly**. Four (4) basic requirements must be met:
1. **Site Preparation**
For existing tracks, subgrade drainage must be directed away from the center line of track, and if possible, the low spots filled before placing the geotextile. For new construction, subgrade and subballast must be finished to the specified line and grade before placing the geotextile.
 2. **Depth**
To provide protection against damage from tamping and to avoid interference with future ballast undercutting/cleaning operations, the geotextile should be twelve inches (12") below the bottom of tie. The minimum depth to prevent puncturing by tamper feet is eight inches (8") below the bottom of tie. There must be at least an 8" separation between the ties and the geotextile before the track can be tamped. To accomplish this, the track must be raised on concrete blocks prior to unloading ballast. If long segments are to have geotextile material installed, ballast can be unloaded on the track section and power jacks can be used to raise the track to obtain the 8" separation prior to tamping.
 3. **Roadbed Drainage**
A means to carry water away from the geotextile must be provided. Where the roadbed section is not a fill section, parallel ditches at two feet (2') below the ballast section. (See Typical Drawing Number CFRC 2602) Where a geotextile is used through a road crossing, drainage structures parallel to the track must be installed. (See Typical Drawing Number CFRC 2611)
 4. **Overlapping**
To maintain continuity, a new roll of geotextile should be lapped approximately two feet (2') over the previous roll. Side overlaps should be approximately eighteen inches (18"). If sewing equipment is used, overlaps can be reduced by six inches (6").
- C. Except for overlaps at roll boundaries, double layer of geotextiles must not be used because slip planes can develop between layers.
- D. Inspect the work area and remove any sharp items which could snag or tear the geotextile.
- E. Stretch the geotextile taut longitudinally and laterally before placing backfill.
- F. Tamper operators should check the operation of their tamper after starting work and at regular intervals during the day ensure that holes are not being punched in the geotextiles. Holes will be repaired by removing the ballast and placing a piece of fabric over the hole. The fabric patch should overlap the hole approximately eighteen inches (18") on all sides.

Installation of Geogrids

- A. Like geotextiles, geogrids **must be installed correctly** in order to function properly.
- B. In general, the installation of geogrids is similar to the installation of geotextiles. (See Installation of Geotextiles above)
- C. It is recommended that the manufacturer's representative be consulted to ensure that the installation plan, techniques and execution are proper.

III. REPORTS

None

Prepared by: RMW

Approved by: Miguel Torres
Miguel Torres - CFRC Chief Operating Officer



MWI 1101-05

Continuous Welded Rail Projects

Issued: 12/9/14

Revised: 3/6/15

Page 1 of 8

PURPOSE:	To set instructions governing the Planning and Installation of CWR.
SAFETY:	Observe all applicable Safe Job Procedures and Safety Rules and Regulations.
LOCATION:	All CFRC tracks.
ENVIRONMENTAL:	Observe all applicable Federal, State, Local Environmental Rules and Regulations.
REFERENCES:	MWI 701 Use of Premium Rail Fasteners with CWR. MWI 702 Reclamation and Reuse of Track Spikes and Rail Anchors. MWI 703 Rail Anchoring Policy. MWI 901 Road Crossing Installation MWI 1125 Installation and Thermal Adjustment of CWR. CFRC 2512, 2513, 2514 Spiking Patterns.

I. DISCUSSION

- A. The goal of this continuous welded rail policy is to ensure that the work meets all CFRC Requirements as well as Engineering Department goals for safety, quality, and cost effectiveness. Because rail is laid in a wide variety of conditions, these instructions will define the process by which the agreed upon results can be obtained. The success of this process will require a coordinated effort from a team consisting of Officers including Transportation, Maintenance of Way, and Signal Departments.
- B. Once the rail laying program has been established any changes after the program is finalized must be submitted through the change order process and have the approval of the Chief Engineer. The Chief Engineer shall notify the CFRC Maintenance of Way Manager of the changes to the rail laying program in writing.
- C. The Chief Engineer will ensure that any revisions to the program or schedule are distributed.

II. PROCEDURE

A. PLANNING

1. The Chief Engineer will arrange a “pre-trip” meeting with appropriate personnel, a minimum of three months prior to the scheduled laying date of the welded rail, to inspect the work site, and to plan the work activity.
2. Personnel at the pre-trip meeting must include the Chief Engineer, CFRC Maintenance of Way Manager, Roadmaster, and a signal representative responsible for the maintenance of the track section on which the rail is to be laid.
3. This group will hi-rail the proposed rail laying site to determine what forces must do to prepare the track for welded rail, to validate the program and quantities of material required and to ensure this material is available for installation. This inspection should include identification of any rail determined to be suitable for reuse “self-help rail”. Refer to MWI 508 for certified rail requirements.
4. If there is any item(s) on which agreement cannot be reached during the inspection, the representatives will jointly discuss the item(s) with the CFRC Maintenance of Way Manager for a decision. The decision made will be added to the inspection notes.
5. The Chief Engineer will attach the pre-trip packet mentioned in Paragraph B.2. (below) to the notes and forward copies to all individuals making the inspection for their review. The final packet will be distributed to at least the Chief Engineer, CFRC Maintenance of Way Manager, and the Roadmaster.

B. PRELIMINARY WORK

1. The Chief Engineer will advise the group of the method, equipment, and team that will be used to lay the rail. The Track Manager will maintain the inspection notes listing the work which needs to be done before the rail can be laid.
2. Track Manager will prepare a pre-trip packet of the project. Items to be included in the packet are but not limited to the following:
 - a) Straight line sketch of the work area

- b) Starting and ending locations.
 - c) Storage areas for released track material.
 - d) Identify rail for self-help and method of communicating this information to preclude errors by contractors or employees.
 - e) Equipment clearing and tie up points.
 - f) Road Crossings at grade: If to be worked, give locations, lengths, material to be used, and specific work details, including street name or DOT crossing number. (see MWI 901 for additional reference)
 - g) Turnouts to be replaced: Give size and hand, type of rail fastening system, power or hand operated, type frog to be installed, length of rail required for diverging side so compromise joints are off the switch ties, milepost location or name of switch. If panelized turnouts will be used, identify locations, methods of unloading and installation.
 - h) Railroad Crossings at grade: If to be replaced, give angle, type of crossing, tie condition, milepost location.
 - i) Indicate any special track or signal material to protect wayside equipment.
 - j) Identify the locations for insulated joints, compromise joints, and transition rails.
 - k) Identify the existing fastening system and the planned fastening system.
 - l) Locations using relay rail will use relay tie plates, when available. Relay tie plates may be used with new rail on tangent track with less than 25 MGT, when available.
 - m) Identify screw spike and lock spike (hairpins) locations.
 - n) Locations of recent curve patch, which do not meet the relay criteria, will be inspected and tie-in points identified.
 - o) Spot check of tie spacing in each mile to assist in ordering tie plates and anchors.
 - p) Bridge types and lengths. Required Open Deck Bridge Tie Fastening must be complied with before welded rail can be laid across a bridge.
 - q) Tunnel locations and lengths. Arrange for lighting, ventilation, and air quality monitoring if required.
 - r) Locations at which special track material is required, and other items that may affect rail installation.
 - s) Indicate Bridge locations that require fall protection.
 - t) Prepare a local Emergency Response Plan including telephone numbers and highway directions to the nearest hospital or medical facility, police and fire departments, and rescue service.
3. The Track Manager and/or Roadmaster will be responsible for coordinating activities prior to the arrival of the rail laying team. This includes but is not limited to:
- a) Preparing the list of track material required and ordering in accordance with current instructions.
 - b) Coordinating with appropriate Manager to ensure that materials arrive on time.
 - c) Performing any track work specified on the inspection notes.

- d) Distributing track material as stated in the pre-trip packet.
 - e) Uniquely identifying rail approved for self-help.
 - f) Unloading rail from rail trains. Ribbons to be unloaded end to end but mismatched, so that the rail ends cannot bind against each other.
 - g) Arrangements should be made to unload rail through road crossings. Unloading for turnouts should be accomplished with only one cut.
 - h) Discussing the proposed work and curfews with the local Transportation Officers to obtain the maximum possible track time.
 - i) Identifying high density road crossing areas, develop plan to assist rail team to maintain maximum productivity.
 - j) Coordinating the blocking of road crossings with state and local authorities.
 - k) Cutting bituminous concrete at road crossings beyond heads of ties to allow room for cribbing and adzing ties.
 - l) Monitoring the progress of work listed on the inspection notes.
4. The Bridge Manager will be responsible for:
- a) Checking bridges to see that they comply with current instructions for laying welded rail and bringing them into compliance where necessary.
 - b) Providing the location of all bridges that require special handling before welded rail can be laid over them to the Chief Engineer.
 - c) Arranging for tunnel ventilation and/or lighting as needed.
 - d) Arranging for outriggers on bridges without sufficient width to support both the new rail being laid and the rail being removed.
 - e) Assist in any special needs for fall protection equipment or bridge specific systems.
 - f) Developing a fire prevention plan for open deck bridges to allow heating of the rail if rail temperature adjustment is necessary. Arrange for a water truck if necessary to protect bridge structures.
5. The Signal Manager will advise the Signal Maintenance Manager of any installations in the work area that do not conform to current signal requirements and could be changed economically to the current Requirement. Consideration should be given to scheduling Signal maintenance or construction activities at this time to take advantage of the curfew or track time given to the rail laying gang.

C. MATERIAL DISTRIBUTION PRIOR to ARRIVAL of TEAM

- 1. Production Teams use bulk delivery for much of the material needs to reduce double handling and eliminate waste. Those materials not handled bulk by the team need to be arranged for by the Track Manager working with the Roadmaster. Details of material distribution requirements follow:
 - a) Propane for rail heaters. Manager – Production Teams will advise Roadmaster of required amount.

- b) Tie Plates, two (2) per tie right side up within the rails if plates are to be replaced. They must be placed along of the centerline of the track. One plate on the tie, one in the crib. Care must be taken to ensure that tie plates do NOT interfere with the Signal System. (bridging track circuit)
 - c) Compromise joints specific to the project will be supplied at the beginning of the project and unloading as designated in the pre-trip inspection. Joint bars must be available in case welding cannot be completed by the end of the day.
 - d) Rail anchors, spikes, screws, or Pandrol clips will be handled bulk through team supply chain.
 - e) Track bolts, nuts, and washers, will be handled bulk through team supply chain.
 - f) Tie plugging material or tie plugs will be handled bulk through team supply chain.
2. At specific locations within the rail laying area.
- a) Distribute insulated joints and transition rails adjacent to their installation location
 - b) At turnout locations: Depending on the method of installation outlined in the pre-trip packet, the frog, switch points, stock rails, guard rails, etc., are to be turned in the proper direction for installation and unloaded as near as possible to the installation location.
 - c) At bridges: Tie pads for bridge ties.
 - d) At road crossings: Crossing material and hardware.
3. The track material distribution shown in Paragraph II.B. 1 – 3 above is based on typical CWR projects installed by production teams. If CWR is laid by division teams, material unloading may be adjusted, as needed, to accommodate specific project requirements and method of installation.

E. MATERIAL RELEASED from RAIL LAYING

- 1. Track material released from rail laying will be placed for pickup on the side of track away from the ballast line. Walkways and ditches must be kept clear. Do not place beneath overhead wire lines.
- 2. Tie plates will be placed apart from other material. If spikes, anchors, and joint bars are picked up separately during rail laying, they will be kept and loaded separately. If spikes, anchors and joint bars are picked up mixed during rail laying, they will be loaded mixed.
- 3. Empty gondolas will be arranged and spotted in an accessible location by the Roadmaster to be loaded with scrap OTM and scrap rail.
- 4. OTM and self-help rail should be clearly marked and discussed during the job briefing to ensure understanding by all parties. Contact Chief Engineer if there are any questions regarding self-help rail authority.

F. QUALITY CONTROL

1. The Chief Engineer or his designated representative will continuously monitor the quality of the work and ensure that all work is completed in a quality manner.
2. The Roadmaster and Track Manager will jointly hi-rail behind the team every week or for short rail lots, upon completion of the rail lot, to verify the quality of the work, the completeness of the project and to confirm that the plan is being followed.
3. The Track Manager will make frequent trips to the team and observe the quality of the work. Where practicable, the rail lot should be inspected by hi-rail with the Track Manager before the team leaves the rail laying location. This trip must occur with sufficient time before the team completes the project to allow for any corrective action to be taken prior to the team's departure from the project. If there is any question concerning any of the work underway or completed, they will immediately discuss with the Chief Engineer.

EMERGENCY RESPONSE PLAN

WORK LOCATION

Division: _____

Starting Date: _____

Subdivision: _____

Team Number: _____

Starting Milepost: _____

Ending Milepost: _____

EMERGENCY RESPONSE DIRECTIONS FROM WORK LOCATION TO NEAREST MEDICAL FACILITY

(Give highway exit numbers and other landmarks that will aid in finding the facility. Give mileage to the nearest tenth of a mile.)

EMERGENCY TELEPHONE NUMBERS

Rescue: (____) _____

Name: _____

Police: (____) _____

Name: _____

Fire: (____) _____

Name: _____

CFRC Radio Channel for Dispatcher: _____

Chief Dispatcher: (____) _____

Chief Engineer: (____) _____

Roadmaster: (____) _____

III. REPORTS

- A. The Track Manager will ensure that the Daily Production Reports are input into the appropriate computer system in Maximo, completed with a hand held device, faxed in using the proper form, or telephoned into the office. These reports must be completed for each day's production. Care must be exercised to ensure that all information is accurate.
- B. Track Manager will prepare and forward the pre-trip packet as identified in Paragraph A.6 within one (1) week of the completion of the hi-rail trip.
- C. Roadmaster will ensure that the rail laid and released in the CWR project is properly charged out in their inventory account within one (1) week after the rail team moves to the next project.

Prepared by: RMW

Approved by: 
Miguel Torres - CFRC Chief Operating Officer

PURPOSE:	To establish uniform policy and procedures for out-of-face, smoothing and spot surfacing teams.
SAFETY:	Observe all applicable Safe Job Procedures and Safety Rules and Regulations.
LOCATION:	All CFRC maintained tracks.
ENVIRONMENTAL:	Observe all applicable Federal, State, Local Environmental Rules and Regulations.

I. DISCUSSION

- A. The goal of this track surfacing policy is to ensure that the work meets or exceeds all CFRC and FRA Standards, as well as Engineering Department goals for safety and quality. Because surfacing work is done in a wide variety of conditions, these instructions will define the process by which agreed upon results can be obtained. The success of this process will require a coordinated effort from a team of Officers, which includes Transportation, Maintenance of Way, and Communications & Signal.
- B. All surfacing operations must be performed in the proper sequence and in a uniform manner. Special attention must be placed on turnout, bridge, tunnel, crossing, and restricted clearance location work. It must be kept as close as possible to the general surfacing.
- C. The track being worked will be protected by an appropriate temporary speed restriction during any period that it is not safe for authorized speed. Refer to *MWI 1109*.
- D. Current instructions governing jointed and welded rail track maintenance in hot weather will be followed carefully. The Roadmaster will arrange to adjust rail, which requires adjustment by cutting, ahead of surfacing operation.
- E. Muddy or fouled ballast locations should be cribbed or undercut in advance of surfacing operations where possible. The forces, as agreed upon in the planning meeting, will do this work. Ballast cleaning, if required, should be done in advance of the surfacing.
- F. Switch timber or spot tie installations should be done in advance of the surfacing operation. The forces, as agreed upon in the planning meeting, will do these installations.
- G. Road crossings are most efficiently re-worked during the Timbering Program. The surfacing program normally ties into the existing road crossings. Only those crossings, which have drainage or geometry defects, should be re-worked within the surfacing program.

- H. Maintenance crews will completely surface all ties installed at the end of each workweek.

II. PROCEDURES

A. DISTRIBUTION OF BALLAST

1. When distributing ballast, care must be taken to control the flow of the material. The Roadmaster will ensure that the proper amount of ballast is unloaded, consistent with the required raise and the CFRC Required Ballast Section (refer to typical drawing 2602).
2. Ballast will not be unloaded on open deck bridges, highway crossings, defect detectors, or other areas where it will damage equipment or interfere with operations. Special care must be taken to ensure that switches can be properly thrown. Sufficient ballast must be provided to do the diverging side of turnouts, ballast decked bridges, and approaches to open decked bridges.
3. When cars are discovered containing excess fines, or other non-desired materials, the employee in charge of unloading will inform the Roadmaster. The Roadmaster is responsible to see that the car number(s) are reported to the employee responsible for ballast cars.
4. Ballast unloading will be kept current with all surfacing operations.

B. SURFACING OPERATING

1. The Surfacing Team Supervisor/Foreman will determine the amount of track raise. The track raise will be based on the available ballast and the following criteria:
 - a. The minimum height necessary to maintain proper profile, superelevation, and required ballast section.
 - b. Sufficient space under the tie to allow ballast to be inserted and compacted.
2. When more than one tamping machine is working in tandem, the foremen and operators must have a clear understanding concerning which ties each tamper will tamp.
3. When more than one tamping machine is working in adjacent areas, operators must have a clear understanding concerning the reference rail and runoffs made between tampers.
4. If a tamper malfunctions during surfacing operations in a manner that adversely affects the quality of the raising, aligning or ballast compaction, the following actions are required:

- a. A temporary runoff of superelevation or track raise, appropriate to the temporary speed restriction, will be made.
- b. The track will be protected by a temporary speed restriction, not exceeding 25 MPH.

Before this temporary speed restriction is removed, the entire limits of the affected area (including the entire curve) must be checked, and reworked if necessary, with a fully functioning tamper to ensure that the quality of the line and surface is consistent with CFRC Requirements.

Some examples of applicable malfunctions are ineffective tamping tools, lifting, lining, or slewing component problems, as well as measurement and data system components problems, etc.

5. The foreman and operators will make inspections, on at least a daily basis or when the rail height changes, to ensure that tamping tools are maintained and adjusted as follows:
 - a. All tamping tools must be in place and functional.
 - b. Tamping tools should be adjusted so that the top of the tool pad is $\frac{1}{2}$ " below the bottom of the crosstie at full insertion.
 - c. Tamping tools should be replaced when the tamping tool pad wears to a dimension of less than 1-3/4" high x 4" wide as measured on the smallest side.
 - d. When changing tamping tools, the *tamping tool pad must not be struck with a hammer* due to the danger of metal chipping from the hardened surface of the pad. The tamping tool will be removed by the method recommended by the machine manufacturer.
 - e. Special attention must be used when tamping concrete ties to ensure correct depth penetration is obtained. Failure to have correct depth penetration will result in damage to the ties if the tamping tool pads press against the side of the ties during the squeeze cycle. Also, care must be used to avoid unintended tie movement and damage to the concrete tie pads.
6. Surfacing operations on or near bridges, at tunnels, at overhead bridges or at other areas of restrictive clearance will conform to the following:
 - a. Ballast section at the ends of bridges will be kept clean and well drained with ties fully supported at proper elevation to conform to that of the bridge.
 - b. Tracks at ends of the bridges, trestles and through tunnels must be kept in good line and surface at all times.

- c. The surface of track shall conform to the existing approach profile of open deck bridges and tunnels.
- d. Required ballast section must be maintained on ballast deck bridges. Therefore, the track shall not exceed an elevation that allows the top of ties to be more than:
 - 1) Four (4) inches above the ballast curb on concrete bridges; or
 - 2) Nine (9) inches above the timber ballast curb on timber bridges.

CAUTION: Ensure that materials do not fall onto roadways or into waterways.

- e. There shall be no changes that reduce the clearance of tracks through tunnels without the prior approval of the CFRC Maintenance of Way Manager.
 - f. Tracks under overhead structures must not be raised to a height that reduces the minimum route clearance, without the prior approval of the CFRC Maintenance of Way Manager. In general, the clearance under each structure should be reviewed to ensure that future route clearance improvement projects would not be adversely impacted.
 - g. Track centers will not be reduced below the minimum route clearance during lining. The Chief Engineer or his designated representative will check restrictive locations in advance of the surfacing team. The track alignment on ballast deck bridges must not be changed without prior approval from the CFRC Maintenance of Way Manager.
- 7. Ballast will be pulled into shy areas as quickly as possible behind the tamping machine and before the end of the workday. Pulling fouled ballast into the ballast section is not permitted.
 - 8. The foreman will make periodic inspections during ballast regulation operations to ensure that care is being taken:
 - a. Do not damage adjacent property, especially at highway underpasses.
 - b. Do not pull fouled ballast or other undesirable material into road crossings. The regulator should work away from the crossings whenever possible.
 - c. Do not damage rail fastening systems.
 - 9. Special care must be taken to ensure that rail anchors within the work area are properly seated against the ties. In elastic fastener areas, ensure that missing fasteners are replaced. When the entire curve is worked, the completed project will comply with *MWI 1113*.
 - 10. When a track stabilizer is used, a sufficient ballast section must be established before the stabilizer passes.

C. MAINTAINING CURVE GEOMETRY

1. Both vertical and horizontal curve geometry and superelevation will conform to CFRC Requirements. Refer to *MWI 1104*.
2. The Chief Engineer will ensure that the Surfacing/Smoothing Team has an accurate copy of the *track charts*, that conforms to current CFRC Requirements, before the work begins. He or a qualified designated employee will determine if advance curve measurement is required for the surfacing/smoothing work and furnish the information to the Surfacing/Smoothing Team.
3. The Foreman/Assistant Foreman, working with the surfacing unit, will mark the control points (TS, SC, CS, and ST) on all curves worked within out-of-face, smoothing, and spot surfacing projects with blue paint.
4. If the surfacing/smoothing work will be done utilizing a tamper equipped with a Computer Aided Geometry System (CAGS) or equal, the tamper can be used to measure the curves. The TS, SC, CS, and ST points will be located while tamping and marked by painting the inside and outside web of the rail blue. All curve data generated by the CAGS must be furnished to the Roadmaster before the surfacing team leaves the Roadmaster's territory.
5. If the surfacing/smoothing work will be done utilizing a tamper that is not equipped with CAGS or capable lining system, the starting and ending points of each curve can be located using a 62-foot chord. Data furnished from a Geometry Vehicle, which has a system that furnishes the information, should be used to determine the accuracy of existing records and if any advance work will be necessary prior to commencing the surfacing and lining operation. The TS, SC, CS, and ST points will be located and marked by painting the inside and outside web of the rail blue.
6. The following procedure will be followed to ensure that track stability is maintained on main and branch lines where:
 - the track is laid with continuous welded rail,
 - on curves one degree (1°) or greater where the maximum authorized speed is 25 miles per hour or greater or on all curves greater than three degrees (3°),
 - and an expected rail temperature of 50° Fahrenheit or below within 24 hours of the work.

Work during these conditions can create situations that lead to “adding” rail to the track, thereby affecting the track’s neutral temperature. The following procedures will assist in evaluating the track.

- a) When the track is to be disturbed, the Roadmaster must ensure references are set at five or more locations before the work is performed. The references will be located at:
- tangent to spiral (TS)
 - spiral to curve (SC)
 - mid point of the curve
 - within the body of the curve, as necessary,
 - curve to spiral (CS)
 - spiral to tangent (ST)

The reference may be a fixed object or a 2" x 2" x 12" wood stake. They should be spaced no more than listed below if practicable:

- 100 feet apart on curves 9° and above
- 200 feet apart on 4° to 9° curves
- 400 feet apart on 2° to 4° curves
- 800 feet apart on 1° to 2° curves

and must be clear of maintenance activities. Do not place stakes at the ends of ties or in walking areas.

Measurements should be taken from the field side head of the near rail to the face of the fixed object or the top near face of the stake. The tape used to make the measurement should not slope more than 1 vertical to 4 horizontal. A record of the reference stake location information will be furnished to the Roadmaster before the Surfacing or Smoothing Team leaves the territory. Use the *Curve Alignment Reference Form* that is included with this MWI to document this information.

- b) During the work the rail temperature will be measured three times during the workday. The high and low temperatures will be recorded on the *Track Disturbance Record* and the report will be furnished to the Roadmaster. The measurements will be taken at the beginning, middle, and the end of the workday on the shady side of the rail web with an approved thermometer. The appropriate temperatures will be recorded on the *Curve Alignment Reference Form* and the *Track Disturbance Rail Addition Record* and the reports will be furnished to the Roadmaster. The *Track Disturbance Rail Addition Record* is to be furnished to the Roadmaster.
- c) The Roadmaster or his designated representative will record the amount of movement periodically for up to 15 days after the work has been completed. If the curve moves inward more than an average of 1", a *Track Disturbance Rail Addition* record must be completed. The Roadmaster is responsible for remedial action prior to hot weather. Corrective action will be one or more of the following:
- Place the curve on its original alignment.
 - Adjust the rail.
 - Place a temporary speed restriction not to exceed 25 MPH until one of the above is accomplished.

Stakes, that could become a tripping hazard, should be removed as soon as possible.

7. Freshly surfaced track will require a temporary speed restriction. See *MWI 1109* for proper application of the temporary speed restriction.

D. FINISHED TRACK GEOMETRY

1. The minimum quality information shown below applies to out-of-face and smoothing teams. Teams with mechanical equipment must comply with *MWI 1113, Surfacing Section*.
2. The deviation from zero (0) cross level on tangent and designated elevation on curve will not be more than:

Track Class	1	$\frac{1}{2}''$
Track Class	2	$\frac{1}{2}''$
Track Classes	3 & 4	$\frac{3}{8}''$
Track Class	5	$\frac{1}{8}''$
Track Class	6	$\frac{1}{8}''$

3. The deviation from uniform profile (sags or humps) in 62 feet will not be more than:

Track Class	1	1"
Track Class	2	$\frac{3}{4}''$
Track Classes	3 & 4	$\frac{1}{2}''$
Track Class	5	$\frac{3}{8}''$
Track Class	6	$\frac{1}{4}''$

4. The deviation from proper alignment on spirals and curves at the midpoint of a 62 foot chord will not be more than:

Track Classes	1 & 2	1"
Track Classes	3 & 4	$\frac{5}{8}''$
Track Class	5	$\frac{1}{8}''$
Track Class	6	$\frac{1}{8}''$

5. Line swings at the end of spirals will not be permitted. Line swings on tangents which deviate from true line at the rate of more than one inch per hundred feet will not be permitted.
6. Rates of runoffs will be equal to or less than one (1) inch in 100 feet at the end of finished work.
7. Runoffs on the diverging portion of turnouts must be located off the long ties and must comply with paragraphs D 2, 3, and 4 above.

E. FINISHED BALLAST SECTION

1. The cross section of dressed ballast after compaction and expected settlement will have full cribs and shoulders that conform to the Required Ballast Section. Refer to *CFRC Typical Drawing 2602*.
2. Excess ballast on the shoulder or in the track will not be permitted at highway and railroad crossing approaches, or defect detectors.
3. Excess ballast will be removed from bridge walkways, abutments and curbs, station platforms, and turnouts.

F. OTHER

1. Communication & Signal Equipment - Care must be taken during surfacing operations to avoid damage to wayside Communication & Signal equipment. When surfacing in and near defect detectors, refer to MWI 1121 for detailed procedures.
2. When surfacing switches, use care around snow melters. Do not damage equipment.
3. Road Crossings - Materials unloaded for use in reworking road crossings and materials removed from road crossings should be placed in a vacant quadrant of the crossing, where possible. These materials should be placed in a manner that will not interfere with the clear line of sight for a highway user or rail equipment operator, and will not interfere with the functioning of the road crossing control signal equipment. Care must be taken to maintain visibility, walking conditions and not impede drainage. Disposal of asphalt and other materials removed from the crossing will use a method consistent with CFRC environmental policy. See *MWI 901* for detailed road crossing information.

III. REPORTS

- A. The Surfacing/Smoothing Team Supervisor/Foreman will ensure that:
1. Daily Production Reports are completed and submitted at the end of each production day,
 2. Track Disturbance Record is completed daily and furnished to the Roadmaster at least weekly,
 3. All curve data generated by the CAGS is furnished to the Roadmaster before the surfacing team leaves the Roadmaster's territory, and
 4. A record of the reference stake location information will be furnished to the Roadmaster before the Surfacing/Smoothing Team leaves his territory. Use the *Curve Alignment Reference Form* that is included with this MWI to document this information. An Excel version of this form is also available.

B. The Chief Engineer will ensure that the *track charts* are updated within 30 days after completion of the work.

Prepared by: RMW

Approved by: Miguel Torres
Miguel Torres - CFRC Chief Operating Officer

CURVE ALIGNMENT REFERENCE FORM

Division _____	Subdivision _____	Track _____	Deg Curve _____
Milepost: _____	Prefix _____	Begin _____	End _____
Work Direction: _____	(low to high MP)	(high to low MP)	(other _____)
Type of Fasteners: _____	(rail anchors)	(Pandrol plates)	_____
Team No. _____	Team Type _____		

	DATE				
	RAIL				
	TEMPERATURE				
	RECORDER				
NO	DESCRIPTION	MEASUREMENT 1 Before Work	MEASUREMENT 2 After Work	MEASUREMENT 3 Follow Up	MEASUREMENT 4 Follow Up

NOTES:
 References should be marked fixed objects or wood stakes if practicable.
 Number reference points in sequence in the direction of work.
 In "Description", note TS, SC, CS, ST, and identify reference.
 Measure from the field side of the near rail to the face of fixed object or stake. References should be spaced no more than:
 100 feet on curves 9 degrees and above
 200 feet on 9 degree to 4 degree curves
 400 feet on 4 degree to 2 degree curves
 800 feet on 2 degree to 1 degree curves
 Reference stakes must be clear of maintenance activities, walking areas, and tie ends.



PURPOSE:	To establish the policy governing Temporary Speed Restrictions.
SAFETY:	Observe all applicable Safety and Operating Rules and Regulations and Safe Job Procedures.
LOCATION:	All CFRC tracks.
ENVIRONMENTAL:	Observe all applicable Federal, State, Local Environmental Rules and Regulations.

I. DISCUSSION

- A. Temporary Speed Restrictions are short duration speed reductions on specific segments of track. They are used when work activities or track conditions restrict the safe movement of trains at Timetable speed. For example, Temporary Speed Restrictions are required, but not limited to the following conditions:
1. Tracks that do not meet the CFRC or FRA Standards for the designated speed.
 2. Tracks that are weakened due to construction or maintenance work on rail, ties, ballast, roadbed, structures, etc.
 3. Tracks that are damaged by accidents.
 4. Adverse or extreme weather conditions.
- B. CFRC covers a large geographic area with varying climatic conditions. Chief Engineer and Roadmaster, and their responsible subordinates are more familiar than anyone else with the characteristics of the track structure and the weather conditions that occur on their respective territories. CFRC relies upon all employees to use good judgment at all times while implementing these instructions and ensuring that the track is properly protected.

II. PROCEDURES.

A. Placing Temporary Speed Restrictions

1. Contact the Train Dispatcher or Control Station and furnish the following information:
 - The Timetable Subdivision on which the temporary speed restriction is to be placed.
 - The Track Type Code of the track on which the restriction applies. The codes are shown on page 11 of this document.

- The speed(s) at which trains may operate. Give passenger train and then freight train speeds.
- The beginning prefix and milepost of the restriction (smaller number).
- The ending prefix and milepost of the restriction (larger number).
- Are Temporary Reduce Speed, End Restriction and Warning signs displayed? Yes/No
- The Engineering Reason Code for the restriction. (The codes are shown on page 12.)
- The initials of the employee issuing the temporary speed restriction.

The temporary speed restriction is effective only after the Train Dispatcher repeats the information and the message number is assigned.

2. Employees that issue temporary speed restrictions should have a copy of the current speed restrictions for the Subdivision to ensure that overlapping milepost limits are not requested.
3. Limits of temporary speed restrictions should be extended, where necessary, to avoid heavy braking on sharp curves, bridges, bridge approaches and recently disturbed track.
4. If there are locations requiring temporary speed restrictions separated by short sections of track, it may be advisable to include them within a single speed restriction. The best course of action will depend on the geography and train operation. Items to consider are:
 - Length of time restrictions will be on.
 - Difference between timetable speed and restricted speed.
 - Type of train operation (passenger vs. heavy freight).
 - Train delay – Short trains can take advantage of space between speed restrictions while long ones may not.
 - Curvature / grade and resulting dynamic action from acceleration and braking.
 - Possible train crew confusion interpreting temporary speed restriction signs when restrictions overlap or are within 2 miles of each other.Good judgment is needed to optimize speed restriction placement.
5. The temporary speed restriction should be the highest speed at which a train may safely pass over the restriction. Speeds of 10 MPH, 25 MPH and over, with increasing increments of 5 MPH may be used when placing the restriction. Speeds between 10 and 25 MPH must not be used on jointed rail track due to harmonic rocking of cars.
6. Temporary speed restriction signs (Typical Drawing 2724) will be placed in accordance per the Operating Rules. If speed restriction will remain on track over night, the signs must be installed.
7. Temporary speed restrictions may cause problems on curves due to trains moving at

speeds below the design speed. The superelevation in these curves tends to increase due to the additional weight on the low rail. Also this unloading of the high rail can lead to wheel climb or lift, especially if the alignment is irregular. The curve should be checked periodically in the vicinity of the temporary speed restriction to detect these and other undesirable conditions.

8. When track is being worked and it is known that it will be opened to traffic with a speed restriction, inform the dispatcher as soon as possible.
9. The Roadmaster should be notified immediately of any temporary speed restriction placed on his territory. The notification should contain, as a minimum the location, the nature of the problem, and an estimate of the material, labor, and time required to repair the track.
10. General Bulletins may be used for temporary speed restrictions if the track conditions or repairs will take an extended period of time (over 30 days) to correct or complete. Obtain concurrence from the Chief Engineer. The request will contain the information identified in paragraph II.A.1.above.

B. Removing Temporary Speed Restrictions

1. Priority in removing temporary speed restrictions should be given to those that cause train-handling difficulties. Speed restrictions placed at isolated or individual locations should be given priority for removal over other locations where a series or group of temporary speed restrictions exist in a relatively short distance.
2. The Roadmaster or designee should remove temporary speed restrictions placed by Engineering Department personnel, after inspection, and as soon as possible.
3. After being advised the restriction is no longer required, the Train Dispatcher will remove the temporary speed restriction.
4. The Engineering Employees removing a temporary speed restriction should have a current copy of the Dispatcher bulletin for the territory in his possession to ensure that gaps in restrictions are not created.
5. The Chief Engineer will initiate the request to the Division Manager to cancel a General Bulletin containing a temporary speed restriction. The Engineering Department Supervisory Employee-in-Charge must notify the Chief Engineer that the track condition has been corrected or the work completed and the restriction is no longer required before he can initiate the request to cancel the General Bulletin.
6. Signs associated with the Temporary Speed Restriction must be removed in conjunction with the removal of the temporary speed restriction. If this is not accomplished, trains will comply with the appropriate operating rules and experience unnecessary delay.

C. Tracks Not in Compliance with CFRC or FRA Standards

1. If a segment of track does not meet all the requirements set by CFRC or FRA, the maximum authorized speed will be reduced to the speed at which it is in compliance.
2. Placing temporary speed restrictions on tracks inspected by Rail Test, GMS/TGC, and Gage/Cross level vehicles are covered in the following MWI's:
 - MWI 501 - Remedial Action for Defects Identified by Rail Test Cars
 - MWI 1102 - Geometry Measurement System Car (GMS) Operations
 - MWI 1106 - Geometry Truck Operation
 - MWI 1111 - Track Geometry Car (TGC) Operations

D. Tracks under Repair

1. Guidelines for Temporary Speed Restrictions are given in the Chart "*Required Actions for Preventing Track Buckling*" which is included in this MWI.
2. Speed through a work area will be reduced, as necessary, to protect the employees making the repairs and the train traffic in the work area.
3. The Employee In Charge of the work will follow procedures given in the Operating Rules and On-Track Safety Rules when providing protection for employees and train traffic.
4. A temporary speed restriction will be placed on all tracks under repair when ballast is insufficient to maintain track stability. After the ballast section has been restored, removal of the temporary speed restriction will be governed by instructions specified in the Chart "*Required Actions for Preventing Track Buckling*" dated the same as this MWI. This current chart is also included in the CFRC *Engineering Field Manual*. (Additional information is provided in Part 7, Track Buckling Prevention Guidelines in the *Field Manual*.)
5. The Roadmaster will maintain completed *Track Disturbance Reports* where the integrity of the track structure has been disturbed.

E. Track Damaged by Accident

1. A train accident or emergency brake application may cause severe damage to track and roadbed. A track on rebuilt roadbed will take longer to stabilize than one that has been shifted on an existing roadbed. The length of time that a temporary speed restriction must remain in effect depends upon the unique conditions at each incident.
2. If the track is damaged to the extent that five (5) or more ties per 39 ft. are replaced or track panels are installed, a 10 MPH temporary speed restriction will be placed on the first train over the damaged track segment. Prior to the second train, a walking inspection will be made of the track. The inspector will be looking for changes in

alignment and surface caused by the passage of the first train. After any necessary track repairs have been completed and the ballast section is sufficient to maintain track stability, then:

- a. If rail temperature is less than 110°F, speed will not exceed 25 MPH (See c).
- b. If rail temperature is 110° F or higher, at least two (2) tonnage trains will be operated at 10 MPH. The 10 MPH restriction will continue until rail temperature has dropped below 110° F (See c).
- c. Depending on the work performed, further removal of the temporary speed restriction will be governed by the instructions specified in the Chart "*Required Actions for Preventing Track Buckling*" dated the same as this MWI.

F. Hot Weather Conditions

1. Temperature criteria:

- a. *Hot Weather* is defined as an ambient temperature of 85° F or higher or rail temperature 110° F or higher.
 - b. *Significantly Increasing Temperature* is defined as ambient temperature fluctuations that occur primarily in the spring of the year where the temperature may change in excess of 40°F from night to mid-day.
2. CWR and tight jointed rail will be inspected daily on *Hot Weather* days or during periods of *significantly increasing temperature*. This is especially important if a temporary speed restriction has been placed because of potential buckling. Inspect between 1200 and 1800 hours. Track not properly maintained during cold weather may buckle during a period of widely fluctuating temperatures or on the first warm spring days.
 3. *Hot Weather Inspections* may be lessened or suspended after temperatures have stabilized and previous inspections have shown that the track structure is sound and complies with requirements.
 4. When in doubt about the temperature, inspect your track. This is especially important on weekends and holidays.
 5. Roadmasters must be familiar with the potential problem areas on their territory. They will ensure that these locations are given priority in carrying out these inspections to safeguard their territory.
 6. Track, which IS NOT in compliance with the CFRC requirements for rail adjustment, ballast section and rail anchor pattern, may require a temporary speed restriction due to *Hot Weather*. Refer to the *Track Buckling Prevention Guidelines* section of the *Engineering Field Manual* for more information.

7. Where track and operating conditions warrant, the following should apply:

During extended periods of high temperature or extreme daily fluctuations, it is the responsibility of the Chief Engineer or his designee to identify these locations and have a train message issued per CFRC operating rule 301.6, Heat Warning when required based on track and train conditions.

The following criteria govern the implementation of a Heat Warning dispatcher message:

- a. *Extended Periods of High Temperature* is consecutive days exceeding:
 - i. 90 degrees north of Pierson, Florida, and Ocala, Florida, or
 - ii. 95 degrees south the aforementioned locations.
- b. *Extreme Daily Fluctuation* is a daily change of 40 degrees or more.
- c. If the restriction is to be listed as milepost segments, that information must be issued to the Operations Center by 2100 hours the day before it is to go into effect.
- d. Heat Warning will remain in effect until canceled.
- e. If actual weather conditions vary from forecast conditions and a Heat Warning is not warranted, it must be canceled with the Operation Center as soon as possible.
- f. The Chief Engineer may suspend the use of this Heat Warning after the temperatures have stabilized and previous inspections have shown that the track structure is sound and complies with the Requirements.

G. All Weather Conditions

1. Temporary speed restrictions must be used to protect the following work operations, which normally do not require cutting rail. The chart in the back of this instruction defines the required actions. This information is also shown, in more detail, in Part 7 of the *Engineering Field Manual*.
 - Crosstie and switch tie replacement
 - Grade crossing renewal
 - Spot surfacing, spot cribbing or smoothing
 - Surfacing out of face or at a bridge approach
 - Shoulder ballast cleaning
 - Spot undercutting and undercutting out of face
 - Bridge work
2. Temporary speed restrictions must be used to protect the following work operations, which normally require cutting the rail. The chart in the back of this instruction defines the required actions. This information is also shown, in more detail, in the *Engineering Field Manual*.

Whether the rail has been adjusted to CFRC requirements or not **and** one or more of the following activities have disturbed the stability of the track structure:

- Where rail length has been increased due to repairs of pull-aparts, broken rails, defective rails or rail joint removals
- Curves that have chorded or moved inward due to maintenance work or cold weather
- Turnout or road crossing installation
- Track panel installation
- Rail laying out of face
- Curve patch rail
- Transposing welded rail
- Any other work that would reduce the adjusted rail temperature below the temperature specified for that location in MWI 1125

A report must be made (see item 3 below).

3. When any of the activities or conditions identified in sections II.G.1. & II.G.2. are performed, regardless of rail temperature, a *Track Disturbance Report* (see page 13) must be completed. Input the information into the Track Disturbance Management System in the Engineering Gateway. The *Track Disturbance Report* should be reviewed periodically to ensure that temporary speed restrictions are placed when temperature conditions warrant.
4. If the maintenance is rail or joint repair, a *Pull Apart and Rail Repair Reporting Form* should be used to collect proper information to input into system. See page 14 for a sample of this form.
5. The Roadmaster will submit a *Buckled Track Report* (see page 15) for all incidences of heat caused lateral track displacements except those occurring during the time the track is being worked. In work areas, lateral movements occurring after the days work activities have been completed or under a train passing through the work area must be reported.

H. Cold Weather Conditions

1. On main tracks, cold weather inspections must be performed as directed by the Roadmaster when the ambient temperature is forecast to drop to 0°F or below. Temporary speed restrictions will be set by the Chief Engineer or his designee. Removal of the temporary speed restriction will be at the discretion of the Chief Engineer or his designee.
2. Inspect for:
 - Broken rails
 - Broken or cracked joint bars (Conventional and Insulated)
 - Pull-aparts
 - Broken and bent bolts

- Wide gap between rail ends
- Curve movement
- Canted rail

Subsequent inspections should be made as required by track conditions and consideration of non-sigaled territory.

3. The Roadmaster will maintain a current list of and pay special attention to locations with anchor patterns not meeting requirements so that inspections and temporary speed restrictions can be issued when required.

I. Strong Wind Weather Conditions

Tracks are not usually damaged by strong winds to the extent that temporary speed restrictions are required. However, temporary speed restrictions or “look out” orders should be issued for areas where wind has caused problems in the past and it is not possible to inspect the track prior to train operations. The speed reductions should be tailored to the severity of the previous problems. Temporary speed restrictions will be removed as soon as the problem has been corrected.

J. Heavy Rain and Flash Flooding Weather Conditions

1. Rainfall can produce large quantities of water that can cause track damage:
 - by washing out bridges, pipelines, roadbed and ballast,
 - by slides and rock falls onto the track, and
 - by making the track impassable from flooding.

The tracks should be inspected as necessary. In some areas, portions of track will be flooded while other portions are not. If the track is accessible, it should be inspected while waiting for the water to recede.

2. Temporary speed restrictions will be placed on specific segments of track that are known to be susceptible to drainage, flood, and/or slide problems. The speed reduction should be consistent with the severity of the conditions. It may be necessary to take a track out of service if high water prevents visual inspection of roadbed in areas that are known to have scouring problems. Temporary speed restrictions should be removed as soon as possible after the track structure has been repaired and the roadbed has stabilized.
3. A list of all locations vulnerable to drainage, flood, and/or slide problems will be maintained at the Roadmaster and Chief Engineer levels so that problem areas can be quickly identified and proper track protection implemented as weather conditions dictate. This list must be reviewed/updated on an annual basis.
4. There are three (3) types of rainfall/flooding alerts, which require specific actions to protect the track. They are Rising Water Warnings, Flash Flood Watches, and Flash

Flood Warnings. Refer to MWI 1110 for details.

K. Hurricanes, Tornadoes, and other Severe Storms

1. Request should be made to take track sections, reported to have been subjected to hurricanes, tornadoes, and other severe storms out of service and an immediate on-the-ground inspection conducted.
2. Based upon this inspection, damages will be identified and prioritized and the appropriate temporary speed restrictions and/or look out orders covering the specific track sections implemented before restoring the track to service. The temporary speed restrictions will be removed as soon as possible after the damage has been repaired and inspected.

L. Heavy Snowfall

1. Normal snowfall without strong winds should not inhibit the safe operation of trains at maximum authorized speed. Heavy snowfall coupled with strong winds can result in severe drifting in cuts, side hill cuts and wooded areas. Often inspections by hi-rail vehicle are impossible due to the vehicle becoming bogged down. In these circumstances, inspection is best done riding a train. Road crossings should be checked and cleared of ice and snow left by highway snowplows. Thawing, freezing and crusting of heavy snow accumulations may require the use of plows or spreaders ahead of trains.
2. The Roadmaster must maintain an updated list of all locations on his territory that are subject to severe drifting. This will enable him to expeditiously issue the appropriate temporary speed restrictions for the existing snowfall conditions.

M. Earthquake Response

1. When an earthquake is detected depending on the magnitude, there are certain inspection requirements to ensure the safe operations of trains. Refer to MWI 1126 for details.

III. REPORTS

1. Sample of "*Track Disturbance Report*" from Gateway, page 13
2. Copy of "*Pull Apart and Rail Repair Reporting Form*", page 14
3. Copy of "*Buckled Track Report*", page 15
4. "*Required Actions for Preventing Track Buckling*", pages 16 to 18.

Prepared by: RMW

Approved by: Miguel Torres
Miguel Torres - CFRC Chief Operating Officer

CFRC

TRACK TYPE CODES


<u>Code</u>	<u>Dispatcher Bulletin</u>	<u>Code</u>	<u>Dispatcher Bulletin</u>
M	MAIN	NEW	NE WYE
S	SIDING	NL	NORTH LEAD
1	NO 1	NS	NORTH SDG
2	NO 2	NW	NORTH WYE
3	NO 3	NWW	NW WYE
4	NO 4	NY	NORTH YARD
BL	BRNCH LEAD	P	PLATFORM
BP	BYPASS MN	PAS	PASS
C	CENTER SDG	PL	PSSGR LEAD
CO	CUTOFF	PM	PSGER MAIN
CT	CONNECTION	POC	POCKET
D	DRILL	P1	PLATFM NO1
EDR	EAST DRILL	P2	PLATFM NO2
ES	EAST SDG	RUN	RUNNING
EWY	EAST WYE	SCL	SCALE
EXT	EXTENSION	SEC	SECONDARY
EY	EAST YARD	SEW	SE WYE
FL	FRGHT LEAD	SL	SOUTH LEAD
FM	FRGHT MAIN	SPR	SPUR
HSE	HOUSE	SS	SOUTH SDG
IL	INTERLOCK	STO	STORAGE
IND	INDUSTRIAL	SW	SOUTH WYE
INL	INDU LEAD	SWW	SW WYE
INT	INTERCHNGE	SY	SOUTH YARD
LL	LONG LEAD	T	TURNOUT
MA1	MARC NO 1	WDR	WEST DRILL
MA2	MARC NO 2	WS	WEST SDG
MA3	MARC NO 3	WWY	WEST WYE
ML	MARC LEAD	Y	YARD

CFRC TEMPORARY SPEED RESTRICTION REASON CODES

<i>Code</i>	<i>Reason</i>	<i>Code</i>	<i>Reason</i>
	<u>Working</u>		<u>Surface</u>
101	Undercutter	401	Cross Level And Warp
102	Ballast Cleaner	402	Alignment
120	Rail Team on Track	403	Excessive Elevation
121	Continuous Welded Rail Not Surfaced	404	Insufficient Elevation
130	Timbering	405	Gage Account Surface Condition
131	Timbering Not Surfaced	406	Insufficient Ballast
140	Surfacing	491	Crosslevel & Warp – Geometry Car
141	Running Time - Ballast Compaction	492	Alignment – Geometry Car
		493	Excessive Elevation – Geometry Car
		494	Insufficient Elevation – Geometry Car
			<u>Roadbed</u>
150	Roadbed Stabilization	501	Unstable Roadbed
			<u>Bridge</u>
160	Bridge Construction	601	Bridge Maintenance Superstructure
161	Bridge Tie Installation	602	Bridge Maintenance Substructure
171	Turnout Work		<u>Other track</u>
172	Road Crossing Work	701	Turnout Condition
173	Construction	702	Highway Crossing
	<u>Rail</u>	703	Rail Crossing
201	Rail Test Car Detected Rail Defects	704	Derailment
202	Joint Condition	705	Geometric Conditions
203	Surface Bent	706	Highway Crossing Warning System
204	Temperature Condition		
205	Gage Account Rail Condition		<u>Other</u>
206	All Other Rail Defects	099	Other
207	Insufficient Rail Anchors		
	<u>Timber</u>		
300	Poor Timber		
301	Gage Account Tie Condition		
390	Poor Timber – Geometry Car		
391	Gage – Geometry Car		

CFRC
Pull Apart and Rail Repair Reporting Form

1. Employee Name: _____ ID# _____
2. Division: _____ Subdivision: _____
3. Type of repair: (Pull Apart) (Rail Repair) (Joint Bars) circle one
4. Date: _____ Rail side (facing increasing milepost) L R
5. Milepost (w/prefix): _____ Track Single 1 2 3 4
Siding Yard Crossover
6. Weight of rail (lb): _____ Alignment: Tangent High Low
7. Rail Type: CWR Jointed Turnout/ Special Trackwork
8. Bolts Sheared Y N Joint Bar Length 6 hole 4 hole
9. Ballast Requirement Y N Frozen Y N
10. Number of Bolts Sheared 0 1 2 3 4
11. Distance pulled apart, gap (inches): _____
12. Measurement before cut ___ FT ___ INCH ___ FRACTION
13. Measurement after cut ___ FT ___ INCH ___ FRACTION
14. Time of repair: _____ Rail Temp(°F): _____ Ambient Temp(°F): _____
15. Designated Rail Laying Temperature(°F): _____
16. Estimated RNT before break/pull apart (°F): _____ (see page 2)
17. Anchor Pattern at pull apart: Every other tie Every Tie Other
18. Anchor condition: _____
19. Anchor or Clip: E Clip on Concrete E Clip on Wood Fastclip on Concrete Other
20. Corrective Action: _____ Corrected: Y N
21. Comments: _____
22. Remedial Action: _____ Speed: _____
23. Joints: Added Eliminated Neither Number: _____
24. Rail: Added Subtracted None Inches: _____ Permanent Y N
25. Entered into system: Y N Date: _____

 Central Florida Rail Corridor		<h2 style="margin: 0;">BUCKLED TRACK REPORT</h2>		<p style="font-size: small; margin: 0;">THE PRIMARY CAUSE FOR THE BUCKLE IS TO BE CHECKED. THE NORMAL METHODS OF CORRECTION TO PREVENT RECURRENCE ARE GIVEN TO THE RIGHT OF THE CAUSE. CHECK ALL CORRECTION BOXES FOR CORRECTIVE ACTION TAKEN. FOR EXAMPLE, A BUCKLE CAUSED BY A LINE DEVIATION WAS CORRECTED BY LINING AND THEN DRESSING THE DISTURBED BALLAST TO THE STANDARD SECTION.</p>			
LOCATION		SKETCH THE BUCKLE		CAUSE		CORRECTION	
DIVISION		TANGENT TRACK.		<input type="checkbox"/> LIGHT BALLAST SECTION BEFORE BUCKLE. LEVEL DISTANCE FROM END OF TIE TO SHOULDER WAS * FEET. CRIB WAS <input type="checkbox"/> EVEN WITH TOP OF TIE. <input type="checkbox"/> * BELOW TOP OF TIE. <input type="checkbox"/> NON-STANDARD BALLAST SECTION (DESCRIBE).		<input type="checkbox"/> BALLAST ADDED AND/OR DRESSED ON BALLAST NOW EXTENDS * BEYOND TIE ON TANGENT AND * ON CURVES (HIGH SIDE).	
PREFIX		CURVED TRACK.		<input type="checkbox"/> LOOSE ANCHORS (NOT TIGHT AGAINST TIE). <input type="checkbox"/> LOOSE ANCHORS (RAIL MOVED THRU ANCHOR). <input type="checkbox"/> INSUFFICIENT NUMBER OF ANCHORS. <input type="checkbox"/> NON-STANDARD ANCHOR PATTERN (DESCRIBE)		<input type="checkbox"/> ANCHORS TIGHTENED AGAINST TIE. <input type="checkbox"/> ANCHORS APPLIED ON * USING PATTERN <input type="checkbox"/> BOXED EVERY TIE. <input type="checkbox"/> BOXED ALTERNATE TIES. <input type="checkbox"/> OTHER (DESCRIBE)	
MILEPOST		OTHER.		TRACK RECENTLY DISTURBED: DATE _____ <input type="checkbox"/> RAIL PATCHING ON _____ <input type="checkbox"/> TRACK PANELS INSTALLED _____ <input type="checkbox"/> TIES INSTALLED _____ <input type="checkbox"/> SURFACED OUT OF FACE _____ <input type="checkbox"/> SPOT SURFACE/SMOOTHING _____ <input type="checkbox"/> CRIBBING/SPOT UNDERCUTTING _____ <input type="checkbox"/> OTHER _____		<input type="checkbox"/> SPEED RESTRICTION MPH FOR _____ DAYS TO STABILIZE TRACK, REMOVED ON _____ NUMBER OF TRAINS OVER THIS LOCATION AT REDUCED SPEED * TONNAGE AT REDUCED SPEED *	
TRACK NUMBER		DISPLACEMENT * _____		<input type="checkbox"/> RAIL NOT PROPERLY ADJUSTED: <input type="checkbox"/> RAIL LAID AT * F (RAIL TEMPERATURE) AND NOT ADJUSTED. <input type="checkbox"/> RAIL REPLACED AT * F (RAIL TEMPERATURE)		<input type="checkbox"/> RAIL ADJUSTED ON _____ TO * F (RAIL TEMPERATURE), REMOVED * FROM NORTH OR WEST RAIL, REMOVED * FROM SOUTH OR EAST RAIL.	
DATE BUCKLED		LENGTH * _____		<input type="checkbox"/> OTHER (DESCRIBE) _____		<input type="checkbox"/> OTHER (DESCRIBE) _____	
TIME BUCKLED (24 HOUR CLOCK)		DISPLACEMENT * _____					
RAIL TEMPERATURE AT TIME OF BUCKLE		LENGTH * _____					
RAIL TEMPERATURE WHEN CORRECTED		DISPLACEMENT * _____					
ALIGNMENT		LENGTH * _____					
<input type="checkbox"/> TANGENT		DISPLACEMENT * _____					
<input type="checkbox"/> CURVE - DEGREE *		LENGTH * _____					
LINE CORRECTED ON		DISPLACEMENT * _____					
BY <input type="checkbox"/> HAND <input type="checkbox"/> MACHINE		LENGTH * _____					
SURFACE CORRECTED ON		DISPLACEMENT * _____					
BY <input type="checkbox"/> HAND <input type="checkbox"/> MACHINE		LENGTH * _____					
DID BUCKLE CAUSE A DERAILMENT		DISPLACEMENT * _____					
<input type="checkbox"/> YES <input type="checkbox"/> NO		LENGTH * _____					
IF YES, GIVE ACCIDENT NUMBER		DISPLACEMENT * _____					
IF YES, GIVE ACCIDENT NUMBER		LENGTH * _____					
REMARKS	SUBMITTED BY _____ TITLE _____ HEADQUARTERS _____ DATE _____ COPIES TO CHIEF ENGINEER-NOW & DIVISION ENGINEER _____						

CFRC REQUIRED ACTIONS FOR PREVENTING TRACK BUCKLING	Temperature Criteria			Actions							Field Manual cross-reference	
	Any ambient temperature	85 °F ambient or higher	Temperature increasing significantly	10 MPH until ballast is made sufficient	10 MPH until adjusted by cutting or lining and anchors and ballast section are made sufficient to maintain track stability	10 MPH for 2 tonnage trains AND rail temperature has dropped below 110 °F	Maximum of 25 MPH until condition is corrected	25 MPH for 10 tonnage trains, in effect until at least 2100 hours the day the tonnage	Further speed restrictions may be necessary dependent on amount of displacement	Inspect every day		Make additional inspections as required
Existing Condition and General Notes												
Track Inspection		●	●								●	7.4
Temporary speed restriction has been placed to protect against track buckling	●									●		7.4
Insufficient ballast to maintain track stability		●		●								7.8.1
Insufficient anchor pattern		●					●					7.8.2
Track not being worked becomes misaligned due to heat	●				●	●		●				7.5.2 7.5.4
Curve not worked shifts inward more than an average of 1"			●				●		●			7.5.2 7.9.5
Greater than 1" of rail added that has not been adjusted		●	●				●					7.5.3
Notes												
For ballast compaction, accumulated tonnage may be used if information is available. A Tonnage Train is defined as a train consisting of at least 5,000 gross tons. (Example: 10 Tonnage Trains = 50,000 tons, 2 tonnage trains = 10,000 tons, etc.)												
19 passenger trains = 1 tonnage train												
The track must be inspected before any speed restriction is changed or removed.												
Submit Track Disturbance Report for all track work listed.												
Note 1: If ties are installed during spot maintenance work when rail temperature is expected to be 110° or greater, a tamper must be used or rail cut and adjusted												
Note 2: The track in Turnout Zone must be surfaced with a tamper or rail cut and adjusted on the day of tie installation.												
Note 3: If rail is added at any time or temperature within the Turnout Zone, a 25 mph speed restriction must be placed until rail is adjusted												

CFRC REQUIRED ACTIONS FOR PREVENTING TRACK BUCKLING	Actions								Field Manual cross-reference			
	10 MPH until ballast is made sufficient to maintain track stability	10 MPH for 1 tonnage train	Maximum of 25 MPH until ballast is made sufficient to maintain track stability	25 MPH for 1 day	25 MPH for 10 tonnage trains	25 MPH for 5 tonnage trains	25 MPH for 2 tonnage trains	25 MPH for 1 tonnage train		50 MPH for 10 tonnage train	50 MPH for 5 tonnage train	
	If rail temperature reaches 110 °F or greater, AFTER work is complete, speed restriction stays in effect until 2100 hours on the day tonnage requirement is met.											
Spot ties - Replace up to 4 ties/39' rail length or 3 of 4 consecutive ties - High tonnage tracks			●					●				7.8.11 A
Spot ties - Replace up to 4 ties/39' rail length or 3 of 4 consecutive ties - Other tracks		●						●				7.8.11 A
Tie & Surfacing or replace 5 or more ties/39' rail length or renewing a grade x-ing - High Tonnage Tracks		●		●					●			7.8.12 A
Tie & Surfacing or replace 5 or more ties/39' rail length or renewing a grade x-ing - Other Tracks		●			●					●		7.8.12 A
Tie & Surfacing with use of a dynamic track stabilizer		●						●				7.8.22 A
Spot Surfacing or Spot Cribbing - an area of 5 ties or less - High Tonnage Tracks		●						●				7.8.13 A
Spot Surfacing or Spot Cribbing - an area of 5 ties or less - Other Tracks		●						●				7.8.13 A
Surfacing out-of-face, smoothing, or surfacing a bridge approach - High Tonnage Tracks		●		●						●		7.8.14 A
Surfacing out-of-face, smoothing, or surfacing a bridge approach - Other Tracks		●			●					●		7.8.14 A
Surfacing a sink, slip or roadbed stabilization problem area - All Tracks	Refer to chart for track maintenance work when rail temperature is 110 °F or greater										7.8.15	
Surfacing with use of a dynamic track stabilizer		●						●				7.8.21 A
Shoulder Ballast Cleaning		●						●				7.8.16 A
Track Undercutting Surfaced - All Tracks	Refer to chart for track maintenance work when rail temperature is 110 °F or greater										7.8.17	
Track Undercutting Surfaced with use of a dynamic track stabilizer	●	●		●								7.8.23 A
Laying or transposing CWR - rail properly adjusted, anchor pattern standard, ballast not disturbed except cribbed in rail seat area for rail anchor installation.	Refer to chart for track maintenance work when rail temperature is 110 °F or greater										7.8.18	
Open-deck bridge tie renewal - Maximum of 25 MPH until all bridge ties are spiked and rail anchors installed, if applicable.	Maximum of 13 consecutive bridge ties unspiked							●				7.8.19
Field welds, pull-a-part repair, replacing defective rails and cutting in epoxy joints in CWR. Rail must be readjusted. Reapply & tighten anchors.												7.10 7.9.1 7.9.2
Integrity of the track structure is disturbed by derailment, track panel installation, turnout or road crossing repairs, or other type work. Additional actions may be required based upon work performed.	●											7.9.3
Track becomes misaligned during work and cannot be restored to proper alignment by lining.	Cut, adjust, and make anchors and ballast section sufficient to maintain track stability. Comply with actions required for the appropriate track maintenance										7.5.1	
Rail is added in Turnout Zone [Note 3]	Maximum of 25 MPH until track is adjusted										4.16	
Curve worked in cold weather shifts inward more than an average of 1" and temperatures are increasing significantly.	Maximum of 25 MPH until a alignment is restored or track is adjusted.										7.5.2 7.9.4	
Notes												
For ballast compaction, accumulated tonnage may be used if information is available. A Tonnage Train is defined as a train consisting of at least 5,000 gross tons. (Example: 10 Tonnage Trains = 50,000 tons, 2 tonnage trains = 10,000 tons, etc.)												
19 passenger trains = 1 tonnage train												
The track must be inspected before any speed restriction is changed or removed.												
Submit Track Disturbance Report for all track work listed.												
Note 1: If ties are installed during spot maintenance work when rail temperature is expected to be 110° or greater, a tamper must be used or rail cut and adjusted												
Note 2: The track in Turnout Zone must be surfaced with a tamper or rail cut and adjusted on the day of tie installation.												
Note 3: If rail is added at anytime or temperature within the Turnout Zone, a 25 mph speed restriction must be placed until rail is a												

CFRC
REQUIRED ACTIONS FOR
PREVENTING TRACK BUCKLING

Track Maintenance Work
when Rail Temperature is
110 °F or Greater

	Actions										Field Manual cross-reference					
	Spot maintenance should not be performed unless necessary for safe passage of trains	10 MPH until ballast is made sufficient to maintain track stability	10 MPH for 10 tonnage trains until 2100 hours the next day	10 MPH for 2 tonnage trains AND rail temperature has dropped below 110°F	10 MPH for 1 tonnage train AND rail temperature has dropped below 110°F	Maximum of 25 MPH for 1 tonnage train	25 MPH for 2 tonnage trains AND rail temperature has dropped below 110°F	25 MPH for 1 day	25 MPH for 10 tonnage trains	25 MPH for 6 tonnage trains		25 MPH for 2 tonnage trains	40 MPH for 1 day	50 MPH for 1 day	50 MPH for 10 tonnage trains	50 MPH for 5 tonnage trains
Spot ties - Replace up to 4 ties/39' rail length or 3 of 4 consecutive ties - High tonnage tracks [Note 1]	•	•		•						•						7.8.11B
Spot ties - Replace up to 4 ties/39' rail length or 3 of 4 consecutive ties - Other tracks [Note 1]	•	•		•						•						7.8.11B
Spot ties in turnout zone - Replace maximum of 4 ties/40' - All tracks [Note 2]	•	•		•						•						7.8.11D
Tie & Surfacing or replace 5 or more ties/39' rail length or renewing a grade x-ing - High tonnage tracks		•		•						•				•		7.8.12B
Tie & Surfacing or replace 5 or more ties/39' rail length or renewing a grade x-ing - Other Tracks		•		•						•					•	7.8.12B
Tie & Surfacing with use of a dynamic track stabilizer		•						•				•				7.8.22B
Spot Surfacing or Spot Cribbing - an area of 5 ties or less - High Tonnage Tracks	•	•		•						•						7.8.13B
Spot Surfacing or Spot Cribbing - an area of 5 ties or less - Other Tracks	•	•		•						•						7.8.13B
Surfacing out-of-face, smoothing, or surfacing a bridge approach - High Tonnage Tracks		•		•						•				•		7.8.14B
Surfacing out-of-face, smoothing, or surfacing a bridge approach - Other Tracks		•		•						•					•	7.8.14B
Surfacing a sink, slip or roadbed stabilization problem area - High tonnage tracks		•		•						•				•		7.8.15
Surfacing a sink, slip or roadbed stabilization problem area - Other tracks		•		•						•				•		7.8.15
Surfacing with use of a dynamic track stabilizer		•						•								7.8.21B
Shoulder Ballast Cleaning		•								•						7.8.16B
Shoulder Ballast Cleaning (If high side of curves is cleaned, see section 7.8.16 C)		•		•						•						7.8.16C
Track Undercutting Surfaced - High tonnage tracks		•	•							•				•		7.8.17
Track Undercutting Surfaced - Other tracks		•	•							•					•	7.8.17
Track Undercutting Surfaced with use of a dynamic track stabilizer		•		•						•			•			7.8.21B
Laying or transposing CWR - rail properly adjusted, anchor pattern standard, ballast not disturbed except cribbed in rail seat area for rail anchor installation.							•									7.8.18
Open-deck bridge tie renewal - Maximum of 25 MPH until all bridge ties are spiked and rail anchors installed, if applicable.										•						7.8.19
Field welds, pull-a-part repair, replacing defective rails and cutting in epoxy joints in CWR. Rail must be readjusted. Reapply & tighten anchors.																7.10 7.9.1 7.9.2
Integrity of the track structure is disturbed by derailment, track panel installation, turnout or road crossing repairs, or other type work. Additional actions may be required based upon work performed.		•														7.9.3
Track becomes misaligned during work and cannot be restored to proper alignment by lining.	Cut, adjust, and make anchors and ballast section sufficient to maintain track stability. Comply with actions required for the appropriate track maintenance work.														7.5.1	
Rail is added in Turnout Zone [Note 3]	Maximum of 25 MPH until track is adjusted.														4.16	
Curve worked in cold weather shifts inward more than an average of 1" and temperatures are increasing significantly.	Maximum of 25 MPH until alignment is restored or track is adjusted.														7.5.2 7.9.4	

Notes

For ballast compaction, accumulated tonnage may be used if information is available. A Tonnage Train is defined as a train consisting of at least 5,000 gross tons. (Example: 10 Tonnage Trains = 50,000 tons, 2 tonnage trains = 10,000 tons, etc.)

19 passenger trains = 1 tonnage train

The track must be inspected before any speed restriction is changed or removed.

Submit Track Disturbance Report for all track work listed.

Note 1: If ties are installed during spot maintenance work when rail temperature is expected to be 110° or greater, a tamper must be used or rail cut and adjusted

Note 2: The track in Turnout Zone must be surfaced with a tamper or rail cut and adjusted on the day of tie installation.

Note 3: If rail is added at any time or temperature within the Turnout Zone, a 25 mph speed restriction must be placed until rail is adjusted.



PURPOSE:	To set instructions governing the Installation and Thermal Adjustment of Continuously Welded Rail (CWR).
SAFETY:	Observe all applicable Safety and Operating Rules and Regulations and Safe Job Procedures.
LOCATION:	All CFRC tracks.
ENVIRONMENTAL:	Observe all applicable Federal, State, Local Environmental Rules and Regulations.
REFERENCES:	MWI 701 Use of Premium Rail Fasteners with CWR MWI 703 Rail Anchoring Policy MWI 901 Road Crossing Installation CFRC 2512, 2513, 2514 Spiking Patterns

I. DISCUSSION

This document concerns the proper procedures for installation and thermally adjusting continuously welded rail installed as part of out of face, curve patch, or new construction projects.

II. PROCEDURE

A. LAYING CONTINUOUS WELDED RAIL

These instructions apply to rail laid out of face, curve patching, repairing of defective rails, or other rail openings in welded rail.

1. For rail replacement projects, ties will be adzed with 0 inch cant (-0" +1/8" to gage) measured at the outside edges of the tie plate during out-of-face and curve patch operations and welded rail laid to 56-1/2 inch gage. Ties on open deck bridges will not be adzed without the approval of the Chief Engineer. For new construction projects, ties will not be adzed.
2. All joints should be welded when the rail is laid. Welding will be done as rail is being laid except when weather conditions prevent adjusting of welded rail for temperature change.

- a. If it is not possible to weld a joint, the rail will be drilled with two holes in each rail end to accommodate joint bars with two (2) bolts in the outermost holes. This joint will be welded as soon as practicable but within 60 days one of the following shall occur:
 - Weld joint **or**
 - Install 6 bolts **or**
 - Box anchor joint on every tie for 130 consecutive ties in each direction.
 - b. For joints being left for later welding, the following information must be marked using permanent paint marker on the web of rail:
 - Date of installation
 - Team Identification
 - Adjusted rail temperature
 - c. The Roadmaster must be notified of the location of the joint and the information noted in item b above.
3. Transition or compromise rails are used to eliminate the need for bolted or field welded compromise joints at permanent compromise locations. They are designed to be full rail height on the end that matches the new rail specified for the project; and a varying rail height on the end that ties into the existing rail. When using transition rails:
- a. Determine the rail height at the compromise point for the existing rail.
 - b. Identify that same rail height on the transition rail.
 - c. Mark and cut the transition rail to match the existing rail height.
- See MWI 507 for additional information on transition and compromise rails.
4. Welded rail will be laid and anchored at a minimum adjusted rail temperature in accordance with the following geographical territories:
- a. A minimum adjusted rail temperature of 95° F will be used for territory north of the States of Tennessee and North Carolina except for the State of Virginia.
 - b. A minimum adjusted rail temperature of 100° F will be used in the State of Virginia.
 - c. A minimum adjusted rail temperature of 105° F will be used for the States of Tennessee and North Carolina and all territory south thereof.

The minimum adjusted rail temperature listed above in items a, b, and c will be reduced by 20°F when rail is installed within tunnels 500' and greater in length. Keep the outside neutral temperature for the first 250' from both ends of the tunnel. Reduce the neutral temperature on the inside of the tunnel beginning 250 from the portal.

The proper minimum adjusted rail temperature will be used to calculate the actual rail expansion needed. See paragraph II.B.7 below for specific details.

5. Welded rail that has not been properly adjusted will be protected by a temporary speed restriction when the ambient temperature is expected to exceed 85° F, rail temperature exceeds 110° F, or when the rail temperature is 40° F greater than the rail laying temperature, whichever occurs first. If rail is laid at a temperature more than 40° F below the designated rail laying temperature, rail must be adjusted or a speed restriction not exceeding 40 mph must be placed prior to rail temperature above designated rail laying temperature. When tight rail conditions exist, be governed by Engineering Field Manual sections 4.5.1 and 7.5.3.
6. The typical rail anchor patterns are detailed in MWI 703, *Rail Anchoring Policy*. Care must be taken to ensure that all welded rail is anchored as required. At locations where the typical pattern does not restrain rail movement due to tonnage, grade, curvature, or other local conditions, the Roadmaster will provide justification to the Chief Engineer for the application of additional anchors.
7. CWR laid across bridges will be anchored as follows:
 - a. Ballast Deck Bridges - CWR will use the typical anchor pattern as described in paragraph MWI 703, *Rail Anchoring Policy*.
 - b. Open Deck Bridges with total length 100 ft or less - CWR will be box anchored on every tie that is fastened to the bridge span.
 - c. Open Deck Bridges with total length between 100 ft. and 500 ft. with an alignment of 2 degrees or less:
 - 1) CWR will be box anchored on every tie that is fastened to the bridge span, throughout all spans less than 100 ft.
 - 2) CWR will be box anchored on every tie that is fastened to the bridge span, for the first 100 ft. from the fixed end of individual spans with length greater than 100 ft.
 - d. Rail anchor pattern will be specified by the Chief Engineer when any of the following conditions exist:
 - 1) Open Deck Bridges with a total length greater than 500 feet
 - 2) Alignment is greater than 2 degrees
 - 3) Bridges with existing rail expansion joints
 - 4) Other special situations
8. The Roadmaster will submit the details of bridges not meeting the

requirements in paragraph 7 above to the Chief Engineer for review. The Chief Engineer will provide the anchorage requirements.

9. The typical track spiking patterns are detailed in CFRC Typical Drawings 2512, 2513, and 2514. Care must be taken to ensure that all welded rail is spiked as required. If positive restraint fasteners are present, lock spikes will be replaced with screw spikes and proper tie plates.

B. ADJUSTING CONTINUOUS WELDED RAIL to OBTAIN PROPER ADJUSTED RAIL TEMPERATURE

1. Welded rail being laid with a rail temperature less than stated in Paragraph II.A.4. will be adjusted for length by heating the rail or using a rail expander.
2. The Manager in charge of the rail laying operation is responsible to see that rail is properly adjusted for length and anchored as it is laid. The anchoring operations will be no more than 100 feet behind the rail heater when in use and the anchors must be applied only when the rail had achieved the necessary expansion movement and the rail is at or above the desired temperature.
3. The Manager in charge of the rail laying project is responsible for the quality of welding within the rail laying team.
4. When field welds are installed, caution must be exercised to ensure that rail length is not increased in the joint welding process.
5. The Manager in charge of the rail laying project will ensure a fire prevention plan is in place for heating rail on open deck bridges as developed during planning meetings prior to the rail laying project. Pursuant to MWI 1101, coordination with the Chief Engineer is required prior to arriving at a bridge where rail will be heated.
6. Tracks in new construction, except when using track laying machine, must be tamped and have a typical ballast section prior to rail adjustment.
7. Adjustment Procedure
 - a. Complete the form, *Record of Rail Laying Temperature for Continuous Welded Rail*, as the day progresses. Each string of welded rail is numbered at both ends near the initial and final weld by the welding plant. Enter this number in the second column, "String Number", as each string is laid.
 - b. Using a rail thermometer, determine the average cold rail temperature of each rail immediately prior to adjustment by taking three measurements along the

string. Measure temperature on the shady side of the web.

- 1) Production Teams will be equipped with approved digital thermometers. These read instantly and temperature measurements can be made quickly. Ensure that non-contact infrared thermometers are held approximately 18 inches to the rail that is being measured to ensure that only the temperature of the rail is being measured and not the surrounding materials.
- 2) Teams will normally be equipped with the typical dial rail thermometer. To obtain an accurate reading leave the thermometer in place until temperature reading becomes steady, normally about five minutes.

Read the rail temperature and enter the average of the three readings in Column C, "Cold Rail Temperature", of the form.

- c. Leave a gap between the string being adjusted and the next string to provide for expansion. The length of the gap should be sufficient to allow for the expansion. The gap is to be protected from opening or closing by applying rail anchors on the string ahead for 50 feet.
- d. If rail is installed in a continuous operation not completely in tie plates to produce a gap at the end, ensure that the required expansion is achieved for each quarter portion calculated for that length of rail.
- e. Determine the required rail expansion from the *Change in Rail Length due to Change in Temperature* Chart.
 - 1) Measure length of the rail and enter in Column A, "Rail Length in Feet".
 - 2) Select the required adjusted rail temperature from Paragraph II.A.4. and enter in Column B.
 - 3) The average cold rail temperature is shown in Column C.
 - 4) Compute the difference in temperature by subtracting Column C from Column B and enter in Column D. If the cold rail temperature is below the required adjusted rail temperature, see next Paragraph to determine the expansion required. If the cold rail temperature is greater than the required adjusted rail temperature, no adjustment needed.
 - 5) Use chart, *Change in Rail Length due to Change in Temperature*, by locating the row corresponding to rail length and column corresponding to the temperature difference computed in the Paragraph above. Read the expansion length in inches at the intersection of the rail length row and temperature length column. Enter in Column E, "Required Expansion".
- f. For strings 720' or longer - reference mark the rail base and the tie plates at the quarter points of the strings. For strings less than 720' long - reference

mark at the center point of the string. The rail should be measured and reference marked at the same time the cold rail temperature is determined. For example, if you have the following conditions:

- 1) String length - 1440 feet - Make reference marks on the base of the rail and a secure tie plate at the 360', the 720', and the 1080' quarter points.
- 2) String length - 500 feet - Make reference marks on the base of the rail and a secure tie plate at the 250' center point.

These reference marks will be used to measure the expansion during adjustment. Adjustment must be as uniform as possible throughout entire string. For example, if you have the following conditions:

- 1) String length - 1440 ft
- 2) Cold rail temperature - 75°F^o
- 3) Adjusted rail temperature - 100°F

Using the *Record of Laying Temperature for Continuous Welded Rail* and the *Change in Rail Length due to Change in Temperature* chart, it is determined that the required expansion is 2 3/4". With the rail reference marked at the quarter points, the foreman would look for one -quarter of the expansion at the first reference mark (11/16"), one-half of the expansion at the second reference mark (1 3/8"), three- quarters of the expansion at the third reference mark (2 1/16") and the full expansion of 2 3/4" at the end of the string.

- g. Rail heaters or rail expanders will be used to obtain the required expansion.
- h. The Manager in charge of the rail laying project will ensure that the rail heater is operated uniformly and continuously. Vibrate the rail to aid in the rail expansion; do not strike the rail with hammers or other devices.
- i. If the required expansion cannot be obtained with rail heaters, do not bump therail. Use rail expanders or cut the rail into shorter strings.
- j. If the complete expansion as determined in Paragraph II.B.5.e. has not been obtained, place a wooden shim in the joint. The length of the wooden shim will be the amount of required expansion less the measured amount that the rail has expanded since laying.
- k. The wooden shim will remain in place until the next rail is laid and anchored for 250 feet. At this time the wooden shim is removed, then the first rail is expanded uniformly to fill the gap and the joint is made.

- l. Record the amount of expansion in Column F, "Actual Expansion". Then compute the temperature compensation based on the actual expansion from the chart on page 14, *Change in Rail Length due to Change in Temperature*, and record this temperature in Column G. Add the "Cold Rail" and "Compensated" temperatures, Columns C + G, to determine the adjusted temperature. This must be equal to or greater than the adjusted rail temperature specified in Paragraph II.A.4.
 - m. The Manager will give the completed *Record of Laying Temperature for Continuous Welded Rail* to the Roadmaster after the rail has been laid. The Roadmaster will forward copies to the Chief Engineer.
6. If rail being installed is at or above desired rail laying temperature prior to being installed, mark each quarter point and note no movement in the *Record of Laying Temperature for Continuous Welded Rail*.
 7. The Manager must ensure that rail is properly adjusted and all documentation completed before the team leaves the rail laying area.

