Technical Requirements

Track Renewal & Grade Crossing Upgrade Project

For the
Central Florida Rail Corridor

Florida Department of Transportation

District 5

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1. Technical Requirements

These technical requirements establish the requirements for the Track Renewal & Grade Crossing Upgrade Project to furnish (excluding some ties and rail), distribute, and install rail, ties, concrete panel highway grade crossings, pedestrian grade crossings, ballast, and other related items of work within the Central Florida Rail Corridor (CFRC). The construction project is located between DeBary and South Orlando, FL, between MP A761.81 and MP A796.63. The work shall include the furnishing of all the necessary tools, equipment, labor, materials, insurance, plans, permits, etc. necessary for the installation of rails, ties, highway grade crossings, pedestrian crossing tie replacement, and other items necessary to complete the work in accordance with the CFRC Maintenance of Way Instructions (MWI) attached as Appendix D, this project's FDOT Specifications, and the other Contract Documents.

1.1 Track Renewal

The track renewal work consists of replacing jointed rail and older Continuous Welded Rail (CWR) with new 115RE & 132RE CWR, replacing wood crossties, and replacing crossties under concrete pedestrian crossing panels with ten foot ties. For all track renewal work, existing anchors shall not be reused, new knock on anchors shall be furnished and installed. The Contractor shall supply and use a dynamic track stabilizer to minimize slow orders. Slow Orders shall comply with CFRC MWI 1109 – Temporary Speed Restrictions.

A) Rail

The Department will furnish some of the rail for the project. See Section 3, Materials of this Technical Requirements for a breakdown of materials to be furnished by the Department. The remaining materials are to be furnished by the Contractor. The Contractor shall furnish, distribute, and install all other materials (insulated joints, other track material (OTM), welds, etc.) as necessary to complete the work. The rail sticks shall be flash butt welded to the lengths needed and field welded using thermite welds. Flash butt welding and field welding shall comply with CFRC MWI 801-06 – CFRC Welding Manual. Rail stockpiles are located at the following locations:

- MP 762.4 - North of Barwick Road, East of Track 2
- MP 766.6 – South of McCracken Road, West of Track 1
- MP 788.5 – South of Virginia Avenue – East of Track 2
- MP 790.6 – South of South Street – East of Track 2

No permanent rail joints will be permitted. Rail shall be installed before the ties so as not to spike kill the ties. Appendix A lists the location of CWR replacement and approximate quantity to be installed. The locations will be identified in the field by the Engineer. All insulated joints not shown to be replaced shall remain in track or be reinstalled following CWR installation. The Contractor shall be responsible for the removal of rail and OTM in accordance with local, state, and federal environmental regulations.

B) Ties

The Department will furnish a portion of the ties. See Section 3, Materials of this Technical Requirements for a breakdown of ties to be furnished by Department. The Contractor shall furnish all other material necessary to complete the Technical Requirements. The Contractor shall furnish, distribute, and install all other materials (OTM, tie plugs, etc.) as necessary to complete the work. The CFRC furnished ties are located at the following locations:

- MP 778.9, East of Track 2 - North St laydown yard
- MP 789.3, West of Track 1 – Colonial Drive laydown yard

Appendix B shows the tie quantities and approximate locations of installation. Ties requiring replacement shall be field identified by the Engineer.

C) Ballast

Shy ballast conditions exist from MP A782.8 to MP A791.9. The Contractor shall purchase, unload, distribute, tamp and regulate the amount of ballast required to bring the ballast section into conformance with the main track standard ballast section in accordance with CFRC MWI 2602 – Ballast Sections. Ballast shall be in conformance with AREMA gradation 4A. For bidding purposes, this quantity is estimated to be 5,000 tons. Ballast work is required for the following segments.

- MP 782.8 to MP 784.7 – Single Track (1.9 track miles)
- MP 784.7 to MP 791.9 – Double Track (14.4 track miles)

D) Pedestrian Crossing Tie Replacement

Pedestrian crossings at the SunRail stations were previously installed using 8.5 foot crossties and a tie parallel to the rail to secure the lag bolts of the crossing panel. The photograph below shows the existing condition of ties at the pedestrian crossings.

At the locations listed below, the Contractor shall remove the asphalt adjacent to the crossing, remove the crossing panels, replace the existing ties with ten-foot ties, and replace and secure the concrete panels and replace the adjacent asphalt.

- South End DeBary Station
- North End Sanford Station
- South End Sanford Station
- South End Lake Mary Station
- North End Longwood Station
- North End Altamonte Station
- South End Altamonte Station
- North End Maitland Station
- South End Maitland Station
- North of Morse Blvd
- South of Morse Blvd
- North End Florida Hospital Station
- South End Florida Hospital Station
- North End LYNX Station
- North End Orlando National Railroad Passenger Corporation (Amtrak) Station
- Orlando Amtrak Station South of the Mini-Hi's
- Orlando Amtrak Station at Amtrak Building
- Middle Orlando Amtrak Station
- North End Sand Lake Road Station
- South End Sand Lake Road Station

Existing ties removed from the pedestrian crossings shall be stockpiled by the Contractor at the Department's Vehicle Storage and Maintenance Facility (VSMF) laydown yard in Sanford.

E) Utility Coordination

The Contractor shall be responsible for maintaining all existing utilities within all work zones. The appropriate utility coordination is the responsibility of the Contractor. The Contractor shall coordinate all rail and tie installation with the Engineer who will be responsible for coordinating with CFRC Signal Maintenance of Way Contractor, Herzog Technologies, Inc., for the necessary signal support to identify, locate, protect, and restore all signal cabling, insulated joints, jumpers, and other items.

The Contractor shall follow Department standards, policies, and procedures for utility coordination. The Department standards, policies, procedures, and design criteria are contained in this project's FDOT Specifications, Rule 14-46.001 (Utility Accommodation Manual), Utility User's Guide, and the Contract terms and conditions. Preliminary review of Utility Compensable Property Interest has indicated that the following Utility Owners may be eligible for reimbursement, should relocation be required.

- CFRC Wayside Signal and Grade Crossing Warning Systems (CFRC Signal Maintenance of Way Contractor to locate CFRC signal utilities)
- CFRC Communications (CFRC Operations and Maintenance Contractor to locate communication, fiber, and station electrical utilities)
- Level 3
- Verizon
- Duke Energy, Inc.

It is the responsibility of the Contractor to verify all utility locations, along with any other Utility Compensable Property Interests, and should relocation be required, include these costs in its Lump Sum price.

F) Railroad Coordination

The Contractor shall coordinate all work with the Engineer and the Department's CFRC operations and maintenance contractor (Bombardier Mass Transit Corporation) and the Department's CFRC signal maintenance of way contractor (Herzog Technologies, Inc.). Signal support shall be provided by Herzog Technologies, Inc. Roadway Worker Protection (RWP) training and track protection/employee in charge (EIC) personnel shall be provided by Bombardier Mass Transit Corporation. Contact information for operations and maintenance and signal maintenance of way contractors are shown below. Based on the hourly rates shown on the price proposal form, the Contractor shall estimate the operations and maintenance contractor and signal maintenance of way contractor man-hours needed to support the work and include these costs in their Lump Sum price.

Bombardier Mass Transit Corporation
Mike Dier, Chief Engineer
(407) 732-6726
Michael.Dier@us.transport.bombardier.com
Track Protection EIC

Herzog Technologies, Inc.
Nathan Morrison
(407) 562-2703
nmorrison@herzog.com
Signal Maintenance of Way Manager
Signal Support

Track work windows shall be in accordance with the Central Florida Operating and Management Agreement (CFOMA). All track shall be returned to service with the appropriate slow order prior to 11 p.m. on week days (Monday through Friday) to accommodate train service. Except as noted otherwise herein, the Contractor shall not perform track work between midnight and 5 a.m.

In double track territory, one track shall remain open to train traffic between control points at all times to allow train traffic to pass. The Contractor shall provide the Engineer with work plans for each portion of the work, including detailed schedules outlining what work will be accomplished in each work period.

Work plans shall be provided to the Engineer a minimum of 45 days prior to starting each portion of work. The Engineer shall be responsible for coordinating the work schedules with CSX Transportation Inc. (CSXT), National Railroad Passenger Corporation (Amtrak), and Florida Central Railroad.

In single track territory, the Engineer will coordinate track outages with tenant railroads to accommodate this Technical Requirements. The Contractor shall provide the Engineer with a single work plan, including schedules, covering all required work within single track territory a minimum of 60 days prior to starting all work within that territory.

The Contractor shall have replacement rail in service to accommodate the scheduled Amtrak service during all construction phases. Rail replacement in single track territory shall be restricted to night windows defined as 10:00 p.m. Friday night to 9:00 a.m. on Saturday morning and 8:00 p.m. Saturday night to 9 a.m. Sunday morning. All rail replacement work in single track territory shall be completed in a maximum of six (6) night windows. Tie replacement in single track territory shall be restricted to night windows defined as 10 p.m. Friday night to 9:00 a.m. on Saturday morning and 8:00 p.m. Saturday night to 9 a.m. Sunday morning. All tie replacement in single track territory shall be completed in a maximum of five (5) night windows.

The Contractor shall provide a six week look-ahead schedule for both single and double track territory, updated weekly, to the Engineer.

G) Critical Technical Requirements

The following outlines the critical technical requirements to complete the Technical Requirements for the track, ties and pedestrian crossing elements of the project. The Contractor is required to complete the Technical Requirements in accordance with the MWIs attached in Appendix D and the following critical technical requirements.

- Rail will be laid and anchored at a minimum rail laying temperature of 105°F
- All rail joints shall be welded
- Lay rail to 56-1/2" gage
- Following new tie insertion or ballast installation, tamp every tie over entire length of new ties installed
- Surface and line all track where new ties are installed. Maintain existing profile and alignment unless otherwise directed by the Engineer
- Following tie or ballast installation, stabilize the track with a dynamic track stabilizer before returning the track for to dispatch for train service
- Submit manufacturer model and specifications for the tamper and dynamic track stabilizer to the Engineer for approval prior to mobilization to the work site
- Final track profile and alignment at station platforms shall comply with the vertical and horizontal platform clearances shown in Table 1. The provided clearances in Table 1 are the maximum and minimum clearances for the final track profile and alignment – no additional tolerances are allowed.

Table 1: Track Clearances through Station Platforms

Track Clearances Through Platforms					
Platform	**Location**	**West Platform**		**East Platform**	
		Horizontal Clearance from gage side of field rail to face of platform (in)	Vertical Clearance from top of rail to top of platform (in)	Horizontal Clearance from gage side of field rail to face of platform (in)	Vertical Clearance from top of rail to top of platform (in)
DeBary	Standard Platform	32.75 to 33.25	7.5 to 8.0	Same as west platform	
	Mini-High(1)(2)	37.75 to 38.25	21.5 to 22.0		
Sanford	Standard Platform	32.75 to 33.25	7.5 to 8.0	Same as west platform	
	Mini-High(1)(2)	37.75 to 38.25	21.5 to 22.0		
Lake Mary	Standard Platform	32.75 to 33.25	7.5 to 8.0	Same as west platform	
	Mini-High(1)(2)	37.75 to 38.25	21.5 to 22.0		
Longwood	Standard Platform	32.75 to 33.25	7.5 to 8.0	Same as west platform	
	Mini-High(1)(2)	N/A	21.5 to 22.0		
Altamonte Springs	Standard Platform	32.75 to 33.25	7.5 to 8.0	Same as west platform	
	Mini-High(1)(2)	37.75 to 38.25	21.5 to 22.0		
Maitland	Standard Platform	32.75 to 33.25	7.5 to 8.0	Same as west platform	
	Mini-High(1)(2)	37.75 to 38.25	21.5 to 22.0		
Winter Park	Standard Platform	35.75 to 36.25	7.5 to 8.0	32.75 to 33.25	7.5 to 8.0
	Mini-High(1)(2)	N/A	21.5 to 22.0	N/A	21.5 to 22.0
Florida Hospital	Standard Platform	32.75 to 33.25	7.5 to 8.0	Same as west platform	
	Mini-High(1)(2)	37.75 to 38.25	21.5 to 22.0		
Lynx	Standard Platform	32.75 to 33.25	7.5 to 8.0	Same as west platform	
	Mini-High(1)(2)	37.75 to 38.25	21.5 to 22.0		
Church St	Standard Platform	37.75 to 38.25	7.5 to 8.0	32.75 to 33.25	7.5 to 8.0
	Mini-High(1)(2)	37.75 to 38.25	21.5 to 22.0	32.75 to 33.25	21.5 to 22.0
Orlando Amtrak	Standard Platform	32.75 to 33.25	7.5 to 8.0	Same as west platform	
	Mini-High(1)(2)	N/A	21.5 to 22.0		

Track Clearances Through Platforms				
Platform	**Location**	**West Platform**		**East Platform**
Sand Lake Road	Standard Platform	32.75 to 33.25	7.5 to 8.0	Same as west platform
Sand Lake Road	Mini-High[1][2]	37.75 to 38.25	21.5 to 22.0	Same as west platform

(1) Mini-High horizontal measurement is to the face of the mini-high step

(2) Mini-high vertical measurement is to the top passenger boarding surface

1.2 Highway Grade Crossing Upgrade

Table 2 lists the 34 locations for highway grade crossing upgrades. Since there are two (2) track crossings at some locations, there are a total of 54 highway grade crossing upgrades. Track crossing removal and replacement with asphalt concrete roadway pavement is required at two (2) locations. Crossing upgrades shall consist of new concrete panels, new rail, new ties, new ballast and subballast, new OTM, new asphalt roadway pavement, milling and resurfacing, lining and surfacing, track stabilization, field welds, and all other materials needed to complete the work consistent with this Technical Requirements. The Contractor shall supply and use a dynamic track stabilizer to minimize slow orders. Slow Orders shall comply with CFRC MWI 1109 – Temporary Speed Restrictions.

Crossing upgrades shall be performed in priority order based on the priorities listed in Table 2. All Priority 1 crossings shall be completed prior to beginning work on Priority 2 crossings. All Priority 2 crossings shall be completed prior to beginning work on Priority 3 crossings.

Table 2: Highway Grade Crossing Upgrades

Highway Grade Crossing Upgrades						
MP	**Crossing**	**Work**	**Priority**	**Total Road Crossing Panel Length (ft)[1]**	**Maximum Road Closure Window**	**Notes**
767.03	W. 18th St.	Upgrade Track 2	3	36	9 p.m. Friday to 9 p.m. Saturday OR 9 p.m. Saturday to 9 p.m. Sunday	
767.07	Southwest Rd.	Upgrade Track 2	2	54	9 p.m. Friday to 9 p.m. Saturday OR 9 p.m. Saturday to 9 p.m. Sunday	
767.51	Country Club Rd.	Upgrade Track 2	3	45	9 p.m. Friday to 9p.m. Saturday OR 9p.m. Saturday to 9p.m. Sunday	

Highway Grade Crossing Upgrades

MP	Crossing	Work	Priority	Total Road Crossing Panel Length (ft)[1]	Maximum Road Closure Window	Notes
773.58	S. Country Club Rd.	Upgrade Track 2	1	81	9 p.m. Friday to 9p.m. Saturday OR 9p.m. Saturday to 9p.m. Sunday	
777.52	E. Palmetto Ave.	Upgrade Track 1	1	36	9 p.m. Friday to 9p.m. Saturday OR 9p.m. Saturday to 9p.m. Sunday	
777.81	CR 427	Upgrade Tracks 1 & 2	1	432	9 p.m. Friday to 3 a.m. Monday	
780.36	Leonard St.	Upgrade Track 2	1	36	9 p.m. Friday to 9 p.m. Saturday OR 9 p.m. Saturday to 9 p.m. Sunday	
780.55	SR 436/ Altamonte Dr.[2]	Upgrade Track 2	1	135	9 p.m. Friday to 3 a.m. Monday	
781.24	Ballard St.	Upgrade Track 1	1	45	9 p.m. Friday to 9 p.m. Saturday OR 9 p.m. Saturday to 9 p.m. Sunday	
783.09	George Ave.	Upgrade SGL Main	3	36	9 p.m. Friday to 9 p.m. Saturday OR 9 p.m. Saturday to 9 p.m. Sunday	
783.66	Palmetto Ave (Private bike crossing)	Upgrade SGL Main	3	27	9 p.m. Friday to 9 p.m. Saturday OR 9 p.m. Saturday to 9 p.m. Sunday	
784.73	North Denning Dr.	Upgrade Tracks 1 & 2	1	108	9 p.m. Friday to 3 a.m. Monday	
785.08	Pennsylvania Ave.	Upgrade Tracks 1 & 2	1	306	9 p.m. Friday to 3 a.m. Monday	Roads intersect at crossing. Considered one location
785.17	Webster Ave.					
786.19	S. Pennsylvania Ave.	Upgrade Tracks 1 & 2	1	198	9 p.m. Friday to 3 a.m. Monday	Roads intersect at crossing. Considered one location
786.19	Holt Ave					
786.56	S. Denning	Upgrade	2	126	9 p.m. Friday to 3	

Highway Grade Crossing Upgrades						
MP	**Crossing**	**Work**	**Priority**	**Total Road Crossing Panel Length (ft)**[1]	**Maximum Road Closure Window**	**Notes**
	Rd.	Tracks 1 & 2			a.m. Monday	
787.45	Wilkinson St	Upgrade Tracks 1 & 2	3	162	9 p.m. Friday to 3 a.m. Monday	
787.62	King St.	Upgrade Tracks 1 & 2	1	144	9 p.m. Friday to 3 a.m. Monday	
787.99	E. Princeton St.	Upgrade Tracks 1 & 2	1	216	9 p.m. Friday to 3 a.m. Monday	
788.43	W. Virginia Dr.	Upgrade Tracks 1 & 2	1	126	9 p.m. Friday to 3 a.m. Monday	
788.74	N. Highland Ave	Upgrade Tracks 1 & 2	2	108	9 p.m. Friday to 3 a.m. Monday	
789.48	W. Colonial Dr.	Upgrade Tracks 1 & 2	1	180	9 p.m. Friday to 3 a.m. Monday	
789.62	W. Concord St.	Upgrade Tracks 1 & 2	3	126	9 p.m. Friday to 3 a.m. Monday	
789.73	W. Amelia St.	Upgrade Tracks 1 & 2	1	126	9 p.m. Friday to 3 a.m. Monday	
790.23	W. Central Blvd	Upgrade Tracks 1 & 2	1	198	9 p.m. Friday to 3 a.m. Monday	
790.29	Pine St	Upgrade Tracks 1 & 2	2	144	9 p.m. Friday to 3 a.m. Monday	
790.82	America St	Upgrade Tracks 1 & 2	3	72	9 p.m. Friday to 3 a.m. Monday	
790.93	Ernestine St	Upgrade Tracks 1 & 2. Remove Track 3	3	72	9 p.m. Friday to 3 a.m. Monday	Crossing Removal
791.02	Gore St	Upgrade Tracks 1 & 2. Remove Track 3	1	144	9 p.m. Friday to 3 a.m. Monday	Crossing Removal
791.24	W. Columbia St	Upgrade Track 2	2	54	9 p.m. Friday to 9 p.m. Saturday OR 9 p.m. Saturday to 9 p.m. Sunday	
792.54	W Pineloch St	Upgrade Tracks 1 & 3	2	72	9 p.m. Friday to 3 a.m. Monday	
792.98	Drennen Rd	Upgrade Tracks 1 & 3	2	72	9 p.m. Friday to 3 a.m. Monday	
793.57	Holden Ave	Upgrade Track 1	3	45	9 p.m. Friday to 9 p.m. Saturday OR 9	

Highway Grade Crossing Upgrades						
MP	**Crossing**	**Work**	**Priority**	**Total Road Crossing Panel Length (ft)[1]**	**Maximum Road Closure Window**	**Notes**
					p.m. Saturday to 9 p.m. Sunday	
794.31	Stratemeyer St	Upgrade Track 2	3	54	9 p.m. Friday to 9 p.m. Saturday OR 9 p.m. Saturday to 9 p.m. Sunday	
795.87	Glen Rose Ave	Upgrade Track 1	3	27	9 p.m. Friday to 9 p.m. Saturday OR 9 p.m. Saturday to 9 p.m. Sunday	

[1] – Length of total road crossing panels is the minimum total length required for all track crossings (i.e., for a 2 track crossing with the length of 100 feet, each track shall have a minimum panel length of 50 feet for each track)

[2] – The SR 436 highway grade crossing shall be the third highway grade crossing to be completed. Two different Priority 1 highway grade crossings shall be completed prior to initiating work at the SR 436 highway grade crossing.

A) Material

The Department will furnish a portion of the rail and ties for the project. See Section 3, Materials for a breakdown of materials to be furnished by the Department. The remaining required materials are to be furnished by the Contractor. All ties and rail within the crossing will be replaced. Ties and rail will be stockpiled at the locations shown below:

Rail:

- MP 762.4 - North of Barwick Road, East of Track 2
- MP 766.6 – South of McCracken Road, West of Track 1
- MP 788.5 – South of Virginia Avenue – East of Track 2
- MP 790.6 – South of South Street – East of Track 2

Ties:

- MP 778.9, East of Track 2 - North St laydown yard
- MP 789.3, West of Track 1 – Colonial Drive laydown yard

The Contractor will distribute the materials as necessary to complete these Technical Requirements. The rail sticks shall be flash butt welded to lengths needed for the crossing track panels and field welded using thermite welds. No joints or thermite welds are permitted within the limits of the track panel for each grade crossing. The Contractor shall supply all other materials (concrete panels, OTM, welds, etc.)

necessary to complete the Technical Requirements consistent with the CFRC MWIs attached in Appendix D, this project's FDOT Specifications, and the other Contract Documents.

B) Temporary Traffic Control Plan

The Contractor shall design a safe and effective Temporary Traffic Control Plan to maintain both rail and highway vehicular traffic during all phases of construction for each highway grade crossing. The temporary traffic control plan shall address how to maintain traffic throughout the duration of the work at each highway grade crossing. The Temporary Traffic Control Plan shall be prepared by a Professional Engineer registered in the State of Florida who is certified in the Advanced Training category by a Department approved training provider.

The Temporary Traffic Control Plans shall comply with the Department's Design Standards and the Roadway Plans Preparation Manual. The Contractor shall use Index Series 600 of the Department's Design Standards, latest edition, where applicable for highway elements. Should these standards not address each work area, a detailed Temporary Traffic Control Plan shall be developed. The Contractor shall prepare the Temporary Traffic Control Plans to include plan sheets, notes, and details. The details shall address the following: typical section sheet(s), general notes and construction sequence sheet(s), typical detail sheet(s), traffic control plan sheet(s), advanced signing sheet(s), and detour sheet(s). The Contractor shall prepare additional plan sheets such as cross sections, profiles, drainage structures, retaining wall details, and sheet piling as necessary for proper construction and implementation of the Temporary Traffic Control Plan.

The Contractor shall submit the Temporary Traffic Control Plans for approval for each highway grade crossing no later than 28 days prior to the road closure occurring at that crossing. The Department and the local jurisdiction shall have 14 days to review and accept the Temporary Traffic Control Plan for each crossing. No road closure will be authorized until the Department and the local agency with jurisdiction over the road have approved the Temporary Traffic Control Plans.

The road closure schedule will be subject to Department and local jurisdiction approval and will not be allowed to interfere with special events (parades, foot races, community events, etc.). Allowable hours for road closures by crossing are listed in Table 2. Road closures will generally be permitted to occur within two windows dependent on the crossing:

- 24 hour period from 9:00 p.m. Friday to 9:00 p.m. Saturday OR from 9:00 p.m. Saturday to 9:00 p.m. Sunday; OR
- 54 hour period from 9:00 p.m. on Friday to 3:00 a.m. on Monday

The following restrictions are placed on simultaneous road closures:

- 18^{th} St. and Southwest Rd. – Cannot be closed at the same time
- SR 436 and Ballard St. – Cannot be closed at the same time
- N. Denning Dr. and Pennsylvania Ave./Webster Ave. – Cannot be closed at the same time
- King St. and Princeton St. – Cannot be closed at the same time

- Princeton St. and Virginia St. – Cannot be closed at the same time
- Colonial Dr. and W. Amelia St. – Cannot be closed at the same time
- America St and Ernestine St. – Cannot be closed at the same time
- Gore St. and W Columbia St. – Cannot be closed at the same time
- Pineloch Ave and Drennen Rd. – Cannot be closed at the same time
- Drennen Rd. and Holden Ave. – Cannot be closed at the same time

See Table 2 Highway Grade Crossing Upgrades for specific closure restrictions at each crossing.

C) Utility Coordination

The Contractor shall be responsible for maintaining all existing utilities within all work zones. The appropriate utility coordination is the responsibility of the Contractor. The Contractor shall coordinate all rail and tie installation with the Engineer who will be responsible for coordinating with CFRC Signal Maintenance of Way Contractor, Herzog Technologies, Inc., for the necessary signal support to identify, locate, protect, and restore all signal cabling, insulated joints, jumpers, and other items.

The Contractor shall follow Department standards, policies, and procedures for utility coordination. The Department standards, policies, procedures, and design criteria are contained in, this project's FDOT Specifications, Rule 14-46.001 (Utility Accommodation Manual), Utility User's Guide, and the Contract terms and conditions. Preliminary review of Utility Compensable Property Interest has indicated that the following Utility Owners may be eligible for reimbursement, should relocation be required.

- CFRC wayside and grade crossing warning systems (CFRC Signal Maintenance of Way Contractor to locate CFRC signal utilities)
- CFRC communications (CFRC Operations and Maintenance Contractor to locate communication, fiber, and station electrical utilities)
- Level 3
- Verizon
- Duke Energy, Inc.

It is the responsibility of the Contractor to verify all utility locations, along with any other Utility Compensable Property Interests, and should relocation be required, include these costs in its Lump Sum price.

D) Railroad Coordination

The Contractor shall coordinate all work with the Engineer and the Department's CFRC operations and maintenance contractor (Bombardier Mass Transit Corporation) and CFRC signal maintenance of way contractor (Herzog Technologies, Inc.). Signal support shall be provided by Herzog Technologies, Inc. RWP training and track protection/employee in charge (EIC) personnel shall be provided by Bombardier Mass Transit Corporation. Contact information for operations and maintenance and signal maintenance of way contractors are shown below. Based on the hourly rates shown on the price proposal form, the contractor shall estimate the operations and maintenance contractor and signal maintenance of way contractor man-hours needed to complete this Technical Requirements and include this cost in their Lump Sum price.

Bombardier Mass Transit Corporation, Inc.
Mike Dier, Chief Engineer
(407) 732-6726
Michael.Dier@us.transport.bombardier.com
Track Protection EIC

Herzog Technologies, Inc.
Nathan Morrison
(407) 562-2703
nmorrison@herzog.com
Signal Maintenance of Way Manager
Signal Support

Track work windows shall be in accordance with the Central Florida Operating and Management Agreement (CFOMA). All track shall be returned to service with the appropriate slow order prior to 11 p.m. on week days (Monday through Friday) to accommodate train service. Except as noted otherwise herein, the Contractor shall not perform track work between midnight and 5 a.m.

The Contractor is limited to performing grade crossing work that requires fouling mainline track from Friday night at 10 p.m. to Monday morning at 4 a.m. The Contractor shall have track panels in place to accommodate the scheduled Amtrak service during all construction phases

In double track territory, one track shall remain open to train traffic between control points at all times to allow train traffic to pass. The Contractor shall provide the Engineer with work plans for each grade crossing, including detailed schedules outlining what work will be accomplished in the work period. The work plans, including schedules, shall be provided a minimum of 45 days prior to starting each grade crossing. The Engineer shall be responsible for coordinating the work schedules with CSXT, Amtrak, and Florida Central Railroad.

In single track territory, the Engineer will coordinate track outages with tenant railroads to accommodate this Technical Requirements. The Contractor shall provide the Engineer with a single work plan including schedules covering all required work within single track territory a minimum of 60 days prior to starting work within single track territory.

The Contractor shall provide a six week look-ahead schedule for both single and double track territory, updated weekly, to the Engineer.

E) Critical Technical Requirements

The following outlines the critical technical requirements to complete the Technical Requirements for the highway grade crossing elements of the project. The Contractor is required to complete the

Technical Requirements in accordance with the MWIs attached as Appendix D and the following critical technical requirements.

- Type of Crossing Surface Material
    - All crossing surfaces shown in Table 2 shall be concrete panel crossings unless otherwise noted.
        - Concrete panels shall have a shunt resistant gap in the metal banding of each gage panel
        - Concrete panels shall be designed for use in signaled territory
        - Concrete panels shall provide sufficient length to replace any existing pedestrian pathways through the highway grade crossing.
        - Rubber inserts shall be high resistance type rubber
        - Panels shall have an option for lag bolt and lift ring hole inserts available for ADA applications. Inserts shall be used in all pedestrian walkway/sidewalk locations.
        - Flangeway rubber inserts shall limit the horizontal flangeway gap to less than or equal to 2.5 inches in pedestrian walkway/sidewalk locations.
        - Shall comply with CFRC MWI 2527 and CFRC Specification 901A
        - Submit shop drawings to the Engineer for approval prior to procurement
- Coordination
    - Provide notification to the Department and local government agency responsible for crossing no later than 28 days prior to road closure
    - Provide notification and duration, 21 days in advance of road closure (911, fire, police, ambulance, rescue, post office, school district, tv/radio)
    - Provide Traffic Control Plans meeting FDOT and local government requirements for each crossing a minimum of 28 days prior to road closure.
- Signal Support – to be provided by CFRC Signal Maintenance of Way Contractor.
    - Assist on jumpers for road closures
    - Removal and reinstallation of track connections
    - Any other signal support, as needed to complete crossing upgrade work
- Asphalt Paving
    - Cut asphalt a minimum of three feet from edge of rail
    - At crossings where more than one track is being upgraded, replace all intertrack asphalt
    - Paved road surface level with top of rail for minimum of 30 inches
    - Runoff minimum of 1 inch per 10 feet
    - Install asphalt in accordance with this project's FDOT Specifications. 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. Asphalt shall be placed in a minimum of two lifts.
    - At Ernestine St. and Gore St. Track 3 removals, replace track crossing with asphalt concrete. Match adjacent pavement thickness
- Ballast
    - Mainline AREMA gradation 4A
    - 12 inches below bottom of tie
    - Compact/roll ballast prior to track panel installation
    - Subballast to be a minimum 6 inches of crusher run

- Roadbed shall be excavated and new ballast and subballast shall be installed to the full extents of the approach ties
    - See CFRC MWI 301
- Rail
    - 115 lb. RE SS rail to be used on all crossings, with exception of the following crossings:
        - MP 767.03 18th St. – Use 132 lb. RE SS
        - MP 767.07 Southwest Rd. – Use 132 lb. RE SS
        - MP 767.51 Country Club Rd. – Use 132 lb. RE SS
    - Rail to extend a minimum of 20 feet beyond outside end of each crossing panel assembly
    - Transition rail shall be used when necessary
    - See CFRC MWI 507
- Welds
    - Field Welds shall be thermite welds. All other welds shall be flash butt
    - Thermite welds may not be located within the limits of new rail for each grade crossing
    - All joints within 50 feet of each side of the crossing must be welded within three days
    - Ultrasonically hand test all welds within 30 days, submit test results to the Engineer
    - See CFRC MWI 801
- Ties
    - New 10-foot timber ties shall be used for grade crossings and include 10 additional 10-foot ties on each approach to the grade crossing panels and under the grade crossing panels
    - The use of white oak ties are prohibited
    - All ties within the crossing panel limits shall be replaced
    - See CFRC MWIs 401, 403, and 2527
    - Dispose of used ties (except removed pedestrian crossing ties to be stockpiled) in accordance with all environmental laws and regulations. Submit tie disposal certificates to the Engineer.
- Gage
    - Standard gage is 56-1/2 inches
- Spiking
    - Within the track panel limits use one rail holding spike and one plate holding spike on gage and field sides
    - Tie plates shall all be new
    - Tie plates shall be double shoulder type
    - Spiking pattern on approach ties shall follow standard spiking patterns
    - See MWI 2512
- Anchors
    - New anchors shall be used on all road crossings
    - On crossings 50 feet in width or greater in CWR territory, each tie shall be box anchored on every tie for 130 ties in each direction (In jointed rail territory use standard anchor patterns)
    - See CFRC MWI 703
- Drainage

- Install 6-inch minimum perforated pipe, 12 inches off the end of the tie on both sides of each replaced track. Daylight perforated pipe to adjacent trackside ditch.
  - Extend perforated pipe to a minimum of 10 feet off each end of the roadway panels.
  - Adequate drainage shall be provided at all four quadrants, sloped or diverted away from the crossing.
- Geotextile Fabric (Filter Fabric)
  - Geotextile fabric shall be used on all crossings
  - Geotextile fabric shall be nonwoven type, 16 to 20 ounces/square yard
  - Install 12 inches below bottom of tie
  - See CFRC MWI 1003
- Signal Conduit
  - Install two (2) four inch orange HDPE SDR-11 conduits with one No. 12 AWG pull wire in each conduit. Cap all pipe ends.
  - Place both conduits in same locations, at bottom of ballast layer, 12 inches off the end of the tie.
  - Extend conduits 10 feet past the end of the crossing panels on both sides of the crossing.
  - Document location on Highway Grade Crossing Installation Report (see attached).
- Cleanup
  - Dispose of all scrap material and remove old asphalt within 7 days after completion of each crossing upgrade.
  - The Contractor shall be responsible for the removal of rail and OTM in accordance with local, state, and federal environmental regulations.
- Documentation
  - Fill out and submit to the Engineer the Highway Grade Crossing Installation Report (see attached Appendix C)
  - Complete other reports as necessary (track disturbance, field welding report, etc.)

2. Schedule & Submittals

The Contractor shall prepare and submit a schedule for completion of the Technical Requirements from Notice-to-Proceed (NTP) through final acceptance by the Department. The schedule shall include all activities required to complete this Technical Requirements and shall show tasks and durations in sufficient detail to allow the Department to analyze the time required to complete. Prior to procurement of the concrete crossing panels, the Contractor shall submit shop drawings to the Engineer for review and approval. All work which requires road closures or will impact rail operations must be within the windows shown in Table 2. Further restrictions may be required based upon local special events (parades, etc.) and the need to accommodate tenant railroads.

Schedule to include as a minimum the following:

- Order Materials
- Deliver Materials
- Plan submittals – Work Plans and Temporary Traffic Control Plans

- Field activities – preparation, curfew requirements, speed restriction start/finish of field activities, execution of each major field activities, clean-up/closeout
- Estimated slow orders & removal plan
- Follow-up Field Testing of welds

The following schedule limitations shall apply to the schedule:

- Pedestrian tie replacement within the stations shall be completed within 84 days from issuance of NTP.
- Grade Crossing Upgrade Priority Group One crossing work shall be completed within 182 days from issuance of NTP
- Grade Crossing Upgrade Priority Group Two crossing work shall be completed within 224 days from issuance of NTP
- Grade Crossing Upgrade Priority Group Three crossing work shall be completed within 330 days from issuance of NTP
- Remainder of track renewal work (excluding rail, tie and pedestrian work within the stations) shall be completed within 330 days from issuance of NTP

3. Materials

The Department will furnish the following ties and rail to the contractor at stockpiled locations to complete the Technical Requirements:

- 61,061 LF 115RE Rail in 74 to 80 foot sticks
- 2,849 LF 132 RE Rail in 74 to 80 foot sticks
- 9,213 8.5 foot ties
- 1,727 10 foot ties

The Contractor shall furnish all other ties, rail, crossing panels and OTM necessary to complete the Technical Requirements.

4. Potential Additional Services

Potential Additional Services are described herein solely for informational purposes and are not to be included in the lump sum price for this project. These additional services are contemplated by the Department, and may or may not be provided, at the Department's sole discretion, by other contractors or this Contractor. If and when such services are sought additional information will be provided to the Contractor.

These potential additional services may include the installation of additional crossing surfaces associated with the implementation of Quiet Zones and other railroad improvements. These potential additional services could include: track panels with rail, ties and concrete crossing panels; concrete crossing panel extensions; and OTM

5. Technical Criteria

All material supply, testing, construction work and documentation shall be in accordance with the latest versions of the following documents at the time of advertisement:

1) CFRC MWI's attached in Appendix D
2) CFRC 49 CFR Part 213 Continuous Welded Rail Plan
3) FRA 49 CFR Part 213 Track Safety Standards
4) AREMA Manual of Practice, Volume 1
5) This Project's FDOT Specifications
6) FDOT Design Standards for Construction Operations on the State Highway System

All Roadway Worker Protection shall be in accordance with the latest version, at the time of advertisement, of the CFRC Roadway Worker Protection plan.

5.1 Additional Definitions

"Central Florida Operating and Management Agreement (CFOMA)" means the Central Florida Operating and Management Agreement between the State of Florida Department of Transportation and CSX Transportation, Inc. pertaining to the Central Florida Rail Corridor, a line of railroad between DeLand, Florida, MP A749.61 and Poinciana, Florida, MP A813.82 and related properties dated November 30, 2007, and amendments.

"VSMF" means Vehicle Storage and Maintenance Facility at Rand Yard in Sanford, Florida.

"Amtrak" means the National Railroad Passenger Corporation.

"CSXT" means CSX Transportation Inc.

5.2 Safety Certification Process

This work is to be certified through the Safety Certification Process in accordance with the SunRail Safety Certification Plan. The contractor shall prepare Safety and Security Construction Conformance Checklists for review and approval by the Engineer. The contractor shall coordinate construction activities, inspections, reports and all other appropriate documentation to ensure verification and conformance with the Safety and Security Construction Conformance Checklists. The Safety Certification process will follow the methodology found in the Federal Transit Authority's "Handbook for Transit Safety and Security Certification", November 2002.

5.3 CFRC Maintenance of Way Instructions/Standard Drawings for Track Renewal & Grade Crossing Upgrade Project

Maintenance of Way Instructions/Standard Drawings for Track Renewal & Grade Crossing Upgrade project to complete the Technical Requirements is included in Appendix D.

The following changes to Maintenance of Way Instructions/Standard Drawings for Track Renewal & Grade Crossing Upgrade Project included in Appendix D apply:

- The terms **CFRC Maintenance of Way Manager, CFRC Chief Operating Office, Chief Engineer, Roadmaster, Track Manager, Signal Maintenance Manager, Signal Manager, Bridge Manager**, are replaced with the term **Engineer**. The definition of the term **Engineer** is defined in the FDOT Standard Specifications for Road and Bridge Construction
- MWI 301-04 page 4 of 7 – Item (6) paragraph (B): The 4th sentence is deleted and replaced with the following:
    - The reports shall be forwarded in a consolidated monthly summary of tests in an electronic tabulated format.
- MWI 99001 page 1 of 20 – Item 1.0 Scope: The 2nd sentence is deleted.
- MWI 507-04 page 2 of 6 – Section I Item G.: Item G is deleted and replaced with the following:
    - G. All flash butt welds will be magnetic particle tested in accordance with AREMA manual for Railway Engineering Volume 1, Chapter 4 Rail, Part 3 Joining of Rail
- MWI 507-04 page 3 of 6 - Section II Item B: The 1st sentence is deleted. The column containing Stock Control # is deleted in its entirety.
- MWI 708-01 page 1 of 3 – Section II Subsection A Item 1: Item 1 is deleted and replaced with the following:
    - 1. Premium insulated joints are joints design to exhibit more elasticity or stiffness than standard insulated joints
- MWI 801-06 various locations – the terms listed in the left side column of the following table are deleted in every instance they appear in MWI 801-06. Replacement terms are provided in the right side column if applicable:

Deleted Term	Replacement
SNOOP	Liquid Leak Detector
Orgo Thermit	N/A
Boutet	N/A
Railtech	N/A
CJ Crucible	sealed, felt lined, lid type crucible
CJ Crucible (one-shot)	Sealed, felt lined, lid type crucible
Victor HD310C Torch Handle	Torch Handle with built in reverse flow check valves
Teflon	Polytetrafluoroethylene (PTFE)
Maximo	N/A
Tempilstick	Temperature indicating stick
CJ Fork	Fork
CJ Crucible Fork	Crucible Fork
Plasser	N/A

- MWI 801-06 Page A-8 – Item 10. Item 10 is deleted and replaced with the following:

    - 10. All ground connection 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.
- MWI 801-06 Page C-1 – Item 1. Item 1 is deleted and replaced with the following:
    - 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 rail heater
- MWI 801-06 Page G-7 – Sketch G-4A. The following sentence is deleted:
    - Ordering Reference Class 015 Item 0001750
- MWI 801-06 Page I-6 – Item 25. Item 25 is deleted.
- MWI 801-06 Page I-7 - Heading for Hydraulic Rail Puller Procedures for Geismar Model TH-120-STP is deleted and replaced with the following:
    - Hydraulic Rail Puller Procedures for 120 Ton Rail Puller
- MWI 801-06 Page I-10 - Heading for Hydraulic Rail Puller Procedures for Simplex RP 120 is deleted and replaced with the following:
    - Hydraulic Rail Puller Procedures for 120 Ton Rail Puller
- MWI 801-06 Page I-14 – Item j. The third sentence in Item j. is deleted and replaced with the following:
    - Use of a “Canting Tool” is very helpful in removing twist from the rail
- MWI 801-06 Page I-16 – Item g. Item g. is deleted and replaced with the following:
    - g. Ready-to-use luting material is available.
- MWI 801-06 Page I-17 – Item d. Item d. is deleted and replaced with the following:
    - d. Follow all manufacturer’s approved preheating instructions
- MWI 801-06 Page I-24 – Item e. Item e. is deleted and replaced with the following:
    - e. The proper preheat working pressures are: Propane – 15 PSI; Oxygen – 65 PSI; Burner Hgt – 1 1/2”
- MWI 801-06 Page I-27 Item d. Sub-item 2. Sub-item 2 is deleted and replaced with the following:
    - 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 elevation.
- MWI 801-06 Page I-32 Item e. Item e. is deleted and replaced with the following:
    - e. Use the manufacturer approved preheating equipment
- MWI 801-06 Page I-35 Item 9. Item 9 is deleted and replaced with the following:
    - 9. REPORTING
        - A welding report 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 the proper credit will be recorded when making Wide Gap Welds. Also record the thermite weld batch/serial numbers.
- MWI 801-06 Page M-1 Item e. Item e. is deleted and replaced with the following:

- e. Electric flash butt welds shall be marked on the field side web of the rail near the weld with an identifying marking. This marking will include the following information:
  - The vender or CFRC equipment making the weld; use vender or CFRC abbreviations
  - The equipment number of the machine/truck making the weld
  - Was this a closure weld?
    - If it was insert a “C” before the sequence number
    - If not, leave blank
  - The weld sequence number
  - The date the weld was made
- A sample marking for a closure weld made by XYZ corporation, using truck # 555 follows: XYZ 555 C 1234 1/18/06

- MWI 801-06 Page M-4 the 6th paragraph under the heading REPAIR WELDING PROCEDURE. The 6th paragraph is deleted and replaced with the following:
  - Temperature Measuring Device – The In-Track Welding Team is normally equipped with a digital thermometer with an industrial surface probe both having temperature ranges of at least -127°C to 600°C. It should read instantly and temperature measurements can be made quickly
- MWI 801-06 Pages N-1 thought N-3. Section N is deleted and replaced with the following:

- **N. APPROVED WELDING ELECTRODES AND WIRES**

FOR USED WITH MANAGANESE FROGS

Size	***Polarity***	***Description***	***Use***
3/16” Electrode	*DCRP*	Coated 22% manganese alloy.	Build-up and repair of manganese components in frogs and crossings.
1/16” Wire	*DCRP*	Flux core, self-shielded 25% manganese alloy.	Build-up and repair of manganese components In frogs and crossings.
5/64” Wire	*DCRP*	Flux core, self-shielded 25% manganese alloy.	Build-up and repair of manganese components in frogs and crossings.
5/32” 3/16” Electrode 5/64” 1/16” Wire	DCRP	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. Peened as deposited except first and last pass.

Size	*Polarity*	*Description*	*Use*
5/32” 3/16” 3/16” Electrode	DCRP DCRP DCRP	Coated High Strength joining electrode. As deposited 160 BHN. Work hardens to 450 BHN.	Repairing flangeway cracks and defects in manganese frogs and crossings, and starter pads for manganese build-up. Keep 3/8" below running surface.
1/16” 5/64” Wire	DCRP	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

Size	*Polarity*	*Description*	*Use*
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..
1/16” 5/64”Wire 1/16”Wire 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 Use approximately 28 Vo
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

Size	***Polarity***	***Description***	***Use***
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
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
1/8” 5/32” 3/16” 1/4" Rod	DCRP		Use ¼” only with machines capable of 300+ amps

OTHER RODS

Size	*Polarity*	*Description*	*Use*
1/4" x 22" 1/4" x 44"	*DCRP*	Tubular metal rod	For removal of defective material from manganese components
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"	*DCRP*	Copper coated carbon arc	For removal of defective material by gouging.
1/8" 5/32" 3/16" 3/32" 1/4"x18" Electrode	*DCRP*	Electrode made to AWS E7018E specifications.	Welding structural steel, repairing roadway machines, frames, etc.

MWI 801-06 Pages O-1 thought O-10. Section O is deleted.

- MWI 901-07 various locations – the terms listed in the left side column of the following table are deleted in every instance they appear in MWI 901-07. Replacement terms are provided in the right side column if applicable:

Deleted Term	Replacement
Torx	Star
(015.0001283.1)	N/A
Pandrol	Positive Restraint Tie

- MWI 1101-05 Page 5 of 8 Item 1. d) – Item 1. d) is deleted and replaced with the following:
  - d) Rail anchors, spikes, screws or positive restraint rail fasteners will be handled bulk through team supply chains
- MWI 1101-05 Page 8 of 8 Item A. Item A. is deleted and replaced with the following:
  - A. The Engineer will ensure that the Daily Production Reports are input into the appropriate computer system, 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.

- MWI 1103-04 Page 10 of 10 Curve Alignment Reference Form, Type of Fasteners, Pandrol Plates; The term Pandrol Plates is deleted and replaced with the following:
  - (Positive Restraint Tie Plates)
- MWI 1109-11 Page 7 of 18 Item 3. Item 3 is deleted and replaced with the following:
  - 3. When any of the activities or conditions identified in section II.G.1. & II.G.2. are performed, regardless of rail temperature, a *Track Disturbance Report* must be completed. The *Track Disturbance* Report should be reviewed periodically to ensure that temporary speed restrictions are placed when temperature conditions warrant.
- MWI 1125-03 Page 8 of 11 Item 4. – Item 4. Is deleted
- MWI 1125-03 Page 11 of 11 Item A. – Item A is deleted and replaced with the following:
  - The employee–in-charge of the rail laying will complete the records of rail laying on a continuous basis during rail installation. All records shall be provided to the Engineer.
- MWI Volume II Standard Drawings – Epoxy Bonded Insulated Joint for 115RE, 132RE, 136RE, and 141RE Rail. The following items are deleted from the subject standard drawing
  - 013.30000300.1 LB FOSTER BONDED INSULATED JOINT BOLT REPLACEMENT KIT
  - 013.30000400.1 PORTEC/KOPPERS BONDED INSULATED JOINT BOLT REPLACEMENT KIT
- MWI Volume II Standard Drawings – Main Track Spiking Patterns Side Track Spiking Patterns. the terms listed in the left side column of the following table are deleted in every instance they appear in subject standard drawing. Replacement terms are provided in the right side column if applicable:

Deleted Term	**Replacement**
PANDROL ROLLED PLATE	POSITIVE RESTRAINT ROLLED PLATE
PANDROL VICTOR PLATE	AREMA TYPE POSITIVE RESTRAINT PLATE

APPENDIX A - CWR INSTALLATION							
LOCATIONS	**Track 1 East Rail**	**Track 1 West Rail**	**Track 2 East Rail**	**Track 2 West Rail**	**Total Lineal Feet**	**Insul-ated Joints**	**REMARKS**
DeBary Station	512	512	0	0	**1024**	**2**	Replace from north of existing insulated joints to 100 feet south of station platform. Install 2 new insulated joints at existing locations. All rail/IJ's to be 132RE.
Lake Mary Station	315	297	0	0	**612**		Replace from Palmetto Ave. grade crossing tangent to spiral (TS) point
Longwood Station	250	260	0	0	**510**		Replace as marked within station
Maitland Station	206	216	0	0	**422**		Replace from spiral to tangent (ST) point to 100 feet south of the mini-hi
CP 783 to Sybelia Ave	283	283	N/A	N/A	**566**		Replace from switch to Sybelia Ave grade crossing
Sybelia Ave to George Ave	495	495	N/A	N/A	**990**		Replace from Sybelia Ave to 2003 rail
Horatio Ave to Packwood Ave	271	267	N/A	N/A	**538**		Replace from Horatio Ave to 2003 rail
Ventris Ave to Palmetto Ave	500	485	N/A	N/A	**985**		Replace from Ventris Ave to 2003 curve rail
Palmetto Ave to Lake Ave	555	212	N/A	N/A	**767**		Replace from south end of curve to Lake Ave grade crossing
Lake Ave to 17/92 UGB	507	0	N/A	N/A	**507**		Replace from Lake Ave grade crossing to tangent to spiral (TS) point of curve
Lake Ave to 17/92 UGB (CURVE)	0	**1283**	N/A	N/A	**1283**		Replace west rail for entire curve with **1283 feet of 115RE head hardened rail**
Lake Ave to 17/92 UGB (BRIDGE)	**400**	**400**	N/A	N/A	**800**		Replace from just north of US 17/92 bridge to just south of US 17/92 bridge. Replace with **400 feet of 115RE head hardened rail for each rail.**
US 17/92 bridge to CP 784	741	726	N/A	N/A	**1467**		Replace from US 17/92 bridge to beginning of curve
CP 784 to N. Denning Dr (CURVE)	**214**	**222**	0	0	**436**	**3**	Replace east and west rail from turnout to N. Denning Dr grade crossing. On west rail, replace insulated joint at turnout and at signal. On east rail, replace insulated joint at signal.
Signal 785.4 to new CWR 130 feet to the north of Signal 785.4	130	34	0	0	**164**		Replace between the signal and the new CWR located approximately 130 feet north of the signal
New York Ave to Signal 785.4	32	0	0	28	**60**		Replace from insulated joints at MP 785.4 signal to New York Ave grade crossing
New York Ave to Canton Ave	0	0	0	**82**	**82**		Replace between the grade crossings with **115RE head hardened rail.**
Canton Ave to Morse Blvd	142	165	167	211	**685**		Replace jointed rail from the Winter Park station pedestrian crossing north of Morse Blvd to Morse Blvd grade crossing
Canton Ave to Morse Blvd (CURVE)				**710**	**710**		Replace Track 2 west rail from Canton Ave grade crossing to the end of the curve with **710 feet of 115RE head hardened rail**

APPENDIX A - CWR INSTALLATION							
LOCATIONS	**Track 1 East Rail**	**Track 1 West Rail**	**Track 2 East Rail**	**Track 2 West Rail**	**Total Lineal Feet**	**Insul-ated Joints**	**REMARKS**
Morse Blvd to New England Ave	155	573	0	**571**	**1299**		Replace Track 1 east rail from Morse Blvd grade crossing to beginning of curve. Track 1 west rail from grade crossing to grade crossing. Track 2 west rail, **replace with 571 feet 115RE head hardened rail** from grade crossing to grade crossing
New England Ave to New York Ave/Lyman Ave	0	260	0	**271**	**531**		Replace Track 1 west rail from New England Ave grade crossing to insulated joint at the signal north of New York Ave/Lyman Ave grade crossing. Track 2 west rail, **replace with 271 feet 115RE head hardened rail** from New England Ave grade crossing to insulated joint at the signal north of New York Ave/Lyman Ave grade crossing.
New York Ave/Lyman Ave to Fairbanks	610	897	0	**300**	**1807**		Replace Track 1 west rail from New York Ave/Lyman Ave grade crossing to Fairbanks Ave grade crossing. Track 1 east rail from spiral to tangent (ST) point to Fairbanks Ave grade crossing. Track 2 west rail, **replace with 300 feet 115RE head hardened rail**, from New York Ave/Lyman Ave grade crossing to spiral to tangent (ST) point
Fairbanks Ave to Holt Ave/Pennsylvania Ave	466	442	0	0	**908**		Replace from grade crossing to grade crossing
Holt Ave/Pennsylvania Ave to Minnesota Ave	590	617	0	0	**1207**		Replace from spiral to tangent (TS) point of curve to Minnesota Ave grade crossing
Minnesota Ave to S. Denning Dr	638	638	0	0	**1276**		Replace from grade crossing to grade crossing
S. Denning to Orlando Ave	776	775	0	0	**1551**		Replace Track 1 replace east rail (452 feet) and west rail (475 feet) from S Denning Dr grade crossing to north end of curve. Track 1 replace east rail (324 feet) and west rail (300 feet) from south end of curve to Orlando Ave grade crossing.
Orlando Ave to Westchester Ave	789	770	0	0	**1559**		Replace from grade crossing to grade crossing
Westchester Ave to Wilkinson St	850	547	0	0	**1397**	**1**	Replace Track 1 replace east rail (484 feet) and west rail (547 feet) from Westchester Ave grade crossing to north end of curve. Track 1 south of curve to Wilkinson St grade crossing, replace east rail (366 feet) and insulated joint on east rail at signal.
King St to Rollins St	625	732	0	0	**1357**		Replace Track 1 replace east and west rails from King St grade crossing to north end of curve.