C. CURVE PATCH WELDED RAIL

1. A string of welded rail used for curve patch must be adjusted to the adjusted rail temperature specified in Paragraph II.A.4.
2. The length of rail removed will be measured, the cold rail temperature of the replacement rail measured and the amount of expansion determined in the same manner as for laying rail out of face. See Paragraph II B.7.
3. The rail ends will be miss-matched until proper adjustment is obtained. See Paragraph II B.7. for detailed procedures.
4. Resistance to expansion may be experienced on sharp curves. If this occurs, it is permissible to anchor one rail length in the center of the curve, bypass the rail ends at each end of the string and then expand and vibrate the rail from the center to each end.

D. REPAIR of DEFECTS

1. Before cutting the rail, make reference marks on the web of the rail at least two feet outside the affected area (cut points or joint). Measure the distance between the marks and record it on the web of the rail. Use a permanent paint marker to mark the rail; do not use chalk, keel, or temporary marks. The

marks should be made on the side of the rail. See figure 1 for detailed information on making reference marks.

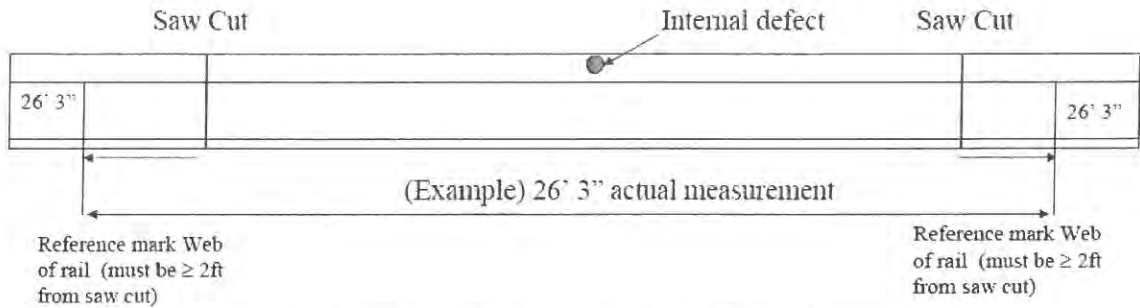


Figure 1. Example of Reference Marks for Rail Plug Change Out

2. Once the rail plug has been replaced, the distance between the reference marks should be the same as the distance recorded on the web of the rail.
3. Record the amount of rail added (if any) on the *Pull Apart and Rail Repair Reporting Form*. A sample of the form is shown in MWI 1109. The *Pull Apart and Rail Repair Reporting Form* shall be completed even if no rail was added. Enter 0 for rail added if the rail was adjusted when installed.
4. This information must be entered Maximo.
5. Rail that has not been properly adjusted will be protected by temporary speed restrictions when the ambient temperature is expected to exceed 85° F, rail temperature exceeds 110° F, or when the rail temperature is 40° F greater than the rail laying temperature. Use the reference marks made in item 1 of this section in determination of whether the track is properly adjusted. Complete a *Track Disturbance Report* once the rail is properly adjusted.

CHANGE IN RAIL LENGTH DUE

TO CHANGE IN TEMPERATURE

- C = 12 X 0.0000065LT
C = CHANGE IN LENGTH IN INCHES
L = LENGTH OF RAIL IN FEET
T = CHANGE IN TEMPERATURE IN DEGREES

LENGTH OF RAIL - FEET	CHANGE IN TEMPERATURE IN DEGREES FAHRENHEIT															
	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80
100	0	0-1/8	0-1/8	0-1/8	0-1/4	0-1/4	0-1/4	0-3/8	0-3/8	0-3/8	0-3/8	0-1/2	0-1/2	0-1/2	0-5/8	0-5/8
200	0-1/8	0-1/8	0-1/4	0-3/8	0-1/2	0-1/2	0-1/2	0-5/8	0-3/4	0-3/4	0-7/8	0-7/8	1	1-1/8	1-1/8	1-1/4
300	0-1/8	0-1/4	0-3/8	0-1/2	0-5/8	0-3/4	0-7/8	1	1-1/8	1-1/2	1-1/2	1-3/4	2	2-1/8	2-3/8	2-1/2
400	0-1/8	0-3/8	0-1/2	0-5/8	0-3/4	1	1-1/8	1-1/4	1-3/8	1-1/2	1-3/4	2	2-1/8	2-3/4	2-7/8	3-1/8
500	0-1/4	0-3/8	0-5/8	0-3/4	1	1-1/8	1-3/8	1-1/2	1-3/4	2	2-1/8	2-3/4	3	3-1/4	3-1/2	3-3/4
600	0-1/4	0-1/2	0-3/4	0-7/8	1-1/8	1-3/8	1-5/8	1-7/8	2-1/8	2-3/8	2-5/8	2-3/4	3	3-1/4	3-7/8	4-3/8
700	0-1/4	0-1/2	0-7/8	1-1/8	1-3/8	1-5/8	1-7/8	2-1/8	2-1/2	2-3/4	3	3-1/4	4	4-3/8	4-5/8	5
800	0-3/8	0-5/8	1	1-1/4	1-1/2	1-7/8	2-1/8	2-1/2	2-3/4	3-1/8	3-1/2	3-3/4	4	4-3/8	4-5/8	5
900	0-3/8	0-3/4	1	1-3/8	1-3/4	2-1/8	2-1/2	2-3/4	3-1/8	3-1/2	3-7/8	4-1/4	4-5/8	5-1/4	5-1/4	5-5/8
1000	0-3/8	0-3/4	1-1/8	1-1/2	2	2-3/8	2-3/4	3-1/8	3-1/2	3-7/8	4-1/4	4-5/8	5-1/8	5-1/2	5-7/8	6-1/4
1100	0-3/8	0-7/8	1-1/4	1-3/4	2-1/8	2-5/8	3	3-3/8	3-7/8	4-1/4	4-3/4	5-1/8	5-5/8	6	6-3/8	6-7/8
1200	0-1/2	0-7/8	1-3/8	1-7/8	2-3/8	2-3/4	3-1/4	3-3/4	4-1/4	4-5/8	5-1/8	5-5/8	6-1/8	6-1/2	7	7-1/2
1300	0-1/2	1	1-1/2	2	2-1/2	3	3-1/2	4	4-5/8	5-1/8	5-5/8	6-1/8	6-5/8	7-1/8	7-5/8	8-1/8
1400	0-1/2	1-1/8	1-5/8	2-1/8	2-3/4	3-1/4	3-7/8	4-3/8	4-7/8	5-1/2	6	6-1/2	7-1/8	7-5/8	8-1/4	8-3/4
1440	0-1/2	1-1/8	1-5/8	2-1/4	2-3/4	3-3/8	3-7/8	4-1/2	5	5-5/8	6-1/8	6-3/4	7-1/4	7-7/8	8-3/8	9
1500	0-5/8	1-1/8	1-3/4	2-3/8	2-7/8	3-1/2	4-1/8	4-5/8	5-1/4	5-7/8	6-3/8	7	7-5/8	8-1/4	8-3/4	9-3/8
1600	0-5/8	1-1/4	1-7/8	2-1/2	3-1/8	3-3/4	4-3/8	5	5-5/8	6-1/4	6-7/8	7-1/2	8-1/8	8-3/4	9-3/8	10
1700	0-5/8	1-3/8	2	2-5/8	3-3/8	4	4-5/8	5-3/8	6	6-5/8	7-1/4	8	8-5/8	9-1/4	10	10-5/8
1800	0-3/4	1-3/8	2-1/8	2-3/4	3-1/2	4-1/4	4-7/8	5-5/8	6-3/8	7	7-3/4	8-3/8	9-1/8	9-7/8	10-1/2	11-1/4

MINIMUM ADJUSTED RAIL LAYING TEMPERATURES:

95° FOR THE TERRITORY NORTH OF THE STATES OF

TENNESSEE AND NORTH CAROLINA EXCEPT VIRGINIA,

100° IN THE STATE OF VIRGINIA,

105° FOR THE STATES OF TENNESSEE, NORTH CAROLINA AND

TERRITORY SOUTH THEREOF.

EXAMPLE 1. FOR MANY INCHES MUST A STRING OF WELDED RAIL
1300 FEET LONG LAID AT A RAIL TEMPERATURE OF 50° EXPAND
TO BE ADJUSTED FOR 95°.

95° ADJUSTED TEMPERATURE

LESS 50° LAYING TEMPERATURE

45° CHANGE IN TEMPERATURE

GO TO THE TABLE AND READ THE LENGTH GIVEN IN THE COLUMN
HEADED BY THE "45" WHERE IT IS CROSSED BY THE ROW LABELED
"1300" IN THE "LENGTH OF RAIL" COLUMN.

AN EXPANSION OF 4-5/8 INCHES IS REQUIRED

EXAMPLE 2. THE ACTUAL RAIL EXPANSION MEASURED WITH THE
STRING OF RAIL GIVEN IN EXAMPLE 1 WAS 4 INCHES. TO WHAT
TEMPERATURE IS THE RAIL ADJUSTED AND IS IT ADJUSTED
WITHIN THE REQUIRED LIMITS.

GO TO THE TABLE AND FIND 4 INCHES ON THE ROW MARKED "1300".
RECORD THE CHANGE IN TEMPERATURE AT THE TOP OF THE COLUMN
IN WHICH THE 4 INCHES APPEARS. IN THIS EXAMPLE, 40°.

45° LAYING TEMPERATURE

PLUS 40° FIELD TEMPERATURE

85° ACTUAL ADJUSTED TEMPERATURE

THIS IS LESS THAN THE 95°, 100° OR 105° REQUIRED DEPENDING
ON LOCATION); THEREFORE, THE RAIL IS NOT ADJUSTED TO
THE REQUIRED LIMIT.

NOTE: AT LOCATIONS, SUCH AS EXPANSION JOINTS, WHERE THERE
IS A "FREE END" CONDITION, USE 1/4 THE AMOUNT SHOWN ABOVE.

III. REPORTS

- A. The employee-in-charge of the rail laying will complete the records of rail laying on a continuous basis during rail installation. This information will be loaded into Maximo. The Roadmaster and Chief Engineer can download the information as needed.
- B. Tracks not properly adjusted using this method must have a track disturbance report completed and provided to the Roadmaster.

Prepared by: RMW

Approved by: *Miguel Torres*
Miguel Torres - CFRC Chief Operating Officer



- PURPOSE:** To establish instructions governing Walkways on Bridges.
- SAFETY:** Observe all applicable Safety and Operating Rules and Regulations and Safe Job Procedures.
- LOCATION:** All CFRC tracks.
- ENVIRONMENTAL:** Observe all applicable Federal, State, Local Environmental Rules and Regulations.

I. DISCUSSION

- A. This policy will be incorporated into all new construction and bridge deck replacements.

II. PROCEDURE

- A. Single-track bridges are to have a minimum of one walkway that shall be located to provide the greatest benefit to personnel working in the area. This walkway shall be located as follows:
1. The same side as that of an adjacent switch stand or signal.
 2. The same side as that of adjacent bridges within a typical train length for the particular territory.
 3. Where it does not conflict with the criteria described in items one or two above, the down-stream side to allow for drift removal.
- B. Multiple-track bridges shall have walkways between all adjacent active tracks. In locations where a switch stand or signal is adjacent to a multiple-track bridge, that bridge shall also have a walkway on the same side as that of the switch stand or signal.
- C. Bridges over either public roadways or other railroad lines carrying regularly scheduled passenger trains shall have walkways on both sides of each active track.

- D. Ballasted or solid deck bridges, with parapets extending at least three and one half feet (3'6") above the top of tie, and with walking space extending at least four feet (4') beyond the end of tie, do not require additional walkways.
- E. All walkways shall have handrails, except those between adjacent active tracks.
- F. Special situations such as a movable span, through truss, lengthy multiple-span bridge, partial reconstruction, partial deck replacement, etc. may be constructed in a manner that prohibits the practical use of typical walkway details. Custom walkway design details or requests for exceptions to this MWI shall be requested from the Chief Engineer.

III. REPORTS

None

Prepared by: RMW

Approved by: 
Miguel Torres - CFRC Chief Operating Officer



- PURPOSE:** To establish a uniform Inner Metal Guard Rails on Bridges policy.
- SAFETY:** Observe all applicable Safety and Operating Rules and Regulations and Safe Job Procedures.
- LOCATION:** All CFRC tracks.
- ENVIRONMENTAL:** Observe all applicable Federal, State, Local Environmental Rules and Regulations.

I. DISCUSSION

The following instructions supersede all previous instructions concerning inner metal guardrails on bridges.

II. PROCEDURE

- A. Inner metal guardrails will be used on each track of all through truss, through plate girder and movable span bridges.
- B. The Chief Engineer may request authority from the CFRC Maintenance of Way Manager to install or retain inner metal guardrails on specific bridges which are not identified in paragraph II.A. The request must include all the physical and operating characteristics of the specific location.
- C. The existing inner metal guardrails, which do not conform to this policy will be removed by the first rail, timbering, or bridge team performing programmed maintenance through the area.
- D. Installation of inner metal guardrails required by this policy will be made by the first rail, timbering, or bridge team performing programmed maintenance through the area. The foreman will coordinate with the Chief Engineer before installation or modification of any inner metal guardrail is made on a movable span bridge.

- E. The Chief Engineer, at his discretion, may use other forces to remove or install inner metal guardrails prior to the first programmed maintenance activity.
- F. Where installed, inner metal guardrails will be in accordance with Typical Drawing Number 2609 in the *Maintenance of Way Regulations and Instructions Manual*.

III. REPORTS

None

Prepared by: RMW

Approved by: Miguel Torres
Miguel Torres - CFRC Chief Operating Officer

- PURPOSE:** To establish a uniform Bridge Approach Tie Policy.
- SAFETY:** Observe all applicable Safety and Operating Rules and Regulations and Safe Job Procedures.
- LOCATION:** All CFRC tracks.
- ENVIRONMENTAL:** Observe all applicable Federal, State, Local Environmental Rules and Regulations.

I. DISCUSSION

The following instructions supersede all previous instructions concerning bridge approach ties.

II. PROCEDURE

- A. Bridge Approach Ties will be used at the following locations:
1. Both approaches of each track on all open deck main track bridges.
 2. On all other than main track open deck bridges where the maximum authorized speed is greater than 15 miles per hour.
- B. The Chief Engineer may request authority from the CFRC Maintenance of Way Manager to install bridge approach ties on specific bridges which are not identified in paragraph II.A. The request must include all the physical and operating characteristics of the specific location.
- C. Installation of bridge approach ties required by this policy will be made by the first timbering team performing programmed maintenance through the area.
- D. The Chief Engineer, at his discretion, may use other forces to install bridge approach ties prior to the first programmed maintenance activity.
- E. Bridge approach ties will tamped in the normal manner on the gage side of the track and for the entire length on the field side of the track.

- F. Where installed, bridge approach ties will be in accordance with Typical Drawing Number 2607.

Prepared by: RMW

Approved by: Miguel Torres
Miguel Torres - CFRC Chief Operating Officer



MWI 2001-09

FRA Track Safety Standards

Issued: 9/23/14

Revised: 5/4/15

PURPOSE:	To provide a copy of the Federal Railroad Administration's Tracks Safety Standards (49 CFR §213).
SAFETY:	Observe all applicable Safety and Operating Rules and Regulations and Safe Job Procedures.
LOCATION:	All CFRC tracks and property.
ENVIRONMENTAL:	Observe all applicable Federal, State, Local Environmental Rules and Regulations.

I. DISCUSSION

A. The FRA Track Safety Standards are being issued in two MWI's:

- MWI 2001 containing the FRA Track Safety Standards, Subparts A through F, governing Train Operations over Excepted Track and Track Classes 1 through 5.
- MWI 2002 containing the FRA Track Safety Standards, Subpart G, governing Train Operations over Track Classes 6 and higher.

B. Attached is a copy of the FRA Track Safety Standards (except §§G). These FRA Standards include all revisions up to their last publication date of March 25, 2014.

C. Note, in some cases CFRC instructions are more restrictive than FRA. The most restrictive rules must be followed.

Prepared by: RMW

Approved by: 
Miguel Torres - CFRC Chief Operating Officer

ELECTRONIC CODE OF FEDERAL REGULATIONS**e-CFR data is current as of April 30, 2015**

Title 49 → Subtitle B → Chapter II → Part 213

Title 49: Transportation

PART 213—TRACK SAFETY STANDARDS**Contents****Subpart A—General**

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- §213.3 Application.
- §213.4 Excepted track.
- §213.5 Responsibility for compliance.
- §213.7 Designation of qualified persons to supervise certain renewals and inspect track.
- §213.9 Classes of track: operating speed limits.
- §213.11 Restoration or renewal of track under traffic conditions.
- §213.13 Measuring track not under load.
- §213.14 Application of requirements to curved track.
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Subpart B—Roadbed

- §213.31 Scope.
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Subpart C—Track Geometry

- §213.51 Scope.
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Subpart D—Track Structure

- §213.101 Scope.
- §213.103 Ballast; general.
- §213.109 Crossties.
- §213.110 Gage restraint measurement systems.
- §213.113 Defective rails.
- §213.115 Rail end mismatch.
- §213.118 Continuous welded rail (CWR); plan review and approval.
- §213.119 Continuous welded rail (CWR); plan contents.
- §213.121 Rail joints.
- §213.122 Torch cut rail.
- §213.123 Tie plates.
- §213.127 Rail fastening systems.
- §213.133 Turnouts and track crossings generally.
- §213.135 Switches.
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- §213.141 Self-guarded frogs.
- §213.143 Frog guard rails and guard faces; gage.

Subpart E—Track Appliances and Track-Related Devices

- §213.201 Scope.
- §213.205 Derails.

Subpart F—Inspection

- §213.231 Scope.
- §213.233 Track inspections.
- §213.234 Automated inspection of track constructed with concrete crossties.
- §213.235 Inspection of switches, track crossings, and lift rail assemblies or other transition devices on moveable bridges.

- §213.237 Inspection of rail.
- §213.238 Qualified operator.
- §213.239 Special inspections.
- §213.241 Inspection records.

Subpart G—Train Operations at Track Classes 6 and Higher

- §213.301 Scope of subpart.
 - §213.303 Responsibility for compliance.
 - §213.305 Designation of qualified individuals; general qualifications.
 - §213.307 Classes of track: operating speed limits.
 - §213.309 Restoration or renewal of track under traffic conditions.
 - §213.311 Measuring track not under load.
 - §213.313 Application of requirements to curved track.
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 - §213.319 Drainage.
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 - §213.323 Track gage.
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 - §213.329 Curves; elevation and speed limitations.
 - §213.331 Track surface.
 - §213.332 Combined track alinement and surface deviations.
 - §213.333 Automated vehicle-based inspection systems.
 - §213.334 Ballast; general.
 - §213.335 Crossties.
 - §213.337 Defective rails.
 - §213.339 Inspection of rail in service.
 - §213.341 Initial inspection of new rail and welds.
 - §213.343 Continuous welded rail (CWR).
 - §213.345 Vehicle/track system qualification.
 - §213.347 Automotive or railroad crossings at grade.
 - §213.349 Rail end mismatch.
 - §213.351 Rail joints.
 - §213.352 Torch cut rail.
 - §213.353 Turnouts, crossovers, and lift rail assemblies or other transition devices on moveable bridges.
 - §213.355 Frog guard rails and guard faces; gage.
 - §213.357 Derails.
 - §213.359 Track stiffness.
 - §213.361 Right of way.
 - §213.365 Visual inspections.
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- Appendix A to Part 213—Maximum Allowable Curving Speeds
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 Appendix D to Part 213—Minimally Compliant Analytical Track (MCAT) Simulations Used for Qualifying Vehicles To Operate at High Speeds and at High Cant Deficiencies

AUTHORITY: 49 U.S.C. 20102-20114 and 20142; Sec. 403, Div. A, Public Law 110-432, 122 Stat. 4885; 28 U.S.C. 2461, note; and 49 CFR 1.89.

SOURCE: 63 FR 34029, June 22, 1998, unless otherwise noted.

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Subpart A—General

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§213.1 Scope of part.

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

(b) Subparts A through F apply to track Classes 1 through 5. Subpart G and 213.2, 213.3, and 213.15 apply to track over which trains are operated at speeds in excess of those permitted over Class 5 track.

[63 FR 34029, June 22, 1998, as amended at 78 FR 16100, Mar. 13, 2013]

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§213.3 Application.

(a) Except as provided in paragraph (b) of this section, this part applies to all standard gage track in the general railroad system of transportation.

(b) This part does not apply to track:

(1) Located inside an installation that is not part of the general railroad system of transportation (i.e., a plant railroad). As used in this part, a plant railroad means a plant or installation that owns or leases a locomotive, uses that locomotive to switch cars throughout the plant or

installation, and is moving goods solely for use in the facility's own industrial processes. The plant or installation could include track immediately adjacent to the plant or installation if the plant railroad leases the track from the general system railroad and the lease provides for (and actual practice entails) the exclusive use of that track by the plant railroad and the general system railroad for purposes of moving only cars shipped to or from the plant. A plant or installation that operates a locomotive to switch or move cars for other entities, even if solely within the confines of the plant or installation, rather than for its own purposes or industrial processes, will not be considered a plant railroad because the performance of such activity makes the operation part of the general railroad system of transportation. Similarly, this exclusion does not apply to track over which a general system railroad operates, even if that track is located within a plant railroad;

(2) Used exclusively for tourist, scenic, historic, or excursion operations that are not part of the general railroad system of transportation. As used in this part, tourist, scenic, historic, or excursion operations that are not part of the general railroad system of transportation means a tourist, scenic, historic, or excursion operation conducted only on track used exclusively for that purpose (i.e., there is no freight, intercity passenger, or commuter passenger railroad operation on the track); or

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

[63 FR 34029, June 22, 1998, as amended at 79 FR 4256, Jan. 24, 2014]

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§213.4 Excepted track.

A track owner may designate a segment of track as excepted track provided that—

(a) The segment is identified in the timetable, special instructions, general order, or other appropriate records which are available for inspection during regular business hours;

(b) The identified segment is not located within 30 feet of an adjacent track which can be subjected to simultaneous use at speeds in excess of 10 miles per hour;

(c) The identified segment is inspected in accordance with 213.233(c) and 213.235 at the frequency specified for Class 1 track;

(d) The identified segment of track is not located on a bridge including the track approaching the bridge for 100 feet on either side, or located on a public street or highway, if railroad cars containing commodities required to be placarded by the Hazardous Materials Regulations (49 CFR part 172), are moved over the track; and

(e) The railroad conducts operations on the identified segment under the following conditions:

(1) No train shall be operated at speeds in excess of 10 miles per hour;

(2) No occupied passenger train shall be operated;

(3) No freight train shall be operated that contains more than five cars required to be placarded by the Hazardous Materials Regulations (49 CFR part 172); and

(4) The gage on excepted track shall not be more than 4 feet 10¼ inches. This paragraph (e)(4) is applicable September 21, 1999.

(f) A track owner shall advise the appropriate FRA Regional Office at least 10 days prior to removal of a segment of track from excepted status.

[63 FR 34029, June 22, 1998]

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§213.5 Responsibility for compliance.

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

(1) Bring the track into compliance;

(2) Halt operations over that track; or

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

(b) If an owner of track to which this part applies designates a segment of track as "excepted track" under the provisions of §213.4, operations may continue over that track without complying with the provisions of subparts B, C, D, and E of this part, unless otherwise expressly stated.

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

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

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

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

(4) A precise identification of the track;

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

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

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

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

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

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§213.7 Designation of qualified persons to supervise certain renewals and inspect track.

(a) Each track owner to which this part applies shall designate qualified persons to supervise restorations and renewals of track under traffic conditions. Each person designated shall have—

(1) At least—

(i) 1 year of supervisory experience in railroad track maintenance; or

(ii) A combination of supervisory experience in track maintenance and training from a course in track maintenance or from a college level educational program related to track maintenance;

(2) Demonstrated to the owner that he or she—

(i) Knows and understands the requirements of this part that apply to the restoration and renewal of the track for which he or she is responsible;

(ii) Can detect deviations from those requirements; and

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

(3) Written authorization from the track owner to prescribe remedial actions to correct or safely compensate for deviations from the requirements in this part.

(b) Each track owner to which this part applies shall designate qualified persons to inspect track for defects. Each person designated shall have—

(1) At least—

(i) 1 year of experience in railroad track inspection; or

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

(2) Demonstrated to the owner that he or she—

(i) Knows and understands the requirements of this part that apply to the inspection of the track for which he or she is responsible;

(ii) Can detect deviations from those requirements; and

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

(3) Written authorization from the track owner to prescribe remedial actions to correct or safely compensate for deviations from the requirements of this part, pending review by a qualified person designated under paragraph (a) of this section.

(c) Individuals designated under paragraphs (a) or (b) of this section that inspect continuous welded rail (CWR) track or supervise the installation, adjustment, and maintenance of CWR track in accordance with the written procedures of the track owner shall have:

(1) Current qualifications under either paragraph (a) or (b) of this section;

(2) Successfully completed a comprehensive training course specifically developed for the application of written CWR procedures issued by the track owner;

(3) Demonstrated to the track owner that the individual:

(i) Knows and understands the requirements of those written CWR procedures;

(ii) Can detect deviations from those requirements; and

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

(4) Written authorization from the track owner to prescribe remedial actions to correct or safely compensate for deviations from the requirements in those procedures and successfully completed a recorded examination on those procedures as part of the qualification process.

(d) Persons not fully qualified to supervise certain renewals and inspect track as required in paragraphs (a) through (c) of this section, but with at least one year of maintenance-of-way or signal experience, may pass trains over broken rails and pull apart provided that—

(1) The track owner determines the person to be qualified and, as part of doing so, trains, examines, and re-examines the person periodically within two years after each prior examination on the following topics as they relate to the safe passage of trains over broken rails or pull apart: rail defect identification, crosstie condition, track surface and alignment, gage restraint, rail end mismatch, joint bars, and maximum distance between rail ends over which trains may be allowed to pass. The sole purpose of the examination is to ascertain the person's ability to

effectively apply these requirements and the examination may not be used to disqualify the person from other duties. A minimum of four hours training is required for initial training;

(2) The person deems it safe and train speeds are limited to a maximum of 10 m.p.h. over the broken rail or pull apart;

(3) The person shall watch all movements over the broken rail or pull apart and be prepared to stop the train if necessary; and

(4) Person(s) fully qualified under §213.7 are notified and dispatched to the location promptly for the purpose of authorizing movements and effecting temporary or permanent repairs.

(e) With respect to designations under paragraphs (a) through (d) of this section, each track owner shall maintain written records of—

(1) Each designation in effect;

(2) The basis for each designation; and

(3) Track inspections made by each designated qualified person as required by §213.241. These records shall be kept available for inspection or copying by the Federal Railroad Administration during regular business hours.

[63 FR 34029, June 22, 1998, as amended at 74 FR 43002, Aug. 25, 2009; 78 FR 16100, Mar. 13, 2013]

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§213.9 Classes of track: operating speed limits.

(a) Except as provided in paragraph (b) of this section and §§213.57(b), 213.59(a), 213.113(a), and 213.137(b) and (c), the following maximum allowable operating speeds apply—

[In miles per hour]

Over track that meets all of the requirements prescribed in this part for—	The maximum allowable operating speed for freight trains is—	The maximum allowable operating speed for passenger trains is—
Excepted track	10	N/A
Class 1 track	10	15
Class 2 track	25	30
Class 3 track	40	60
Class 4 track	60	80
Class 5 track	80	90

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

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§213.11 Restoration or renewal of track under traffic conditions.

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

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§213.13 Measuring track not under load.

When unloaded track is measured to determine compliance with requirements of this part, the amount of rail movement, if any, that occurs while the track is loaded must be added to the measurements of the unloaded track.

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§213.14 Application of requirements to curved track.

Unless otherwise provided in this part, requirements specified for curved track apply only to track having a curvature greater than 0.25 degree.

[78 FR 16100, Mar. 13, 2013]

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§213.15 Penalties.

(a) Any person who violates any requirement of this part or causes the violation of any such requirement is subject to a civil penalty of at least \$650 and not more than \$25,000 per violation, except that: Penalties may be assessed against individuals only for willful violations, and, where a grossly negligent violation or a pattern of repeated violations has created an imminent hazard of death or injury to persons, or has caused death or injury, a penalty not to exceed \$105,000 per violation may be assessed. “Person” means an entity of any type covered under 1 U.S.C. 1, including but not limited to the following: a railroad; a manager, supervisor, official, or other employee or agent of a railroad; any owner, manufacturer, lessor, or lessee of railroad equipment, track, or facilities; any independent contractor providing goods or services to a railroad; any employee of such owner, manufacturer, lessor, lessee, or independent contractor; and anyone held by the Federal Railroad Administrator to

be responsible under §213.5(d) or §213.303(c). Each day a violation continues shall constitute a separate offense. See appendix B to this part for a statement of agency civil penalty policy.

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

[63 FR 34029, June 22, 1998, as amended at 69 FR 30593, May 28, 2004; 72 FR 51196, Sept. 6, 2007; 73 FR 79701, Dec. 30, 2008; 77 FR 24419, Apr. 24, 2012]

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§213.17 Waivers.

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

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

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

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§213.19 Information collection.

(a) The information collection requirements of this part were reviewed by the Office of Management and Budget pursuant to the Paperwork Reduction Act of 1995 (44 U.S.C. 3501 *et seq.*) and are assigned OMB control number 2130-0010.

(b) The information collection requirements are found in the following sections: §§213.4, 213.5, 213.7, 213.17, 213.57, 213.119, 213.122, 213.233, 213.237, 213.241, 213.303, 213.305, 213.317, 213.329, 213.333, 213.339, 213.341, 213.343, 213.345, 213.353, 213.361, 213.369.

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Subpart B—Roadbed

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§213.31 Scope.

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

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§213.33 Drainage.

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

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§213.37 Vegetation.

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

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

(b) Obstruct visibility of railroad signs and signals:

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

(2) At highway-rail crossings; (This paragraph (b)(2) is applicable September 21, 1999.)

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

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

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

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Subpart C—Track Geometry

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§213.51 Scope.

This subpart prescribes requirements for the gage, alinement, and surface of track, and the elevation of outer rails and speed limitations for curved track.

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§213.53 Gage.

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

(b) Gage shall be within the limits prescribed in the following table—

Class of track	The gage must be at least—	But not more than—
Excepted track	N/A	4'10 1/4".
Class 1 track	4'8"	4'10".
Class 2 and 3 track	4'8"	4'9 3/4".
Class 4 and 5 track	4'8"	4'9 1/2".

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§213.55 Track alinement.

(a) Except as provided in paragraph (b) of this section, alinement may not deviate from uniformity more than the amount prescribed in the following table:

Class of track	Tangent track		Curved track	
	The deviation of the mid-offset from a 62-foot line ¹ may not be more than—(inches)	The deviation of the mid-ordinate from a 31-foot chord ² may not be more than—(inches)	The deviation of the mid-ordinate from a 31-foot chord ² may not be more than—(inches)	The deviation of the mid-ordinate from a 62-foot chord ² may not be more than—(inches)
Class 1 track	5		³ N/A	5
Class 2 track	3		³ N/A	3
Class 3 track	13/4		11/4	13/4
Class 4 track	11/2		1	11/2
Class 5 track	3/4		1/2	5/8

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

² The ends of the chord shall be at points on the gage side of the outer rail, five-eighths of an inch below the top of the railhead.

³ N/A—Not Applicable

(b) For operations at a qualified cant deficiency, E_u, of more than 5 inches, the alinement of the outside rail of the curve may not deviate from uniformity more than the amount prescribed in the following table:

Class of track	Curved track	
	The deviation of the mid-ordinate from a 31-foot chord ¹ may not be more than—(inches)	The deviation of the mid-ordinate from a 62-foot chord ¹ may not be more than—(inches)
Class 1 track ²	³ N/A	11/4
Class 2 track ²	³ N/A	11/4
Class 3 track	3/4	11/4
Class 4 track	3/4	7/8
Class 5 track	1/2	5/8

¹The ends of the chord shall be at points on the gage side of the outer rail, five-eighths of an inch below the top of the railhead.

²Restraining rails or other systems may be required for derailment prevention.

³N/A—Not Applicable

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§213.57 Curves; elevation and speed limitations.

(a) The maximum elevation of the outside rail of a curve may not be more than 8 inches on track Classes 1 and 2, and 7 inches on track Classes 3 through 5. The outside rail of a curve may not be lower than the inside rail by design, except when engineered to address specific track or operating conditions; the limits in §213.63 apply in all cases.

(b) The maximum allowable posted timetable operating speed for each curve is determined by the following formula—

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

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Where—

V_{\max} = Maximum allowable posted timetable operating speed (m.p.h.).

E_a = Actual elevation of the outside rail (inches).¹

¹Actual elevation, E_a , for each 155-foot track segment in the body of the curve is determined by averaging the elevation for 11 points through the segment at 15.5-foot spacing. If the curve length is less than 155 feet, the points are averaged through the full length of the body of the curve.

E_u = Qualified cant deficiency² (inches) of the vehicle type.

²If the actual elevation, E_a , and degree of curvature, D , change as a result of track degradation, then the actual cant deficiency for the maximum allowable posted timetable operating speed, V_{\max} , may be greater than the qualified cant deficiency, E_u . This actual cant deficiency for each curve may not exceed the qualified cant deficiency, E_u , plus 1 inch.

D = Degree of curvature (degrees).³

³Degree of curvature, D , is determined by averaging the degree of curvature over the same track segment as the elevation.

(c) All vehicles are considered qualified for operating on track with a cant deficiency, E_u , not exceeding 3 inches. Table 1 of appendix A to this part is a table of speeds computed in accordance with the formula in paragraph (b) of this section, when E_u equals 3 inches, for various elevations and degrees of curvature.

(d) Each vehicle type must be approved by FRA to operate on track with a qualified cant deficiency, E_u , greater than 3 inches. Each vehicle type must demonstrate, in a ready-for-service load condition, compliance with the requirements of either paragraph (d)(1) or (2) of this section.

(1) When positioned on a track with a uniform superelevation equal to the proposed cant deficiency:

(i) No wheel of the vehicle type unloads to a value less than 60 percent of its static value on perfectly level track; and

(ii) For passenger cars, the roll angle between the floor of the equipment and the horizontal does not exceed 8.6 degrees; or

(2) When operating through a constant radius curve at a constant speed corresponding to the proposed cant deficiency, and a test plan is submitted to and approved by FRA in accordance with §213.345(e) and (f):

(i) The steady-state (average) load on any wheel, throughout the body of the curve, is not less than 60 percent of its static value on perfectly level track; and

(ii) For passenger cars, the steady-state (average) lateral acceleration measured on the floor of the carbody does not exceed 0.15g.

(e) The track owner or railroad shall transmit the results of the testing specified in paragraph (d) of this section to FRA's Associate Administrator for Railroad Safety/Chief Safety Officer (FRA) requesting approval for the vehicle type to operate at the desired curving speeds allowed under the formula in paragraph (b) of this section. The request shall be made in writing and contain, at a minimum, the following information—

(1) A description of the vehicle type involved, including schematic diagrams of the suspension system(s) and the estimated location of the center of gravity above top of rail;

(2) The test procedure,⁴ including the load condition under which the testing was performed, and description of the instrumentation used to qualify the vehicle type, as well as the maximum values for wheel unloading and roll angles or accelerations that were observed during testing; and

⁴The test procedure may be conducted whereby all the wheels on one side (right or left) of the vehicle are raised to the proposed cant deficiency, the vertical wheel loads under each wheel are measured, and a level is used to record the angle through which the floor of the vehicle has been rotated.

(3) For vehicle types not subject to parts 229 or 238 of this chapter, procedures or standards in effect that relate to the maintenance of all safety-critical components of the suspension system(s) for the particular vehicle type. Safety-critical components of the suspension system are those that impact or have significant influence on the roll of the carbody and the distribution of weight on the wheels.

(f) In approving the request made pursuant to paragraph (e) of this section, FRA may impose conditions necessary for safely operating at the higher curving speeds. Upon FRA approval of the request, the track owner or railroad shall notify FRA in writing no less than 30 calendar days prior to the proposed implementation of the approved higher curving speeds allowed under the formula in paragraph (b) of this section. The notification shall contain, at a minimum, identification of the track segment(s) on which the higher curving speeds are to be implemented.

(g) The documents required by this section must be provided to FRA by:

(1) The track owner; or

(2) A railroad that provides service with the same vehicle type over trackage of one or more track owner(s), with the written consent of each affected track owner.

(h)(1) Vehicle types permitted by FRA to operate at cant deficiencies, E_u , greater than 3 inches but not more than 5 inches shall be considered qualified under this section to operate at those permitted cant deficiencies for any track segment. The track owner or railroad shall notify FRA in writing no less than 30 calendar days prior to the proposed implementation of such curving speeds in accordance with paragraph (f) of this section.

(2) Vehicle types permitted by FRA to operate at cant deficiencies, E_u , greater than 5 inches shall be considered qualified under this section to operate at those permitted cant deficiencies only for the previously operated or identified track segments(s).

(i) For vehicle types intended to operate at any curving speed producing more than 5 inches of cant deficiency, the following provisions of subpart G of this part shall apply: §§213.333(a) through (g), (j)(1), (k) and (m), 213.345, and 213.369(f).

(j) As used in this section—

(1) *Vehicle* means a locomotive, as defined in §229.5 of this chapter; a freight car, as defined in §215.5 of this chapter; a passenger car, as defined in §238.5 of this chapter; and any rail rolling equipment used in a train with either a freight car or a passenger car.

(2) *Vehicle type* means like vehicles with variations in their physical properties, such as suspension, mass, interior arrangements, and dimensions that do not result in significant changes to their dynamic characteristics.

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§213.59 Elevation of curved track; runoff.

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

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

[63 FR 34029, June 22, 1998, as amended at 78 FR 16101, Mar. 13, 2013]

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§213.63 Track surface.

(a) Except as provided in paragraph (b) of this section, each track owner shall maintain the surface of its track within the limits prescribed in the following table:

Track surface (inches)	Class of track				
	1	2	3	4	5
The runoff in any 31 feet of rail at the end of a raise may not be more than	3 1/2	3	2 11/2	2	1 1/2
The deviation from uniform profile on either rail at the mid-ordinate of a 62-foot chord may not be more than	3 23/4	2 1/4	2 1/4	2 1/4	1 1/4
The deviation from zero crosslevel at any point on tangent or reverse crosslevel elevation on curves may not be more than	3	2 13/4	1 3/4	1 1/4	1
The difference in crosslevel between any two points less than 62 feet apart may not be more than ^{1 2}	3 21/4	2 1/4	2 13/4	1 1/2	1 1/2
*Where determined by engineering decision prior to June 22, 1998, due to physical restrictions on spiral length and operating practices and experience, the variation in crosslevel on spirals per 31 feet may not be more than	2 13/4	1 1/4	1 1/4	1	3/4

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

²However, to control harmonics on Class 2 through 5 jointed track with staggered joints, the crosslevel differences shall not exceed 1 1/4 inches in all of six consecutive pairs of joints, as created by seven low joints. Track with joints staggered less than 10 feet apart shall not be considered as having staggered joints. Joints within the seven low joints outside of the regular joint spacing shall not be considered as joints for purposes of this footnote.

(b) For operations at a qualified cant deficiency, E_u, of more than 5 inches, each track owner shall maintain the surface of the curve within the limits prescribed in the following table:

Track surface (inches)	Class of track				
	1	2	3	4	5
The deviation from uniform profile on either rail at the mid-ordinate of a 31-foot chord may not be more than	N/A ¹	N/A ¹	1	1	1
The deviation from uniform profile on either rail at the mid-ordinate of a 62-foot chord may not be more than	2 1/4	2 1/4	1 3/4	1 1/4	1
The difference in crosslevel between any two points less than 10 feet apart (short warp) shall not be more than	2	2 13/4	1 3/4	1 3/4	1 1/2

¹N/A—Not Applicable.

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§213.65 Combined track alignment and surface deviations.

On any curved track where operations are conducted at a qualified cant deficiency, E_u, greater than 5 inches, the combination of alignment and surface deviations for the same chord length on the outside rail in the curve, as measured by a TGMS, shall comply with the following formula:

$$\frac{3}{4} \times \left| \frac{\Delta_n}{A_i} + \frac{S_m}{S_i} \right| \leq 1$$

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Where—

A_m = measured alinement deviation from uniformity (outward is positive, inward is negative).

A_L = allowable alinement limit as per §213.55(b) (always positive) for the class of track.

S_m = measured profile deviation from uniformity (down is positive, up is negative).

S_L = allowable profile limit as per §213.63(b) (always positive) for the class of track.

$$\left| \frac{A_m + S_m}{A_L + S_L} \right| = \text{the absolute (positive) value of the result of } \frac{A_m + S_m}{A_L + S_L}$$

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[78 FR 16102, Mar. 13, 2013]

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Subpart D—Track Structure

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§213.101 Scope.

This subpart prescribes minimum requirements for ballast, cross ties, track assembly fittings, and the physical conditions of rails.

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§213.103 Ballast; general.

Unless it is otherwise structurally supported, all track shall be supported by material which will—

- (a) Transmit and distribute the load of the track and railroad rolling equipment to the subgrade;
- (b) Restrain the track laterally, longitudinally, and vertically under dynamic loads imposed by railroad rolling equipment and thermal stress exerted by the rails;
- (c) Provide adequate drainage for the track; and
- (d) Maintain proper track crosslevel, surface, and alinement.

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§213.109 Crossties.

- (a) Crossties shall be made of a material to which rail can be securely fastened.
- (b) Each 39-foot segment of track shall have at a minimum—
 - (1) A sufficient number of crossties that in combination provide effective support that will—
 - (i) Hold gage within the limits prescribed in §213.53(b);
 - (ii) Maintain surface within the limits prescribed in §213.63; and
 - (iii) Maintain alinement within the limits prescribed in §213.55;
 - (2) The minimum number and type of crossties specified in paragraph (b)(4) of this section and described in paragraph (c) or (d), as applicable, of this section effectively distributed to support the entire segment;
 - (3) At least one non-defective crosstie of the type specified in paragraphs (c) and (d) of this section that is located at a joint location as specified in paragraph (e) of this section; and
 - (4) The minimum number of crossties as indicated in the following table.

FRA track class	Tangent track, turnouts, and curves	
	Tangent track and curved track less than or equal to 2 degrees	Turnouts and curved track greater than 2 degrees
Class 1	5	6
Class 2	8	9
Class 3	8	10
Class 4 and 5	12	14

- (c) Crossties, other than concrete, counted to satisfy the requirements set forth in paragraph (b)(4) of this section shall not be—
 - (1) Broken through;
 - (2) Split or otherwise impaired to the extent the crosstie will allow the ballast to work through, or will not hold spikes or rail fasteners;
 - (3) So deteriorated that the crosstie plate or base of rail can move laterally 1/2 inch relative to the crosstie; or
 - (4) Cut by the crosstie plate through more than 40 percent of a crosstie's thickness.
- (d) Concrete crossties counted to satisfy the requirements set forth in paragraph (b)(4) of this section shall not be—

- (1) Broken through or deteriorated to the extent that prestressing material is visible;
 - (2) 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 $\frac{3}{8}$ inch relative to the crosstie;
 - (3) Deteriorated such that the base of either rail can move laterally more than $\frac{3}{8}$ inch relative to the crosstie on curves of 2 degrees or greater; or can move laterally more than $\frac{1}{2}$ inch relative to the crosstie on tangent track or curves of less than 2 degrees;
 - (4) Deteriorated or abraded at any point under the rail seat to a depth of $\frac{1}{2}$ inch or more;
 - (5) Deteriorated such that the crosstie's fastening or anchoring system, including rail anchors (see §213.127(b)), is unable to maintain longitudinal rail restraint, or maintain rail hold down, or maintain gage due to insufficient fastener toeload; or
 - (6) Configured with less than two fasteners on the same rail except as provided in §213.127(c).
- (e) Class 1 and 2 track shall have one crosstie whose centerline is within 24 inches of each rail joint (end) location. Class 3, 4, and 5 track shall have either one crosstie whose centerline is within 18 inches of each rail joint location or two crossties whose centerlines are within 24 inches either side of each rail joint location. The relative position of these crossties is described in the following three diagrams:

- (1) Each rail joint in Class 1 and 2 track shall be supported by at least one crosstie specified in paragraphs (c) and (d) of this section whose centerline is within 48 inches as shown in Figure 1.

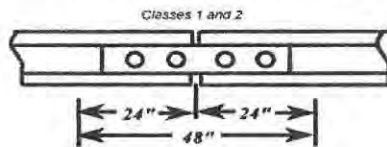


Figure 1

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- (2) Each rail joint in Class 3, 4, and 5 track shall be supported by either at least one crosstie specified in paragraphs (c) and (d) of this section whose centerline is within 36 inches as shown in Figure 2, or:

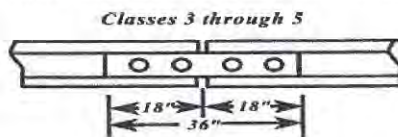


Figure 2

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- (3) Two crossties, one on each side of the rail joint, whose centerlines are within 24 inches of the rail joint location as shown in Figure 3.

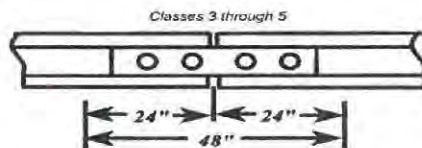


Figure 3

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- (f) For track constructed without crossties, such as slab track, track connected directly to bridge structural components, track over servicing pits, etc., the track structure shall meet the requirements of paragraph (b)(1) of this section.

[76 FR 18084, Apr. 1, 2011]

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§213.110 Gage restraint measurement systems.

(a) A track owner may elect to implement a Gage Restraint Measurement System (GRMS), supplemented by the use of a Portable Track Loading Fixture (PTLF), to determine compliance with the crosstie and fastener requirements specified in §§213.109 and 213.127 provided that—

- (1) The track owner notifies the appropriate FRA Regional office at least 30 days prior to the designation of any line segment on which GRMS technology will be implemented; and

- (2) The track owner notifies the appropriate FRA Regional office at least 10 days prior to the removal of any line segment from GRMS designation.

(b) Initial notification under paragraph (a)(1) of this section shall include—

- (1) Identification of the line segment(s) by timetable designation, milepost limits, class of track, or other identifying criteria; and
- (2) The most recent record of million gross tons of traffic per year over the identified segment(s).

(c)(1) The track owner shall also provide to FRA sufficient technical data to establish compliance with the following minimum design requirements of a GRMS vehicle:

(2) Gage restraint shall be measured between the heads of rail—

(i) At an interval not exceeding 16 inches;

(ii) Under an applied vertical load of no less than 10 kips per rail; and

(iii) Under an applied lateral load that provides for a lateral/vertical load ratio of between 0.5 and 1.25⁵, and a load severity greater than 3 kips but less than 8 kips per rail.

⁵GRMS equipment using load combinations developing L/V ratios that exceed 0.8 shall be operated with caution to protect against the risk of wheel climb by the test wheelset.

(d) Load severity is defined by the formula:

$$S = L - cV$$

Where—

S = Load severity, defined as the lateral load applied to the fastener system (kips).

L = Actual lateral load applied (kips).

c = Coefficient of friction between rail/tie, which is assigned a nominal value of 0.4.

V = Actual vertical load applied (kips), or static vertical wheel load if vertical load is not measured.

(e) The measured gage values shall be converted to a Projected Loaded Gage 24 (PLG24) as follows—

$$PLG24 = UTG + A \times (LTG - UTG)$$

Where—

UTG = Unloaded track gage measured by the GRMS vehicle at a point no less than 10 feet from any lateral or vertical load application.

LTG = Loaded track gage measured by the GRMS vehicle at a point no more than 12 inches from the lateral load application point.

A = The extrapolation factor used to convert the measured loaded gage to expected loaded gage under a 24-kip lateral load and a 33-kip vertical load.

For all track—

$$A = \frac{13.513}{(L - 0.258 \times V) - .009 \times (L - 0.258 \times V)^2}$$

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Note: The A factor shall not exceed a value of 3.184 under any valid loading configuration.

L = Actual lateral load applied (kips).

V = Actual vertical load applied (kips), or static vertical wheel load if vertical load is not measured.

(f) The measured gage and load values shall be converted to a Gage Widening Projection (GWP) as follows:

$$GWP = (LTG - UTG) \times \frac{8.26}{L - 0.258 \times V}$$

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(g) The GRMS vehicle shall be capable of producing output reports that provide a trace, on a constant-distance scale, of all parameters specified in paragraph (l) of this section.

(h) The GRMS vehicle shall be capable of providing an exception report containing a systematic listing of all exceptions, by magnitude and location, to all the parameters specified in paragraph (l) of this section.

(i) The exception reports required by this section shall be provided to the appropriate person designated as fully qualified under §213.7 prior to the next inspection required under §213.233.

(j) The track owner shall institute the necessary procedures for maintaining the integrity of the data collected by the GRMS and PTLF systems. At a minimum, the track owner shall—

(1) Maintain and make available to the Federal Railroad Administration documented calibration procedures on each GRMS vehicle which, at a minimum, shall specify a daily instrument verification procedure that will ensure correlation between measurements made on the ground and those recorded by the instrumentation with respect to loaded and unloaded gage parameters; and

(2) Maintain each PTLF used for determining compliance with the requirements of this section such that the 4,000-pound reading is accurate to within five percent of that reading.

(k) The track owner shall provide training in GRMS technology to all persons designated as fully qualified under §213.7 and whose territories are subject to the requirements of this section. The training program shall be made available to the Federal Railroad Administration upon request. At a minimum, the training program shall address—

- (1) Basic GRMS procedures;
- (2) Interpretation and handling of exception reports generated by the GRMS vehicle;
- (3) Locating and verifying defects in the field;
- (4) Remedial action requirements;
- (5) Use and calibration of the PTLF; and
- (6) Recordkeeping requirements.

(l) The GRMS record of lateral restraint shall identify two exception levels. At a minimum, the track owner shall initiate the required remedial action at each exception level as defined in the following table—

GRMS parameters ¹	If measurement value exceeds	Remedial action required
First Level Exception		
UTG	58 inches	(1) Immediately protect the exception location with a 10 m.p.h. speed restriction, then verify location; (2) Restore lateral restraint and maintain in compliance with PTLF criteria as described in paragraph (m) of this section; and (3) Maintain compliance with §213.53(b) as measured with the PTLF.
LTG	58 inches	
PLG24	59 inches	
GWP	1 inch	
Second Level Exception		
LTG	57 3/4 inches on Class 4 and 5 track ²	(1) Limit operating speed to no more than the maximum allowable under §213.9 for Class 3 track, then verify location; (2) Maintain in compliance with PTLF criteria as described in paragraph (m) of this section; and (3) Maintain compliance with §213.53(b) as measured with the PTLF.
PLG24	58 inches	
GWP	0.75 inch	

¹Definitions for the GRMS parameters referenced in this table are found in paragraph (p) of this section.

²This note recognizes that good track will typically increase in total gage by as much as one-quarter of an inch due to outward rail rotation under GRMS loading conditions. For Class 2 and 3 track, the GRMS LTG values are also increased by one-quarter of an inch to a maximum of 58 inches. However, for any class of track, GRMS LTG values in excess of 58 inches are considered First Level exceptions and the appropriate remedial action(s) must be taken by the track owner. This 1/4-inch increase in allowable gage applies only to GRMS LTG. For gage measured by traditional methods, or with the use of the PTLF, the table in §213.53(b) applies.

(m) Between GRMS inspections, the PTLF may be used as an additional analytical tool to assist fully qualified §213.7 individuals in determining compliance with the crosstie and fastener requirements of §§213.109 and 213.127. When the PTLF is used, whether as an additional analytical tool or to fulfill the requirements of paragraph (l), it shall be used subject to the following criteria—

(1) At any location along the track that the PTLF is applied, that location will be deemed in compliance with the crosstie and fastener requirements specified in §§213.109 and 213.127 provided that—

- (i) The total gage widening at that location does not exceed 5/8 inch when increasing the applied force from 0 to 4,000 pounds; and
- (ii) The gage of the track under 4,000 pounds of applied force does not exceed the allowable gage prescribed in §213.53(b) for the class of track.

(2) Gage widening in excess of 5/8 inch shall constitute a deviation from Class 1 standards.

(3) A person designated as fully qualified under §213.7 retains the discretionary authority to prescribe additional remedial actions for those locations which comply with the requirements of paragraph (m)(1)(i) and (ii) of this section.

(4) When a functional PTLF is not available to a fully qualified person designated under §213.7, the criteria for determining crosstie and fastener compliance shall be based solely on the requirements specified in §§213.109 and 213.127.

(5) If the PTLF becomes non-functional or is missing, the track owner will replace or repair it before the next inspection required under §213.233.

(6) Where vertical loading of the track is necessary for contact with the lateral rail restraint components, a PTLF test will not be considered valid until contact with these components is restored under static loading conditions.

(n) The track owner shall maintain a record of the two most recent GRMS inspections at locations which meet the requirements specified in §213.241(b). At a minimum, records shall indicate the following—

- (1) Location and nature of each First Level exception; and
- (2) Nature and date of remedial action, if any, for each exception identified in paragraph (n)(1) of this section.

(o) The inspection interval for designated GRMS line segments shall be such that—

(1) On line segments where the annual tonnage exceeds two million gross tons, or where the maximum operating speeds for passenger trains exceeds 30 mph, GRMS inspections must be performed annually at an interval not to exceed 14 months; or

(2) On line segments where the annual tonnage is two million gross tons or less and the maximum operating speed for passenger trains does not exceed 30 mph, the interval between GRMS inspections must not exceed 24 months.

(p) As used in this section—

(1) *Gage Restraint Measurement System (GRMS)* means a track loading vehicle meeting the minimum design requirements specified in this section.

(2) *Gage Widening Projection (GWP)* means the measured gage widening, which is the difference between loaded and unloaded gage, at the applied loads, projected to reference loads of 16 kips of lateral force and 33 kips of vertical force.

(3) *L/V ratio* means the numerical ratio of lateral load applied at a point on the rail to the vertical load applied at that same point. GRMS design requirements specify an L/V ratio of between 0.5 and 1.25.

(4) *Load severity* means the amount of lateral load applied to the fastener system after friction between rail and tie is overcome by any applied gage-widening lateral load.

(5) *Loaded Track Gage (LTG)* means the gage measured by the GRMS vehicle at a point no more than 12 inches from the lateral load application point.

(6) *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.

(7) *Projected Loaded Gage (PLG)* means an extrapolated value for loaded gage calculated from actual measured loads and deflections. PLG 24 means the extrapolated value for loaded gage under a 24,000 pound lateral load and a 33,000 pound vertical load.

(8) *Unloaded Track Gage (UTG)* means the gage measured by the GRMS vehicle at a point no less than 10 feet from any lateral or vertical load.

[66 FR 1899, Jan. 10, 2001; 66 FR 8372, Jan. 31, 2001, as amended at 78 FR 16102, Mar. 13, 2013]

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§213.113 Defective rails.

(a) When an owner of track learns that a rail in the track contains any of the defects listed in the table contained in paragraph (c) of this section, a person designated under §213.7 shall determine whether the track may continue in use. If the designated person determines that the track may continue in use, operation over the defective rail is not permitted until—

- (1) The rail is replaced or repaired; or
- (2) The remedial action prescribed in the table contained in paragraph (c) of this section is initiated.

(b) When an owner of track learns that a rail in the track contains an indication of any of the defects listed in the table contained in paragraph (c) of this section, the track owner shall verify the indication. The track owner must verify the indication within four hours, unless the track owner has an indication of the existence of a defect that requires remedial action A, A2, or B identified in the table contained in paragraph (c) of this section, in which case the track owner must immediately verify the indication. If the indication is verified, the track owner must—

- (1) Replace or repair the rail; or
- (2) Initiate the remedial action prescribed in the table contained in paragraph (c) of this section.

(c) A track owner who learns that a rail contains one of the following defects shall prescribe the remedial action specified if the rail is not replaced or repaired, in accordance with this paragraph's table:

REMEDIAL ACTION TABLE

Defect	Length of defect (inch(es))		Percentage of existing rail head cross-sectional area weakened by defect		If the defective rail is not repaired, take the remedial action prescribed in note
	More than	But not more than	Less than	But not less than	
Compound Fissure			70 100	5 70 100	B. A2. A.
Transverse Fissure					
Detail Fracture					
Engine Burn Fracture			25 60 100	5 25 60 100	C. D. A2, or [E and H]. A, or [E and H].
Defective Weld					
Horizontal Split Head					
Vertical Split Head					
Split Web Piped Rail	1	2			
Head Web Separation	2	4			H and F. I and G.
Defective Weld (Longitudinal)	(1)	(1)			B. A.
Bolt Hole Crack	1/2	1			
Broken Base	1	1 1/2			H and F. H and G. B. A.
Ordinary Break	6 (1)	(1)			D. A, or [E and I]. A or E.
Damaged Rail					
Flattened Rail					
Crushed Head			Depth ≥ 3/4 and Length ≥ 8		C. H.

(1) Break out in rail head.

(2) Remedial action D applies to a moon-shaped breakout, resulting from a derailment, with length greater than 6 inches but not exceeding 12 inches and width not exceeding one-third of the rail base width.

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Notes:

A. Assign a person designated under § 213.7 to visually supervise each operation over the defective rail.

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

B. Limit operating speed over the defective rail to that as authorized by a person designated under § 213.7(a), who has at least one year of supervisory experience in railroad track maintenance. The operating speed cannot be over 30 m.p.h. or the maximum allowable speed under § 213.9 for the class of track concerned, whichever is lower.

C. Apply joint bars bolted only through the outermost holes to the defect within 10 days after it is determined to continue the track in use. In the case of Class 3 through 5 track, limit the operating speed over the defective rail to 30 m.p.h. until joint bars are applied; thereafter, limit the speed to 50 m.p.h. or the maximum allowable speed under § 213.9 for the class of track concerned, whichever is lower. When a search for internal rail defects is conducted under § 213.237, and defects are discovered in Class 3 through 5 track that require remedial action C, the operating speed shall be limited to 50 m.p.h. or the maximum allowable speed under § 213.9 for the class of track concerned, whichever is lower, for a period not to exceed 4 days. If the defective rail has not been removed from the track or a permanent repair made within 4 days of the discovery, limit operating speed over the defective rail to 30 m.p.h. until joint bars are applied; thereafter, limit speed to 50 m.p.h. or the maximum allowable speed under § 213.9 for the class of track concerned, whichever is lower. When joint bars have not been applied within 10 days, the speed must be limited to 10 m.p.h. until joint bars are applied.

D. Apply joint bars bolted only through the outermost holes to the defect within 7 days after it is determined to continue the track in use. In the case of Class 3 through 5 track, limit operating speed over the defective rail to 30 m.p.h. or less as authorized by a person designated under § 213.7(a), who has at least one year of supervisory experience in railroad track maintenance, until joint bars are applied; thereafter, limit speed to 50 m.p.h. or the maximum allowable speed under § 213.9 for the class of track concerned, whichever is lower. When joint bars have not been applied within 7 days, the speed must be limited to 10 m.p.h. until the joint bars are applied.

E. Apply joint bars to the defect and bolt in accordance with § 213.121(d) and (e).

F. Inspect the rail within 90 days after it is determined to continue the track in use. If the rail remains in the track and is not replaced or repaired, the reinspection cycle starts over with each successive reinspection unless the

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reinspection reveals the rail defect to have increased in size and therefore become subject to a more restrictive remedial action. This process continues indefinitely until the rail is removed from the track or repaired. If not inspected within 90 days, limit speed to that for Class 2 track or the maximum allowable speed under § 213.9 for the class of track concerned, whichever is lower, until it is inspected.

G. Inspect rail within 30 days after it is determined to continue the track in use. If the rail remains in the track and is not replaced or repaired, the reinspection cycle starts over with each successive reinspection unless the reinspection reveals the rail defect to have increased in size and therefore become subject to a more restrictive remedial action. This process continues indefinitely until the rail is removed from the track or repaired. If not inspected within 30 days, limit speed to that for Class 2 track or the maximum allowable speed under § 213.9 for the class of track concerned, whichever is lower, until it is inspected.

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

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

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(d) As used in this section—

(1) *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.

(2) *Broken base* means any break in the base of the rail.

(3) *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.

(4) *Crushed head* means a short length of rail, not at a joint, which has drooped or sagged across the width of the rail head to a depth of $\frac{3}{8}$ inch or more below the rest of the rail head and 8 inches or more in length. Unlike flattened rail where the depression is visible on the rail head only, the sagging or drooping is also visible in the head/web fillet area.

(5) *Damaged rail* means any rail broken or otherwise damaged by a derailment, broken, flat, or unbalanced wheel, wheel slipping, or similar causes.

(6) *Defective weld* means a field or plant weld containing any discontinuities or pockets, exceeding 5 percent of the rail head area individually or 10 percent in the aggregate, oriented in or near the transverse plane, due to incomplete penetration of the weld metal between the rail ends, lack of fusion between weld and rail end metal, entrainment of slag or sand, under-bead or shrinkage cracking, or fatigue cracking. Weld defects may originate in the rail head, web, or base, and in some cases, cracks may progress from the defect into either or both adjoining rail ends. If the weld defect progresses longitudinally through the weld section, the defect is considered a split web for purposes of remedial action required by this section.

(7) *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.

(8) *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.

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

(10) *Head and web separation* means a progressive fracture, longitudinally separating the head from the web of the rail at the head fillet area.

(11) *Horizontal split head* means a horizontal progressive defect originating inside of the rail head, usually $\frac{1}{4}$ inch or more below the running surface and progressing horizontally in all directions, and generally accompanied by a flat spot on the running surface. The defect appears as a crack lengthwise of the rail when it reaches the side of the rail head.

(12) *Ordinary break* means a partial or complete break in which there is no sign of a fissure, and in which none of the other defects described in this paragraph (d) is found.

(13) *Piped rail* means a vertical split in a rail, usually in the web, due to failure of the shrinkage cavity in the ingot to unite in rolling.

(14) *Split web* means a lengthwise crack along the side of the web and extending into or through it.

(15) *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.

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

[79 FR 4256, Jan. 24, 2014; 79 FR 4633, Jan. 29, 2014]

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§213.115 Rail end mismatch.

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

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

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§213.118 Continuous welded rail (CWR); plan review and approval.

(a) Each track owner with track constructed of CWR shall have in effect and comply with a plan that contains written procedures which address: the installation, adjustment, maintenance, and inspection of CWR; inspection of CWR joints; and a training program for the application of those procedures.

(b) The track owner shall file its CWR plan with the FRA Associate Administrator for Railroad Safety/Chief Safety Officer (Associate Administrator). Within 30 days of receipt of the submission, FRA will review the plan for compliance with this subpart. FRA will approve, disapprove or conditionally approve the submitted plan, and will provide written notice of its determination.

(c) The track owner's existing plan shall remain in effect until the track owner's new plan is approved or conditionally approved and is effective pursuant to paragraph (d) of this section.

(d) The track owner shall, upon receipt of FRA's approval or conditional approval, establish the plan's effective date. The track owner shall advise in writing FRA and all affected employees of the effective date.

(e) FRA, for cause stated, may, subsequent to plan approval or conditional approval, require revisions to the plan to bring the plan into conformity with this subpart. Notice of a revision requirement shall be made in writing and specify the basis of FRA's requirement. The track owner may, within 30 days of the revision requirement, respond and provide written submissions in support of the original plan. FRA renders a final decision in writing. Not more than 30 days following any final decision requiring revisions to a CWR plan, the track owner shall amend the plan in accordance with FRA's decision and resubmit the conforming plan. The conforming plan becomes effective upon its submission to FRA.

[74 FR 43002, Aug. 25, 2009]

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§213.119 Continuous welded rail (CWR); plan contents.

The track owner shall comply with the contents of the CWR plan approved or conditionally approved under §213.118. The plan shall contain the following elements—

- (a) Procedures for the installation and adjustment of CWR which include—
 - (1) Designation of a desired rail installation temperature range for the geographic area in which the CWR is located; and
 - (2) De-stressing procedures/methods which address proper attainment of the desired rail installation temperature range when adjusting CWR.
- (b) Rail anchoring or fastening requirements that will provide sufficient restraint to limit longitudinal rail and cross-tie movement to the extent practical, and specifically addressing CWR rail anchoring or fastening patterns on bridges, bridge approaches, and at other locations where possible longitudinal rail and cross-tie movement associated with normally expected train-induced forces, is restricted.
- (c) CWR joint installation and maintenance procedures which require that—
 - (1) Each rail shall be bolted with at least two bolts at each CWR joint;
 - (2) In the case of a bolted joint installed during CWR installation after October 21, 2009, the track owner shall either, within 60 days—
 - (i) Weld the joint;
 - (ii) Install a joint with six bolts; or
 - (iii) Anchor every tie 195 feet in both directions from the joint; and
 - (3) In the case of a bolted joint in CWR experiencing service failure or a failed bar with a rail gap present, the track owner shall either—
 - (i) Weld the joint;
 - (ii) Replace the broken bar(s), replace the broken bolts, adjust the anchors and, within 30 days, weld the joint;
 - (iii) Replace the broken bar(s), replace the broken bolts, install one additional bolt per rail end, and adjust anchors;
 - (iv) Replace the broken bar(s), replace the broken bolts, and anchor every tie 195 feet in both directions from the CWR joint; or
 - (v) Replace the broken bar(s), replace the broken bolts, add rail with provisions for later adjustment pursuant to paragraph (d)(2) of this section, and reapply the anchors.
- (d) Procedures which specifically address maintaining a desired rail installation temperature range when cutting CWR, including rail repairs, in-track welding, and in conjunction with adjustments made in the area of tight track, a track buckle, or a pull-apart. Rail repair practices shall take into consideration existing rail temperature so that—
 - (1) When rail is removed, the length installed shall be determined by taking into consideration the existing rail temperature and the desired rail installation temperature range; and
 - (2) Under no circumstances should rail be added when the rail temperature is below that designated by paragraph (a)(1) of this section, without provisions for later adjustment.
- (e) Procedures which address the monitoring of CWR in curved track for inward shifts of alignment toward the center of the curve as a result of disturbed track.
- (f) Procedures which govern train speed on CWR track when—
 - (1) Maintenance work, track rehabilitation, track construction, or any other event occurs which disturbs the roadbed or ballast section and reduces the lateral or longitudinal resistance of the track; and
 - (2) The difference between the average rail temperature and the average rail neutral temperature is in a range that causes buckling-prone conditions to be present at a specific location; and
 - (3) In formulating the procedures under paragraphs (f)(1) and (f)(2) of this section, the track owner shall—
 - (i) Determine the speed required, and the duration and subsequent removal of any speed restriction based on the restoration of the ballast, along with sufficient ballast re-consolidation to stabilize the track to a level that can accommodate expected train-induced forces. Ballast re-consolidation can be achieved through either the passage of train tonnage or mechanical stabilization procedures, or both; and
 - (ii) Take into consideration the type of cross-ties used.
- (g) Procedures which prescribe when physical track inspections are to be performed.
 - (1) At a minimum, these procedures shall address inspecting track to identify—
 - (i) Buckling-prone conditions in CWR track, including—
 - (A) Locations where tight or kinky rail conditions are likely to occur; and
 - (B) Locations where track work of the nature described in paragraph (f)(1)(i) of this section has recently been performed; and
 - (ii) Pull-apart prone conditions in CWR track, including locations where pull-apart or stripped-joint rail conditions are likely to occur; and

- (2) In formulating the procedures under paragraph (g)(1) of this section, the track owner shall—
 - (i) Specify when the inspections will be conducted; and
 - (ii) Specify the appropriate remedial actions to be taken when either buckling-prone or pull-apart prone conditions are found.
- (h) Procedures which prescribe the scheduling and conduct of inspections to detect cracks and other indications of potential failures in CWR joints. In formulating the procedures under this paragraph, the track owner shall—
 - (1) Address the inspection of joints and the track structure at joints, including, at a minimum, periodic on-foot inspections;
 - (2) Identify joint bars with visible or otherwise detectable cracks and conduct remedial action pursuant to §213.121;
 - (3) Specify the conditions of actual or potential joint failure for which personnel must inspect, including, at a minimum, the following items:
 - (i) Loose, bent, or missing joint bolts;
 - (ii) Rail end batter or mismatch that contributes to instability of the joint; and
 - (iii) Evidence of excessive longitudinal rail movement in or near the joint, including, but not limited to; wide rail gap, defective joint bolts, disturbed ballast, surface deviations, gap between tie plates and rail, or displaced rail anchors;
 - (4) Specify the procedures for the inspection of CWR joints that are imbedded in highway-rail crossings or in other structures that prevent a complete inspection of the joint, including procedures for the removal from the joint of loose material or other temporary material;
 - (5) Specify the appropriate corrective actions to be taken when personnel find conditions of actual or potential joint failure, including on-foot follow-up inspections to monitor conditions of potential joint failure in any period prior to completion of repairs;
 - (6) Specify the timing of periodic inspections, which shall be based on the configuration and condition of the joint:
 - (i) Except as provided in paragraphs (h)(6)(ii) through (h)(6)(iv) of this section, track owners must specify that all CWR joints are inspected, at a minimum, in accordance with the intervals identified in the following table:

MINIMUM NUMBER OF INSPECTIONS PER CALENDAR YEAR¹

	Freight trains operating over track with an annual tonnage of:			Passenger trains operating over track with an annual tonnage of:	
	Less than 40 mgt	40 to 60 mgt	Greater than 60 mgt	Less than 20 mgt	Greater than or equal to 20 mgt
Class 5 & above	2	3 ²	4 ²	3 ²	3 ²
Class 4	2	3 ²	4 ²	2	3 ²
Class 3	1	2	2	2	2
Class 2	0	0	0	1	1
Class 1	0	0	0	0	0
Excepted Track	0	0	0	n/a	n/a

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

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

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

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

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

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

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

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

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

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

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

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

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

(ii) [Reserved]

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

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

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

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

(i) The track owner shall have in effect a comprehensive training program for the application of these written CWR procedures, with provisions for annual re-training, for those individuals designated under §213.7(c) as qualified to supervise the installation, adjustment, and maintenance of CWR track and to perform inspections of CWR track. The track owner shall make the training program available for review by FRA upon request.

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

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

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

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

(k) The track owner shall make readily available, at every job site where personnel are assigned to install, inspect or maintain CWR, a copy of the track owner's CWR procedures and all revisions, appendices, updates, and referenced materials related thereto prior to their effective date. Such CWR procedures shall be issued and maintained in one CWR standards and procedures manual.

(l) As used in this section—

Adjusting/de-stressing means a procedure by which a rail's neutral temperature is re-adjusted to the desired value. It typically consists of cutting the rail and removing rail anchoring devices, which provides for the necessary expansion and contraction, and then re-assembling the track.

Annual re-training means training every calendar year.

Buckling incident means the formation of a lateral misalignment sufficient in magnitude to constitute a deviation from the Class 1 requirements specified in §213.55. These normally occur when rail temperatures are relatively high and are caused by high longitudinal compressive forces.

Buckling-prone condition means a track condition that can result in the track being laterally displaced due to high compression forces caused by critical rail temperature combined with insufficient track strength and/or train dynamics.

Continuous welded rail (CWR) means rail that has been welded together into lengths exceeding 400 feet. Rail installed as CWR remains CWR, regardless of whether a joint or plug is installed into the rail at a later time.

Corrective actions mean those actions which track owners specify in their CWR plans to address conditions of actual or potential joint failure, including, as applicable, repair, restrictions on operations, and additional on-foot inspections.

CWR joint means any joint directly connected to CWR.

Desired rail installation temperature range means the rail temperature range, within a specific geographical area, at which forces in CWR should not cause a buckling incident in extreme heat, or a pull apart during extreme cold weather.

Disturbed track means the disturbance of the roadbed or ballast section, as a result of track maintenance or any other event, which reduces the lateral or longitudinal resistance of the track, or both.

Mechanical stabilization means a type of procedure used to restore track resistance to disturbed track following certain maintenance operations. This procedure may incorporate dynamic track stabilizers or ballast consolidators, which are units of work equipment that are used as a substitute for the stabilization action provided by the passage of tonnage trains.

Pull apart or stripped joint means a condition when no bolts are mounted through a joint on the rail end, rendering the joint bar ineffective due to excessive expansive or contractive forces.

Pull-apart prone condition means a condition when the actual rail temperature is below the rail neutral temperature at or near a joint where longitudinal tensile forces may affect the fastenings at the joint.

Rail anchors mean those 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.

Rail neutral temperature is the temperature at which the rail is neither in compression nor tension.

Rail temperature means the temperature of the rail, measured with a rail thermometer.

Remedial actions mean those actions which track owners are required to take as a result of requirements of this part to address a non-compliant condition.

Tight/kinky rail means CWR which exhibits minute alinement irregularities which indicate that the rail is in a considerable amount of compression.

Tourist, scenic, historic, or excursion operations mean railroad operations that carry passengers with the conveyance of the passengers to a particular destination not being the principal purpose.

Track lateral resistance means the resistance provided by the rail/crosstie structure against lateral displacement.

Track longitudinal resistance means the resistance provided by the rail anchors/rail fasteners and the ballast section to the rail/crosstie structure against longitudinal displacement.

Train-induced forces means the vertical, longitudinal, and lateral dynamic forces which are generated during train movement and which can contribute to the buckling potential of the rail.

Unscheduled detour operation means a short-term, unscheduled operation where a track owner has no more than 14 calendar days' notice that the operation is going to occur.

[74 FR 43002, Aug. 25, 2009, as amended at 74 FR 53889, Oct. 21, 2009; 75 FR 4705, Jan. 29, 2010; 79 FR 4258, Jan. 24, 2014]

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§213.121 Rail joints.

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

(b) If a joint bar on Classes 3 through 5 track is cracked, broken, or because of wear allows excessive vertical movement of either rail when all bolts are tight, it shall be replaced.

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

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

(e) In the case of continuous welded rail track, each rail shall be bolted with at least two bolts at each joint.

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

(g) No rail shall have a bolt hole which is torch cut or burned in Classes 2 through 5 track. For Class 2 track, this paragraph (g) is applicable September 21, 1999.

(h) No joint bar shall be reconfigured by torch cutting in Classes 3 through 5 track.

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§213.122 Torch cut rail.

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

(1) Within one year of September 21, 1998, all torch cut rail ends in Class 5 track shall be removed;

(2) Within two years of September 21, 1998, all torch cut rail ends in Class 4 track shall be removed; and

(3) Within one year of September 21, 1998, all torch cut rail ends in Class 3 track over which regularly scheduled passenger trains operate, shall be inventoried by the track owner.

(b) Following the expiration of the time limits specified in paragraphs (a)(1), (2), and (3) of this section, any torch cut rail end not removed from Classes 4 and 5 track, or any torch cut rail end not inventoried in Class 3 track over which regularly scheduled passenger trains operate, shall be removed within 30 days of discovery. Train speed over that rail end shall not exceed the maximum allowable for Class 2 track until removed.

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§213.123 Tie plates.

(a) In Classes 3 through 5 track where timber crossties are in use there shall be tie plates under the running rails on at least eight of any 10 consecutive ties.

(b) In Classes 3 through 5 track no metal object which causes a concentrated load by solely supporting a rail shall be allowed between the base of the rail and the bearing surface of the tie plate. This paragraph (b) is applicable September 21, 1999.)

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§213.127 Rail fastening systems.

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

(b) If rail anchors are applied to concrete crossties, the combination of the crossties, fasteners, and rail anchors must provide effective longitudinal restraint.

(c) Where fastener placement impedes insulated joints from performing as intended, the fastener may be modified or removed, provided that the crosstie supports the rail.

[76 FR 18086, Apr. 1, 2011]

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§213.133 Turnouts and track crossings generally.

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

(b) Classes 3 through 5 track shall be equipped with rail anchoring through and on each side of track crossings and turnouts, to restrain rail movement affecting the position of switch points and frogs. For Class 3 track, this paragraph (b) is applicable September 21, 1999.)

(c) Each flangeway at turnouts and track crossings shall be at least 1½ inches wide.

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§213.135 Switches.

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

(b) Each switch point shall fit its stock rail properly, with the switch stand in either of its closed positions to allow wheels to pass the switch point. Lateral and vertical movement of a stock rail in the switch plates or of a switch plate on a tie shall not adversely affect the fit of the switch point to the stock rail. Broken or cracked switch point rails will be subject to the requirements of §213.113, except that where remedial actions C, D, or E require the use of joint bars, and joint bars cannot be placed due to the physical configuration of the switch, remedial action B will govern, taking into account any added safety provided by the presence of reinforcing bars on the switch points.

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

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

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

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

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

(h) Unusually chipped or worn switch points shall be repaired or replaced. Metal flow shall be removed to insure proper closure.

(i) Tongue & Plain Mate switches, which by design exceed Class 1 and excepted track maximum gage limits, are permitted in Class 1 and excepted track.

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§213.137 Frogs.

(a) The flangeway depth measured from a plane across the wheel-bearing area of a frog on Class 1 track shall not be less than 1¾ inches, or less than 1½ inches on Classes 2 through 5 track.

(b) If a frog point is chipped, broken, or worn more than five-eighths inch down and 6 inches back, operating speed over the frog shall not be more than 10 m.p.h.

(c) If the tread portion of a frog casting is worn down more than three-eighths inch below the original contour, operating speed over that frog shall not be more than 10 m.p.h.

(d) Where frogs are designed as flange-bearing, flangeway depth may be less than that shown for Class 1 if operated at Class 1 speeds.

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§213.139 Spring rail frogs.

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

(b) The toe of each wing rail shall be solidly tamped and fully and tightly bolted.

(c) Each frog with a bolt hole defect or head-web separation shall be replaced.

(d) Each spring shall have compression sufficient to hold the wing rail against the point rail.

(e) The clearance between the holddown housing and the horn shall not be more than one-fourth of an inch.

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§213.141 Self-guarded frogs.

(a) The raised guard on a self-guarded frog shall not be worn more than three-eighths of an inch.

(b) If repairs are made to a self-guarded frog without removing it from service, the guarding face shall be restored before rebuilding the point.

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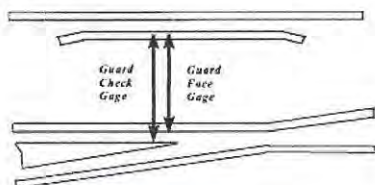
§213.143 Frog guard rails and guard faces; gage.