APPENDIX A - CWR INSTALLATION							
LOCATIONS	**Track 1 East Rail**	**Track 1 West Rail**	**Track 2 East Rail**	**Track 2 West Rail**	**Total Lineal Feet**	**Insul-ated Joints**	**REMARKS**
Florida Hospital Station (Rollins St to Princeton St)	436	560	0	0	**996**		Replace Track 1 replace east and west rails from south end of curve to Princeton St grade crossing
Princeton St to Virginia Ave	**1453**	730	0	0	**2183**		Replace Track 1 in the curve, **replace east rail with 713 feet of 115RE head hardened rail**. Track 1 from south end of curve to Virginia Ave grade crossing, replace east rail (740 feet) and west rail (730 feet).
Highland Ave to Magnolia Ave	178	497	0	0	**675**		Replace Track 1 west rail, replace rail from south end of curve to Magnolia Ave grade crossing. Track 1 east rail, replace jointed rail north of Magnolia Ave grade crossing.
Magnolia Ave to Orange Ave	276	180	0	0	**456**		Replace Track 1 replace east and west rails from Magnolia Ave grade crossing to north end of curve.
Marks St to Colonial Dr	110	0	0	0	**110**		Replace Track 1 east rail, replace jointed rail north of Colonial Dr grade crossing.
Colonial Dr to Concord St	654	636	0	0	**1290**		Replace from grade crossing to grade crossing
Concord St to Amelia St	463	462	0	0	**925**		Replace from grade crossing to grade crossing
LYNX Station (Amelia St to Livingston St)	560	560	0	0	**1120**		Replace from grade crossing to grade crossing
Livingston St to Robinson St	553	563	0	0	**1116**	**2**	Replace from grade crossing to grade crossing. Replace existing insulated joints at signal
Robinson St to Jefferson St.	281	278	0	0	**559**		Replace from grade crossing to grade crossing
Jefferson St to Washington St	144	68	0	0	**212**		Replace Track 1 north of switch, replace east rail (108 feet) and west rail (26 feet). Track 1 south of switch, replace east rail (36 feet) and west rail (42 feet)
Washington St to Central Ave	478	470	0	0	**948**		Replace from grade crossing to grade crossing
Central Ave to Pine St	180	180	0	0	**360**		Replace from grade crossing to grade crossing.
Pine St to Church St	268	268	0	0	**536**		Replace from grade crossing to grade crossing
Church St Station (Church St to South St)	555	525	0	0	**1080**		Replace from grade crossing to grade crossing
Church St Station (South St to Anderson St Bridge) (Curve)	0	0	0	**879**	**879**		Track 2, **replace west rail in curve with 879 feet of 115RE head hardened rail**
Under Anderson St overhead bridge (tangent between two curves	218	98	101	0	**417**	**0**	Replace tangent section between the two curves, approximately under the Anderson St bridge

APPENDIX A - CWR INSTALLATION							
LOCATIONS	**Track 1 East Rail**	**Track 1 West Rail**	**Track 2 East Rail**	**Track 2 West Rail**	**Total Lineal Feet**	**Insul-ated Joints**	**REMARKS**
Anderson St Bridge to America St (Curve)	0	0	**953**	**965**	**1918**	**0**	Track 2, **replace east rail (953 feet) and west rail (965 feet) within curve with 115RE head hardened rail.**
America St to Ernestine St	515	512	0	0	**1027**	**0**	Replace from grade crossing to grade crossing
Ernestine St. to Crossover south of Ernestine St	37	32	0	0	**69**	**0**	Replace Track 1 from Ernestine St grade crossing to the crossover south of Ernestine St.
Crossover north of Gore St to Gore St grade crossing	135	121	0	0	**256**	**0**	Replace from the crossover north of Gore St to the Gore St grade crossing
Gore St grade crossing to the north end of the crossover south of Gore St	187	190	0	0	**377**	**0**	Replace from Gore St grade crossing to the north end of the crossover south of Gore St
South end of crossover south of Gore St to the new CWR to the south	34	33	0	0	**67**	**0**	Replace from the south end of the crossover south of Gore St to the new CWR to the south of the crossover
Track 1 to 3 turnout to the new CWR to the north of the turnout	83	77	0	0	**160**	**0**	Replace from the track 1 to 3 turnout North of Columbia St to the new CWR to the north of the turnout
Track 1 to 3 turnout to Columbia St	250	258	**45**	**45**	**598**	**2**	Replace from the track 1 to 3 turnout to Columbia St. Cut out the 45 foot insulated joints on east and west rails from track 3 and replace with standard 115 RE rail. Replace the existing east and west rail poly bars on track 1 at the signal with the track 3 insulated joints.
Columbia St to turnout north of Kaley St	2482	2482	0	0	**4964**	**0**	Replace from grade crossing to grade crossing
Kaley St. to crossover south of Kaley St	94	93	0	0	**187**	**0**	Replace from Kaley St grade crossing to first crossover south of Kaley St
Sand Lake Station	540	540	0	0	**1080**	**2**	Replace from 100 feet north of the station to 100 feet south of the mini-high. Replace two IJ's at north end of the station.
NON-STATION TOTAL LF	**20393**	**20696**	**1266**	**4062**	**46417**	**8**	**Eliminates 1950's jointed rail**
STATIONS TOTAL LF	**1823**	**1825**	**0**	**0**	**3648**	**4**	**Replaces old CWR within stations**
Note: red numbers indicate head hardened rail shall be used							
Note: All rail is 115 RE SS unless otherwise noted.							
				Rail Miles:	**9.48**		
				Track Miles	**4.74**		

APPENDIX B - TIES TO BE REPLACED				
STATIONS & Other Locations	**Track 1**	**Track 2**	**Total**	**Remarks**
DeBary Station	66	0	**66**	
Sanford Station	41	130	**171**	
Old Sanford Station (North of McCracken Rd)	156	162	**318**	
Lake Mary Station	14	0	**14**	
Longwood Station	50	0	**50**	Ties located on the north end of the station
Altamonte Station	0	75	**75**	
Maitland Station	78	0	**78**	
CP 783 to Sybelia Ave	20	**N/A**	**20**	Ties located between switch and Sybelia Ave road crossing
Sybelia Ave to George Ave	60	**N/A**	**60**	Ties located between grade crossings
George Ave to Horatio Ave	70	**N/A**	**70**	Ties located between grade crossings
Horatio Ave to Packwood Ave	90	**N/A**	**90**	Ties located between grade crossings
Packwood Ave to Maitland Ave	20	**N/A**	**20**	Ties located between grade crossings
Maitland Ave to Ventris Ave	40	**N/A**	**40**	Ties located between grade crossings
Ventris Ave to Palmetto Ave	175	**N/A**	**175**	Ties located between grade crossings
Palmetto Ave to Lake Ave	230	**N/A**	**230**	Ties located between grade crossings
Lake Ave to US 17/92 bridge	510	**N/A**	**510**	Ties located between Lake Ave and US 17/92 bridge
US 17/92 bridge to CP 784	170	**N/A**	**170**	Ties located between US 17/92 bridge and switch
CP 784 to N. Denning Drive	50	30	**80**	Ties located between switch and N. Denning Drive grade crossing
Denning Dr to Penn/Webster Ave	273	247	**520**	Ties located between grade crossings
Penn/Webster Ave to New York Ave	298	226	**524**	Ties located between grade crossings
Winter Park Station	127	147	**274**	Ties located from north end of station to Morse Blvd grade crossing
Winter Park Station	32	0	**32**	Ties located from Morse Blvd grade crossing to New England Ave grade crossing
Winter Park Station	100	76	**176**	Ties located from New England Ave grade crossing to Lyman Ave grade crossing
Lyman Ave /New York Ave to Fairbanks Ave	152	0	**152**	Ties located between grade crossings
Fairbanks Ave to Holt/Penn Ave	72	73	**145**	Ties located between grade crossings
Holt/Penn Ave to Minnesota Ave	163	158	**321**	Ties located between grade crossings
Minnesota Ave to S Denning Dr	131	0	**131**	Ties located between grade crossings
Denning Dr to US 17/92	202	220	**422**	Ties located between grade crossings
US 17/92 to Westchester Ave	145	157	**302**	Ties located between grade crossings
Westchester Ave to Wilkinson St	309	0	**309**	Ties located between grade crossings
Wilkinson St to King St	174	0	**174**	Ties located between grade crossings
King St to Rollins St	143	0	**143**	Ties located between grade crossings

APPENDIX B - TIES TO BE REPLACED				
STATIONS & Other Locations	**Track 1**	**Track 2**	**Total**	**Remarks**
Florida Hospital Station	212	209	**421**	Ties located between Rollins St grade crossing and Princeton St grade crossing
Princeton Ave to Virginia Ave	362	0	**362**	Ties located between grade crossings
Virginia Ave to Alden Rd	107	0	**107**	Ties located between grade crossings
Alden Rd to Highland Ave	37	0	**37**	Ties located between grade crossings
Highland Ave to Magnolia Ave	233	0	**233**	Ties located between grade crossings
Magnolia Ave to Orange Ave	87	0	**87**	Ties located between grade crossings
Colonial Dr to Concord St	124	140	**264**	Ties located between grade crossings
LYNX Station	154	160	**314**	Ties located between Amelia St grade crossing and Livingston St grade crossing
Robinson St to Jefferson St	60	60	**120**	Ties located between grade crossings
Jefferson St to Washington St	5	40	**45**	Track 1 ties located between switch and Washington St grade crossing. Track 2 ties located between grade crossings
Washington St to Central Ave	45	49	**94**	Ties located between grade crossings
Central Ave to Pine St	25	28	**53**	Ties located between grade crossings
Pine St to Church St	44	54	**98**	Ties located between grade crossings
Church Street Station	126	120	**246**	Ties located between Church St grade crossing and South St grade crossing
Church Street Station	96	87	**183**	Ties located between South St grade crossing and signal at MP 790.5
Signal at MP 790.5 to East-West Expressway Overhead Bridge	80	33	**113**	Ties located between signal at MP 790.5 and East-West Expressway overhead bridge
America St to Ernestine St	118	68	**186**	Ties located between grade crossings
Ernestine St to Crossover	21	0	**21**	Ties located between Ernestine St grade crossing and crossover
Crossover north of Gore St to Gore St	42	0	**42**	Ties located between crossover and Gore St
Gore St to Crossover south of Gore St	57	77	**134**	Ties located between Gore St and crossover
Crossover south of Gore St to turnout to Track 3	37	77	**114**	Ties located between crossover and turnout to Track 3
Track 1 to 3 Turnout to Columbia Ave	61	0	**61**	Ties located between turnout to Track 3 and Columbia Ave grade crossing
Orlando Amtrak Station	165	450	**615**	Ties located between Columbia Ave grade crossing and south end of Orlando Amtrak station
South end of Orlando Amtrak Station to Kaley St	100	186	**286**	Ties located between south end of Orlando Amtrak station and Kaley St grade crossing
Kaley St to Crossover south of Kaley St	16	19	**35**	Ties located between Kaley St grade crossing and crossover
Sand Lake Rd Station	70	0	**70**	
TOTALS	**6645**	**3558**	**10203**	**8.5' ties**
Pedestrian Crossing 10' Ties 6 EA @ 40 locations (see Section 1.1.D for locations)			**240**	**10' Ties**

Central Florida Rail Corridor

Appendix C
Highway Grade Crossing Installation Report

Date Installed: ______________

Track (s): ______________ MP: ______________

Crossing Name: ______________________________

Type of Crossing: ______________________________ (Public, Private, Pedestrian)

Length of Crossing (ft): ______________

Rail Weight: ______________

Crossing Type Installed ______________________________ (Conc. Panel, Asph. w/ Rubber, etc.)

Panel Manufacturer: ______________________________

Surfaced? ______________ Track Stabilizer Used? ______________

# of Welds: ______________ Slow Order Applied/Duration? ______________

Ballast Depth: ______________ inches

Perforated Pipe Used/Size? Yes or No Size / ______ inches Bury Depth: ______ inches

Track: ______ Side: E or W

Two 4" Signal Conduit with pull wire installed? Yes or No Bury Depth: ______ inches

Track: ______ Side: E or W

Filter Fabric Used? Yes or No Bury Depth: ______ inches

Contractor's name performing crossing work: ______________________________

Contractor's name performing detour work: ______________________________

Contractor's name performing paving work: ______________________________

Notes: ______________________________

Foreman's Signature: ______________________________ Date: ______________

Manager's Signature: ______________________________ Date: ______________

CFRC
Central Florida Rail Corridor

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Appendix D

Maintenance of Way Instructions/Standard Drawings
for
Track Renewal & Grade Crossing Upgrade Project

Volume I: Maintenance of Way Instructions

Volume II: Standard Drawings

Volume III: Common Standards

Volume I:

Maintenance of Way Instructions

Central Florida Rail Corridor

PURPOSE:	To provide uniform Ballast and Sub-ballast Specifications.
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 Specifications for Prepared Railroad Track Ballast and Sub-ballast were developed by a team from the Engineering Department.

II. PROCEDURE

A. The detailed specifications follow:

B. These specifications will be used for the purchase of all Track Ballast and Sub-ballast installed on CFRC.

Prepared by: RMW

Reviewed by: ____________________
Gerry Woods - CFRC Maintenance of Way Manager

Approved by: ____________________
Edward Connolly - CFRC Chief Operating Officer

CFRC

T R A N S P O R T A T I O N

SPECIFICATIONS FOR

PREPARED RAILROAD

TRACK BALLAST and SUB-BALLAST

Approved: December 9, 2013
Revised: May 22, 2014

CFRC

SPECIFICATIONS FOR PREPARED RAILROAD TRACK BALLAST AND SUB-BALLAST

(1) SCOPE:

These specifications cover the requirement for grading and other significant physical properties of mineral aggregates for prepared track ballast and sub-ballast. The suppliers governed by this specification, 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, Trap Rock, and Dolomite Limestone, produced in a crushing-screening plant designed to satisfy the specifications listed herein.

(3) GENERAL REQUIREMENTS:

The type and sizes of prepared ballast shall be designated by the Railroad in conformance to approved standards. 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 specification as determined by methods of test.

If material loaded does not conform to these specifications, 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 and soundness 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 specification.) 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 specification. 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%

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%

Dolomite = 28%

Except as otherwise specified by Railroad

(C) Granite ballast is predominately considered the CFRC Standard. Any deviation must be approved by the CFRC Maintenance of Way Manager. The following guidelines should be followed in determining the type of ballast application for each territorial location:

1. Granite ballast should be used on lines having tonnage in excess of 10 MGT annually.

2. Dolomite Limestone will not be used on CFRC owned tracks without a deviation approved by the CFRC Maintenance of Way Manager.

3. Dolomite = $MgCo^3$ More Than 36% - Approved
Dolomite Limestone = $MgCo^3$ 28-36% - Approved
Limestone = $MgCo^3$ Less Than 28% - Not Approved
Slag Ballast - Not Approved

It is the O&M firm's responsibility to evaluate annual tonnage application when ordering weekly ballast requirements (based on the above guidelines). The Chief Engineer's office will determine the best solution to be administered.

(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% after 5 cycles.

   or

2. in the magnesium sulfate soundness test, the weighted average loss shall not be in excess of 11% after 5 cycles.

(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 CFRC specification.

(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.

(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:

			SUB BALLAST	
SCREEN SIZE	MAIN LINE AREMA #4A	YARD AREMA #5	GA BASE	CRUSHER RUN
2-1/2"	100%			
2"	90 - 100%			
1-1/2"	60 - 90%	100%	100%	100%
1"	10 - 30%	90 - 100%		
3/4"	0 - 10%	40 - 75%	60 - 100%	
1/2"		15 - 35%		
3/8"	0 - 2%	0 - 15%		
NO. 4		0 - 5%		
NO. 8				
NO. 10			30 - 55%	15 - 45%
NO. 60			8 - 35%	
NO. 200			5 - 12%	5 - 12%

(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.

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 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 standard 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.

Central Florida Rail Corridor

MWI 401-02

Timber Crosstie and
Switch Tie Specifications
Issued: 12/9/13
Revised: 5/23/14

PURPOSE: To provide uniform Timber Crosstie and Switch Specifications.

LOCATION: All CFRC tracks.

I. DISCUSSION

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

Prepared by: RMW

Reviewed by: ______________________________
Gerry Woods - CFRC Maintenance of Way Manager

Approved by: ______________________________
Edward Connolly - CFRC Chief Operating Officer

Timber Crosstie and Switch Tie

Procurement Specification

1.0 **Scope** – This procurement specification establishes the minimum detailed technical requirements for Timber Crossties and Timber Switch Ties for use by CFRC. It is CFRC's desire to enter into a long-term contract with suppliers of quality timber crossties and timber switch ties. The suppliers governed by this specification, shall have or establish a quality system that complies with and is certified to the standards 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 CFRC for safety and track reliability. The crossties and switch ties acquired under this specification 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 CFRC shall as a minimum meet the material quality, dimensional, and processing requirements of sections 3, 4, and 5 of this specification as directed and applied by the contract.

1.2 **Requirements Rating Criteria** – Assignment of specification importance shall be designated by one of the following:

(C) – Critical Characteristic

(M) – Major Characteristic

(I) – Incidental Characteristic

This specification 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 specification 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 standard 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 (I)** – 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).

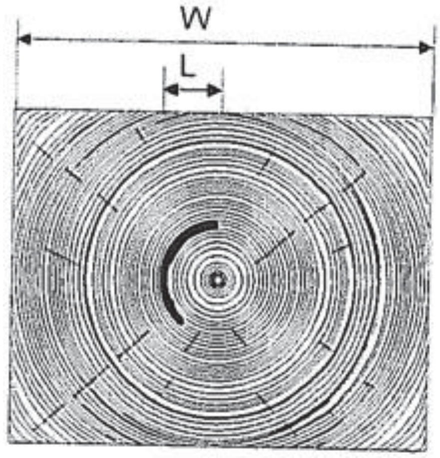


Fig. A

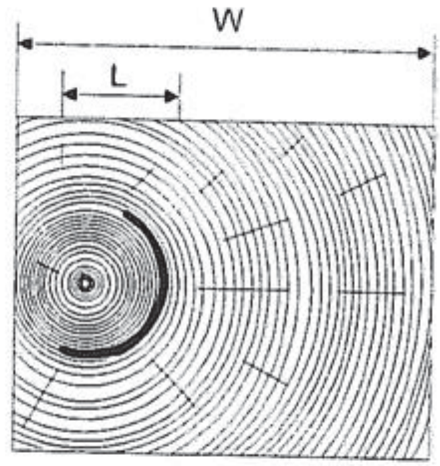


Fig. B

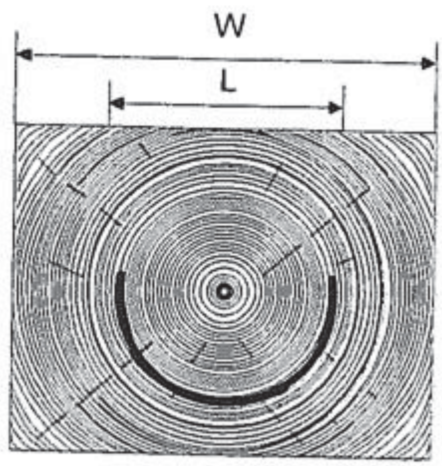


Fig. C

The procedure illustrated in the above diagrams shall be used in determining the length of the shake. One which is not more than 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 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 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).

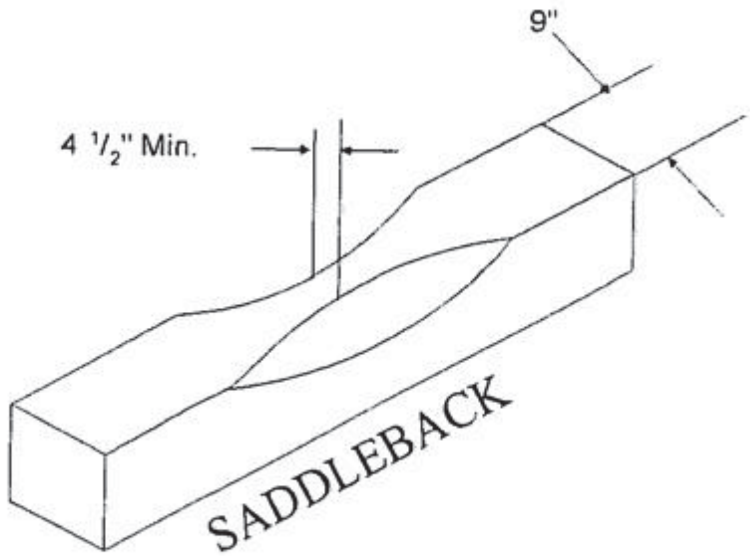


Fig. D

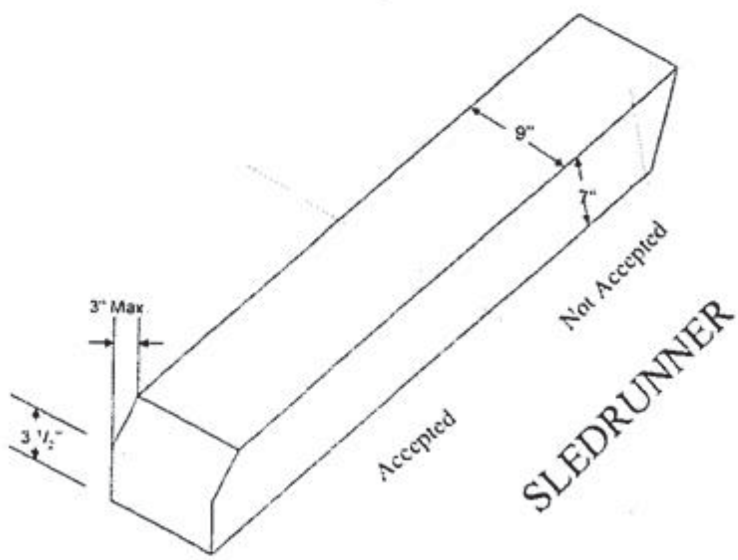


Fig. E

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

1) 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 standard timber crossties (see 3.2.2.2 for standard 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**

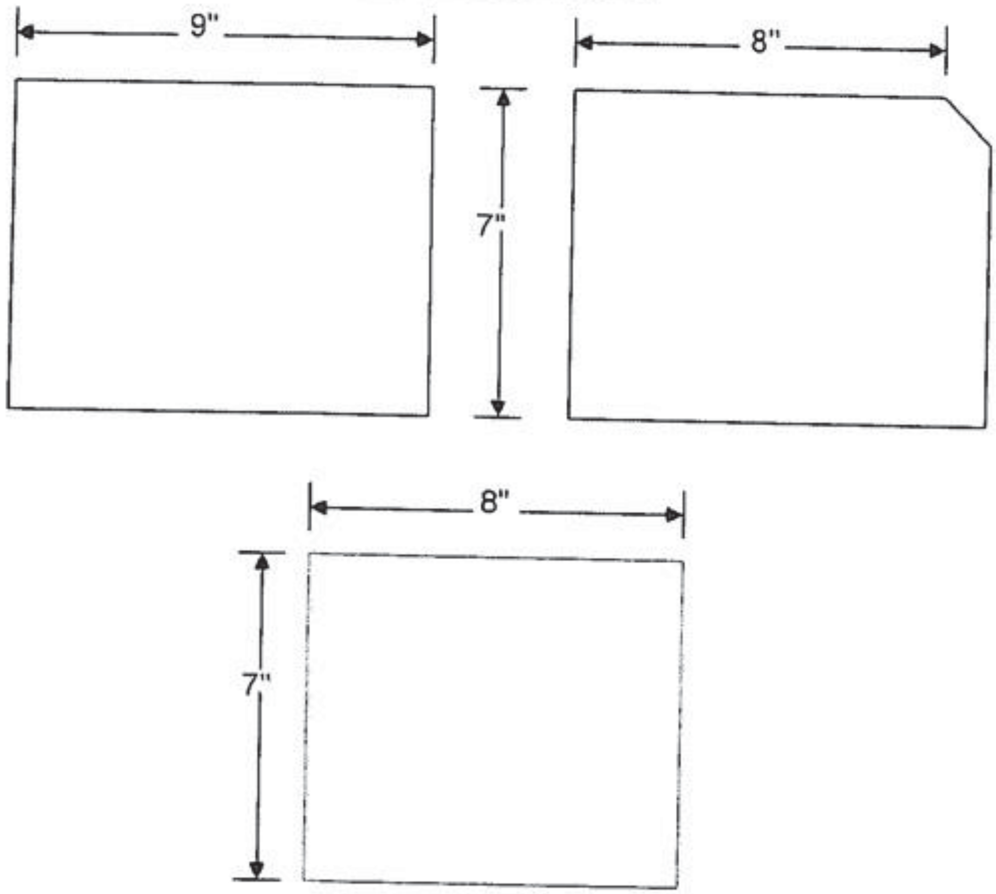
 2) A straight line along a side from the middle of one end to the middle of the other end lies more than two inches from the top and the bottom of the tie.

c) A tie is not well hewed or sawed when its surfaces are cut into with score marks more then 1/2 inch deep or when its surfaces are not even.

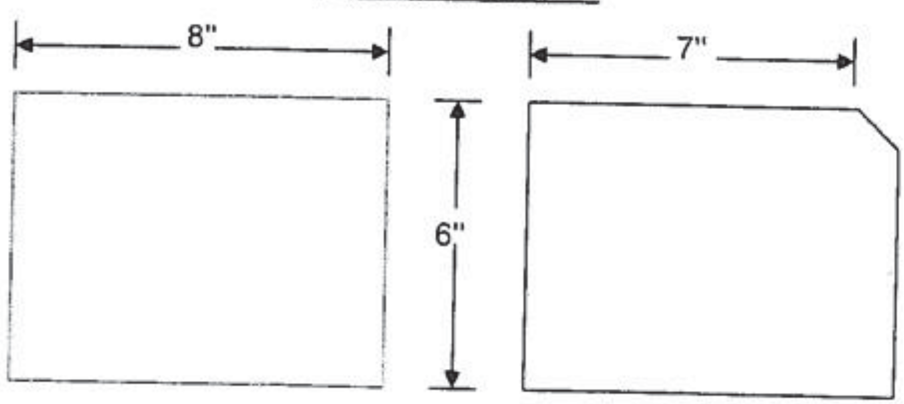
d) The top and bottom of a tie will be considered parallel if any difference in the thickness at the ends does not exceed 1/2 inch.

e) The following size categories shall apply for 7” and 6” crossties :

7" GRADE CROSSTIES



6" GRADE CROSSTIES



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 standard shall be rejected.

c) The thickness and widths specified are minimums for the standard sizes.

d) Ties over 1 inch longer, thicker, or wider than the standard 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 CFRC (See para. 3.1.1, a).

3.2.2.3.2 **Rot** – Crossties with rot shall not be acceptable for use or purchase by CFRC (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 CFRC (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 CFRC (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 CFRC. 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 then 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 standard sizes.

e) Switch ties over 1 inch longer, thicker, or wider than the standard 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 CFRC (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 CFRC (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 CFRC (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 CFRC (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 CFRC. 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 CFRC 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 CFRC.

   6) Culls – All ties not meeting minimum standards for mainline or branchline ties.

c) Ties, which do not meet this specification, are separated as rejects or culls and handled as directed by CFRC Purchasing and Materials in the agreement.

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 specification 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.

3.4.6**Selective End Plates (C)** –

a) Seasoned ties which are split no more than $^{1}/_{4}$ 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 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**Tramming (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 treated using AWPA Standard P2 creosote, or using a creosote/petroleum blend with the petroleum based creosote component not to exceed 25%, to obtain 7# pcf net retention for oak, and 8.5# pcf for mixed hardwood governed by treating specifications 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 CFRC 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 $^{1}/_{2}$ 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 Paragraph 3, 14 AWPA C–6.

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 CFRC until equipment is repaired.

b) The contractor shall upon request from CFRC provide the log and graph, and the tram ticket for review and inspection.

c) For oak crossties, switch ties, and crossing timbers, a net retention of at least seven pounds per cubic foot, unless refusal takes place.

d) For mixed hardwood crossties, a net retention of at least eight and one half pounds per cubic foot is required, unless refusal takes place.

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

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 specification.

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).

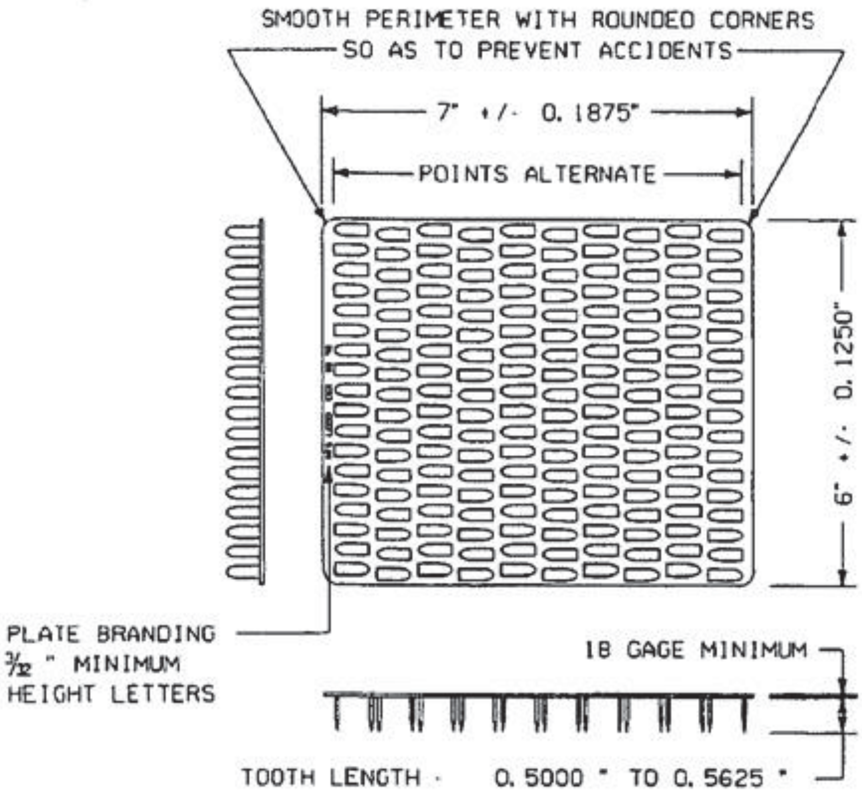
a) The material for nail plates shall be structural steel, ASTM A653, grade 40, 18-gage minimum and hot dipped galvanized, ASTM A924, coating designation G60.

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:

Florence	*CFRC*	*FL*	*99*
Green Springs	*CFRC*	*GS*	*99*
Guthrie	*CFRC*	*GU*	*99*
Montgomery	*CFRC*	*MO*	*99*



NOTES.

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

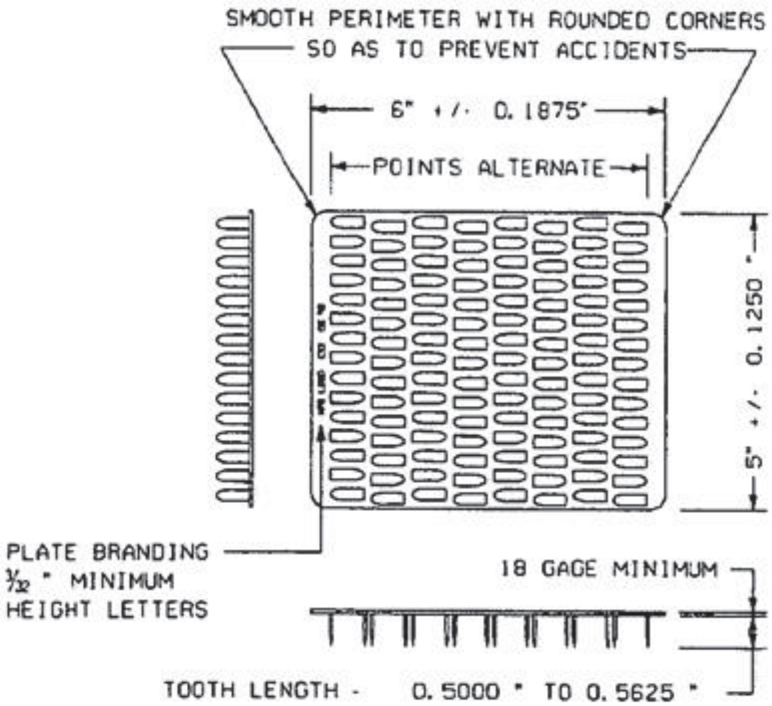
NUMBER AND ALIGNMENT OF ROWS TO BE DETERMINED BY THE PLATE MANUFACTURER. A MINIMUM OF 180 TEETH OR A MINIMUM DENSITY OF 4. 1 TEETH PER SQUARE INCH OF MEASURED PLATE AREA. WHICHEVER PROVIDES THE GREATEST NUMBER OF TEETH, IS REQUIRED.

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 SPECIFICATION, 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 specification and as directed in the contract agreement.

b) CFRC 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 specification.

c) Final acceptance of ties shall be based on destination inspection by CFRC at the location designated by CFRC in the agreement.

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

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

Prepared by: RMW

Reviewed by:

Gerry Woods - CFRC Maintenance of Way Manager

Approved by:

Edward Connolly - CFRC Chief Operating Officer

Central Florida Rail Corridor

MWI 403-02

Specifications and Use of Nail Plates for Cross and Switch Ties
Issued: 12/9/13
Revised: 5/28/14

PURPOSE:	To establish the specification for Nail Plates used to control splitting in Cross Ties and the procedure for their installation.
LOCATION:	All CFRC tracks.

I. DISCUSSION

The CFRC Specifications 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

Reviewed by: ______________________________
Gerry Woods - CFRC Maintenance of Way Manager

Approved by: ______________________________
Edward Connolly - 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 standard 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:

Stock Control # *Description*

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

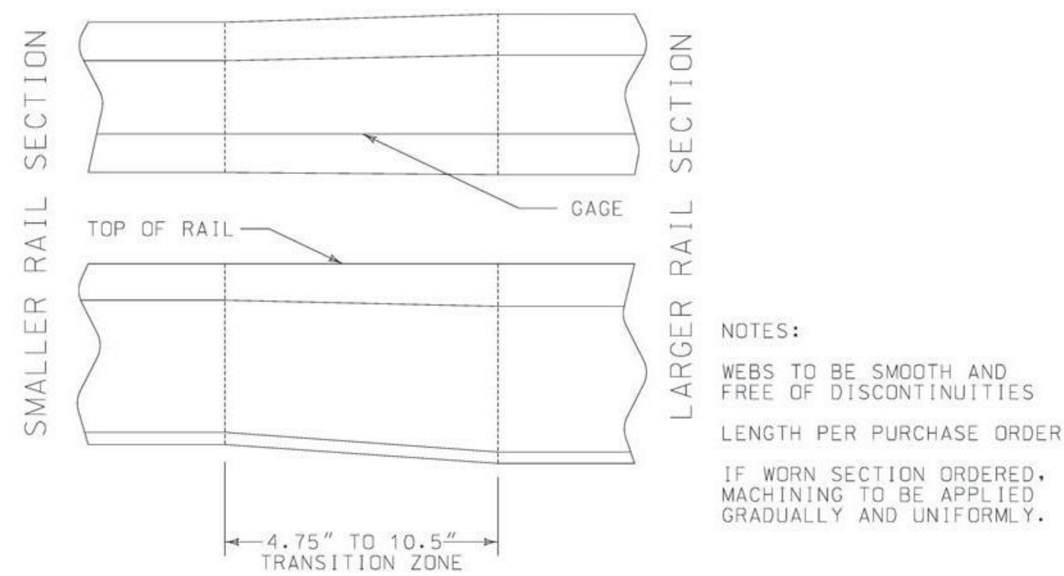
Reviewed by: ____

Gerry Woods - CFRC Maintenance of Way Manager

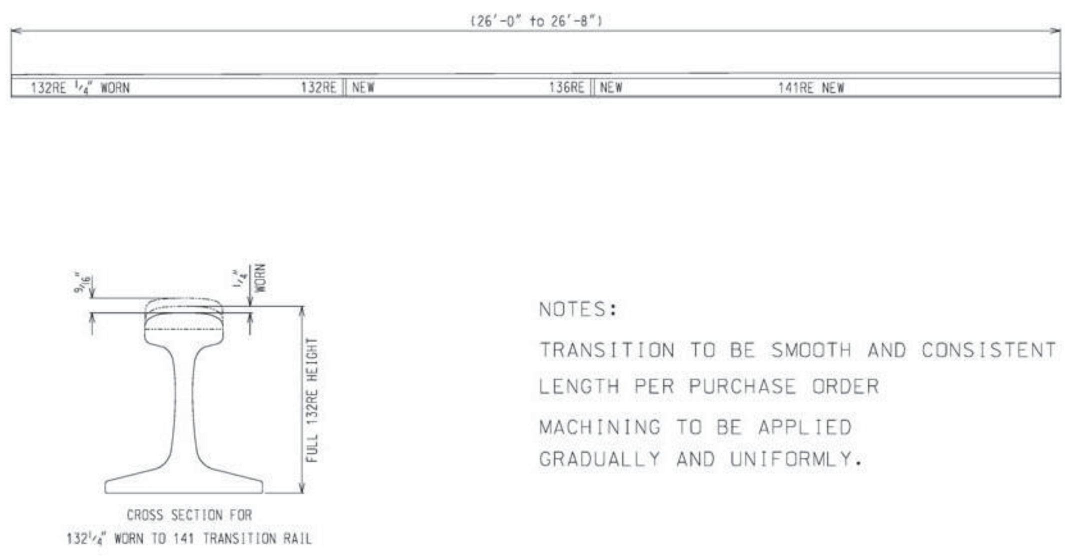
Approved by: ____

Edward Connolly - CFRC Chief Operating Officer

APPENDIX A

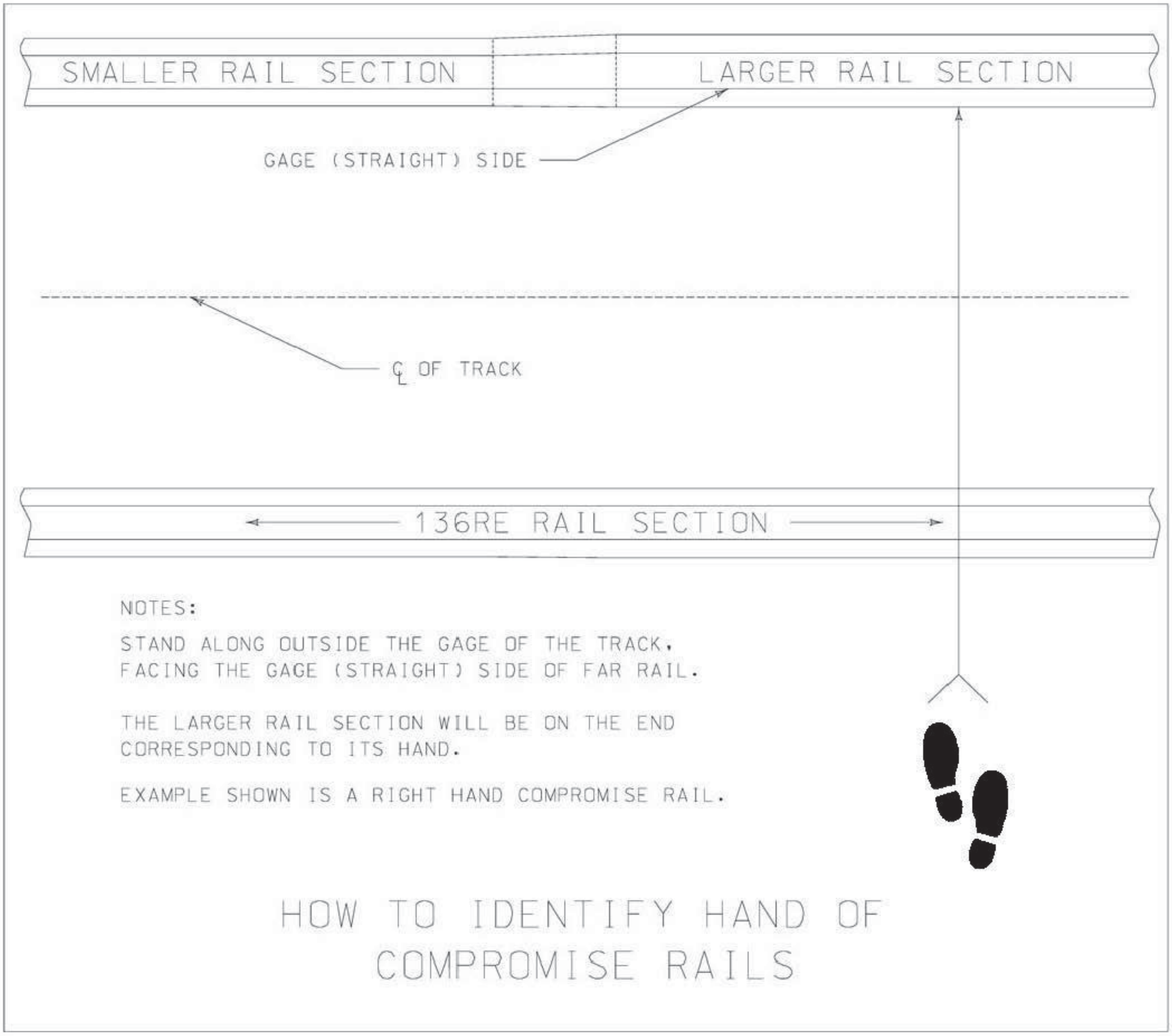


GENERAL ARRANGEMENT FOR COMPROMISE RAILS



GENERAL ARRANGEMENT FOR TRANSITION RAILS

APPENDIX B


SMALLER RAIL SECTION
LARGER RAIL SECTION
GAGE (STRAIGHT) SIDE
℄ OF TRACK
136RE RAIL SECTION
NOTES:
STAND ALONG OUTSIDE THE GAGE OF THE TRACK, FACING THE GAGE (STRAIGHT) SIDE OF FAR RAIL.
THE LARGER RAIL SECTION WILL BE ON THE END CORRESPONDING TO ITS HAND.
EXAMPLE SHOWN IS A RIGHT HAND COMPROMISE RAIL.
HOW TO IDENTIFY HAND OF COMPROMISE RAILS

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 standard during the nextRail 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 standard 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.

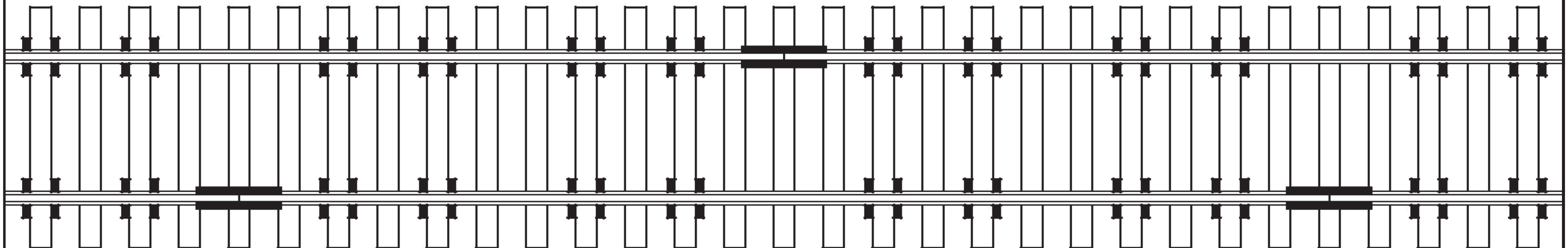
Prepared by: RMW

Reviewed by: ______________________________

Gerry Woods - CFRC Maintenance of Way Manager

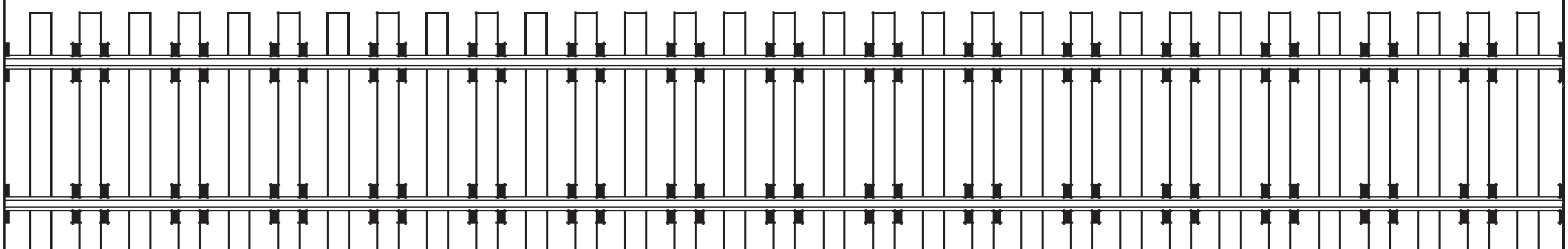
Approved by: ______________________________

Edward Connolly - CFRC Chief Operating Officer



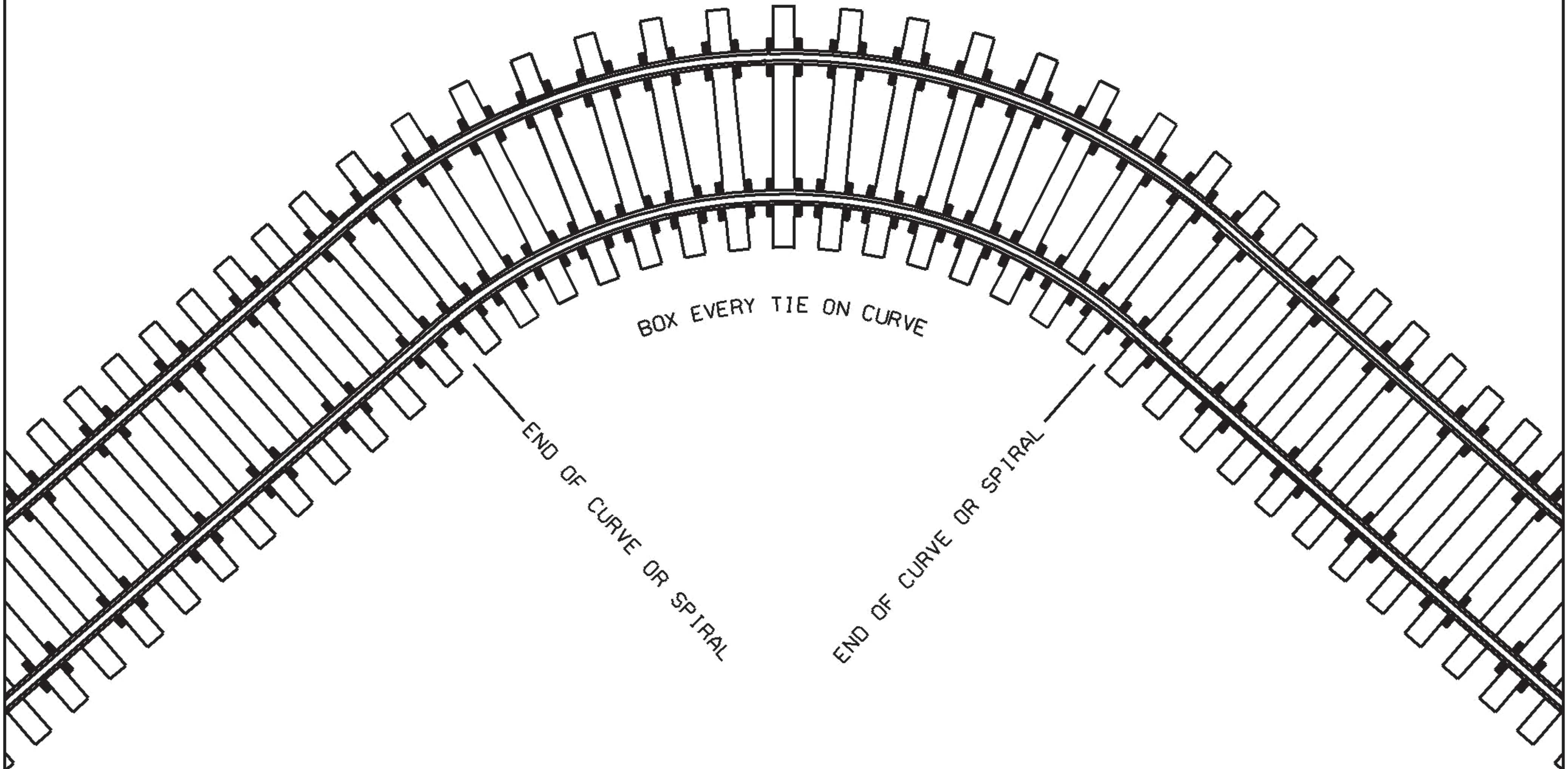
JOINTED RAIL - 16 ANCHORS PER 39 FOOT RAIL, BOX ANCHOR 8 TIES.

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

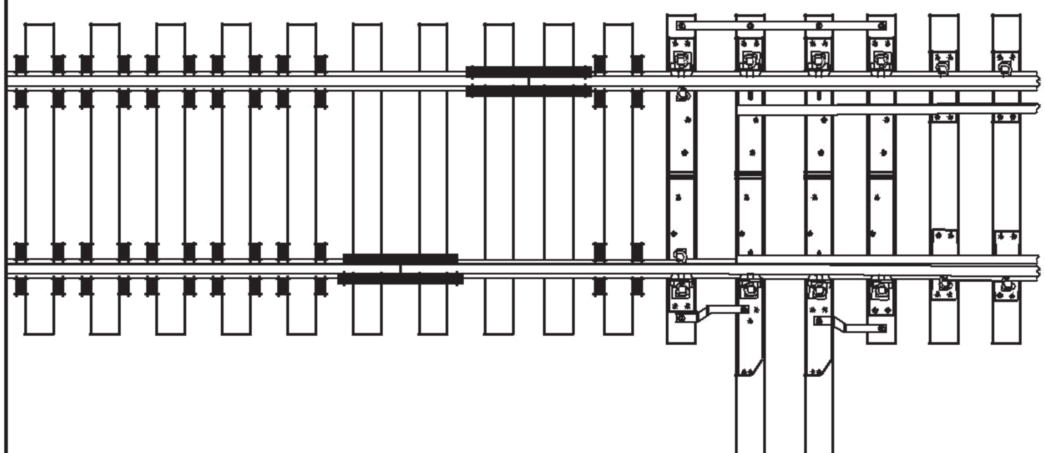
RAIL ANCHOR PATTERNS

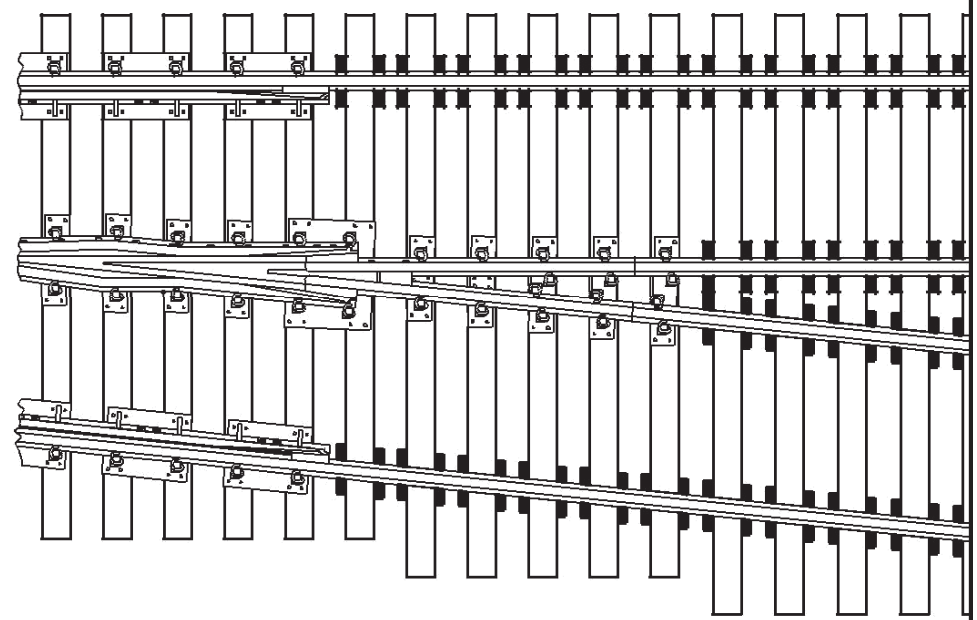
AHEAD OF SWITCH POINT :

- 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 :

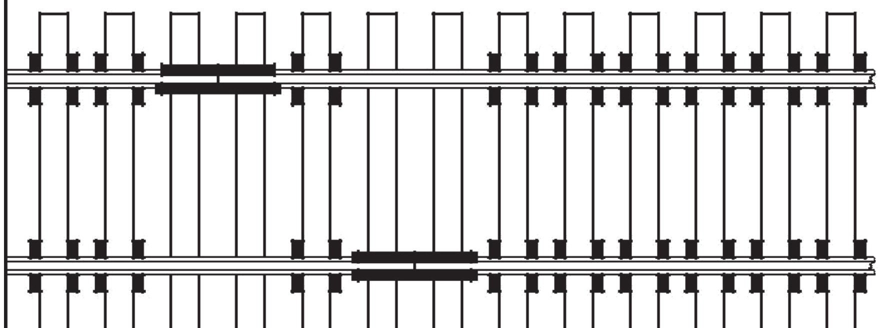
- BOX ANCHOR EVERY TIE FOR 130 TIES.

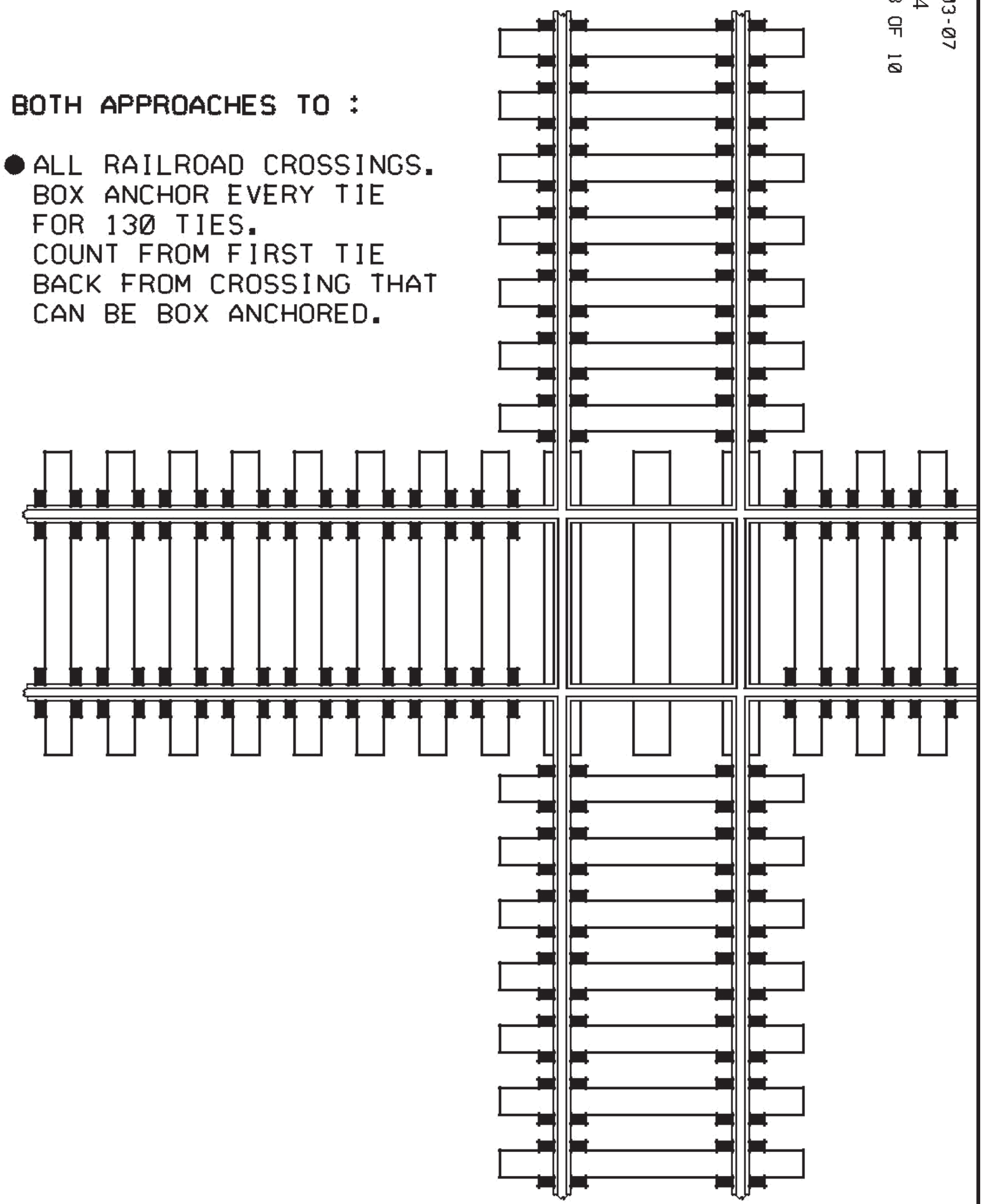
USE NORMAL ANCHOR PATTERN FOR :

- 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.

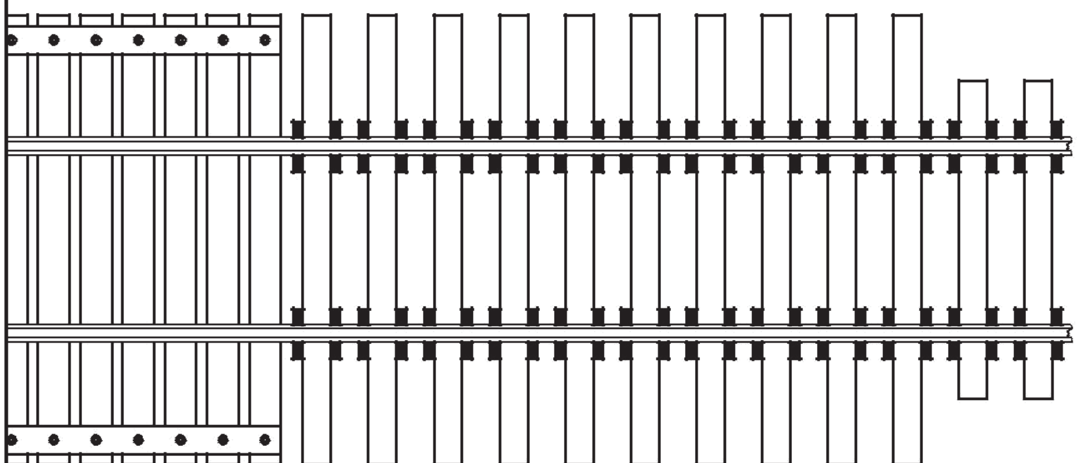




WELDED RAIL ANCHOR PATTERN ADDITIONS

BOTH APPROACHES TO :

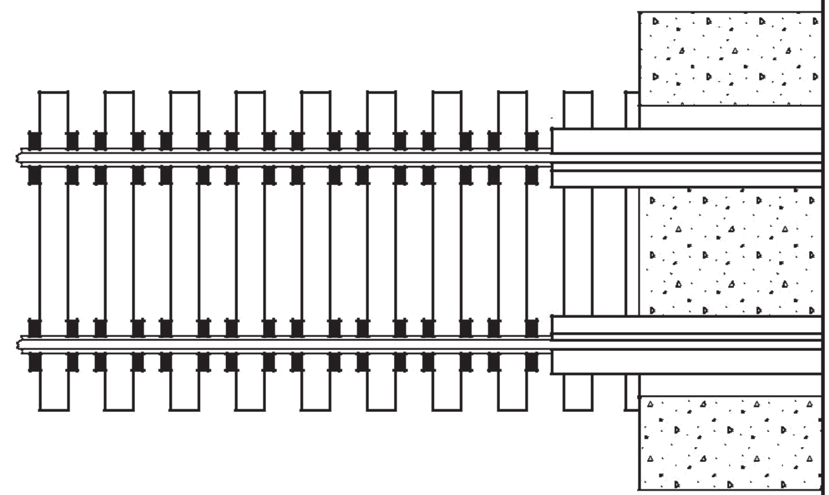
- ALL OPEN DECK BRIDGES.
  BOX ANCHOR EVERY TIE FOR 130 TIES.



COUNT FROM BACKWALL OF BRIDGE.

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.

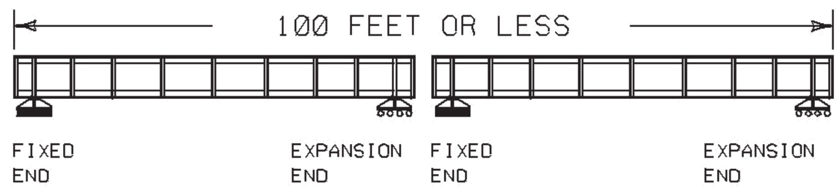


COUNT FROM FIRST TIE BACK FROM END OF CROSSING OR FROM JOINTS FOR CROSSING WARNING IF NOT EPOXY GLUED JOINTS.