The guard check and guard face gages in frogs shall be within the limits prescribed in the following table—

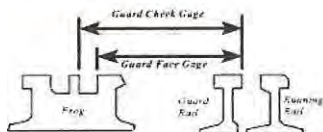
Class of track	Guard check gage	Guard face gage
	The distance between the gage line of a frog to the guard line ¹ of its guard rail or guarding face, measured across the track at right angles to the gage line ² , may not be less than—	The distance between guard lines ¹ , measured across the track at right angles to the gage line ² , may not be more than—
Class 1 track	4' 6 1/8"	4' 5 1/4"
Class 2 track	4' 6 1/4"	4' 5 1/8"
Class 3 and 4 track	4' 6 3/8"	4' 5 1/8"
Class 5 track	4' 6 1/2"	4' 5"

¹A line along that side of the flangeway which is nearer to the center of the track and at the same elevation as the gage line.

²A line 5/8 inch 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.



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Subpart E—Track Appliances and Track-Related Devices

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§213.201 Scope.

This subpart prescribes minimum requirements for certain track appliances and track-related devices.

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§213.205 Derails.

(a) Each derail shall be clearly visible.

(b) When in a locked position, a derail shall be free of lost motion which would prevent it from performing its intended function.

(c) Each derail shall be maintained to function as intended.

(d) Each derail shall be properly installed for the rail to which it is applied. (This paragraph (d) is applicable September 21, 1999.)

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Subpart F—Inspection

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§213.231 Scope.

This subpart prescribes requirements for the frequency and manner of inspecting track to detect deviations from the standards prescribed in this part.

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§213.233 Track inspections.

(a) All track shall be inspected in accordance with the schedule prescribed in paragraph (c) of this section by a person designated under §213.7.

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

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

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

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

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

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

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

(d) If the person making the inspection finds a deviation from the requirements of this part, the inspector shall immediately initiate remedial action.

NOTE TO §213.233: Except as provided in paragraph (b) of this section, no part of this section will in any way be construed to limit the inspector's discretion as it involves inspection speed and sight distance.

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§213.234 Automated inspection of track constructed with concrete cross-ties.

(a) *General.* Except for track described in paragraph (c) of this section, the provisions in this section are applicable on and after July 1, 2012. In addition to the track inspection required under §213.233, for Class 3 main track constructed with concrete cross-ties over which regularly scheduled passenger service trains operate, and for Class 4 and 5 main track constructed with concrete cross-ties, automated inspection technology shall be used as indicated in paragraph (b) of this section, as a supplement to visual inspection, by Class I railroads (including Amtrak), Class II railroads, other intercity passenger railroads, and commuter railroads or small governmental jurisdictions that serve populations greater than 50,000. Automated inspection shall identify and report exceptions to conditions described in §213.109(d)(4).

(b) *Frequency of automated inspections.* Automated inspections shall be conducted at the following frequencies:

(1) If annual tonnage on Class 4 and 5 main track and Class 3 main track with regularly scheduled passenger service, exceeds 40 million gross tons (mgt) annually, at least twice each calendar year, with no less than 160 days between inspections.

(2) If annual tonnage on Class 4 and 5 main track and Class 3 main track with regularly scheduled passenger service is equal to or less than 40 mgt annually, at least once each calendar year.

(3) On Class 3, 4, and 5 main track with exclusively passenger service, either an automated inspection or walking inspection must be conducted once per calendar year.

(4) Track not inspected in accordance with paragraph (b)(1) or (b)(2) of this section because of train operation interruption shall be reinspected within 45 days of the resumption of train operations by a walking or automated inspection. If this inspection is conducted as a walking inspection, the next inspection shall be an automated inspection as prescribed in this paragraph.

(c) *Nonapplication.* Sections of tangent track 600 feet or less constructed of concrete cross-ties, including, but not limited to, isolated track segments, experimental or test track segments, highway-rail crossings, and wayside detectors, are excluded from the requirements of this section.

(d) *Performance standard for automated inspection measurement system.* The automated inspection measurement system must be capable of indicating and processing rail seat deterioration requirements that specify the following:

- (1) An accuracy, to within $\frac{1}{8}$ of an inch;
- (2) A distance-based sampling interval, which shall not exceed five feet; and
- (3) Calibration procedures and parameters assigned to the system, which assure that indicated and recorded values accurately represent rail seat deterioration.

(e) *Exception reports to be produced by system; duty to field-verify exceptions.* The automated inspection measurement system shall produce an exception report containing a systematic listing of all exceptions to §213.109(d)(4), identified so that an appropriate person(s) designated as fully qualified under §213.7 can field-verify each exception.

(1) Exception reports must be provided to or be made available to all persons designated as fully qualified under §213.7 and whose territories are subject to the requirements of §213.234.

(2) Each exception must be located and field-verified no later than 48 hours after the automated inspection.

(3) All field-verified exceptions are subject to all the requirements of this part.

(4) Exception reports must note areas identified between $\frac{3}{8}$ of an inch and $\frac{1}{2}$ of an inch as an "alert."

(f) *Recordkeeping requirements.* The track owner shall maintain and make available to FRA a record of the inspection data and the exception record for the track inspected in accordance with this paragraph for a minimum of two years. The exception reports must include the following:

- (1) Date and location of limits of the inspection;
- (2) Type and location of each exception;
- (3) Results of field verification; and
- (4) Remedial action if required.

(g) *Procedures for integrity of data.* The track owner shall institute the necessary procedures for maintaining the integrity of the data collected by the measurement system. At a minimum, the track owner shall do the following:

(1) Maintain and make available to FRA documented calibration procedures of the measurement system that, at a minimum, specify an instrument verification procedure that ensures correlation between measurements made on the ground and those recorded by the instrumentation; and

(2) Maintain each instrument used for determining compliance with this section such that it accurately provides an indication of the depth of rail seat deterioration in accordance with paragraph (d)(1) of this section.

(h) *Training.* The track owner shall provide annual training in handling rail seat deterioration exceptions to all persons designated as fully qualified under §213.7 and whose territories are subject to the requirements of §213.234. At a minimum, the training shall address the following:

- (1) Interpretation and handling of the exception reports generated by the automated inspection measurement system;
- (2) Locating and verifying exceptions in the field and required remedial action; and
- (3) Recordkeeping requirements.

[76 FR 18086, Apr. 1, 2011, as amended at 76 FR 55825, Sept. 9, 2011]

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§213.235 Inspection of switches, track crossings, and lift rail assemblies or other transition devices on moveable bridges.

(a) Except as provided in paragraph (c) of this section, each switch, turnout, track crossing, and moveable bridge lift rail assembly or other transition device shall be inspected on foot at least monthly.

(b) Each switch in Classes 3 through 5 track that is held in position only by the operating mechanism and one connecting rod shall be operated to all of its positions during one inspection in every 3 month period.

(c) In the case of track that is used less than once a month, each switch, turnout, track crossing, and moveable bridge lift rail assembly or other transition device shall be inspected on foot before it is used.

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§213.237 Inspection of rail.

(a) In addition to the inspections required by §213.233, each track owner shall conduct internal rail inspections sufficient to maintain service failure rates per rail inspection segment in accordance with this paragraph (a) for a 12-month period, as determined by the track owner and calculated within 45 days of the end of the period. These rates shall not include service failures that occur in rail that has been replaced through rail relay since the time of the service failure. Rail used to repair a service failure defect is not considered relayed rail. The service failure rates shall not exceed—

(1) 0.1 service failure per year per mile of track for all Class 4 and 5 track;

(2) 0.09 service failure per year per mile of track for all Class 3, 4, and 5 track that carries regularly-scheduled passenger trains or is a hazardous materials route; and

(3) 0.08 service failure per year per mile of track for all Class 3, 4, and 5 track that carries regularly-scheduled passenger trains and is a hazardous materials route.

(b) Each rail inspection segment shall be designated by the track owner no later than March 25, 2014 for track that is Class 4 or 5 track, or Class 3 track that carries regularly-scheduled passenger trains or is a hazardous materials route and is used to determine the milepost limits for the individual rail inspection frequency.

(1) To change the designation of a rail inspection segment or to establish a new segment pursuant to this section, a track owner must submit a detailed request to the FRA Associate Administrator for Railroad Safety/Chief Safety Officer (Associate Administrator). Within 30 days of receipt of the submission, FRA will review the request. FRA will approve, disapprove, or conditionally approve the submitted request, and will provide written notice of its determination.

(2) The track owner's existing designation shall remain in effect until the track owner's new designation is approved or conditionally approved by FRA.

(3) The track owner shall, upon receipt of FRA's approval or conditional approval, establish the designation's effective date. The track owner shall advise in writing FRA and all affected railroad employees of the effective date.

(c) Internal rail inspections on Class 4 and 5 track, or Class 3 track with regularly-scheduled passenger trains or that is a hazardous materials route, shall not exceed a time interval of 370 days between inspections or a tonnage interval of 30 million gross tons (mgt) between inspections, whichever is shorter. Internal rail inspections on Class 3 track that is without regularly-scheduled passenger trains and not a hazardous materials route must be inspected at least once each calendar year, with no more than 18 months between inspections, or at least once every 30 mgt, whichever interval is longer, but in no case may inspections be more than 5 years apart.

(1) Any rail used as a replacement plug rail in track that is required to be tested in accordance with this section must have been tested for internal rail flaws.

(2) The track owner must verify that any plug rail installed after March 25, 2014 has not accumulated more than a total of 30 mgt in previous and new locations since its last internal rail flaw test, before the next test on the rail required by this section is performed.

(3) If plug rail not in compliance with this paragraph (c) is in use after March 25, 2014, trains over that rail must not exceed Class 2 speeds until the rail is tested in accordance with this section.

(d) If the service failure rate target identified in paragraph (a) of this section is not achieved, the track owner must inform FRA of this fact within 45 days of the end of the defined 12-month period in which the performance target is exceeded. In addition, the track owner may provide to FRA an explanation as to why the performance target was not achieved and provide a remedial action plan.

(1) If the performance target rate is not met for two consecutive years, then for the area where the greatest number of service failures is occurring, either:

(i) The inspection tonnage interval between tests must be reduced to 10 mgt; or

(ii) The class of track must be reduced to Class 2 until the target service failure rate is achieved.

(2) In cases where a single service failure would cause the rate to exceed the applicable service failure rate as designated in paragraph (a) of this section, the service failure rate will be considered to comply with paragraph (a) of this section unless a second such failure occurs within a designated 12-month period. For the purposes of this paragraph (d)(2), a period begins no earlier than January 24, 2014.

(e) Each defective rail shall be marked with a highly visible marking on both sides of the web and base except that, where a side or sides of the web and base are inaccessible because of permanent features, the highly visible marking may be placed on or next to the head of the rail.

(f) Inspection equipment shall be capable of detecting defects between joint bars, in the area enclosed by joint bars.

(g) If the person assigned to operate the rail defect detection equipment (i.e., the qualified operator) determines that a valid search for internal defects could not be made over a particular length of track, that particular length of track may not be considered as internally inspected under paragraphs (a) and (c) of this section.

(h) If a valid search for internal defects could not be conducted, the track owner shall, before expiration of the time or tonnage limits in paragraph (a) or (c) of this section—

(1) Conduct a valid search for internal defects;

(2) Reduce operating speed to a maximum of 25 m.p.h. until such time as a valid search can be made; or

(3) Replace the rail that had not been inspected.

(i) The person assigned to operate the rail defect detection equipment must be a qualified operator as defined in §213.238 and have demonstrated proficiency in the rail flaw detection process for each type of equipment the operator is assigned.

(j) As used in this section—

(1) *Hazardous materials route* means track over which a minimum of 10,000 car loads or intermodal portable tank car loads of hazardous materials as defined in 49 CFR 171.8 travel over a period of one calendar year; or track over which a minimum of 4,000 car loads or intermodal portable tank car loads of the hazardous materials specified in 49 CFR 172.820 travel, in a period of one calendar year.

(2) *Plug rail* means a length of rail that has been removed from one track location and stored for future use as a replacement rail at another location.

(3) *Service failure* means a broken rail occurrence, the cause of which is determined to be a compound fissure, transverse fissure, detail fracture, or vertical split head.

(4) *Valid search* means a continuous inspection for internal rail defects where the equipment performs as intended and equipment responses are interpreted by a qualified operator as defined in §213.238.

[79 FR 4258, Jan. 24, 2014]

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§213.238 Qualified operator.

(a) Each provider of rail flaw detection shall have a documented training program in place and shall identify the types of rail flaw detection equipment for which each equipment operator it employs has received training and is qualified. A provider of rail flaw detection may be the track owner. A track owner shall not utilize a provider of rail flaw detection that fails to comply with the requirements of this paragraph.

(b) A qualified operator shall be trained and have written authorization from his or her employer to:

(1) Conduct a valid search for internal rail defects utilizing the specific type(s) of equipment for which he or she is authorized and qualified to operate;

(2) Determine that such equipment is performing as intended;

(3) Interpret equipment responses and institute appropriate action in accordance with the employer's procedures and instructions; and

(4) Determine that each valid search for an internal rail defect is continuous throughout the area inspected and has not been compromised due to environmental contamination, rail conditions, or equipment malfunction.

(c) To be qualified, the operator must have received training in accordance with the documented training program and a minimum of 160 hours of rail flaw detection experience under direct supervision of a qualified operator or rail flaw detection equipment manufacturer's representative, or some combination of both. The operator must demonstrate proficiency in the rail defect detection process, including the equipment to be utilized, prior to initial qualification and authorization by the employer for each type of equipment.

(d) Each employer shall reevaluate the qualifications of, and administer any necessary recurrent training for, the operator as determined by and in accordance with the employer's documented program. The reevaluation process shall require that the employee successfully complete a recorded examination and demonstrate proficiency to the employer on the specific equipment type(s) to be operated. Proficiency may be determined by a periodic review of test data submitted by the operator.

(e) Each employer of a qualified operator shall maintain written or electronic records of each qualification in effect. Each record shall include the name of the employee, the equipment to which the qualification applies, date of qualification, and date of the most recent reevaluation, if any.

(f) Any employee who has demonstrated proficiency in the operation of rail flaw detection equipment prior to January 24, 2014, is deemed a qualified operator, regardless of the previous training program under which the employee was qualified. Such an operator shall be subject to paragraph (d) of this section.

(g) Records concerning the qualification of operators, including copies of equipment-specific training programs and materials, recorded examinations, demonstrated proficiency records, and authorization records, shall be kept at a location designated by the employer and available for inspection and copying by FRA during regular business hours.

[79 FR 4259, Jan. 24, 2014]

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§213.239 Special inspections.

In the event of fire, flood, severe storm, or other occurrence which might have damaged track structure, a special inspection shall be made of the track involved as soon as possible after the occurrence and, if possible, before the operation of any train over that track.

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§213.241 Inspection records.

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

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

(c) Records of internal rail inspections required by §213.237 shall specify the—

(1) Date of inspection;

(2) Track inspected, including beginning and end points;

(3) Location and type of defects found under §213.113;

(4) Size of defects found under §213.113, if not removed prior to the next train movement;

(5) Initial remedial action taken and the date thereof; and

(6) Location of any track not tested pursuant to §213.237(g).

(d) The track owner shall retain a rail inspection record under paragraph (c) of this section for at least two years after the inspection and for one year after initial remedial action is taken.

(e) The track owner shall maintain records sufficient to demonstrate the means by which it computes the service failure rate on all track segments subject to the requirements of §213.237(a) for the purpose of determining compliance with the applicable service failure rate target.

(f) Each track owner required to keep inspection records under this section shall make those records available for inspection and copying by FRA upon request.

(g) For purposes of complying with the requirements of this section, a track owner may maintain and transfer records through electronic transmission, storage, and retrieval provided that—

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

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

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

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

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

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

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

[63 FR 34029, June 22, 1998, as amended at 70 FR 66298, Nov. 2, 2005; 79 FR 4259, Jan. 24, 2014]

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Appendix A to Part 213—Maximum Allowable Curving Speeds

This appendix contains four tables identifying maximum allowing curving speeds based on 3, 4, 5, and 6 inches of unbalance (cant deficiency), respectively.

TABLE 1—THREE INCHES UNBALANCE

Degree of curvature	Elevation of outer rail (inches)												
	0	1/2	1	1 1/2	2	2 1/2	3	3 1/2	4	4 1/2	5	5 1/2	6
	Maximum allowable operating speed (m.p.h.)												
0°30'	93	100	107	113	120	125	131	136	141	146	151	156	160
0°40'	80	87	93	98	104	109	113	118	122	127	131	135	139
0°50'	72	77	83	88	93	97	101	106	110	113	117	121	124
1°00'	65	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'	53	58	62	65	69	72	76	79	82	85	87	90	93
1°45'	49	53	57	61	64	67	70	73	76	78	81	83	86
2°00'	46	50	53	57	60	63	65	68	71	73	76	78	80
2°15'	44	47	50	53	56	59	62	64	67	69	71	73	76
2°30'	41	45	48	51	53	56	59	61	63	65	68	70	72
2°45'	39	43	46	48	51	53	56	58	60	62	64	66	68
3°00'	38	41	44	46	49	51	53	56	58	60	62	64	65
3°15'	36	39	42	44	47	49	51	53	55	57	59	61	63
3°30'	35	38	40	43	45	47	49	52	53	55	57	59	61
3°45'	34	37	39	41	44	46	48	50	52	53	55	57	59
4°00'	33	35	38	40	42	44	46	48	50	52	53	55	57
4°30'	31	33	36	38	40	42	44	45	47	49	50	52	53
5°00'	29	32	34	36	38	40	41	43	45	46	48	49	51
5°30'	28	30	32	34	36	38	39	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	44
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	30	32	33	34	35	36
11°00'	20	21	23	24	25	27	28	29	30	31	32	33	34
12°00'	19	20	22	23	24	26	27	28	29	30	31	32	33

TABLE 2—FOUR INCHES UNBALANCE

Degree of curvature	Elevation of outer rail (inches)												
	0	1/2	1	1 1/2	2	2 1/2	3	3 1/2	4	4 1/2	5	5 1/2	6
	Maximum allowable operating speed (m.p.h.)												
0°30'	107	113	120	125	131	136	141	146	151	156	160	165	169
0°40'	93	98	104	109	113	118	122	127	131	135	139	143	146
0°50'	83	88	93	97	101	106	110	113	117	121	124	128	131
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

TABLE 3—FIVE INCHES UNBALANCE

Degree of curvature	Elevation of outer rail (inches)												
	0	1/2	1	1 1/2	2	2 1/2	3	3 1/2	4	4 1/2	5	5 1/2	6
	Maximum allowable operating speed (m.p.h.)												
0°30'	120	125	131	136	141	146	151	156	160	165	169	173	177
0°40'	104	109	113	118	122	127	131	135	139	143	146	150	150
0°50'	93	97	101	106	110	113	117	121	124	128	131	134	137
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

TABLE 4—SIX INCHES UNBALANCE

Degree of curvature	Elevation of outer rail (inches)												
	0	1/2	1	1 1/2	2	2 1/2	3	3 1/2	4	4 1/2	5	5 1/2	6
	Maximum allowable operating speed (m.p.h.)												
0°30'	131	136	141	146	151	156	160	165	169	173	177	181	185
0°40'	113	118	122	127	131	135	139	143	146	150	154	157	160
0°50'	101	106	110	113	117	121	124	128	131	134	137	140	143
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

[78 FR 16113, Mar. 13, 2013]

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Appendix B to Part 213—Schedule of Civil Penalties

Section	Violation	Willful Violation ¹
Subpart A—General:		
213.4(a) Excepted track ²	\$2,500	\$5,000
213.4(b) Excepted track ²	2,500	5,000
213.4(c) Excepted track ²	2,500	5,000
213.4(d) Excepted track ²	2,500	5,000
213.4(e):		
(1) Excepted track	5,000	7,500
(2) Excepted track	7,000	10,000
(3) Excepted track	7,000	10,000
(4) Excepted track	5,000	7,500
213.4(f) Excepted track	2,000	4,000
213.7 Designation of qualified persons to supervise certain renewals and inspect track	1,000	2,000
213.9 Classes of track: Operating speed limits	2,500	2,500
213.11 Restoration or renewal of track under traffic conditions	2,500	2,500

213.13 Measuring track not under load	1,000	2,000
Subpart B—Roadbed:		
213.33 Drainage	2,500	5,000
213.37 Vegetation	1,000	2,000
Subpart C—Track Geometry:		
213.53 Gage	5,000	7,500
213.55 Track alinement	5,000	7,500
213.57 Curves; elevation and speed limitations	2,500	5,000
213.59 Elevation of curved track; runoff	2,500	2,500
213.63 Track surface	5,000	7,500
213.65 Combined track alinement and surface deviations	5,000	7,500
Subpart D—Track structure:		
213.103 Ballast; general	2,500	5,000
213.109 Crossties		
(a) Material used	1,000	2,000
(b) Distribution of ties	2,500	5,000
(c) and (d) Sufficient number of non-defective ties	1,000	2,000
(e) Joint ties	2,500	5,000
(f) Track constructed without crossties	2,500	5,000
213.110 Gage restraint measurement systems	5,000	7,500
213.113 Defective rails	5,000	7,500
213.115 Rail end mismatch	2,500	5,000
213.118 Continuous welded rail plan (a) through (e)	5,000	7,500
213.119 Continuous welded rail plan contents (a) through (k)	5,000	7,500
213.121 (a) Rail joints	2,500	5,000
213.121 (b) Rail joints	2,500	5,000
213.121 (c) Rail joints	5,000	7,500
213.121 (d) Rail joints	2,500	5,000
213.121 (e) Rail joints	2,500	5,000
213.121 (f) Rail joints	2,500	5,000
213.121 (g) Rail joints	2,500	5,000
213.121 (h) Rail joints	5,000	7,500
213.122 Torch cut rail	2,500	5,000
213.123 Tie plates	1,000	2,000
213.127 Rail Fastening Systems	2,500	5,000
213.133 Turnouts and track crossings, generally	1,000	1,000
213.135 Switches:		
(a) through (g)	2,500	5,000
(h) chipped or worn points	5,000	7,500
213.137 Frogs	2,500	5,000
213.139 Spring rail frogs	2,500	5,000
213.141 Self-guarded frogs	2,500	5,000
213.143 Frog guard rails and guard faces; gage	2,500	5,000
Subpart E—Track appliances and track-related devices:		
213.205 Derails	2,500	5,000
Subpart F—Inspection:		
213.233 Track inspections	2,000	4,000
213.234 Automated inspection of track constructed with concrete crossties	5,000	7,500
213.235 Switches, crossings, transition devices	2,000	4,000
213.237 Inspection of rail	2,500	5,000
213.238 Qualified operator	\$2,500	\$5,000
213.239 Special inspections	2,500	5,000
213.241 Inspection records	1,000	1,000
Subpart G—Train operations at track classes 6 and higher:		
213.305 Designation of qualified individuals; general qualifications	1,000	2,000
213.307 Classes of track: operating speed limits	2,500	5,000
213.309 Restoration or renewal of track under traffic conditions	2,500	5,000
213.311 Measuring track not under load	1,000	2,000
213.319 Drainage	2,500	5,000
213.321 Vegetation	1,000	2,000
213.323 Track gage	5,000	7,500
213.327 Track alinement	5,000	7,500
213.329 Curves; elevation and speed limits	2,500	5,000
213.331 Track surface	5,000	7,500
213.332 Combined track alinement and surface deviations	5,000	7,500
213.333 Automated vehicle-based inspection systems	5,000	7,500
213.335 Crossties		

(a) Material used	1,000	2,000
(b) Distribution of ties	2,500	5,000
(c) Sufficient number of nondefective ties, non-concrete	1,000	2,000
(d) Sufficient number of nondefective concrete ties	1,000	2,000
(e) Joint ties	2,500	5,000
(f) Track constructed without crossties	2,500	5,000
(g) Non-defective ties surrounding defective ties	2,500	5,000
(h) Tie plates	2,500	5,000
(i) Tie plates	1,000	2,000
213.337 Defective rails	5,000	7,500
213.339 Inspection of rail in service	2,500	5,000
213.341 Inspection of new rail	2,500	5,000
213.343 Continuous welded rail (a) through (h)	5,000	7,500
213.345 Vehicle/track system qualification:		
(a) through (d)	5,000	7,500
(e) through (i)	2,500	5,000
213.347 Automotive or railroad crossings at grade	5,000	7,500
213.349 Rail end mismatch	2,500	5,000
213.351 (a) Rail joints	2,500	5,000
213.351 (b) Rail joints	2,500	5,000
213.351 (c) Rail joints	5,000	7,500
213.351 (d) Rail joints	2,500	5,000
213.351 (e) Rail joints	2,500	5,000
213.351 (f) Rail joints	5,000	7,500
213.351 (g) Rail joints	5,000	7,500
213.352 Torch cut rails	2,500	5,000
213.353 Turnouts, crossovers, transition devices	1,000	2,000
213.355 Frog guard rails and guard faces; gage	2,500	5,000
213.357 Derails	2,500	5,000
213.359 Track stiffness	5,000	7,500
213.361 Right of way	5,000	7,500
213.365 Visual inspections	2,500	5,000
213.367 Special inspections	2,500	5,000
213.369 Inspections records	2,000	4,000

¹A penalty may be assessed against an individual only for a willful violation. The Administrator reserves the right to assess a penalty of up to \$105,000 for any violation where circumstances warrant. See 49 CFR part 209, appendix A.

²In addition to assessment of penalties for each instance of noncompliance with the requirements identified by this footnote, track segments designated as excepted track that are or become ineligible for such designation by virtue of noncompliance with any of the requirements to which this footnote applies are subject to all other requirements of part 213 until such noncompliance is remedied.

[63 FR 34029, June 22, 1998; 63 FR 45959, Aug. 28, 1998, as amended at 70 FR 66299, Nov. 2, 2005; 73 FR 79701, Dec. 30, 2008; 74 FR 43006, Aug. 25, 2009; 77 FR 24419, Apr. 24, 2012; 78 FR 16115, Mar. 13, 2013; 79 FR 4260, Jan. 24, 2014]

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Appendix C to Part 213 [Reserved]

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Appendix D to Part 213—Minimally Compliant Analytical Track (MCAT) Simulations Used for Qualifying Vehicles To Operate at High Speeds and at High Cant Deficiencies

1. This appendix contains requirements for using computer simulations to comply with the vehicle/track system qualification testing requirements specified in subpart G of this part. These simulations shall be performed using a track model containing defined geometry perturbations at the limits that are permitted for a specific class of track and level of cant deficiency. This track model is known as MCAT, Minimally Compliant Analytical Track. These simulations shall be used to identify vehicle dynamic performance issues prior to service or, as appropriate, a change in service, and demonstrate that a vehicle type is suitable for operation on the track over which it is intended to operate.

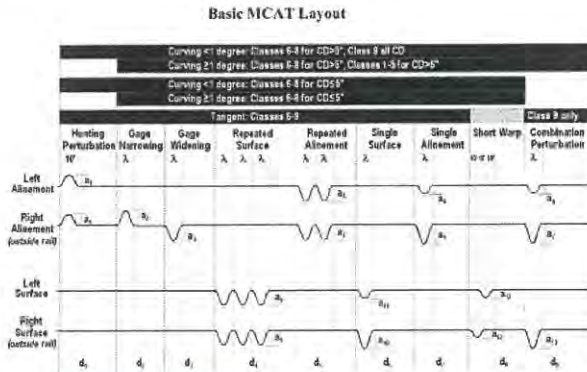
2. As specified in §213.345(c)(2), MCAT shall be used for the qualification of new vehicle types intended to operate at track Class 7 speeds or above, or at any curving speed producing more than 6 inches of cant deficiency. MCAT may also be used for the qualification of new vehicle types intended to operate at speeds corresponding to Class 6 track, as specified in §213.345(c)(1). In addition, as specified in §213.345(d)(1), MCAT may be used to qualify on new routes vehicle types that have previously been qualified on other routes and are intended to operate at any curving speed producing more than 6 inches of cant deficiency, or at curving speeds that both correspond to track Class 7 speeds or above and produce more than 5 inches of cant deficiency.

(a) *Validation.* To validate the vehicle model used for simulations under this part, the track owner or railroad shall obtain vehicle simulation predictions using measured track geometry data, chosen from the same track section over which testing shall be performed as specified in §213.345(c)(2)(ii). These predictions shall be submitted to FRA in support of the request for approval of the qualification testing plan. Full validation of the vehicle model used for simulations under this part shall be determined when the results of the simulations demonstrate that they replicate all key responses observed during qualification testing.

(b) *MCAT layout.* MCAT consists of nine segments, each designed to test a vehicle's performance in response to a specific type of track perturbation. The basic layout of MCAT is shown in figure 1 of this appendix, by type of track (curving or tangent), class of track, and cant

deficiency (CD). The values for wavelength, λ , amplitude of perturbation, a , and segment length, d , are specified in this appendix. The bars at the top of figure 1 show which segments are required depending on the speed and degree of curvature. For example, the hunting perturbation section is not required for simulation of curves greater than or equal to 1 degree.

Figure 1 of Appendix D to Part 213



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(1) *MCAT segments.* MCAT's nine segments contain different types of track deviations in which the shape of each deviation is a versine having wavelength and amplitude varied for each simulation speed as further specified. The nine MCAT segments are defined as follows:

(i) *Hunting perturbation* (a_1): This segment contains an alinement deviation having a wavelength, λ , of 10 feet and amplitude of 0.25 inch on both rails to test vehicle stability on tangent track and on track that is curved less than 1 degree.

(ii) *Gage narrowing* (a_2): This segment contains an alinement deviation on one rail to reduce the gage from the nominal value to the minimum permissible gage or maximum alinement (whichever comes first).

(iii) *Gage widening* (a_3): This segment contains an alinement deviation on one rail to increase the gage from the nominal value to the maximum permissible gage or maximum alinement (whichever comes first).

(iv) *Repeated surface* (a_9): This segment contains three consecutive maximum permissible profile variations on each rail.

(v) *Repeated alinement* (a_4): This segment contains two consecutive maximum permissible alinement variations on each rail.

(vi) *Single surface* (a_{10}, a_{11}): This segment contains a maximum permissible profile variation on one rail. If the maximum permissible profile variation alone produces a condition which exceeds the maximum allowed warp condition, a second profile variation is also placed on the opposite rail to limit the warp to the maximum permissible value.

(vii) *Single alinement* (a_5, a_6): This segment contains a maximum permissible alinement variation on one rail. If the maximum permissible alinement variation alone produces a condition which exceeds the maximum allowed gage condition, a second alinement variation is also placed on the opposite rail to limit the gage to the maximum permissible value.

(viii) *Short warp* (a_{12}): This segment contains a pair of profile deviations to produce a maximum permissible 10-foot warp perturbation. The first is on the outside rail, and the second follows 10 feet farther on the inside rail. Each deviation has a wavelength, λ , of 20 feet and variable amplitude for each simulation speed as described below. This segment is to be used only on curved track simulations.

(ix) *Combined perturbation* (a_7, a_8, a_{13}): This segment contains a maximum permissible down and out combined geometry condition on the outside rail in the body of the curve. If the maximum permissible variations produce a condition which exceeds the maximum allowed gage condition, a second variation is also placed on the opposite rail as for the MCAT segments described in paragraphs (b)(1)(vi) and (vii) of this appendix. This segment is to be used for all simulations on Class 9 track, and only for curved track simulations at speeds producing more than 5 inches of cant deficiency on track Classes 6 through 8, and at speeds producing more than 6 inches of cant deficiency on track Classes 1 through 5.

(2) *Segment lengths:* Each MCAT segment shall be long enough to allow the vehicle's response to the track deviation(s) to damp out. Each segment shall also have a minimum length as specified in table 1 of this appendix, which references the distances in figure 1 of this appendix. For curved track segments, the perturbations shall be placed far enough in the body of the curve to allow for any spiral effects to damp out.

TABLE 1 OF APPENDIX D TO PART 213 MINIMUM LENGTHS OF MCAT SEGMENTS

Distances (ft)								
d_1	d_2	d_3	d_4	d_5	d_6	d_7	d_8	d_9
1000	1000	1000	1500	1000	1000	1000	1000	1000

(3) *Degree of curvature.*

(i) For each simulation involving assessment of curving performance, the degree of curvature, D , which generates a particular level of cant deficiency, E_u , for a given speed, V , shall be calculated using the following equation, which assumes a curve with 6 inches of superelevation:

$$D = \frac{6 + E_u}{0.00017 \times V^2}$$

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Where—

D = Degree of curvature (degrees).

V = Simulation speed (m.p.h.).

E_u = Cant deficiency (inches).

(ii) Table 2 of this appendix depicts the degree of curvature for use in MCAT simulations of both passenger and freight equipment performance on Class 2 through 9 track, based on the equation in paragraph (b)(3)(i) of this appendix. The degree of curvature for use in MCAT simulations of equipment performance on Class 1 track is not depicted; it would be based on the same equation using an appropriate superelevation. The degree of curvature for use in MCAT simulations of freight equipment performance on Class 6 (freight) track is shown in italics for cant deficiencies not exceeding 6 inches, to emphasize that the values apply to freight equipment only.

**Table 2 of Appendix D to Part 213
Degree of Curvature for Use in MCAT Simulations (Track Classes 2 through 9)**

Passenger	m.p.h.	Cant Deficiency (inches)							in p.h.	Freight			
		Tangent	3	4	5	6	7	8			9		
Class 2	20								46.4	50.0	53.5	20	Class 2
	25								29.7	32.0	34.3	25	
	30								20.0	22.2	23.8	30	
Class 3	35								15.2	16.3	17.3	35	Class 3
	40								11.6	12.5	13.4	40	
	45								9.17	9.68	10.2	45	
	50								7.43	8.00	8.57	50	
	55								6.14	6.61	7.08	55	
Class 4	60								5.16	5.50	5.95	60	Class 4
	65								4.40	4.73	5.07	65	
	70								3.79	4.08	4.37	70	
	75								3.30	3.56	3.81	75	
Class 5	80								2.90	3.13	3.35	80	Class 5
	85	0.00	1.70	1.88	2.10	2.27	2.57	2.77	2.97	3.17	3.35	85	
	90	0.00	1.59	1.76	1.94	2.12	2.29	2.47	2.65	2.83	3.00	90	
Class 6	95	0.00	1.42	1.58	1.74	1.90	2.06	2.22	2.37	2.52	2.67	95	Class 6
	100	0.00	1.29	1.43	1.57	1.71	1.86	2.00	2.14	2.28	2.42	100	
	105	0.00	1.17	1.30	1.43	1.55	1.68	1.81	1.94	2.07	2.20	105	
	110	0.00	1.08	1.18	1.30	1.42	1.53	1.65	1.77	1.88	2.00	110	
Class 7	115	0.00	0.97	1.08	1.19	1.30	1.40	1.51	1.62	1.72	1.82	115	Class 7
	120	0.00	0.89	0.99	1.09	1.19	1.29	1.39	1.49	1.59	1.69	120	
	125	0.00	0.82	0.91	1.01	1.12	1.19	1.28	1.37	1.46	1.55	125	
Class 8	130	0.00	0.76	0.86	0.93	1.01	1.10	1.18	1.27	1.35	1.43	130	Class 8
	135	0.00	0.71	0.78	0.85	0.94	1.02	1.10	1.18	1.25	1.33	135	
	140	0.00	0.66	0.73	0.80	0.87	0.95	1.02	1.09	1.16	1.23	140	
	145	0.00	0.61	0.68	0.75	0.82	0.89	0.95	1.02	1.08	1.15	145	
	150	0.00	0.57	0.63	0.70	0.76	0.83	0.89	0.95	1.01	1.07	150	
	155	0.00	0.54	0.59	0.65	0.71	0.77	0.83	0.89	0.94	1.00	155	
Class 9	160	0.00	0.50	0.56	0.61	0.67	0.73	0.78	0.84	0.89	0.94	160	Class 9
	165	0.00	0.47	0.52	0.58	0.63	0.68	0.73	0.79	0.83	0.88	165	
	170	0.00	0.44	0.49	0.54	0.59	0.64	0.69	0.74	0.79	0.83	170	
	175	0.00	0.42	0.47	0.51	0.56	0.61	0.65	0.70	0.74	0.78	175	
	180	0.00	0.40	0.44	0.49	0.53	0.57	0.62	0.66	0.70	0.74	180	
	185	0.00	0.38	0.42	0.46	0.50	0.54	0.58	0.63	0.66	0.70	185	
	190	0.00	0.36	0.40	0.44	0.47	0.51	0.55	0.59	0.63	0.66	190	
	195	0.00	0.34	0.38	0.41	0.45	0.49	0.53	0.57	0.60	0.64	195	
	200	0.00	0.32	0.36	0.39	0.43	0.46	0.50	0.54	0.57	0.61	200	
	205	0.00	0.31	0.34	0.37	0.41	0.44	0.48	0.51	0.54	0.58	205	
210	0.00	0.29	0.32	0.35	0.39	0.42	0.45	0.49	0.52	0.55	210		
215	0.00	0.28	0.31	0.34	0.37	0.40	0.43	0.46	0.49	0.52	215		
220	0.00	0.27	0.30	0.32	0.35	0.39	0.41	0.44	0.47	0.50	220		

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(c) *Required simulations.*

(1) To develop a comprehensive assessment of vehicle performance, simulations shall be performed for a variety of scenarios using MCAT. These simulations shall be performed on tangent or curved track, or both, depending on the level of cant deficiency and speed (track class) as summarized in table 3 of this appendix.

TABLE 3 OF APPENDIX D TO PART 213 SUMMARY OF REQUIRED VEHICLE PERFORMANCE ASSESSMENT USING SIMULATIONS

	New vehicle types	Previously qualified vehicle types
Curved track: cant deficiency ≤6 inches	Curving performance simulation: not required for track Classes 1 through 5; optional for track Class 6; required for track Classes 7 through 9	Curving performance simulation: not required for track Classes 1 through 6; optional for track Classes 7 through 9 for cant deficiency >5 inches.
Curved track: cant deficiency >6 inches	Curving performance simulation required for all track classes	Curving performance simulation optional for all track classes.
Tangent track	Tangent performance simulation: not required for track Classes 1 through 5; optional for track Class 6; required for track Classes 7 through 9	Tangent performance simulation not required for any track class.

(i) All simulations shall be performed using the design wheel profile and a nominal track gage of 56.5 inches, using tables 4, 5, 6, or 7 of this appendix, as appropriate. In addition, all simulations involving the assessment of curving performance shall be repeated using a nominal track gage of 57.0 inches, using tables 5, 6, or 7 of this appendix, as appropriate.

(ii) If the wheel profile is different than American Public Transportation Administration (APTA) wheel profiles 320 or 340, then for tangent track segments all simulations shall be repeated using either APTA wheel profile 320 or 340, depending on the established conicity that is common for the operation, as specified in APTA SS-M-015-06, Standard for Wheel Flange Angle of Passenger Equipment (2007). This APTA standard is incorporated by reference into this appendix with the approval of the Director of the Federal Register under 5 U.S.C. 552(a) and 1 CFR part 51. To enforce any edition other than that specified in this appendix, FRA must publish notice of change in the FEDERAL REGISTER and

the material must be made available to the public. All approved material is available for inspection at the Federal Railroad Administration, Docket Clerk, 1200 New Jersey Avenue SE., Washington, DC 20590 (telephone 202-493-6030), and is available from the American Public Transportation Association, 1666 K Street NW, Suite 1100, Washington, DC 20006 (telephone 202-496-4800; www.apta.com). It is also available for inspection at the National Archives and Records Administration (NARA). For information on the availability of this material at NARA, call 202-741-6030 or go to http://www.archives.gov/federal_register/code_of_federal_regulations/ibr_locations.html. An alternative worn wheel profile may be used in lieu of either APTA wheel profile, if approved by FRA.

(iii) All simulations shall be performed using a wheel/rail coefficient of friction of 0.5.

(2) *Vehicle performance on tangent track Classes 6 through 9.* For maximum vehicle speeds corresponding to track Class 6 and higher, the MCAT segments described in paragraphs (b)(1)(i) through (vii) of this appendix shall be used to assess vehicle performance on tangent track. For track Class 9, simulations must also include the combined perturbation segment described in paragraph (b)(1)(ix) of this appendix. A parametric matrix of MCAT simulations shall be performed using the following range of conditions:

(i) *Vehicle speed.* Simulations shall demonstrate that at up to 5 m.p.h. above the proposed maximum operating speed, the vehicle type shall not exceed the wheel/rail force and acceleration criteria defined in the Vehicle/Track Interaction Safety Limits table in §213.333. Simulations shall also demonstrate acceptable vehicle dynamic response by incrementally increasing speed from 95 m.p.h. (115 m.p.h. if a previously qualified vehicle type on an untested route) to 5 m.p.h. above the proposed maximum operating speed (in 5 m.p.h. increments).

(ii) *Perturbation wavelength.* For each speed, a set of three separate MCAT simulations shall be performed. In each MCAT simulation for the perturbation segments described in paragraphs (b)(1)(ii) through (vii) and (b)(1)(ix) of this appendix, every perturbation shall have the same wavelength. The following three wavelengths, λ , shall be used: 31, 62, and 124 feet. The hunting perturbation segment described in paragraph (b)(1)(i) of this appendix has a fixed wavelength, λ , of 10 feet.

(iii) *Amplitude parameters.* Table 4 of this appendix provides the amplitude values for the MCAT segments described in paragraphs (b)(1)(i) through (vii) and (b)(1)(ix) of this appendix for each speed of the required parametric MCAT simulations. The last set of simulations shall be performed at 5 m.p.h. above the proposed maximum operating speed using the amplitude values in table 4 that correspond to the proposed maximum operating speed. For qualification of vehicle types at speeds greater than track Class 6 speeds, the following additional simulations shall be performed:

(A) For vehicle types being qualified for track Class 7 speeds, one additional set of simulations shall be performed at 115 m.p.h. using the track Class 6 amplitude values in table 4 (i.e., a 5 m.p.h. overspeed on Class 6 track).

(B) For vehicle types being qualified for track Class 8 speeds, two additional sets of simulations shall be performed. The first set at 115 m.p.h. using the track Class 6 amplitude values in table 4 (i.e., a 5 m.p.h. overspeed on Class 6 track), and a second set at 130 m.p.h. using the track Class 7 amplitude values in table 4 (i.e., a 5 m.p.h. overspeed on Class 7 track).

(C) For vehicle types being qualified for track Class 9 speeds, three additional sets of simulations shall be performed. The first set at 115 m.p.h. using the track Class 6 amplitude values in table 4 (i.e., a 5 m.p.h. overspeed on Class 6 track), a second set at 130 m.p.h. using the track Class 7 amplitude values in table 4 (i.e., a 5 m.p.h. overspeed on Class 7 track), and a third set at 165 m.p.h. using the track Class 8 amplitude values in table 4 (i.e., a 5 m.p.h. overspeed on Class 8 track).

Table 4 of Appendix D to Part 213
Track Class 6 through 9 Amplitude Parameters (in inches)
for MCAT Simulations on Tangent Track

		Gauge 56 1/2"			
		Class 6	Class 7	Class 8	Class 9
Max. Operating Speed (m.p.h.)		115	125	130	135
Min. Operating Speed (m.p.h.)		115	125	130	135
MCAT Segment	Parameter	Regional Distribution			
		North	South	West	East
Single	in	0.175	0.175	0.175	0.175
High Speeding	in	0.175	0.175	0.175	0.175
Class 6/Class 7	in	0.175	0.175	0.175	0.175
Repaired Surface	in	0.175	0.175	0.175	0.175
Repaired Alignment	in	0.175	0.175	0.175	0.175
Single Track	in	0.175	0.175	0.175	0.175
Single Alignment	in	0.175	0.175	0.175	0.175
Single Worn	in	0.175	0.175	0.175	0.175
Combined Perturbation	in	0.175	0.175	0.175	0.175
		Amplitude Parameters (in feet)			
Wavelength $\lambda = 10$		0.250	0.250	0.250	0.250
Wavelength $\lambda = 20$		0.500	0.500	0.500	0.500
Wavelength $\lambda = 31$	A ₁	0.500	0.500	0.500	0.500
	A ₂	0.750	0.750	0.750	0.750
	A ₃	0.750	0.750	0.750	0.750
	A ₄	0.750	0.750	0.750	0.750
	A ₅	0.750	0.750	0.750	0.750
	A ₆	0.750	0.750	0.750	0.750
Wavelength $\lambda = 62$	A ₁	0.500	0.500	0.500	0.500
	A ₂	0.750	0.750	0.750	0.750
	A ₃	0.750	0.750	0.750	0.750
	A ₄	0.750	0.750	0.750	0.750
	A ₅	0.750	0.750	0.750	0.750
	A ₆	0.750	0.750	0.750	0.750
Wavelength $\lambda = 124$	A ₁	0.500	0.500	0.500	0.500
	A ₂	0.750	0.750	0.750	0.750
	A ₃	0.750	0.750	0.750	0.750
	A ₄	0.750	0.750	0.750	0.750
	A ₅	0.750	0.750	0.750	0.750
	A ₆	0.750	0.750	0.750	0.750

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(3) *Vehicle performance on curved track Classes 6 through 9.* For maximum vehicle speeds corresponding to track Class 6 and higher, the MCAT segments described in paragraphs (b)(1)(ii) through (vii) of this appendix shall be used to assess vehicle performance on curved track. For curves less than 1 degree, simulations must also include the hunting perturbation segment described in paragraph (b)(1)(i) of this appendix.

For track Class 9 and for cant deficiencies greater than 5 inches, simulations must also include the combined perturbation segment described in paragraph (b)(1)(ix) of this appendix. A parametric matrix of MCAT simulations shall be performed using the following range of conditions:

(i) *Vehicle speed.* Simulations shall demonstrate that at up to 5 m.p.h. above the proposed maximum operating speed, the vehicle type shall not exceed the wheel/rail force and acceleration criteria defined in the Vehicle/Track Interaction Safety Limits table in §213.333. Simulations shall also demonstrate acceptable vehicle dynamic response by incrementally increasing speed from 95 m.p.h. (115 m.p.h. if a previously qualified vehicle type on an untested route) to 5 m.p.h. above the proposed maximum operating speed (in 5 m.p.h. increments).

(ii) *Perturbation wavelength.* For each speed, a set of three separate MCAT simulations shall be performed. In each MCAT simulation for the perturbation segments described in paragraphs (b)(1)(ii) through (vii) and paragraph (b)(1)(ix) of this appendix, every perturbation shall have the same wavelength. The following three wavelengths, λ , shall be used: 31, 62, and 124 feet. The hunting perturbation segment described in paragraph (b)(1)(i) of this appendix has a fixed wavelength, λ , of 10 feet, and the short warp perturbation segment described in paragraph (b)(1)(viii) of this appendix has a fixed wavelength, λ , of 20 feet.

(iii) *Track curvature.* For each speed, a range of curvatures shall be used to produce cant deficiency conditions ranging from greater than 3 inches up to the maximum intended for qualification (in 1 inch increments). The value of curvature, D, shall be determined using the equation defined in paragraph (b)(3) of this appendix. Each curve shall include representations of the MCAT segments described in paragraphs (b)(1)(i) through (ix) of this appendix, as appropriate, and have a fixed superelevation of 6 inches.

(iv) *Amplitude parameters.* Table 5 of this appendix provides the amplitude values for each speed of the required parametric MCAT simulations for cant deficiencies greater than 3 inches and not more than 5 inches. Table 6 of this appendix provides the amplitude values for each speed of the required parametric MCAT simulations for cant deficiencies greater than 5 inches. The last set of simulations at the maximum cant deficiency shall be performed at 5 m.p.h. above the proposed maximum operating speed using the amplitude values in table 5 or 6 of this appendix, as appropriate, that correspond to the proposed maximum operating speed and cant deficiency. For these simulations, the value of curvature, D, shall correspond to the proposed maximum operating speed and cant deficiency. For qualification of vehicle types at speeds greater than track Class 6 speeds, the following additional simulations shall be performed:

(A) For vehicle types being qualified for track Class 7 speeds, one additional set of simulations shall be performed at 115 m.p.h. using the track Class 6 amplitude values in table 5 or 6 of this appendix, as appropriate (i.e., a 5 m.p.h. overspeed on Class 6 track) and a value of curvature, D, that corresponds to 110 m.p.h. and the proposed maximum cant deficiency.

(B) For vehicle types being qualified for track Class 8 speeds, two additional sets of simulations shall be performed. The first set of simulations shall be performed at 115 m.p.h. using the track Class 6 amplitude values in table 5 or 6 of this appendix, as appropriate (i.e., a 5 m.p.h. overspeed on Class 6 track) and a value of curvature, D, that corresponds to 110 m.p.h. and the proposed maximum cant deficiency. The second set of simulations shall be performed at 130 m.p.h. using the track Class 7 amplitude values in table 5 or 6, as appropriate (i.e., a 5 m.p.h. overspeed on Class 7 track) and a value of curvature, D, that corresponds to 125 m.p.h. and the proposed maximum cant deficiency.

(C) For vehicle types being qualified for track Class 9 speeds, three additional sets of simulations shall be performed. The first set of simulations shall be performed at 115 m.p.h. using the track Class 6 amplitude values in table 5 or 6 of this appendix, as appropriate (i.e., a 5 m.p.h. overspeed on Class 6 track) and a value of curvature, D, that corresponds to 110 m.p.h. and the proposed maximum cant deficiency. The second set of simulations shall be performed at 130 m.p.h. using the track Class 7 amplitude values in table 5 or 6, as appropriate (i.e., a 5 m.p.h. overspeed on Class 7 track) and a value of curvature, D, that corresponds to 125 m.p.h. and the proposed maximum cant deficiency. The third set of simulations shall be performed at 165 m.p.h. using the track Class 8 amplitude values in table 5 or 6, as appropriate (i.e., a 5 m.p.h. overspeed on Class 8 track) and a value of curvature, D, that corresponds to 160 m.p.h. and the proposed maximum cant deficiency.

Table 5 of Appendix D to Part 213

Track Classes 6 through 9 Amplitude Parameters (in inches)
for MCAT Simulations on Curved Track with Cant Deficiency > 3 and ≤ 5 Inches

Max. Unbalanced Speed (m.p.h.) Max. Simulation Speed (m.p.h.)	Grade 16.5°				Grade 27.5°			
	Class 6	Class 7	Class 8	Class 9	Class 6	Class 7	Class 8	Class 9
115	1.25	1.50	1.75	2.00	1.15	1.40	1.65	1.90
118	1.30	1.55	1.80	2.05	1.20	1.45	1.70	1.95

MCAT Segment	Parameter	Segment Description			
		Class 6	Class 7	Class 8	Class 9
Hunting	λ	10	10	10	10
Gage Normalcy	θ	0.001	0.001	0.001	0.001
Single Polishing	θ	0.01	0.01	0.01	0.01
Resonant Surface	θ	0.01	0.01	0.01	0.01
Resonant Abrasion	θ	0.01	0.01	0.01	0.01
Single Surface	θ , ω	0.01	0.01	0.01	0.01
Single Abrasion	θ , ω	0.01	0.01	0.01	0.01
Short Warp	λ	20	20	20	20
Combined Perturbation	θ , ω , λ	0.01	0.01	0.01	0.01

Wavelength λ	Amplitude Parameters (inches)			
	θ	ω	λ	ω
31	0.250	0.250	0.250	0.250
62	0.125	0.125	0.125	0.125
124	0.062	0.062	0.062	0.062

¹ For curves = 1 degree

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Table 6 of Appendix D to Part 213
Track Class 6 through 9 Amplitude Parameters (in inches)
for MCAT Simulations on Curved Track with Cant Deficiency > 5 Inches

Class 6 66 ft ¹				Class 7 72 ft ¹				Class 8 78 ft ¹				Class 9 84 ft ¹			
Max. Operating Speed (in m.p.h.)	119	125	161	125	161	161	200	110	125	162	200	110	125	162	200
Max. Simulated Speed (in m.p.h.)	115	120	160	120	160	160	228	115	120	160	228	115	120	160	228
MCAT Segments	Parameter	Segment Description													
Warping	a_1	D(1)(ii)													
Cant Deficiency	a_2	D(1)(ii)													
Cant Deficiency	a_3	D(1)(ii)													
Fastener Friction	a_4	D(1)(ii)													
Residual Superelevation	a_5	D(1)(ii)													
Single Fastener	a_6	D(1)(ii)													
Single Attachment	a_7	D(1)(ii)													
Short Warp	a_8	D(1)(ii)													
Composite Perturbation	a_9, a_{10}, a_{11}	D(1)(ii)													
Amplitude Parameters (Inches)															
Wavelength $\lambda = 105$	a_1	0.292	0.292	0.292	0.292										
Wavelength $\lambda = 210$	a_1	0.575	0.575	0.575	0.575										
Wavelength $\lambda = 210$	a_2	0.500	0.500	0.500	0.250										
	a_3	0.750	0.500	0.500	0.500										
	a_4	0.275	0.275	0.275	0.275										
	a_5	0.500	0.500	0.500	0.500										
	a_6	0.500	0.200	0.500	0.500										
	a_7	0.375	0.375	0.375	0.375										
	a_8	0.000	0.000	0.000	0.000										
	a_9	0.750	0.750	0.500	0.275										
	a_{10}	1.000	1.000	0.750	0.500										
	a_{11}	0.500	0.500	0.500	0.500										
Wavelength $\lambda = 420$	a_1	0.575	0.575	0.575	0.275										
	a_2	0.750	0.500	0.500	0.500										
	a_3	0.500	0.275	0.575	0.575										
	a_4	0.275	0.275	0.275	0.275										
	a_5	0.500	0.500	0.500	0.500										
	a_6	0.500	0.200	0.500	0.500										
	a_7	0.375	0.375	0.375	0.375										
	a_8	0.000	0.000	0.000	0.000										
	a_9	0.750	0.750	0.500	0.275										
	a_{10}	1.000	1.000	0.750	0.500										
Wavelength $\lambda = 840$	a_1	0.575	0.575	0.575	0.275										
	a_2	0.750	0.500	0.500	0.500										
	a_3	0.500	0.275	0.575	0.575										
	a_4	0.275	0.275	0.275	0.275										
	a_5	0.500	0.500	0.500	0.500										
	a_6	0.500	0.200	0.500	0.500										
	a_7	0.375	0.375	0.375	0.375										
	a_8	0.000	0.000	0.000	0.000										
	a_9	0.750	0.750	0.500	0.275										
	a_{10}	1.000	1.000	0.750	0.500										
Wavelength $\lambda = 1260$	a_1	0.575	0.575	0.575	0.275										
	a_2	0.750	0.500	0.500	0.500										
	a_3	0.500	0.275	0.575	0.575										
	a_4	0.275	0.275	0.275	0.275										
	a_5	0.500	0.500	0.500	0.500										
	a_6	0.500	0.200	0.500	0.500										
	a_7	0.375	0.375	0.375	0.375										
	a_8	0.000	0.000	0.000	0.000										
	a_9	0.750	0.750	0.500	0.275										
	a_{10}	1.000	1.000	0.750	0.500										

¹ For curves <1 degree ² 0.375 for $E_c > 7^*$

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(4) *Vehicle performance on curved track Classes 1 through 5 at high cant deficiency.* For maximum vehicle speeds corresponding to track Classes 1 through 5, the MCAT segments described in paragraphs (b)(1)(ii) through (ix) of this appendix shall be used to assess vehicle performance on curved track if the proposed maximum cant deficiency is greater than 6 inches. A parametric matrix of MCAT simulations shall be performed using the following range of conditions:

(i) *Vehicle speed.* Simulations shall demonstrate that at up to 5 m.p.h. above the proposed maximum operating speed, the vehicle shall not exceed the wheel/rail force and acceleration criteria defined in the Vehicle/Track Interaction Safety Limits table in §213.333. Simulations shall also demonstrate acceptable vehicle dynamic response at 5 m.p.h. above the proposed maximum operating speed.

(ii) *Perturbation wavelength.* For each speed, a set of two separate MCAT simulations shall be performed. In each MCAT simulation for the perturbation segments described in paragraphs (b)(1)(ii) through (vii) and paragraph (b)(1)(ix) of this appendix, every perturbation shall have the same wavelength. The following two wavelengths, λ , shall be used: 31 and 62 feet. The short warp perturbation segment described in paragraph (b)(1)(viii) of this appendix has a fixed wavelength, λ , of 20 feet.

(iii) *Track curvature.* For a speed corresponding to 5 m.p.h. above the proposed maximum operating speed, a range of curvatures shall be used to produce cant deficiency conditions ranging from 6 inches up to the maximum intended for qualification (in 1 inch increments). The value of curvature, D, shall be determined using the equation in paragraph (b)(3) of this appendix. Each curve shall contain the MCAT segments described in paragraphs (b)(1)(ii) through (ix) of this appendix and have a fixed superelevation of 6 inches.

(iv) *Amplitude parameters.* Table 7 of this appendix provides the amplitude values for the MCAT segments described in paragraphs (b)(1)(ii) through (ix) of this appendix for each speed of the required parametric MCAT simulations.

Table 7 of Appendix D to Part 213
Track Class 1 through 5 Amplitude Parameters (in inches)
for MCAT Simulations on Curved Track with Cant Deficiency > 6 Inches

		Gage 55.5"					Gage 67.5"				
		Class 1	Class 2	Class 3	Class 4	Class 5	Class 1	Class 2	Class 3	Class 4	Class 5
Max. Curvature (degrees p.c.)		25	25	65	65	20	25	25	65	65	20
Max. Sup. Excess Speed (m.p.h.)		20	35	65	65	65	20	35	65	65	65
NCAI Segments	Parameter	Segment Description					Segment Description				
Warping	Δ										
Gage Narrowing	Δ			10.17(0.0)						10.17(0.0)	
Gage Widening	Δ			10.17(0.0)						10.17(0.0)	
Response Surface	Δ			10.17(0.0)						10.17(0.0)	
Response Surface	Δ			10.17(0.0)						10.17(0.0)	
Single Surface	Δ			10.17(0.0)						10.17(0.0)	
Single Surface	Δ			10.17(0.0)						10.17(0.0)	
Single Surface	Δ			10.17(0.0)						10.17(0.0)	
Combined Warpage	Δ			10.17(0.0)						10.17(0.0)	
Combined Warpage	Δ			10.17(0.0)						10.17(0.0)	
		Amplitude Parameters (inches)					Amplitude Parameters (inches)				
Wavelength $\lambda = 150$	Δ										
	Δ	1.000	1.000	0.675	0.675	0.750	1.000	1.000	0.675	0.675	0.750
	Δ	0.500	0.500	0.500	0.500	0.500	1.250	1.250	1.250	0.500	0.500
	Δ	1.250	1.250	1.250	0.800	0.800	0.750	0.750	0.750	0.500	0.500
	Δ	0.750	0.750	0.750	0.750	0.500	0.750	0.750	0.750	0.750	0.500
	Δ	0.800	0.800	0.800	0.250	0.250	0.800	0.800	0.800	0.250	0.250
	Δ	0.500	0.500	0.500	0.500	0.333	0.500	0.500	0.500	0.500	0.333
	Δ	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500
	Δ	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
	Δ	0.500	0.500	0.500	1.000	1.000	1.000	1.000	1.000	1.000	1.000
	Δ	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500
	Δ	0.667	0.667	0.667	0.667	0.667	0.667	0.667	0.667	0.667	0.667
Wavelength $\lambda = 225$	Δ										
	Δ	0.500	0.500	0.500	0.500	0.500	1.250	1.250	1.250	0.500	0.500
	Δ	1.250	1.250	1.250	0.800	0.800	0.750	0.750	0.750	0.500	0.500
	Δ	0.750	0.750	0.750	0.750	0.500	0.750	0.750	0.750	0.750	0.500
	Δ	0.800	0.800	0.800	0.250	0.250	0.800	0.800	0.800	0.250	0.250
	Δ	0.500	0.500	0.500	0.500	0.333	0.500	0.500	0.500	0.500	0.333
	Δ	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500
	Δ	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
	Δ	0.500	0.500	0.500	1.000	1.000	1.000	1.000	1.000	1.000	1.000
	Δ	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500
	Δ	0.667	0.667	0.667	0.667	0.667	0.667	0.667	0.667	0.667	0.667
Wavelength $\lambda = 315$	Δ										
	Δ	0.500	0.500	0.500	0.500	0.500	1.250	1.250	1.250	0.500	0.500
	Δ	1.250	1.250	1.250	0.800	0.800	0.750	0.750	0.750	0.500	0.500
	Δ	0.750	0.750	0.750	0.750	0.500	0.750	0.750	0.750	0.750	0.500
	Δ	0.800	0.800	0.800	0.250	0.250	0.800	0.800	0.800	0.250	0.250
	Δ	0.500	0.500	0.500	0.500	0.333	0.500	0.500	0.500	0.500	0.333
	Δ	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500
	Δ	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
	Δ	0.500	0.500	0.500	1.000	1.000	1.000	1.000	1.000	1.000	1.000
	Δ	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500
	Δ	0.667	0.667	0.667	0.667	0.667	0.667	0.667	0.667	0.667	0.667
Wavelength $\lambda = 625$	Δ										
	Δ	0.500	0.500	0.500	0.500	0.500	1.250	1.250	1.250	0.500	0.500
	Δ	1.250	1.250	1.250	0.800	0.800	0.750	0.750	0.750	0.500	0.500
	Δ	0.750	0.750	0.750	0.750	0.500	0.750	0.750	0.750	0.750	0.500
	Δ	0.800	0.800	0.800	0.250	0.250	0.800	0.800	0.800	0.250	0.250
	Δ	0.500	0.500	0.500	0.500	0.333	0.500	0.500	0.500	0.500	0.333
	Δ	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500
	Δ	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
	Δ	0.500	0.500	0.500	1.000	1.000	1.000	1.000	1.000	1.000	1.000
	Δ	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500
	Δ	0.667	0.667	0.667	0.667	0.667	0.667	0.667	0.667	0.667	0.667

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Need assistance?



MWI 2107-03 Curve Superelevation

Markings

Issued: 12/9/13 Revised: 3/16/15

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PURPOSE: To provide uniform instructions for *Curve Superelevation Marking*.

SAFETY: Observe all applicable Safety and Operating Rules and Regulations and Safe Job Procedures

LOCATION: All CFRC tracks.

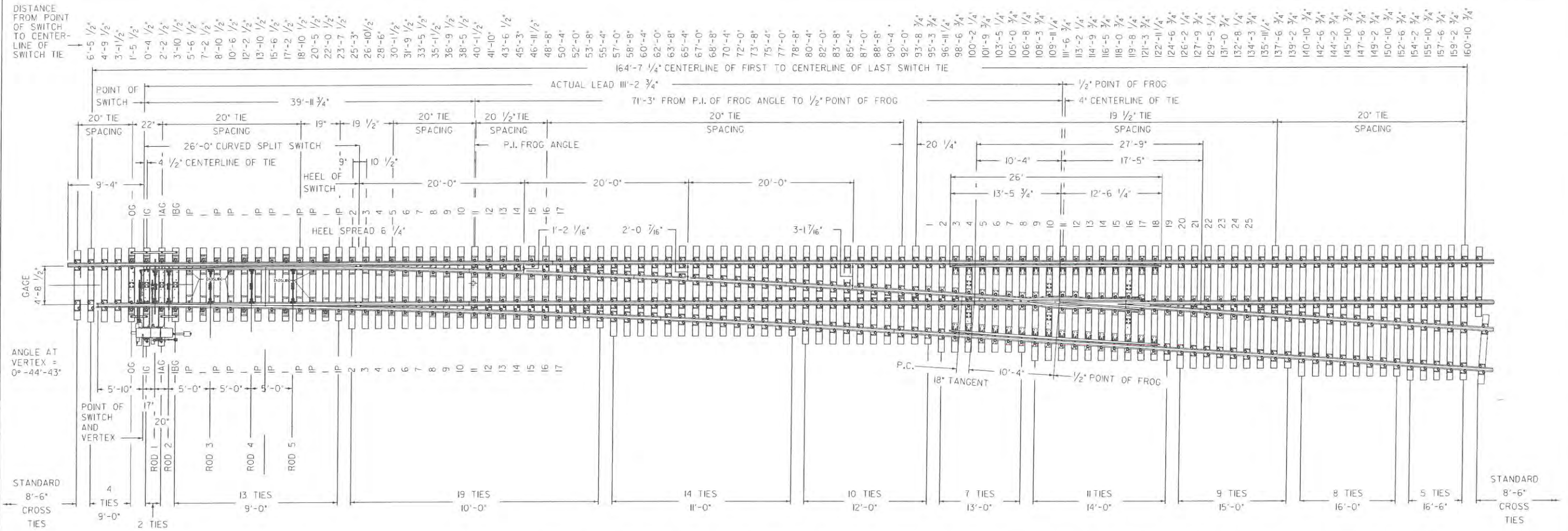
DISCUSSION

- A. The curves will be marked to indicate the control points for the curve's superelevation.
- Tangent to Spiral point (TS),
 - Spiral to Curve point (SC),
 - Curve to Spiral point (CS) and
 - Spiral to Tangent point (ST).
- B. The primary and required method will be blue paint on the web of the rail. (see MWI 1103)
- C. The following supplemental method may be used in addition to the blue paint method shown in paragraph B above at the discretion of the Chief Engineer. One (1) cut spike may be driven into center of the ties closest to the TS point and the ST point. Two (2) cut spikes may be driven into center of the ties closest to the SC point and CS point.

Prepared by: RMW

Approved by: Miguel Torres
Miguel Torres - CFRC Chief Operating Officer

11/5/12 - ADDED FRONT ROD ASSEMBLY



PLAN OF RIGHT HAND TURNOUT

WORKMANSHIP AND MATERIALS SHALL BE PER CURRENT AREMA SPECIFICATIONS UNLESS OTHERWISE SPECIFIED. SINCE THE ALLOWABLE VARIATION IN STANDARD LENGTHS OF RAILS, FROGS AND SWITCH POINTS IS GREATER THAN THE NORMAL EXPANSION GAPS AT RAIL JOINTS AND THICKNESS OF INSULATING END POST IN INSULATED JOINTS, NO ALLOWANCE HAS BEEN MADE FOR EXPANSION GAPS AND INSULATION END POSTS IN COMPUTING LENGTHS OF RAIL SHOWN.

USE 26'-0" CURVED SPLIT SWITCH WITH UNIFORM RISERS PER DRAWING 2321. SEE DRAWING 2218 FOR STRAIGHT AND CURVED CLOSURE RAILS, AND STRAIGHT AND CURVED LEAD RAILS. MANUFACTURER SHALL VERIFY ALL DIMENSIONS BEFORE FABRICATION.

SWITCH HAS ADJUSTABLE BOLTLESS BRACES. PREFERRED SWITCH BRACE IS PRS CLAMP TIE. ALTERNATE IS BETHLEHEM BOLTLESS.

FROG USES MILLED SEAT AND FLAT PLATES WITH WELDED PANDROL SHOULDERS PER DRAWING 2415.

EVERY TIE WILL BE BOX ANCHORED FOR A DISTANCE OF 234 FEET AHEAD OF THE SWITCH POINT, AND EVERY TIE ON BOTH TRACKS WILL BE BOX ANCHORED FOR A DISTANCE OF 234 FEET BEYOND THE JOINT OR WELD AT THE HEEL OF FROG.

THE NUMBER OF INSULATED JOINTS REQUIRED DEPENDS ON TURNOUT LOCATION.

USE 6-1/2" COMMON STANDARD SCREWS ON ALL PLATES 3/4" THICK OR MORE. OTHERWISE USE 6" SCREW SPIKES. SWITCH PLATE AND TIE LAYOUT ARRANGED FOR POWER THROW MECHANISM PER TRAIN CONTROL STANDARDS. ALL FROG PLATES TO BE MILLED SEAT 3/4" UNDER RAIL BASE

TURNOUT DATA	
NUMBER	15
ANGLE	3°-49'-06"
TOTAL LENGTH	27'-9"
TOE LENGTH	10'-4"
HEEL LENGTH	17'-5"
TOE SPREAD	7 3/4"
HEEL SPREAD	14 7/16"
LENGTH OF SWITCH POINT	26'-0"
HEEL SPREAD	6 1/4"
HEEL ANGLE	1°-32'-57"

BILL OF SWITCH TIES					
SWITCH POINT	THICKNESS OF POINT	LENGTH	TURNOUT ONLY	CROSSOVER TRACK CENTERS	
				14'-0"	15'-0"
STRAIGHT POINT	0"	9'-0"	17	34	34
	0°-44'-47"	10'-0"	19	38	38
	1,855.769'	11'-0"	14	28	28
	1,851.061'	12'-0"	10	20	20
CURVED POINT	0"	12'-0" (Dapped)	2	4	4
	0°	9'-0"	17	34	34

ORDERING INFORMATION		
CLASS	ITEM	DESCRIPTION
10	6650300	TURNOUT paneled RH 136RE ON WOOD TIES NO 15 W/RBM FROG PER CSX DWG 2217 & 2218
10	6650310	TURNOUT paneled LH 136RE ON WOOD TIES NO 15 W/RBM FROG PER CSX DWG 2217 & 2218

QUANTITY		DESCRIPTION
1		NO.15 RAILBOUND MANGANESE STEEL FROG, COMPLETE, PER DWG. 2415 BONDED FOR SIGNALS
2		GUARD RAILS, COMPLETE, (26' ADJUSTABLE)
1		58'-10" STRAIGHT STOCK RAIL PER DRAWING 2322
1		58'-8" BENT STOCK RAIL PER DRAWING 2322
1		38'-5" RAIL W/PREMIUM INSULATED JT.10'-0"-28'-5" LEGS
1		38'-5" RAIL W/PREMIUM INSULATED JT.20'-0"-18'-5" LEGS
1		STRAIGHT CLOSURE RAIL: 61'-4 3/4"
1		CURVED CLOSURE RAIL: 23'-1"
260		FEET OF PREMIUM WELDED RAIL
1		26'-0" CURVED SPLIT SWITCH, COMPLETE, WITH UNIFORM RISERS, PER DWGS. 2321, 2322, 2323, 2324, 2325, AND 2326
1		FRONT ROD ASSEMBLY PER S5001 AND S5044
12		JOINTS, COMPLETE INCL. J CLIPS AND BOLTS
6		INSULATED JOINTS, COMPLETE INC. E2063B CLIPS
1300		SCREW SPIKES 6 1/2" LONG OR 7 1/2" LONG EVERGRIP SPIKES
3		KEG TRACK SPIKES
196		PANDROL TIE PLATES
659		PANDROL CLIPS, REGULAR
1		PANDROL CLIP, LEFT HAND

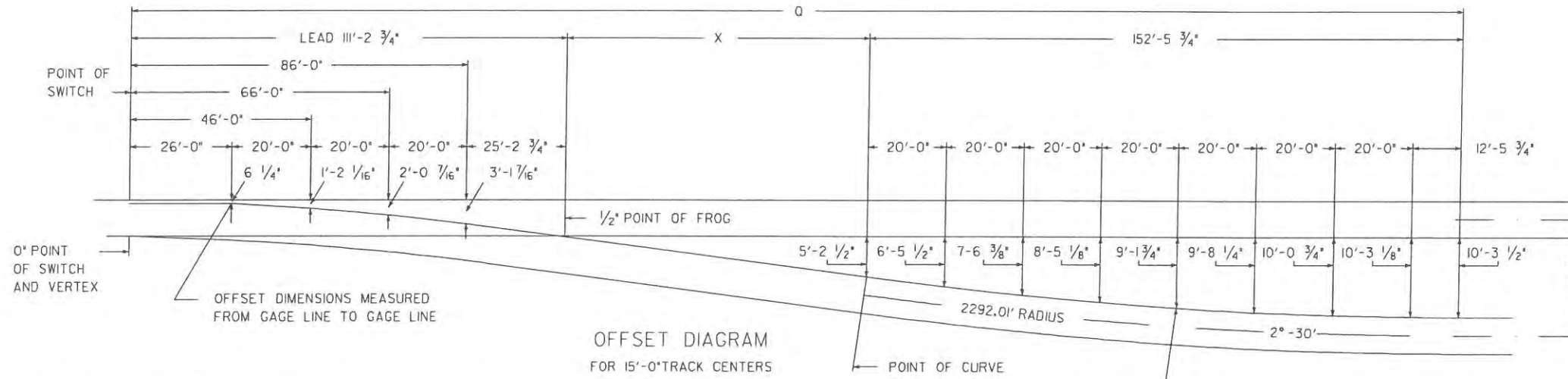


NO. 15 TURNOUT AND CROSSOVER WITH 26'-0" CURVED SWITCH POINTS FOR 136RE RAIL

Miguel Torres

APPROVED - MIGUEL TORRES
CFRC CHIEF OPERATING OFFICER

PREPARED BY: RMW ISSUED: 9/9/2015 REVISED: 4/2/2015

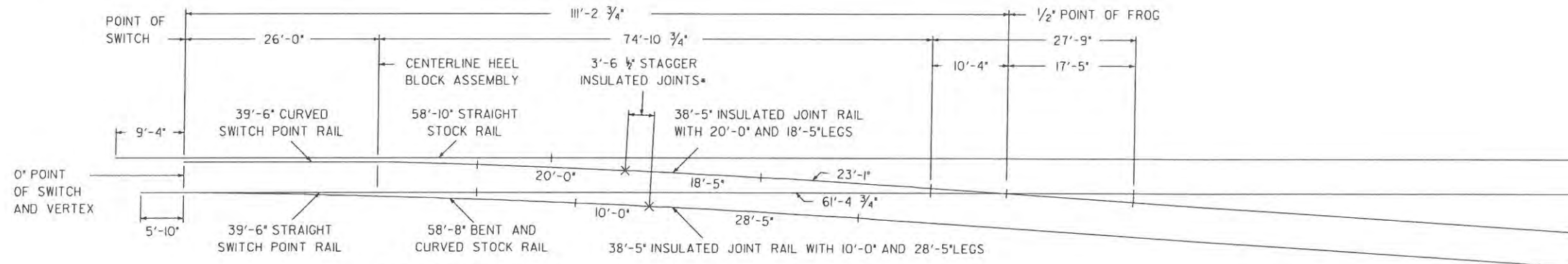


OFFSET DIAGRAM FOR 15'-0" TRACK CENTERS

OFFSET DIMENSIONS MEASURED FROM GAGE LINE TO GAGE LINE, FOR TRACK CENTERS OTHER THAN 15'-0", INCREASE OR DECREASE OFFSET DIMENSIONS BY SAME AMOUNT THAT TRACK CENTERS ARE INCREASED OR DECREASED FROM 15'-0", AND ADJUST "X" DISTANCE.

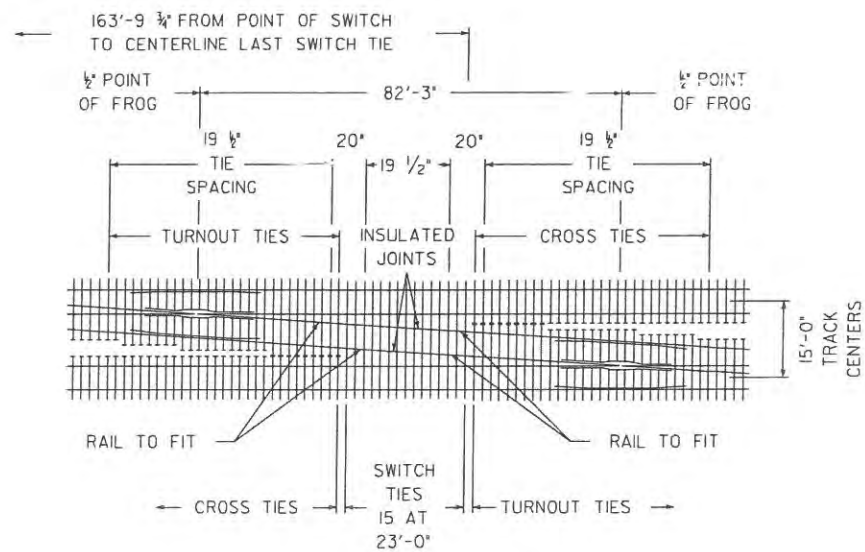
CROSSOVER DATA		
TRACK CENTERS	DISTANCE BETWEEN 1/2 POINTS OF FROGS	
	MAIN TRACK	CROSSOVER
15'-0"	82'-3 3/8"	82'-8 31/32"
14'-0"	67'-3 3/16"	67'-8 29/32"
1'-0" CHANGE	14'-11 13/16"	15'-0 3/16"
1" CHANGE	14.9844'	15.0156'

TRACK CENTERS	CURVE DATA	
	DIMENSION	
	Q	X
13'-0"	311'-2"	47'-5 1/2"
14'-0"	326'-1 3/4"	62'-5 1/4"
15'-0"	341'-1 5/8"	77'-5 1/8"
16'-0"	356'-1 3/8"	92'-4 7/8"
1.0" CHANGE	14.9844'	14.9844'

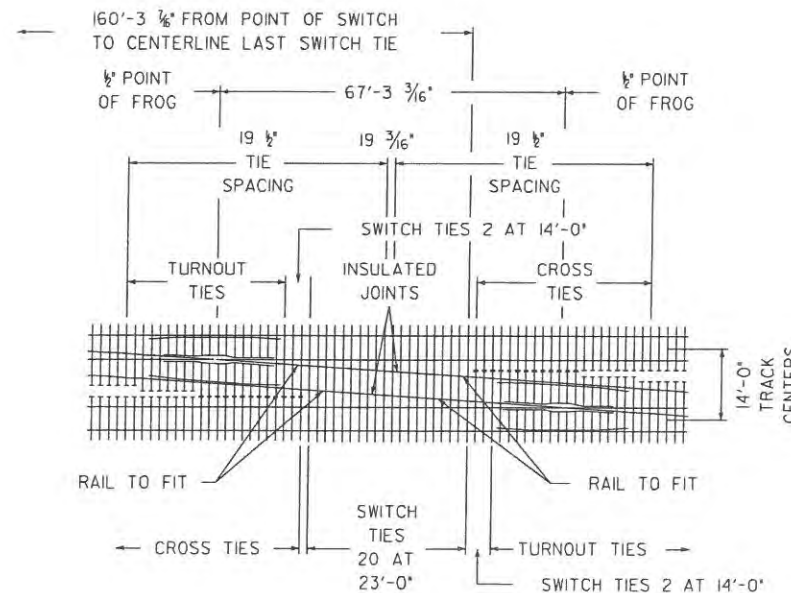


RAIL LAYOUT DIAGRAM

* IF INSULATED JOINTS ARE REQUIRED, USE PREMIUM INSULATED JOINT IN 38'-5" RAIL WITH LEGS AS SHOWN. MAXIMUM STAGGER ANY PAIR OF INSULATED JOINTS IS 4'-6".