WELDED RAIL ANCHOR PATTERN ADDITIONS

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

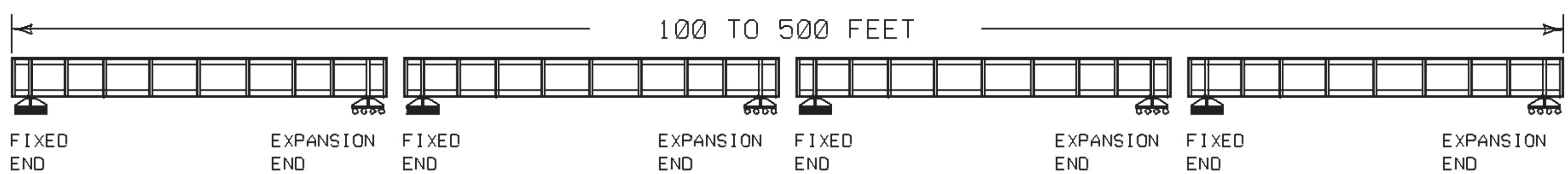
- RAIL ANCHORS WILL BE APPLIED ON ALL TIES FASTENED TO THE BRIDGE SPAN.



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 THROUGHTOUT 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

MWI 708-01

Insulated Joint Installation Policy

Issued: 12/9/13
Revised: 9/25/14

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 up to standard 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. Standard duty insulated joints are standard 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 – Standard 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 Standard Insulated Joints is contained in Appendix I. Ordering information for commonly used Encapsulated Insulated Joints is contained in Appendix II.

Prepared by: RMW

Reviewed by: ____
Gerry Woods - CFRC Maintenance of Way Manager

Approved by: ____
Edward Connolly - CFRC Chief Operating Officer

Appendix I. Matrix of Bonded Insulated Joints—Standard 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"

STANDARD

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 136RE 141RE	6”x6”x7-3/8”x6”x6
	6-1/2”x6-1/2”x5-3/8”x6-1/2”x6-1/2”

* Note – only most common joint configurations shown.

Central Florida Rail Corridor

Maintenance of Way

Welding Manual

ISSUED: December 9, 2013
REVISED: June 13, 2014

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:

Prepared by: RMW

Reviewed by: ______________________________

Gerry Woods - CFRC Maintenance of Way Manager

Approved by: ______________________________

Edward Connolly - CFRC Chief Operating Officer

CFRC
Central Florida Rail Corridor

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 **<u>not</u>** 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 vales, 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 standard 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, standard joint bars shall be applied on only one joint at a time. (When the insulated joint is on the closure rail, the installation of

standard 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.

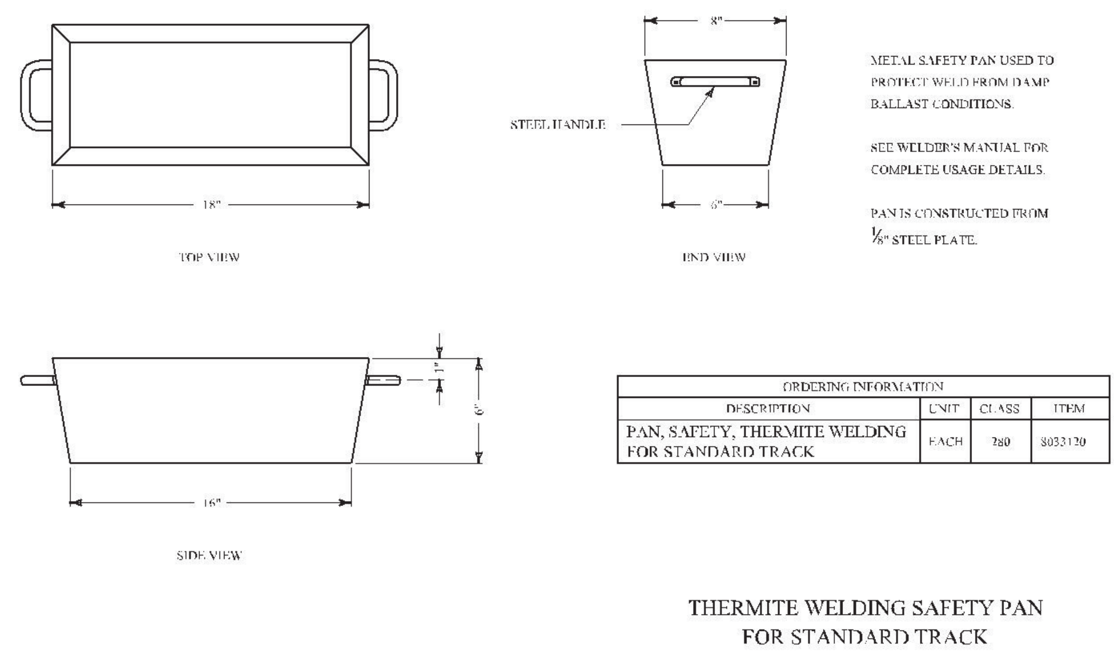
5. When a weld must be made on an open deck bridge: A safety pan will be placed directly under the weld. The safety pan is a metal container approximately 10" x 26" x 6" with 3" of dry sand in the bottom as illustrated in Sketch A-2.

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.

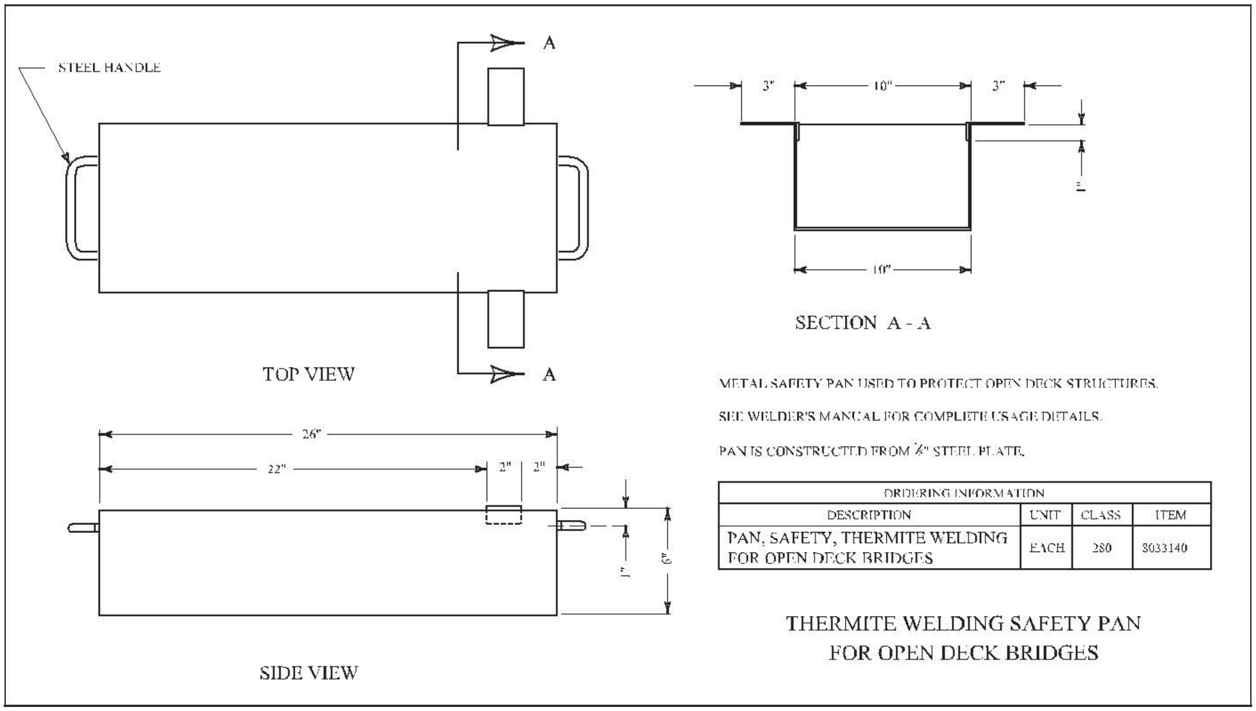


ORDERING INFORMATION			
DESCRIPTION	UNIT	CLASS	ITEM
PAN, SAFETY, THERMITE WELDING FOR STANDARD TRACK	EACH	280	8033120

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-1

Photo A-2

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 <u>direct supervision</u> 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 ¾" 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 standards.
    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.

Rail Temperature	*Weather Conditions*	
	Clear	*Wind, light rain, or snow*
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.

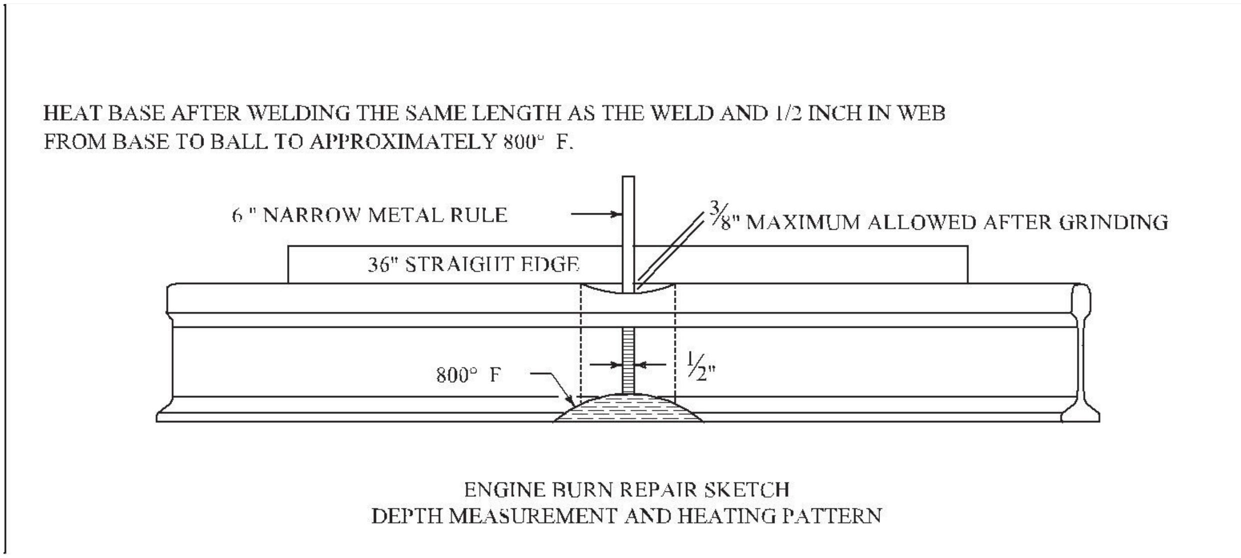
5. Grind out all damaged metal down to sound, clean parent metal. The removal shall not be accomplished through the use of a torch. Special care must be used to remove enough metal to eliminate all shatter cracks.

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



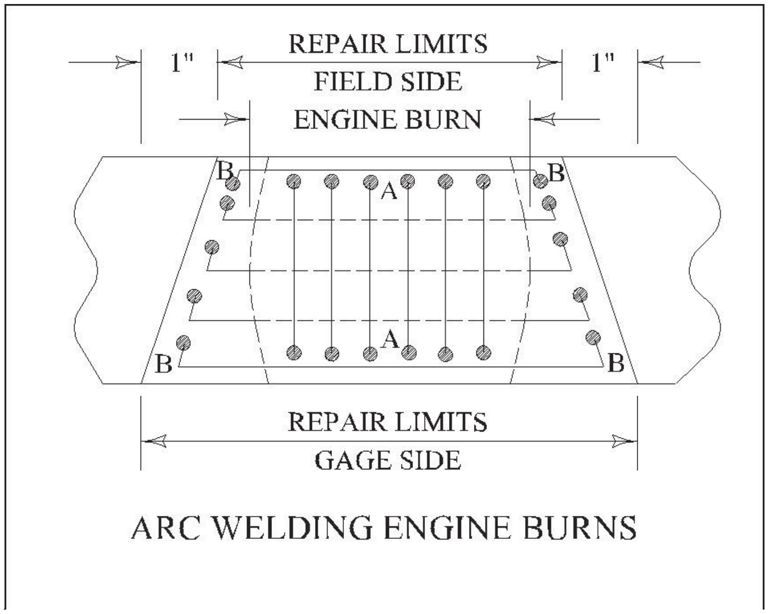
Sketch C-1

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.

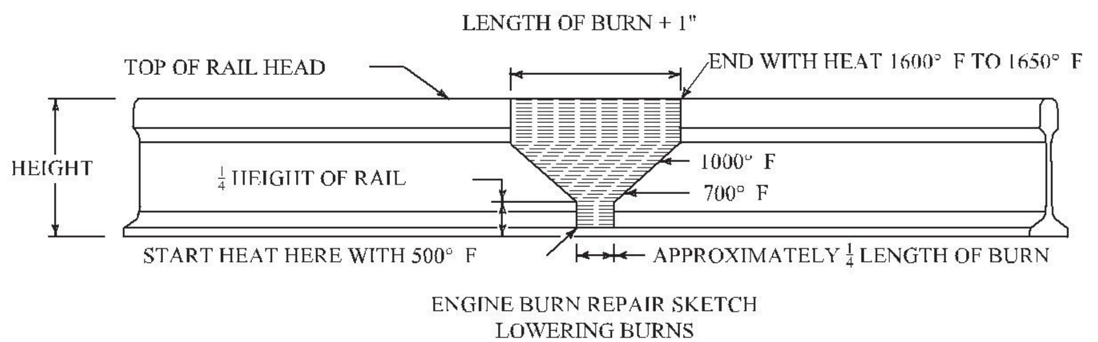
13. Use the surface grinding attachment to grind the weld area to a smooth surface and true rail contour.

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).

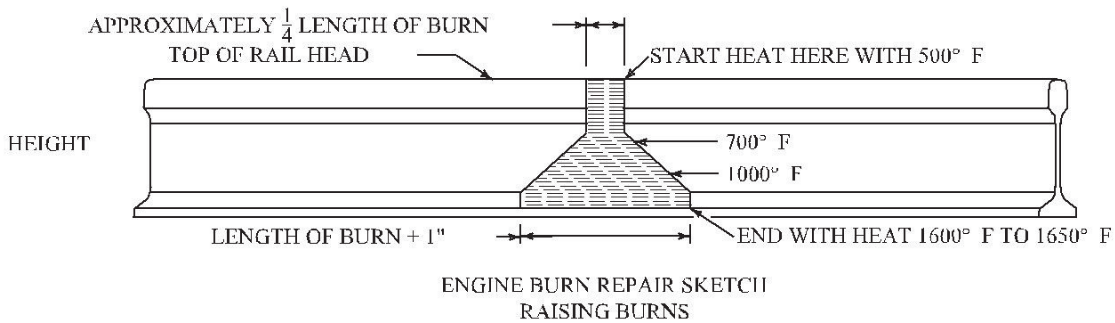
15. Remove shims from one tie and tamp that tie before removing the shims from the next tie. Replace any rail anchors that were removed.

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.

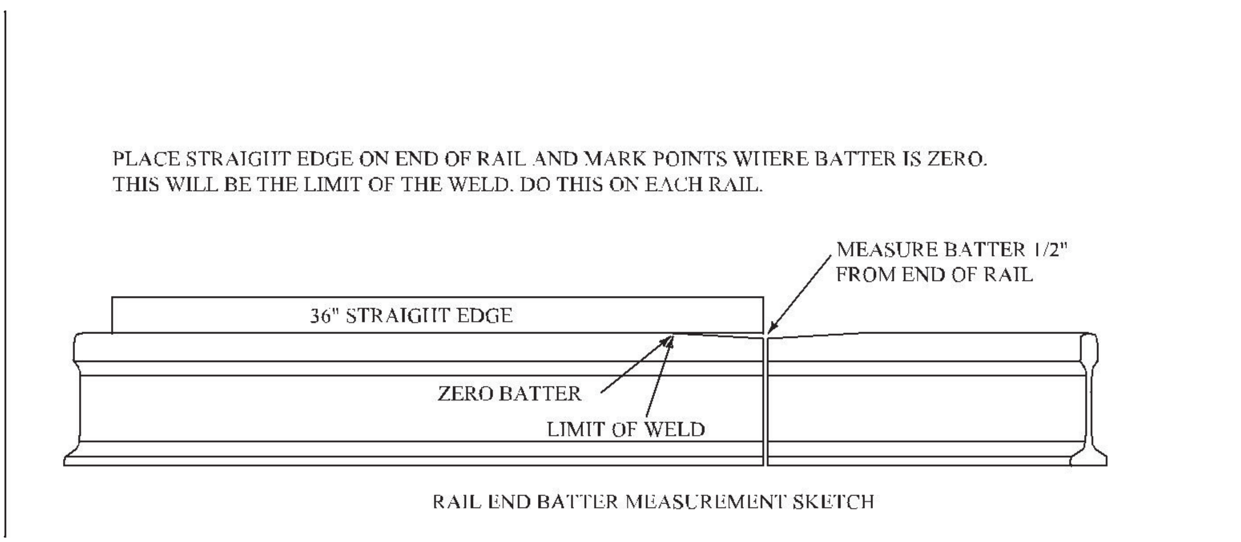
2. Rail ends that have been repaired by welding will not be thermite welded until the rail end has been cropped to remove the entire previously repaired area.

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:

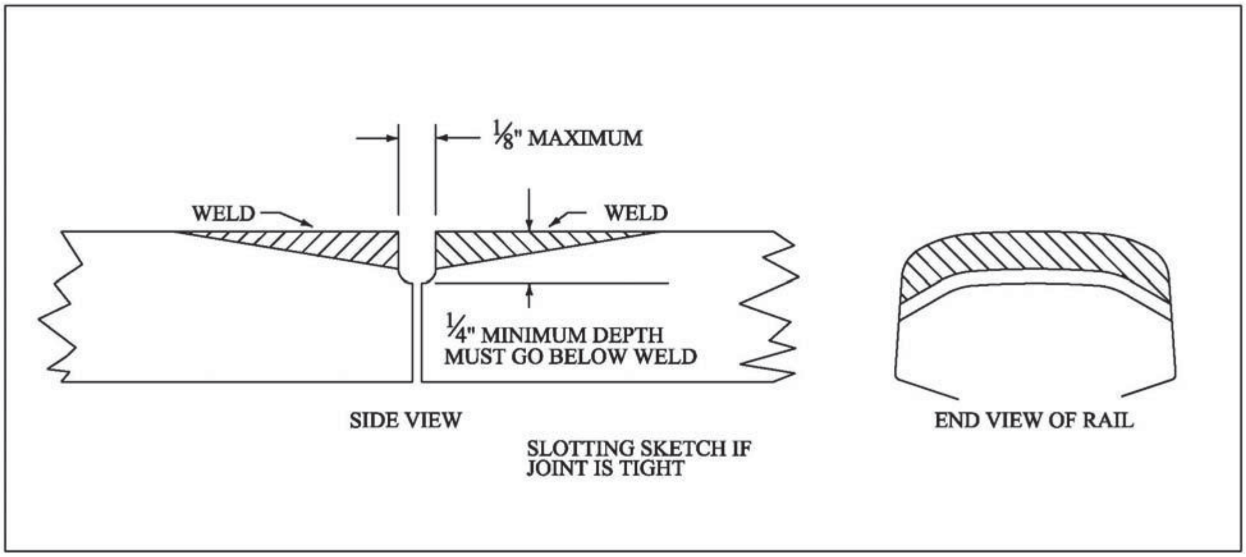
   1/8 inch (0.125") where freight train speed exceeds 60 MPH
   1/4 inch (0.250") where freight train speed exceeds 40 MPH
   3/8 inch (0.375") where freight train speed exceeds 10 MPH
   1/2 inch (0.500") where freight train speed is 10 MPH or on excepted track.

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.

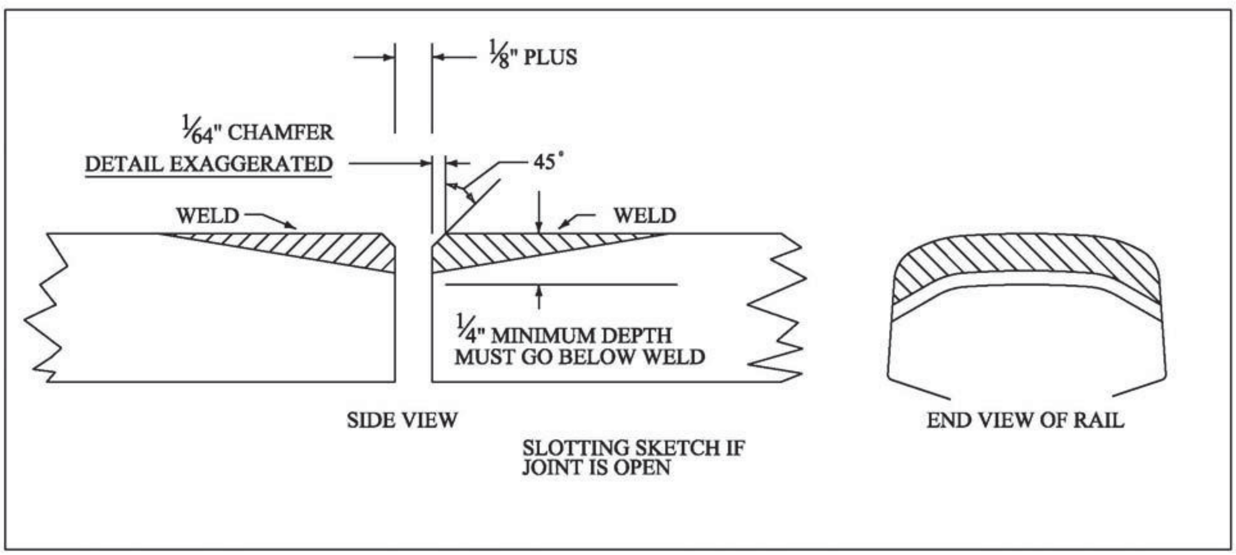


Sketch D-1

6. Rail ends will be slotted by grinding to prevent chipping due to overflow. For rail gaps of 1/8" or less see Sketch D-2. For rail gaps greater than 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:

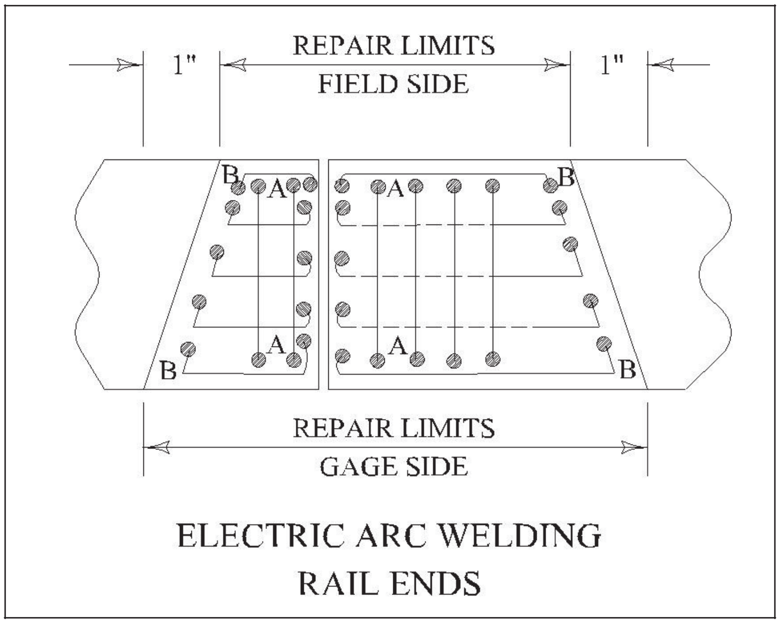
ELECTRIC ARC PROCESS

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.

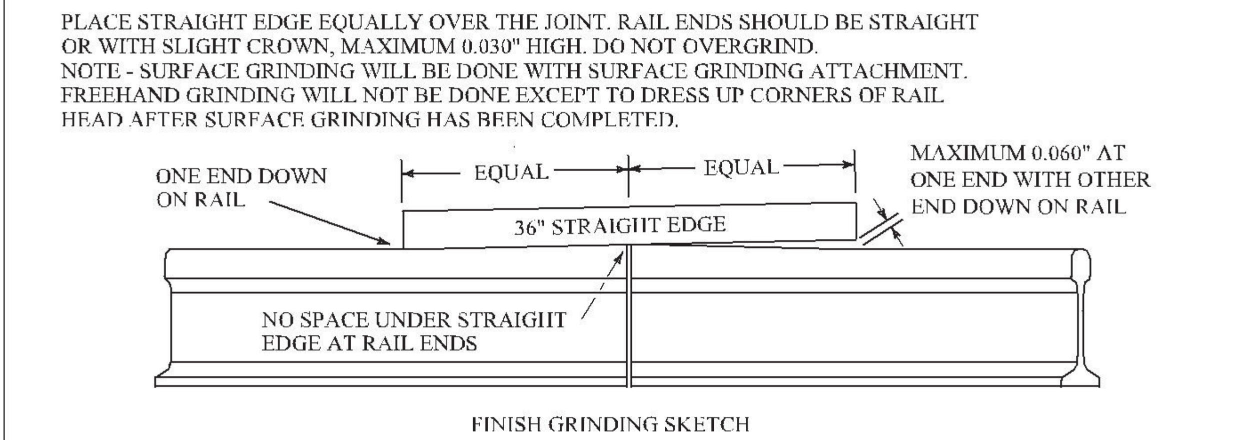
7. With fully heat treated and head hardened rails, post-heat the welded area to approximately 800°F immediately after the welding operations. After post-heating, it is most important that the rail cool slowly to 200°F. It may be necessary to protect the weld area with insulation, such as an insulated 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.



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.

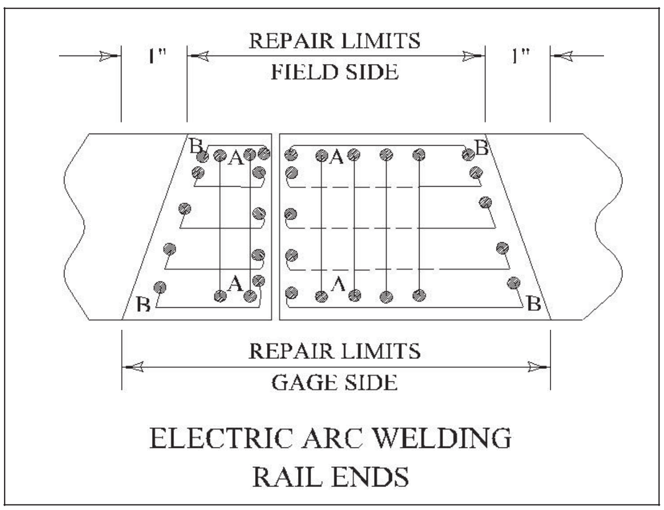
4. The area to be repaired should be welded in multiple layers. Each welding bead must be peened and enough time allowed between beads to keep the rail end within the allowable

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 standard with many still in use), deep head hardened steel rails (current standard), 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 standard 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.

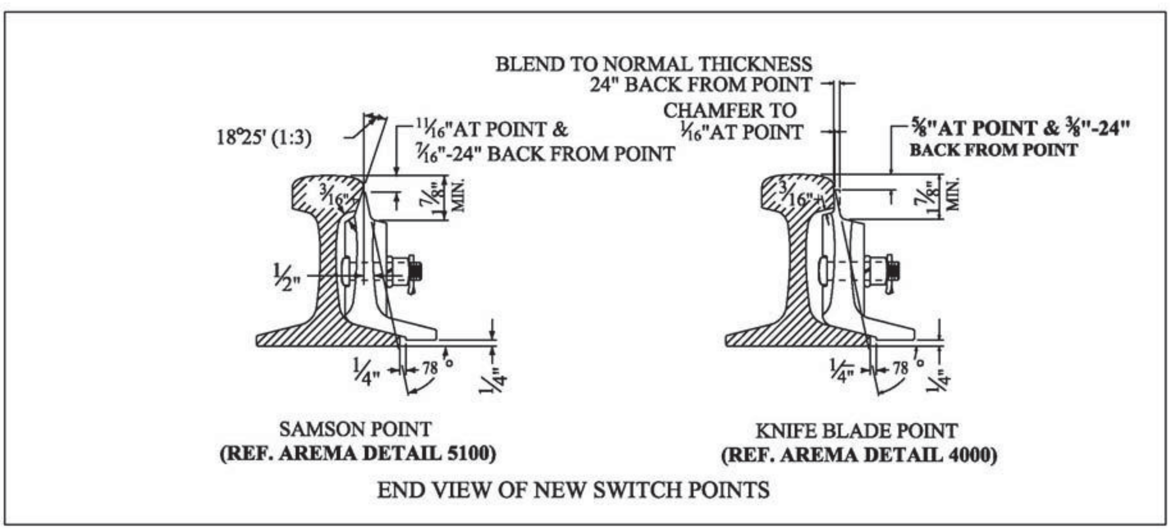
   Exception: Do not post heat switch points with manganese steel tip inserts.