CROSSOVER - 15'-0" TRACK CENTERS



CROSSOVER - 14'-0" TRACK CENTERS



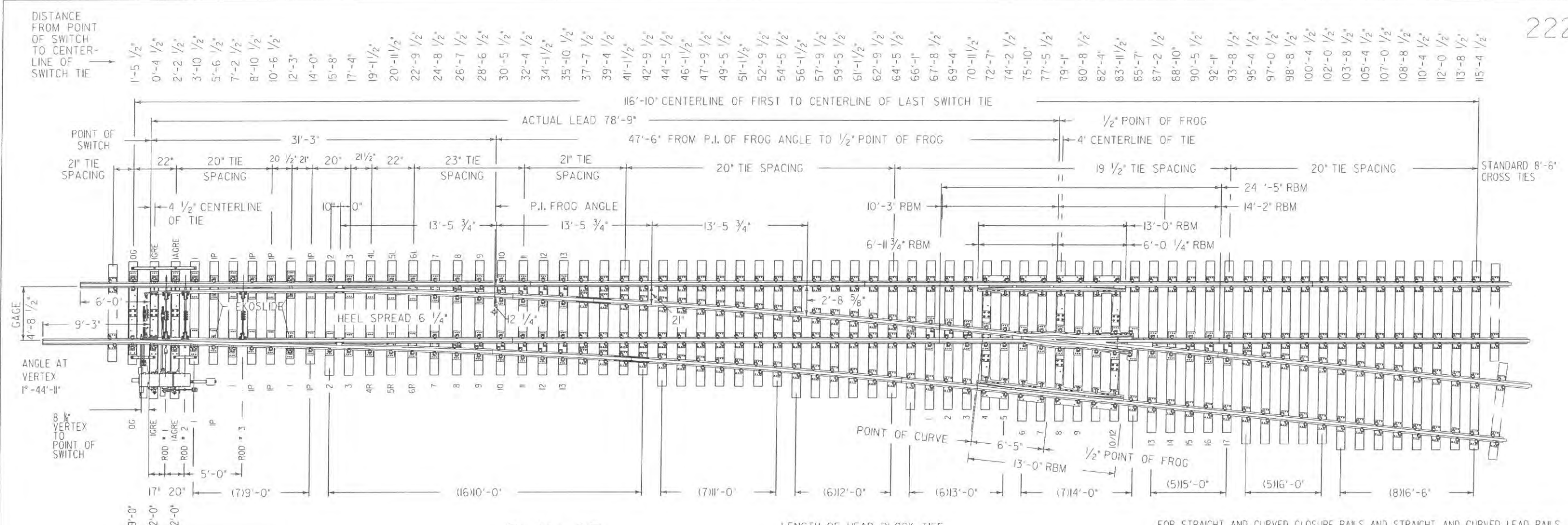
Central Florida Rail Corridor
NUMBER 15 OFFSET AND LAYOUT
DIAGRAMS FOR 136RE RAIL

Miguel Torres

APPROVED - MIGUEL TORRES
CFRC CHIEF OPERATING OFFICER

PREPARED BY: RMW ISSUED: 9/9/2015 REVISED: 4/2/2015

11/6/12 ADDED FRONT ROD ASSEMBLY



PLAN OF RIGHT HAND TURNOUT

SWITCH PLATE AND TIE LAYOUT ARRANGED FOR POWER THROW MECHANISM PER SIGNAL SECTION DRAWING NO. S5001

LENGTH OF HEAD BLOCK TIES
 13'-0" FOR HAND OPERATED
 14'-0" FOR HAND OPERATED WITH CIRCUIT CONTROLLER
 12'-0" FOR MACHINE OPERATED
 16'-0" FOR SPRING SWITCH
 VERTICAL SWITCH RODS SHOWN

FOR STRAIGHT AND CURVED CLOSURE RAILS, AND STRAIGHT AND CURVED LEAD RAILS, SEE DRAWING 2225.
 SWITCH HAS ADJUSTABLE BOLTLESS BRACES. PREFERRED SWITCH BRACE IS PRS CLAMPTITE, ALTERNATE IS BETHLEHEM BOLTLESS.
 RBM FROG USES MILLED SEAT PLATES WITH WELDED PANDROL SHOULDERS PER DRAWING 2431.
 ON PLATES WHERE THERE ARE 3 ADJACENT ROUND HOLES, THE CENTER HOLE IS RESERVED FOR FUTURE MAINTENANCE.
 RAIL ANCHORS ARE NOT TO BE USED IF PANDROL TIE PLATES ARE INSTALLED.
 IF PANDROL PLATES ARE NOT USED, ALL TIES IN THE TURNOUT TO WHICH AN ANCHOR CAN BE APPLIED WILL BE BOX ANCHORED ON BOTH THE THROUGH TRACK AND DIVERGING TRACK. EVERY TIE WILL BE BOX ANCHORED FOR A DISTANCE OF 130 TIES AHEAD OF THE SWITCH POINT. EVERY TIE ON BOTH TRACKS WILL BE BOX ANCHORED FOR A DISTANCE OF 130 TIES BEYOND THE END OF SWITCH TIES ON THE FROG END OF TURNOUT. DO NOT PLACE ANCHORS WHERE THEY MAY INTERFERE WITH MOVING PARTS.

BILL OF SWITCH TIES			
LENGTH	TURNOUT ONLY	CROSSOVER	
		14'-0"	15'-0"
9'-0"	8	16	16
10'-0"	16	32	32
11'-0"	7	14	14
12'-0"	6	12	12
12'-0" (Dapped)*	2	4	4
13'-0"	6	12	12
14'-0"	7	22	14
15'-0"	5	0	16
16'-0"	5	0	0
16'-6"	8	0	0
23'-0"	0	10	8
TOTAL NO.	70	122	128
BOARD MEAS.	4549.8	7881.5	8312.0

ALL SWITCH TIES ARE 7" X 9"
 * ADJUST THE NUMBER OF 12'-0" DAPPED TIES IF LAYOUT REQUIRES THE USE OF 13'-0", 14'-0", OR 16'-0" HEAD BLOCK TIES.

TURNOUT DATA		BILL OF TRACK MATERIAL		ORDERING INFORMATION	
NUMBER	RBM	QUANTITY	DESCRIPTION	CLASS	ITEM
10		1	NO.10 RAILBOUND MANGANESE STEEL FROG, COMPLETE, PER DRAWING 2422 BONDED FOR SIGNALS.	010	6650171
2		2	GUARD RAILS COMPLETE, WITH A 7'-0" MINIMUM STRAIGHT GUARDING FACE.	010	6650170
1		1	39'-0" STRAIGHT STOCK RAIL PER DRAWING 2307.	010	6650250
1		1	39'-0" BENT STOCK RAIL PER DRAWING 2307.	010	6650180
1		1	16'-6" LONG RAIL STRAIGHT SPLIT SWITCH, COMPLETE, WITH UNIFORM RISERS, PER DRAWINGS 2307, 2317, 2325, 2326, 2335, 2336, & 2337.	010	6650181
1		1	FRONT ROD ASSEMBLY PER S5001 AND S5044	010	6650255
1		1	35'-8" RAIL WITH INSULATED JT. 12'-11"-23'-7" LEGS		
1		1	37'-2" RAIL WITH INSULATED JT. 7'-0"-30'-2" LEGS		
11		11	JOINTS, COMPLETE INCL. J CLIPS AND BOLTS		
200	lbs		TRACK SPIKES		
144			PANDROL TIE PLATES		
434			PANDROL CLIPS		
884			6 1/2" SCREW SPIKES OR 7/2" EVERGRIP SCREWS		
223			FEET OF PREMIUM RAIL		

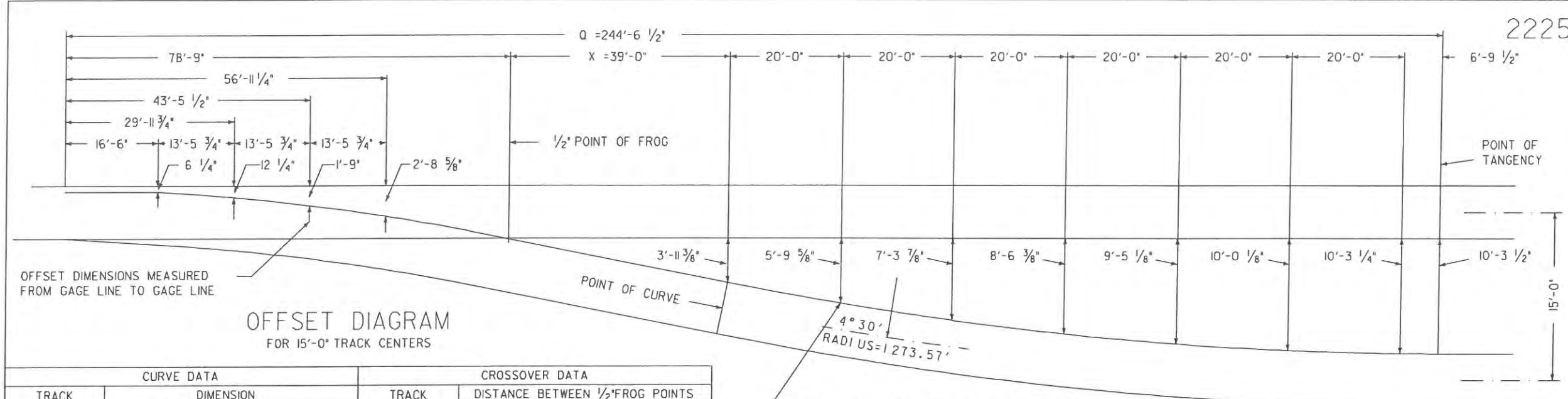
ALL FROG PLATES TO BE MILLED SEAT 1" THICK 1/4" MILLED
 WORKMANSHIP AND MATERIALS SHALL BE PER CURRENT AREMA SPECIFICATIONS UNLESS OTHERWISE SPECIFIED.
 SINCE THE ALLOWABLE VARIATION IN STANDARD LENGTHS OF RAILS, FROGS AND SWITCH POINTS IS GREATER THAN THE NORMAL EXPANSION GAPS AT RAIL JOINTS AND THICKNESS OF FIBRE END POST IN INSULATED JOINTS, NO ALLOWANCE HAS BEEN MADE FOR EXPANSION GAPS AND FIBRE END POSTS IN COMPUTING LENGTHS OF RAIL SHOWN.



NUMBER 10 TURNOUT AND CROSSOVER RAILBOUND MANGANESE FROG FOR 136RE RAIL

Miguel Torres

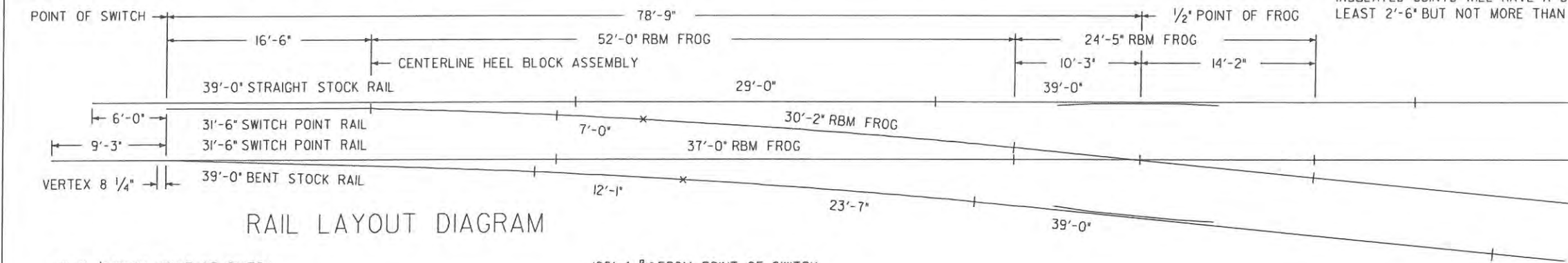
APPROVED - MIGUEL TORRES
 CFRC CHIEF OPERATING OFFICER



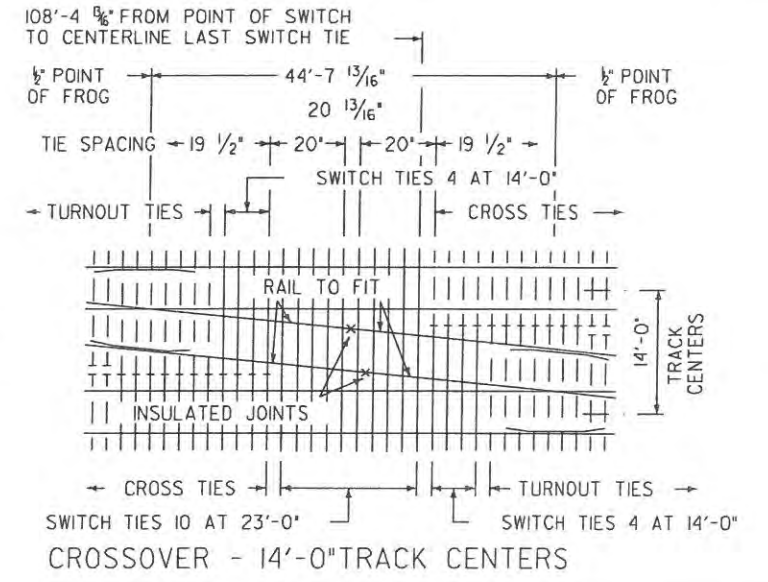
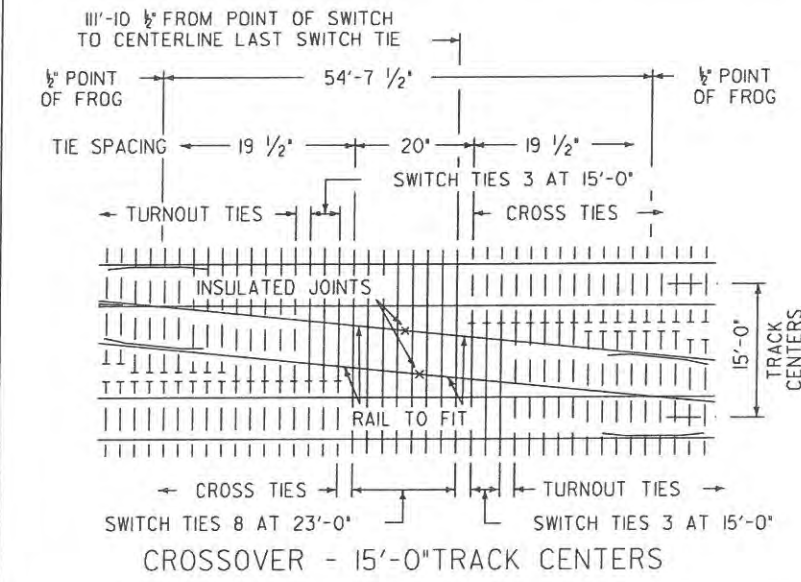
TRACK CENTERS	CURVE DATA		TRACK CENTERS	CROSSOVER DATA	
	Q	X		DISTANCE BETWEEN 1/2° FROG POINTS	
13'-0"	224'-7 1/8"	19'-0 5/8"	15'-0"	54'-7 1/2"	55'-4 1/2"
14'-0"	234'-6 7/8"	29'-0 3/8"	14'-0"	44'-7 13/16"	45'-4 3/16"
15'-0"	244'-6 1/2"	39'-0"	1'-0" CHANGE	9'-11 1/16"	10'-0 5/16"
16'-0"	254'-6 1/4"	48'-11 3/4"	1.0" CHANGE	9.974"	10.026"
1.0" CHANGE	9.974"	9.974"			

OFFSET DIMENSIONS MEASURED FROM GAGE LINE TO GAGE LINE. FOR TRACK CENTERS OTHER THAN 15'-0" REDUCE OR INCREASE OFFSET DIMENSIONS BY SAME AMOUNT THAT TRACK CENTERS ARE INCREASED OR DECREASED FROM 15'-0", AND ADJUST *X* DISTANCE.

IF INSULATED JOINTS ARE REQUIRED WITH 31'-6" LONG SWITCH POINT RAILS, USE PREMIUM INSULATED JOINTS IN THE FOLLOWING LENGTH RAILS. FOR RAILBOUND MANGANESE FROGS (DWG 2422). 37'-2" LONG WITH 7'-0" AND 30'-2" LEGS 35'-8" LONG WITH 12'-1" AND 23'-7" LEGS INSULATED JOINTS WILL HAVE A STAGGER OF AT LEAST 2'-6" BUT NOT MORE THAN 4'-6".



RAIL LAYOUT DIAGRAM



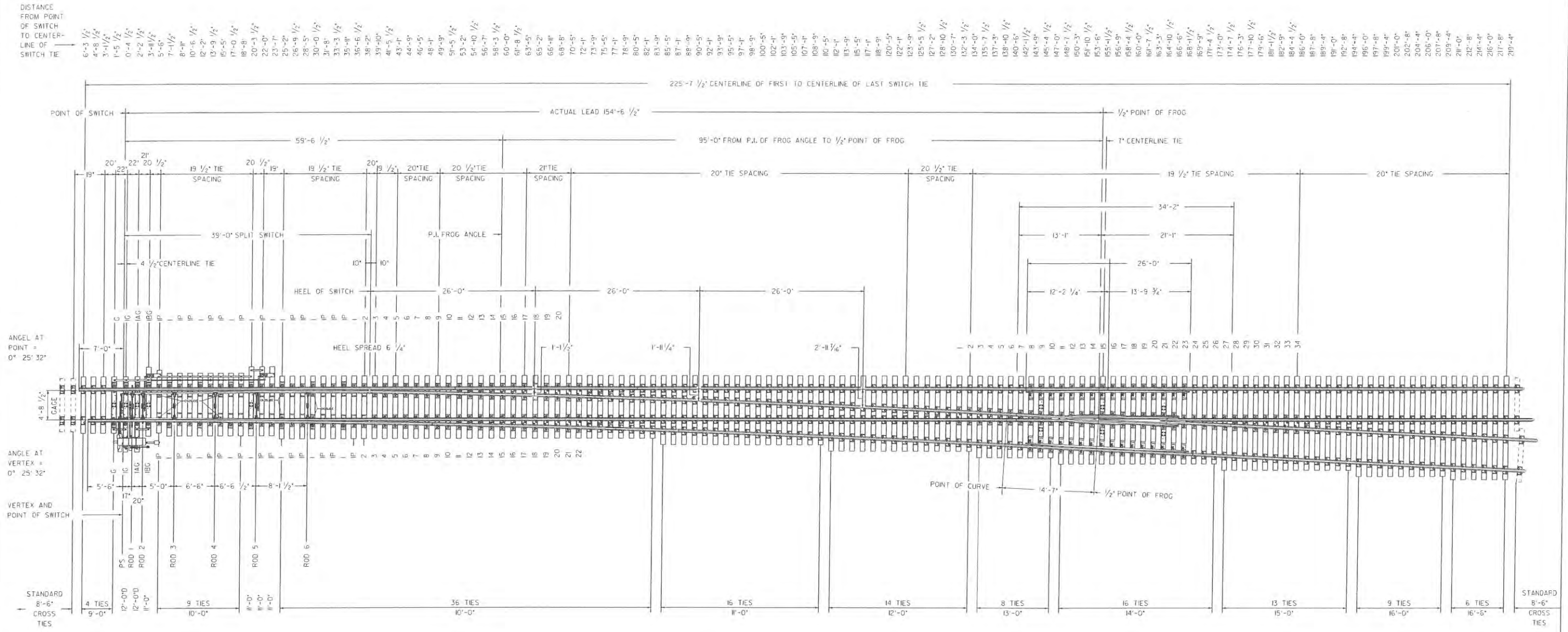
NUMBER 10 OFFSET AND LAYOUT DIAGRAMS WITH RAILBOUND MANGANESE FROG FOR 136RE RAIL

Miguel Torres
APPROVED - MIGUEL TORRES

CFRC CHIEF OPERATING OFFICER

PREPARED BY: RMW ISSUED: 9/9/2015 REVISED: 4/2/2015

1/7 1/2" ADDED FRONT ROD ASSEMBLY



PLAN OF RIGHT HAND TURNOUT

WORKMANSHIP AND MATERIALS SHALL BE PER CURRENT AREMA SPECIFICATIONS UNLESS OTHERWISE SPECIFIED.

SINCE THE ALLOWABLE VARIATION IN STANDARD LENGTHS OF RAILS, FROGS AND SWITCH POINTS IS GREATER THAN THE NORMAL EXPANSION GAPS AT RAIL JOINTS AND THICKNESS OF INSULATING END POST IN INSULATED JOINTS, NO ALLOWANCE HAS BEEN MADE FOR EXPANSION GAPS AND INSULATING END POSTS IN COMPUTING LENGTHS OF RAIL SHOWN.

USE 39'-0" CURVED SWITCH WITH UNIFORM RISERS PER DRAWING 2338.

SEE DRAWING 2339 FOR STRAIGHT AND CURVED CLOSURE AND LEAD RAILS.

SWITCH SHOWS ADJUSTABLE PANDROL BRACES BUT PREFERRED IS PRS CLAMPTITE.

PREFERRED ALTERNATE FROGS INCLUDE ONE OR MORE OF THE FOLLOWING ATTRIBUTES: CONFORMAL RUNNING SURFACE, HEAVY POINT, WELDED HEEL (WBM), LOW IMPACT HEEL, AND/OR TAPERED HEEL.

FROG USES MILLED SEAT PLATES WITH WELDED PANDROL SHOULDER PER DRAWING 2435 WITH GAGE PLATES PER DRAWING 2425.

THE NUMBER OF INSULATED JOINTS REQUIRED DEPENDS ON TURNOUT LOCATION.

PREMIUM RAIL IS TO BE USED FOR ALL CONNECTING RAILS.

SWITCH PLATE AND TIE LAYOUT ARRANGED FOR POWER THROW MECHANISM PER C & S STANDARDS.

MANUFACTURER SHALL VERIFY ALL DIMENSIONS BEFORE FABRICATION.

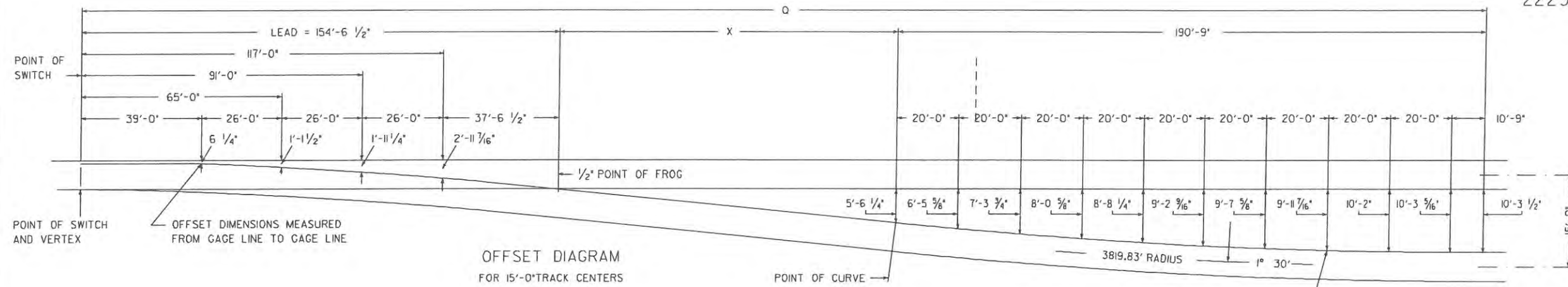
TURNOUT DATA		ORDERING INFORMATION		BILL OF TRACK MATERIAL ON TURNOUT TIES	
NUMBER	20	ITEM NO.	DESCRIPTION	QUANTITY	DESCRIPTION
ANGLE	2°-51'-51"			1	NO.20 RAILBOUND MANGANESE STEEL FROG, COMPLETE, PER DRAWING 2435 BONDED FOR SIGNALS.
TOTAL LENGTH	34'-2"	010.6650210.1	TURNOUT PANELED ON WOOD TIES NO 20 WITH RBM FROG RH	2	GUARD RAILS, BOLTLESS ADJUSTABLE, 26'-0", COMPLETE, PER DRAWING 242 SHEET 2.
TIE LENGTH	13'-1"				
HEEL LENGTH	21'-1"	010.6650220.1	TURNOUT PANELED ON WOOD TIES NO 20 WITH RBM FROG LH	1	59'-6" STRAIGHT STOCK RAIL PER DRAWING 2339.
HEEL SPREAD	7 1/2"				
HEEL SPREAD	13 3/4"				
LENGTH OF SWITCH POINT	39'-0"	BILL OF SWITCH TIES			
HEEL SPREAD	6 1/4"	LENGTH	TURNOUT	CROSSOVER	
HEEL ANGLE	1°-06'-17"		14'-0"	15'-0"	
THICKNESS OF POINT	0"	9'-0"	4	8	1
ANGLE AT POINT	0°-25'-32"	10'-0"	45	90	1
RADIUS	3291.6863'	11'-0"	20	40	1
VERTEX DISTANCE	0"	12'-0"	14	28	539
THICKNESS OF POINT	0"	12'-0" (Dapped)	2	4	4
ANGLE AT POINT	0°-27'-19"	13'-0"	8	16	2 OR 4
RADIUS (OF STOCK RAIL)	3600.9900'	14'-0"	16	38	11
VERTEX DISTANCE	0'-0"	15'-0"	13	0	26
ACTUAL LEAD	154'-6 1/2"	16'-0"	9	0	0
RADIUS OF CENTERLINE	3289.3321'	16'-6"	6	0	0
DEGREE OF CURVE	1°-44'-31"	23'-0"	0	24	16
STRAIGHT CLOSURE LENGTH	102'-5 1/2"	TOTAL NUMBER	137	248	266
CURVED CLOSURE LENGTH	102'-6 1/2"	BOARD MEASURE	8,682.5	16,103.0	16,743.5
P.C. TO 1/2" POINT OF FROG	14'-7"	ALL SWITCH TIES ARE 7'X 9'			670

CFRC
Central Florida Rail Corridor

NUMBER 20 TURNOUT AND CROSSOVER
RAILBOUND MANGANESE FROG
FOR I36RE RAIL ONLY

Miguel Torres
APPROVED - MIGUEL TORRES
CFRC CHIEF OPERATING OFFICER

PREPARED BY: RMW ISSUED: 9/9/2015 REVISED: 4/2/2015

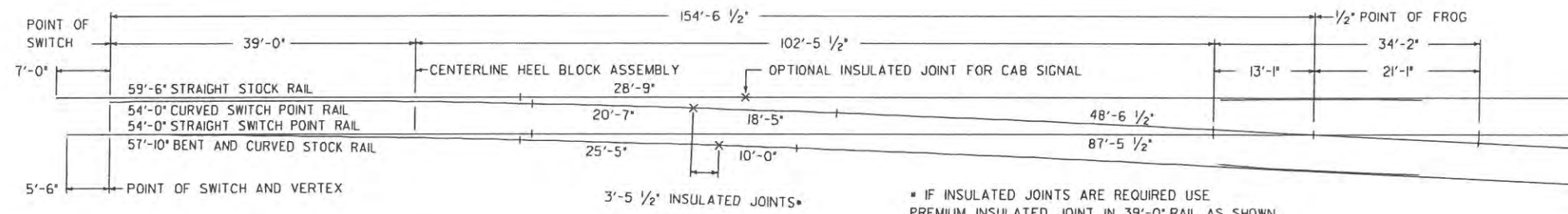


OFFSET DIAGRAM
FOR 15'-0" TRACK CENTERS

OFFSET DIMENSIONS MEASURED FROM GAGE LINE TO GAGE LINE. FOR TRACK CENTERS OTHER THAN 15'-0", INCREASE OR DECREASE OFFSET DIMENSIONS BY SAME AMOUNT THAT TRACK CENTERS ARE INCREASED OR DECREASED FROM 15'-0", AND ADJUST "X" DISTANCE.

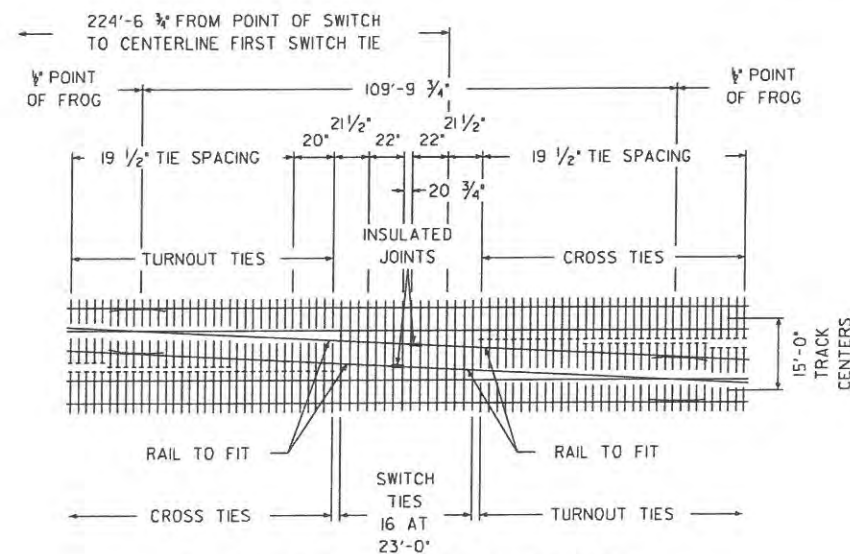
TRACK CENTERS	DISTANCE BETWEEN 1/2 POINTS OF FROGS	
	MAIN TRACK	CROSSOVER
15'-0"	109'-9 3/4"	110'-2 1/4"
14'-0"	89'-9 7/8"	90'-2 1/8"
1.0" CHANGE	19'-11 7/8"	20'-0 1/8"
1'-0" CHANGE	19.988'	20.013'

TRACK CENTERS	CURVE DATA	
	O	X
13'-0"	414'-10 15/32"	69'-6 31/32"
14'-0"	434'-10 1/32"	89'-6 27/32"
15'-0"	454'-10 1/32"	109'-6 23/32"
16'-0"	474'-10 3/32"	129'-6 19/32"
1.0" CHANGE	19.988'	19.988'

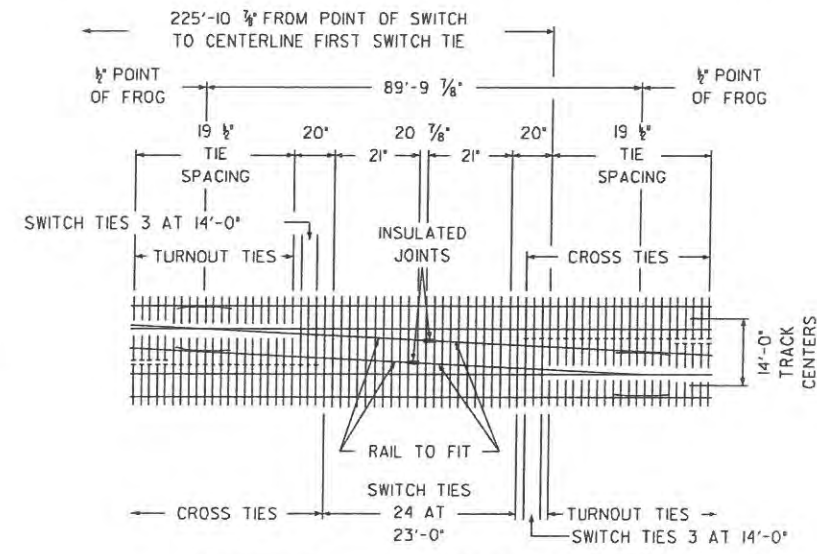


RAIL LAYOUT DIAGRAM

IF INSULATED JOINTS ARE REQUIRED USE PREMIUM INSULATED JOINT IN 39'-0" RAIL AS SHOWN. MAXIMUM STAGGER ANY PAIR OF INSULATED JOINTS IS 4'-6".



CROSSOVER - 15'-0" TRACK CENTERS



CROSSOVER - 14'-0" TRACK CENTERS



Central Florida Rail Corridor

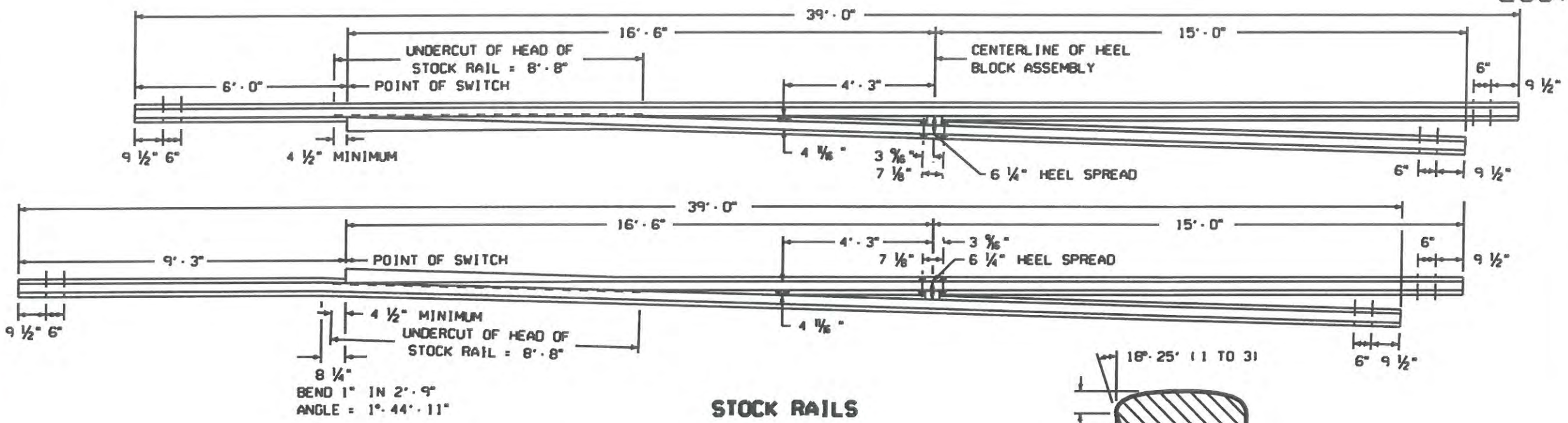
NUMBER 20 OFFSET AND LAYOUT DIAGRAMS
FOR 136RE RAIL

Miguel Torres

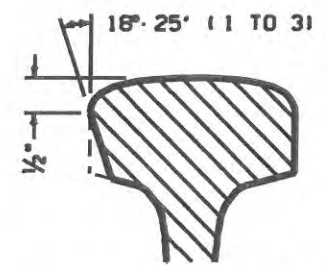
APPROVED - MIGUEL TORRES

CFRC CHIEF OPERATING OFFICER

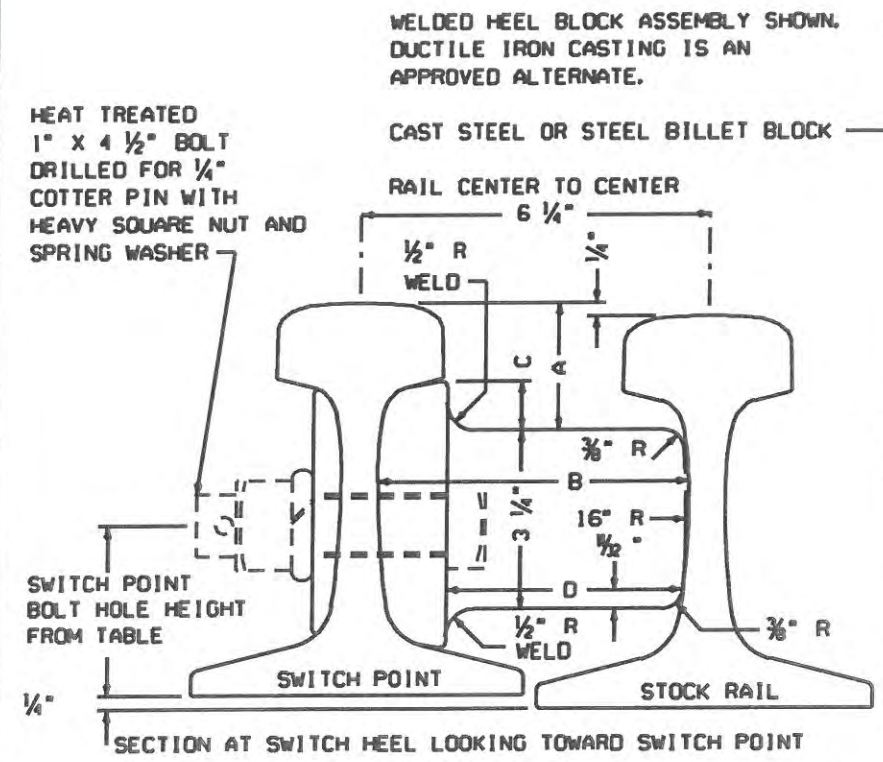
PREPARED BY: RMW ISSUED: 9/9/2015 REVISED: 4/2/2015



STOCK RAILS



UNDERCUT DETAIL



FLOATING HEEL BLOCK ASSEMBLY

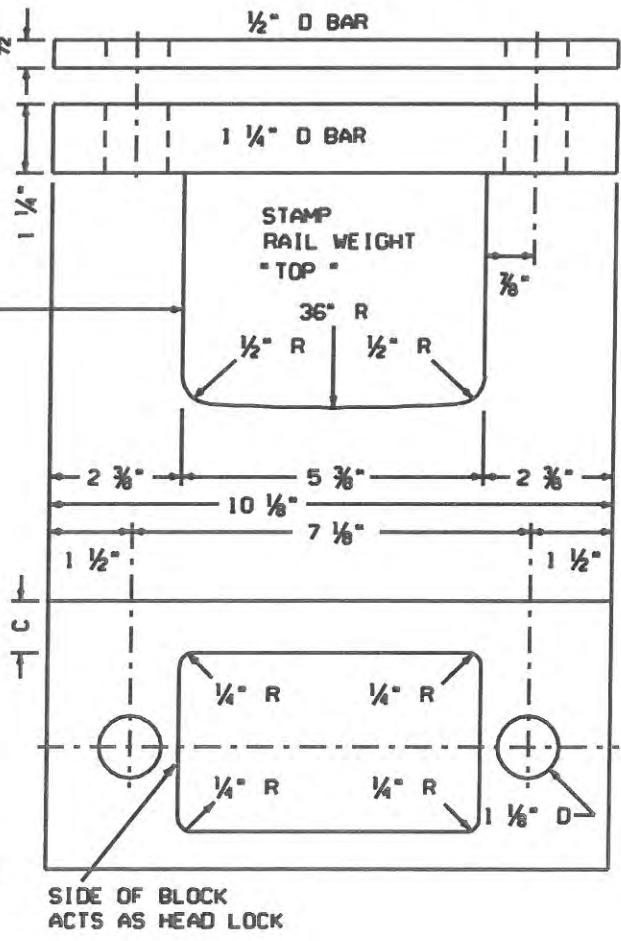


TABLE OF DIMENSIONS - INCHES

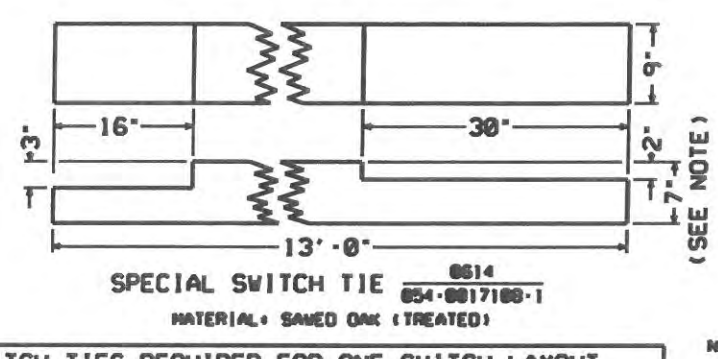
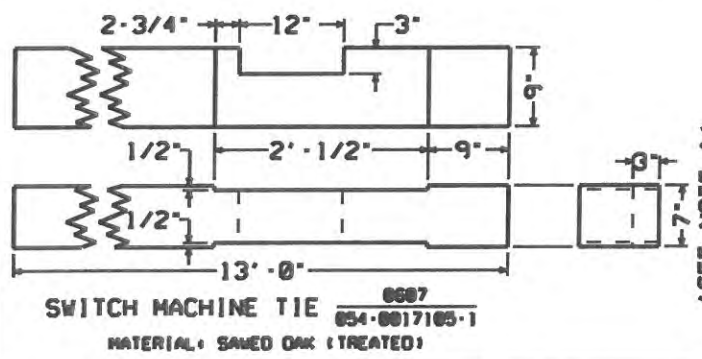
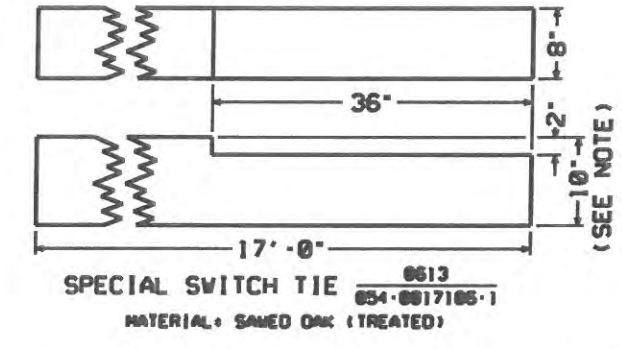
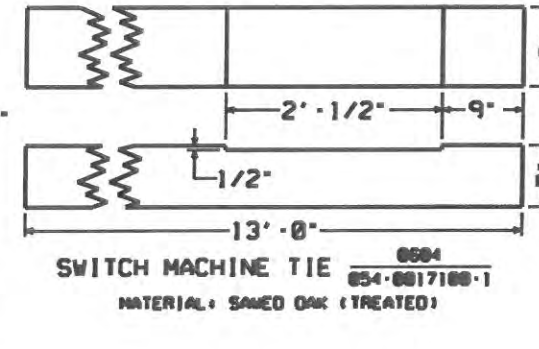
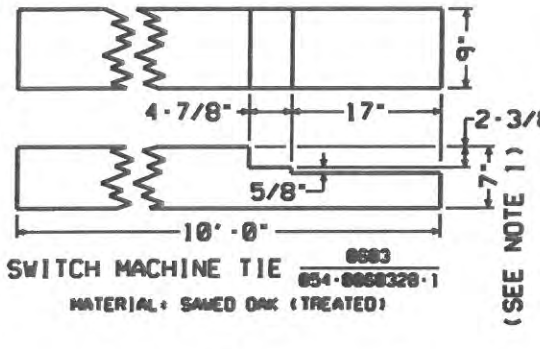
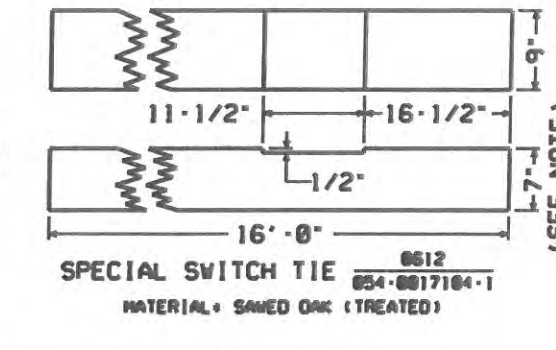
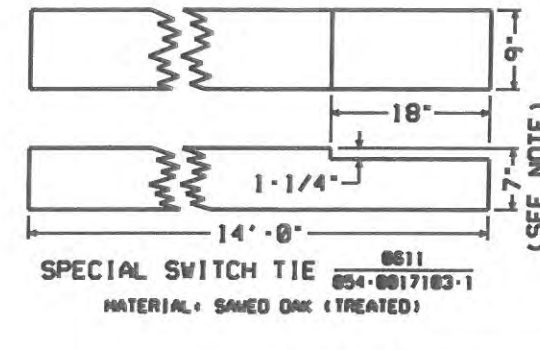
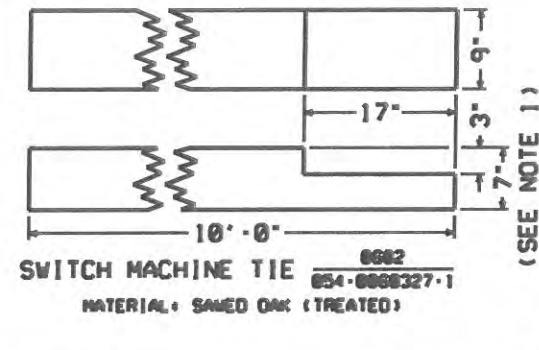
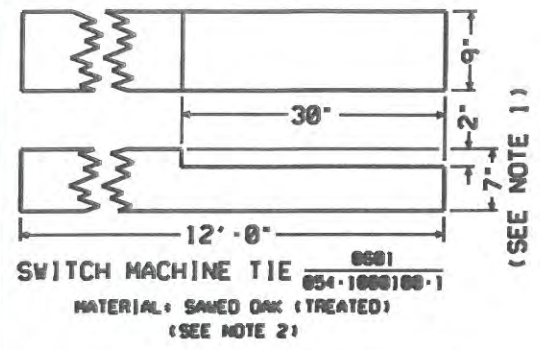
RAIL WEIGHT	BOLT HOLE HEIGHT	TOP OF RAIL TO TOP OF SPACER "A"	WEB TO WEB SPREAD "B"	TOP D BAR TO TOP OF SPACER "C"	D BAR TO TO WEB CONTACT "D"
136 RE	3 7/8	2 1/2	5 7/8	7/8	4 1/4
132 RE	3 7/8	2 7/8	5 7/8	7/8	4 1/4
122 CB	2 7/8	2 7/8	5 7/8	1/2	4 7/8
115 RE	2 7/8	2 7/8	5 7/8	1/2	4 7/8



STOCK RAILS FOR 16'-6" SWITCH POINTS WITH FLOATING HEEL BLOCK ASSEMBLY FOR 115RE, 122CB, 132RE, AND 136RE RAIL

Miguel Torres
APPROVED - MIGUEL TORRES

CFRC CHIEF OPERATING OFFICER



SWITCH MACHINE TIES REQUIRED FOR ONE SWITCH LAYOUT						
SWITCH MACHINE	LAYOUT DRAWING NUMBER	TIE DETAIL NUMBER				
		0601	0602	0603	0604	0607
STYLE M-22A ELECTRIC	SS001	2				
STYLE M-3 & M-23A ELECTRIC	SS001	2				
MODEL 5A THROUGH 5H ELECTRIC	SS002	2				
STYLE A-5 ELECTRO-PNEUMATIC	SS004		2	2		
STYLE T-21 HAND OPERATED	SS005				1	1
SV. PT. DERAIL W/ M-22A OR M-23A	SS012	2				
MODEL H8 DERAIL W/ ELEC. SV. MACH.	SS015	1				
STYLE DA-10 DIRECT ACTION	SS016	2				
SV. PT. DERAIL W/ MOD. 5A THRU 5H	SS021	2				

NOTES:
 1 - DEPTH OF DAPS ON ALL TIES MUST BE AS SHOWN, AND MEASURED FROM TOP SURFACE OF TIE. TIE DIMENSIONS MAY VARY FROM PLUS .1 INCH TO MINUS .1 INCH.
 2 - FOR REPLACEMENT ON EXISTING ELECTRIC SWITCH MACHINE LAYOUTS REQUIRING 14 FT. TIES, DETAIL NO. 0601, USE ITEM NO. 054-1000110-1.

SWITCH MACHINE TIES DRAWING SS060

SPECIAL SWITCH TIES REQUIRED FOR ONE SWITCH LAYOUT					
APPLICATION	LAYOUT DRAWING NUMBER	TIE DETAIL NUMBER			
		0611	0612	0613	0614
MODEL 51-A STAND W/STYLE SL-21A ELEC. LOCK	SS009	1			
MODEL 51-A STAND W/MODEL 10 ELEC. LOCK	SS010	1			
MODEL 50-A STAND W/MODEL B MECH. SWITCHMAN	SS011		2		
MODEL H8 DERAIL W/STYLE SL-21A ELEC. LOCK	SS013	1			
MODEL H8 DERAIL W/MODEL 10 ELEC. LOCK	SS014	1			
MODEL H8 DERAIL W/ ELECTRIC SWITCH MACHINE	SS015				1
ELECTRIC SWITCH MACHINE AT SWING NOSE FROG	SS018			2	

NOTE:
 DEPTH OF DAPS ON ALL TIES MUST BE AS SHOWN, AND MEASURED FROM TOP SURFACE OF TIE. TIE DIMENSIONS MAY VARY FROM PLUS 1/4 INCH TO MINUS 1/4 INCH.

SPECIAL SWITCH TIES DRAWING SS061

THE SWITCH MACHINE AND SPECIAL SWITCH TIES USED BY TRAIN CONTROL AND SHOWN ON THIS DRAWING ARE FROM TRAIN CONTROL DRAWINGS SS060 REVISED TO JULY 1, 1996, AND SS061 REVISED TO JULY 1, 1996.

THESE TIES ARE NORMALLY TRAIN CONTROL ITEMS AND ARE INCLUDED AS REFERENCE MATERIAL FOR ENGINEERING DEPARTMENT EMPLOYEES.

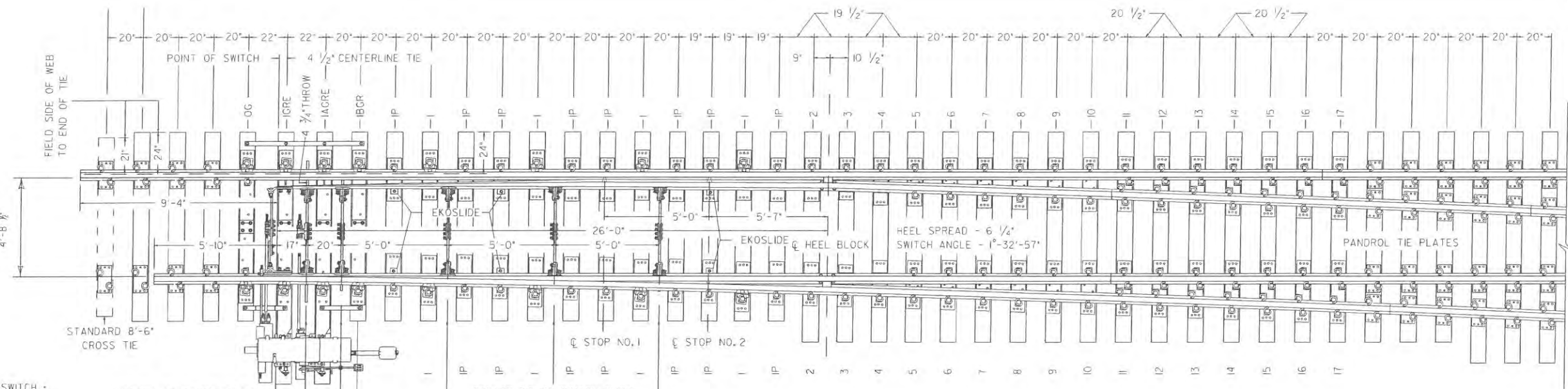
THE LATEST REVISION OF TRAIN CONTROL DRAWINGS SS060 OR SS061 WILL GOVERN IF THERE ARE DIFFERENCES IN DIMENSIONS OR IN THE NUMBER OF TIES REQUIRED BETWEEN THE TRAIN CONTROL DRAWING AND THIS DRAWING.

CFRC
 Central Florida Rail Corridor
 SWITCH MACHINE AND SPECIAL SWITCH TIES
 USED BY SIGNAL DEPARTMENT IN TURNOUTS

Miguel Torres
 APPROVED - MIGUEL TORRES
 CFRC CHIEF OPERATING OFFICER

PREPARED BY: RMW ISSUED: 9/9/2015 REVISED: 4/2/2015

10/2/12 CHANGE SECOND TOP CUT TO 1/4" BY 3/16".
 11/5/12 USE 1" RADIUS ON SWITCH POINT GAGE CORNER.
 11/5/12 INCLUDE SIGNAL FRONT ROD.

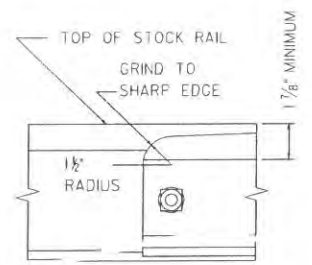


CHANGES REQUIRED FOR SPRING SWITCH :

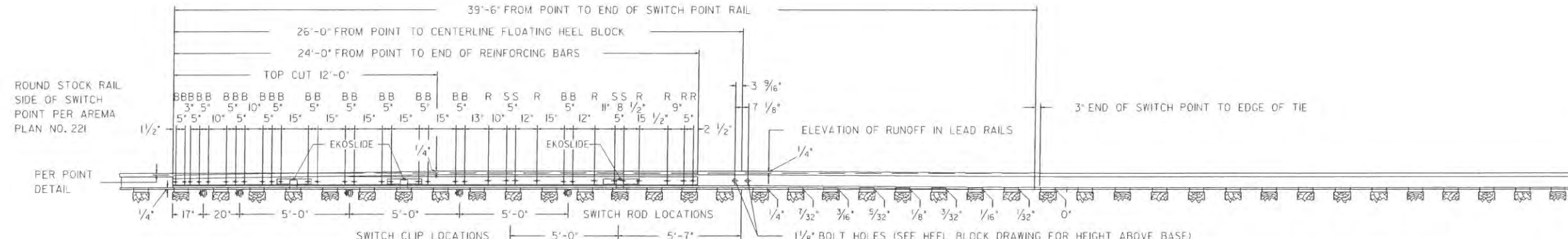
1. USE 16'-0" HEADBLOCK TIES.
2. USE IGR AND IAGR GAGE PLATES INSTEAD OF IGRE AND IAGRE GAGE PLATES
3. USE SWITCH POINTS REINFORCED WITH 'D' BARS 1 1/2" THICK.
4. USE SWITCH RODS DESIGNED FOR SPRING SWITCH PER DRAWING 2326.
5. INSTALL MECHANICAL SWITCHMAN PER SIGNAL DRAWINGS.

VERTEX AT SWITCH POINT
 CENTERLINE OF SWITCH CLIPS FOR NUMBER 1 SWITCH ROD, SWITCH ROD 6'-9" LONG.
 CENTERLINE OF SWITCH CLIPS FOR NUMBER 2 SWITCH ROD, SWITCH ROD 5'-8" LONG.
 CENTERLINE OF SWITCH CLIPS FOR NUMBER 3 SWITCH ROD, SWITCH ROD 4'-4" LONG.
 CENTERLINE OF SWITCH CLIPS FOR NUMBER 4 SWITCH ROD, SWITCH ROD 4'-4" LONG.
 CENTERLINE OF SWITCH CLIPS FOR NUMBER 5 SWITCH ROD, SWITCH ROD 5'-8" LONG.
 ADJUST SWITCH RODS PER INSTRUCTIONS IN DRAWING 2326.

PLAN OF RIGHT HAND SWITCH LAYOUT
 (REFERENCE AREMA PLAN 125)



(REF. AREMA 221)
END OF SWITCH POINT



REINFORCING BARS TO BE 1/2" THICK (1 1/2" THICK FOR SPRING SWITCH) SECURED BY :
 3/8" DIA. RIVETS OR HUCK BOLTS IN CENTERLINE OF WEB IN HOLES MARKED S OR R.
 HOLES MARKED 'B' IN 'ELEVATION OF SWITCH POINT' TO BE FURNISHED WITH 1" DIA. BOLTS AND ARE 2 1/8" ABOVE BASE OF SWITCH POINT RAIL.
 HOLE SPACING DIFFERS FROM AREMA HOLE SPACING DUE TO NUMBER 5 SWITCH ROD.

WORKMANSHIP AND MATERIALS SHALL BE PER CURRENT AREMA SPECIFICATIONS UNLESS OTHERWISE SPECIFIED.
 1. SWITCH POINT GAGE SIDE RADIUS TO BE 1" RATHER THAN 3/8".
 MANUFACTURER SHALL VERIFY ALL DIMENSIONS BEFORE FABRICATION.

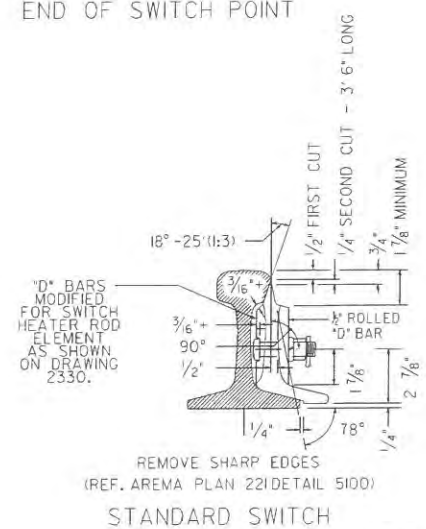
A MARKER PLATE SHALL BE PLACED ON THE GAGE SIDE OF BOTH SWITCH POINTS NEAR THE HEEL BLOCK END IN RAISED OR DEEPLY CUT CHARACTERS TO INDICATE MFR., 26'-0", UNIFORM, RAIL SECTION AND DATE.

SWITCH POINTS TO BE MADE FROM HEAD HARDENED PREMIUM RAIL, 39'-6" LONG.

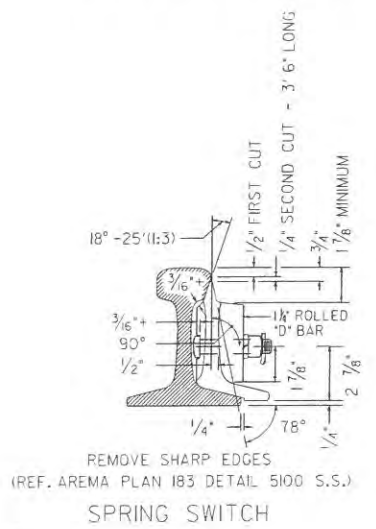
STOCK RAILS TO BE MADE FROM HEAD HARDENED PREMIUM RAIL.

STRAIGHT SIDE OF TURNOUT IS LINE SIDE FOR SWITCH TIES. NORMAL SWITCH TIE DISTANCE IS 24" FROM THE WEB OF RAIL ON THE FIELD SIDE. SWITCH TIES FOR SIGNAL EQUIPMENT ARE DIMENSIONED SEPARATELY.

INCLUDE FRONT ROD ASSEMBLY PER S5001 AND S5044.

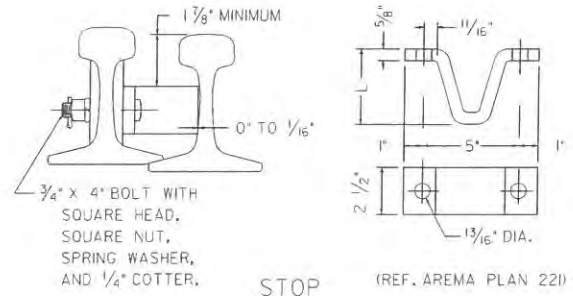


REMOVE SHARP EDGES
 (REF. AREMA PLAN 221 DETAIL 5100)
STANDARD SWITCH



REMOVE SHARP EDGES
 (REF. AREMA PLAN 183 DETAIL 5100 S.S.)
SPRING SWITCH

POINT DETAILS
 136RE RAIL



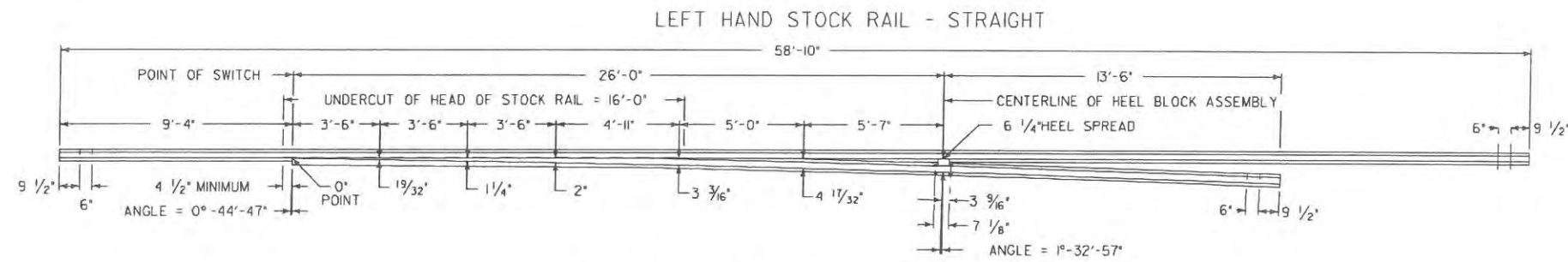
STOP LENGTH - L		
RAIL WT	STOP 1	STOP 2
136RE	1 7/8"	3 1/4"



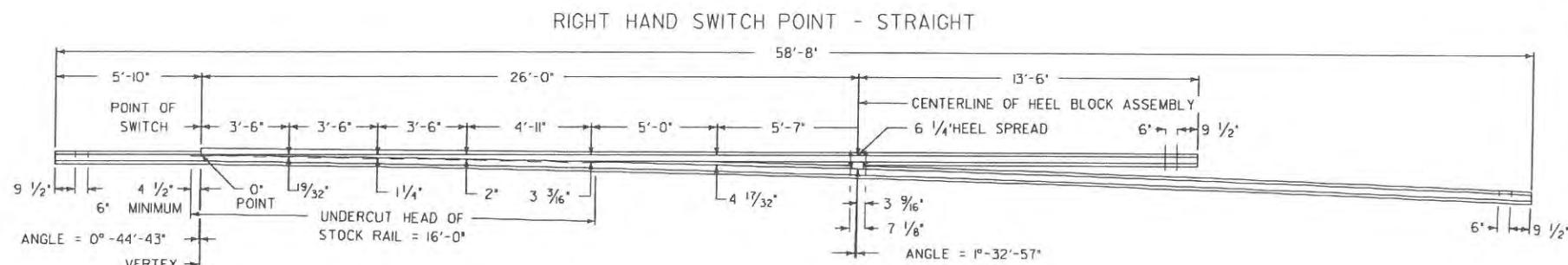
26'-0" CURVED SPLIT SWITCH UNIFORM RISERS,
 MACHINE OPERATED FOR 136RE RAIL

Miguel Torres
 APPROVED - MIGUEL TORRES

CFRC CHIEF OPERATING OFFICER

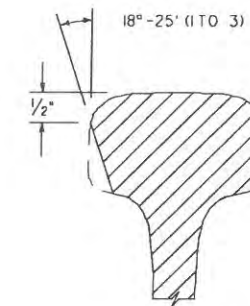


LEFT HAND SWITCH POINT - CURVED - RADIUS 1855.769'

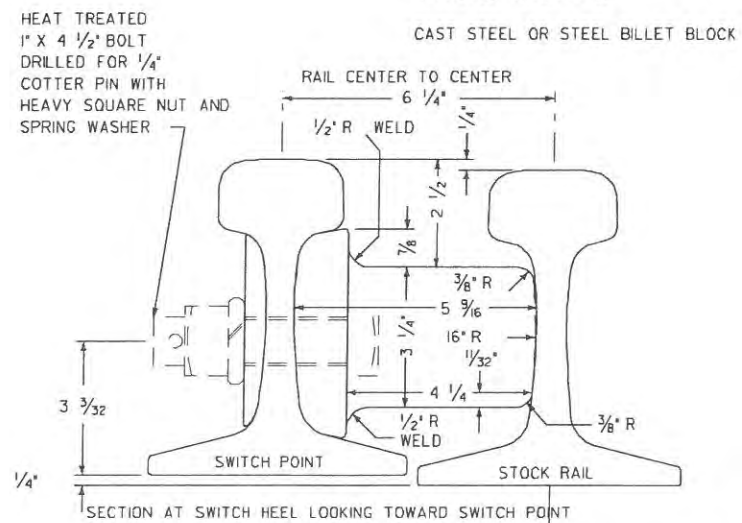


RIGHT HAND STOCK RAIL - BENT AND CURVED - RADIUS 1851.061'
STOCK RAILS FOR 26'-0" SWITCH POINTS

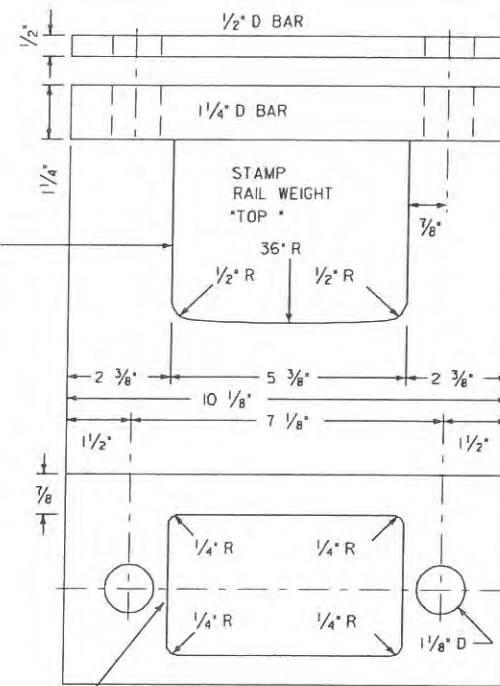
- NOTES:
1. SPREAD DIMENSIONS ARE MEASURED FROM GAGE LINE TO GAGE LINE.
 2. MANUFACTURER SHALL VERIFY ALL DIMENSIONS BEFORE FABRICATION.
 3. POINTS AND STOCK RAILS FOR MAINTENANCE REPLACEMENT ARE NOT TO BE END DRILLED.



UNDERCUT DETAIL



FLOATING HEEL BLOCK ASSEMBLY



WELDED HEEL BLOCK ASSEMBLY SHOWN. DUCTILE IRON CASTING IS AN APPROVED ALTERNATE.

CAST STEEL OR STEEL BILLET BLOCK

SIDE OF BLOCK ACTS AS HEAD LOCK



Central Florida Rail Corridor
STOCK RAILS FOR 136RE RAIL
26'-0" CURVED SWITCH POINTS

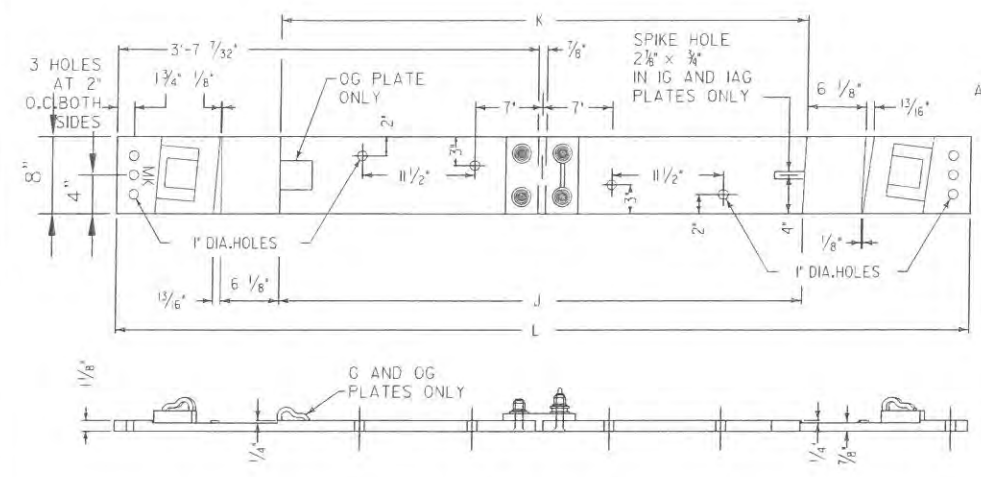
Miguel Torres

APPROVED - MIGUEL TORRES

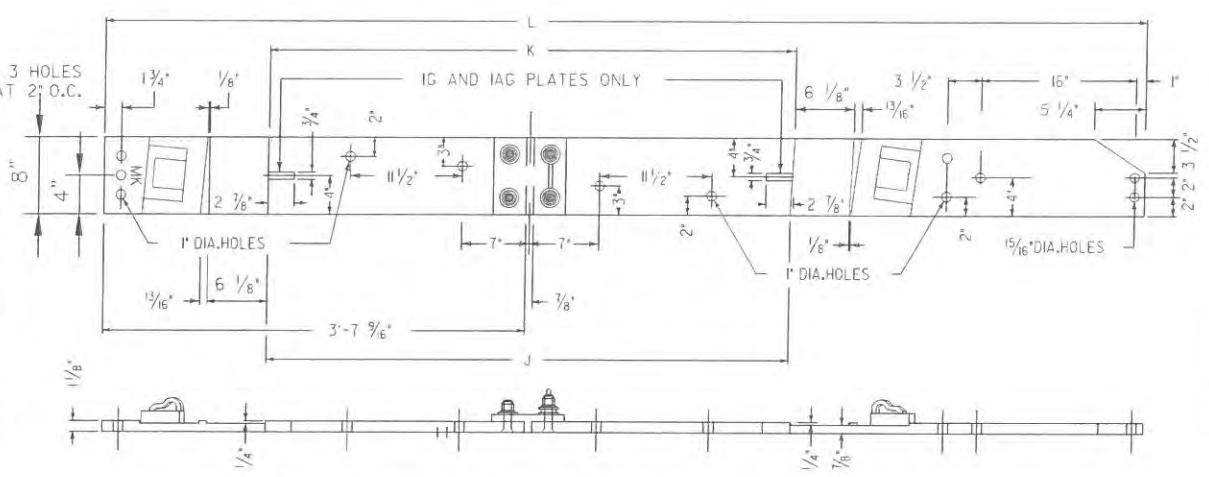
CFRC CHIEF OPERATING OFFICER

PREPARED BY: RMW ISSUED: 9/9/2015 REVISED: 4/2/2015

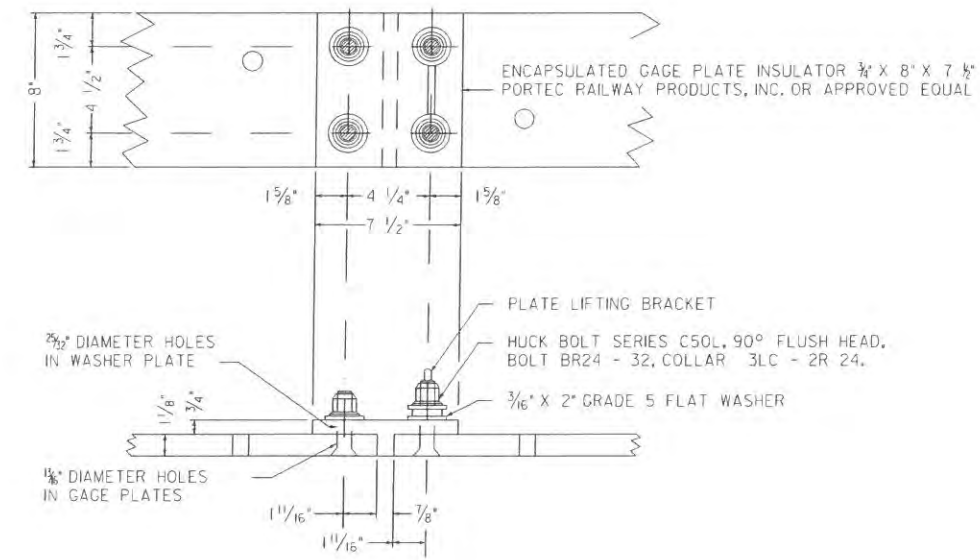
MILLED SEAT CORNERS TO HAVE 1/16" RADIUS



GAGE PLATE NUMBERS OG, GR, GL, IGR, IGL, IAGR, IAGL, IBGR, IBGL WITH PANDROL STYLE BRACES



GAGE PLATE NUMBERS IGR, IGL, IAGR, IAGL FOR MACHINE OPERATED SWITCH



GAGE PLATE INSULATION DETAIL

- PUT BENT STOCK RAIL PLATE IN PROPER LOCATION.
- SET GAGE SIDE RAIL SHOULDERS TO DISTANCES GIVEN IN CFRC STANDARD DRAWINGS.
- CHECK GAP BETWEEN PLATES, GAP OF 1/8" +/- 1/16".
- MARK AND DRILL HOLES FOR WASHER PLATE.
- REMOVE SHARP EDGES AND BURRS.
- SILICON SEALER TO BE GE IS808 TRANSLUCENT SEALER OR EQUIVALENT. CLEAN PLATES PER MANUFACTURER'S INSTRUCTIONS AFTER DRILLING AND PRIOR TO BOLTING INSULATOR TO PLATES.

ALL 26'-0" SWITCHES USE 4 GAGE PLATES.
 THE OG PLATE IS FOR THE TIE AHEAD OF THE POINT.
 THE IG PLATE IS FOR THE TIE AT THE POINT.
 THE IAG PLATE IS FOR THE TIE AFTER THE IG PLATE.
 THE IBG PLATE IS FOR THE TIE AFTER THE IAG PLATE.

THE OG PLATE HAS BOTH RAIL SEATS SQUARE TO THE PLATE AND CAN BE USED FOR EITHER RIGHT OR LEFT HAND TURNOUTS.

THE IG, IAG, AND IBG PLATES HAVE THE RAIL SEAT FOR THE BENT STOCK RAIL MILLED AT AN ANGLE TO THE PLATE AND CAN BE USED ONLY FOR THE HAND OF TURNOUT FOR WHICH THE RAIL SEAT WAS MILLED.
 FOR RIGHT HAND TURNOUTS, USE PLATES MARKED: IGR, IAGR, AND IBGR.
 FOR LEFT HAND TURNOUTS, USE PLATES MARKED: IGL, AGL, AND IBGL.

MACHINE OPERATED SWITCHES, USE PLATES THAT ARE MADE WITH AN EXTENSION WHICH CONNECTS TO THE SWITCH MACHINE.
 FOR RIGHT HAND TURNOUTS, USE PLATES MARKED: IGR, AND IAGR.
 FOR LEFT HAND TURNOUTS, USE PLATES MARKED: IGL, AND IAGL.

ALL GAGE PLATES WILL BE DEEPLY STAMPED IN 1/2" HIGH CHARACTERS TO INDICATE CFRC, MANUFACTURER, 26'-0", 136 RE, AND THE PLATE NUMBER AS DESCRIBED ABOVE.

PERMISSIBLE VARIATION OF RISER ELEVATION FROM DESIGN ELEVATION IS PLUS 1/32", MINUS 0".

RAIL SEATS ARE TO BE FLAT WITHIN 1/64".
 RAIL SEATS TO BE ON PARALLEL PLANES.
 MILLED SEAT CORNERS TO HAVE 1/16" RADIUS

GAGE PLATES FOR USE WITH PANDROL RAIL FASTENERS MUST MEET PANDROL DESIGN STANDARDS.

GAGE PLATES FOR USE WITH OTHER STYLE RAIL BRACES MUST MEET THAT MANUFACTURER'S STANDARDS.

SPIKE HOLES TO BE 1" DIAMETER FOR USE WITH 1 5/16" DIAMETER BY 6 1/2" LONG SCREW SPIKES.

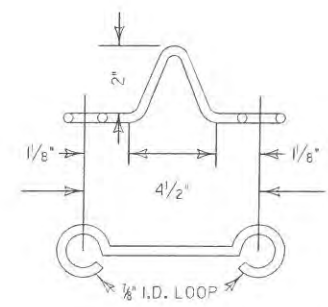
HOLES DESIGNED TO SPIKE THE SWITCH POINT IN THE CLOSED ON PLATES IG AND IAG TO BE AS SHOWN ON PLANS.

PLATES ARE DRAWN FOR RIGHT HAND TURNOUTS.

MANUFACTURER SHALL VERIFY ALL DIMENSIONS BEFORE FABRICATION.

SWITCH SHOWS ADJUSTABLE BOLTLESS BRACES. PREFERRED SWITCH BRACE IS PRS CLAMPTITE.

26'-0" CURVED SWITCHES 136RE RAIL			
PLATE NUMBER	LENGTH L	J	K
OG	7'- 3 5/16"	4'- 5 3/8"	4'- 5 3/8"
IGR	7'- 3 3/4"	4'- 5 9/16"	4'- 5 1/16"
IGL	7'- 3 3/4"	4'- 5 9/16"	4'- 5 1/16"
IGRE	8'- 11 3/16"	4'- 5 9/16"	4'- 5 1/16"
IGLE	8'- 11 3/16"	4'- 5 9/16"	4'- 5 1/16"
IAGR	7'- 3 3/4"	4'- 5 1/8"	4'- 5 3/4"
IAGL	7'- 3 3/4"	4'- 5 1/8"	4'- 5 3/4"
IAGRE	8'- 11 3/16"	4'- 5 1/8"	4'- 5 3/4"
IAGLE	8'- 11 3/16"	4'- 5 1/8"	4'- 5 3/4"
IBGR	7'- 4 1/2"	4'- 6 1/32"	4'- 6 3/32"
IBGL	7'- 4 1/2"	4'- 6 1/32"	4'- 6 3/32"



DETAIL FOR LIFTING HOOK

- INSTALL PER LOCATION SHOWN ON GAGE PLATE DRAWINGS.
- 1/2" ROUND OR 1/2" SQUARE MILD STEEL.
- USE (2) CUT FLAT WASHERS ARE TO BE FURNISHED. INSTALL LIFTING BRACKET AND OTHER COMPONENTS IN THE FOLLOWING ORDER: (INSUL / WASHER / HOOK / WASHER / COLLAR



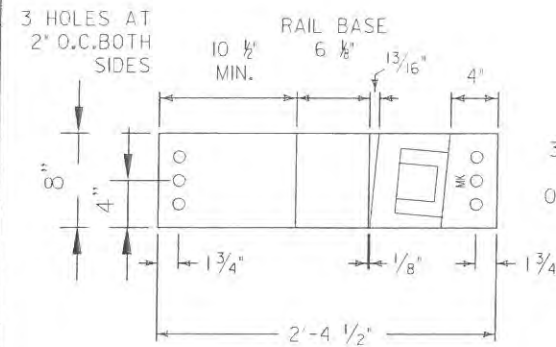
GAGE PLATES FOR 26'-0" SWITCH WITH 136RE RAIL

Miguel Torres
 APPROVED - MIGUEL TORRES

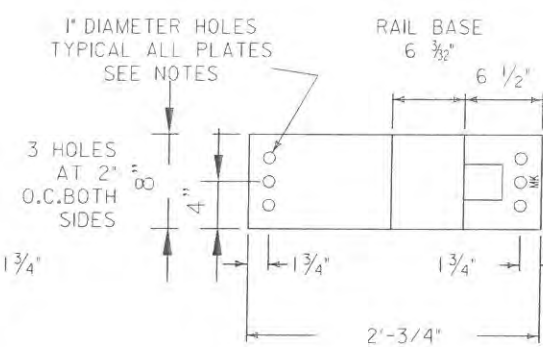
CFRC CHIEF OPERATING OFFICER

MILLED SEAT CORNERS TO HAVE 1/16" RADIUS.

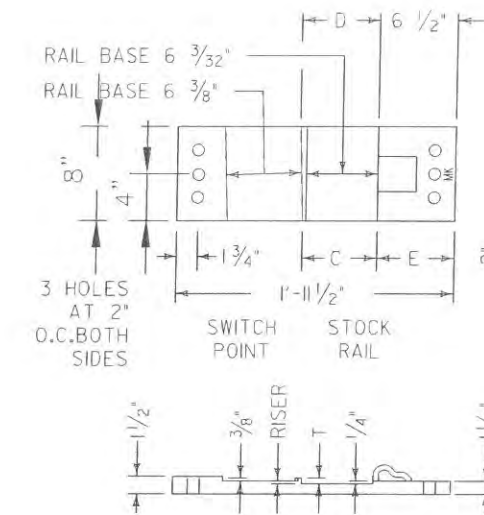
TURNOUT PLATES FOR 26'-0" SWITCHES WITH I36 RE RAIL						
WITH RAIL BASE ELEVATION RUNOFF						
PLATE NO.	L	C	D	E	T	RISER ELEV.
3	23 1/2"	6 3/8"	6 5/8"	6 1/2"	1/2"	1/4"
4	26 1/2"	6 15/16"	7 3/16"	6 1/2"	15/32"	7/32"
5	27 1/2"	7 1/2"	7 3/4"	6 1/2"	7/16"	3/16"
6	28 1/4"	8 1/8"	8 3/8"	6 1/2"	13/32"	5/32"
7	28 3/4"	8 3/4"	9"	6 1/2"	3/8"	1/8"
8	29 1/2"	9 3/8"	9 5/8"	6 9/16"	11/32"	3/32"
9	30"	10"	10 1/4"	6 9/16"	5/16"	1/16"
10	30 3/4"	10 11/16"	10 15/16"	6 9/16"	9/32"	1/32"
WITHOUT RAIL BASE ELEVATION RUNOFF						
11	31 1/2"	11 3/8"	11 5/8"	6 5/8"		
12	32 1/4"	12 1/16"	12 5/16"	6 5/8"		
13	33"	12 13/16"	13 1/16"	6 5/8"		
14	33 3/4"	13 9/16"	13 7/8"	6 21/32"		
15	34 1/2"	14 5/16"	14 5/8"	6 21/32"		
16	35 1/4"	15 1/16"	15 3/8"	6 21/32"		
17	36"	15 15/16"	16 3/16"	6 21/32"		



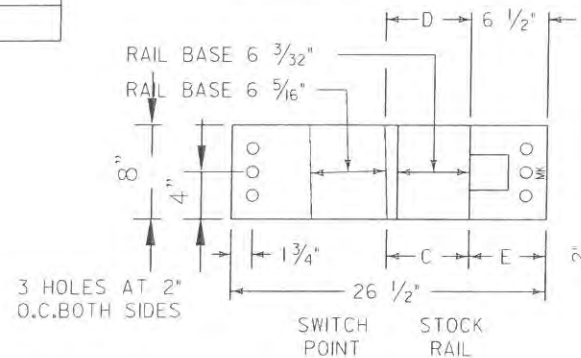
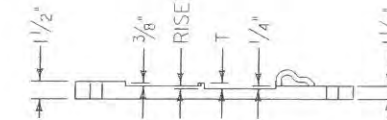
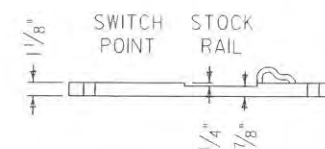
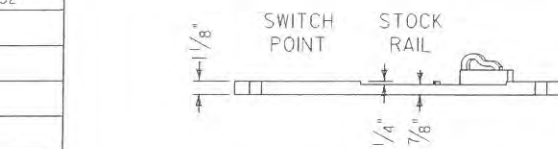
BRACE PLATE NO. 1



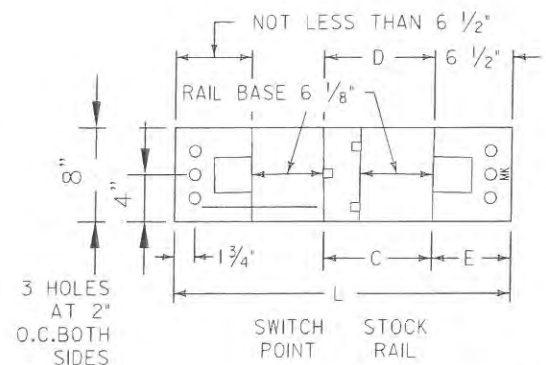
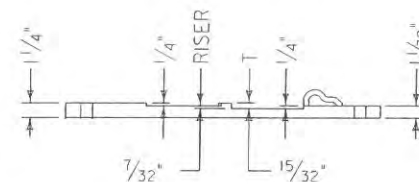
SHOULDER SLIDE AND HEEL PLATES NO. 1P AND 2



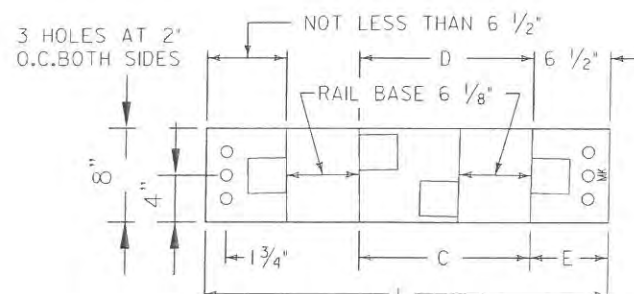
HEEL PLATE NO. 3



TURNOUT PLATE PLATE NO. 4



TURNOUT PLATES PLATES NO. 5 THRU 10



TURNOUT PLATES PLATES NO. 11 THRU 17

SWITCH AND TURNOUT PLATES ARE DESIGNED TO USE PANDROL RAIL FASTENERS, SHOULDERS AND BOLTLESS ADJUSTABLE RAIL BRACES. PREFERRED SWITCH BRACE IS PRS CLAMPTITE. ALTERNATE IS BETHLEHEM BOLTLESS. FASTENERS, SHOULDERS AND BRACES MUST MEET MANUFACTURERS DESIGN STANDARDS OR APPROVED ALTERNATE.

MANUFACTURER SHALL VERIFY ALL DIMENSIONS BEFORE FABRICATION.

ALL SWITCH AND TURNOUT PLATES WILL BE DEEPLY STAMPED IN 1/8" CHARACTERS TO INDICATE CFRC, MANUFACTURER, SWITCH LENGTH, RAIL SECTION AND PLATE NUMBER. PLATES NUMBERED 3 THRU 10 WILL ALSO BE MARKED RIGHT OR LEFT HAND. MARK LOCATION SHOWN AS "MK".

PLATE MARKINGS 1 THRU 10 WILL BE LOCATED ON THE END OF THE PLATE ON THE FIELD SIDE. PLATE MARKINGS 11 THRU 17 WILL BE LOCATED ON THE END OF THE PLATE.

SPIKE HOLES TO BE 1" DIAMETER FOR USE WITH 5/8" DIAMETER BY 6 1/2" LONG SCREW SPIKES EXCEPT RAIL BASE CONTACT HOLES WILL BE 3/4" BY 1/8" WITH 1/8" UNDER BASE OF RAIL.

OMIT SPIKE HOLES BETWEEN RAIL BASES ON PLATE NO.4.

PERMISSIBLE VARIATION OF RISER ELEVATION FROM DESIGN ELEVATION OF ALL BRACE, SLIDE, HEEL AND NUMBERED 1, 1P, 2 AND 3 IS PLUS 1/2", MINUS 0".

PERMISSIBLE VARIATION OF RISER ELEVATION FROM DESIGN ELEVATION OF TURNOUT PLATES NUMBERED 4 THRU 17 IS PLUS OR MINUS 1/64".

RAIL SEATS ARE TO BE FLAT WITHIN 1/64".

RAIL SEATS TO BE ON PARALLEL PLANES.

MILLED SEAT CORNERS TO HAVE 1/16" RADIUS.

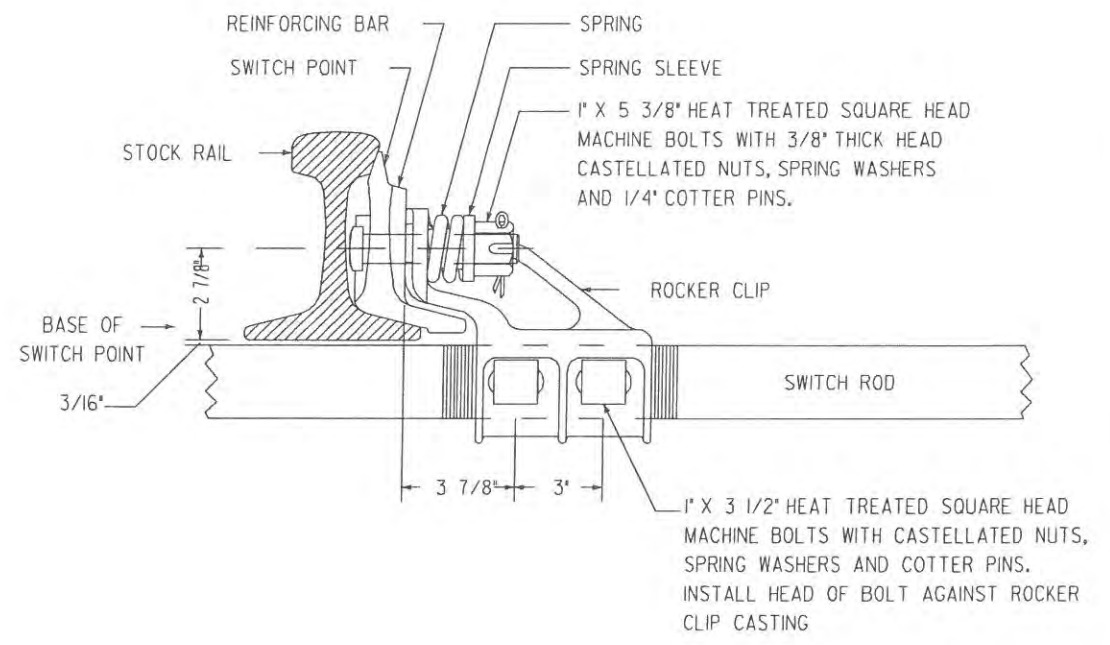
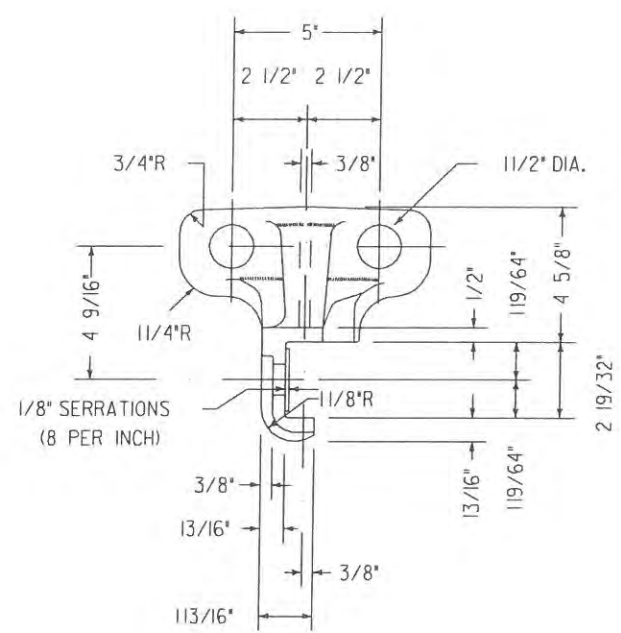
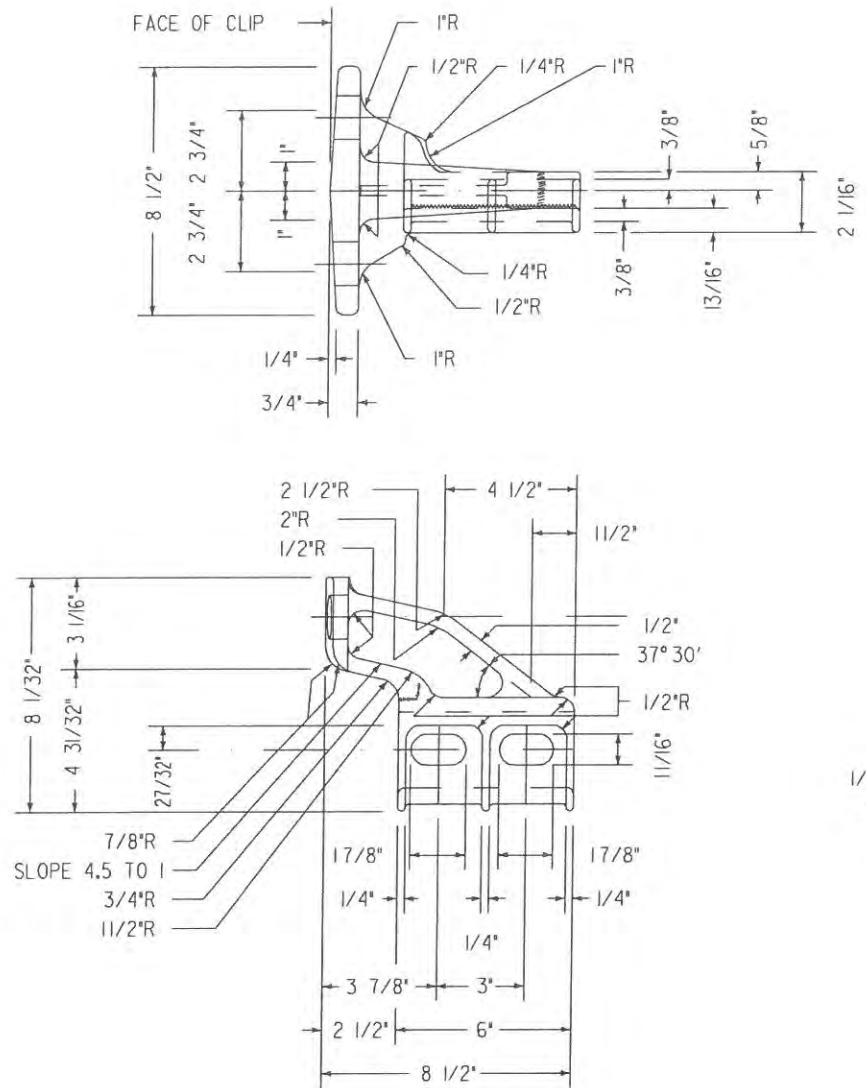


Central Florida Rail Corridor
SWITCH AND TURNOUT PLATES
FOR 26'-0" SWITCHES WITH
UNIFORM RISERS FOR I36RE

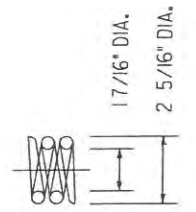
Miguel Torres

APPROVED - MIGUEL TORRES

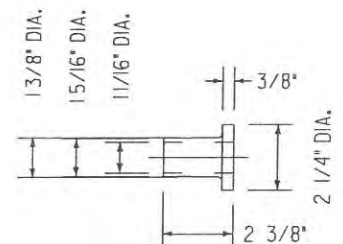
CFRC CHIEF OPERATING OFFICER



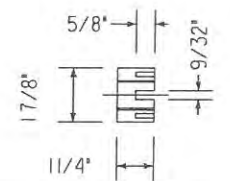
ORDERING INFORMATION:
CLIP ROCKER ADJUSTABLE FOR
SWITCH RODS CFRC DWG 2325



OPEN END, GROUND,
COMPRESSION SPRING
7/16" DIA. WIRE
FREE LENGTH 1-1/4"
(1/4" SPACE BETWEEN COILS)
ASTM A 229 CLASS I



MALLEABLE IRON
SPRING SLEEVE



CASTELLATED HEX NUT
FOR 1" BOLT

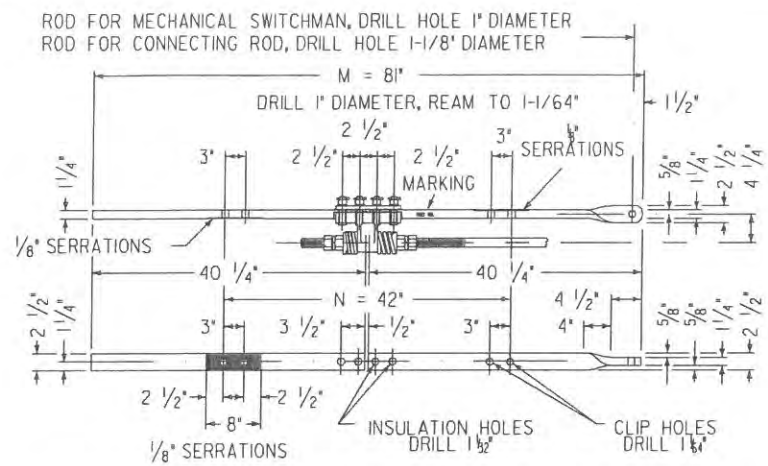


ADJUSTABLE ROCKER CLIP

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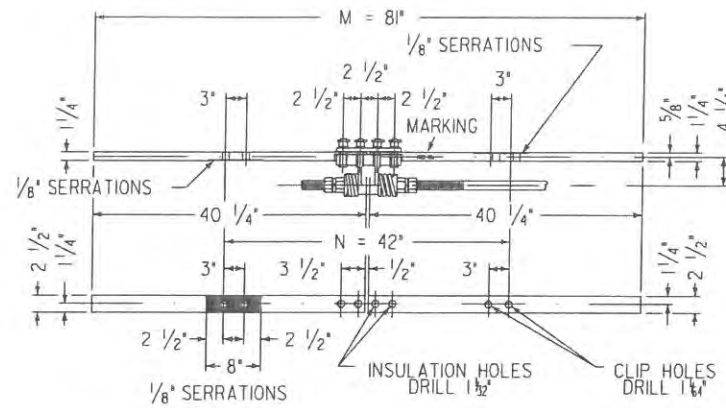
PREPARED BY: RMW ISSUED: 9/9/2015 REVISED: 4/2/2015



ROD FOR MECHANICAL SWITCHMAN, DRILL HOLE 1" DIAMETER
 ROD FOR CONNECTING ROD, DRILL HOLE 1-1/8" DIAMETER

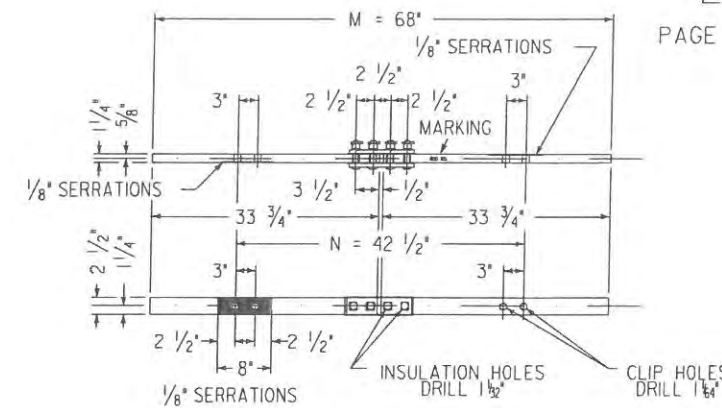
NUMBER 1V R 16'-6" SWITCH ROD TO BE EQUIPPED WITH ABC RAIL COMPANY BRACKET PER DRAWING NUMBER SRI-53 OR EQUAL APPROVED BY THE SIGNAL DEPARTMENT.

INSULATED VERTICAL SWITCH ROD NUMBER 1V R, 16'-6"
 (RIGHT HAND SHOWN)

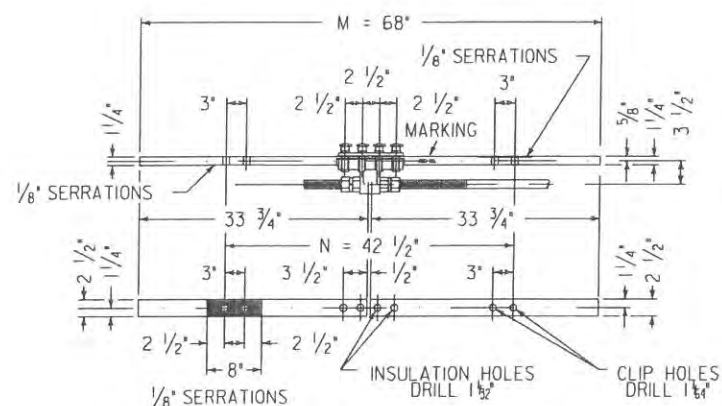


NUMBER 1V R SWITCH ROD TO BE EQUIPPED WITH ABC RAIL COMPANY BRACKET PER DRAWING NUMBER SRI-53 OR EQUAL APPROVED BY THE SIGNAL DEPARTMENT.

INSULATED VERTICAL SWITCH ROD NUMBER 1V R

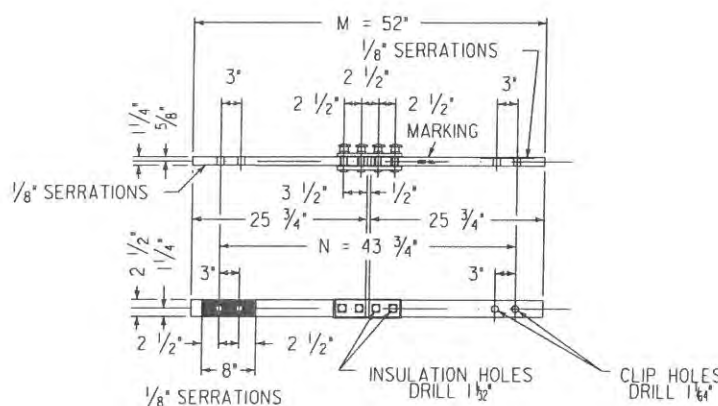


INSULATED VERTICAL SWITCH ROD NUMBER 2V R

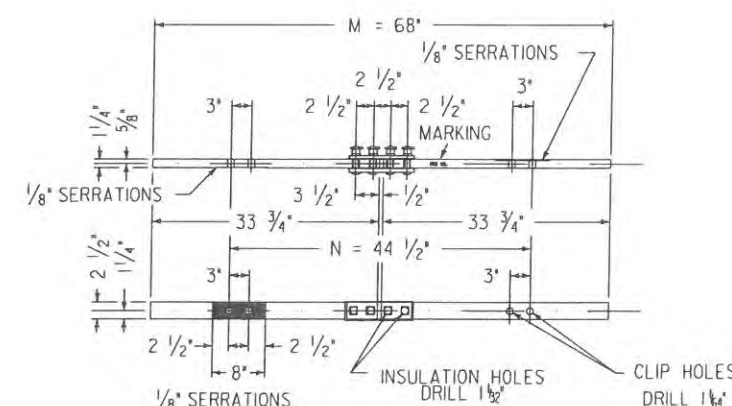


NUMBER 2V R 39'-0" SWITCH ROD TO BE EQUIPPED WITH ABC RAIL COMPANY BRACKET PER DRAWING NUMBER SRI-17 OR EQUAL APPROVED BY THE SIGNAL DEPARTMENT.

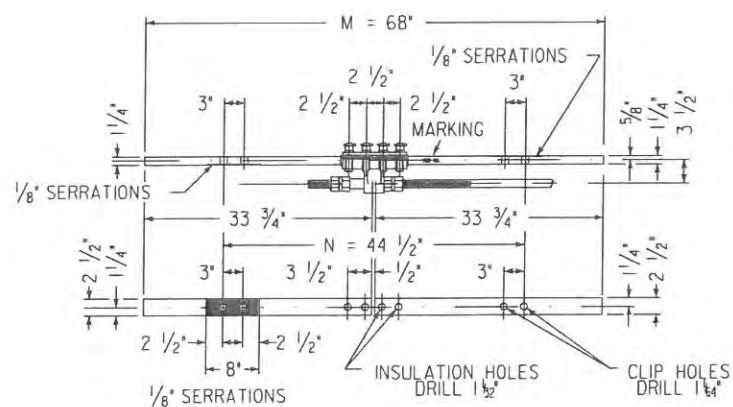
INSULATED VERTICAL SWITCH ROD NUMBER 2V R, 39'-0"



INSULATED VERTICAL SWITCH RODS NUMBERS 3, 4 V R

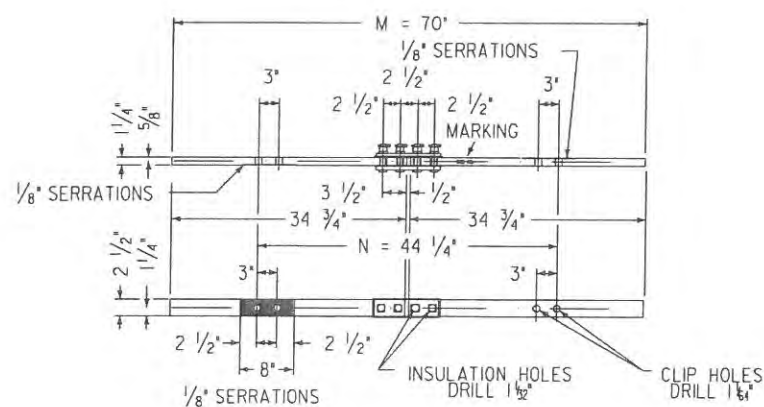


INSULATED VERTICAL SWITCH ROD NUMBER 5V R, 26'-0"



NUMBER 5V R 39'-0" SWITCH ROD TO BE EQUIPPED WITH ABC RAIL COMPANY BRACKET PER DRAWING NUMBER SRI-17 OR EQUAL APPROVED BY THE SIGNAL DEPARTMENT.

INSULATED VERTICAL SWITCH ROD NUMBER 5V R, 39'-0"



INSULATED VERTICAL SWITCH ROD NUMBER 6V R, 39'-0"



Central Florida Rail Corridor

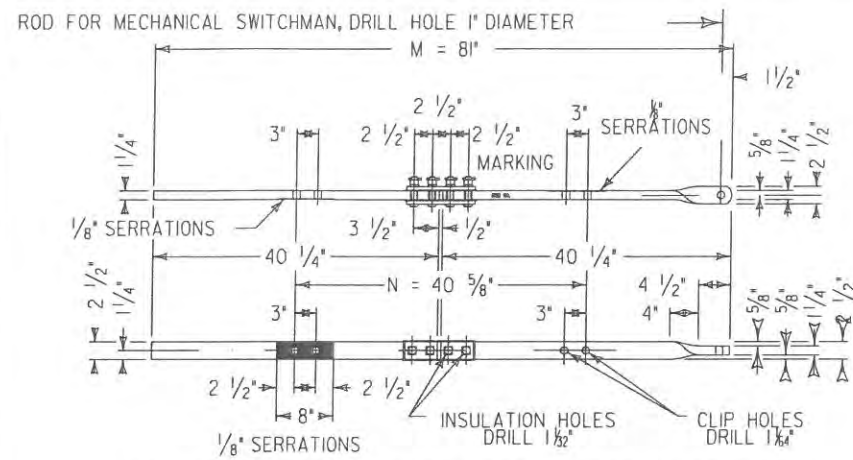
SWITCH RODS FOR USE WITH ROCKER CLIPS

Miguel Torres

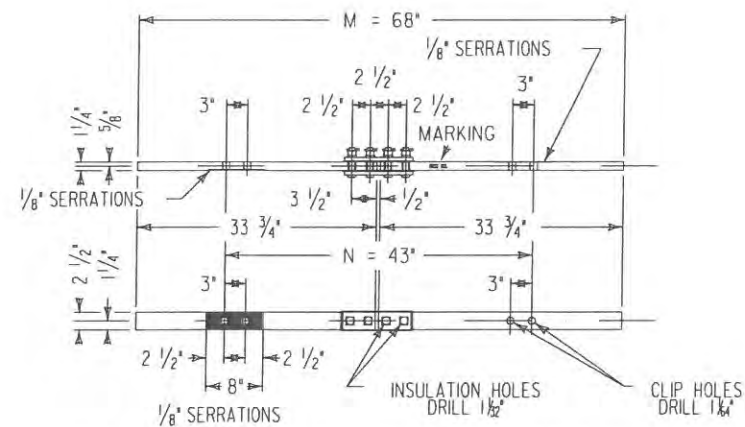
APPROVED - MIGUEL TORRES

CFRC CHIEF OPERATING OFFICER

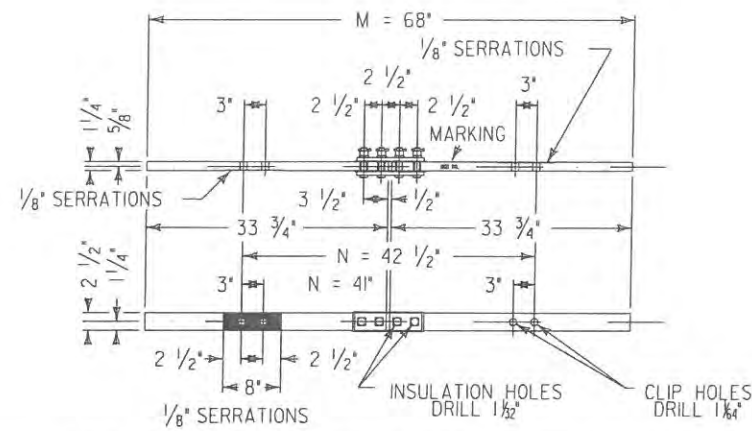
PREPARED BY: RMW ISSUED: 9/9/2015 REVISED: 4/2/2015



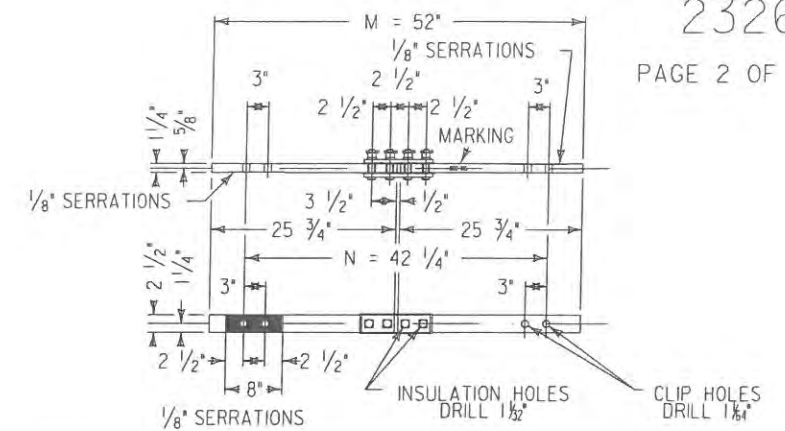
INSULATED VERTICAL SWITCH ROD NUMBER 1V SS R



INSULATED VERTICAL SWITCH ROD NUMBER 2V SS R



INSULATED VERTICAL SWITCH ROD NUMBER 3V SS R



INSULATED VERTICAL SWITCH RODS NUMBERS 3, 4V SS R

SWITCH RODS - 16'-6" SPRING SWITCH - ROCKER CLIPS					
ROD NO.	M	INITIAL SETTING	N	MARKING	CLASS
ISS	6'-9"	4'-0 3/8"	3'-4 5/8"	CFRC NO 1SS L	SET OF 3 WITH CLIPS LH
2SS	5'-8"	4'-1"	3'-5"	CFRC NO 2SS L	
3SS	4'-4"	4'-2 5/8"	3'-6 1/4"	CFRC NO 3 4 SS L	
ISS	6'-9"	4'-0 3/8"	3'-4 5/8"	CFRC NO 1SS R	SET OF 3 WITH CLIPS RH
2SS	5'-8"	4'-1"	3'-5"	CFRC NO 2SS R	
3SS	4'-4"	4'-2 5/8"	3'-6 1/4"	CFRC NO 3 4 SS R	
SWITCH RODS - 26'-0" SPRING SWITCH - ROCKER CLIPS					
ROD NO.	M	INITIAL SETTING	N	MARKING	CLASS
ISS	6'-9"	4'-0 1/8"	3'-4 5/8"	CFRC NO 1SS R	SET OF 5 WITH CLIPS
2SS	5'-8"	4'-0 5/8"	3'-5"	CFRC NO 2SS R	
3SS	4'-4"	4'-1 3/8"	3'-6 1/4"	CFRC NO 3 4 SS R	
4SS	4'-4"	4'-2 11/16"	3'-6 1/4"	CFRC NO 3 4 SS R	
5SS	5'-8"	4'-2 11/16"	3'-7"	CFRC NO 5SS R	
SWITCH RODS - 30'-0" SPRING SWITCHES - ROCKER CLIPS					
ROD NO.	M	INITIAL SETTING	N	MARKING	CLASS
ISS	6'-9"	4'-0 5/8"	3'-4 5/8"	CFRC NO 1SS R	SET OF 4 WITH CLIPS
2SS	5'-8"	4'-0 7/8"	3'-5"	CFRC NO 2SS R	
3SS	4'-4"	4'-1 3/16"	3'-6 1/4"	CFRC NO 3 4 SS R	
4SS	4'-4"	4'-2 1/2"	3'-6 1/4"	CFRC NO 3 4 SS R	

SWITCH RODS - 16'-6" SWITCH - ROCKER CLIPS					
ROD NO.	M	INITIAL SETTING	N	MARKING	CLASS
IV	6'-9"	4'-1 1/8"	3'-6"	CFRC NO 1V R 16'-6"	SET OF 3 WITH CLIPS AND BASKET LH
IV	6'-9"	4'-1 1/8"	3'-6"	CFRC NO 1V R 16'-6"	
2V	5'-8"	4'-2 1/2"	3'-6 1/2"	CFRC NO 2 V R	
3V	4'-4"	4'-4 1/8"	3'-7 3/4"	CFRC NO 3 4 V R	SET OF 5 WITH CLIPS AND BASKET
IV	6'-9"	4'-1 7/8"	3'-6"	CFRC NO 1V R 16'-6"	
IV	6'-9"	4'-1 7/8"	3'-6"	CFRC NO 1V R 16'-6"	
2V	5'-8"	4'-2 1/2"	3'-6 1/2"	CFRC NO 2 V R	SET OF 4 WITH CLIPS AND BASKET
3V	4'-4"	4'-4 1/8"	3'-7 3/4"	CFRC NO 3 4 V R	
5V	5'-8"	4'-4 3/16"	3'-8 1/2"	CFRC NO 5 V R 26'-0"	
SWITCH RODS - 30'-0" SWITCH - ROCKER CLIPS					
ROD NO.	M	INITIAL SETTING	N	MARKING	CLASS
IV	6'-9"	4'-2 1/8"	3'-6"	CFRC NO 1V R	SET OF 6 WITH CLIPS AND BASKETS
2V	5'-8"	4'-2 3/8"	3'-6 1/2"	CFRC NO 2 V R	
3V	4'-4"	4'-3 1/16"	3'-7 3/4"	CFRC NO 3 4 V R	
4V	4'-4"	4'-4"	3'-7 3/4"	CFRC NO 3 4 V R	
SWITCH RODS - 39'-0" SWITCH - ROCKER CLIPS					
ROD NO.	M	INITIAL SETTING	N	MARKING	CLASS
IV	6'-9"	4'-2"	3'-6"	CFRC NO 1V R	SET OF 6 WITH CLIPS AND BASKETS
2V	5'-8"	4'-2 1/4"	3'-6 1/2"	CFRC NO 2 V R 39'-0"	
3V	4'-4"	4'-2 7/8"	3'-7 3/4"	CFRC NO 3 4 V R	
4V	4'-4"	4'-3 3/4"	3'-7 3/4"	CFRC NO 3 4 V R	
5V	5'-8"	4'-4 1/2"	3'-8 1/2"	CFRC NO 5 V R 39'-0"	
6V	5'-10"	4'-4 1/4"	3'-8 1/4"	CFRC NO 6 V R 39'-0"	

SWITCH ROD MARKING

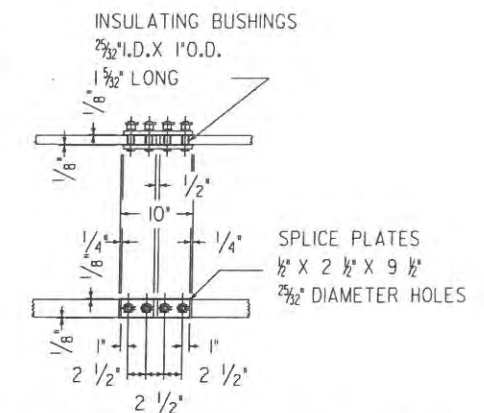
SWITCH RODS SHALL BE DEEPLY STAMPED IN 1/2" CHARACTERS TO INDICATE ROD NUMBER, V FOR VERTICAL ROD, R FOR ROCKER CLIP, SWITCH LENGTH IF REQUIRED, AND MANUFACTURER AT THE LOCATION SHOWN ON DRAWING.

NOTES

SWITCH ROD ADJUSTMENT

THE 'INITIAL SETTING' COLUMN IN THE TABLE OF DIMENSIONS IS THE NORMAL BACK TO BACK OF 'D' BARS DISTANCE FOR A THROW OF 4 3/4". THIS DISTANCE IS APPROXIMATE AS TOLERANCES ALLOWED IN THE ROLLING OF RAIL AND IN THE MANUFACTURE OF SWITCH POINTS MAY CREATE VARIATIONS IN THE SWITCH POINT. THIS REQUIRES THAT EACH SWITCH POINT MUST BE ADJUSTED IN THE FIELD FOR THE BEST FIT. USE THE DIMENSIONS GIVEN IN THE TABLE FOR THE INITIAL POSITIONING OF THE SWITCH POINTS AND ADJUST FOR PROPER FIT AGAINST BOTH STOCK RAILS FOR THE FULL LENGTH OF THE SIDE PLANNING AND FOR THE PROPER THROW OF SWITCH.

INSULATION TO BE PLACED IN CENTER OF SWITCH RODS. (REF. AREMA DETAIL 3001) INSULATION PER SIGNAL SECTION SPECIFICATIONS.
3/4" X 4 1/2" BOLTS WITH A.S.A. REG. SQ. HEADS, A.S.A. HEAVY SQ. NUTS, SPRING WASHERS, AND 1/4" COTTERS.



INSULATION DETAILS FOR SWITCH RODS

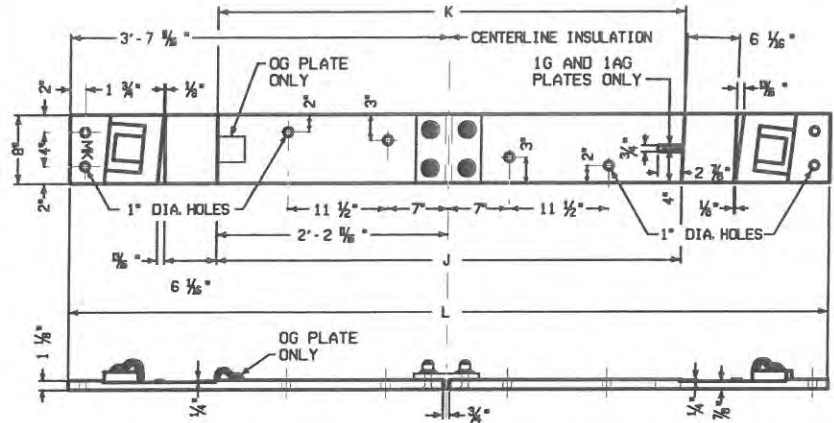


SWITCH RODS FOR USE WITH ROCKER CLIPS

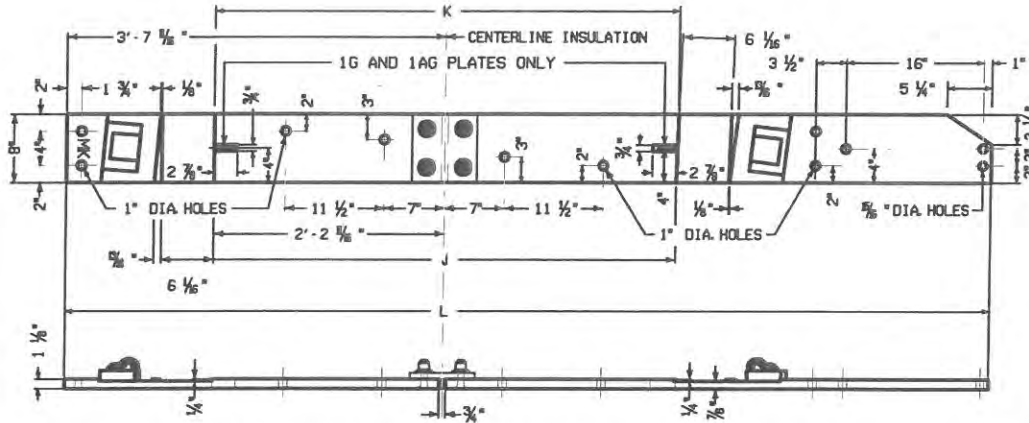
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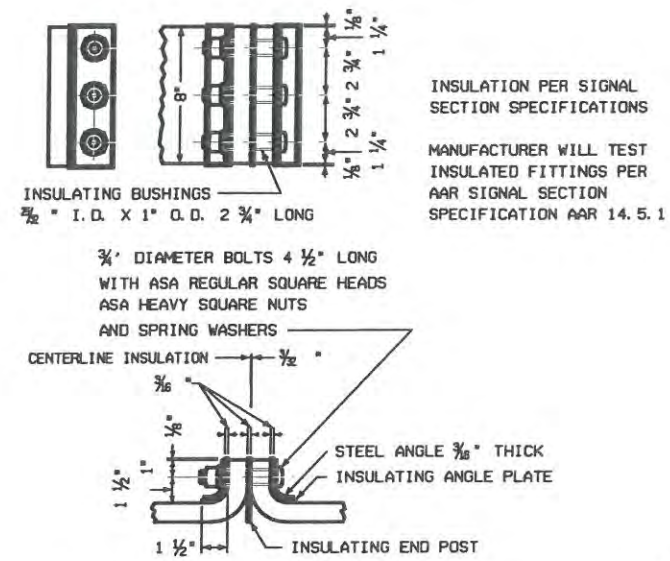
CFRC CHIEF OPERATING OFFICER



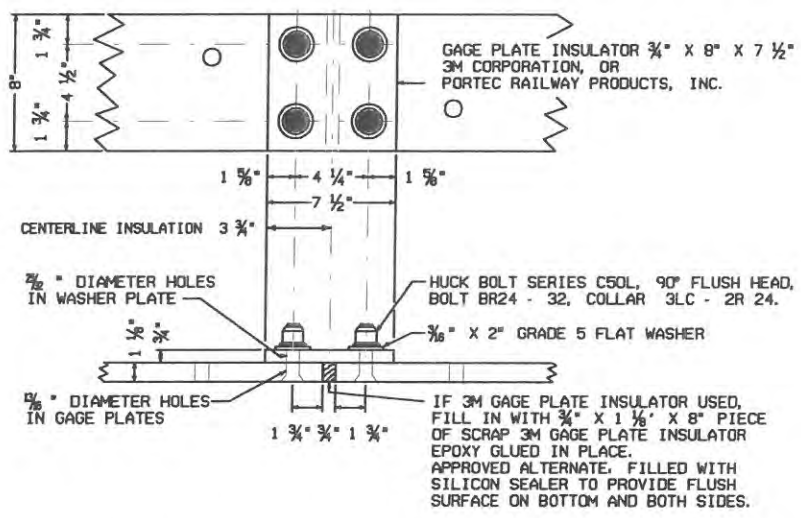
GAGE PLATE NUMBERS OG, 1GR, 1GL, 1AGR, 1AGL WITH PANDROL STYLE BRACES



GAGE PLATE NUMBERS 1GRE, 1GLE, 1AGRE, 1AGLE WITH PANDROL STYLE BRACES



ALTERNATE GAGE PLATE INSULATION AREMA DETAIL 4103



- PUT STRAIGHT STOCK RAIL PLATE IN PROPER LOCATION.
- MARK AND DRILL HOLES FOR WASHER PLATE.
- PUT BENT STOCK RAIL PLATE IN PROPER LOCATION.
- REMOVE SHARP EDGES AND BURRS.
- SET GAGE SIDE RAIL SHOULDERS TO DISTANCES GIVEN IN TABLE ON THIS DRAWING.
- SILICON SEALER TO BE GE IS808 TRANSLUCENT SEALER OR EQUIVALENT. CLEAN PLATES PER MANUFACTURER'S INSTRUCTIONS AFTER DRILLING AND PRIOR TO BOLTING INSULATOR TO PLATES.
- CHECK GAP BETWEEN PLATES, GAP OF $\frac{3}{8}$ " \pm $\frac{1}{16}$ ".

GAGE PLATE INSTALLATION

16'-6" SWITCHES			
136RE RAIL			
PLATE NUMBER	LENGTH L	J	K
OG	7'- 3 $\frac{5}{16}$ "	4'- 5 $\frac{3}{16}$ "	4'- 5 $\frac{3}{16}$ "
1GR	7'- 3 $\frac{3}{4}$ "	4'- 5 $\frac{3}{16}$ "	4'- 5 $\frac{3}{16}$ "
1GL	7'- 3 $\frac{3}{4}$ "	4'- 5 $\frac{3}{16}$ "	4'- 5 $\frac{3}{16}$ "
1GRE	8'- 11 $\frac{3}{16}$ "	4'- 5 $\frac{3}{16}$ "	4'- 5 $\frac{3}{16}$ "
1GLE	8'- 11 $\frac{3}{16}$ "	4'- 5 $\frac{3}{16}$ "	4'- 5 $\frac{3}{16}$ "
1AGR	7'- 3 $\frac{3}{4}$ "	4'- 6 $\frac{3}{16}$ "	4'- 6 $\frac{3}{16}$ "
1AGL	7'- 3 $\frac{3}{4}$ "	4'- 6 $\frac{3}{16}$ "	4'- 6 $\frac{3}{16}$ "
1AGRE	8'- 11 $\frac{3}{16}$ "	4'- 6 $\frac{3}{16}$ "	4'- 6 $\frac{3}{16}$ "
1AGLE	8'- 11 $\frac{3}{16}$ "	4'- 6 $\frac{3}{16}$ "	4'- 6 $\frac{3}{16}$ "

ALL 16'-6" SWITCHES USE 3 GAGE PLATES.

THE OG PLATE IS FOR THE TIE AHEAD OF THE POINT. THE 1G PLATE IS FOR THE TIE AT THE POINT. THE 1AG PLATE IS FOR THE TIE AFTER THE 1G PLATE.

THE OG PLATE HAS BOTH RAIL SEATS SQUARE TO THE PLATE AND CAN BE USED FOR EITHER RIGHT OR LEFT HAND TURNOUTS.

THE 1G AND THE 1AG PLATES HAVE THE RAIL SEAT FOR THE BENT STOCK RAIL MILLED AT AN ANGLE TO THE PLATE AND CAN BE USED ONLY FOR THE HAND OF TURNOUT FOR WHICH THE RAIL SEAT WAS MILLED. FOR RIGHT HAND TURNOUTS, THE PLATES ARE MARKED 1GR AND 1AGR. FOR LEFT HAND TURNOUTS, 1GL AND 1AGL.

FOR USE WITH MACHINE OPERATED SWITCHES, PLATES ARE MADE WITH AN EXTENSION WHICH CONNECTS TO THE SWITCH MACHINE. FOR RIGHT HAND TURNOUTS, THE PLATES ARE MARKED 1GRE, AND 1AGRE. FOR LEFT HAND TURNOUTS, 1GLE, AND 1AGLE.

ALL GAGE PLATES WILL BE DEEPLY STAMPED IN $\frac{1}{2}$ " HIGH CHARACTERS TO INDICATE CSX, MANUFACTURER, 16'-6", 136RE, AND THE PLATE NUMBER DESCRIBED ABOVE.

PERMISSIBLE VARIATION OF RISER ELEVATION FROM DESIGN ELEVATION IS PLUS $\frac{1}{32}$ ", MINUS 0".

RAIL SEATS ARE TO BE FLAT WITHIN $\frac{1}{16}$ ".

RAIL SEATS TO BE ON PARALLEL PLANES.

GAGE PLATES FOR USE WITH PANDROL RAIL FASTENERS MUST MEET PANDROL DESIGN STANDARDS.

GAGE PLATES FOR USE WITH BETHLEHEM STYLE RAIL BRACES MUST MEET BETHLEHEM DESIGN STANDARDS.

ROUND SPIKE HOLES TO BE 1" DIAMETER FOR USE WITH $\frac{5}{8}$ " DIAMETER BY 6" OR 6 $\frac{1}{2}$ " LONG SCREW SPIKES.

RECTANGULAR HOLES TO SPIKE POINT CLOSED ON 1G AND 1AG PLATES TO BE AS SHOWN ON PLANS.

PLATES ARE DRAWN FOR RIGHT HAND TURNOUTS.

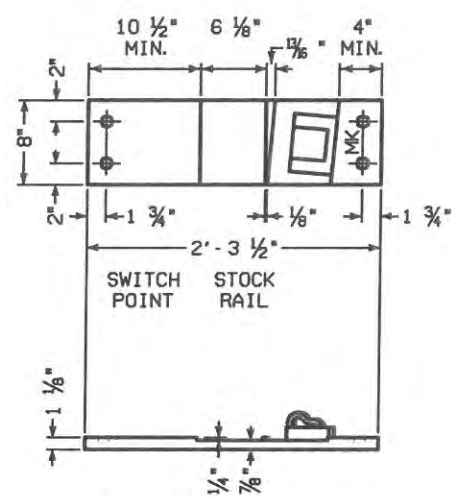
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GAGE PLATES FOR 16'-6" SWITCH FOR 136RE RAIL ONLY

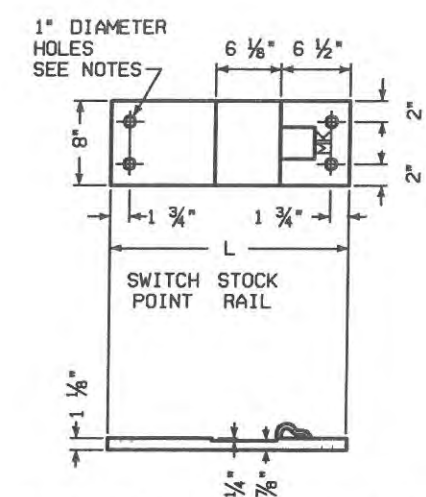
Miguel Torres
APPROVED - MIGUEL TORRES

CFRC CHIEF OPERATING OFFICER

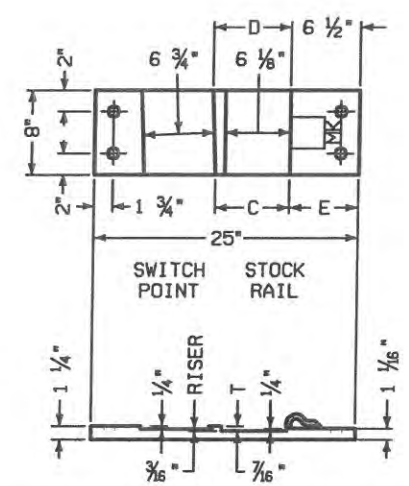
BRACE, SLIDE AND HEEL PLATES 16'-6" SWITCHES						
PLATE NUMBER	L	RAIL BASE				
1	2'- 3 1/2"	6 1/8"				
1P & 2	1'- 10 1/2"	6 1/8"				
3	2'- 0"	6 1/8"				
TURNOUT PLATES - 16'-6" SWITCH WITH RAIL BASE ELEVATION RUNOFF						
PLATE NO.	L	C	D	E	T	RISER ELEV.
4	25"	7 1/2"	7 1/2"	6 1/2"	7/16"	3/16"
5	26"	7 3/4"	8 1/16"	6 1/2"	3/8"	1/8"
6	27"	8 5/2"	8 7/2"	6 1/2"	5/16"	1/16"
WITHOUT RAIL BASE ELEVATION RUNOFF						
7	29"	9 1/2"	9 7/2"	6 7/2"		
8	30"	10 3/2"	10 7/2"	6 7/2"		
9	31"	11 1/4"	11 5/8"	6 7/2"		
10	32"	12 5/16"	12 1/16"	6 7/2"		
11	33"	13 1/2"	13 7/2"	6 7/16"		
12	34"	14 5/2"	14 7/8"	6 7/16"		
13	35 1/4"	15 1/16"	16"	6 7/16"		



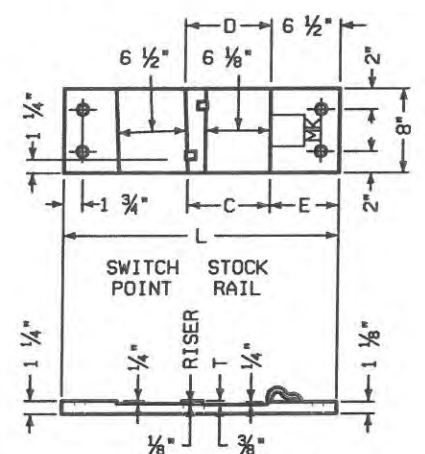
BRACE PLATE NO. 1



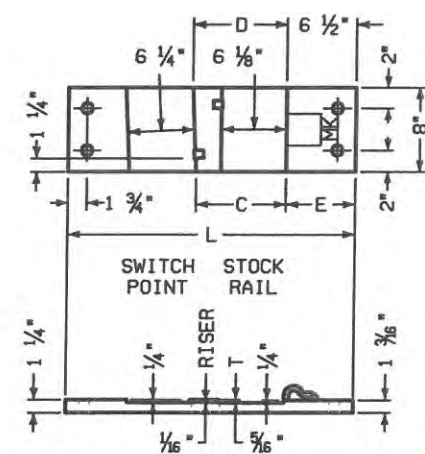
SHOULDER SLIDE AND HEEL
PLATES NO. 1P, 2, AND 3



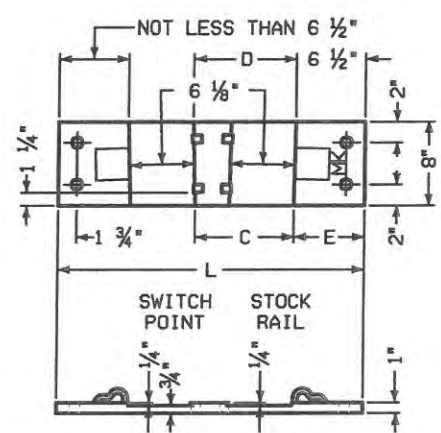
TURNOUT PLATE NO. 4



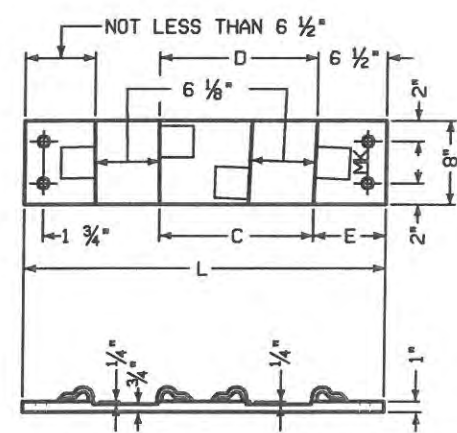
TURNOUT PLATE NO. 5



TURNOUT PLATE NO. 6



TURNOUT PLATE NO. 7



TURNOUT PLATES NO. 8 THRU 13

SWITCH AND TURNOUT PLATES ARE DESIGNED TO USE PANDROL RAIL FASTENERS. SHOULDERS AND BETHLEHEM BOLTLESS ADJUSTABLE RAIL BRACES. FASTENERS, SHOULDERS AND BRACES MUST MEET PANDROL AND BETHLEHEM DESIGN STANDARDS.

ALL SWITCH AND TURNOUT PLATES WILL BE DEEPLY STAMPED IN 1/2" CHARACTERS TO INDICATE CSX, MANUFACTURER, SWITCH LENGTH, 136RE, AND PLATE NUMBER. PLATES NUMBERED 4 THRU 6 WILL ALSO BE MARKED RIGHT OR LEFT HAND. MARK LOCATION SHOWN AS "MK".

PLATE MARKINGS 1 THRU 6 WILL BE LOCATED ON THE END OF THE PLATE ON THE FIELD SIDE. PLATE MARKINGS 7 THRU 13 WILL BE LOCATED ON THE END OF THE PLATE.

ROUND SPIKE HOLES TO BE 1" DIAMETER FOR USE WITH 5/8" DIAMETER BY 6" OR 6 1/2" LONG SCREW SPIKES. RECTANGULAR SPIKE HOLES WILL BE 3/4" BY 7/8" WITH 1/8" UNDER BASE OF RAIL.

PERMISSIBLE VARIATION OF RISER ELEVATION FROM DESIGN ELEVATION OF ALL BRACE, SLIDE, HEEL AND NUMBERED 1, 1P, 2 AND 3 IS PLUS 1/2", MINUS 0".

PERMISSIBLE VARIATION OF RISER ELEVATION FROM DESIGN ELEVATION OF TURNOUT PLATES NUMBERED 4 THRU 13 IS PLUS OR MINUS 1/4".

RAIL SEATS ARE TO BE FLAT WITHIN 1/64".

RAIL SEATS TO BE ON PARALLEL PLANES.



Central Florida Rail Corridor

SWITCH AND TURNOUT PLATES FOR 16'-6"
STRAIGHT SWITCHES WITH UNIFORM RISER:
FOR 136RE RAIL ONLY

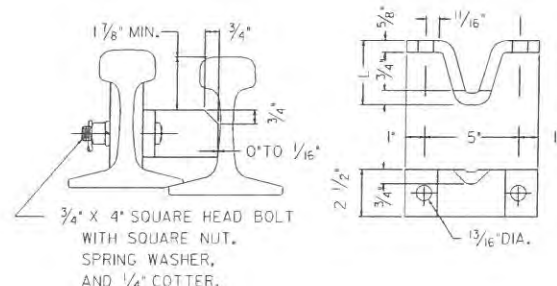
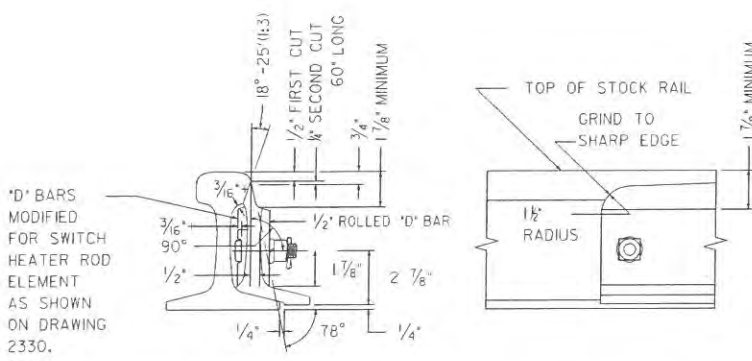
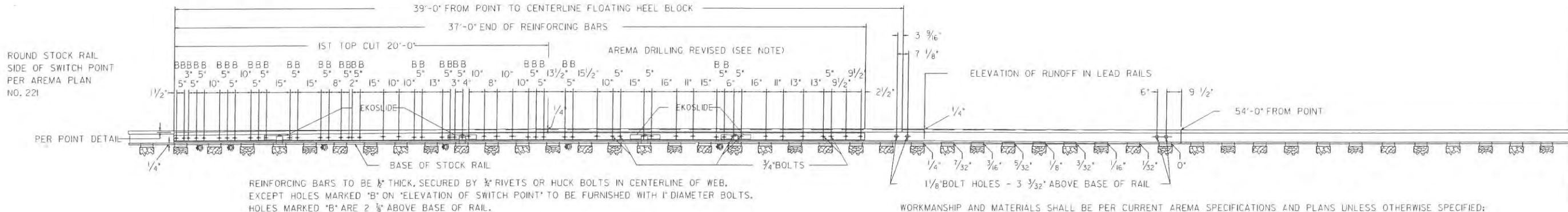
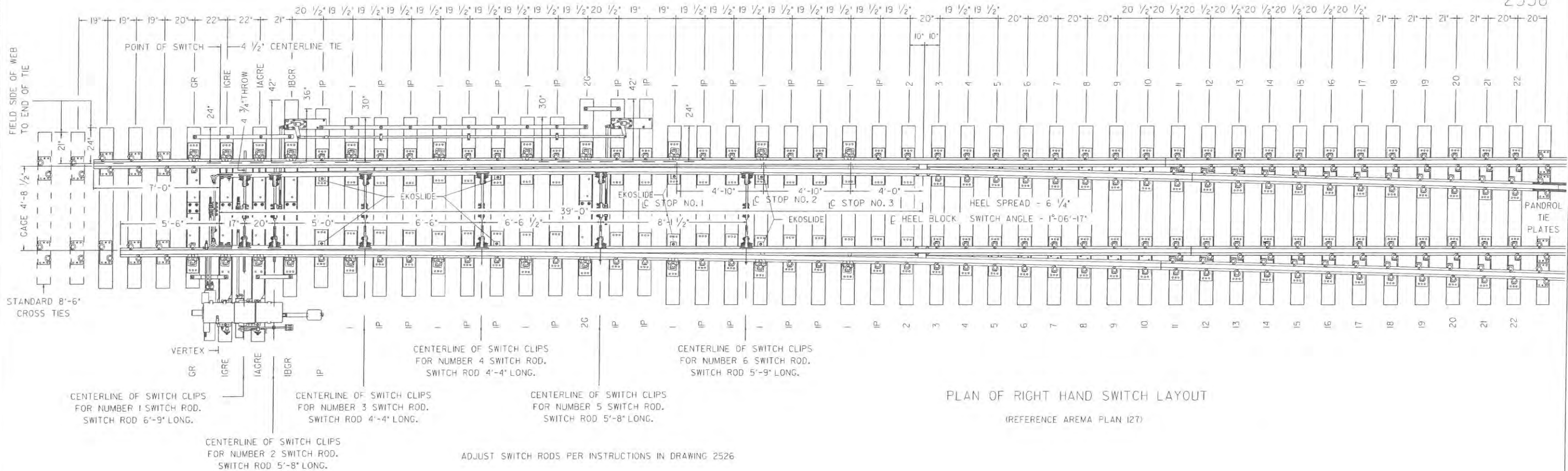
Miguel Torres

APPROVED - MIGUEL TORRES

CFRC CHIEF OPERATING OFFICER

PREPARED BY: RMW ISSUED: 9/9/2015 REVISED: 4/2/2015

5/25/12 ADDED EKOSLIDE ROLLERS
11/29/12 SWITCH POINT GAGE CORNER RESIUS TO BE 1" RATHER THAN 5/8"
11/29/12 INCLUDE FRONT ROD ASSEMBLY PER S5001 AND S5044.



WORKMANSHIP AND MATERIALS SHALL BE PER CURRENT AREMA SPECIFICATIONS AND PLANS UNLESS OTHERWISE SPECIFIED:

- 1. SWITCH POINT GAGE CORNER RESIUS TO BE 1" RATHER THAN 5/8".
- A MARKER PLATE SHALL BE PLACED ON THE GAGE SIDE OF BOTH SWITCH POINTS NEAR THE HEEL BLOCK END, IN RAISED OR DEEPLY CUT CHARACTERS, TO INDICATE: MANUFACTURER, 39'-0", UNIFORM, 136RE RAIL, AND DATE.
- SWITCH POINTS TO BE MADE FROM HEAD HARDENED RAIL 54'-0" LONG. STOCK RAILS TO BE MADE FROM HEAD HARDENED RAIL.
- STRAIGHT SIDE OF TURNOUT IS LINE SIDE FOR SWITCH TIES. NORMAL SWITCH TIE DISTANCE IS 24" FROM THE WEB OF RAIL ON THE FIELD SIDE. SWITCH TIES FOR SIGNAL EQUIPMENT ARE DIMENSIONED SEPARATELY.
- LONGITUDINAL DRILLING REVISED FROM AREMA NEAR SWITCH ROD NUMBER 5 AND FOR CONCRETE UNIVERSALITY.
- INCLUDE FRONT ROD ASSEMBLY PER S5001 AND S5044.

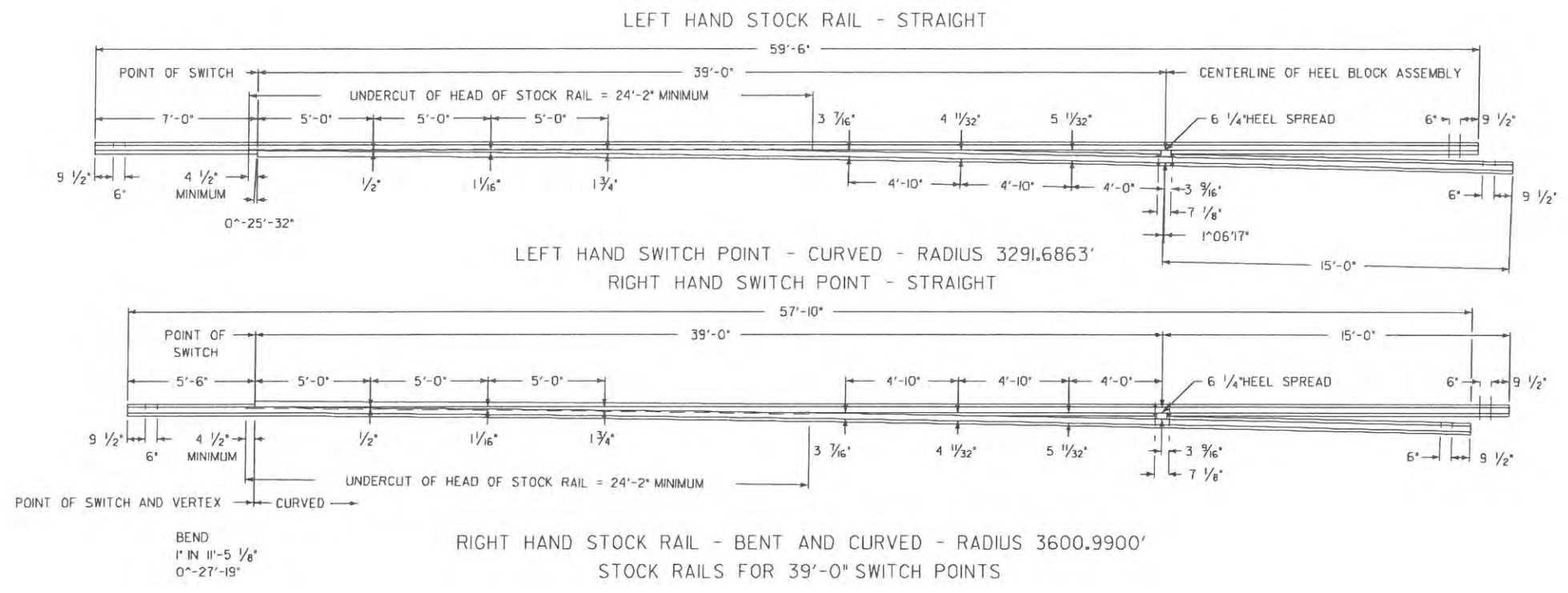
STOP LENGTH - L			
RAIL WT	STOP 1	STOP 2	STOP 3
136#	2 1/8"	3 1/2"	4 1/2"

CFRC
Central Florida Rail Corridor
39'-0" CURVED SWITCH UNIFORM RISERS,
MACHINE OPERATED FOR 136RE RAIL

Miguel Torres
APPROVED - MIGUEL TORRES

CFRC CHIEF OPERATING OFFICER

PREPARED BY: RMW ISSUED: 9/9/2015 REVISED: 4/2/2015



NOTES:
 1. SPREAD DIMENSIONS ARE MEASURED FROM GAGE LINE TO GAGE LINE.
 2. POINTS AND STOCK RAILS FOR MAINTENANCE REPLACEMENT ARE NOT TO BE END DRILLED.

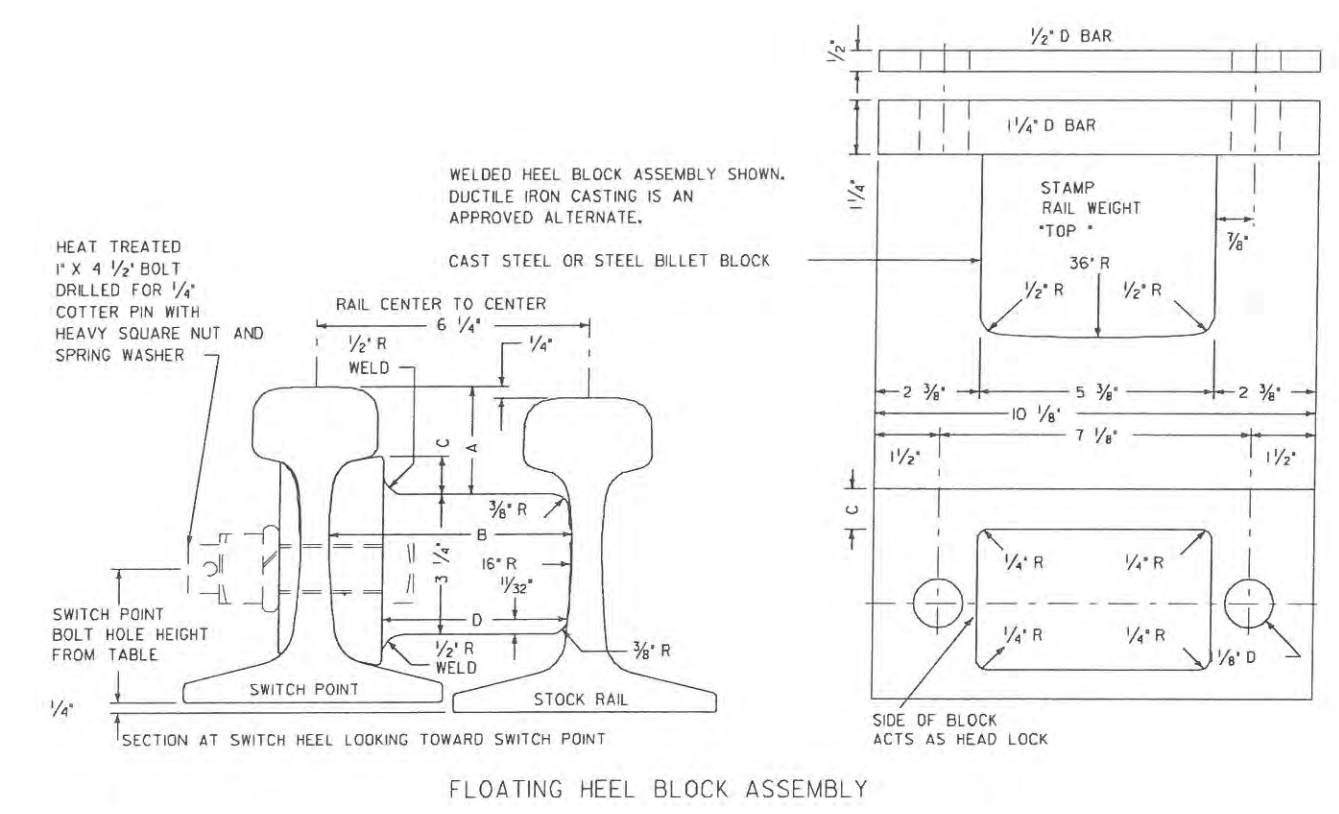
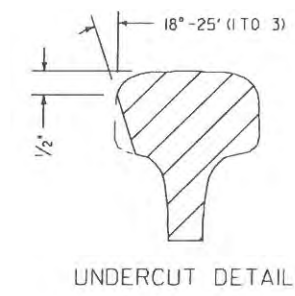


TABLE OF DIMENSIONS - INCHES

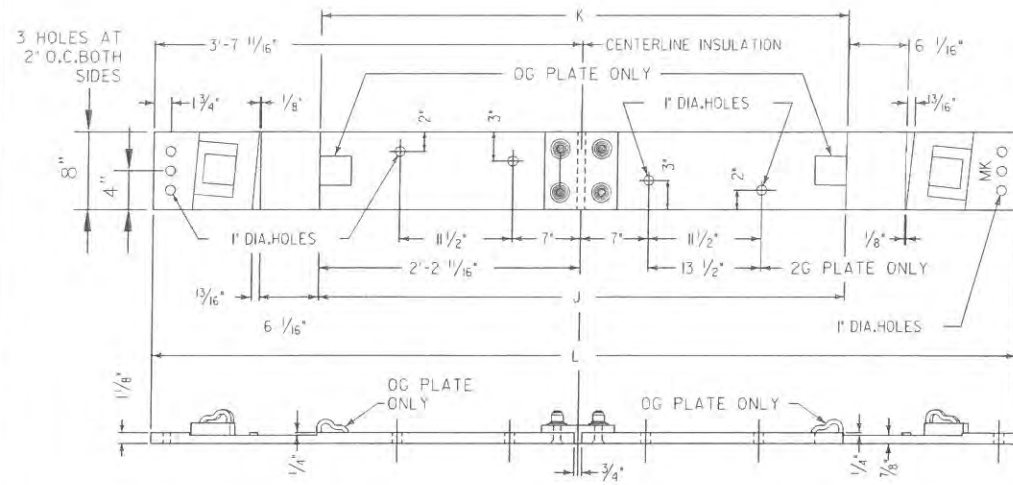
RAIL WEIGHT	BOLT HOLE HEIGHT	TOP OF RAIL TO TOP OF SPACER * A *	WEB TO WEB SPREAD * B *	TOP D BAR TO TOP OF SPACER * C *	D BAR TO TO WEB CONTACT * D *
136 RE	3 3/32	2 1/2	5 9/16	7/8	4 1/4

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 Central Florida Rail Corridor
 STOCK RAILS FOR 39'-0" SWITCH POINTS
 FOR 136RE RAIL ONLY

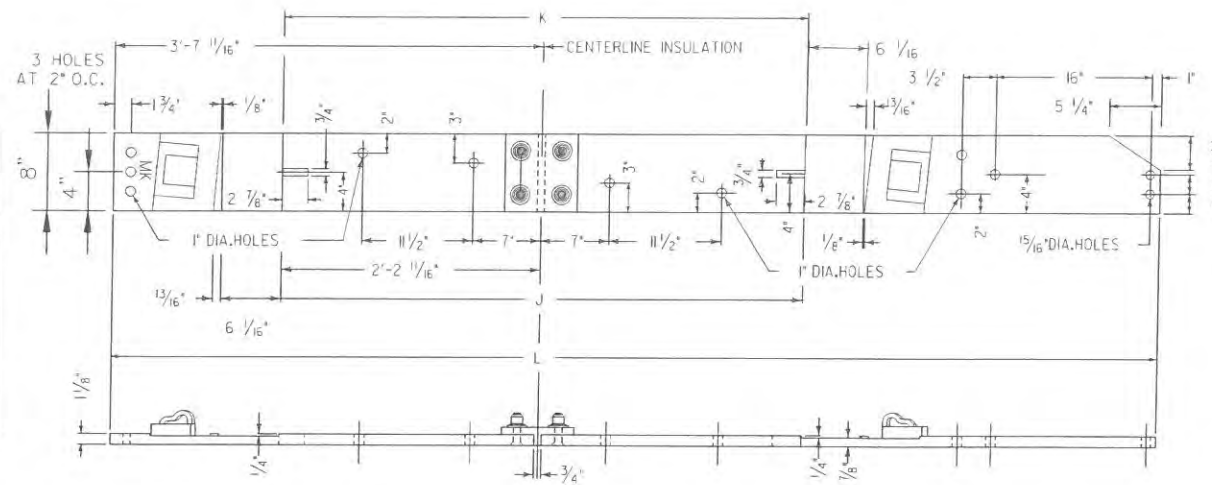
Miguel Torres
 APPROVED - MIGUEL TORRES

CFRC CHIEF OPERATING OFFICER
 PREPARED BY: RMW ISSUED: 9/9/2015 REVISED: 4/2/2015

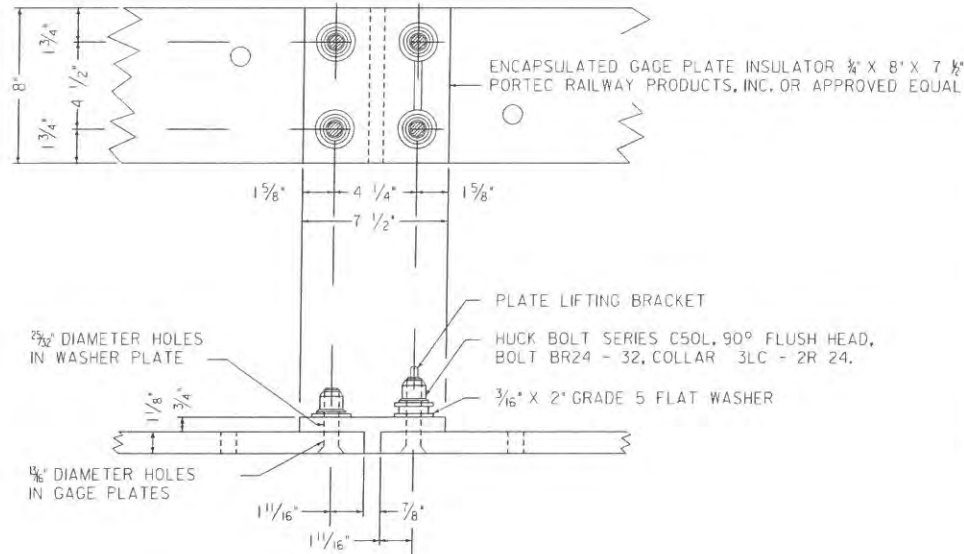
11/30/12 MILLED SEAT CORNERS TO HAVE 1/16" RADIUS.



GAGE PLATE NUMBERS OG, IBGR, IBGL, 2GR, 2GL WITH PANDROL STYLE BRACES



GAGE PLATE NUMBERS IGRE, IGLE, IAGRE, IAGLE WITH PANDROL STYLE BRACES



GAGE PLATE INSULATION DETAIL

- PUT BENT STOCK RAIL PLATE IN PROPER LOCATION.
- SET GAGE SIDE RAIL SHOULDERS TO DISTANCES GIVEN IN CSX STANDARD DRAWINGS.
- CHECK GAP BETWEEN PLATES, GAP OF 3/16" +/- 1/16".
- MARK AND DRILL HOLES FOR WASHER PLATE.
- REMOVE SHARP EDGES AND BURRS.
- SILICON SEALER TO BE GE IS808 TRANSLUCENT SEALER OR EQUIVALENT. CLEAN PLATES PER MANUFACTURER'S INSTRUCTIONS AFTER DRILLING AND PRIOR TO BOLTING INSULATOR TO PLATES.

ALL 39'-0" SWITCHES USE 5 GAGE PLATES.