5. Grinding procedures.

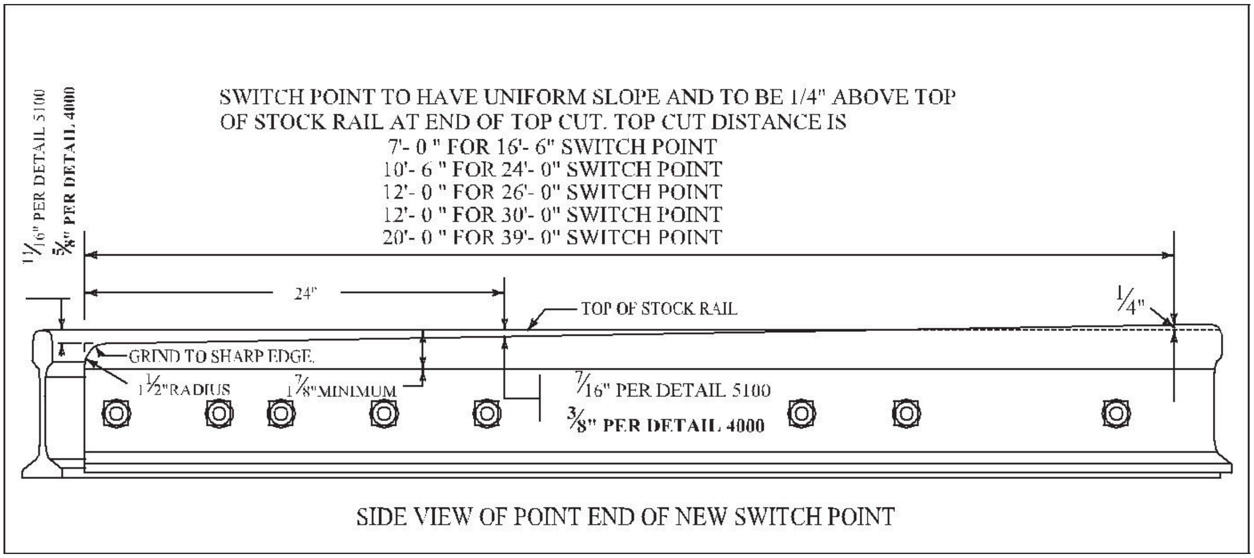
   a. First, grind the back side of the point. Check with a 36” straightedge after grinding. Check for proper fit with the stock rail by throwing the switch.
   b. Second, grind the gage face of the point. Check with a 36” straightedge after grinding.
   c. Third, grind the top of the point. Check with 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.

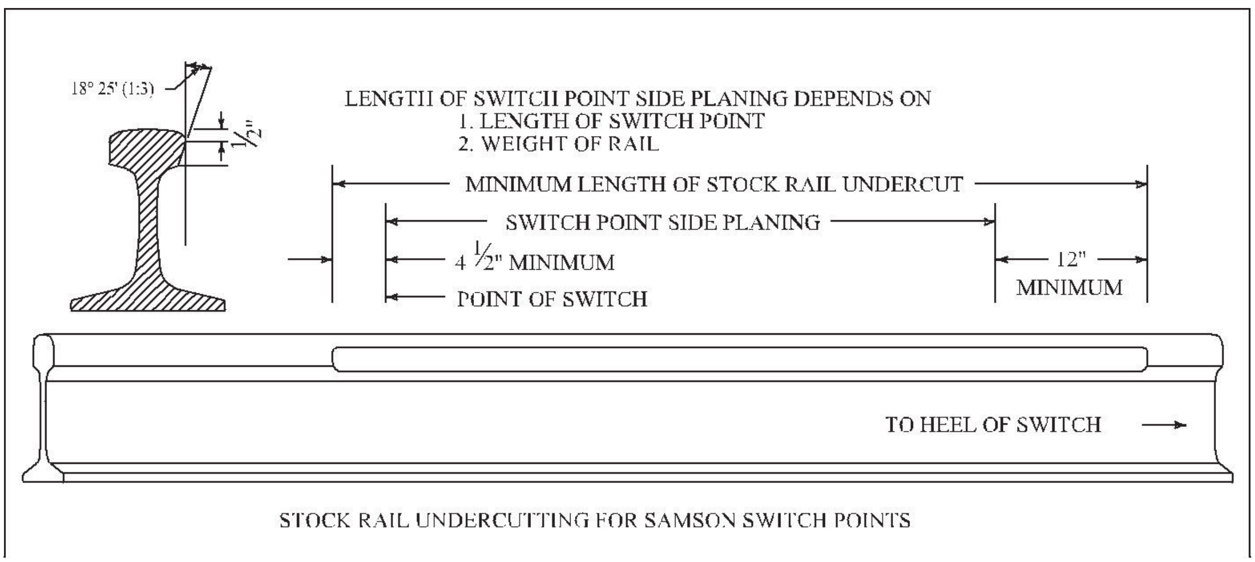
7. Traffic must not be allowed to use the switch until the switch point temperature is below 200°F.



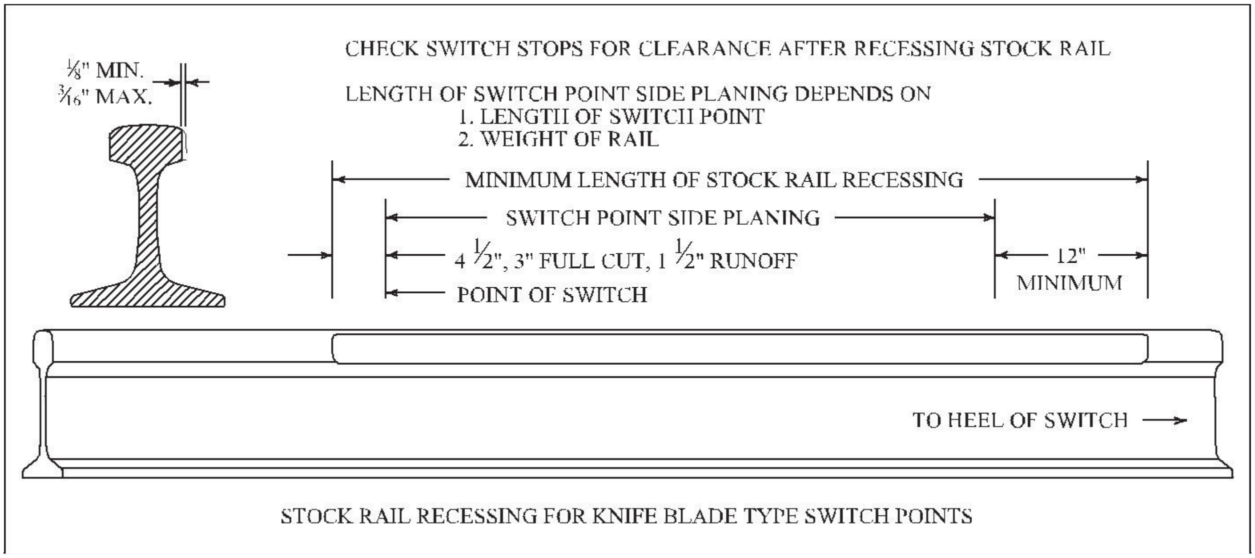
Sketch F-1



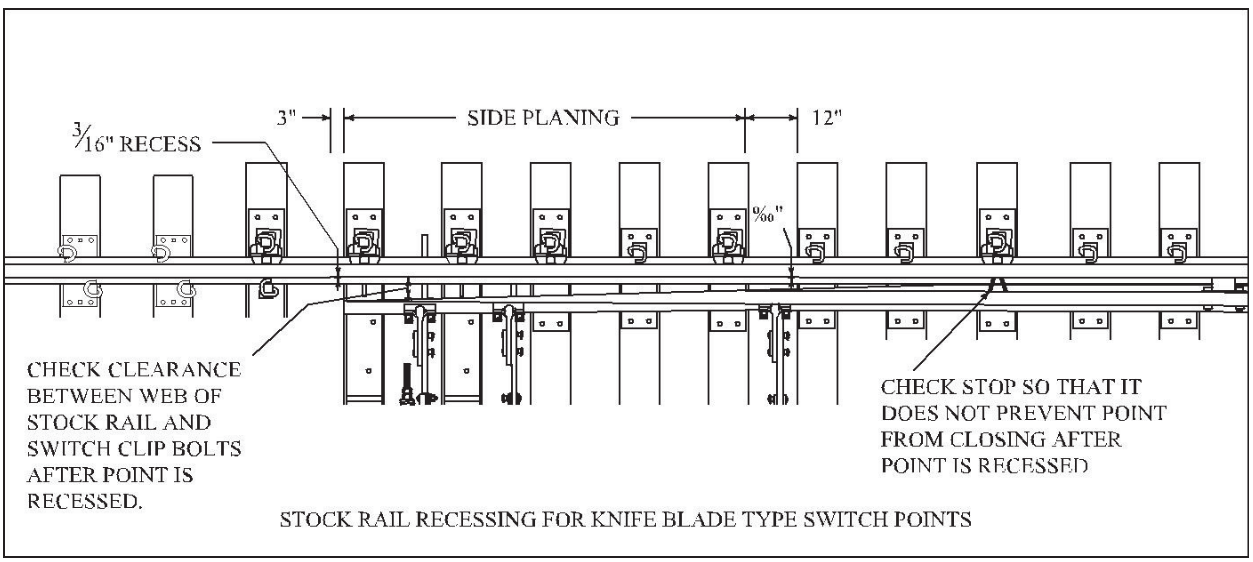
Sketch F-2



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 CIRCULATER 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 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 ¼" 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.

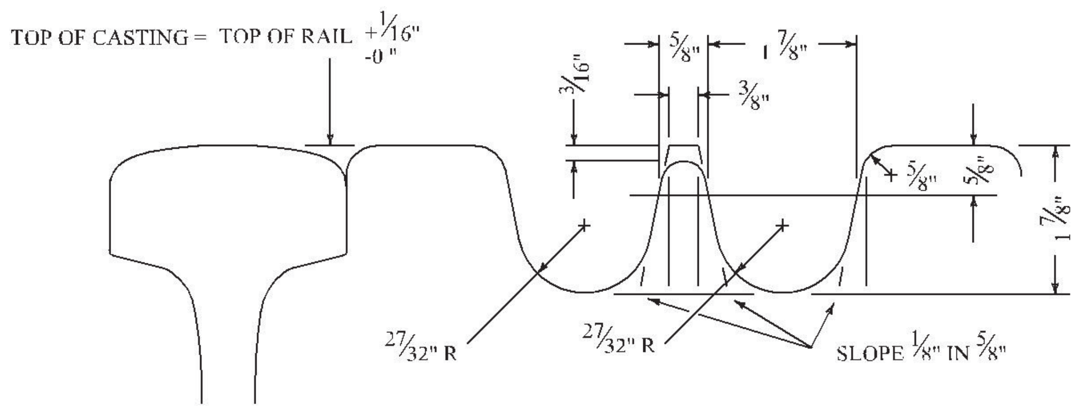
The Welder must monitor the temperature of the casting during the repair by using an approved thermometer or a 500°F Tempilstik. To use the Tempilstik, mark the component approximately ½" below the surface on which the weld metal will be deposited. If the Tempilstik mark melts during the welding process, 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 standard 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

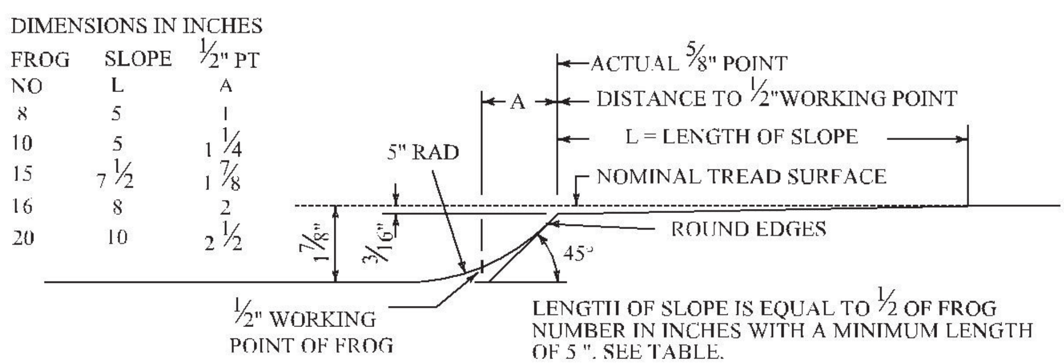
and radii.

11. 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.



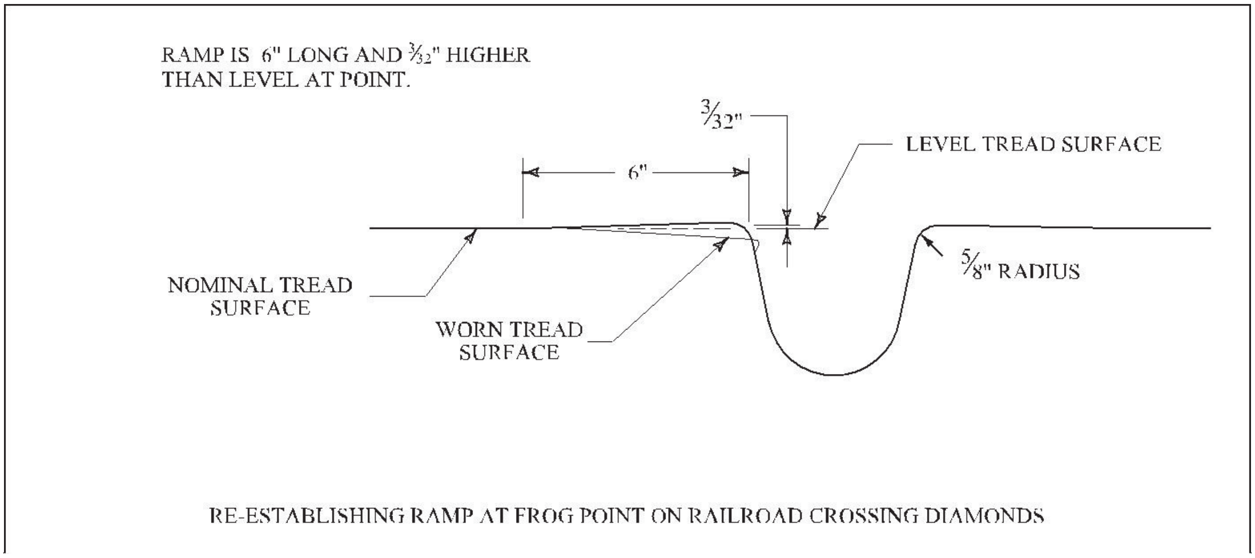
CROSS SECTION AT FROG POINT - WITH DEPRESSED POINT

Sketch G-1

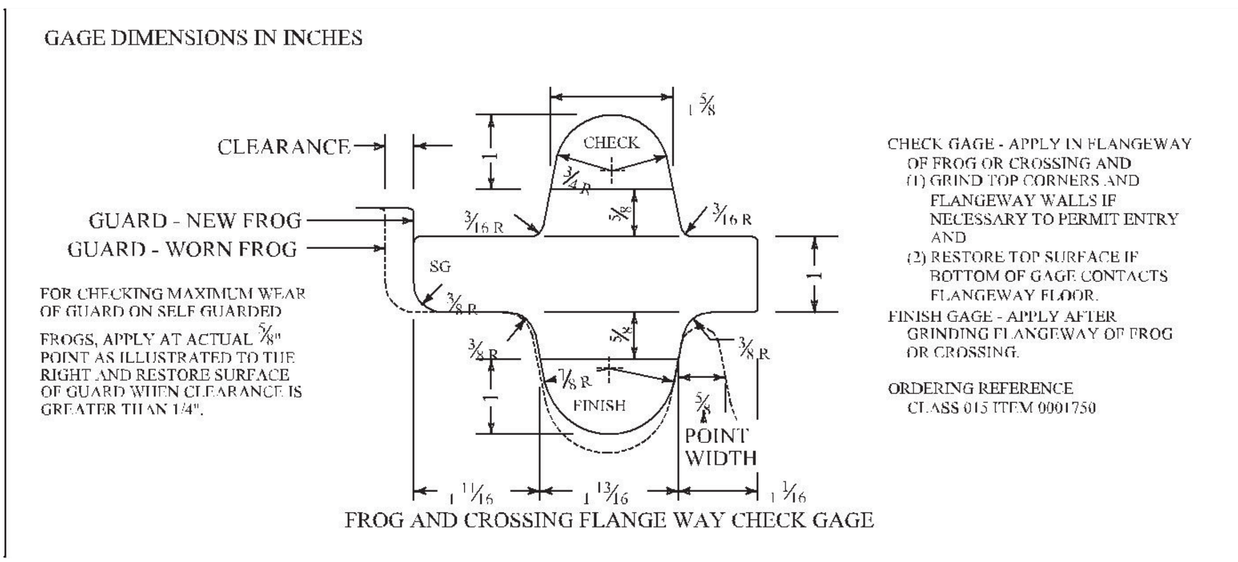


SIDE VIEW OF FROG POINT WITH DEPRESSED POINT

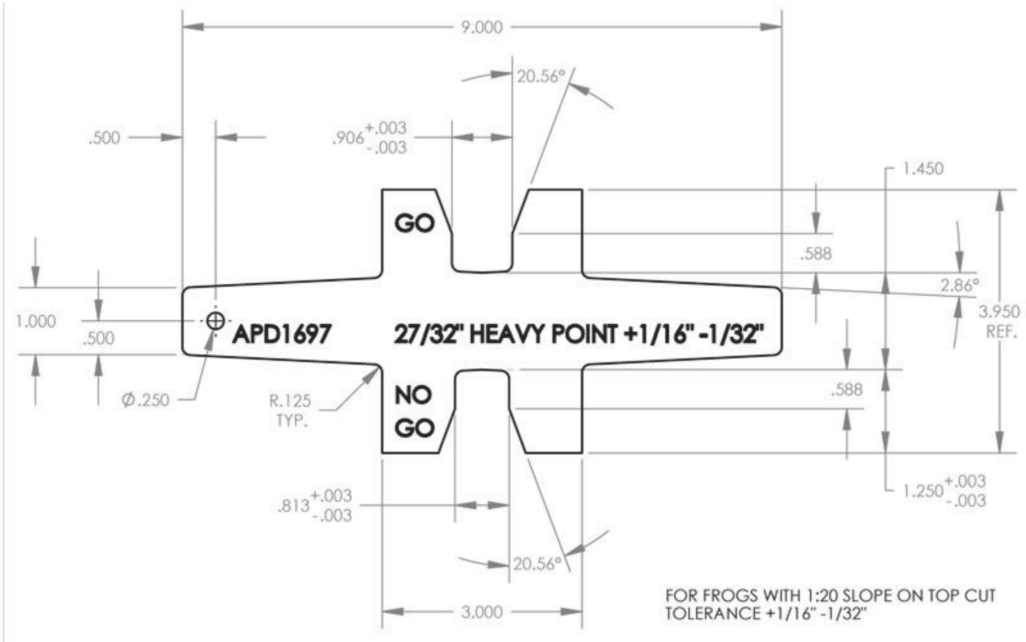
Sketch G-2



Sketch G-3



Sketch G-4A

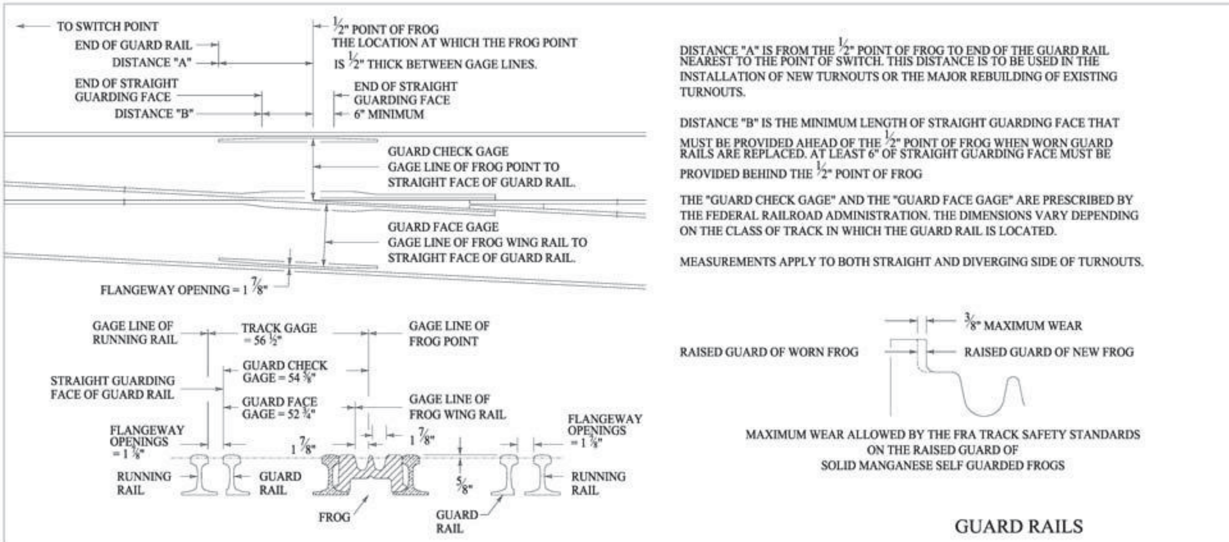


Sketch G4-B

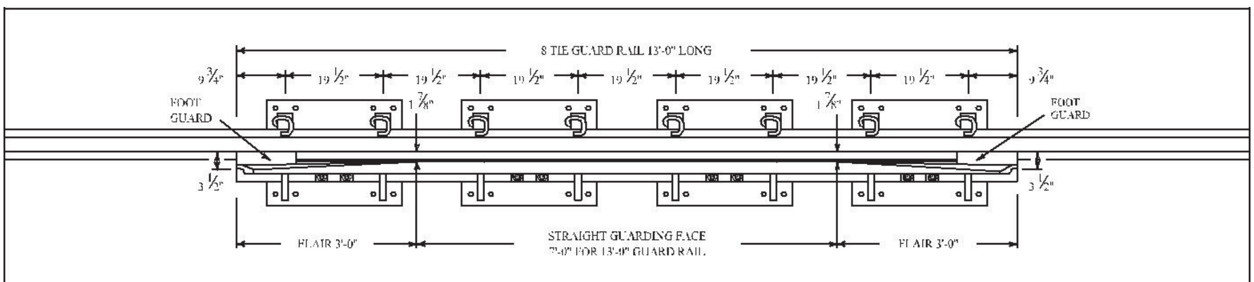
12. The junction between the castings and rail components will be slotted 1/8” wide and ¼” deep to prevent chipping and spalling of the metal.

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.



Sketch G-5



FRA TRACK SAFETY STANDARDS LIMITS FOR GUARD RAILS			LOCATION OF GUARD RAIL IN TRACK				
CLASS OF TRACK	GUARD CHECK GAGE NOT LESS THAN	GUARD FACE GAGE NOT MORE THAN	FROG NUMBER	TYPE FROG	GUARD RAIL LENGTH	DISTANCE "A"	DISTANCE "B"
1	4'-6 ⅛"	4'-5 ¼"	8	RBM	13'-0"	6'-11 ¾"	1'-6"
2	4'-6 ¼"	4'-5 ⅛"	10	RBM	13'-0"	6'-11 ¾"	1'-8"
3,4	4'-6 ⅜"	4'-5 ⅛"	16	RBM	20'-0"	9'-1 ¼"	2'-8"
5,6	4'-6 ½"	4'-5"	20	RBM	20'-0"	8'-7 ¼"	3'-4"
NEW	4'-6 ⅝"	4'-4 ¾"	10	SPRING			
"NEW" IS GIVEN AS INFORMATION ONLY. "NEW" IS NOT A FRA TRACK SAFETY STANDARD.			MAIN TRACK DIVERGING TRACK		20'-0" 13'-0"	13'-8 ¾" 6'-11 ¾"	6'-0" 3'-6"

GUARD RAILS

Sketch G-6

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 ¼", 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 ¼" 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 standard 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.

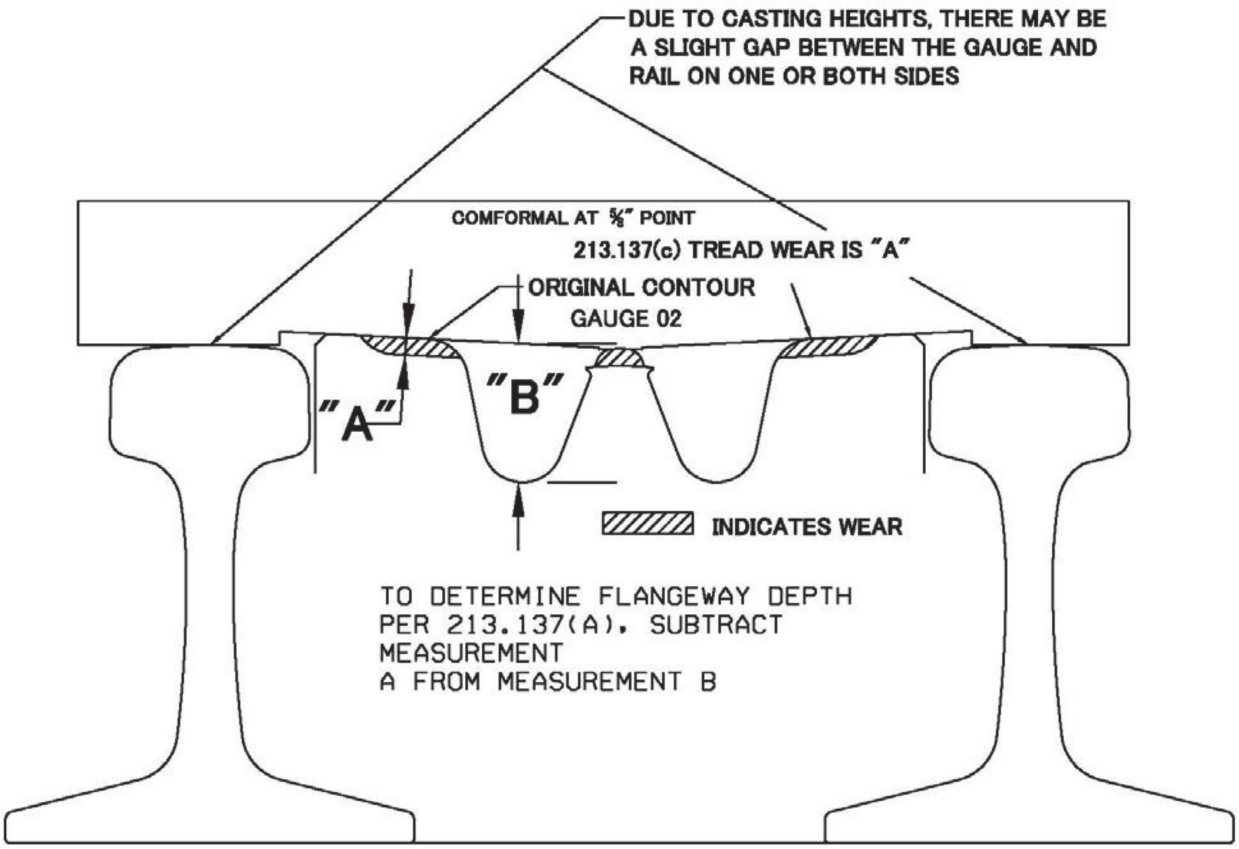
This section addresses the maintenance and repair of conformal frogs with wrap rails and boltless (WBM) frogs. The weld repair of a Boltless Conformal (WBM) frog is the same as for the conformal frogs with wrap rails, however do not use the same gauges for a wrap rail conformal frog on the boltless conformal 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 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 3/8" below wrap rail height, the wing tread must be repaired or slow order to 10 mph.

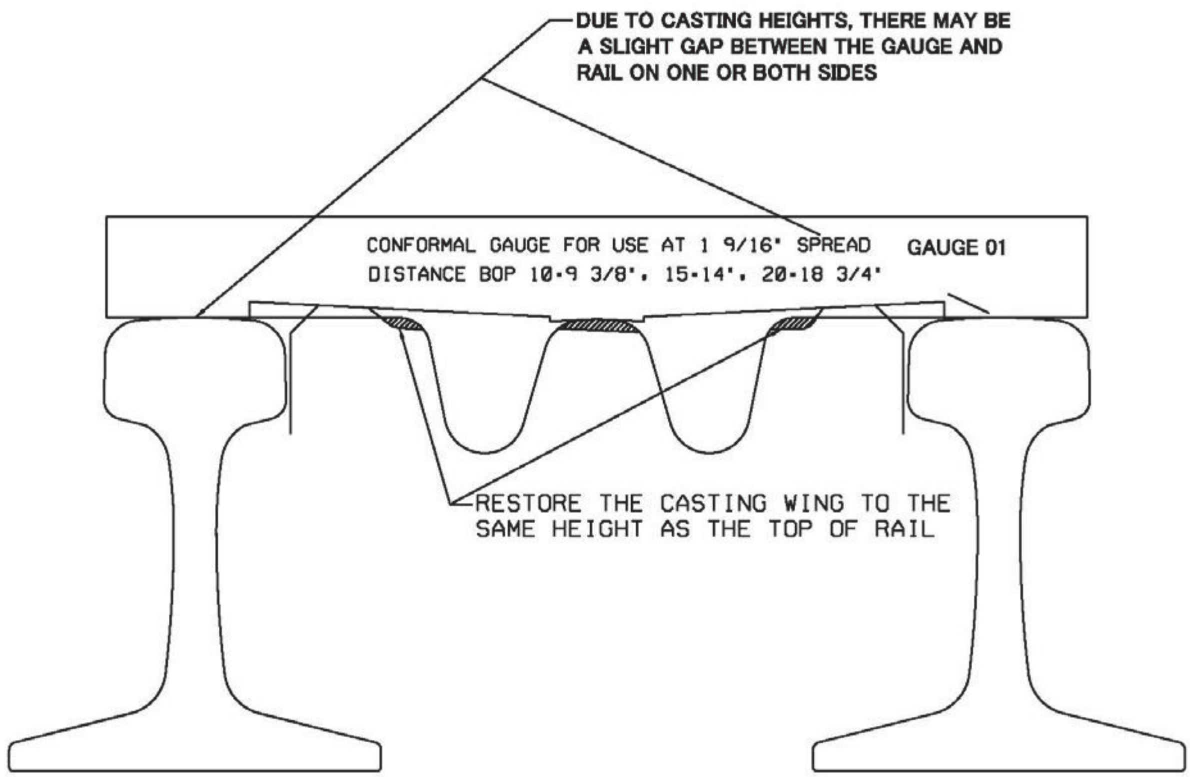


CONFORMAL GAUGE FOR CHECKING TREAD WEAR AND FLANGEWAY DEPTH AT POINT

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"

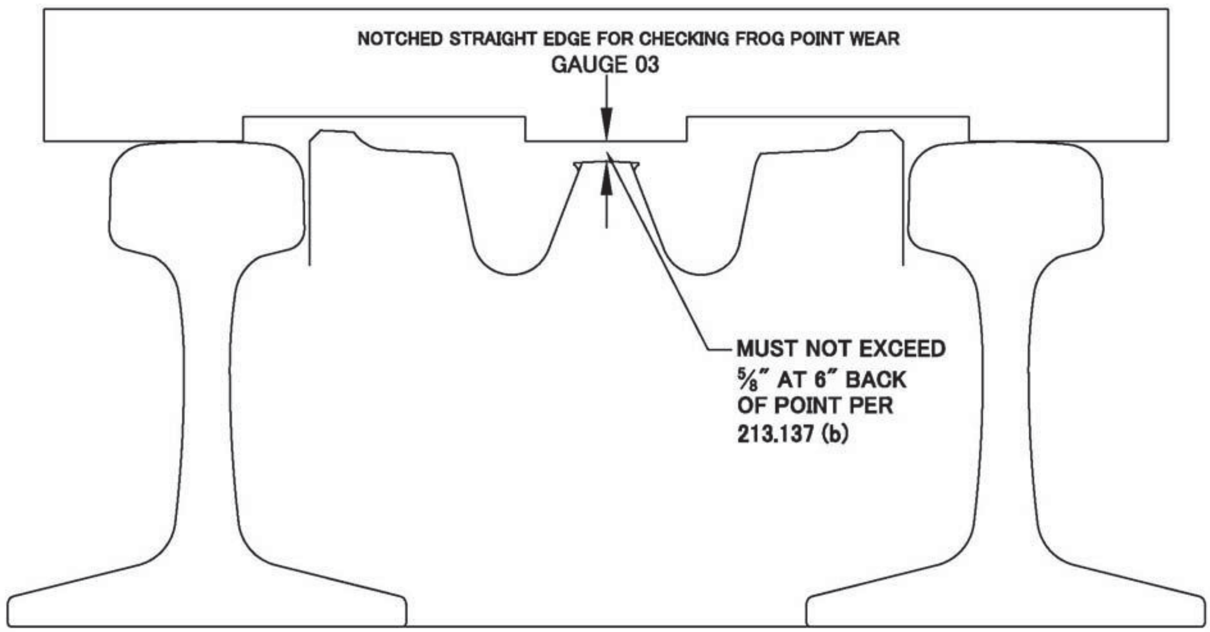
Table 1 – For Conformal frogs with wrap rails

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

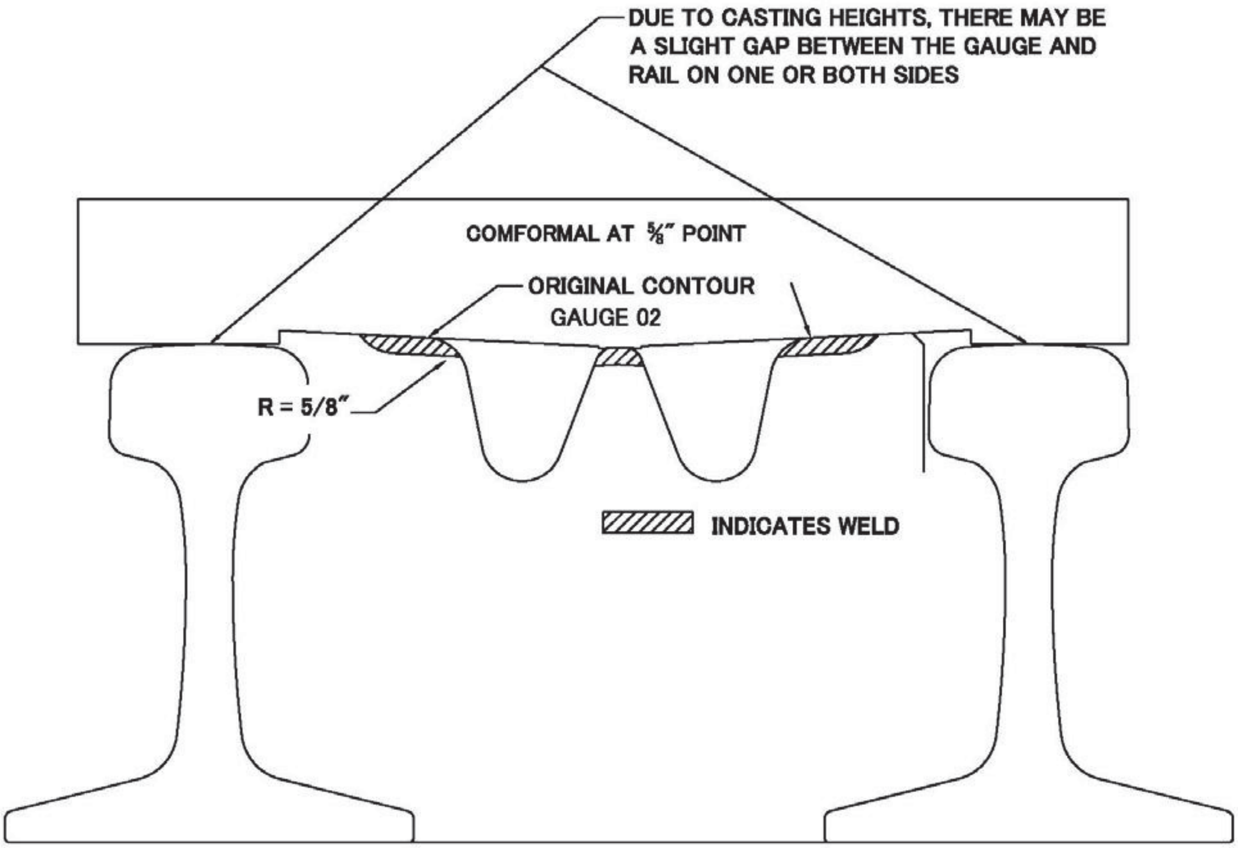


GAUGE TO CHECK 5/8" POINT WEAR ON CONFORMAL FROGS

Sketch G-9

<u>Maintenance grinding of the overflow should be performed when needed</u>.

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 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 standard joint bars installed.

7. To remove torch cut ends on standard or alloy rails for thermite welding or installing standard 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 CIRCULATER 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 700ºF.
   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 <u>not</u> 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.

    Standard 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:

Rail Temperature	*Weather Conditions*	
	Clear	*Wind, light rain, or snow*
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 thermite 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:

- 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 toprails, 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 2¾" 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 standards.

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 ¾" wide gap weld).**

6. If Rail jumps open, this gap **must not** be used to make the weld. You must still cut (1") or (2¾" 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 ¾" 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 MISSALIGHNING. A 200-FOOT DISTANCE OR OUT OF SOLID ANCHORS, IS A GOOD RULE TO A FOLLOW.

20. Begin making weld by using MWI 801 Thermite 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 standards.**

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.

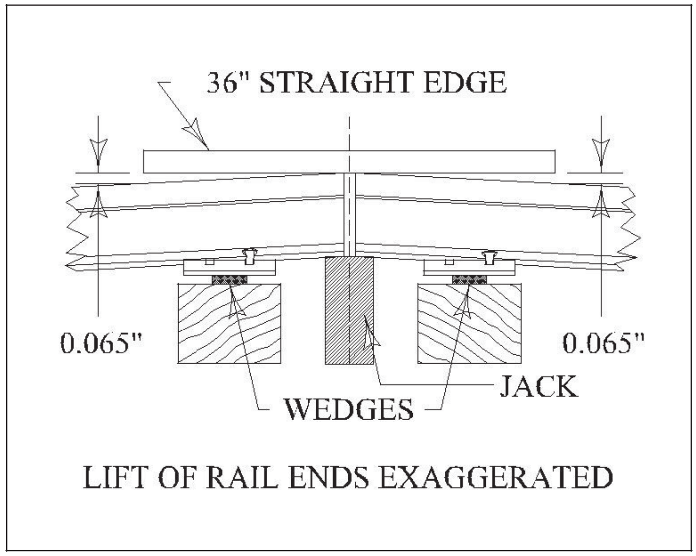
e. **Ensure that the correct gap is obtained**. The correct gap for all rail sections is 1” with a tolerance of 1/16” (1” to 1 1/16” permitted). The gap will be measured on both sides of the head and web (4 measurements) to confirm the proper gap has been established.

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 ¼” is permitted. If the rail height difference is greater than ¼”, the weld will be made with the running surfaces of the rails mismatched and no more than a ¼” 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 ¼” 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 grove. 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 flash-back 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.

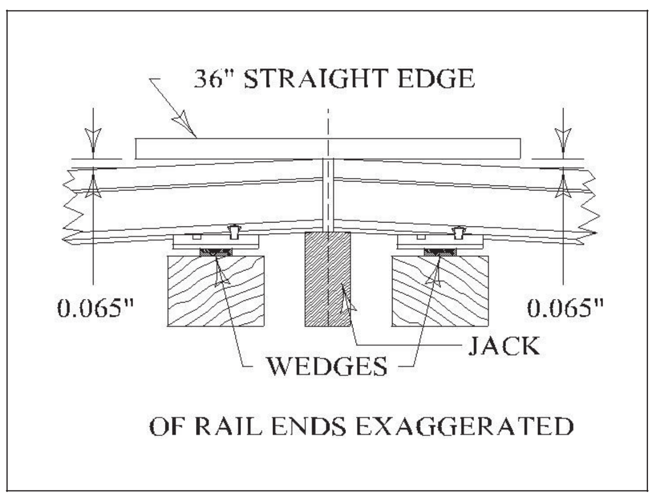
f. If the gap between rail ends is too small, the ends may be cut to give the proper gap.

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 ¼” is permitted. If the rail height difference is greater than ¼”, 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 ¼ 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 (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 ½" 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:

Rail Size	***Duration***
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: <u>**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.**</u>

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 ½". 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 ¾” 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.

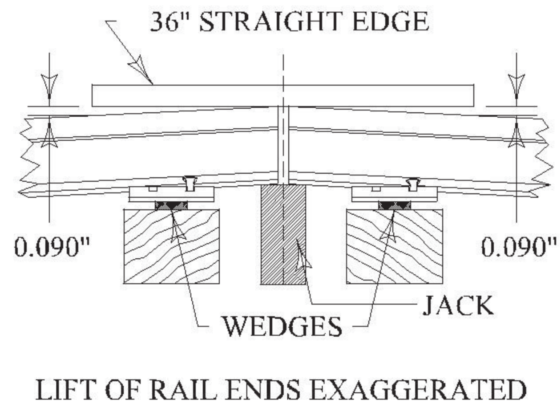
f. If the gap between rail ends is too small, the ends may be trimmed with a saw to give the proper gap.

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 ¼ 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 (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 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

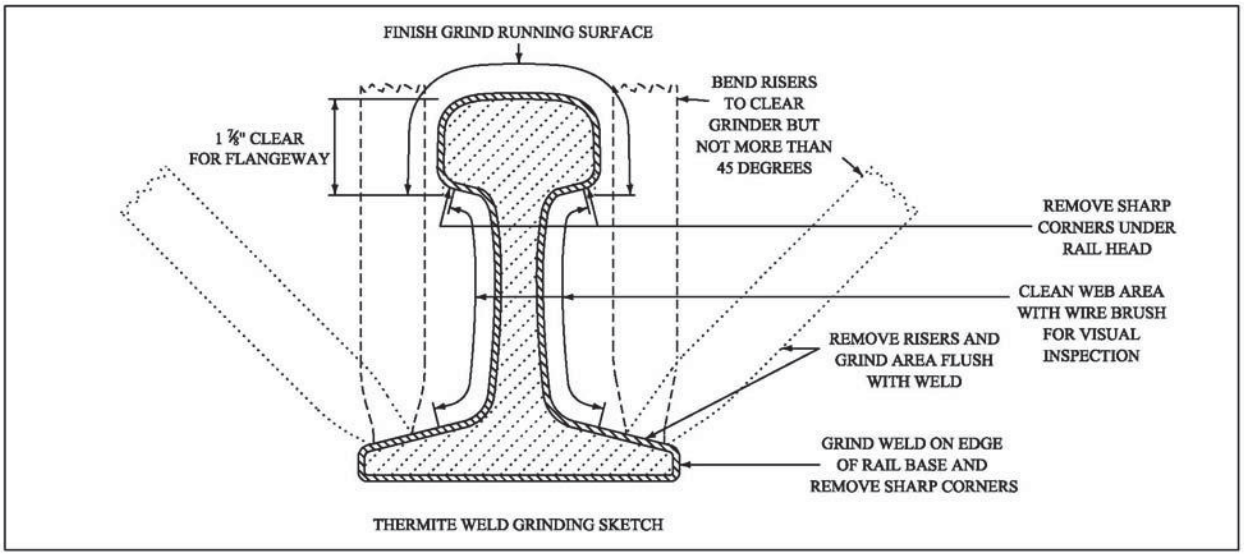
a. All thermite welds must be ground before the heat leaves the weld. Do not re-introduce heat into the sides of the weld where it will be ground. **Do not finish grind the rail head freehand.**

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 standard 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 recoding 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 florescent 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 standard 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 that 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 standard. Minimum upset required is ½”. When using puller, holding pressure until the weld has cooled to 700^{O}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 standard 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. <u>Tools</u>: A 36” straightedge and a taper gauge will be used to take measurements from the finished weld.

   b. <u>Procedure</u>: 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. <u>Rail Height Mismatch:</u>
   Maximum Height Differential 0.250”

   b. <u>Rail Head:</u>
   Vertical offset: 0.125”
   Gage side horizontal offset: 0.050”
   Horizontal kink: 0.025”

   c. <u>Rail Base:</u>
   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 ½" should open in the rail.

11. If a gap of at least 1 ½" 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 standard. 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 standard. 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^{O} F Variation to ensure that the Actual Adjusted Rail Temperature is within 10^{O} 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.

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

Name	*Size*	*Polarity*	*Description*	*Use*
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 540W - 10 lbs. 540W – 10 lbs.	1/16” 5/64”Wire 1/16”Wire 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 Use approximately 28 Vo
Frogalloy/M122 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 ¼” only with machines capable of 300+ amps

Other Rods.

Name	*Size*	*Polarity*	*Description*	*Use*
Slice Torch	1/4” x 22” 1/4” x 44”	*DCRP*	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”	*DCRP*	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	*DCRP*	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/Fiberglas 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/Refective 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 - TWNB-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 Standard 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 Standard 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" X5/8"-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
	6/4-3/4" 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 ½”, 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. Standard 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 rails[1.] 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 Specifications (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 standard 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 Standard 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 andtimber crossings. For concrete and full depth rubber crossings, compy 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	11/32 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	11/32 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 standard 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. <u>Solid tamping is important.</u> The tamper must use double insertions and, if capable, tamp the total length of the tie. <u>Care must be taken to avoid center binding of the tie.</u>

5. When track is tamped, ballast **<u>MUST</u>** 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 Standard 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 standard CFRC specification 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 Standard Road Crossing designs. Unless the crossing is covered by an agreement/contract, the Standard design will be determined during the preplanning inspection. The Chief Engineer will select the appropriate Standard 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 specification 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 Director Engineering Standards or the Division 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 then 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 at 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.

   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) standard 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. <u>When using this method, one truck equals 100 cars</u>.

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**	
Cars per Day*	**0 – 10 MGT / year**	**10+ MGT / year**
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 Standard 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 specification 901A, as attached.

   The crossing information follows:

Rail Weight	*Description*
115 – 122 132 – 136 141	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.

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. <u>Normal Duty Highway Crossing (Rubber / Asphalt / Timber) (RAT)</u> – Shown on CFRC Standard 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. <u>Normal Duty Highway Crossing (Timber / Asphalt)</u> – Shown on CFRC Standard 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:

Rail Weight	*Description*
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 Standard 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:

Rail Weight	*Description*
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 Standard 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:

Rail Weight	*Description*
90 – 100 115 122 132 136 140 141	Crossing, Rubber Interface Light duty, for wood ties. Order by "Track feet" in 8 ft. increments. Each "Track foot" includes 2 gage side and 2 field side sections.
90 – 141	Clip/Clamp which may be used to secure rubber. Use in each crib.
132 – 136 141	Crossing, Rubber Interface Light duty 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 Standard 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:
   a. Use second hand wood material if available or order material described for Standard 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 standard, shown on CFRC Standard 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 specifications. 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

Reviewed by: ______________________________________
Gerry Woods - CFRC Maintenance of Way Manager

Approved by: ______________________________________
Edward Connolly - CFRC Chief Operating Officer

CFRC Central Florida Rail Corridor	**Road Crossing Planning and Installation Checklist**

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.

10 Days Prior SPT Team Arrival To Project

___ Review project work plan and time sensitive crossing due dates with Chief Engineer, when applicable.

1 Week Prior to Project Work

___ Review and re-confirm project scope, timeline, alternate routes and who will furbish barricades with highway officials.

___ Contact local 911 center, fire, police, ambulance, rescue, post office, school district, television and radio station, and newspapers to notify of the closure and planned duration.

___ Ensure dated crossing closure signs are placed onto crossings that serve as the only entrance and exits into a neighborhood, farm, industrial park etc.

___ Obtain emergency phone number for highway officials and local 911 Dispatchers.

___ Contact underground utility locator service (811) at least 48 hours prior to start of project.

___ Notify signal maintainer of work to arrange for necessary adjustment of equipment and removal/reinstallation of track connections.

___ Notify crossing renewal team of location, equipment required, and when to show up.

- ___ Backhoe
- ___ Truck with hydraulic power unit
- ___ Dump Truck
- ___ Hydraulic power tools
- ___ Tamper
- ___ Regulator
- ___ Track stabilizer
- ___ Asphalt placement equipment

___ Ensure that track time is arranged for the day prior to the crossing work

REMOVAL OF OLD CROSSING

___ Three days before planned closure, ensure all items in Project Planning are completed and their status is checked up.

___ Ensure that detour signing and barricading is in place

___ Ensure that track time is in place. 707 or authority is in effect. All warning signs are in place and that slow orders required are communicated to the dispatcher prior to taking the track.

___ If removing rail or replacing a panel:

- ___ Ensure that signal maintainer has removed track connections and disable warning devices
- ___ Cut rail
- ___ Lift or remove panel and move from immediate job site area

- ___ Clear out old ballast from crossing area for a 12” depth below crosstie 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 (>250ºF).
- ___ 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.

Specification 901A

Specifications 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 ¼" 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.

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 standard 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 specifications, lifting eye specifications 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, standards 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.

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 stages on plastic and covered with plastic. Contact local Environmental Specialist to arrange for proper disposal of soiled material.

I. DISCUSSION

Geotextiles

A. Geotextiles, also know 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 standard 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".

<u>Ordering Geogrids</u>

A. Requisitions for geogrids will be submitted in the normal manner.

B. The specifications 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.

<u>Installation of Geotextiles</u>

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 Standard Drawing Number CFRC 2602) Where a geotextile is used through a road crossing, drainage structures parallel to the track must be installed. (See Standard 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

Reviewed by: ____
Gerry Woods - CFRC Maintenance of Way Manager

Approved by: ____
Edward Connolly - CFRC Chief Operating Officer

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 Standards 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. Standard 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 miss-matched, 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 standards and could be changed economically to the current Standard. 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

Reviewed by: ____
Gerry Woods - CFRC Maintenance of Way Manager

Approved by: ____
Edward Connolly - 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. <u>DISTRIBUTION OF BALLAST</u>

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 Standard Ballast Section (refer to standard 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-standard 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. <u>SURFACING OPERATING</u>

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 standard 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 Standards.

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 ½” 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. Standard 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 Standards. 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 Standards, 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^{o}) 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^{o} and above
   - 200 feet apart on 4^{o} to 9^{o} curves
   - 400 feet apart on 2^{o} to 4^{o} curves
   - 800 feet apart on 1^{o} to 2^{o} 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	½”
Track Class 2	½”
Track Classes 3 & 4	3/8"
Track Class 5	1/8"
Track Class 6	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	¾”
Track Classes 3 & 4	½”
Track Class 5	3/8’
Track Class 6	¼”

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	3/8"
Track Class 5	1/8"
Track Class 6	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 Standard Ballast Section. Refer to *CFRC Standard 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

Reviewed by: ______________________________
Gerry Woods - CFRC Maintenance of Way Manager

Approved by: ______________________________
Edward Connolly - 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)		
Type of Fasteners:	(rail anchors)	(Pandrol plates)	(other ____________)	
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 (Standard 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 standards.

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 standards 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 Standards.

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 standards 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-signaled territory.

3. The Roadmaster will maintain a current list of and pay special attention to locations with substandard anchor patterns 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

Reviewed by: ______________________________

Gerry Woods - CFRC Maintenance of Way Manager

Approved by: ______________________________

Edward Connolly - CFRC Chief Operating Officer

CFRC

TRACK TYPE CODES

Code	Dispatcher Bulletin
M	MAIN
S	SIDING
1	NO 1
2	NO 2
3	NO 3
4	NO 4
BL	BRNCH LEAD
BP	BYPASS MN
C	CENTER SDG
CO	CUTOFF
CT	CONNECTION
D	DRILL
EDR	EAST DRILL
ES	EAST SDG
EWY	EAST WYE
EXT	EXTENSION
EY	EAST YARD
FL	FRGHT LEAD
FM	FRGHT MAIN
HSE	HOUSE
IL	INTERLOCK
IND	INDUSTRIAL
INL	INDU LEAD
INT	INTERCHNGE
LL	LONG LEAD
MA1	MARC NO 1
MA2	MARC NO 2
MA3	MARC NO 3
ML	MARC LEAD

Code	Dispatcher Bulletin
NEW	NE WYE
NL	NORTH LEAD
NS	NORTH SDG
NW	NORTH WYE
NWW	NW WYE
NY	NORTH YARD
P	PLATFORM
PAS	PASS
PL	PSSGR LEAD
PM	PSGER MAIN
POC	POCKET
P1	PLATFM NO1
P2	PLATFM NO2
RUN	RUNNING
SCL	SCALE
SEC	SECONDARY
SEW	SE WYE
SL	SOUTH LEAD
SPR	SPUR
SS	SOUTH SDG
STO	STORAGE
SW	SOUTH WYE
SWW	SW WYE
SY	SOUTH YARD
T	TURNOUT
WDR	WEST DRILL
WS	WEST SDG
WWY	WEST WYE
Y	YARD

CFRC
TEMPORARY SPEED RESTRICTION REASON CODES

Code	*Reason*
	Working
101	Undercutter
102	Ballast Cleaner
120	Rail Team on Track
121	Continuous Welded Rail Not Surfaced
130	Timbering
131	Timbering Not Surfaced
140	Surfacing
141	Running Time - Ballast Compaction
150	Roadbed Stabilization
160	Bridge Construction
161	Bridge Tie Installation
171	Turnout Work
172	Road Crossing Work
173	Construction
	Rail
201	Rail Test Car Detected Rail Defects
202	Joint Condition
203	Surface Bent
204	Temperature Condition
205	Gage Account Rail Condition
206	All Other Rail Defects
207	Insufficient Rail Anchors
	Timber
300	Poor Timber
301	Gage Account Tie Condition
390	Poor Timber – Geometry Car
391	Gage – Geometry Car

Code	*Reason*
	Surface
401	Cross Level And Warp
402	Alignment
403	Excessive Elevation
404	Insufficient Elevation
405	Gage Account Surface Condition
406	Insufficient Ballast
491	Crosslevel & Warp – Geometry Car
492	Alignment – Geometry Car
493	Excessive Elevation – Geometry Car
494	Insufficient Elevation – Geometry Car
	Roadbed
501	Unstable Roadbed
	Bridge
601	Bridge Maintenance Superstructure
602	Bridge Maintenance Substructure
	Other track
701	Turnout Condition
702	Highway Crossing
703	Rail Crossing
704	Derailment
705	Geometric Conditions
706	Highway Crossing Warning System
	Other
099	Other

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 Standard** 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(ºF)**:_____ **Ambient Temp(ºF)**:_____
15. **Designated Rail Laying Temperature(ºF)**:_______
16. **Estimated RNT before break/pull apart (ºF):________** (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

BUCKLED TRACK REPORT

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.

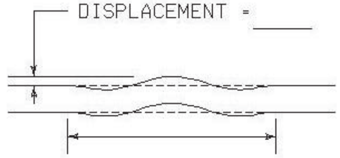
LOCATION

- DIVISION
- TIMETABLE SUBDIVISION
- PREFIX
- MILEPOST
- TRACK NUMBER
- DATE BUCKLED
- TIME BUCKLED (24 HOUR CLOCK)
- RAIL TEMPERATURE AT TIME OF BUCKLE
- RAIL TEMPERATURE WHEN CORRECTED
- ALIGNMENT
  - ☐ TANGENT
  - ☐ CURVE - DEGREE =
- LINE CORRECTED ON
- BY ☐ HAND ☐ MACHINE
- SURFACE CORRECTED ON
- BY ☐ HAND ☐ MACHINE
- DID BUCKLE CAUSE A DERAILMENT ☐ YES ☐ NO
- IF YES, GIVE ACCIDENT NUMBER

SKETCH THE BUCKLE

TANGENT TRACK.

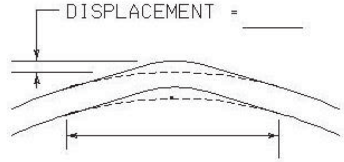
DISPLACEMENT = ____



LENGTH = ________

CURVED TRACK.

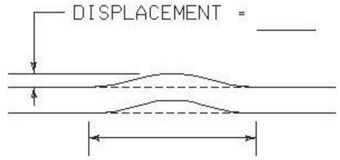
DISPLACEMENT = ____



LENGTH = ________

OTHER.