THE OG PLATE IS FOR THE TIE AHEAD OF THE POINT. THE IG PLATE IS FOR THE TIE AT THE POINT. THE IAG PLATE IS FOR THE TIE AFTER THE IG PLATE. THE IBG PLATE IS FOR THE TIE AFTER THE IAG PLATE. THE ZG PLATE IS FOR THE TIE AHEAD OF THE NUMBER 5 SWITCH ROD.

THE OG PLATE HAS BOTH RAIL SEATS SQUARE TO THE PLATE AND CAN BE USED FOR EITHER RIGHT OR LEFT HAND TURNOUTS.

THE IG, IAG, IBG AND ZG PLATES HAVE THE RAIL SEAT FOR THE BENT STOCK RAIL MILLED AT AN ANGLE TO THE PLATE AND CAN BE USED ONLY FOR THE HAND OF TURNOUT FOR WHICH THE RAIL SEAT WAS MILLED. FOR RIGHT HAND TURNOUTS, THE PLATES ARE MARKED IGR, IAGR, IBGR AND ZGR. FOR LEFT HAND TURNOUTS, IGL, IAGL, IBGL AND ZGL.

FOR USE WITH MACHINE OPERATED SWITCHES, PLATES ARE MADE WITH AN EXTENSION WHICH CONNECTS TO THE SWITCH MACHINE. FOR RIGHT HAND TURNOUTS, THE PLATES ARE MARKED IGRE, AND IAGRE. FOR LEFT HAND TURNOUTS, IGLE, AND IAGLE.

ALL GAGE PLATES WILL BE DEEPLY STAMPED IN 1/2" HIGH CHARACTERS TO INDICATE CSX, MANUFACTURER, 39'0", 136RE, AND THE PLATE NUMBER DESCRIBED ABOVE.

PERMISSIBLE VARIATION OF RISER ELEVATION FROM DESIGN ELEVATION IS PLUS 1/2", MINUS 0".

RAIL SEATS ARE TO BE FLAT WITHIN 0.016". RAIL SEATS TO BE ON PARALLEL PLANES. MILLED SEAT CORNERS TO HAVE 1/16" RADIUS.

GAGE PLATES FOR USE WITH PANDROL RAIL FASTENERS MUST MEET PANDROL DESIGN STANDARDS.

GAGE PLATES FOR USE WITH BETHLEHEM STYLE RAIL BRACES MUST MEET BETHLEHEM DESIGN STANDARDS.

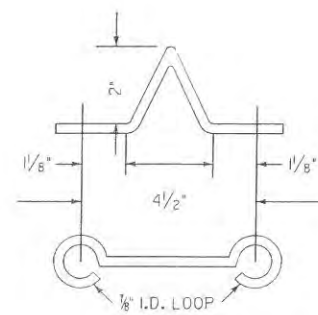
ROUND SPIKE HOLES TO BE 1" DIAMETER FOR USE WITH 1 1/2" DIAMETER BY 6 1/2" LONG SCREW SPIKES.

RECTANGULAR HOLES TO SPIKE POINT CLOSED ON IG AND IAG PLATES TO BE AS SHOWN ON PLANS.

PLATES ARE DRAWN FOR RIGHT HAND TURNOUTS.

SWITCH SHOWS ADJUSTABLE BOLTLESS BRACES. PREFERRED SWITCH BRACE IS PRS CLAMPTITE. ALTERNATE IS BETHLEHEM BOLTLESS.

39'-0" SWITCHES, 0° POINT			
136RE RAIL			
PLATE NUMBER	LENGTH L	J	K
OG	7'- 3 9/16"	4'- 5 3/8"	4'- 5 3/8"
IGRE	8'-11 3/16"	4'- 5 13/32"	4'- 5 15/32"
IGLE	8'-11 3/16"	4'- 5 13/32"	4'- 5 15/32"
IAGRE	8'-11 3/16"	4'- 5 9/16"	4'- 5 21/32"
IAGLE	8'-11 3/16"	4'- 5 9/16"	4'- 5 21/32"
IBGR	7'- 4 1/2"	4'- 5 3/4"	4'- 5 27/32"
IBGL	7'- 4 1/2"	4'- 5 3/4"	4'- 5 27/32"
2GR	7'- 6"	4'- 7 31/32"	4'- 8 1/16"
2GL	7'- 6"	4'- 7 31/32"	4'- 8 1/16"



DETAIL FOR LIFTING HOOK

INSTALL PER LOCATION SHOWN ON GAGE PLATE DRAWINGS.

1/2" ROUND OR 1/2" SQUARE MILD STEEL.

USE (2) CUT FLAT WASHERS ARE TO BE FURNISHED. INSTALL LIFTING BRACKET AND OTHER COMPONENTS IN THE FOLLOWING ORDER: (INSUL / WASHER / HOOK / WASHER / COLLAR)

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Central Florida Rail Corridor
GAGE PLATES FOR 39'-0" SWITCH
FOR 136RE RAIL

Miguel Torres

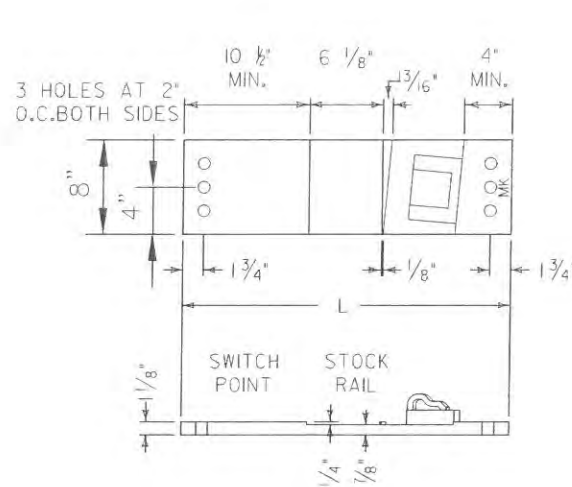
APPROVED - MIGUEL TORRES

CFRC CHIEF OPERATING OFFICER

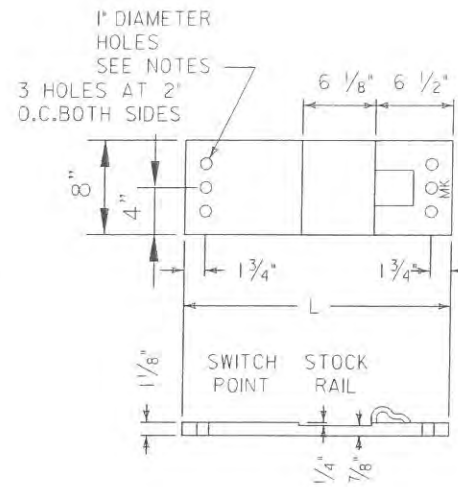
PREPARED BY: RMW ISSUED: 9/9/2015 REVISED: 4/2/2015

11/30/12 MILLED SEAT CORNERS TO HAVE 1/16" RADIUS.

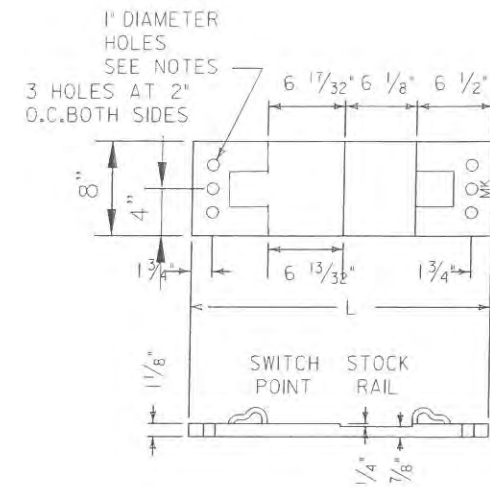
BRACE, SLIDE, AND HEEL PLATES 39'-0" SWITCHES						
PLATE NUMBER	L	RAIL BASE				
1	2'-4 1/2"	6 1/8"				
IP & 2	2'-3/4"	6 1/8"				
3	2'-1 1/2"	6 1/8"				
TURNOUT PLATES - 39'-0" SWITCH WITH RAIL BASE ELEVATION RUNOFF						
PLATE NO.	L	C	D	E	T	RISER ELEV.
4	26 1/4"	6 3/4"	6 29/32"	6 9/16"	15/32"	7/32"
5	26 1/2"	7 5/32"	7 5/16"	6 9/16"	7/16"	3/16"
6	27"	7 9/16"	7 23/32"	6 19/32"	13/32"	5/32"
7	27 1/2"	8"	8 5/32"	6 19/32"	3/8"	1/8"
8	27 3/4"	8 1/16"	8 19/32"	6 19/32"	11/32"	3/32"
9	28 1/4"	8 7/8"	9 1/16"	6 19/32"	5/16"	1/16"
10	28 3/4"	9 11/32"	9 17/32"	6 19/32"	9/32"	1/32"
WITHOUT RAIL BASE ELEVATION RUNOFF						
11	29 1/4"	9 13/16"	10"	6 19/32"		
12	29 3/4"	10 5/16"	10 1/2"	6 19/32"		
13	30 1/4"	10 13/16"	11"	6 19/32"		
14	30 3/4"	11 5/16"	11 1/2"	6 19/32"		
15	31 1/4"	11 27/32"	12 1/32"	6 19/32"		
16	31 3/4"	12 3/8"	12 9/16"	6 19/32"		
17	32 1/2"	12 29/32"	13 1/8"	6 19/32"		
18	33"	13 15/32"	13 11/16"	6 5/8"		
19	33 1/2"	14 1/32"	14 9/32"	6 5/8"		
20	34"	14 5/8"	14 21/32"	6 5/8"		
21	34 3/4"	15 7/32"	15 15/32"	6 5/8"		
22	35 1/4"	15 13/16"	16 1/16"	6 5/8"		



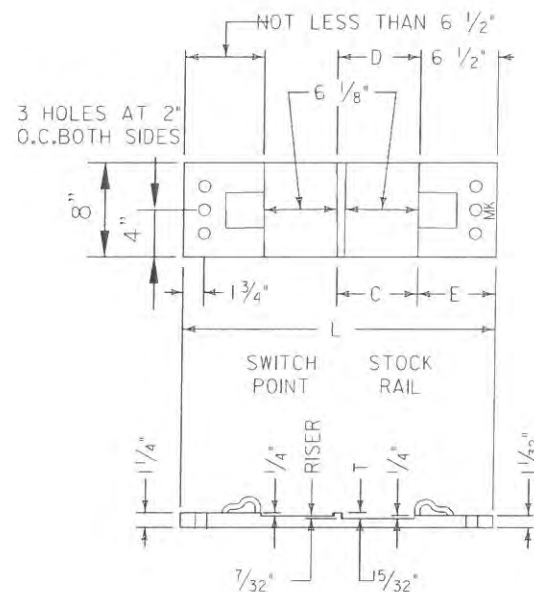
BRACE PLATE NO. 1



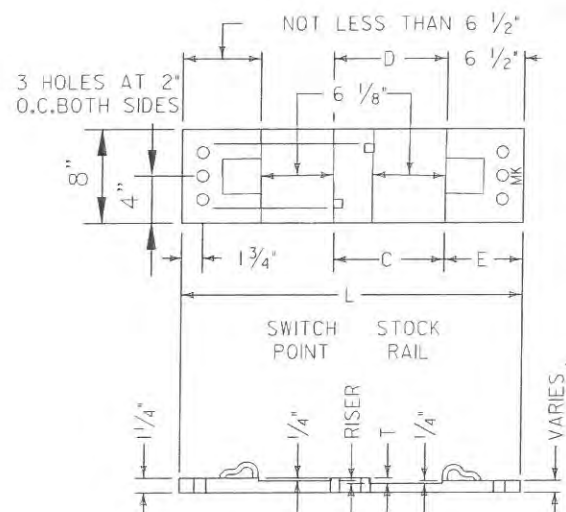
SHOULDER SLIDE AND HEEL
PLATES NO. IP AND 2



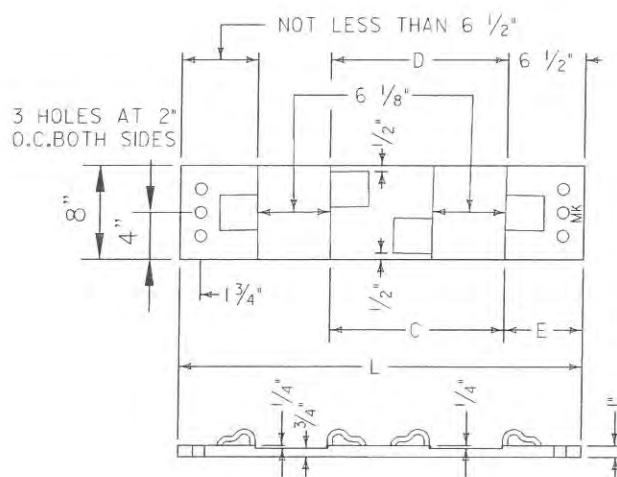
HEEL PLATE NO. 3



TURNOUT PLATE
PLATE NO. 4



TURNOUT PLATES
PLATES NO. 5 THRU 10



TURNOUT PLATES
PLATES NO. 11 THRU 22

SWITCH AND TURNOUT PLATES ARE DESIGNED TO USE PANDROL RAIL FASTENERS. SHOULDERS AND BETHLEHEM BOLTLESS ADJUSTABLE RAIL BRACES. FASTENERS, SHOULDERS AND BRACES MUST MEET MANUFACTURERS STANDARDS. PREFERRED SWITCH BRACE IS PRS CLAMPTITE. ALTERNATE IS BETHLEHEM BOLTLESS.

ALL SWITCH AND TURNOUT PLATES WILL BE DEEPLY STAMPED IN 1/2" CHARACTERS TO INDICATE CSX, MANUFACTURER, SWITCH LENGTH, ISGRE, AND PLATE NUMBER. PLATES NUMBERED 4 THRU 10 WILL ALSO BE MARKED RIGHT OR LEFT HAND. MARK LOCATION SHOWN AS "MK".

PLATE MARKINGS 1 THRU 10 WILL BE LOCATED ON THE END OF THE PLATE ON THE FIELD SIDE. PLATE MARKINGS 11 THRU 22 WILL BE LOCATED ON THE END OF THE PLATE.

ROUND SPIKE HOLES TO BE 1" DIAMETER FOR USE WITH 5/8" DIAMETER BY 6 1/2" LONG SCREW SPIKES. RECTANGULAR SPIKE HOLES WILL BE 3/4" BY 1/8" WITH 1/8" UNDER BASE OF RAIL.

PANDROL SHOULDERS ARE PERPENDICULAR TO BASE OF RAIL. SHOULDERS ARE AT CENTERLINE OF PLATE UNLESS THEY ARE DIMENSIONED SEPARATELY.

PERMISSIBLE VARIATION OF RISER ELEVATION FROM DESIGN ELEVATION OF ALL BRACE, SLIDE, HEEL AND NUMBERED 1, IP, 2 AND 3 IS PLUS 1/32", MINUS 0".

PERMISSIBLE VARIATION OF RISER ELEVATION FROM DESIGN ELEVATION OF TURNOUT PLATES NUMBERED 4 THRU 16 IS PLUS OR MINUS 0.016".

RAIL SEATS ARE TO BE FLAT WITHIN 0.016".
RAIL SEATS TO BE ON PARALLEL PLANES.
MILLED SEAT CORNERS TO HAVE 1/16" RADIUS.



Central Florida Rail Corridor

SWITCH AND TURNOUT PLATES 39'-0"
CURVED SWITCHES WITH UNIFORM RISERS

Miguel Torres

APPROVED - MIGUEL TORRES

CFRC CHIEF OPERATING OFFICER

PREPARED BY: RMW ISSUED: 9/9/2015 REVISED: 4/2/2015

1. SUPPLIER SHALL VERIFY ALL DIMENSIONS BEFORE FABRICATION.
2. SHOP DRAWINGS, THAT HAVE BEEN APPROVED BY CFRC ARE REQUIRED BEFORE FABRICATION.
3. AREMA PLAN 100- (LATEST REVISION)

M 2, MANGANESE STEEL CASTINGS

M 2.4, BEND TEST - THIS TEST IS NOT REQUIRED.

M 2.5.4, RADIOGRAPHIC TESTING AND/OR SECTIONING IS REQUIRED.

M 2.5.4.3, RADIOGRAPHIC TESTING SHALL BE PERFORMED AT THE FOLLOWING FREQUENCIES.

TURNOUT FROGS

INITIAL ACCEPTANCE - THE INITIAL FIVE (5) CASTINGS FOR EVERY PATTERN AT EVERY FOUNDRY WILL BE RADIOGRAPHED.

IF ONE (1) CASTING FAILS THEN THE NEXT FIVE (5) WILL BE RADIOGRAPHED. THIS TESTING PATTERN WILL BE CONTINUED UNTIL FIVE (5) CONSECUTIVE CASTINGS PASS THE RADIOGRAPHIC REQUIREMENTS.

CONTINUING REQUIREMENTS - AFTER COMPLETING THE INITIAL ACCEPTANCE REQUIREMENTS, THEN THE FIFTH (5th) CASTING WILL BE TESTED AND THEN EVERY TWENTIETH (20th) THEREAFTER. IF ANY CASTING FAILS, THE PROCESS WILL REVERT TO THE INITIAL ACCEPTANCE CRITERIA AND THE SEQUENCE WILL BEGIN AGAIN.

RAILROAD CROSSING FROGS

FOR SINGLE CROSSINGS - AT LEAST 2 OF THE FROGS WILL BE RADIOGRAPHED. ONE ACUTE ANGLE AND ONE OBTUSE ANGLE FROG WILL BE INSPECTED.

FOR DOUBLE CROSSINGS - AT LEAST 4 OF THE FROGS WILL BE RADIOGRAPHED. AT LEAST TWO FROGS FROM EACH CROSSING AND AT LEAST TWO ACUTE ANGLE AND TWO OBTUSE ANGLE FROGS WILL BE INSPECTED.

FOR QUAD AND GREATER CROSSINGS - AT LEAST 5 OF THE FROGS WILL BE RADIOGRAPHED. AT LEAST ONE FROG FROM EACH CROSSING AND AT LEAST TWO ACUTE ANGLE AND TWO OBTUSE ANGLE FROGS WILL BE INSPECTED.

FAILED CASTINGS ARE NOT ACCEPTABLE.

RADIOGRAPHIC INTERNAL SOUNDNESS LEVELS ARE SHOWN ON AREMA PLANS (LATEST REVISION) NUMBERS 1012-96, 1013-96, 1014-96, 1015-96, 1016-96 AND 1017-96.

M 2.7.1, DEPTH HARDENING - EXPLOSIVE HARDEN CASTING TO A MINIMUM 352 BHN.

M 2.7.5, CASTINGS FAILING TO MEET THE DEPTH HARDENING REQUIREMENTS ARE NOT ACCEPTABLE.

4. RAIL USED IN FROGS SHALL BE HEAD HARDENED OR FULLY HEAT TREATED AND MEET THE OTHER REQUIREMENTS OF THE CURRENT CFRC RAIL SPECIFICATIONS.



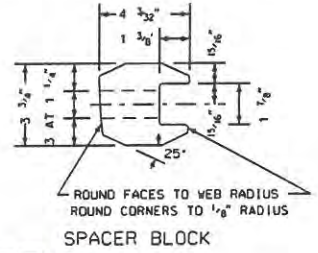
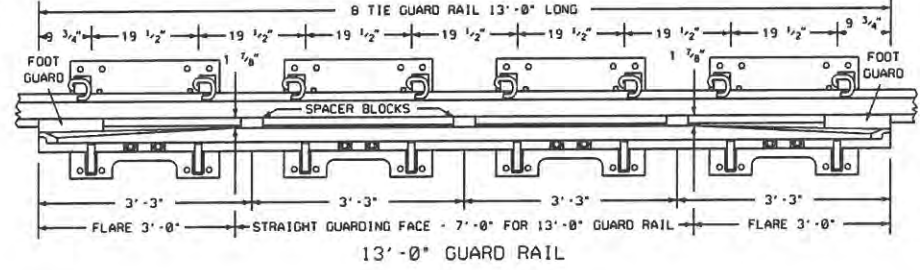
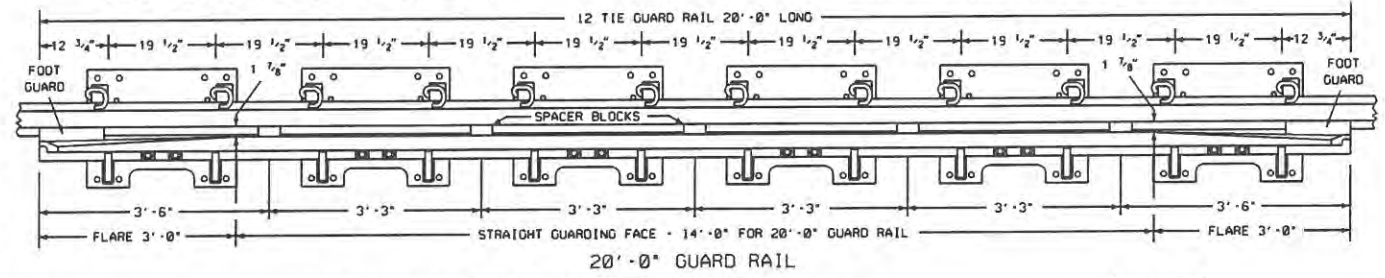
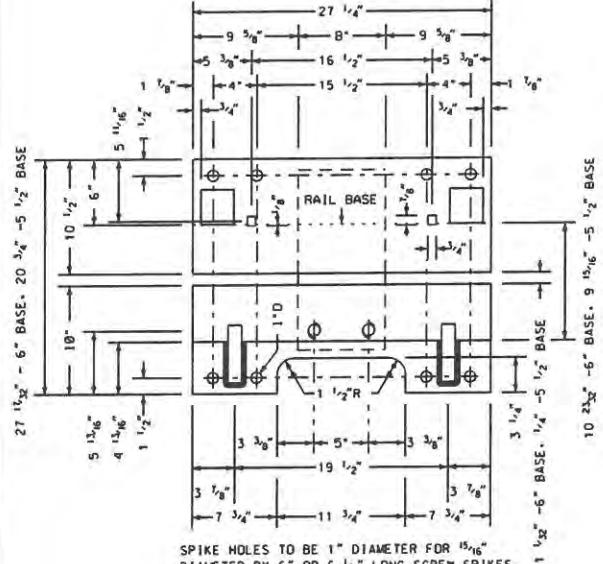
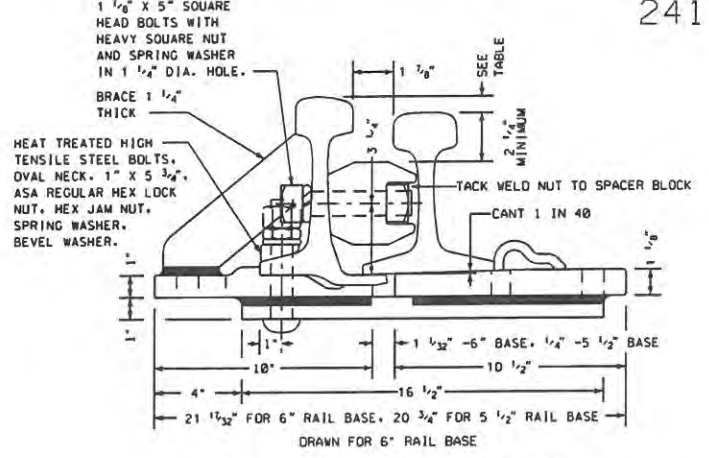
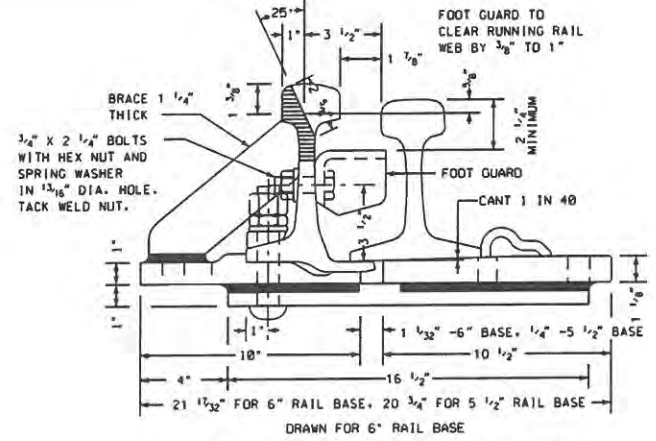
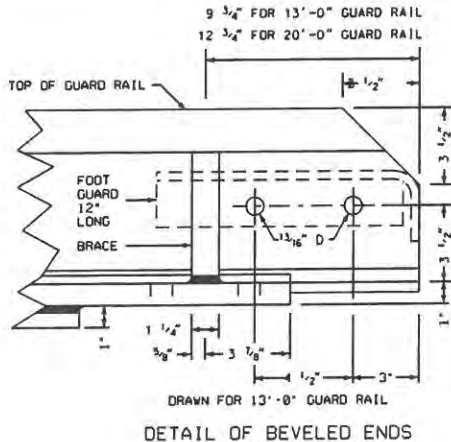
FROGS

GENERAL REQUIREMENTS AND
AREMA CLARIFICATIONS

Miguel Torres

APPROVED - MIGUEL TORRES

CFRC CHIEF OPERATING OFFICER



SPIKE HOLES TO BE 1\"/>

SPIKE HOLES CONTRACTING RAIL BASE ARE 3/4\"/>

BOLT HOLES FOR FASTENING GUARD RAIL ARE 1 1/8\"/>

NOTES:
 CENTER PUNCH AND PAINT MARK BOTH ENDS OF NON-PLANNED SIDE OF GUARD RAIL TO INDICATE END OF FLARE.
 PANDROL SHOULDERS MUST MEET PANDROL DESIGN STANDARDS.

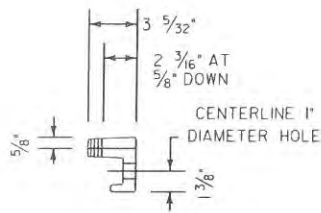
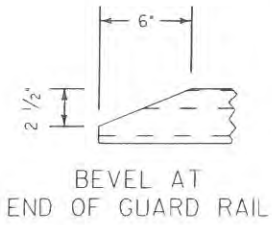
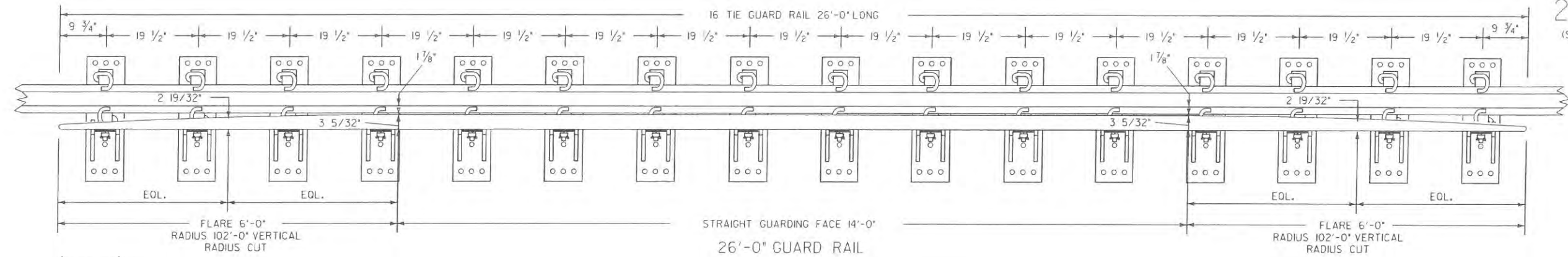
CFRC
 Central Florida Rail Corridor
HOOK FLANGE GUARD RAILS
 FOR 115RE, 122CB, 132RE, 136RE, 140RE, AND 141LB RAIL

Miguel Torres

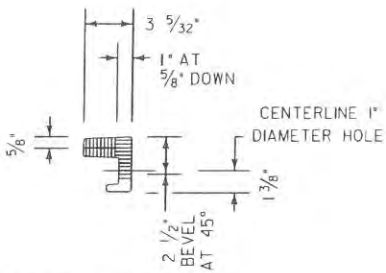
APPROVED - MIGUEL TORRES
 CFRC CHIEF OPERATING OFFICER

PREPARED BY: RMW ISSUED: 9/9/2015 REVISED: 4/2/2015

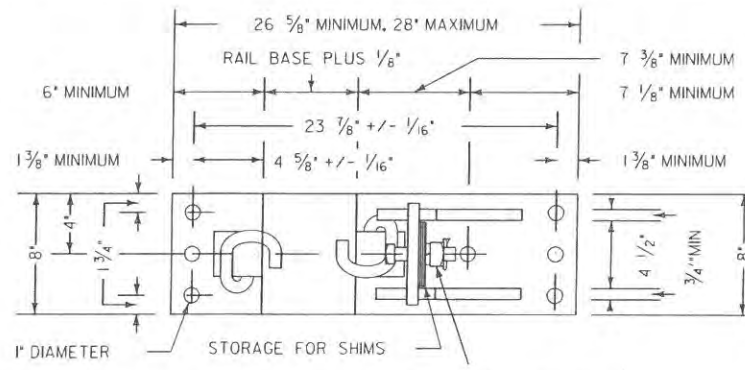
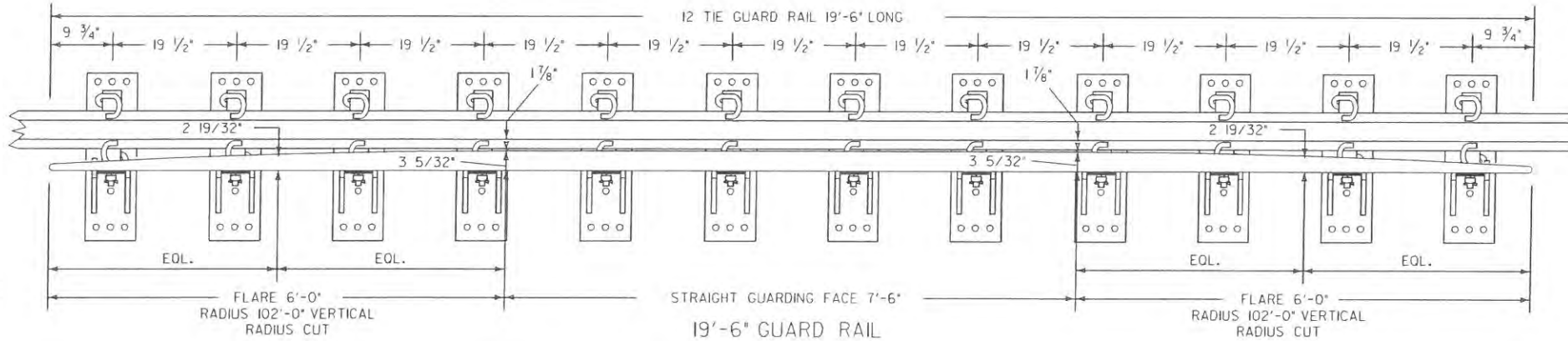
RUNNING RAIL SECTION	RUNNING RAIL HEIGHT	GUARD RAIL SECTION	GUARD RAIL HEIGHT	HEIGHT ABOVE RUNNING RAIL	GUARD RAIL USAGE		GUARD RAIL ITEM NUMBERS		
					NO.	LENGTH	DESCRIPTION	ORDERING INFORMATION	
141LB	7 3/16"	GT140RE	8 1/8"	1 1/16"	NO. 8 RBM	2 AT 13'-0"	010 6450033	BOLT, BUTTON HEAD, OVAL NECK, 1 X 5-3/4" HEX LOCK NUT, HEX JAM NUT, SPRING WASHER, BEVEL WASHER	
140RE	7 3/16"	GT140RE	8 1/8"	1 3/16"	NO. 10 RBM	1 AT 13'-0"			
136RE	7 3/16"	GT140RE	8 1/8"	1 3/16"	NO. 10 SPC	1 AT 20'-0"			
132RE	7 1/8"	GT140RE	8 1/8"	1"	NO. 15 RBM		LENGTH	5 1/2" BASE	6" BASE
122CB	6 23/32"	GT140RE	8 1/8"	1 1/32"	NO. 16 RBM	2 AT 20'-0"	13'-0"	010 6420010	010 6450010
115RE	6 3/8"	GT126RE	7 3/8"	3/4"	NO. 20 RBM		20'-0"	010 6420020	010 6450020



CROSS SECTION 24" FROM
END OF GUARD RAIL

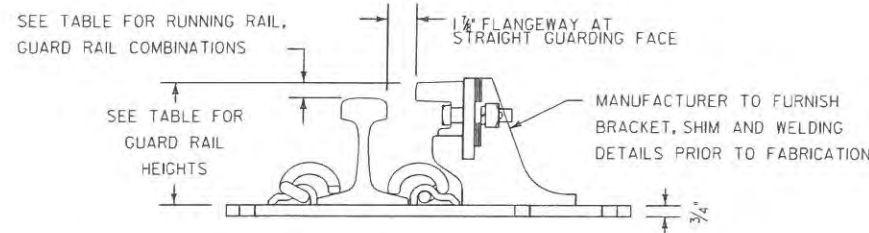


CROSS SECTION AT
END OF GUARD RAIL



7/8" x 4" SQUARE HEAD BOLT, SPRING WASHER
HEAVY SQUARE NUT, DRILLED FOR 3/16" MIN. COTTER

RUNNING RAIL AND GUARD RAIL NOT SHOWN ABOVE
PLATE AND BRACKET



CROSS SECTION THROUGH STRAIGHT GUARDING FACE

THE STRAIGHT GUARDING FACE IS TO BE IN THE SAME LOCATION WHEN EITHER A HOOK FLANGE OR AN ADJUSTABLE GUARD RAIL IS INSTALLED IN A TURNOUT.

MANUFACTURING NOTES:

- THE 26'-0" AND 19'-6" GUARD RAILS ARE A COMMON STANDARD WITH NS, UP AND BNSF RAILROADS.
- GUARD RAIL SECTION: U.I.C. 33CI, (U69) UIC 860-0 GRADE 90A, GUARD FACE MINIMUM OF 319 BRINELL.
- BASEPLATE, BRACKET AND SHIMS: MILD STEEL PER AREMA SPECIFICATION M.7.
- GUARD RAIL BOLT AND NUT: PER AREMA SPECIFICATION M11.
- SPRING WASHER: PER AREMA SPECIFICATION M12.
- WORKMANSHIP AND TOLERANCES PER AREMA SPECIFICATIONS FOR SPECIAL TRACKWORK.
- WELDING: PER LATEST REVISION OF ANSI/AWS D11.
- PANDROL SHOULDERS MUST MEET PANDROL DESIGN STANDARDS.
- MINIMUM ADJUSTMENT USING SHIMS: 1/2" IN 1/16" INCREMENTS (3 SHIMS AT 1/8", 2 SHIMS AT 1/16" OR EQUIVALENT).
- CENTER PUNCH AND PAINT MARK BOTH ENDS OF NON-PLANED SIDE OF GUARD RAIL TO INDICATE END OF FLARE.

INSTALLATION NOTE:

THE VARIATION IN RAIL HEAD WIDTHS AND THE TOLERANCES ALLOWED IN THE MANUFACTURE OF GUARD RAILS MAY REQUIRE THE USE OF SHIMS WITH THE INSTALLATION OF A NEW GUARD RAIL. MEASURE THE GUARD CHECK GAGE AND WIDTH OF THE FLANGEWAY OPENING AFTER INSTALLATION AND ADJUST OPENING TO 1 7/8" WHEN NECESSARY.

GUARD RAIL USAGE	
FROG	LENGTH
NO. 8 RBM	2 AT 19'-6"
NO. 10 RBM	
NO. 10 SPG	1 AT 19'-6"
	1 AT 26'-0"
NO. 15 RBM	2 AT 26'-0"
NO. 16 RBM	
NO. 20 RBM	

RUNNING RAIL SECTION	RUNNING RAIL HEIGHT	GUARD RAIL HEIGHT	HEIGHT ABOVE RUNNING RAIL
I4IRE	7 7/16"	8 1/4"	1 3/16"
I40RE	7 3/16"	8 1/4"	1 5/16"
I36RE	7 1/16"	8 1/4"	1 5/16"
I32RE	7 1/8"	8 1/4"	1 1/8"
I22CB	6 25/32"	8 1/4"	1 15/32"
I15RE	6 3/8"	7 3/8"	3/4"

GUARD RAIL ITEM NUMBERS	
LENGTH	WEARING BAR, REPLACEMENT
19'-6"	OIO 6420025
26'-0"	OIO 6420030



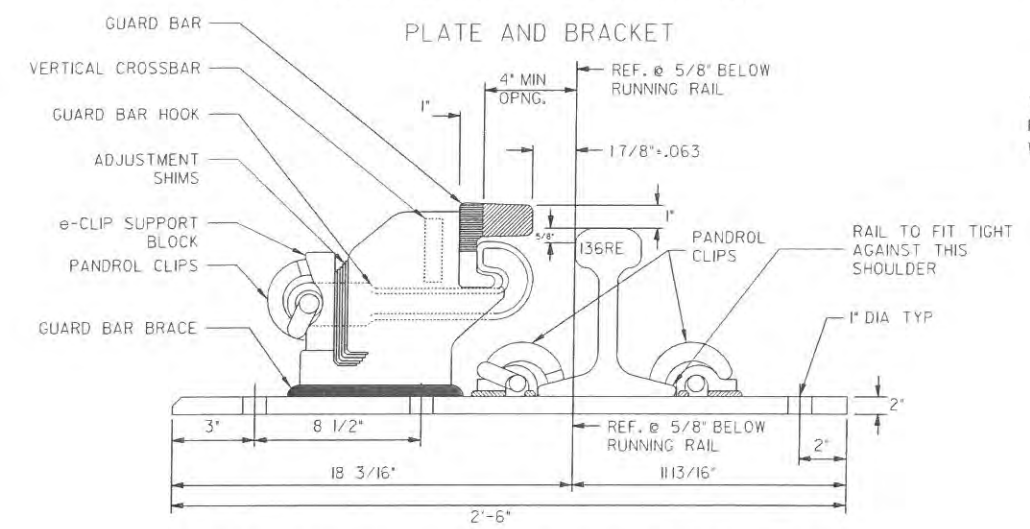
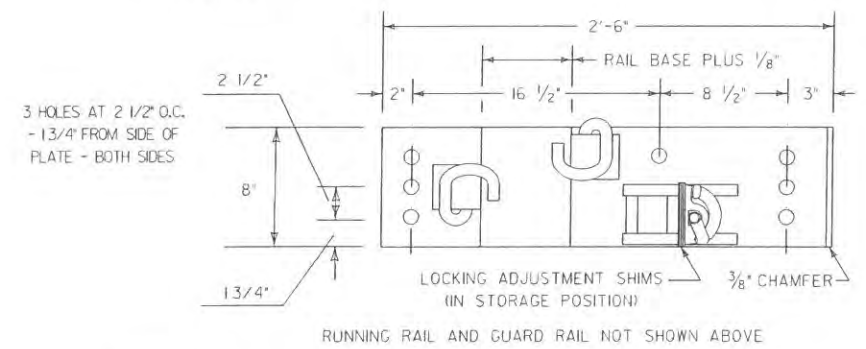
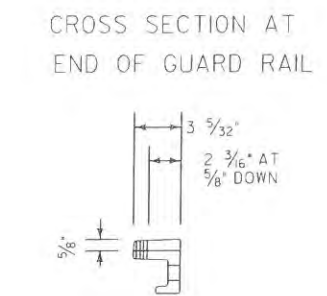
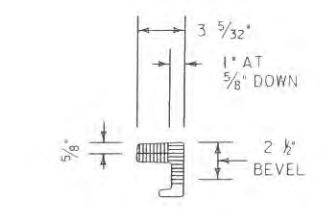
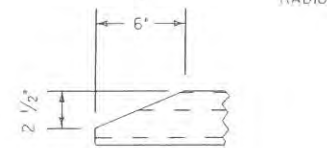
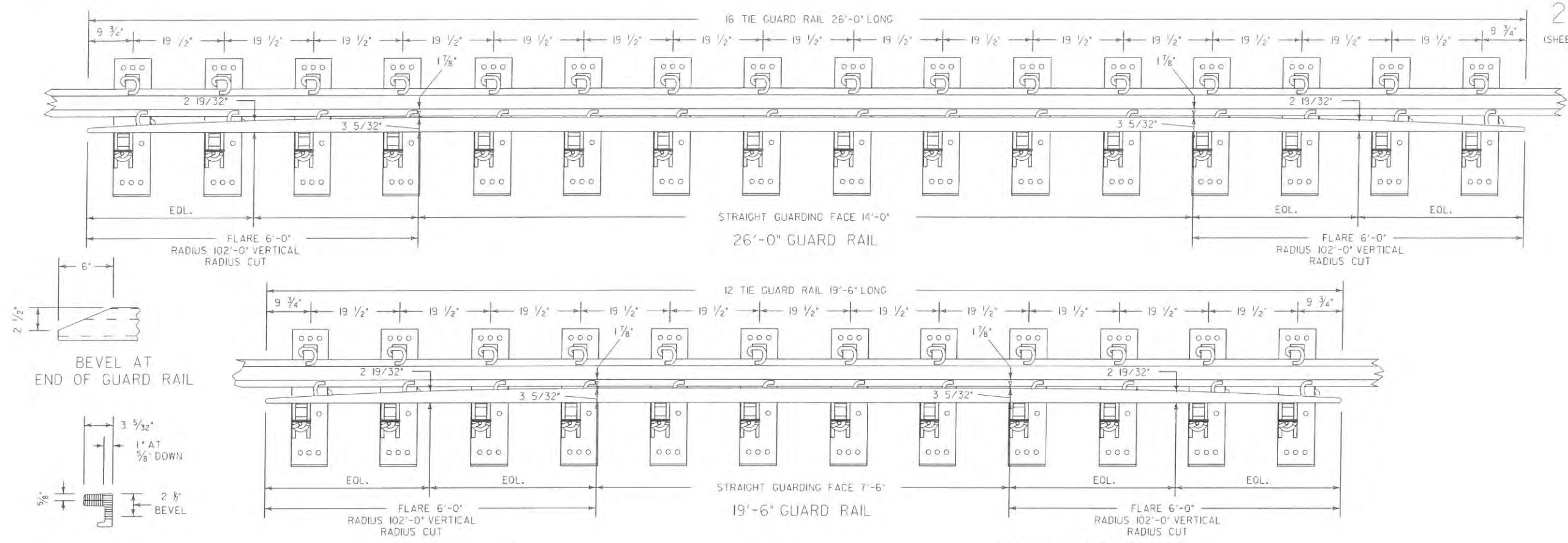
BOLTED ADJUSTABLE GUARD RAILS FOR I15RE, I22CB, I32RE, I36RE, I40RE, AND I4IRE RAIL MAINTENANCE ONLY

Miguel Torres
APPROVED - MIGUEL TORRES

CFRC CHIEF OPERATING OFFICER

PREPARED BY: RMW ISSUED: 9/9/2015 REVISED: 4/2/2015

2/5/13 - ADDED WEARING BAR SCN
2/25/13 - REVISED SCN FOR ORDERING GUARD RAILS



MANUFACTURING NOTES:

- BOLTLESS DESIGN, USING PANDROL E-CLIP.
- THE 26'-0" AND 19'-6" GUARD RAILS ARE A COMMON STANDARD WITH NS, UP AND BNSF RAILROADS.
- GUARD RAIL SECTION: U.I.C. 33CL (U69) UIC 860-0 GRADE. GUARD FACE MINIMUM OF 350 BRINELL.
- BASEPLATE, BRACKET AND SHIMS: MILD STEEL PER AREMA SPECIFICATION M.7.
- PANDROL SHOULDERS MUST MEET PANDROL DESIGN STANDARDS.
- WELDING: PER ANSI/AWS D11-92 OR LATEST REVISION.
- WORKMANSHIP AND TOLERANCES PER AREMA SPECIFICATIONS FOR SPECIAL TRACKWORK.
- MINIMUM ADJUSTMENT USING SHIMS: 3/16" IN 1/16" INCREMENTS (4 SHIMS AT 1/8", 1 SHIM AT 1/16").
- CENTER PUNCH AND PAINT MARK BOTH ENDS OF NON-PLANED SIDE OF GUARD RAIL TO INDICATE END OF FLARE.

INSTALLATION NOTE:

THE VARIATION IN RAIL HEAD WIDTHS AND THE TOLERANCES ALLOWED IN THE MANUFACTURE OF GUARD RAILS MAY REQUIRE THE USE OF SHIMS WITH THE INSTALLATION OF A NEW GUARD RAIL. MEASURE GUARD CHECK GAGE AND WIDTH OF FLANGWAY OPENING AFTER INSTALLATION AND ADJUST OPENING TO 1 1/8" WHEN NECESSARY.

GUARD RAIL USAGE	
FROG	LENGTH
NO. 8 RBM	2 AT 19'-6"
NO. 10 RBM	
NO. 10 SPC	1 AT 19'-6"
	1 AT 26'-0"
NO. 15 RBM	2 AT 26'-0"
NO. 16 RBM	
NO. 20 RBM	

RUNNING RAIL SECTION	RUNNING RAIL HEIGHT	GUARD RAIL HEIGHT	HEIGHT ABOVE RUNNING RAIL
I4IRE	7 7/16"	8 1/4"	1 3/16"
I40RE	7 5/16"	8 1/4"	1 5/16"
I36RE	7 5/16"	8 1/4"	1 5/16"
I32RE	7 1/8"	8 1/4"	1 1/8"
I22CB	6 2 3/32"	8 1/4"	1 1 5/32"
I15RE	6 5/8"	7 3/8"	3/4"

GUARD RAIL ITEM NUMBERS		
LENGTH	5 1/2" BASE	6" BASE
19'-6"	OIO 6420015	OIO 6450015
26'-0"	OIO 6420050	OIO 6450050

THE STRAIGHT GUARDING FACE IS TO BE IN THE SAME LOCATION WHEN EITHER A HOOK FLANGE OR AN ADJUSTABLE GUARD RAIL IS INSTALLED IN A TURNOUT.

GUARD RAIL ITEM NUMBERS	
LENGTH	WEARING BAR, REPLACEMENT
19'-6"	OIO 6420027
26'-0"	OIO 6420032

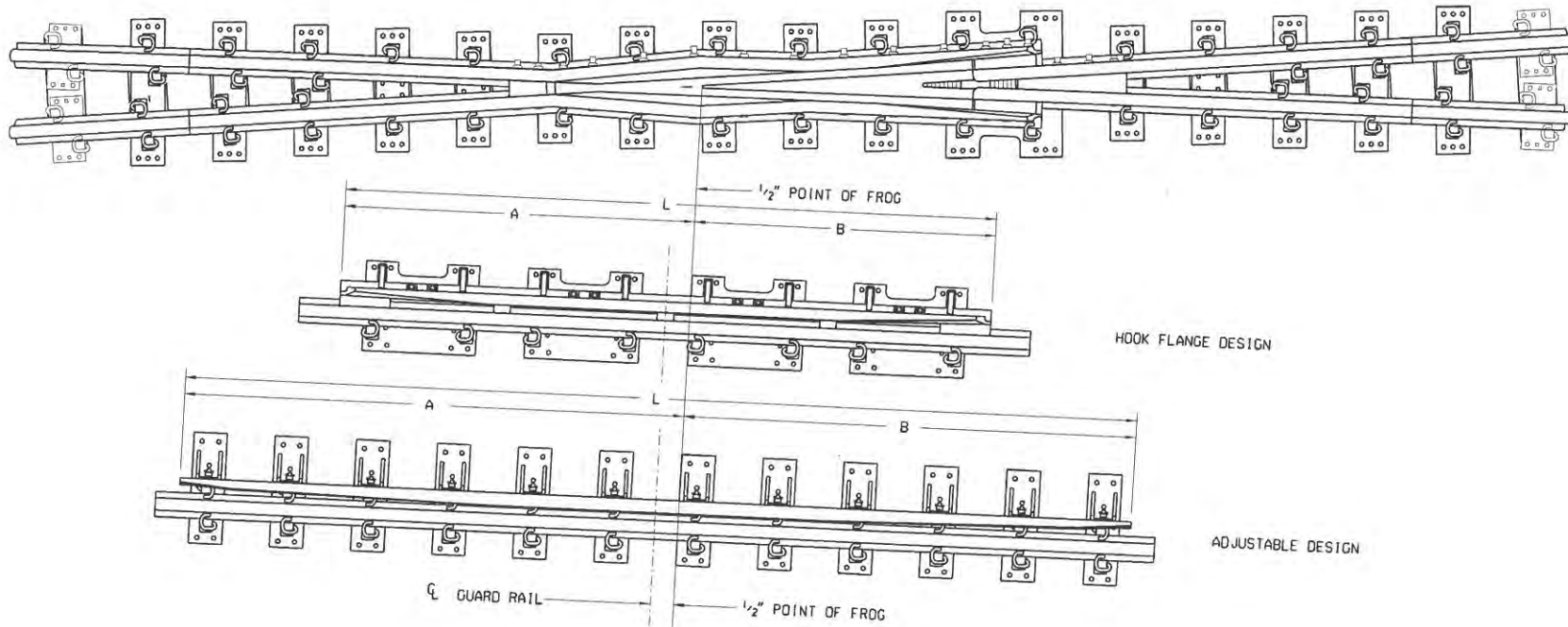


BOLTLESS ADJUSTABLE GUARD RAILS FOR I15RE, I22CB, I32RE, I36RE, I40RE AND I41RE RAIL

Miguel Torres
APPROVED - MIGUEL TORRES
CFRC CHIEF OPERATING OFFICER

PREPARED BY: RMW ISSUED: 9/9/2015 REVISED: 4/2/2015

GUARD RAIL HAS CURVED FLARES
SHIM PACK CORRECTED TO 9/16" TOTAL THICKNESS



TURNOUT AND FROG	PRIMARY GUARD RAIL DESIGN						ALTERNATE GUARD RAIL DESIGN					
	STRAIGHT SIDE			DIVERGING SIDE			STRAIGHT SIDE			DIVERGING SIDE		
	L	A	B	L	A	B	L	A	B	L	A	B
NO. 8	HOOK FLANGE			HOOK FLANGE			ADJUSTABLE			ADJUSTABLE		
RBM	13'-0"	6'-11 ³ / ₄ "	6'-0 ¹ / ₄ "	13'-0"	6'-4 ⁵ / ₈ "	6'-7 ³ / ₈ "	19'-6"	9'-7 ⁵ / ₈ "	9'-10 ³ / ₈ "	19'-6"	9'-7 ⁵ / ₈ "	9'-10 ³ / ₈ "
NO. 10	HOOK FLANGE			HOOK FLANGE			ADJUSTABLE			ADJUSTABLE		
RBM	13'-0"	6'-11 ³ / ₄ "	6'-0 ¹ / ₄ "	13'-0"	6'-6 ¹ / ₈ "	6'-5 ¹ / ₈ "	19'-6"	10'-2 ³ / ₄ "	9'-3 ¹ / ₄ "	19'-6"	9'-9 ¹ / ₈ "	9'-8 ⁷ / ₈ "
NO. 10	HOOK FLANGE			HOOK FLANGE			ADJUSTABLE			ADJUSTABLE		
SPRING	20'-0"	12'-1 ¹ / ₄ "	7'-10 ³ / ₄ "	13'-0"	6'-6 ¹ / ₈ "	6'-5 ¹ / ₈ "	26'-0"	16'-9 ³ / ₄ "	9'-2 ¹ / ₄ "	19'-6"	9'-9 ¹ / ₈ "	9'-8 ⁷ / ₈ "
NO. 15	ADJUSTABLE			ADJUSTABLE			HOOK FLANGE			HOOK FLANGE		
RBM	26'-0"	13'-5 ³ / ₄ "	12'-6 ¹ / ₄ "	26'-0"		12'-9 ³ / ₄ "	20'-0"	9'-6 ¹ / ₈ "	10'-5 ⁷ / ₈ "	20'-0"	9'-2 ⁵ / ₈ "	10'-9 ³ / ₈ "
NO. 20	ADJUSTABLE			ADJUSTABLE			HOOK FLANGE			HOOK FLANGE		
RBM	26'-0"	11'-7 ¹ / ₄ "	14'-4 ³ / ₄ "	26'-0"	11'-4 ¹ / ₂ "	14'-7 ¹ / ₂ "	20'-0"	8'-7 ¹ / ₄ "	11'-4 ³ / ₄ "	20'-0"	8'-4 ¹ / ₂ "	11'-7 ¹ / ₂ "



GUARD RAILS
USAGE AND LOCATION

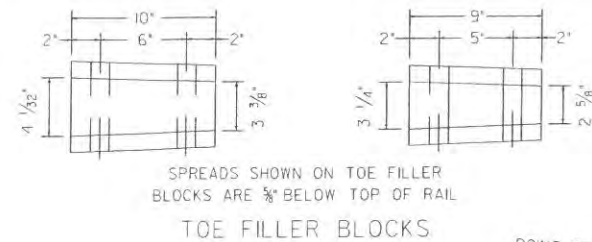
Miguel Torres

APPROVED - MIGUEL TORRES
CFRC CHIEF OPERATING OFFICER

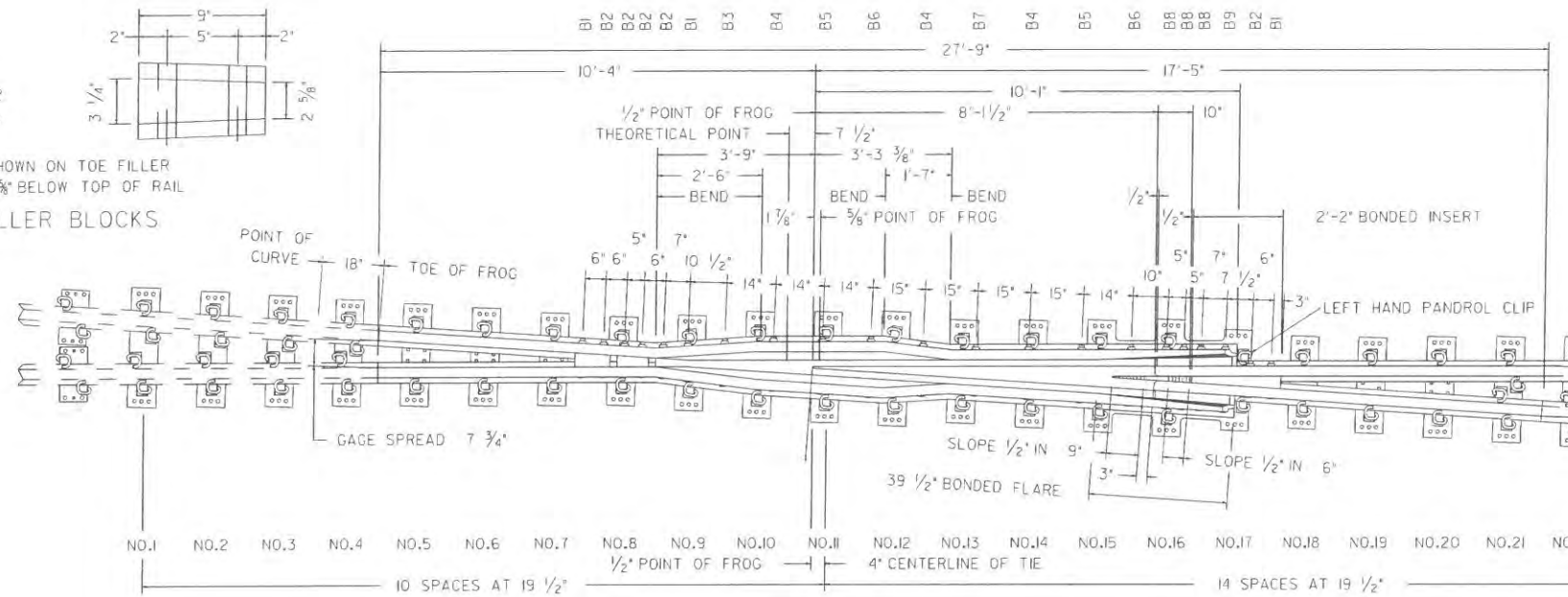
11/30/12 ALL PLATES TO BE MILLED SEAT.
11/30/12 APPLY SIGNAL BONDS TO WING RAILS PER DRAWING SS5010N PTO.

11/30/12 ALL FROG PLATES TO BE MILLED SEAT 1" THICK 1/4" MILLED WITH 1/16" CORNER RADIUS.

12/18/12 - CORRECTED FROG POINT DETAIL



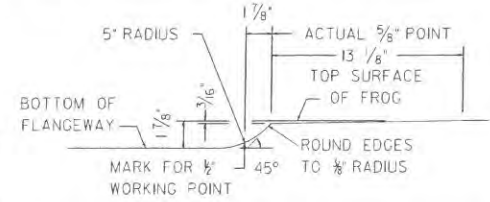
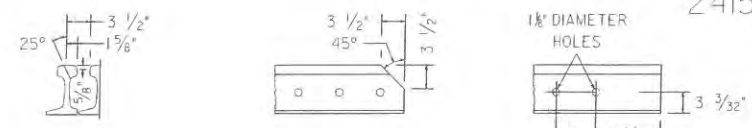
SPREADS SHOWN ON TOE FILLER BLOCKS ARE 3/8" BELOW TOP OF RAIL
TOE FILLER BLOCKS



PLANING AT END OF WING RAIL

BEVELED END OF WING RAIL

RAIL END DRILLING



ELEVATION OF CONVENTIONAL POINT

3 HOLES AT 2 1/2" O.C. - 1 3/4" FROM SIDE OF PLATE - BOTH SIDES

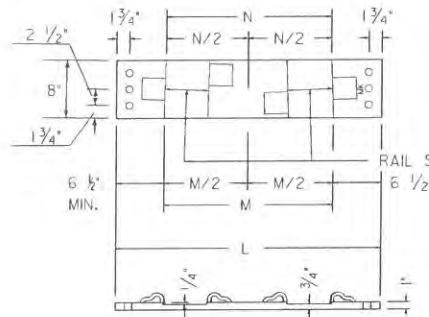


PLATE NOS. 1, 2, 3, 4, 19, 20, 21, 22, 23, 24, 25

FROG PLATES ARE PERPENDICULAR TO CENTERLINE OF FROG

MILLED SEAT PLATES WITH WELDED SHOULDERS

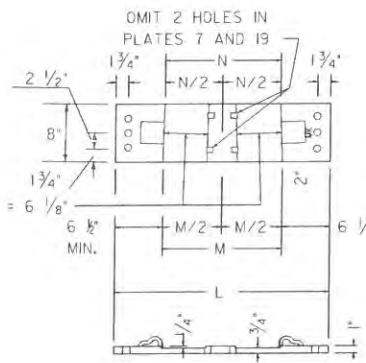


PLATE NOS. 5, 6, 7, 19, 20

SPIKE HOLES TO BE 1" DIAMETER FOR 5/8" DIAMETER BY 6 1/2" LONG SCREW SPIKES.

SPIKE HOLES CONTACTING RAIL BASE ARE 3/4" X 1/4" WITH 1/8" UNDER RAIL BASE WITH EDGE OF SPIKE HOLE 1/8" IN FROM EDGE OF PLATE.

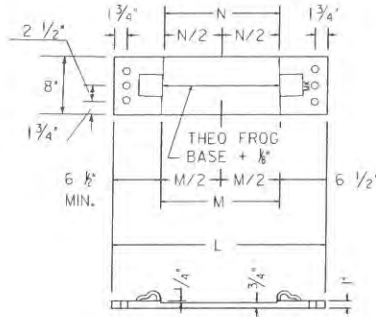
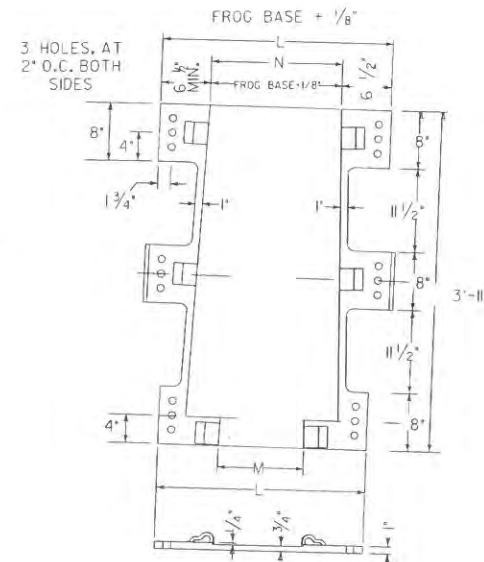


PLATE NOS. 8, 9, 10, 11, 12, 13, 14, 18

MILLED PLATES WITH WELDED SHOULDERS



THREE TIE PLATE
REPLACE PLATE NOS. 15, 16, 17 (PLATE NO. 16 HAS CHAMFERED ENDS)

TOP VIEW SHOWS CONVENTIONAL RBM FROG. PREFERRED FROG IS CONFORMAL HEAVY POINT WITH GLUED TAPERED HEEL PER AREMA PLAN 621-09 SHOWN BELOW OR SOLID MANGANESE (WBM OR FWB).

ALL FROG PLATES TO BE MILLED SEAT 1" THICK 1/4" MILLED WITH 1/16" CORNER RADIUS.

- EXCEPTIONS FROM AREMA PLAN 625 LATEST REVISION:
 - FROG LENGTH.
 - USE MILLED SEAT PLATES WITH PANDROL SHOULDERS.
 - FROG HEEL HAS BONDED INSERT.

MANUFACTURER SHALL VERIFY ALL DIMENSIONS BEFORE FABRICATION.

ALL FROG PLATES SHALL BE DEEPLY STAMPED IN 1/2" CHARACTERS TO INDICATE CSX, MFR., FROG NO.15, RAIL SECTION AND PLATE NUMBER. MARK WILL BE ON SAME END OF PLATES WHEN PLATES ARE INSTALLED IN TRACK.

A MARKER SHALL BE PLACED ON THE OUTSIDE OF THE WING RAIL NEAR THE 1/2" POINT OF FROG IN RAISED OR DEEPLY CUT CHARACTERS TO INDICATE CSX, MFR., FROG NO.15, RBM, RAIL SECTION AND DATE. SERIAL NUMBER OF CASTING TO BE PLACED IN A LOCATION THAT IS VISIBLE WHEN THE FROG IS INSTALLED IN TRACK.

WORKMANSHIP AND MATERIALS, INCLUDING BEVELING RAIL ENDS, SHALL BE PER CURRENT CSX AND AREMA SPECIFICATIONS. PANDROL SHOULDERS MUST MEET PANDROL DESIGN STANDARDS.

CASTING TO BE RADIOGRAPHED FOR INTERNAL SOUNDNESS. SEE DRAWING 2400.

EXPLOSIVE HARDEN MANGANESE STEEL CASTING TO 352 BRINELL PER CURRENT AREMA PLAN 100- LATEST REVISION. CASTINGS FAILING TO MEET HARDNESS ARE NOT ACCEPTABLE.

FROG RAILS TO BE HEAD HARDENED PREMIUM RAIL.

BASE OF FROG SHALL MEET THEORETICAL WIDTH PLUS OR MINUS 1/8" INCH AND FIT IN PLATES SHOWN IN TABLE AT LEFT.

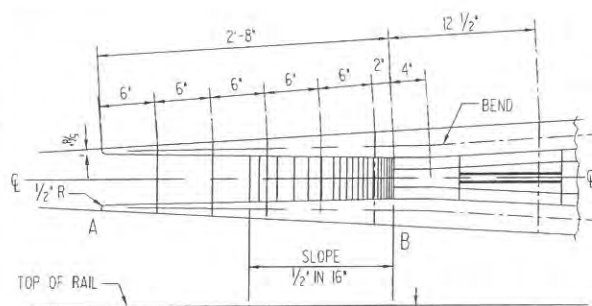
FROG ANGLE IS 3 -49'-06"

FROG BODY BOLTS ARE GRADE 8, 1 1/8" DIAMETER, WITH FLAT WASHERS, SECURITY LOCKNUTS, AND TORQUED TO 2,200 +/- 200 FT. LBS. LUBRICATED.

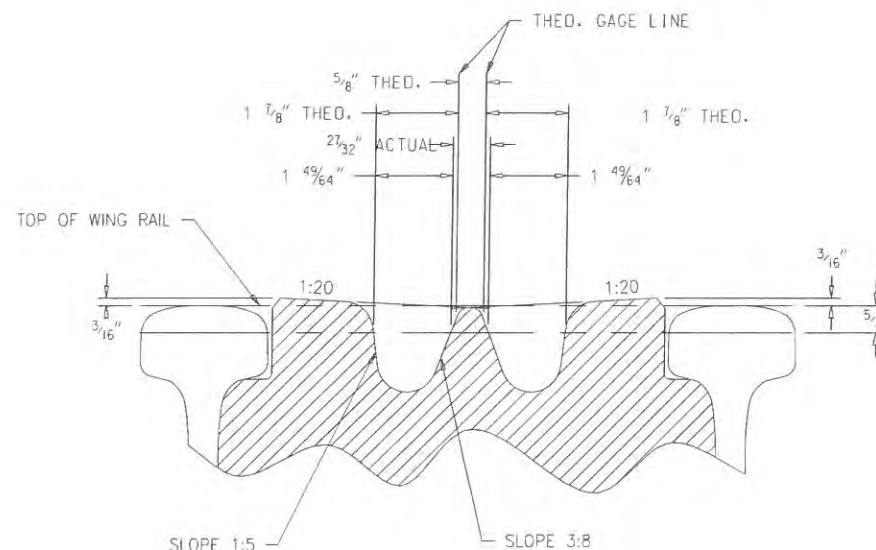
APPLY SIGNAL BONDS TO WING RAILS PER DRAWING SS5010N PTO.

FROG PLATE DATA							
MILLED SEAT PLATES				MILLED SEAT PLATES			
PL. NO.	6" RAIL BASE			PL. NO.	6" RAIL BASE		
	L	M	N		L	M	N
1	34 1/2"	15 1/32"	14 27/32"	8	25 3/4"	12 7/16"	11 29/32"
2	33 1/4"	14 3/32"	13 9/16"	9	27 1/2"	14 3/32"	12 9/16"
3	32"	12 13/16"	12 9/32"	10	30 3/4"	17 23/32"	16 1/4"
4	30 3/4"	11 1/32"	10 3/32"	11	32"	18 19/32"	18 1/16"
5	29 1/2"	10 1/4"	9 23/32"	12	33"	19 5/8"	18 1/8"
6	28 1/4"	8 15/16"	8 13/32"	13	29 3/4"	16 13/32"	15 1/8"
7	26 3/4"	7 13/32"	7 1/16"	14	31"	17 23/32"	17 3/16"
15	32 1/4"	19 1/4"	18 23/32"	18	26 1/2"	13 9/32"	12 3/4"
16	33 3/4"	20 9/16"	20 1/16"				
17	29"	12"	11 1/2"				
19	27 1/2"	8 17/32"	8"				
20	29"	9 27/32"	9 9/16"				
21	30 1/4"	11 5/32"	10 5/8"				
22	31 1/2"	12 1/16"	11 29/32"				
23	32 3/4"	13 3/4"	13 7/32"				
24	34 1/4"	15 1/32"	14 1/2"				
25	35 1/2"	16 1/32"	15 19/16"				

BOLT DATA					
BOLT NO.	LENGTH	NO. REOD	BOLT NO.	LENGTH	NO. REOD
B1	11"	5	B6	17"	2
B2	10"	4	B7	14"	1
B3	13"	1	B8	18"	3
B4	15"	3	B9	19"	1
B5	16"	2			



TAPERED HEEL DETAIL



HEAVY POINT DETAIL @ THEORETICAL 5/8" POINT



NUMBER 15 RAILBOUND MANGANESE STEEL FROG WITH BONDED TAPERED HEEL AND CONFORMAL RUNNING SURFACE FOR 136RE RAIL

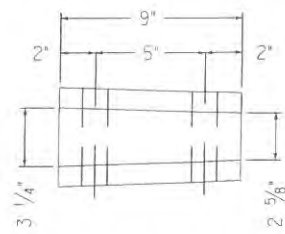
Miguel Torres

APPROVED - MIGUEL TORRES

CFRC CHIEF OPERATING OFFICER

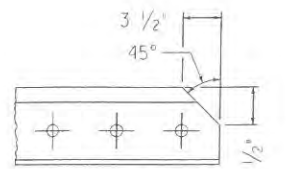
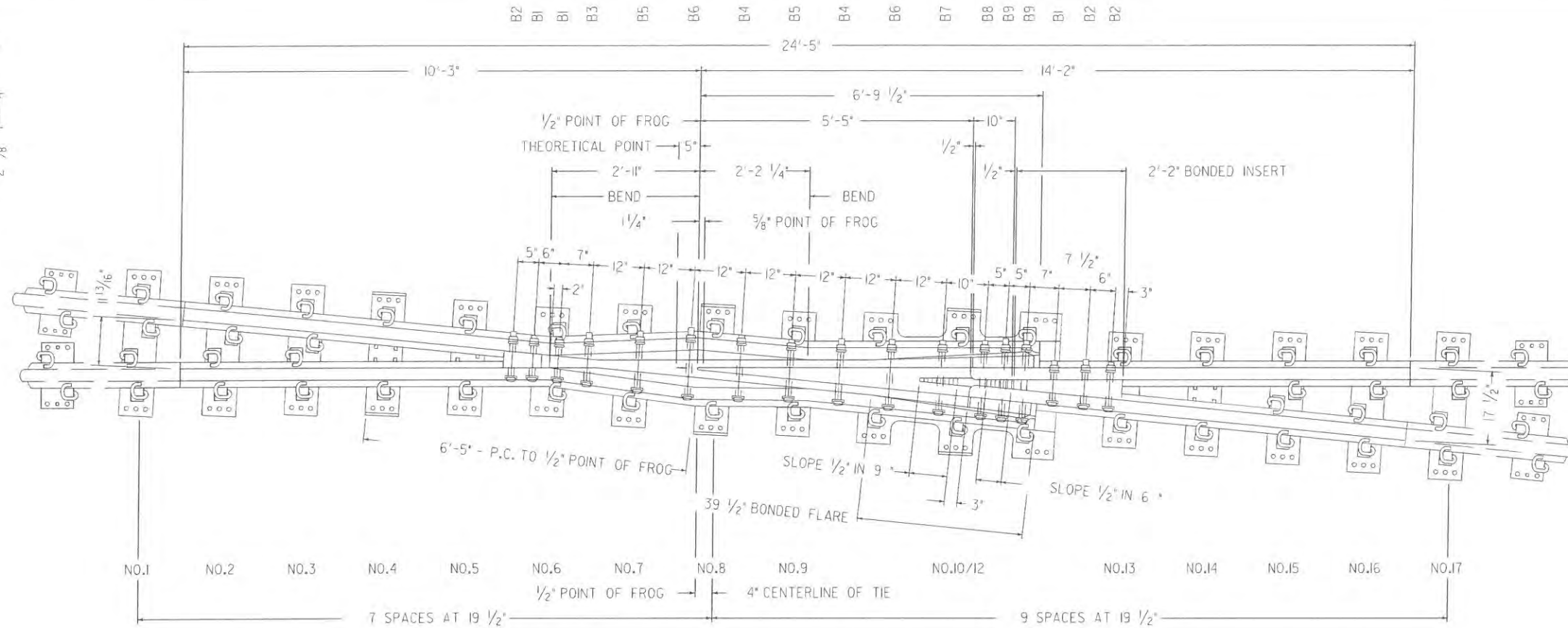
PREPARED BY: RMW ISSUED: 9/9/2015 REVISED: 4/2/2015

12/18/12 - CORRECTED FROG POINT DETAILS

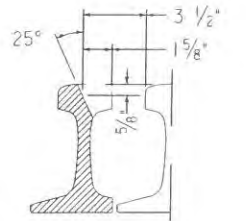


SPREADS SHOWN ON TOE FILLER BLOCK ARE 1/8" BELOW TOP OF RAIL

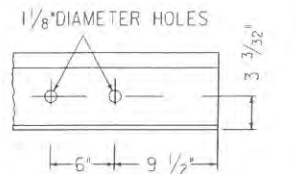
TOE FILLER BLOCK



BEVELED END OF WING RAIL

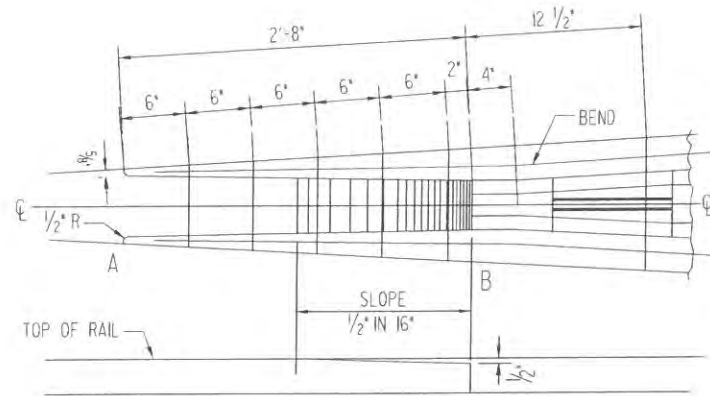


PLANING AT END OF WING RAIL

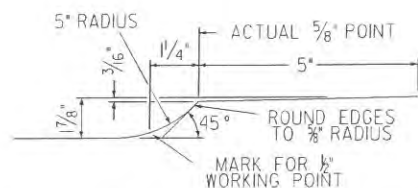


TO BE FURNISHED EXCEPT WHEN BLANK ENDS ARE SPECIFIED ON THE PURCHASE ORDER

RAIL END DRILLING



TAPERED HEEL DETAIL



ELEVATION OF CONVENTIONAL POINT

BOLT DATA 13/8" DIAMETER					
BOLT NO.	LENGTH	NO. REOD	BOLT NO.	LENGTH	NO. REOD
B1	10'	3	B6	16'	2
B2	11'	3	B7	17'	1
B3	12'	1	B8	18'	1
B4	15'	2	B9	19'	2
B5	14'	2	B10	20'	2

EXCEPTIONS FROM LATEST REVISION OF AREMA PLAN 623.

1. FROG LENGTH
2. USE MILLED SEAT PLATES WITH PANDROL SHOULDERS.
3. FROG HEEL IS TAPERED AND EPOXY BONDED.

ALL FROG PLATES TO BE MILLED SEAT 1" THICK, 1/4" MILLED

A MARKER PLATE SHALL BE PLACED ON THE ON THE OUTSIDE OF THE WING RAIL NEAR THE 1/2 INCH POINT OF FROG IN RAISED OR DEEPLY CUT CUT CHARACTERS TO INDICATE CSX, MFR., FROG NO. 10, RBM, 136RE RAIL AND DATE, SERIAL NUMBER OF CASTING TO BE PLACED IN A LOCATION THAT IS VISIBLE WHEN THE FROG IS INSTALLED IN TRACK.

WORKMANSHIP AND MATERIALS, INCLUDING BEVELING RAIL ENDS, SHALL BE PER CURRENT CSX AND AREMA SPECIFICATIONS. PANDROL SHOULDERS MUST MEET PANDROL DESIGN DESIGN STANDARDS.

THE INTERNAL SOUNDNESS OF FROG CASTINGS WILL BE VERIFIED BY RADIOGRAPHIC TESTING PER CURRENT AREMA PLAN 100- LATEST REVISION. CASTINGS FAILING TO MEET SOUNDNESS REQUIREMENTS ARE NOT ACCEPTABLE.

EXPLOSIVE HARDENED MANGANESE STEEL CASTING TO 352 BRINELL PER CURRENT AREMA PLAN 100-LATEST REVISION. CASTINGS FAILING TO MEET HARDNESS REQUIREMENTS ARE NOT ACCEPTABLE.

RAIL TO BE HEAD HARDENED.

BASE OF FROG SHALL MEET THEORETICAL PLUS OR MINUS 1/8 INCH AND FIT IN PLATES SHOWN IN TABLE ON DRAWING 2431.

FROG PLATES ARE PERPENDICULAR TO CENTERLINE OF FROG.

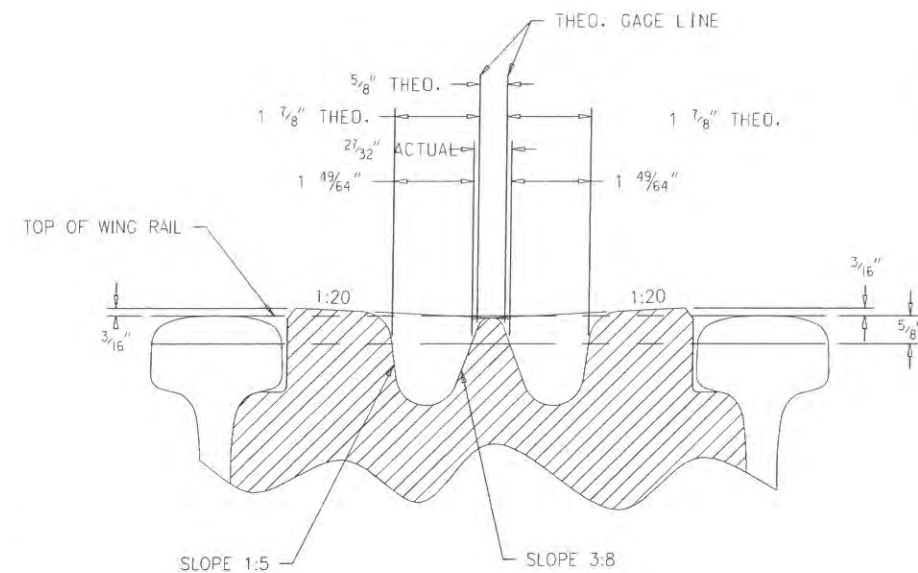
FROG BODY BOLTS ARE GRADE 8, 1 3/8" DIAMETER, WITH FLAT WASHERS AND SECURITY LOCKNUTS, AND TORQUED TO 2,200 +200/-0 FT. LBS LUBRICATED.

FROG ANGLE IS 5° -43' -29°.

THE FROG MANUFACTURER IS TO SUBMIT A DESCRIPTION OF THE EPOXY BONDING PROCEDURES TO BE USED AND THE ENVIRONMENTAL DATA SHEETS FOR THE EPOXY GLUE AND ANY OTHER CHEMICALS WITH RESIDUAL EFFECTS TO BE USED PRIOR TO THE MANUFACTURE OF FROGS.

TOP VIEW SHOWS CONVENTIONAL RBM FROG. PREFERRED FROG IS CONFORMAL HEAVY POINT WITH GLUED TAPERED HEEL PER AREMA PLAN 621-09 OR SOLID MANGANESE (WBM OR FWB)

APPLY SIGNAL BONDS TO WING RAILS PER DRAWING 555010N PTO.



HEAVY POINT DETAIL@ THEORETICAL 5/8" POINT



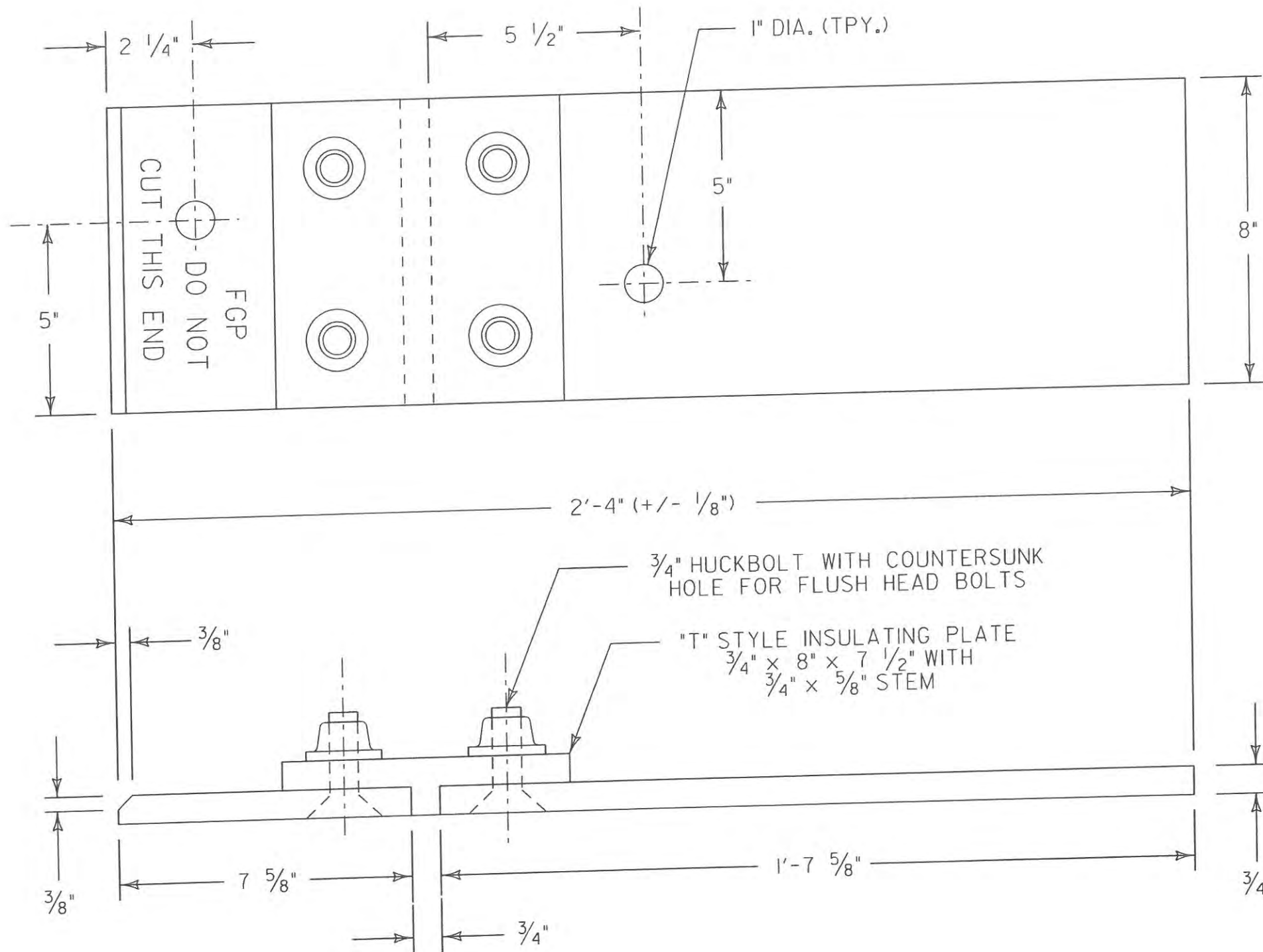
NUMBER 10 RAILBOUND MANGANESE STEEL FROG WITH BONDED TAPERED HEEL AND CONFORMAL RUNNING SURFACE FOR 136RE RAIL

Miguel Torres

APPROVED - MIGUEL TORRES

CFRC CHIEF OPERATING OFFICER

PREPARED BY: RMW ISSUED: 9/9/2015 REVISED: 4/2/2015



INSTALLATION NOTES:

AFTER GUARD CHECK GAGE HAS BEEN SET, CUSTOM CUT FGP TO FIT BETWEEN THE GUARD RAIL AND FROG PLATES AND WELD. THE GUARD RAIL AND FROG PLATES ARE CHAMFERED TO ALLOW FOR FILLET WELD. NEVER TRIM A CHAMFERED END.

PLATES SHALL BE DEEPLY (1/16") STAMPED WITH 1/2" LETTERS TO INDICATE CFRC, MANUFACTURER, PLATE NUMBER (FGP), AND THE CAUTION (DO NOT CUT THIS END) SHOWN ABOVE.

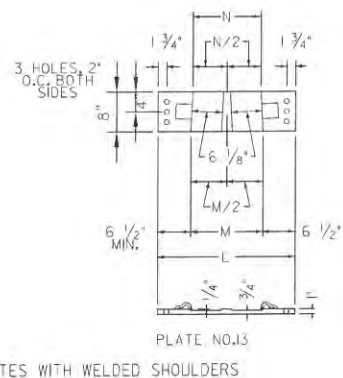
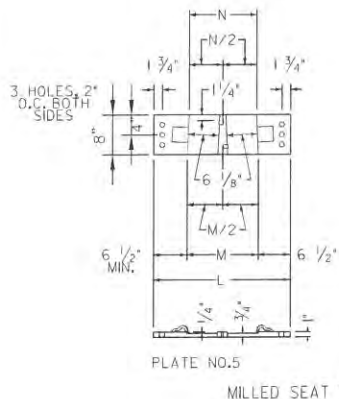
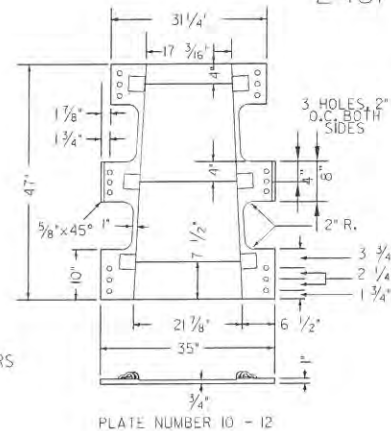
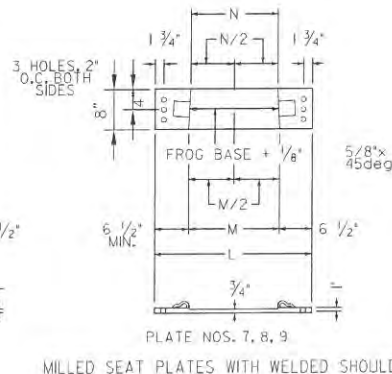
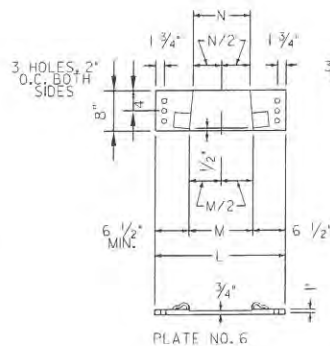
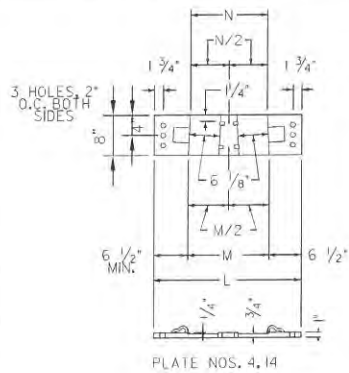
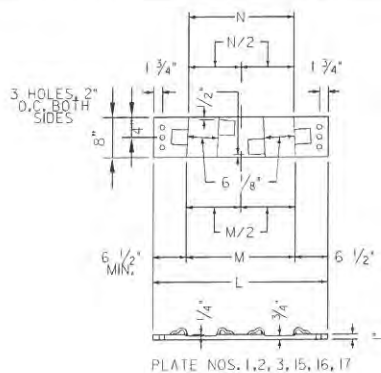
DESCRIPTION	UNITS
FROG GAGE PLATE CUSTOM CUT IN FIELD	EACH

CFRC
Central Florida Rail Corridor
FROG GAGE PLATE

Miguel Torres
APPROVED - MIGUEL TORRES

CFRC CHIEF OPERATING OFFICER

PREPARED BY: RMW ISSUED: 9/9/2015 REVISED: 4/2/2015



- EXCEPTIONS FROM AREMA PLAN 623 LATEST REVISION:
 1. FROG LENGTH.
 2. USE MILLED SEAT PLATES WITH PANDROL SHOULDERS.

ALL FROG PLATES SHALL BE DEEPLY STAMPED IN 1/2" CHARACTERS TO INDICATE CFRC, MFR., FROG NO., IO, I36 RE, AND PLATE NUMBER. MARK WILL BE ON SAME END OF PLATES WHEN PLATES ARE INSTALLED IN TRACK.

WORKMANSHIP AND MATERIALS SHALL BE PER CURRENT CFRC AND AREMA SPECIFICATIONS.

PANDROL SHOULDERS MUST MEET PANDROL DESIGN STANDARDS.

BASE OF FROG SHALL MEET THEORETICAL WIDTH PLUS OR MINUS 1/8" AND FIT IN PLATES SHOWN IN TABLE.

FROG PLATES ARE PERPENDICULAR TO CENTERLINE OF FROG.

PANDROL SHOULDERS ARE PERPENDICULAR TO BASE OF FROG. SHOULDERS ARE AT CENTERLINE OF PLATE UNLESS THEY ARE DIMENSIONED SEPARATELY.

ROUND SPIKE HOLES TO BE 1" DIAMETER FOR 1 5/16" DIA, 6 1/2" OR 7" LONG SCREW SPIKES.

RECTANGULAR SPIKE HOLES CONTACTING RAIL BASE ARE 3/4" X 7/8" WITH 1/8" UNDER RAIL BASE AND 1/4" IN FROM EDGE OF PLATE.

PLATES 4 AND 8 TO HAVE 5/16" X 45° CHAMFER ALONG 8" ENDS FOR WELDING GAGE PLATE.

FROG ANGLE 5°-43'-29".

ALL FROG PLATES TO BE MILLED SEAT 1" THICK 1/4" MILLED WITH 1/16" CORNER RADIUS.

NUMBER 10 RBM FROG PLATE DATA FOR I36RE RAIL							
MILLED SEAT PLATES				MILLED SEAT PLATES			
PLATE NUMBER	I36RE RAIL			PLATE NUMBER	I36RE RAIL		
	L	M	N		L	M	N
1	35"	21 7/8"	21 1/8"	10	SEE DETAIL		
2	33 1/4"	20 1/32"	19 9/32"	11	SEE DETAIL		
3	31 1/4"	18 5/32"	17 3/8"	12	SEE DETAIL		
4	29 1/2"	16 7/32"	15 13/32"				
5	27 1/2"	14 1/4"	13 15/32"	13	27 1/2"	14 7/16"	13 5/8"
6	26"	12 3/4"	11 13/32"	14	29 1/2"	16 3/8"	15 9/16"
7	29 1/4"	16 1/8"	14 3/4"	15	31 1/2"	18 11/32"	17 17/32"
8	31 1/4"	18 1/8"	17 1/2"	16	33 1/2"	20 5/16"	19 1/2"
9	29 3/4"	16 9/16"	15 13/16"	17	35 1/4"	22 1/4"	21 7/16"



FROG PLATES FOR NUMBER 10 RBM FROG FOR I36RE RAIL

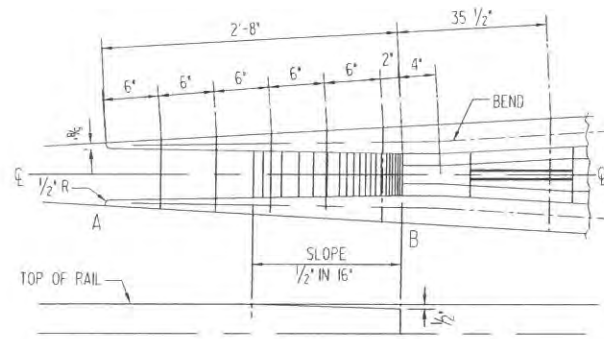
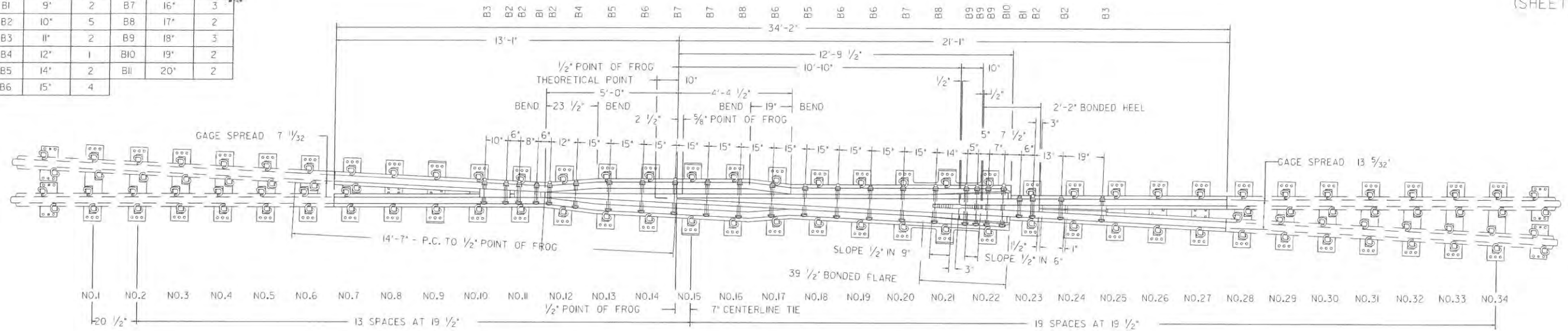
Miguel Torres

APPROVED - MIGUEL TORRES

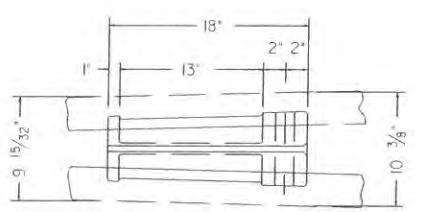
CFRC CHIEF OPERATING OFFICER

12/18/12 - CORRECTED FROG POINT DETAILS

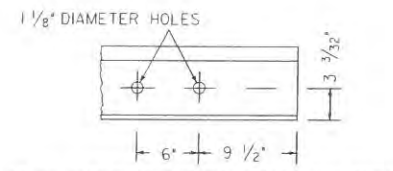
BOLT DATA					
BOLT NO.	LENGTH	NO. RECD.	BOLT NO.	LENGTH	NO. RECD.
B1	9"	2	B7	16"	3
B2	10"	5	B8	17"	2
B3	11"	2	B9	18"	3
B4	12"	1	B10	19"	2
B5	14"	2	B11	20"	2
B6	15"	4			



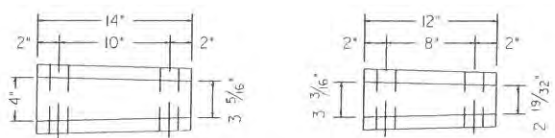
TAPERED HEEL DETAIL



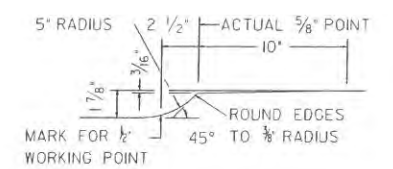
HEEL FILLER BLOCKS
SPREADS SHOWN ON HEEL FILLER BLOCKS ARE 3/8\"/>



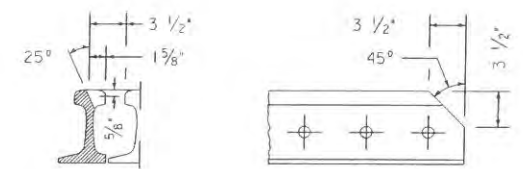
RAIL END DRILLING
TO BE FURNISHED EXCEPT WHEN BLANK ENDS ARE SPECIFIED ON THE PURCHASE ORDER



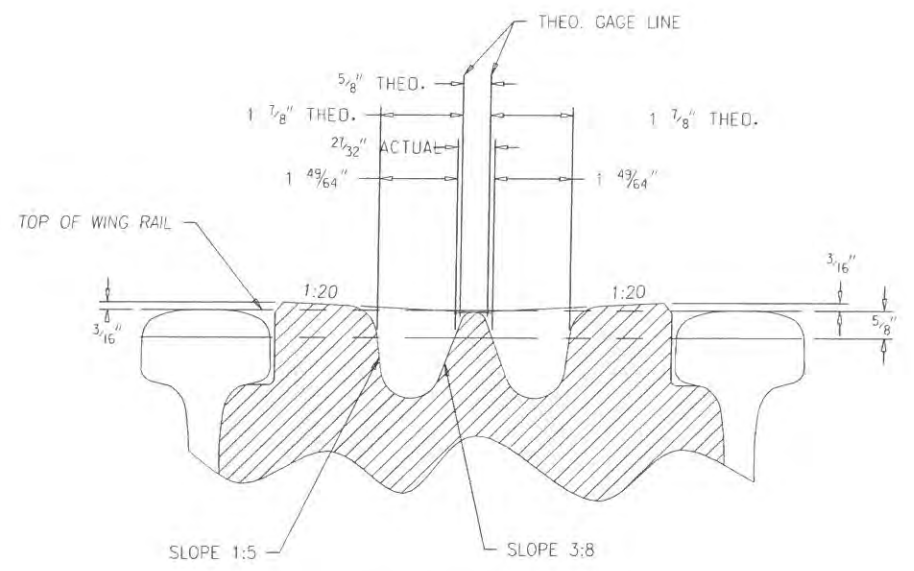
TOE FILLER BLOCKS
SPREADS SHOWN ON TOE FILLER BLOCKS ARE 3/8\"/>



ELEVATION OF CONVENTIONAL POINT



PLANING AT END BEVELED END
WING RAIL DETAILS



HEAVY POINT DETAIL
@ THEORETICAL 5/8\"/>

- EXCEPTIONS FROM AREMA PLAN 625 LATEST REVISION:
1. FROG LENGTH.
 2. USE MILLED SEAT PLATES WITH PANDROL SHOULDERS.
 3. FROG HEEL IS EPOXY BONDED.
 4. USE OF FROG GAGE PLATES.
 5. ALL FROG PLATES TO BE MILLED SEAT 1\"/>

ALL FROG PLATES SHALL BE DEEPLY STAMPED IN 1/2\"/>

A MARKER PLATE SHALL BE PLACED ON THE OUTSIDE OF THE WING RAIL NEAR THE 1/2\"/>

THE INTERNAL SOUNDNESS OF FROG CASTINGS WILL BE VERIFIED BY RADIOGRAPHIC TESTING PER CURRENT AREMA PLAN 100- LATEST REVISION. CASTINGS FAILING TO MEET SOUNDNESS REQUIREMENTS ARE NOT ACCEPTABLE.

WORKMANSHIP AND MATERIALS, INCLUDING BEVELING RAIL ENDS, SHALL BE PER CURRENT CFRC AND AREMA SPECIFICATIONS. PANDROL SHOULDERS MUST MEET PANDROL DESIGN STANDARDS.

EXPLOSIVE HARDENED MANGANESE STEEL CASTING TO 352 BRINELL PER CURRENT AREMA PLAN 100- LATEST REVISION. CASTINGS FAILING TO MEET HARDNESS REQUIREMENTS ARE NOT ACCEPTABLE.

FROG RAILS TO BE HEAD HARDENED.

BASE OF FROG SHALL MEET THEORETICAL WIDTH PLUS OR MINUS 1/8\"/>

FROG BODY BOLTS ARE GRADE 8, 1 1/2\"/>

THE MANUFACTURER SHALL VERIFY ALL DIMENSIONS BEFORE FABRICATION.

FROG ANGLE IS 2° -51\"/>

TOP VIEW SHOWS CONVENTIONAL RBM FROG. PREFERRED FROG IS CONFORMAL HEAVY POINT WITH GLUED TAPERED HEEL PER AREMA PLAN 621 OR SOLID MANGANESE (WBM OR FWB)

APPLY SIGNAL BONDS TO WING RAILS PER DRAWING S55010 P10.



Central Florida Rail Corridor

NUMBER 20 RAILBOUND BONDED HEEL
MANGANESE STEEL FROG FOR 136RE RAIL

Miguel Torres
APPROVED - MIGUEL TORRES

CFRC CHIEF OPERATING OFFICER

PREPARED BY: RMW ISSUED: 9/9/2015 REVISED: 4/2/2015

12/18/12 - SPECIFIED FROG PLATES TO BE MILLED WITH 1/16" CORNER RADIUS.

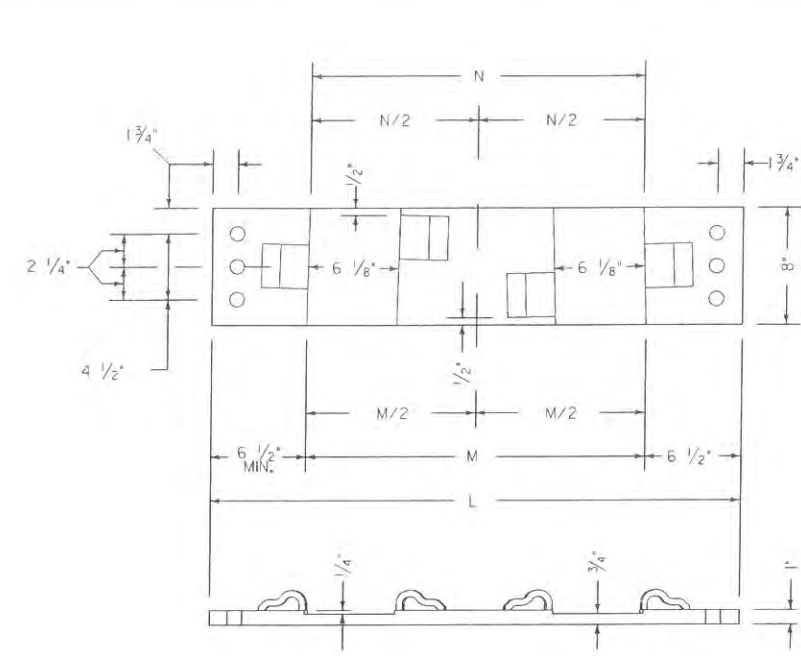


PLATE NOS. 1, 2, 3, 4, 5, 6, 7,
28, 29, 30, 31, 32, 33, 34

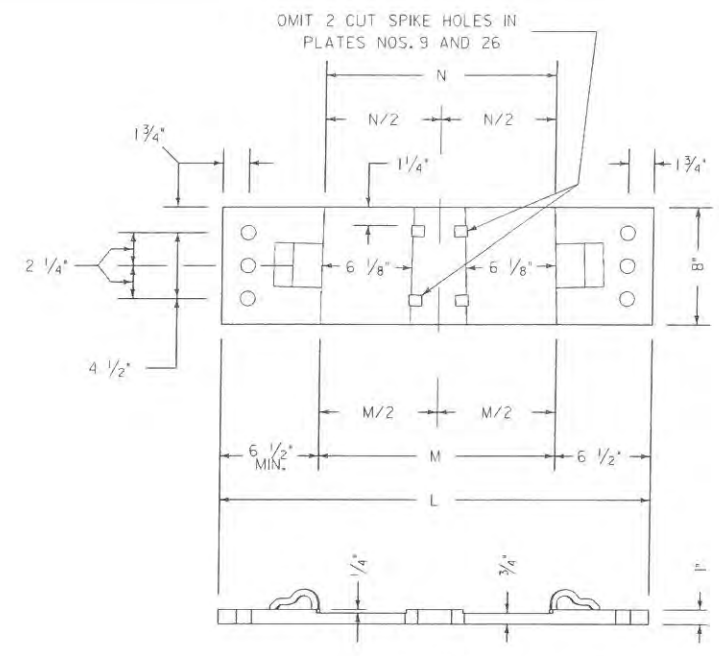


PLATE NOS. 8, 9, 26, 27
(PLATE NO. 9 HAS CHAMFERED ENDS LIKE PLATE 15)

PL. NO.	136RE RAIL			CHAMFER PLATE
	L	M	N	
1	35"	21 13/16"	21 7/16"	
2	34"	20 27/32"	20 15/32"	
3	33"	19 29/32"	19 1/2"	
4	32 1/4"	18 15/16"	18 9/16"	
5	31 1/4"	18"	17 19/32"	
6	30 1/4"	17 1/32"	16 5/8"	
7	29 1/4"	16 1/32"	15 21/32"	
8	28 1/4"	15 1/16"	14 21/32"	
9	28 1/2"	14 3/32"	13 11/16"	YES
10	26 1/2"	13 1/4"	12 27/32"	
11	25 1/2"	12 9/32"	11 7/8"	
12	27 1/4"	14 1/16"	12 15/32"	
13	29 3/4"	16 5/8"	16 7/32"	
14	30 3/4"	17 19/32"	17 3/16"	
15	32"	18 9/16"	18 5/32"	YES
16	32 3/4"	19 17/32"	19 5/32"	
17	31 1/4"	18"	16 13/32"	
18	30"	16 3/4"	16 11/32"	
19	31"	17 23/32"	17 5/16"	
20	32"	18 11/16"	18 9/32"	YES
21	34 1/4"	19 21/32"	19 9/32"	
22	33 3/4"	20 21/32"	20 1/4"	
23	25 1/4"	12 7/32"	11 13/16"	
24	26 1/4"	13 3/16"	12 25/32"	
25	27 1/4"	14 5/32"	13 25/32"	
26	28 1/4"	15 5/32"	14 3/4"	
27	29 1/4"	16 1/8"	15 23/32"	
28	30 1/4"	17 3/32"	16 11/16"	
29	31 1/4"	18 1/16"	17 21/32"	
30	32 1/4"	19 1/32"	18 21/32"	
31	33 1/4"	20 1/32"	19 5/8"	
32	34"	21"	20 19/32"	
33	35"	21 31/32"	21 9/16"	
34	36"	22 15/16"	22 17/32"	

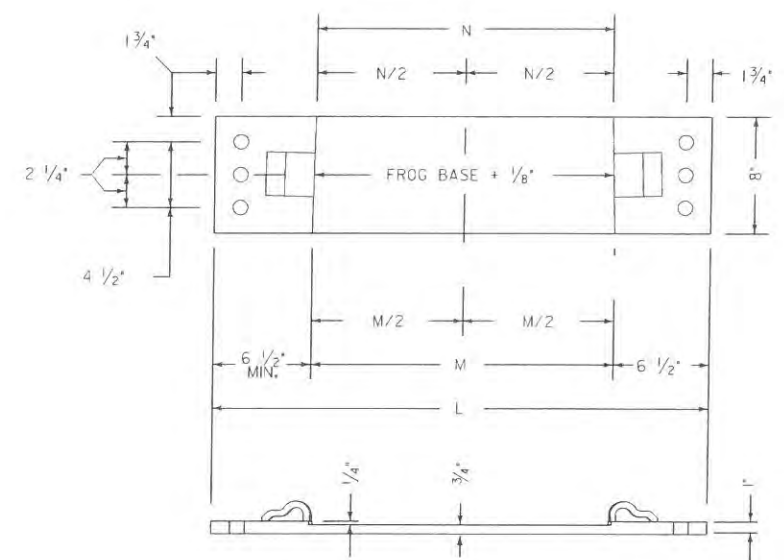


PLATE NOS. 10, 11, 12, 13, 14
16, 17, 18, 19, 23, 24, 25

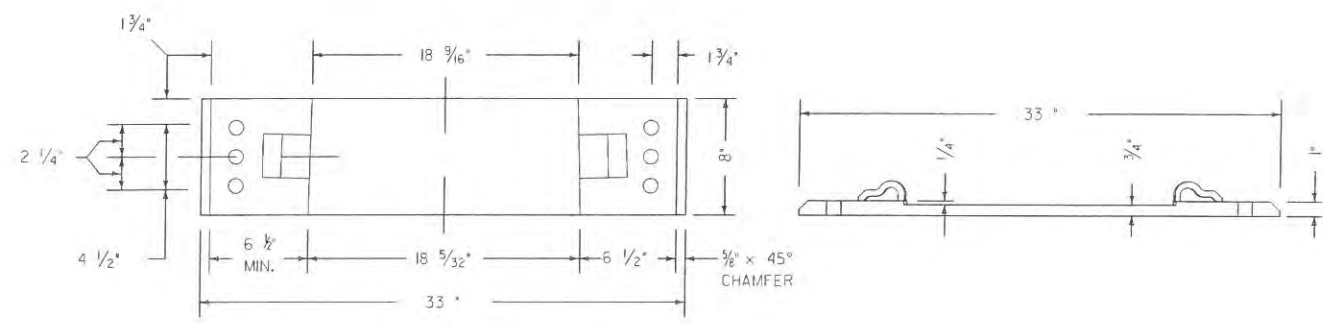
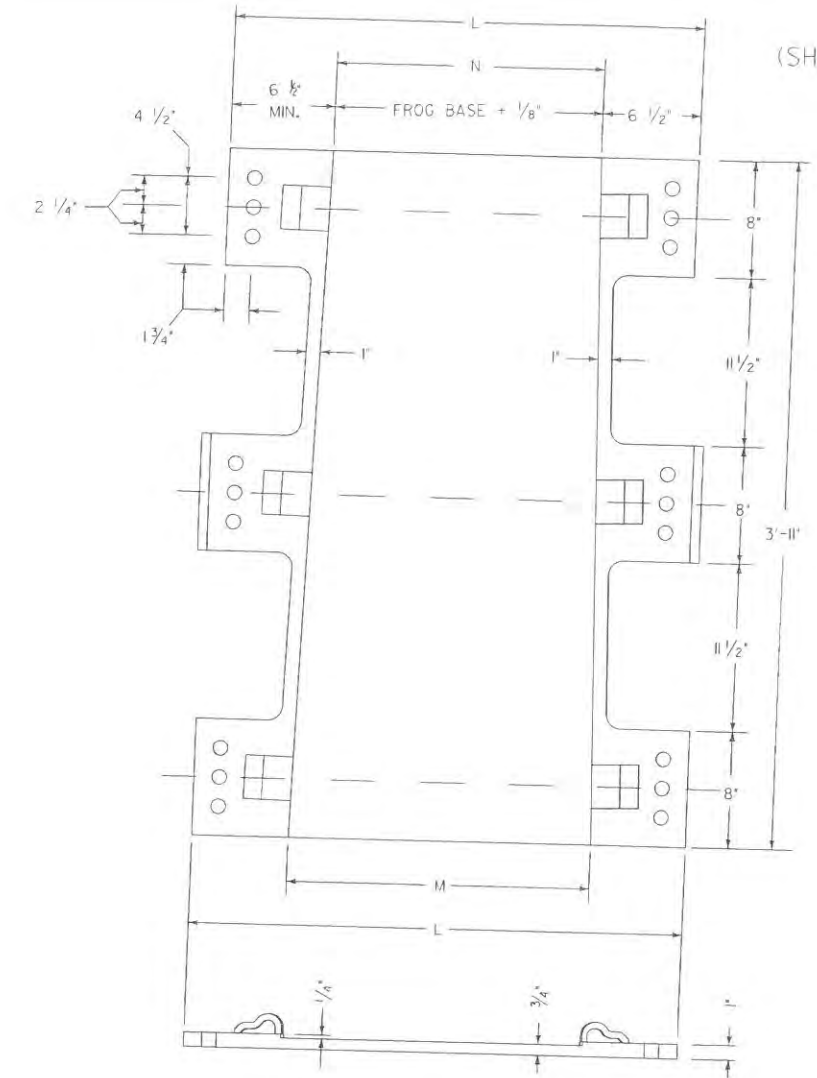


PLATE NO. 15

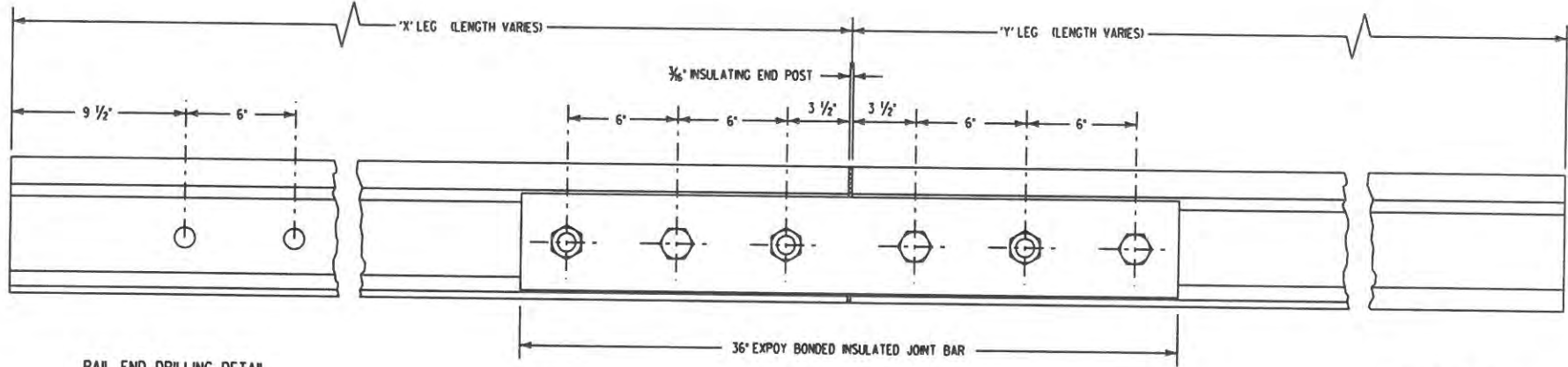


THREE TIE PLATE
REPLACES PLATE NOS. 20, 21, 22
(PLATE NO. 21 HAS CHAMFERED ENDS)

FROG PLATES ARE PERPENDICULAR TO CENTERLINE OF FROG
PANDROL SHOULDERS ARE PERPENDICULAR TO BASE OF FROG. SHOULDERS ARE AT CENTERLINE OF PLATE UNLESS THEY ARE DIMENSIONED SEPARATELY.
ROUND SPIKE HOLES TO BE 1" DIAMETER FOR 5/8" DIAMETER x 6 1/2" LONG SCREW SPIKES.
RECTANGULAR SPIKE HOLES CONTACTING RAIL BASE ARE 3/4" x 1/2" WITH 1/8" UNDER RAIL BASE.
ALL FROG PLATES TO BE MILLED SEAT 1" THICK 1/4" MILLED WITH 1/16" CORNER RADIUS.

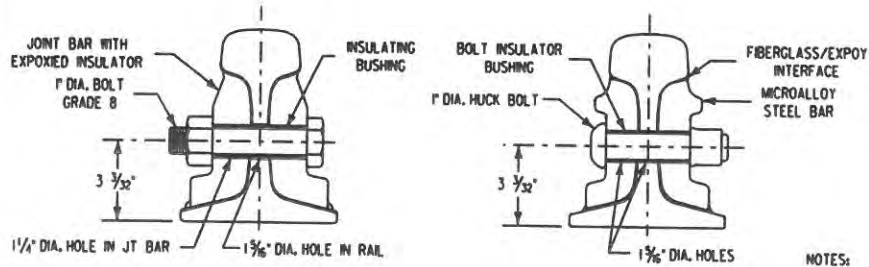
CFRC
Central Florida Rail Corridor
NUMBER 20 RAILBOUND MANGANESE STEEL
FROG PLATES FOR 136RE RAIL

Miguel Torres
APPROVED - MIGUEL TORRES
CFRC CHIEF OPERATING OFFICER

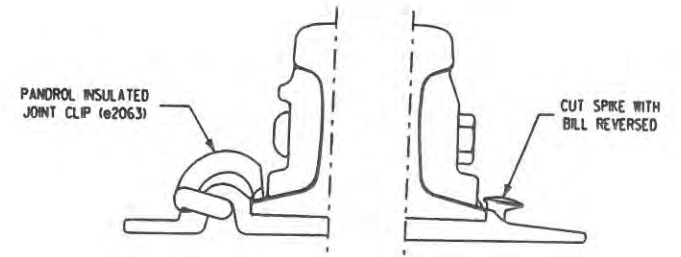


RAIL END DRILLING DETAIL (IF SPECIFIED IN ORDER)

BLANK END DETAIL



TYPICAL CROSS SECTIONS



TYPICAL FASTENING DETAIL

- NOTES:
1. JOINTS TO BE CONSTRUCTED IN ACCORDANCE TO AREMA SPECIFICATIONS PER CHAPTER 4 SECTION 3
 2. ALL JOINTS ARE EPOXY BONDED
 3. ALL JOINTS USE HEAD HARDENED RAIL PER CFRC REQUIREMENTS
 4. ALL JOINTS HAVE 3/8\"/>
 - 5. MANUFACTURER IS TO PAINT THE BALANCED LIFTING POINTS OF PLUG
 - 6. TOTAL LENGTHS FOR ALL WEIGHT SECTIONS TO BE 20' AND 40'
 - 7. TOLERANCES FOR LENGTHS:
 - A. +/- .4\"/>
 - B. +/- .2\"/>

013.3000300J	LB FOSTER BONDED INSULATED JOINT BOLT REPLACEMENT KIT
013.3000400J	PORTEC/KOPPERS BONDED INSULATED JOINT BOLT REPLACEMENT KIT

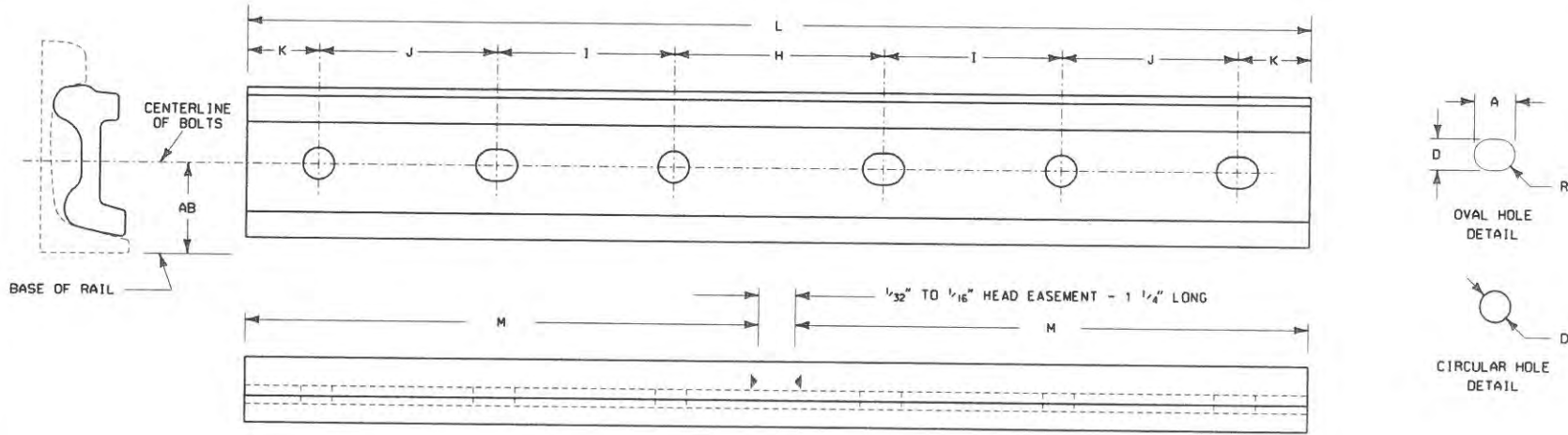
ORDERING INFORMATION FOR COMMON INSULATED JOINTS				
PREMIUM INSULATED JOINTS				
RAIL WEIGHT	TOTAL LENGTH	LEG LENGTH 'X'	LEG LENGTH 'Y'	
#5RE	20'	13'-4"	6'-8"	
#5RE	40'	23'-4"	16'-8"	
#22CB	20'	13'-4"	6'-8"	
#22CB	40'	23'-4"	16'-8"	
#132RE	20'	13'-4"	6'-8"	
#132RE	40'	23'-4"	16'-8"	
#136RE	20'	13'-4"	6'-8"	
#136RE	40'	23'-4"	16'-8"	
#14IRE	20'	13'-4"	6'-8"	
#14IRE	40'	23'-4"	16'-8"	

ORDERING INFORMATION FOR COMMON INSULATED JOINTS				
REGULAR INSULATED JOINTS				
RAIL WEIGHT	TOTAL LENGTH	LEG LENGTH 'X'	LEG LENGTH 'Y'	
#5RE	20'	13'-4"	6'-8"	
#5RE	40'	23'-4"	16'-8"	
#22CB	20'	13'-4"	6'-8"	
#22CB	40'	23'-4"	16'-8"	
#132RE	20'	13'-4"	6'-8"	
#132RE	40'	23'-4"	16'-8"	
#136RE	20'	13'-4"	6'-8"	
#136RE	40'	23'-4"	16'-8"	
#14IRE	20'	13'-4"	6'-8"	
#14IRE	40'	23'-4"	16'-8"	

CFRC
Central Florida Rail Corridor
 EPOXY BONDED INSULATED JOINT
 FOR #15RE, #132RE, #136RE, AND #14IRE RAIL

Miguel Torres

APPROVED - MIGUEL TORRES
 CFRC CHIEF OPERATING OFFICER



TYPICAL JOINT BARS													
RAIL SECTION	BOLT SIZE	AB	R	D	A	K	J	I	H	L	M	RAIL DRILLING	SCN
141 RE													
136 RE	1"	3 3/32"	1 7/32"	1 1/16"	1 13/32"	2 7/16"	6"	6"	7 1/8"	36"	17 3/8"	1 1/8"	
132 RE													
122 CB	1"	2 7/8"	1 7/32"	1 1/16"	1 13/32"	2 7/16"	6"	6"	7 1/8"	36"	17 3/8"	1 1/8"	
115 RE	1"	2 7/8"	1 7/32"	1 1/16"	1 13/32"	2 7/16"	6"	6"	7 1/8"	36"	17 3/8"	1 1/8"	
MAINTENANCE USE JOINT BARS													
140 RE	1 1/8"	3 3/32"	1 9/32"	1 3/16"	1 9/16"	2 7/16"	6 1/2"	6 1/2"	5 1/8"	36"	17 3/8"	1 1/4"	
	1 1/8"	3"	1 9/32"	1 3/16"	1 13/32"	2 7/16"	6"	6"	5 1/2"	36"	17 3/8"	1 1/4"	
	1 1/8"	3"	1 7/32"	1 1/16"	1 13/32"	2 7/16"	6"	6"	7 1/8"	36"	17 3/8"	1 1/8"	
136 RE	1 1/8"	3 3/32"	1 9/32"	1 3/16"	1 9/16"	2 7/16"	6"	6"	7 1/8"	36"	17 3/8"	1 1/4"	
132 RE													
136 NYC	1 1/8"	3 1/8"	1 9/32"	1 3/16"	1 9/16"	2 7/16"	6"	6"	7 1/8"	36"	17 3/8"	1 1/4"	
127 DM													
133 RE	1"	3"	1 7/32"	1 1/16"	1 13/32"	2 7/16"	6"	6"	7 1/8"	36"	17 3/8"	1 1/8"	
131 RE	1 1/8"	3 3/32"	1 9/32"	1 3/16"	1 9/16"	2 7/16"	6 1/2"	6 1/2"	5 1/8"	36"	17 3/8"	1 1/4"	
130 RE	1 1/8"	2 31/32"	1 9/32"	1 3/16"	1 9/16"	2 7/16"	6 1/2"	6 1/2"	5 1/8"	36"	17 3/8"	1 1/4"	
127 DY	1"	3 1/8"	1 7/32"	1 1/16"	1 13/32"	3 15/16"	5 5/8"	5 5/8"	5 5/8"	36"	17 3/8"	1 1/8"	
119 RE													
115 RE	1"	2 7/8"	1 7/32"	1 1/16"	1 13/32"	2 7/16"	6 1/2"	6 1/2"	5 1/8"	36"	17 3/8"	1 1/8"	
112 RE	1"	2 7/8"	1 7/32"	1 1/16"	1 13/32"	2 7/16"	6 1/2"	6 1/2"	5 1/8"	36"	17 3/8"	1 1/8"	
						2 15/16"	-	6 1/2"	5 1/8"	24"	11 3/8"	1 1/8"	
110 RE	1 1/8"	2 53/64"	1 9/32"	1 3/16"	1 9/16"	3 3/4"	-	5 1/2"	5 1/2"	24"	11 3/8"	1 1/4"	
100 RE	1 1/8"	2 1/2"	1 9/32"	1 3/16"	1 9/16"	3 3/4"	-	5 1/2"	5 1/2"	24"	11 3/8"	1 1/4"	
100 RB	1"	2 53/64"	1 7/32"	1 1/8"	1 1/2"	3"	-	6"	6"	24"	11 3/8"	1 1/8"	
	1"	2 51/64"	1 7/32"	1 1/8"	1 1/2"	3 3/4"	-	5 1/2"	5 1/2"	24"	11 3/8"	1 1/8"	

TYPICAL BOLTS		
DIAMETER	LENGTH	DESCRIPTION
1"	5 1/2"	BOLT/NUT
	5 3/4"	BOLT/NUT
	6"	BOLT/NUT
		WASHER
1 1/8"	6"	BOLT/NUT
		WASHER

CFRC
Central Florida Rail Corridor
JOINT BARS FOR TYPICAL
RAIL SECTIONS

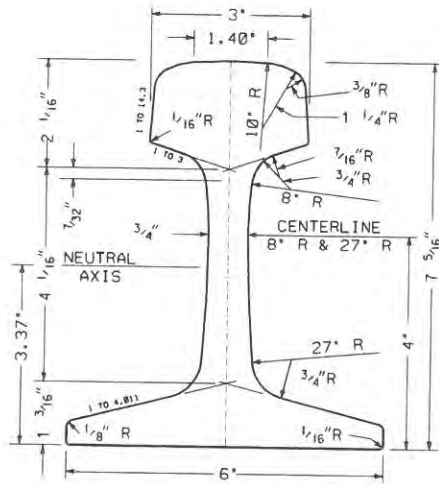
Miguel Torres

APPROVED - MIGUEL TORRES

CFRC CHIEF OPERATING OFFICER

PREPARED BY: RMW ISSUED: 9/9/2015 REVISED: 4/2/2015

- NOTES
1. NOT ALL RAIL SIZES AND JOINT COMBINATIONS SHOWN FOR SMALLER RAIL SIZES.
 2. ALL JOINT BARS TO BE MANUFACTURED IN ACCORDANCE WITH AREMA SPECIFICATIONS
 3. ALL JOINT BARS TO HAVE SUPPLIER, MANUFACTURER (IF NOT THE SAME), COMPATIBLE SECTIONS, HEAT NUMBER, AND YEAR OF MANUFACTURE CLEARLY AND PERMANENTLY MARKED ON JOINT BAR WITH RAISED LETTERS OR DEEP STAMPING PURSUANT TO AREMA SPECIFICATIONS.



140 RE

AREA :
 HEAD - 5.08 IN.² = 37.2 %
 WEB - 3.71 IN.² = 27.1 %
 BASE - 4.88 IN.² = 35.7 %

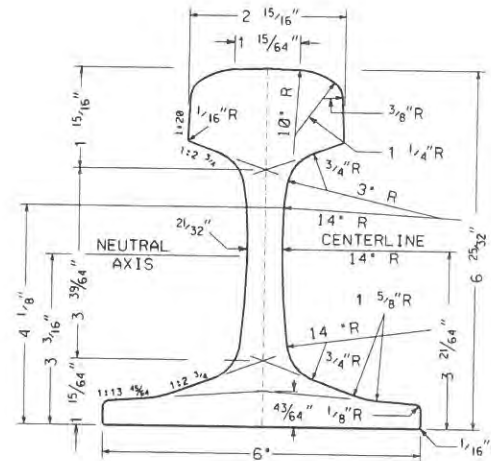
RAIL WEIGHT :
 139.36 LBS./YD.

MOMENT OF INERTIA :
 95.9 IN.⁴

SECTION MODULUS :
 HEAD - 24.3 IN.³
 BASE - 28.6 IN.³

NET TONS PER TRACK MILE :
 245.28 TONS

RAIL DRILLING :
 3 IN. ABOVE BASE



122 CB

AREA :
 12.01 IN.²

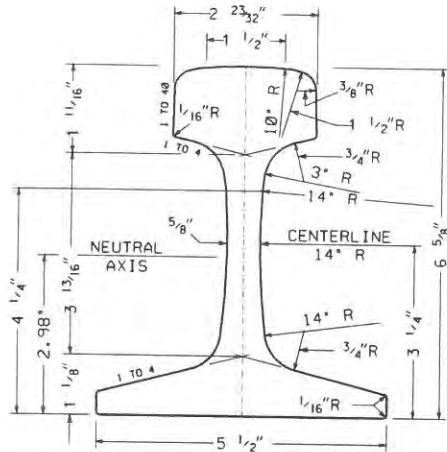
RAIL WEIGHT :
 122.5 LBS./YD.

MOMENT OF INERTIA :
 74.0 IN.⁴

SECTION MODULUS :
 HEAD - 28.6 IN.³
 BASE - 23.3 IN.³

NET TONS PER TRACK MILE :
 239.35 TONS

RAIL DRILLING :
 2 7/8 IN. ABOVE BASE



115 RE

AREA :
 HEAD - 3.91 IN.² = 34.8 %
 WEB - 3.05 IN.² = 27.1 %
 BASE - 4.29 IN.² = 38.1 %

RAIL WEIGHT :
 114.7 LBS./YD.

MOMENT OF INERTIA :
 65.6 IN.⁴

SECTION MODULUS :
 HEAD - 18.0 IN.³
 BASE - 22.0 IN.³

NET TONS PER TRACK MILE :
 202.4 TONS

RAIL DRILLING :
 2 7/8 IN. ABOVE BASE



Central Florida Rail Corridor

115 RE, 122 CB AND 140 RE

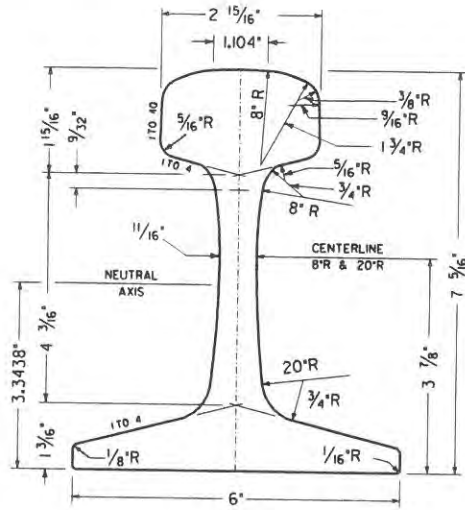
RAIL SECTIONS

Miguel Torres

APPROVED - MIGUEL TORRES

CFRC CHIEF OPERATING OFFICER

PREPARED BY: RMW ISSUED: 9/9/2015 REVISED: 4/2/2015



136 RE

AREA :
 HEAD - 4.82 IN.² = 36.3 %
 WEB - 3.64 IN.² = 27.1 %
 BASE - 4.87 IN.² = 36.6 %

RAIL WEIGHT :
 135.9 LBS./YD.

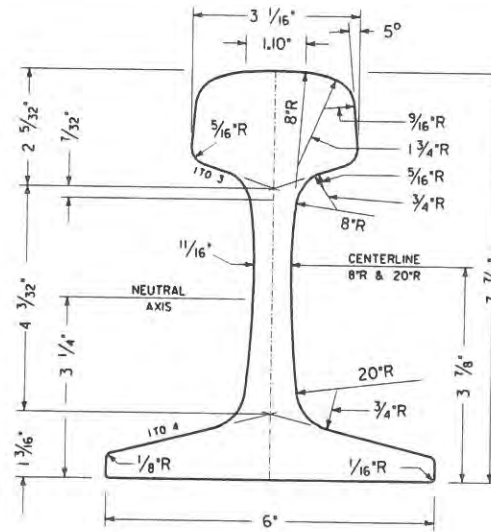
MOMENT OF INERTIA :
 94.2 IN.⁴

SECTION MODULUS :
 HEAD = 23.7 IN.³
 BASE = 28.2 IN.³

NET TONS PER TRACK MILE :
 239.36 TONS

RAIL DRILLING :
 3 3/32 IN. ABOVE BASE

HEAD WIDTH :
 MAXIMUM = 2.9375 IN.
 AT GAGE PT. = 2.8903 IN.



141 RE

AREA :
 HEAD - 5.38 IN.² = 38.9 %
 WEB - 3.56 IN.² = 25.8 %
 BASE - 4.87 IN.² = 35.3 %

RAIL WEIGHT :
 140.91 LBS./YD.

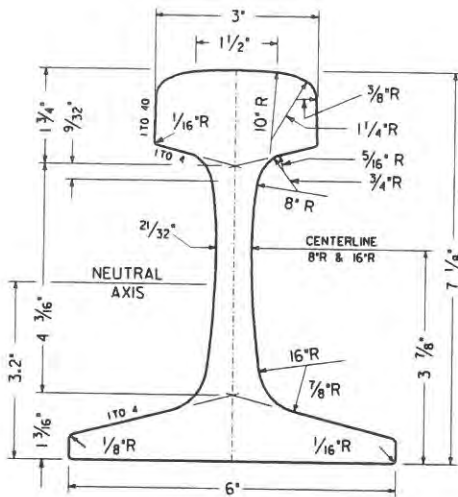
MOMENT OF INERTIA :
 100.44 IN.⁴

SECTION MODULUS :
 HEAD = 25.3 IN.³
 BASE = 29.0 IN.³

NET TONS PER TRACK MILE :
 248.00 TONS

RAIL DRILLING :
 3 3/32 IN. ABOVE BASE

HEAD WIDTH :
 MAXIMUM = 3.0625 IN.
 AT GAGE PT. = 2.9063 IN.



132 RE

AREA :
 HEAD - 4.42 IN.² = 34.1 %
 WEB - 3.66 IN.² = 28.3 %
 BASE - 4.87 IN.² = 36.6 %

RAIL WEIGHT :
 132.1 LBS./YD.

MOMENT OF INERTIA :
 87.9 IN.⁴

SECTION MODULUS :
 HEAD = 22.4 IN.³
 BASE = 27.4 IN.³

NET TONS PER TRACK MILE :
 232.32 TONS

RAIL DRILLING :
 3 3/32 IN. ABOVE BASE

HEAD WIDTH :
 MAXIMUM = 3.0000 IN.
 AT GAGE PT. = 2.9650 IN.



Central Florida Rail Corridor

132 RE, 136 RE, AND 141 RE
 RAIL SECTIONS

Miguel Torres

APPROVED - MIGUEL TORRES

CFRC CHIEF OPERATING OFFICER

PREPARED BY: RMW ISSUED: 9/9/2015 REVISED: 4/2/2015

SPIKING REQUIREMENTS

TRACK ALIGNMENT		MAIN TRACKS AND SIDINGS								OTHER TRACKS			
		MAXIMUM AUTHORIZED FREIGHT SPEED AND TONNAGE								MAXIMUM SPEED & TONNAGE			
		UP TO 45 MPH		>25 MPH & 10 MGT		46 MPH TO 60 MPH		61 MPH AND HIGHER		UP TO 25 MPH		>25 MPH & 10 MGT	
DEGREE FROM	DEGREE TO	SPIKES PER TIE PLATE	SPIKING PATTERN	SPIKES PER TIE PLATE	SPIKING PATTERN	SPIKES PER TIE PLATE	SPIKING PATTERN	SPIKES PER TIE PLATE	SPIKING PATTERN	SPIKES PER TIE PLATE	SPIKING PATTERN	SPIKES PER TIE PLATE	SPIKING PATTERN
TANGENT		2	A	3	B	3	B	4	C	2	A	3	B
0°-01'	1°-59'	3	B	3	B	4	C	4	C	2	A	3	B
2°-00'	3°-59'	4	C	4	C	4	C	4	C	3	B	3	B
4°-00'	5°-59'	4	C	4	C	4	C	4	C	4	C	4	C
6°-00'	11°-59'	5	D	5	D	5	D	5	D	4	C	4	C
12°-00'	12°-59'	5	D	5	D	5	D	5	D	4	C	4	C
13°-00' AND UP		5	D	5	D	5	D	5	D	5	D	5	D

MAIN TRACK - A TRACK, OTHER THAN AN AUXILIARY TRACK, EXTENDING THROUGH YARDS AND BETWEEN STATIONS, UPON WHICH TRAINS ARE OPERATED IN CONFORMANCE WITH RULES OR SPECIAL INSTRUCTIONS.

SIDING - AN AUXILIARY TRACK DESIGNATED IN SPECIAL INSTRUCTIONS FOR THE MEETING OR PASSING OF TRAINS.

SIDE TRACK - AN AUXILIARY TRACK FOR PURPOSES OTHER THAN MEETING OR PASSING TRAINS.

THE SPIKING PATTERN ON CURVES WILL BEGIN AT THE TANGENT TO SPIRAL MARKER PLATE AND END AT SPIRAL TO TANGENT MARKER PLATE.

THE SPIKING PATTERN ON COMPOUND CURVES WILL BE BASED ON THE HIGHEST DEGREE OF CURVATURE IN THE CURVE AND WILL BE USED FOR THE ENTIRE CURVE.

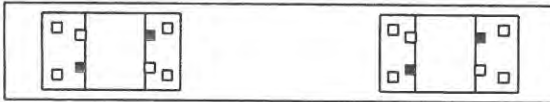
SIX AXLE LOCOMOTIVES WITH CONVENTIONAL TRUCKS ARE RESTRICTED FROM OPERATING ON CURVES OVER 17°-00'.

SIX AXLE LOCOMOTIVES WITH RADIAL STEERING TRUCKS ARE RESTRICTED FROM OPERATING ON CURVES OVER 23°-00'.

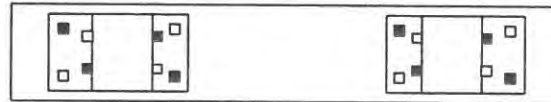
THREE SPIKES PATTERN B AS MINIMUM WILL BE USED ON ALL TRACKS USING DISTRIBUTED OR PUSHER LOCOMOTIVES

IF A TIE PLATE DOES NOT HAVE TWO GAGE SIDE RAIL SPIKES, USE ADDITIONAL SPIKES AS SHOWN IN PATTERN C & D

SPIKING PATTERN "A"



SPIKING PATTERN "C"



SPIKING PATTERN "B"

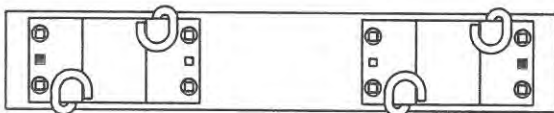


SPIKING PATTERN "D"



- - TRACK SPIKE
- ⊙ - TIE PLATE SCREW

POSITIVE RESTRAINT RAIL FASTENERS
ALL TRACK ALIGNMENTS



PANDROL ROLLED PLATE



PANDROL VICTOR PLATE



Central Florida Rail Corridor

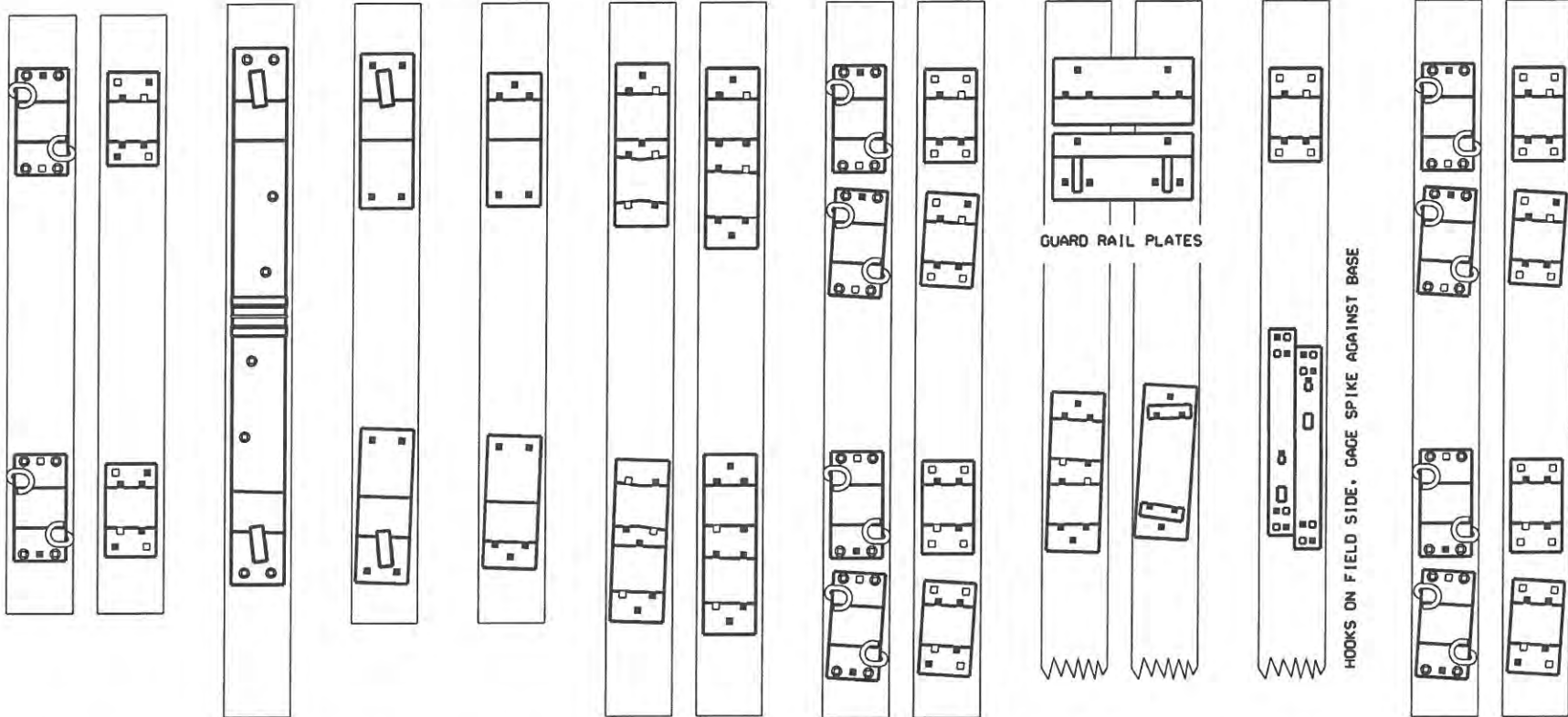
MAIN TRACK SPIKING PATTERNS
SIDE TRACK SPIKING PATTERNS

Miguel Torres

APPROVED - MIGUEL TORRES
CFRC CHIEF OPERATING OFFICER

TURNOUT PLATE AREA

FROG PLATE AREA



TIE PLATES
AHEAD OF
SWITCH POINT

GAGE
PLATES

BRACE
PLATES

SLIDE AND
HEEL
PLATES

MILLED SEAT
TURNOUT PLATES

TIE PLATES
BETWEEN FROG
AND TURNOUT
PLATES

WELDED STOP
AND
MILLED SEAT
FROG PLATES

HOOK TWIN
TIE PLATES

TIE PLATES
BETWEEN FROG
AND END OF
SWITCH TIES

- • TRACK SPIKE
- • TIE PLATE SCREW

IF POSITIVE RESTRAINT RAIL FASTENERS ARE USED IN THE TURNOUT, POSITIVE RESTRAINT TIE PLATES MUST BE USED FOR A MINIMUM OF 15 TIES AHEAD OF THE OG PLATE, AND PAST THE FROG ON BOTH TRACKS UNTIL THE END OF THE SWITCH TIES IS REACHED.

IF REGULAR TIE PLATES ARE USED, SPIKE THE 15 TIE PLATES AHEAD OF THE OG PLATE WITH SPIKING PATTERN 'D' IN ALL OTHER THAN YARD TRACKS. IN YARD TRACKS USE SPIKING 'B'.

CONE NECK LAG SCREWS MAY BE USED IN GAGE PLATES WITH SQUARE HOLES IN PLACE OF TRACK SPIKES.

GUARD RAIL PLATES

HOOKS ON FIELD SIDE, GAGE SPIKE AGAINST BASE



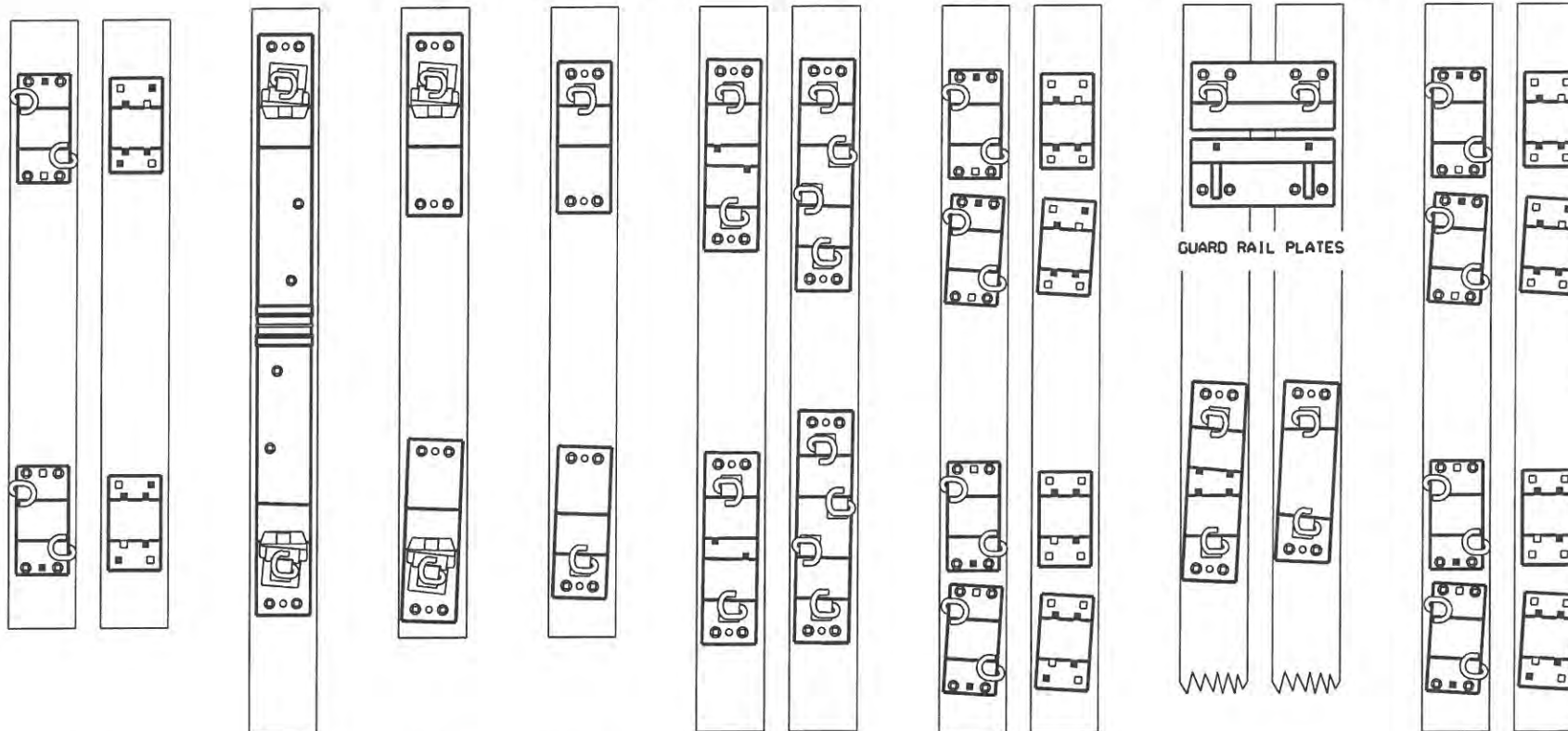
TURNOUT SPIKING PATTERNS WITH
BETHLEHEM 811 STYLE BRACES

Miguel Torres

APPROVED - MIGUEL TORRES

CFRC CHIEF OPERATING OFFICER

TURNOUT PLATE AREA



TIE PLATES
AHEAD OF
SWITCH POINT

GAGE
PLATES

BRACE
PLATES

SLIDE AND
HEEL
PLATES

MILLED SEAT
TURNOUT PLATES

TIE PLATES
BETWEEN FROG
AND TURNOUT
PLATES

WELDED STOP
AND
MILLED SEAT
FROG PLATES

TIE PLATES
BETWEEN FROG
AND END OF
SWITCH TIES

- • TRACK SPIKE
- • TIE PLATE SCREW
- • HOLE

IF POSITIVE RESTRAINT RAIL FASTENERS ARE USED IN THE TURNOUT, POSITIVE RESTRAINT TIE PLATES MUST BE USED FOR A MINIMUM OF 15 TIES AHEAD OF THE OG PLATE, AND PAST THE FROG ON BOTH TRACKS UNTIL THE END OF THE SWITCH TIES IS REACHED.

IF REGULAR TIE PLATES ARE USED, SPIKE THE 15 TIE PLATES AHEAD OF THE OG PLATE WITH SPIKING PATTERN "D" IN ALL OTHER THAN YARD TRACKS. IN YARD TRACKS USE SPIKING "B".

CONE NECK LAG SCREWS MAY BE USED IN GAGE PLATES WITH SQUARE HOLES IN PLACE OF TRACK SPIKES.

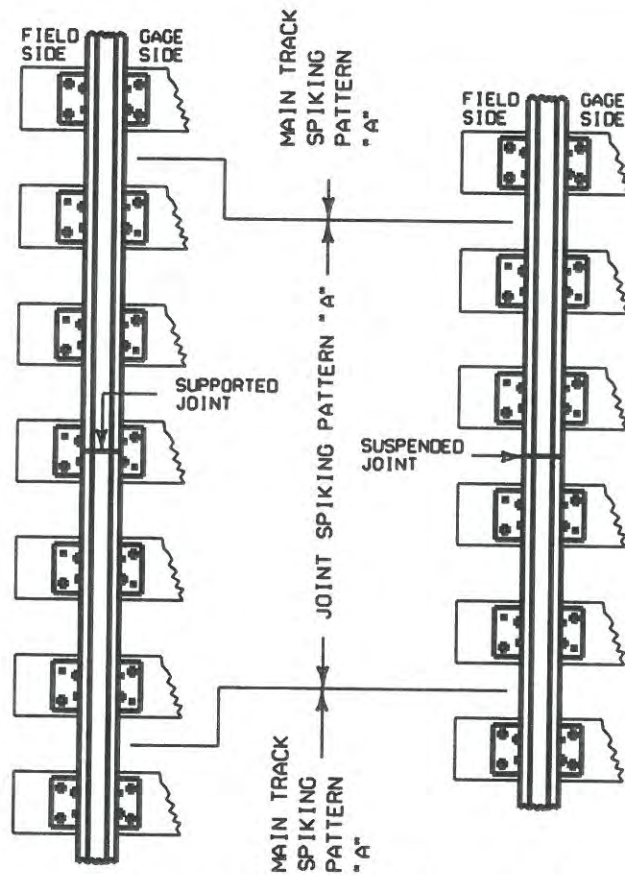


TURNOUT SPIKING PATTERNS WITH
BETHLEHEM BOLTLESS STYLE BRACES

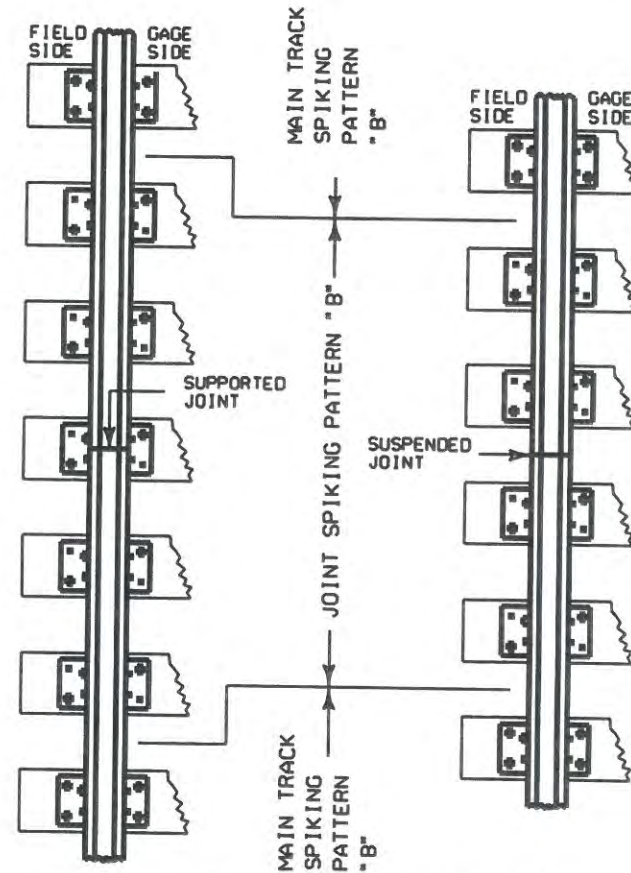
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CFRC CHIEF OPERATING OFFICER



JOINT SPIKING PATTERN "A"



JOINT SPIKING PATTERN "B"

■ = TRACK SPIKE

JOINT SPIKING PATTERN "A" USED WITH MAIN TRACK SPIKING PATTERN "A".

JOINT SPIKING PATTERN "B" USED WITH MAIN TRACK SPIKING PATTERNS "B", "C" AND "D".

SEE DRAWING 2512 FOR SPIKING PATTERNS WHEN POSITIVE RESTRAINT RAIL FASTENERS ARE USED.



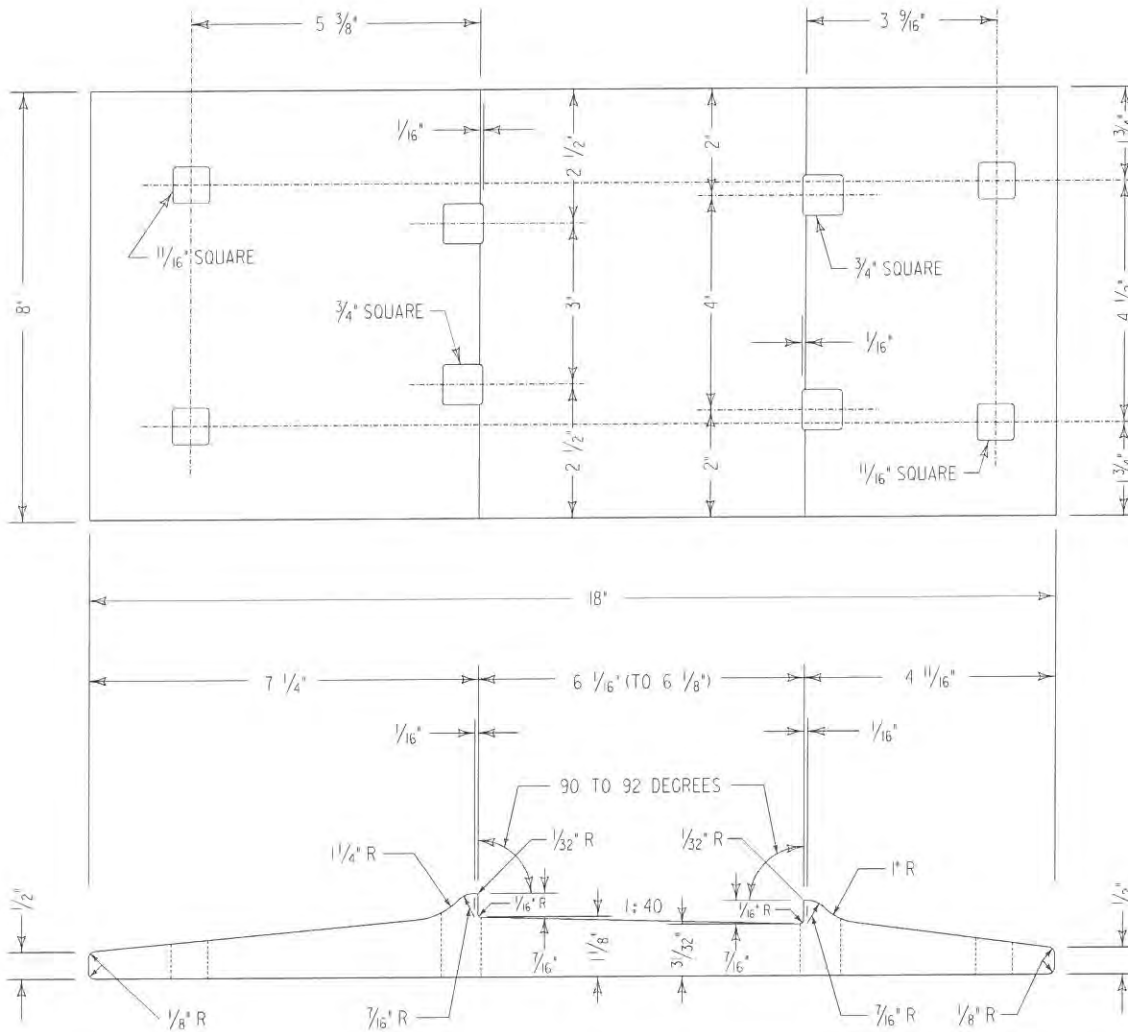
**Central Florida Rail Corridor
JOINT AREA SPIKING PATTERNS**

Miguel Torres

APPROVED - MIGUEL TORRES

CFRC CHIEF OPERATING OFFICER

PREPARED BY: RMW ISSUED: 9/9/2015 REVISED: 4/2/2015



NOTES

1. PLATES ARE TO BE FURNISHED WITHOUT RIBS.
2. RAIL SEAT IS TO BE FLAT, WITHOUT CAMBER.
3. ALL SPIKE HOLES USE 1/16" FILLETS IN THE CORNERS.
4. PLATES TO BE BRANDED IN ACCORDANCE WITH SECTION 5 OF THE AREMA MANUAL.
5. MATERIAL AND PROCESS ARE TO CONFORM TO AREMA STANDARDS.
 CARBON - 0.15 % MIN.
 COPPER - 0.20 % MIN.
6. ESTIMATED WEIGHT - 36.52 LBS.



8" X 18" TIE PLATE
FOR 6" BASE RAIL SECTIONS

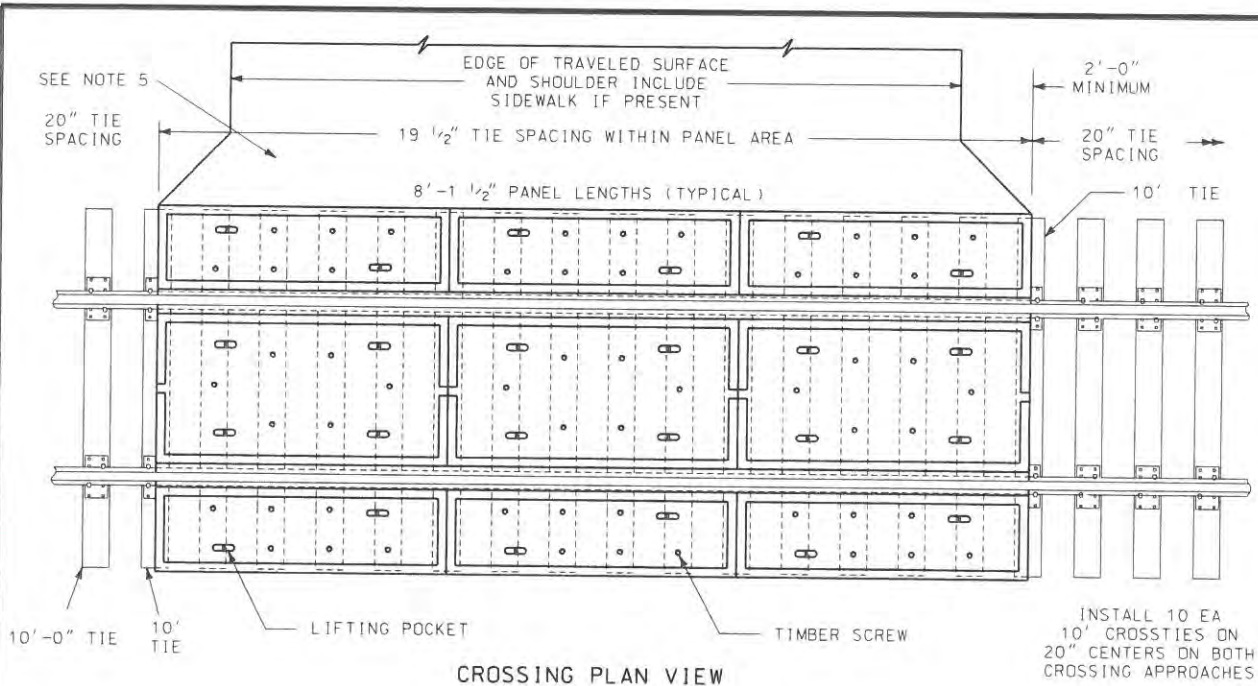
Miguel Torres

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PREPARED BY: RMW ISSUED: 9/9/2015 REVISED: 4/2/2015

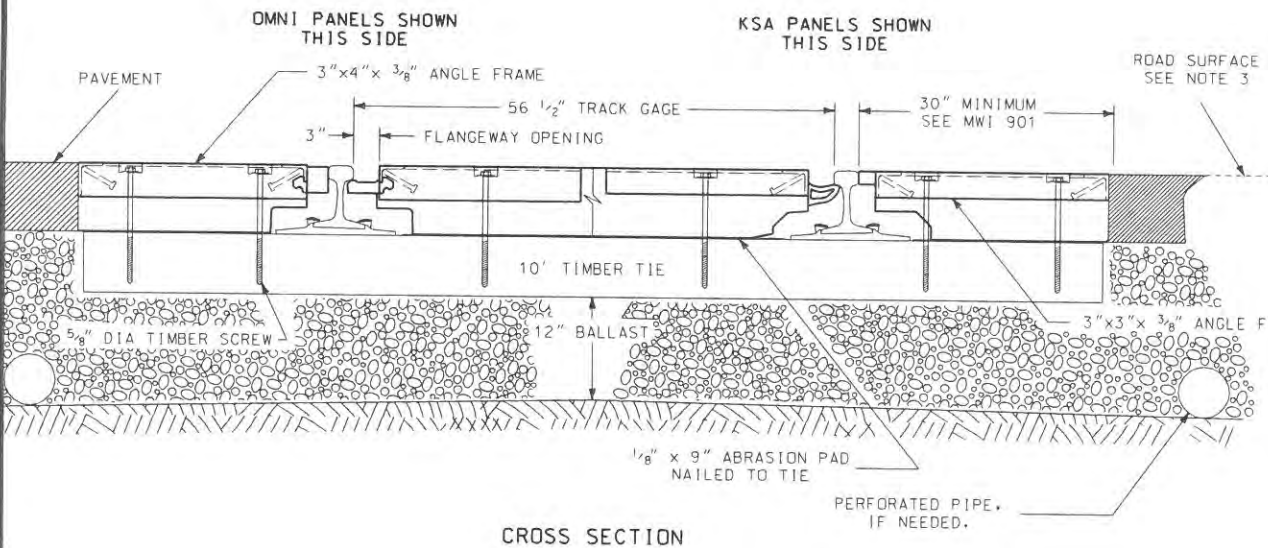
ORDERING INFORMATION			
DESCRIPTION	UNITS	CLASS	
PLATE, TIE, 8" X 18" FOR 6" BASE RAILS	EACH	O13	



CROSSING PLAN VIEW

NOTES

1. MWI 901 (LATEST REVISION) IS TO BE USED IN CONJUNCTION WITH THIS DRAWING.
2. FOR NEW CONSTRUCTION, HIGHWAY SHOULD INTERSECT RAILROAD AT OR NEARLY RIGHT ANGLES.
3. FOR NEW CONSTRUCTION, HIGHWAY SURFACE SHOULD NOT BE MORE THAN 3 IN. HIGHER OR LOWER THAN TOP OF NEAR RAIL 30 FT. FROM THE RAIL ALONG THE ROAD CENTERLINE, UNLESS TRACK SUPERELEVATION DICTATES OTHERWISE.
4. USE STATE DOT REQUIREMENTS FOR BITUMINOUS CONCRETE AND SPRAY TACK COAT FOR THE STATE IN WHICH THE CROSSING IS LOCATED.
5. CROSSING SHOULD BE CONTINUOUS BETWEEN ROADWAY OR SIDEWALK EDGES. IF NOT PRACTICABLE, DRAINAGE MUST BE PROVIDED BETWEEN PAVED AREAS TO ELIMINATE WATER POCKETS.
6. SLOPE PAVING TO RETURN TO ORIGINAL PAVEMENT SURFACE. LENGTH OF TRANSITION WILL DEPEND ON LOCAL CONDITIONS. USE A RUNOFF OF 1 IN. PER 10 FT. WHERE PRACTICABLE.
7. IF ROADBED STABILIZATION IS REQUIRED, EXTEND IT 10 FT. BEYOND EDGE OF CROSSING UNDER TRACK.
8. APPROXIMATE WEIGHT FOR 136RE MATERIALS:
3,200 LBS. - CONCRETE CENTER PANEL
1,700 LBS. - CONCRETE FIELD PANEL
9. PERFORATED PIPE TO BE SIZED AND LOCATED FOR SITE CONDITIONS. USE 6" MIN. DIA. PIPE AND LOCATE AT LEAST 12" BEYOND END OF TIE.
10. INSTALL 10 EA 10 FT. CROSSTIES EITHER SIDE OF CROSSING. INSTALL 10 FT. CROSSTIES 20" CENTER-TO-CENTER.



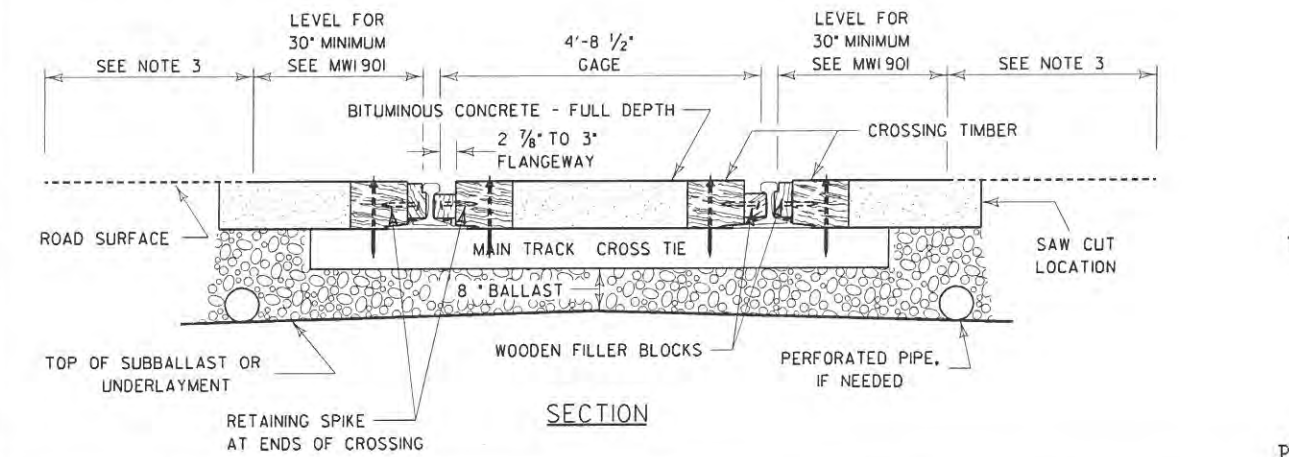
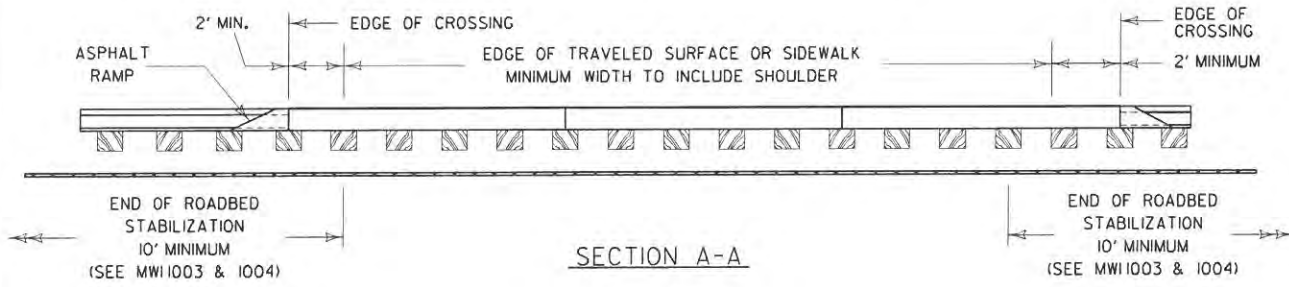
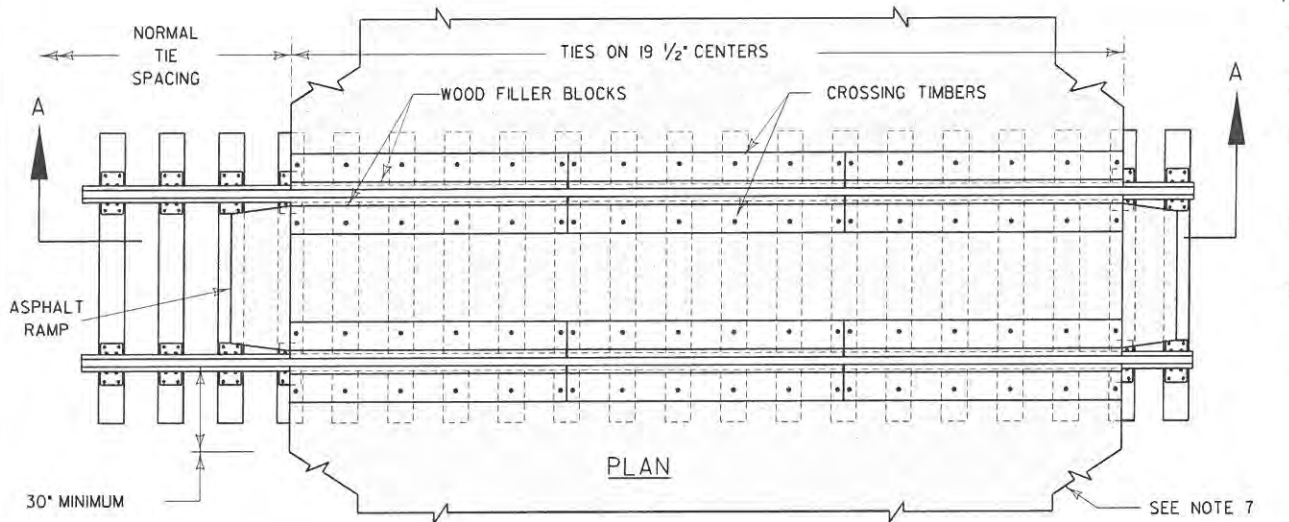
CROSS SECTION

ORDERING INFORMATION	
RAIL WGT.	DESCRIPTION
115 - 122	CROSSING, CONCRETE PANELS, HEAVY DUTY, FOR 10 FT. WOOD TIES. ORDER BY "TRACK FEET" IN APPROX. 8 FT. INCREMENTS. EACH 8'-1 1/2" SECTION INCLUDES 1 CONCRETE CENTER AND 2 CONCRETE FIELD PANELS WITH RUBBER FILLERS.
132 - 136	
141	

CFRC
Central Florida Rail Corridor
HEAVY DUTY ROAD CROSSING
FULL WIDTH CONCRETE ON WOOD TIES

Miguel Torres

APPROVED - MIGUEL TORRES
 CFRC CHIEF OPERATING OFFICER



NOTES

1. MWI 901 (LATEST REVISION) IS TO BE USED IN CONJUNCTION WITH THIS DRAWING.
2. FOR NEW CONSTRUCTION, HIGHWAY SHOULD INTERSECT RAILROAD AT OR NEARLY RIGHT ANGLES.
3. FOR NEW CONSTRUCTION, HIGHWAY SURFACE SHOULD NOT BE MORE THAN 3' HIGHER OR LOWER THAN TOP OF THE NEAR RAIL 30' FROM THE RAIL ALONG THE ROAD CENTERLINE, UNLESS TRACK SUPERELEVATION DICTATES OTHERWISE.
4. USE STATE D.O.T. SPECIFICATIONS FOR BITUMINOUS CONCRETE AND ASPHALT SPRAY TACK COAT FOR THE STATE IN WHICH THE CROSSING IS LOCATED.
5. CROSSINGS SHOULD BE CONTINUOUS BETWEEN ROADWAY OR SIDEWALK EDGES. IF NOT PRACTICABLE, ADEQUATE DRAINAGE MUST BE PROVIDED BETWEEN CROSSING AREAS TO ELIMINATE WATER POCKETS.
6. SLOPE PAVING TO RETURN TO ORIGINAL PAVEMENT SURFACE. LENGTH OF TRANSITION WILL DEPEND ON LOCAL CONDITIONS. USE A RUNOFF OF 1IN. PER 10 FT. WHERE PRACTICABLE.
7. IF ROADBED STABILIZATION IS REQUIRED, EXTEND IT 10 FT. BEYOND EDGE OF CROSSING UNDER TRACK.
8. DRILL CROSSING TIMBERS OVER EACH TIE FOR TIMBER SCREW 1/16" DIA. WITH 2 1/2" DIA. x 1" COUNTERSINK.
9. PERFORATED PIPE TO BE SIZED AND LOCATED FOR SITE CONDITIONS. USE 6" MIN. DIA. PIPE AND LOCATE AT LEAST 12" BEYOND END OF TIE.

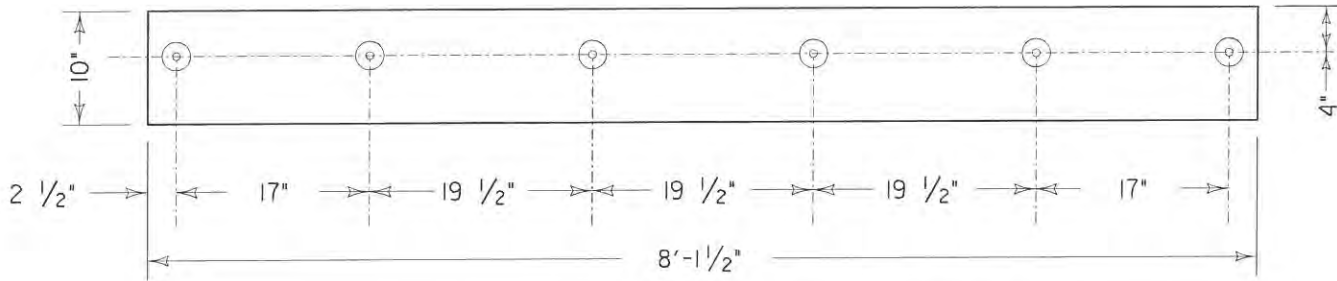
ORDERING INFORMATION	
RAIL WGT.	DESCRIPTION
115	CROSSING TIMBER / WOOD FILLER. ORDER BY *TRACK FEET* IN APPROXIMATE 8 FT. INCREMENTS. EACH *TRACK FOOT* INCLUDES 4 TIMBER SECTIONS AND 4 FILLER BLOCK PIECES. DELIVERED IN 8'- 1 1/2' LONG SECTIONS.
122	
132	
136	
140	
141	
ALL	SCREW, TIMBER 5/8" x 12" WITH TORX SQUARE WASHER HEAD.



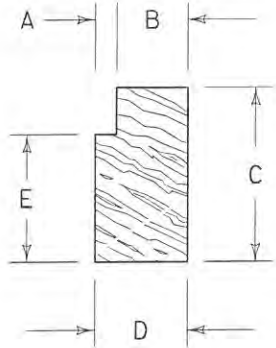
NORMAL DUTY ROAD CROSSING
TIMBER AND ASPHALT ON WOOD TIES

Miguel Torres
APPROVED - MIGUEL TORRES

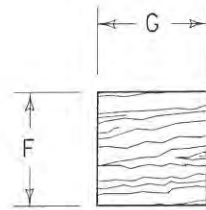
CFRC CHIEF OPERATING OFFICER



CROSSING TIMBER
PLAN VIEW



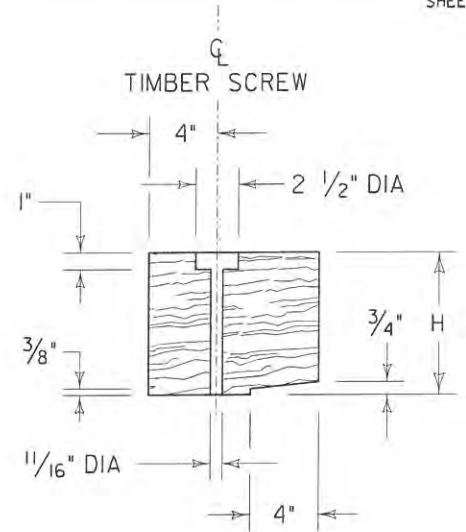
FIELD SIDE
FILLER BLOCK DETAIL



GAGE SIDE
FILLER BLOCK DETAIL

NOTES

1. TIMBERS ARE NOT PREDRILLED UNLESS SPECIFIED IN THE REQUISITION.
2. GAGE AND FIELD TIMBERS ARE IDENTICAL.
3. TOLERANCES:
A, E, AND G : $\frac{1}{16}$ " +/-
ALL OTHERS : $\frac{1}{8}$ " +/-
4. CROSSING TIMBER TO BE OAK OR GUM.
TREATMENT PER MW 99001
LIKE CROSSIES
5. FILLER BLOCKS TO BE SOUTHERN
YELLOW PINE GRADE 2 WITH
10 LB / CU FT TREATMENT
6. TIMBERS & FILLERS
TO BE MARKED
FOR RAIL SIZE



CROSSING TIMBER
SECTION AT SCREW LOCATION

RAIL WGT	A	B	C	D	E	F	G	H
115 RE	$\frac{3}{4}$	$2 \frac{3}{4}$	$5 \frac{3}{8}$	$3 \frac{1}{2}$	$3 \frac{7}{8}$	$3 \frac{3}{8}$	4	$7 \frac{1}{2}$
122 CB	$\frac{3}{4}$	$2 \frac{3}{4}$	$5 \frac{5}{8}$	$3 \frac{1}{2}$	4	$3 \frac{5}{8}$	4	$7 \frac{1}{2}$
132 RE	$\frac{5}{8}$	$2 \frac{7}{8}$	6	$3 \frac{1}{2}$	$4 \frac{1}{2}$	$3 \frac{7}{8}$	$3 \frac{7}{8}$	8
136 RE	$\frac{5}{8}$	$2 \frac{7}{8}$	$6 \frac{1}{4}$	$3 \frac{1}{2}$	$4 \frac{1}{2}$	$3 \frac{7}{8}$	$3 \frac{7}{8}$	$8 \frac{3}{8}$
140 RE	$\frac{3}{4}$	$2 \frac{3}{4}$	$6 \frac{1}{16}$	$3 \frac{1}{2}$	$4 \frac{5}{16}$	$3 \frac{7}{8}$	4	$8 \frac{3}{8}$
141 RE	$1 \frac{1}{16}$	$2 \frac{13}{16}$	$6 \frac{3}{8}$	$3 \frac{1}{2}$	$4 \frac{1}{2}$	$3 \frac{7}{8}$	$3 \frac{7}{8}$	$8 \frac{3}{8}$

ALL DIMENSIONS ARE IN INCHES.

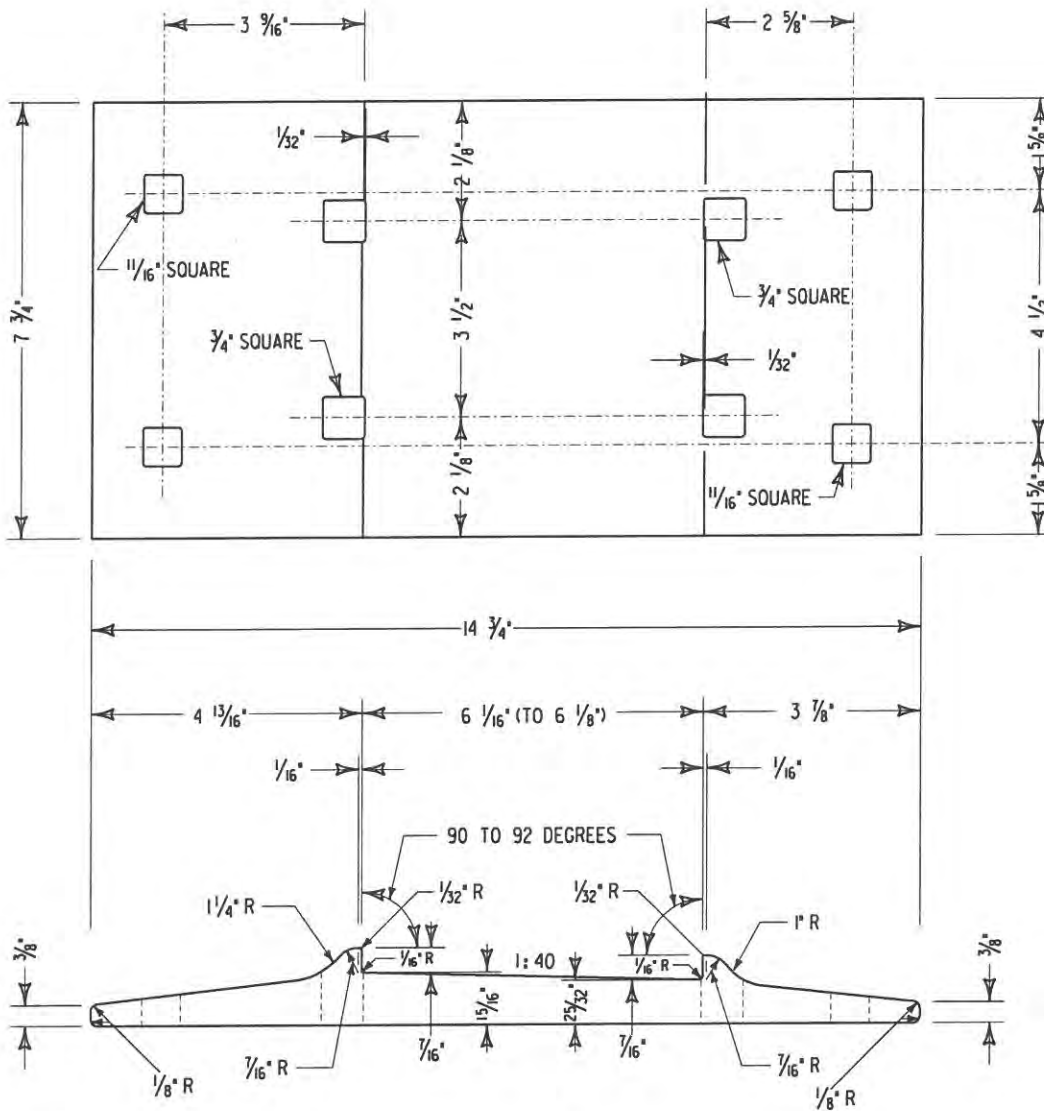


TIMBER AND ASPHALT CROSSING
CROSSING TIMBER AND FILLER BLOCK DETAILS

Miguel Torres

APPROVED - MIGUEL TORRES

CFRC CHIEF OPERATING OFFICER



NOTES

1. PLATES ARE TO BE FURNISHED WITHOUT RIBS.
2. RAIL SEAT IS TO BE FLAT, WITHOUT CAMBER.
3. ALL SPIKE HOLES USE 1/16" FILLETS IN THE CORNERS.
4. PLATES TO BE BRANDED IN ACCORDANCE WITH SECTION 5 OF THE AREMA MANUAL.
5. MATERIAL AND PROCESS ARE TO CONFORM TO AREMA STANDARDS.
 CARBON - 0.15 % MIN.
 COPPER - 0.20 % MIN.
6. ESTIMATED WEIGHT - 23.32 LBS.



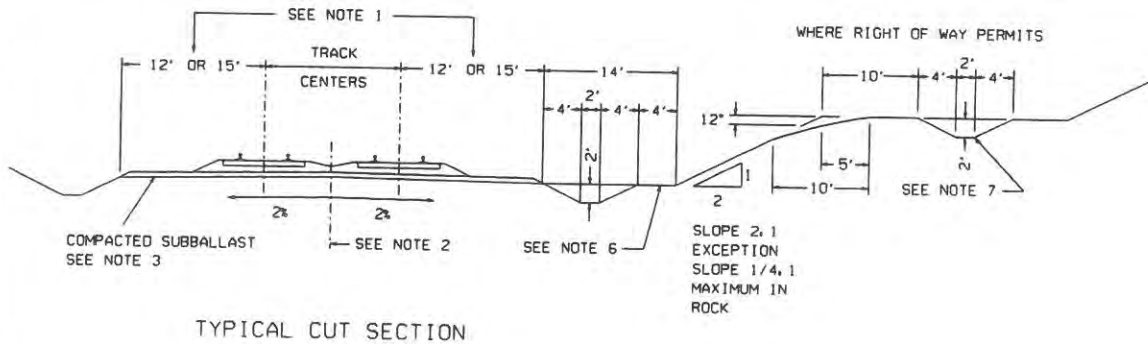
Central Florida Rail Corridor
7 3/4" X 14 3/4" TIE PLATE
FOR 6" BASE RAIL SECTIONS

Miguel Torres

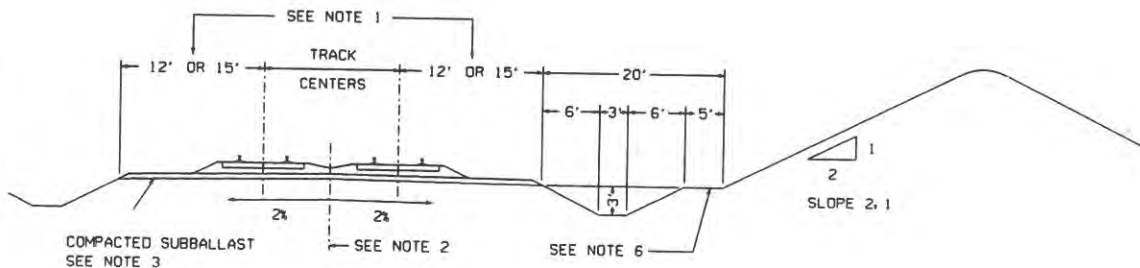
APPROVED - MIGUEL TORRES
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PREPARED BY: RMW ISSUED: 9/9/2015 REVISED: 4/2/2015

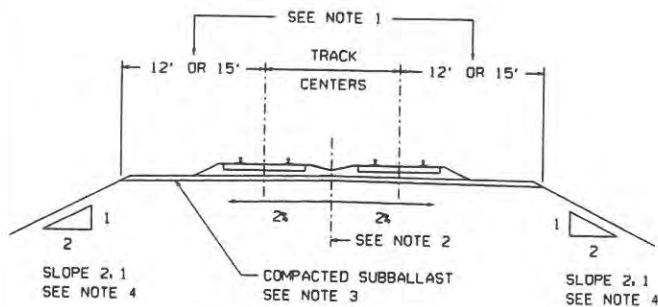
ORDERING INFORMATION	
DESCRIPTION	UNITS
PLATE, TIE, 7 3/4" X 14 3/4" FOR 6" BASE RAILS	EACH



TYPICAL CUT SECTION



TYPICAL WET CUT SECTION



TYPICAL FILL SECTION

NOTES:

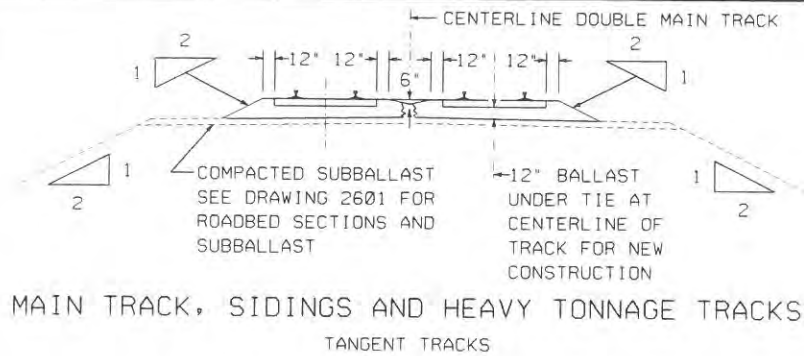
1. ROADBED WIDTHS AT TOP OF SUBGRADE.
 - A. SINGLE MAIN TRACKS, SIDINGS, AND HEAVY TONNAGE TRACKS, 15'-0" FROM CENTERLINE OF TRACK, 30'-0" TOTAL
 - B. SINGLE YARD, INDUSTRY, AND OTHER TRACK, 12'-0" FROM CENTERLINE OF TRACK, 24'-0" TOTAL
 - C. MULTIPLE PARALLEL TRACKS, 12'-0" OR 15'-0" FROM CENTERLINE OF TRACK DEPENDING ON THE TYPE OF TRACKS PLUS DISTANCE BETWEEN TRACK CENTERLINES.
2. LOCATION OF GRADE POINT.
 - A. SINGLE MAIN OR OTHER TRACK IS THE CENTERLINE OF TRACK.
 - B. DOUBLE MAIN TRACKS IS THE CENTERLINE BETWEEN TRACKS.
 - C. GRADE POINT FOR MAIN TRACK AND SIDING IS CENTERLINE OF MAIN TRACK.
3. DEPTH OF SUBBALLAST.
 - A. SUBBALLAST ON MAIN TRACKS, SIDINGS AND HEAVY TONNAGE TRACKS IS 6" OVER THE 30' ROADBED WIDTH.
 - B. SUBBALLAST ON YARD, INDUSTRIAL AND OTHER TRACKS IS 4" OVER THE 24' ROADBED WIDTH.
4. THE SLOPE ON FILL SECTIONS MAY BE INCREASED TO A MAXIMUM OF 1 1/2 TO 1 AT LOCATIONS WHERE THE BEARING CAPACITY OF THE NATURAL BED HAS BEEN VERIFIED BY FIELD TESTS AND THE STABILITY OF THE FILL MATERIAL VERIFIED BY LABORATORY TESTS.
5. INSTRUCTIONS FOR THE USE AND INSTALLATION OF GEOTEXTILES AND GEOGRIDS ARE INCLUDED IN MWI-1003.
6. OMIT BENCH WHERE EXCAVATION IS 5 FEET OR LESS.
7. OMIT BERM DITCH WHEN NATURAL GROUND SLOPES AWAY FROM THE EXCAVATION.

CFRC
ROADBED SECTIONS

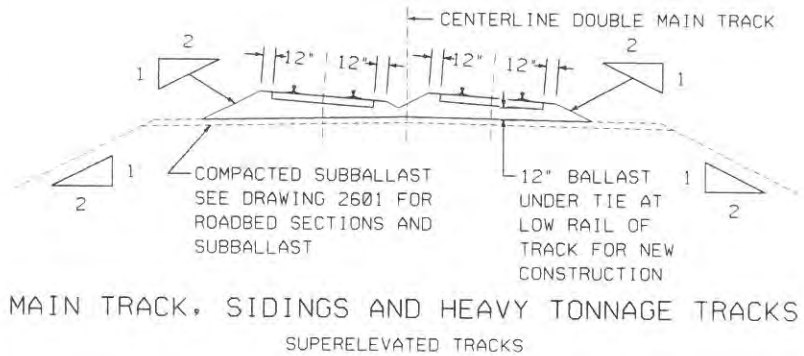
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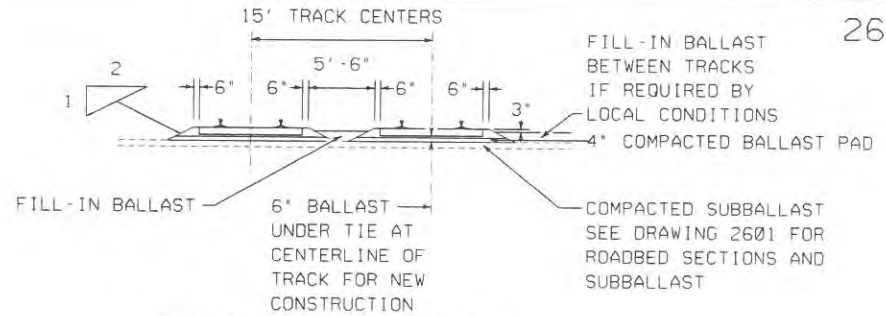
CFRC CHIEF OPERATING OFFICER



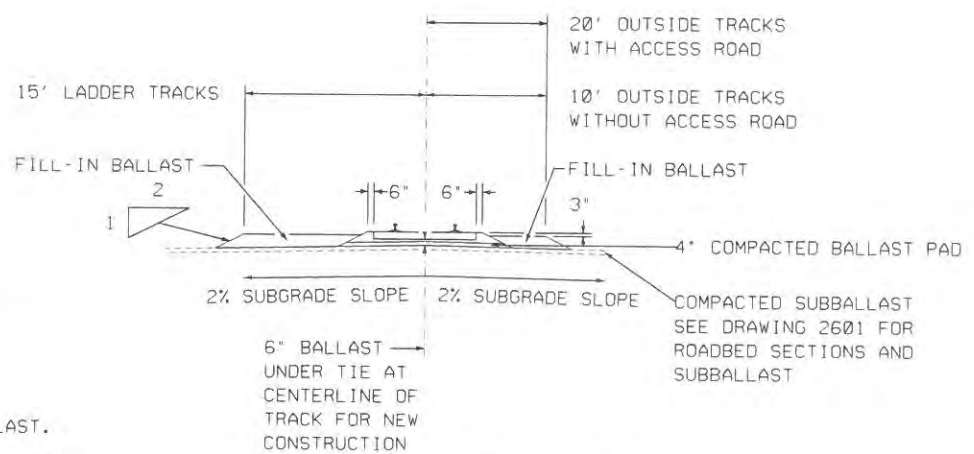
MAIN TRACK, SIDINGS AND HEAVY TONNAGE TRACKS
TANGENT TRACKS



MAIN TRACK, SIDINGS AND HEAVY TONNAGE TRACKS
SUPERELEVATED TRACKS



INTERIOR YARD TRACKS



LADDER AND OUTSIDE TRACKS

NOTES.

1. BALLAST TO CONFORM TO THE CURRENT CFRC REQUIREMENTS FOR BALLAST.
2. AREMA GRADATION 4A BALLAST IS TO BE USED ON ALL TRACK EXCEPT YARD TRACKS WHERE AREMA GRADATION 5 IS TO BE USED.
3. BALLAST PAD 4" THICK OF AREMA GRADATION 4A WILL BE USED UNDER TRACK FOR NEW CONSTRUCTION OF YARD TRACKS.
4. FILL-IN BALLAST WILL BE AREMA GRADATION 5.
5. BALLAST TO BE EVEN WITH TOP OF TIE.
6. BALLAST SHOULDER WILL EXTEND 12" FROM END OF TIE TO EDGE OF SLOPE ON ALL MAIN TRACKS, SIDING, AND HEAVY TONNAGE TRACKS.
7. BALLAST SHOULDER WILL EXTEND 6" FROM END OF TIE TO EDGE OF SLOPE ON ALL YARD TRACKS AND INDUSTRIAL SIDING TRACKS.



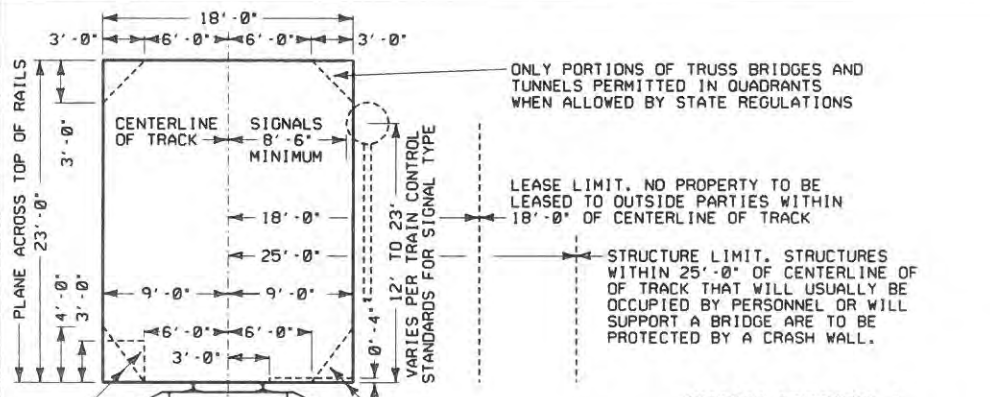
Central Florida Rail Corridor
BALLAST SECTIONS

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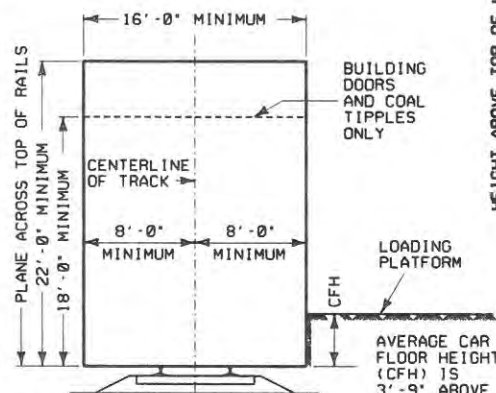
CFRC CHIEF OPERATING OFFICER

PREPARED BY: RMW ISSUED: 9/9/2015 REVISED: 4/2/2015



GENERAL

MAIN TRACKS, YARD TRACKS AND SIDINGS



INDUSTRIAL SIDE TRACKS

GRAPH NUMBER 1

DIAGONAL LINES INDICATE SUPERELEVATION

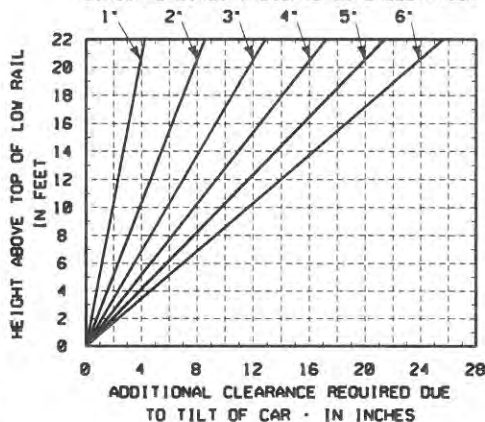


TABLE NUMBER 1

ADDITIONAL CLEARANCE REQUIRED DUE TO CURVATURE - IN INCHES												
DEGREE OF CURVE	1	2	3	4	5	6	7	8	9	10	11	12
ALL LOCATIONS EXCEPT FLORIDA	1 1/2	3	4 1/2	6	7 1/2	9	10 1/2	12	13 1/2	15	16 1/2	18
IN THE STATE OF FLORIDA	2	4	6	8	10	12	14	16	18	20	22	24

- REQUIRED CLEARANCES ARE TO BE USED FOR ALL NEW CONSTRUCTION WHERE THERE ARE NO LEGAL REQUIREMENTS THAT DICTATE GREATER CLEARANCES.
- CLEARANCES FOR RECONSTRUCTION, REHABILITATION AND ALTERATION WORK ARE DEPENDENT ON EXISTING PHYSICAL CONDITIONS. WHERE POSSIBLE, THEY WILL BE IMPROVED TO COMPLY WITH THE REQUIRED CLEARANCES.
- STATE OR CANADIAN CLEARANCE LAWS MUST NOT BE VIOLATED. LEGAL REQUIREMENTS MAY BE MODIFIED ONLY BY THE GOVERNMENTAL BODY THAT ISSUED THEM.
- REQUIRED CLEARANCE MAY BE MODIFIED ONLY IF APPROVED BY THE CHIEF ENGINEER DESIGN, CONSTRUCTION, AND CAPACITY.
- REQUIRED CLEARANCE DIAGRAMS SHOWN ARE FOR TANGENT TRACK AND INCREASES MUST BE PROVIDED FOR THE EFFECTS OF CURVATURE AND SUPERELEVATION.

A. ADDITIONAL CLEARANCE DUE TO CURVATURE:

WHEN A FIXED OBSTRUCTION IS LOCATED ADJACENT TO A CURVED TRACK, THE HORIZONTAL CLEARANCE WILL BE INCREASED 1 1/2 INCHES PER DEGREE OF CURVATURE ON BOTH SIDES OF THE TRACK CENTERLINE PER TABLE 1. EXCEPTION: FLORIDA REQUIRES 2 INCHES PER DEGREE.

B. ADDITIONAL CLEARANCE DUE TO SUPERELEVATION:

WHEN A FIXED OBSTRUCTION IS LOCATED ADJACENT TO A SUPERELEVATED TRACK, THE HORIZONTAL CLEARANCE ON THE LOW RAIL SIDE OF THE TRACK WILL BE INCREASED TO ALLOW FOR TILT. THE MINIMUM INCREASE IS SHOWN ON GRAPH NO. 1.

C. ADDITIONAL CLEARANCE DUE TO CURVATURE AND SUPERELEVATION:

WHEN A FIXED OBSTRUCTION IS LOCATED ADJACENT TO A CURVED AND SUPERELEVATED TRACK, THE HORIZONTAL CLEARANCE INCREASE WILL BE THE SUM OF THE INCREASES OBTAINED USING 5.A AND 5.B ABOVE. EXCEPTION: CANADA REQUIRES A MINIMUM OF 2 INCHES PER DEGREE.

D. ADDITIONAL CLEARANCE ON TANGENT TRACKS:

WHEN A FIXED OBSTRUCTION IS ADJACENT TO TANGENT TRACK BUT THE TRACK IS CURVED WITHIN 80 FEET OF THE OBSTRUCTION, THE HORIZONTAL CLEARANCE WILL BE INCREASED AS FOLLOWS:

DISTANCE FROM OBSTRUCTION TO CURVED TRACK - FEET	INCREASED HORIZONTAL CLEARANCE
0 TO 20	100% OF PARAGRAPH 5.C
21 TO 40	75% OF PARAGRAPH 5.C
41 TO 60	50% OF PARAGRAPH 5.C
61 TO 80	25% OF PARAGRAPH 5.C

- VERTICAL CLEARANCE ON SUPERELEVATED TRACK IS MEASURED FROM THE TOP OF THE HIGH RAIL.

CFRC
Central Florida Rail Corridor
CLEARANCE DIAGRAMS

Miguel Torres

APPROVED - MIGUEL TORRES
 CFRC CHIEF OPERATING OFFICER

DIMENSIONS - NOTES:

ARE SHOWN IN FEET AND INCHES (FT-IN).
 ARE FOR TANGENT TRACK, SEE MWI2604 FOR INCREASE DUE TO CURVATURE.
 VERTICAL CLEARANCE IS MEASURED FROM TOP OF HIGH RAIL FOR THE ENTIRE FULL HORIZONTAL WIDTH DESCRIBED BELOW.
 HORIZONTAL CLEARANCE IS MEASURED FROM CENTERLINE OF NEAREST TRACK.
 APPLY TO ALL NEW CONSTRUCTION, RECONSTRUCTION AND ALTERATIONS
 ALL COLUMNS ARE MINIMUM EXCEPT COLUMNS 22, 24, 27, AND 29 WHICH ARE MAXIMUM
 CFH = CAR FLOOR HEIGHT.
 REFERENCE CHAPTER 28 OF AREMA MANUAL FOR RAILWAY ENGINEERING FOR ENTIRE DETAILS OF STATE LEGAL CLEARANCES

TRACK CENTERS

MAIN TRACKS	ANY TWO NON-MAIN TRACKS	ADJACENT NON-MAIN TRACK TO ANY MAIN TRACK	LADDER TRACK ADJACENT TO ANY PARALLEL TRACK	TWO ADJACENT PARALLEL LADDER TRACKS	LADDER TRACKS AND CABOOSE TRACKS	TEAM TRACKS IN PAIRS	UNLOADING TRACKS AT PLATFORMS	MAIN TRACK AND BULK LOADING OR UNLOADING TRACK
1	2	3	4	5	6	7	8	9
15-0	14-0	15-0	19-0	19-0	14-0	13-6	13-6	18-0

VERTICAL

HORIZONTAL

GENERAL (UNLESS PROVIDED FOR)	THRU BRIDGES	HIGHWAY BRIDGE (SPANNING TRACKS)	TUNNELS	BUILDING DOORS	IN BUILDINGS	GENERAL (UNLESS PROVIDED FOR)	THRU BRIDGES	HIGHWAY BRIDGE (SPANNING TRACKS)	TUNNELS	BUILDING DOORS	IN BUILDINGS
10	11	12	13	14	15	16	17	18	19	20	21
23-0	23-0	23-0	23-0	18-0	22-0	9-0	9-0	25-0	9-0	8-0	8-0

EXCEPTIONS:

COLUMN 6 SHALL BE 17-0 IN MASSACHUSETTS
 COLUMN 7 AND 8 SHALL BE 14-0 IN MICHIGAN
 COLUMN 14 SHALL BE 21-0 IN OHIO; 22-0 IN INDIANA, WEST VIRGINIA, & CANADA; 22-6 IN CONNECTICUT, MASSACHUSETTS, & MICHIGAN
 COLUMN 15 SHALL BE 22-6 IN CONNECTICUT, MASSACHUSETTS, & MICHIGAN; 23-0 IN DELAWARE
 COLUMN 16 SHALL BE 12-0 IN PENNSYLVANIA
 COLUMN 20 SHALL BE 8-6 IN MASSACHUSETTS AND MICHIGAN
 COLUMN 21 SHALL BE 8-6 IN MICHIGAN

HORIZONTAL

PLATFORMS				SIGNALS				POLES	ORE AND COAL DOCKS	
CENTERLINE OF TRACK GENERAL				LOW BETWEEN TRACKS		SWITCH BOXES ETC.				
PASSENGER		FREIGHT		HEIGHT	CLEARANCE	HEIGHT	CLEARANCE			
A	B	C	D	26	27	28	29	30	31	32
0-8	5-1	CFH	8-0	8-6	3-0	6-0	0-4	3-0	12-0	8-0

EXCEPTIONS: COLUMN 22 SHALL BE 0-4 IN ILLINOIS
 COLUMN 23 SHALL BE 5-2 IN CONNECTICUT
 COLUMN 25 SHALL BE 8-6 IN CONNECTICUT, MARYLAND, MICHIGAN, NEW YORK, & PENNSYLVANIA
 COLUMN 26 SHALL BE 9-0 IN DELAWARE; 12-0 IN PENNSYLVANIA
 COLUMN 27 SHALL BE 4-0 IN CANADA
 COLUMN 29 SHALL BE 0-5 IN CANADA
 COLUMN 30 SHALL BE 3-10 IN CANADA
 COLUMN 32 SHALL BE 8-4 1/4 IN CANADA; 8-6 IN DC, & MARYLAND



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BRIDGE BACKWALL

EDGE OF TIE FLUSH WITH FACE OF BACKWALL

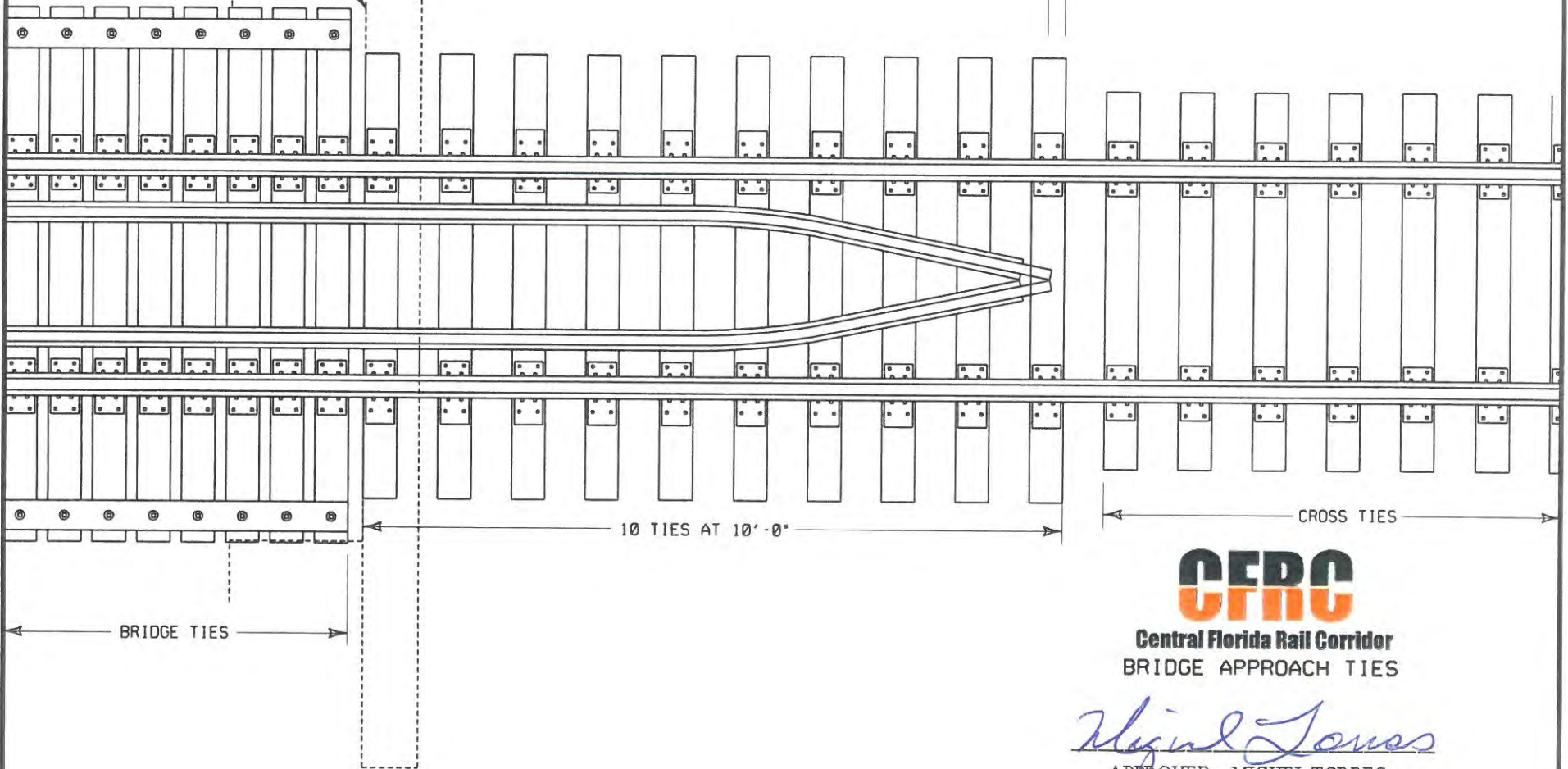
BRIDGE SEAT

BRIDGE APPROACH TIES

TIES 20' CENTER TO CENTER
OR MATCH TO EXISTING TIE SPACING.
USE 18" TIE PLATES MINIMUM (SEE DRAWING 2516) OR
POSITIVE RESTRAINT FASTENERS (SEE MWI 701)

NOTE

MW11404 (LATEST REVISION) IS
TO BE USED IN CONJUNCTION
WITH THIS DRAWING.



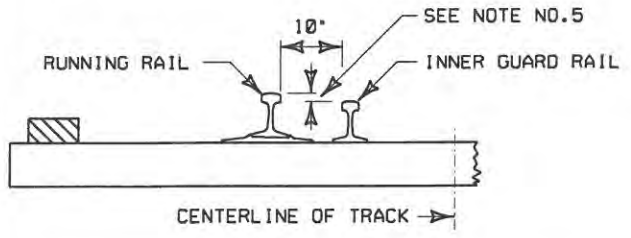
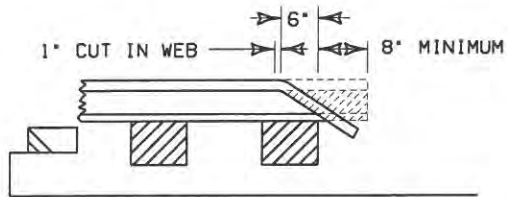
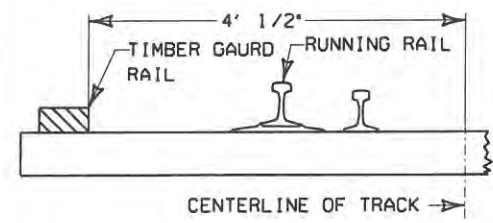
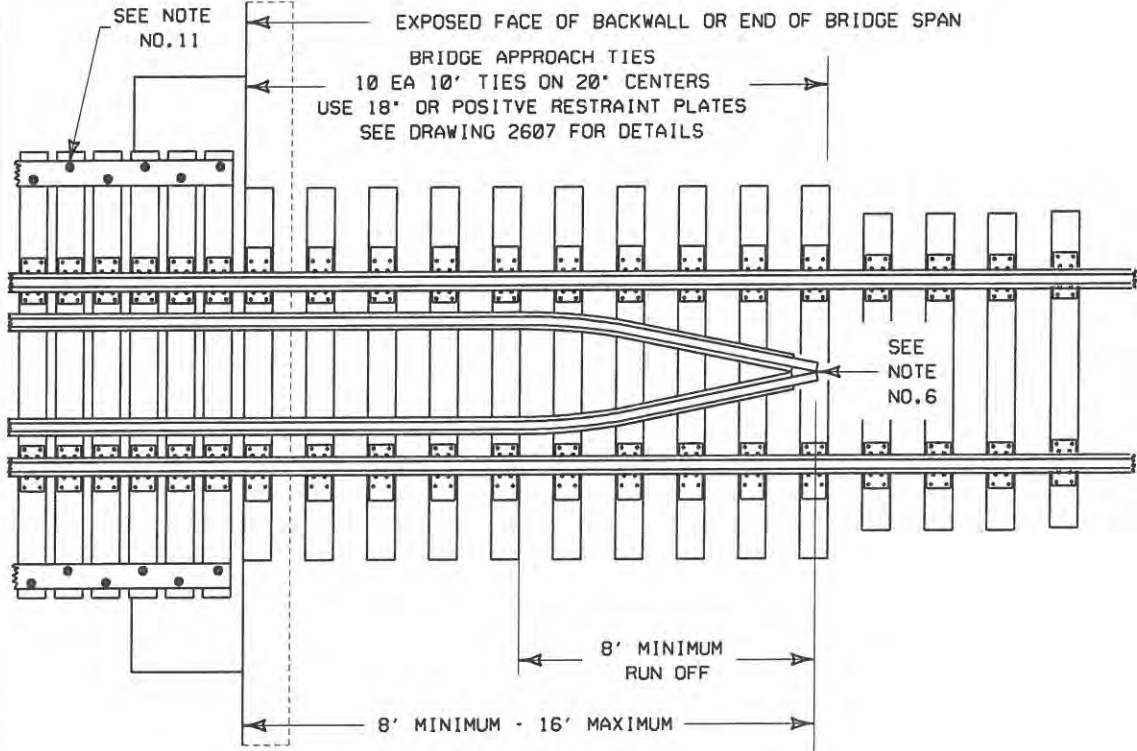
Central Florida Rail Corridor
BRIDGE APPROACH TIES

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PREPARED BY: RMW ISSUED: 9/9/2015 REVISED: 4/2/2015



CUT OUT SHADED PART OF WEB AND BASE.
BEND RAIL HEAD DOWN WITH END BELOW
TOP OF TIE.

NOTES.

1. INNER GUARD RAIL WILL BE USED ON THROUGH TRUSS, THROUGH PLATE GIRDER AND MOVABLE SPAN BRIDGES.
2. THE GUARD POINT IS TO BE PLACED NOT LESS THAN 8 FEET AWAY FROM THE END OF THE SPAN.
3. IF THE BRIDGE CONSISTS OF SOME SPANS THAT DO NOT REQUIRE INNER GUARD RAILS AND OTHER SPANS THAT DO, THE GUARD POINT WILL BE PLACED A MINIMUM OF 8 FEET AHEAD OF THE SPAN REQUIRING THE INNER GUARD RAIL.
4. GUARD RAILS ARE TO BE SCRAP RAIL FREE FROM SHORT KINKS WITH SMOOTH SIDE LAID NEXT TO THE RUNNING RAIL.
5. TOP OF THE RUNNING RAIL SHALL BE AT LEAST 1 INCH, BUT NOT OVER 3 INCHES ABOVE THE TOP OF THE GUARD RAIL.
6. RAIL BASES AT POINT TO BE FROM 0' TO 3' APART.
7. TIE PLATES WILL BE USED UNDER RUNNING RAIL BUT NOT UNDER GUARD RAIL.
8. JOINTS IN GUARD RAIL WILL NOT BE PLACED OPPOSITE JOINTS IN THE RUNNING RAIL. JOINTS ARE TO BE FULLY BOLTED.
9. GUARD RAILS WILL HAVE A SPIKE ON BOTH SIDES OF THE RAIL BASE IN EVERY TIE.
10. JOINTS IN GUARD RAILS SHALL BE AS CLOSE AS POSSIBLE TO THE FACE OF THE BACKWALL.
11. TIMBER GAIRD RAIL IS TO BE LAG BOLTED TO EACH TIE. THE LAG BOLT PATTERN IS TO BE STAGGERED
12. TIMBER GAIRD RAIL IS 4' X 8'



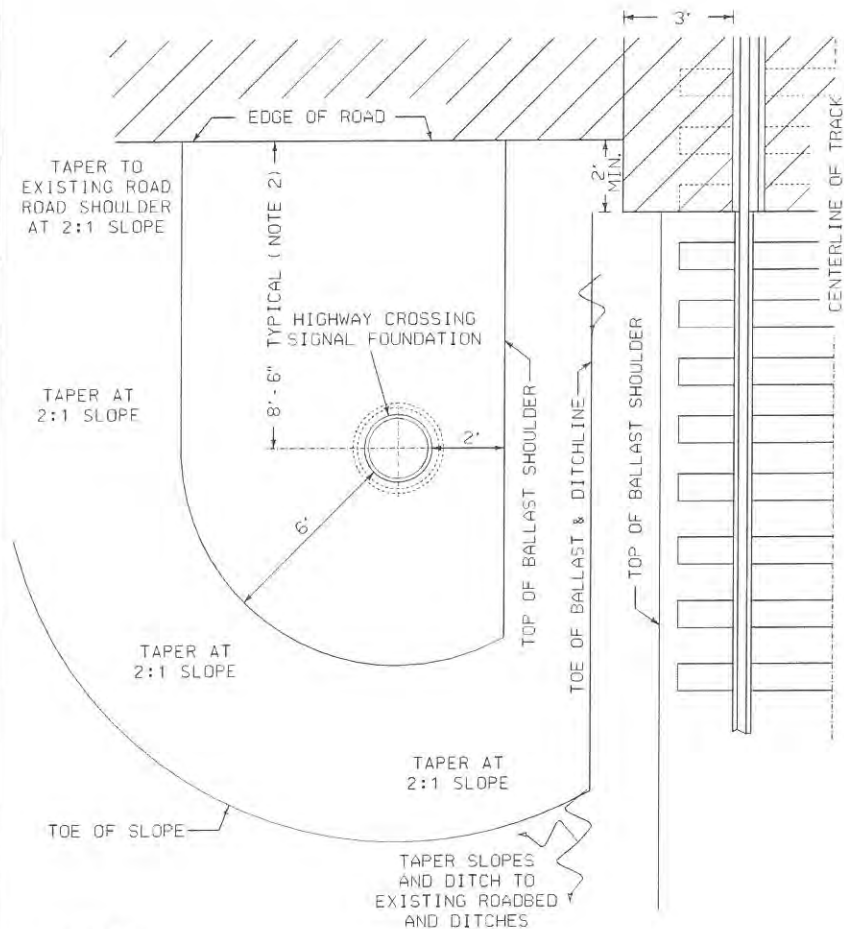
Central Florida Rail Corridor

GUARD RAIL ON OPEN DECK BRIDGES

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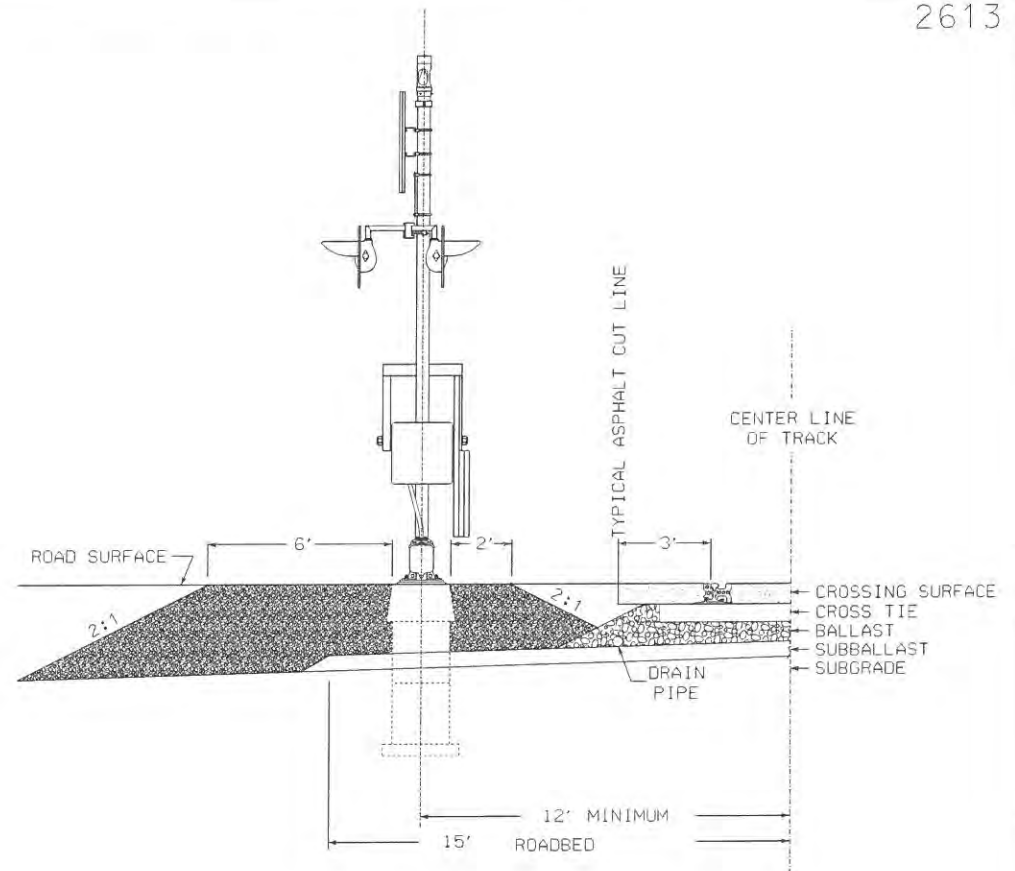
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NOTES

1. ACTIVE CROSSING WARNING DEVICE QUADRANTS OF CROSSINGS SHOULD ALLOW FOR SUFFICIENT DRAINAGE OF THE CROSSING AND GOOD WALKING CONDITIONS FOR SIGNAL MAINTENANCE. THE PARTY PERFORMING CROSSING OR SIGNAL RENEWAL IS RESPONSIBLE TO ENSURE PROPER DRAINAGE AND WALKING CONDITIONS HAVE BEEN PROVIDED, PRIOR TO DEMOBILIZATION.
2. TYPICAL OFFSET FROM EDGE OF ROAD TO CENTERLINE OF FOUNDATION IS 8'-6". REFER TO TRAIN CONTROL SYSTEM REFERENCE SS220 FOR ADDITIONAL DETAIL.
3. CROSSING SIGNAL WALKWAY AREA TO CONSIST OF AREMA #5 WALKWAY BALLAST PER MWI 301.
4. ROAD CROSSING TO BE INSTALLED PER MWI-901.
5. ROADBED DETAILS PER MWI TYPICAL DRAWING 2601.
6. BALLAST SECTION DETAILS PER MWI TYPICAL DRAWING 2602.



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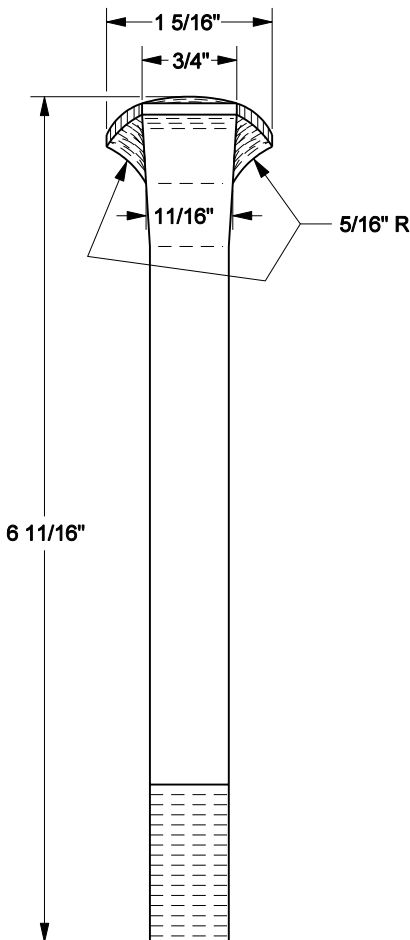
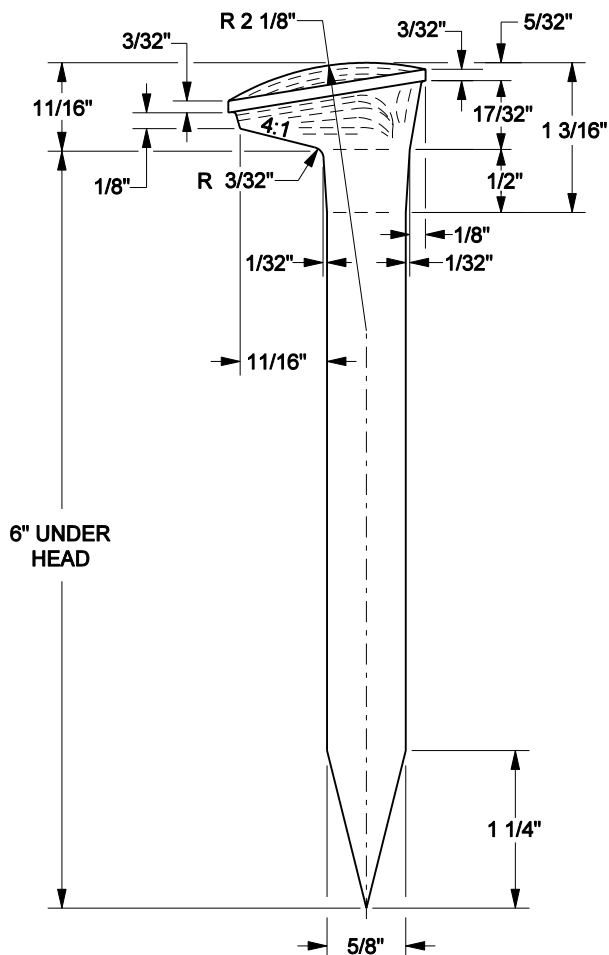
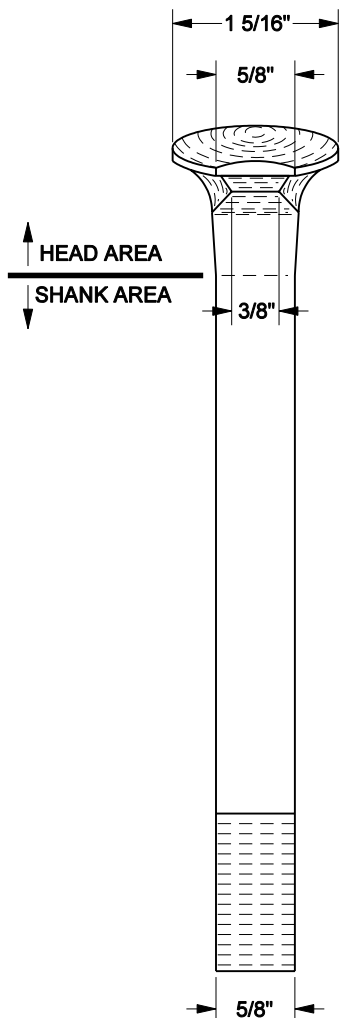
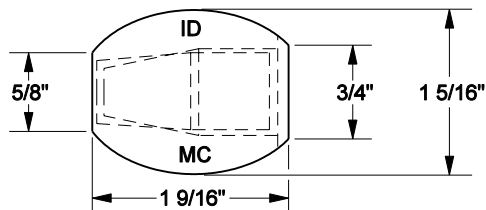
TYPICAL LAYOUT AT HIGHWAY CROSSING
WITH ACTIVE WARNING DEVICE

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PREPARED BY: RMW ISSUED: 9/9/2015 REVISED: 4/2/2015



6" UNDER HEAD

6" CUT TRACK SPIKE

NOTES:

1. MATERIAL AND WORKMANSHIP TO BE IN ACCORDANCE WITH CURRENT AREMA MANUAL REQUIREMENTS FOR MEDIUM CARBON SPIKES.
2. PERMISSIBLE SHANK STRAIGHTNESS VARIATION, MEASURED IN EITHER PLANE, SHALL NOT EXCEED 0.0313".
3. MANUFACTURER'S I.D. AND THE LETTERS "MC" SHALL BE PRESSED ON THE HEAD OF EACH SPIKE WHILE BEING FORMED.
4. WEIGHT = APPROXIMATELY 0.83 LBS. EACH.

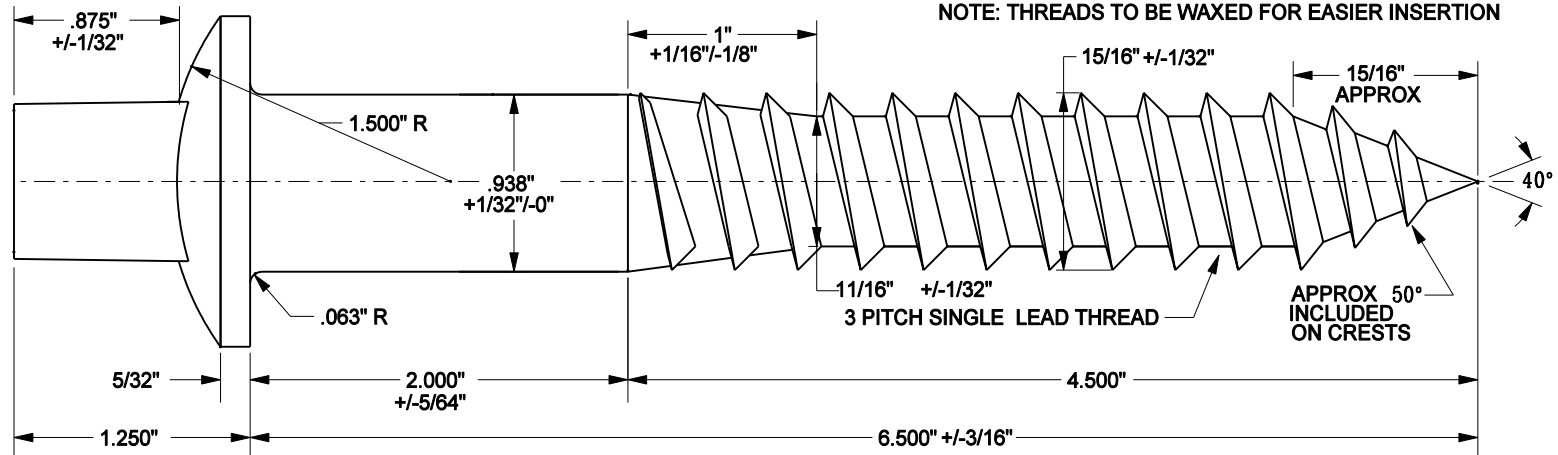


COMMON DRAWINGS

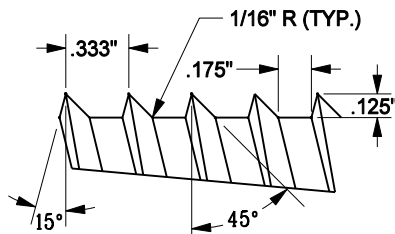
6" TRACK SPIKE

FILE OWNER: CFRC	DATE: 9/26/2014
REV. NO.: 2	DWG NO: 130005

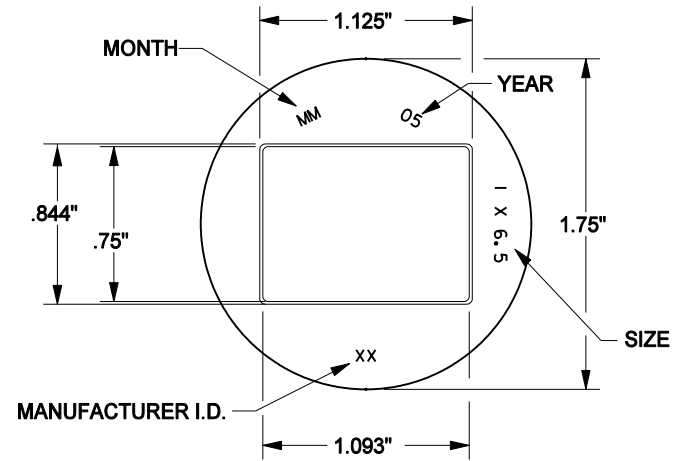
130005



- NOTES:
1. STANDARD SCREWS TO BE MADE FROM LOW CARBON STEEL (CARBON CONTENT OF 0.18 TO 0.25) 74,000 PSI MINIMUM TENSILE STRENGTH AND MEET THE COMMON STANDARDS SPECIFICATIONS FOR STANDARD COACH SCREWS.
 2. HIGH TENSILE SCREWS TO BE MADE FROM HIGH CARBON STEEL 120,000 PSI MINIMUM TENSILE STRENGTH.
 3. MONTH AND YEAR OF MANUFACTURE, AND MANUFACTURER'S I.D. MUST BE HOT FORGED ON HEAD. HEAD MUST BE CENTERED RELATIVE TO SHANK.
 4. SCREWS TO BE DIPPED BY MANUFACTURER IN HOT WAX; MELTED AT 128 DEGREES FARENHEIT.
 5. WEIGHT = 1.43 LBS.



THREAD DETAIL



TOP VIEW OF HEAD
NOTE: ALL DRIVE DIMENSIONS $\pm 1/64''$

REQUIRED SOCKETS AND DRILL BITS
DESCRIPTION
SOCKET FOR USE WITH 1" DRIVE IMPACT WRENCH
SOCKET FOR USE WITH 23MM DRIVE (GEISMAR)
DRILL BIT - 11/16"
DRILL BIT - 3/4"



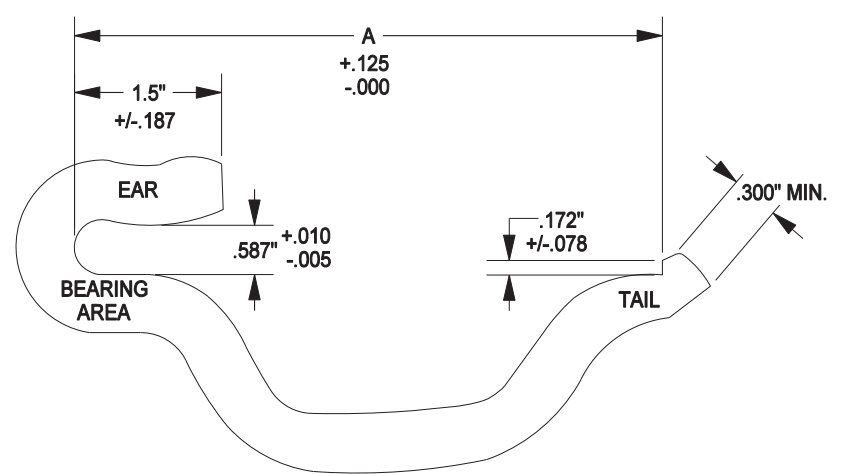
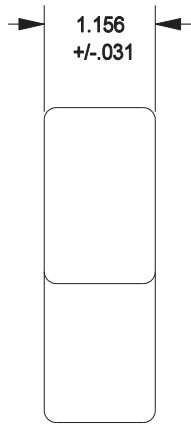
Central Florida Rail Corridor

COMMON STANDARDS

**RECTANGULAR HEAD
TIMBER COACH SCREW**

FILE OWNER: CFRC	DATE: 9/26/2014
REV. NO.: 3	DWG NO: 130800

130800



RAIL BASE SIZE	A	WEIGHTS
5 1/2"	5.625"	1.96 LBS.
6"	6.125"	2.094 LBS.

- NOTES:
1. MATERIAL: HIGH CARBON STEEL
 2. HEAT TREAT TO Rc 34-47
TARGET RANGE Rc 39-44
 3. ALL DIMENSIONS ARE MINIMUM UNLESS OTHERWISE SPECIFIED.
 4. TYPICAL CHEMISTRY: CARBON .58-.90, MANGANESE .7-1.1, SILICON .5 MAX



**BAR STOCK ANCHOR FOR
5 1/2" AND 6" BASE RAIL**

FILE OWNER: CFRC	DATE: SEPT 25, 2014
REV. NO.: 1	DWG NO: 135010

135010