DISPLACEMENT = ____



LENGTH = ________

CAUSE / CORRECTION

CAUSE	CORRECTION
☐ LIGHT BALLAST SECTION BEFORE BUCKLE. LEVEL DISTANCE FROM END OF TIE TO SHOULDER WAS ____'. CRIB WAS ☐ EVEN WITH TOP OF TIE. ☐ ____" BELOW TOP OF TIE. ☐ NON-STANDARD BALLAST SECTION (DESCRIBE). ________	☐ BALLAST ADDED AND/OR DRESSED ON ________. BALLAST NOW EXTENDS ____' BEYOND TIE ON TANGENT AND ____' ON CURVES (HIGH SIDE).
☐ LOOSE ANCHORS (NOT TIGHT AGAINST TIE). ☐ LOOSE ANCHORS (RAIL MOVED THRU ANCHOR). ☐ INSUFFICIENT NUMBER OF ANCHORS. ☐ NON-STANDARD ANCHOR PATTERN (DESCRIBE) ________	☐ ANCHORS TIGHTENED AGAINST TIE. ☐ ANCHORS APPLIED ON ________ USING PATTERN: ☐ BOXED EVERY TIE. ☐ BOXED ALTERNATE TIES. ☐ OTHER (DESCRIBE) ________
TRACK RECENTLY DISTURBED: DATE ☐ RAIL PATCHING ON ____ ☐ TRACK PANELS INSTALLED ____ ☐ TIES INSTALLED ____ ☐ SURFACED OUT OF FACE ____ ☐ SPOT SURFACE/SMOOTHING ____ ☐ CRIBBING/SPOT UNDERCUTTING ____ ☐ OTHER ________ ____	☐ SPEED RESTRICTION ____ MPH FOR ____ DAYS TO STABILIZE TRACK. REMOVED ON ________. NUMBER OF TRAINS OVER THIS LOCATION AT REDUCED SPEED : ________. TONNAGE AT REDUCED SPEED : ________.
RAIL NOT PROPERLY ADJUSTED: ☐ RAIL LAID ________ AT ____° F (RAIL TEMPERATURE) AND NOT ADJUSTED. ☐ RAIL REPLACED ________ AT ____° F (RAIL TEMPERATURE)	☐ RAIL ADJUSTED ON ________ ____ TO° F (RAIL TEMPERATURE). REMOVED ____" FROM NORTH OR WEST RAIL. REMOVED ____" FROM SOUTH OR EAST RAIL.
☐ OTHER (DESCRIBE) ________	☐ OTHER (DESCRIBE) ________

REMARKS ________________

SUBMITTED BY ________ TITLE ________

HEADQUARTERS ________ DATE ________

COPIES TO CHIEF ENGINEER-MOW & DIVISION ENGINEER

DESIGN FILE: MWI1109.DGN REVISED 5/4/05

CFRC

REQUIRED ACTIONS FOR PREVENTING TRACK BUCKLING

Existing Condition and General Notes	Temperature Criteria			Actions								
	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	Field Manual cross-reference
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 passener 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 adjus

CFRC

REQUIRED ACTIONS FOR PREVENTING TRACK BUCKLING

Track Maintenance Work when Rail Temperature is <u>Less Than 110 °F</u>	Actions: 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	Field Manual cross-reference
	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 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 passener 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 a

CFRC

REQUIRED ACTIONS FOR PREVENTING TRACK BUCKLING

Track Maintenance Work when Rail Temperature is **110 °F or Greater**	Actions: 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	Field Manual cross-reference
							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 [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.	Maximum of 5 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 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 passener 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 standard rail anchor patterns are detailed in MWI 703, *Rail Anchoring Policy*. Care must be taken to ensure that all welded rail is anchored to standard. At locations where the standard 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 standard 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 standard track spiking patterns are detailed in CFRC Standard Drawings 2512, 2513, and 2514. Care must be taken to ensure that all welded rail is spiked to standard. If positive restraint fasteners are present, lock spikes will be replaced with screw spikes and proper tie plates.

B. <u>ADJUSTING CONTINUOUS WELDED RAIL to OBTAIN PROPER ADJUSTED RAIL TEMPERATURE</u>

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 standard 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 standard 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. <u>CURVE PATCH WELDED RAIL</u>

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. <u>REPAIR of DEFECTS</u>

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.

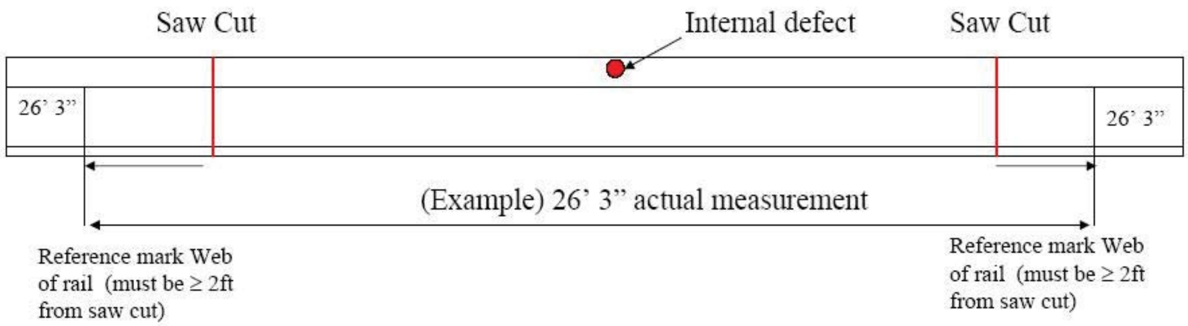


Figure 1. Example of Reference Marks for Rail Plug Change Out

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.

Central Florida Rail Corridor

RECORD OF RAIL LAYING TEMPERATURES FOR CONTINUOUS WELDED RAIL

YEAR:_______ DIVISION:__________________ SUBDIVISION:_______________________

LAYING DATES:______________________________ NEAREST STATION:___________________

RAIL WEIGHT:_____ TYPE RAIL ANCHORS:________________ TYPE BALLAST:______________

RAIL N S E W	DATE	STRING NUMBER	MILEPOSTS INCLUDING PREFIX		TRACK SC 1 2 YD WYE	RAIL LENGTH IN FEET	RAIL TEMPERATURE			REQUIRED EXPANSION IN INCHES	ACTUAL EXPANSION OBTAINED IN INCHES	LIST CHANGE IN TEMPERATURE FROM CHART IN MWI 1125	ADJUSTED LAYING TEMPERATURE
			FROM	TO			DESIGNATED RAIL LAYING TEMPERATURE 95, 100, OR 105	COLD RAIL TEMPERATURE	DIFFERENCE IN TEMPERATURE				
						A	B	C	D	E	F	G	C + G

ADJUSTMENT SUPERVISOR: __________________________ RAIL MANAGER: __________________________

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

CHANGE IN RAIL LENGTH DUE TO CHANGE IN TEMPERATURE

	CHANGE IN TEMPERATURE IN DEGREES FAHRENHEIT															
LENGTH OF RAIL - FEET	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	1-1/8	1-1/4	1-3/8	1-1/2	1-5/8	1-3/4	1-7/8
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	1-7/8	2	2-1/8	2-3/8	2-1/2
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	2-3/8	2-1/2	2-3/4	2-7/8	3-1/8
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	3-1/2	3-3/4
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	3-1/2	3-7/8	4-1/8	4-3/8
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	3-3/8	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	4-7/8	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. HOW 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 ½ 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

Reviewed by: ______________________________
Gerry Woods - CFRC Maintenance of Way Manager

Approved by: ______________________________
Edward Connolly - CFRC Chief Operating Officer

Central Florida Rail Corridor

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 Standard Drawing Number 2607.

Prepared by: RMW

Reviewed by: ______________________________________
Gerry Woods - CFRC Maintenance of Way Manager

Approved by: ______________________________________
Edward Connolly - CFRC Chief Operating Officer

MWI 2107-03
Curve Superelevation Markings

Issued: 12/9/13 Revised: 10/9/14

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.

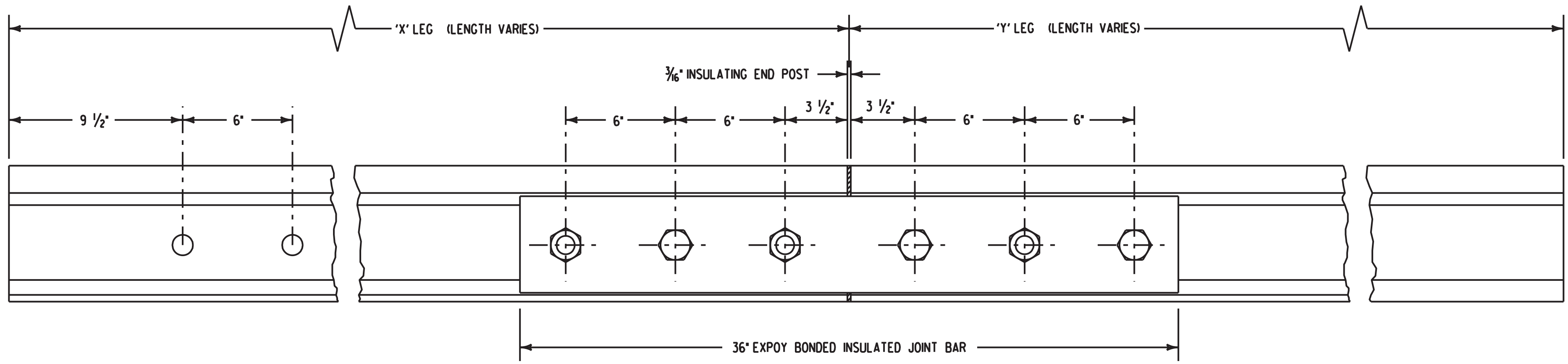
Prepared by: RMW

Reviewed by: ______________________________
Gerry Woods - CFRC Maintenance of Way Manager

Approved by: ______________________________
Edward Connolly - CFRC Chief Operating Officer

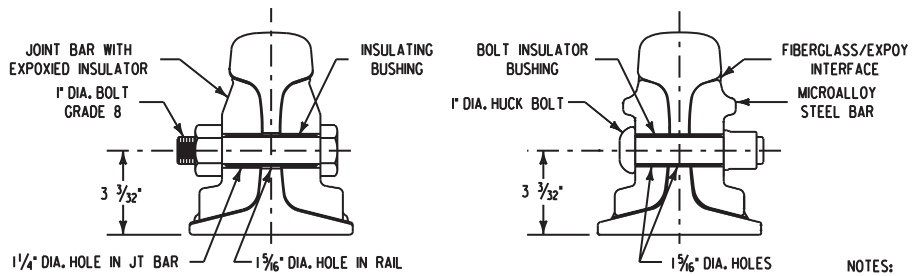
Volume II:

Standard Drawings

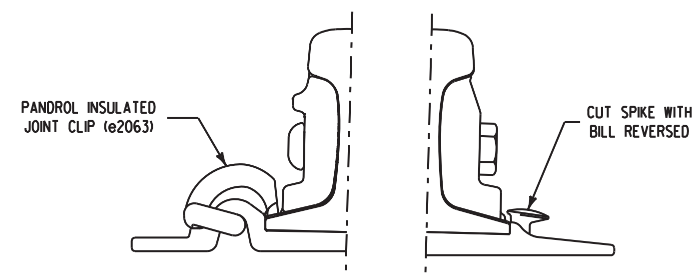


RAIL END DRILLING DETAIL
(IF SPECIFIED IN ORDER)

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 SPECIFICATIONS
4. ALL JOINTS HAVE 3/16" INSULATING END POSTS
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" TOTAL LENGTH
   B. +/- 2" FOR EACH LEG

013.3000300.1	LB FOSTER BONDED INSULATED JOINT BOLT REPLACEMENT KIT
013.3000400.1	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'
115RE	20'	13'-4"	6'-8"
115RE	40'	23'-4"	16'-8"
122CB	20'	13'-4"	6'-8"
122CB	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"
141RE	20'	13'-4"	6'-8"
141RE	40'	23'-4"	16'-8"

ORDERING INFORMATION FOR COMMON INSULATED JOINTS

STANDARD INSULATED JOINTS

RAIL WEIGHT	TOTAL LENGTH	LEG LENGTH 'X'	LEG LENGTH 'Y'
115RE	20'	13'-4"	6'-8"
115RE	40'	23'-4"	16'-8"
122CB	20'	13'-4"	6'-8"
122CB	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"
141RE	20'	13'-4"	6'-8"
141RE	40'	23'-4"	16'-8"

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EPOXY BONDED INSULATED JOINT FOR 115RE, 132RE, 136RE, AND 141RE RAIL

APPROVED - GERRY WOODS
CFRC MAINTENANCE OF WAY MANAGER

APPROVED - EDWARD CONNOLLY
CFRC CHIEF OPERATING OFFICER

PREPARED BY:
R.M. WHITE

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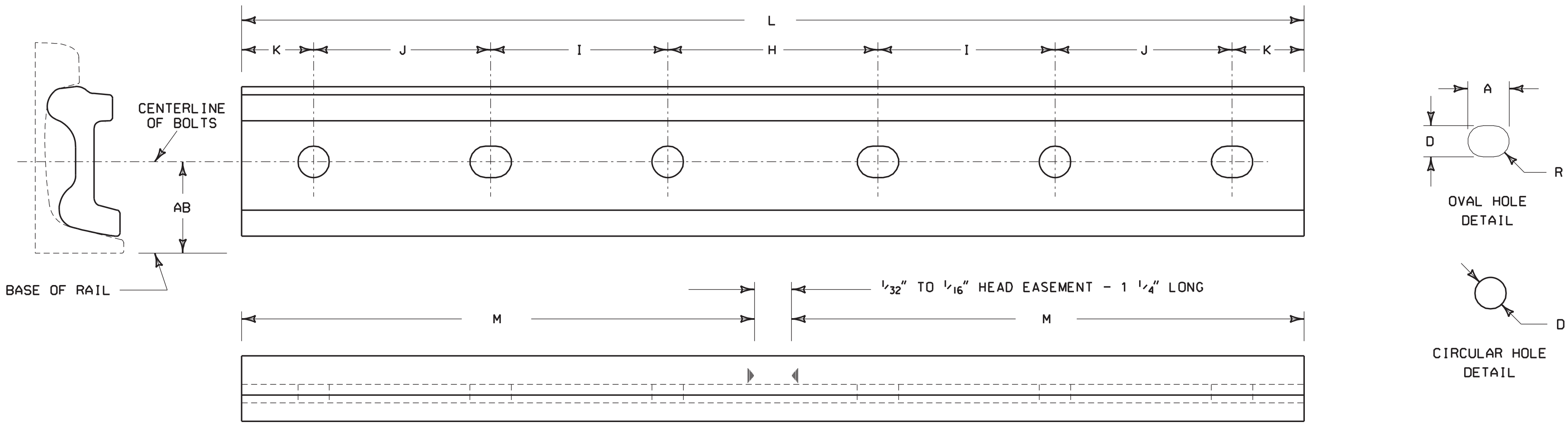
2506



RAIL SECTION	BOLT SIZE	AB	R	D	A	K	J	I	H	L	M	RAIL DRILLING	SCN
STANDARD JOINT BARS													
141 RE 136 RE 132 RE	1"	3 3/32"	17/32"	1 1/16"	1 13/32"	2 7/16"	6"	6"	7 1/8"	36"	17 3/8"	1 1/8"	
122 CB	1"	2 7/8"	17/32"	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"	17/32"	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" 1 1/8" 1"	3 3/32" 3 " 3 "	19/32" 19/32" 17/32"	1 3/16" 1 3/16" 1 1/16"	1 9/16" 1 1/2" 1 13/32"	2 7/16" 2 1/4" 2 7/16"	6 1/2" 7" 6"	6 1/2" 6" 6"	5 1/8" 5 1/2" 7 1/8"	36" 36" 36"	17 3/8" 17 3/8" 17 3/8"	1 1/4" 1 1/4" 1 1/8"	
136 RE 132 RE	1 1/8"	3 3/32"	19/32"	1 3/16"	1 9/16"	2 7/16"	6"	6"	7 1/8"	36"	17 3/8"	1 1/4"	
136 NYC 127 DM	1 1/8"	3 1/8"	19/32"	1 3/16"	1 9/16"	2 7/16"	6"	6"	7 1/8"	36"	17 3/8"	1 1/4"	
133 RE	1"	3"	17/32"	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"	19/32"	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"	19/32"	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"	17/32"	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"	17/32"	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"	17/32"	1 1/16"	1 13/32"	2 7/16" 2 15/16"	6 1/2" –	6 1/2" 6 1/2"	5 1/8" 5 1/8"	36" 24"	17 3/8" 11 3/8"	1 1/8" 1 1/8"	
110 RE	1 1/8"	2 53/64"	19/32"	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"	19/32"	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" 1"	2 65/128" 2 65/128"	17/32" 17/32"	1 1/8" 1 1/8"	1 1/2" 1 1/2"	3 " 3 3/4"	– –	6" 5 1/2"	6" 5 1/2"	24" 24"	11 3/8" 11 3/8"	1 1/8" 1 1/8"	

STANDARD 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

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JOINT BARS FOR STANDARD RAIL SECTIONS

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.

APPROVED - GERRY WOODS
CFRC MAINTENANCE OF WAY MANAGER

APPROVED - EDWARD CONNOLLY
CFRC CHIEF OPERATING OFFICER

PREPARED BY:
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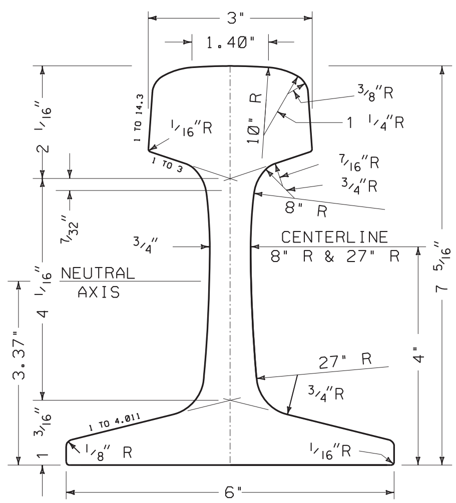
2507



140 RE

AREA :
HEAD - 5.08 IN.^{2} - 37.2 %
WEB - 3.71 IN.^{2} = 27.1 %
BASE - 4.88 IN.^{2} - 35.7 %

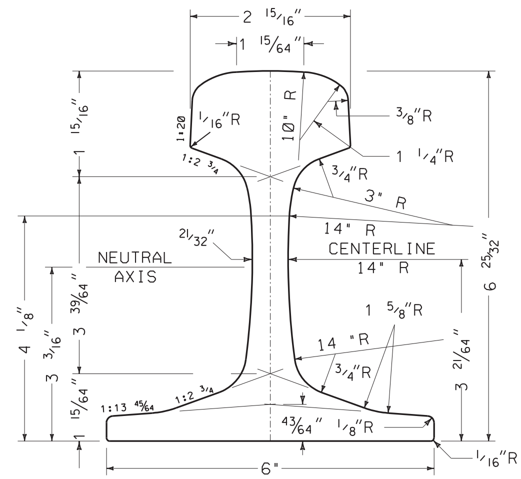
RAIL WEIGHT :
139.36 LBS./YD.

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}

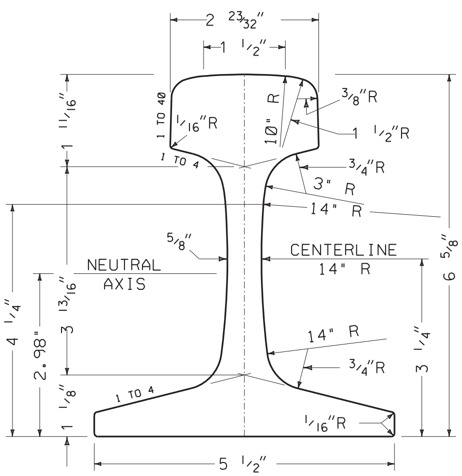
RAIL WEIGHT :
122.5 LBS./YD.

MOMENT OF INERTIA :
74.0 IN.^{4}

SECTION MODULUS :
HEAD - 20.6 IN.^{3}
BASE - 23.3 IN.^{3}

NET TONS PER TRACK MILE :
239.36 TONS

RAIL DRILLING :
2 7/8IN. 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 7/8IN. ABOVE BASE

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115 RE, 122 CB AND 140 RE RAIL SECTIONS

APPROVED - GERRY WOODS
CFRC MAINTENANCE OF WAY MANAGER

APPROVED - EDWARD CONNOLLY
CFRC CHIEF OPERATING OFFICER

PREPARED BY:
R.M. WHITE

ISSUED: DECEMBER 9, 2013
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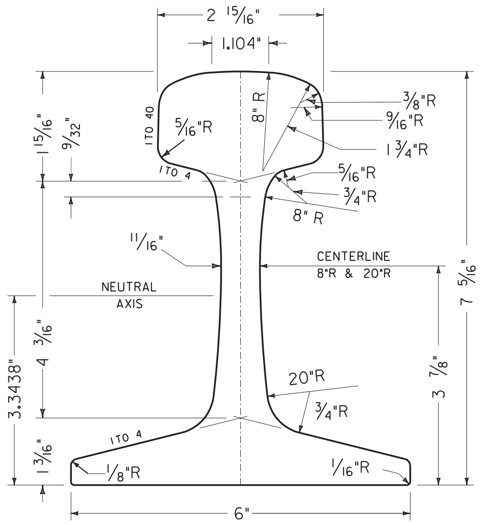
EDITORIAL REVISION 8/8/08 - CORRECT MISSING BOTTOM RADIUS DIMENSION 122CB



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.

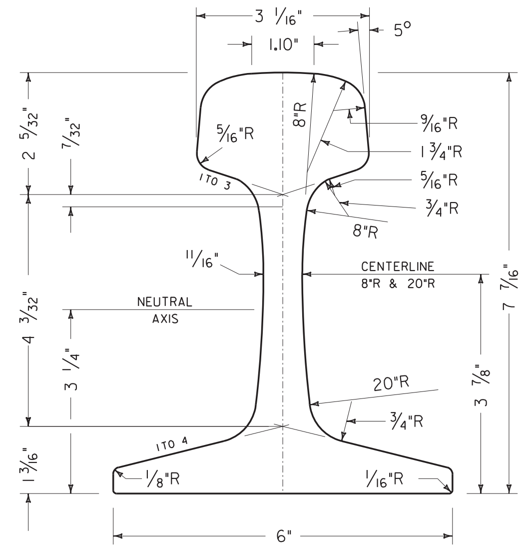
MOMENT OF INERTIA :
94.2 IN.^{4}

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.

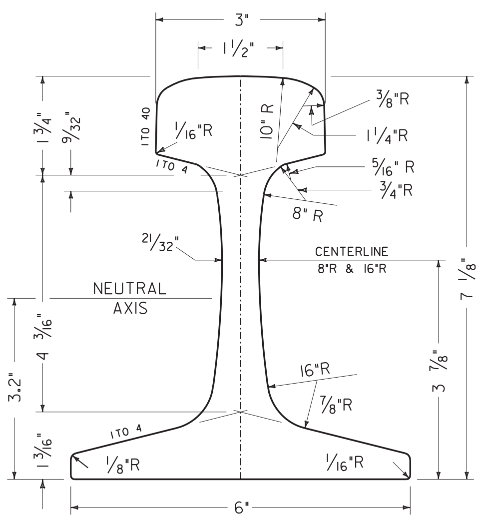
MOMENT OF INERTIA :
100.44 IN.^{4}

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.

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132 RE, 136 RE, AND 141 RE RAIL SECTIONS

APPROVED - GERRY WOODS
CFRC MAINTENANCE OF WAY MANAGER

APPROVED - EDWARD CONNOLLY
CFRC CHIEF OPERATING OFFICER

PREPARED BY:
R.M. WHITE

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REVISED: SEPTEMBER 26, 2104

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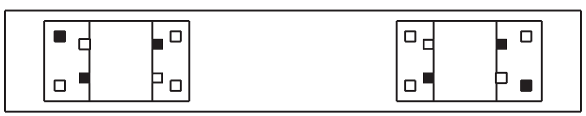
SPIKING REQUIRMENTS

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

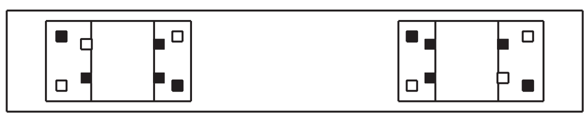
SPIKING PATTERN "A"

SPIKING PATTERN "C"

SPIKING PATTERN "B"



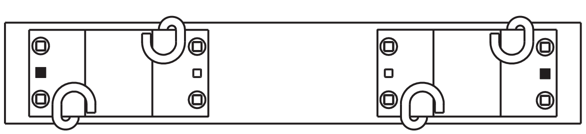
SPIKING PATTERN "D"



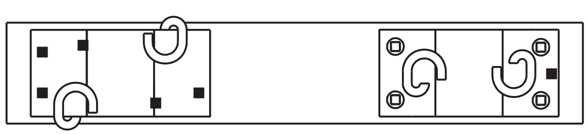
■ - TRACK SPIKE

◎ - TIE PLATE SCREW

POSITIVE RESTRAINT RAIL FASTENERS
ALL TRACK ALIGNMENTS



PANDROL ROLLED PLATE



PANDROL VICTOR PLATE

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

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MAIN TRACK SPIKING PATTERNS
SIDE TRACK SPIKING PATTERNS

APPROVED - GERRY WOODS
CFRC MAINTENANCE OF WAY MANAGER

APPROVED - EDWARD CONNOLLY
CFRC CHIEF OPERATING OFFICER

PREPARED BY:
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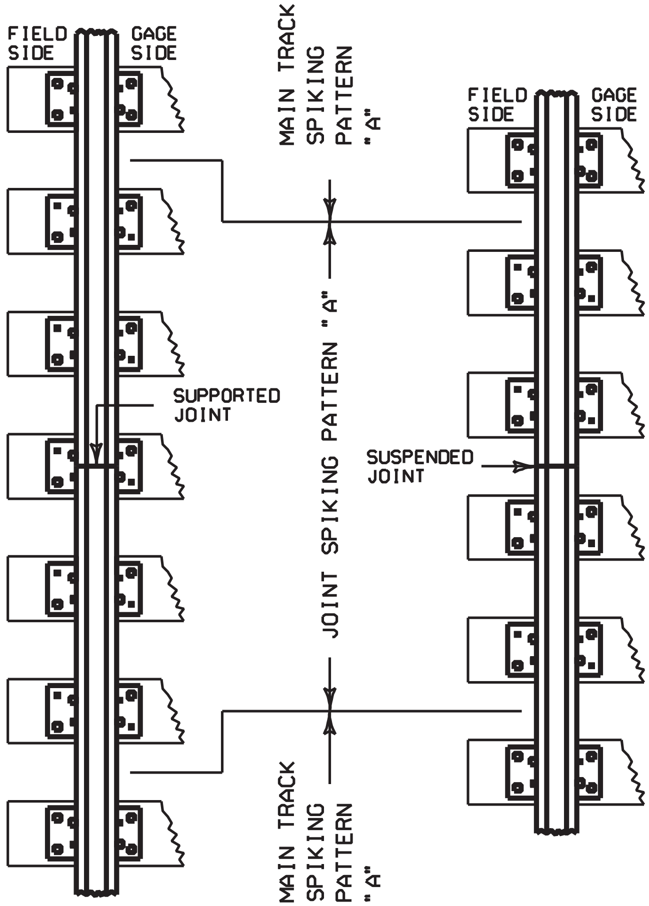
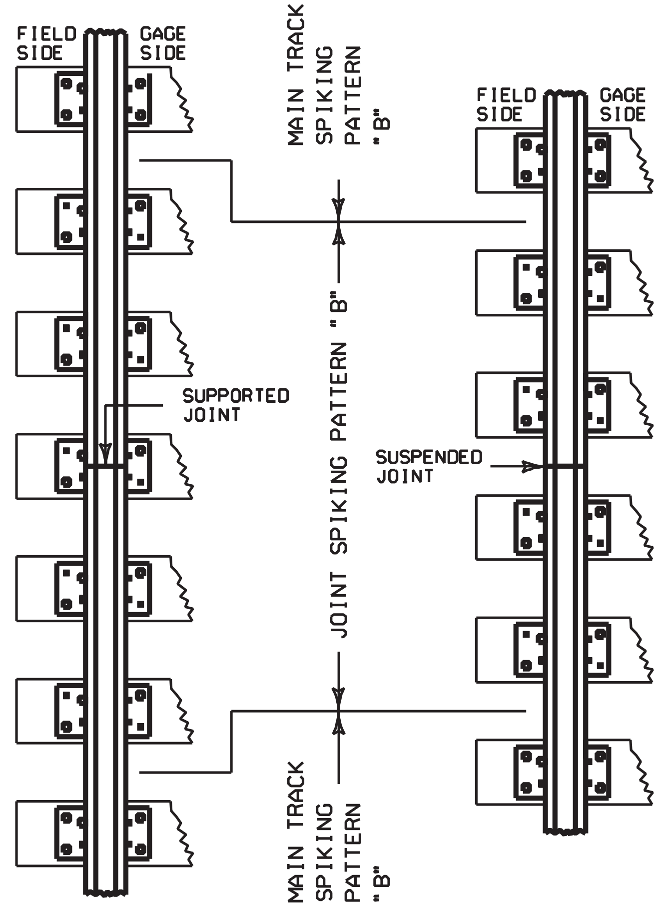
2514



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.

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JOINT AREA SPIKING PATTERNS

APPROVED - GERRY WOODS
CFRC MAINTENANCE OF WAY MANAGER

APPROVED - EDWARD CONNOLLY
CFRC CHIEF OPERATING OFFICER

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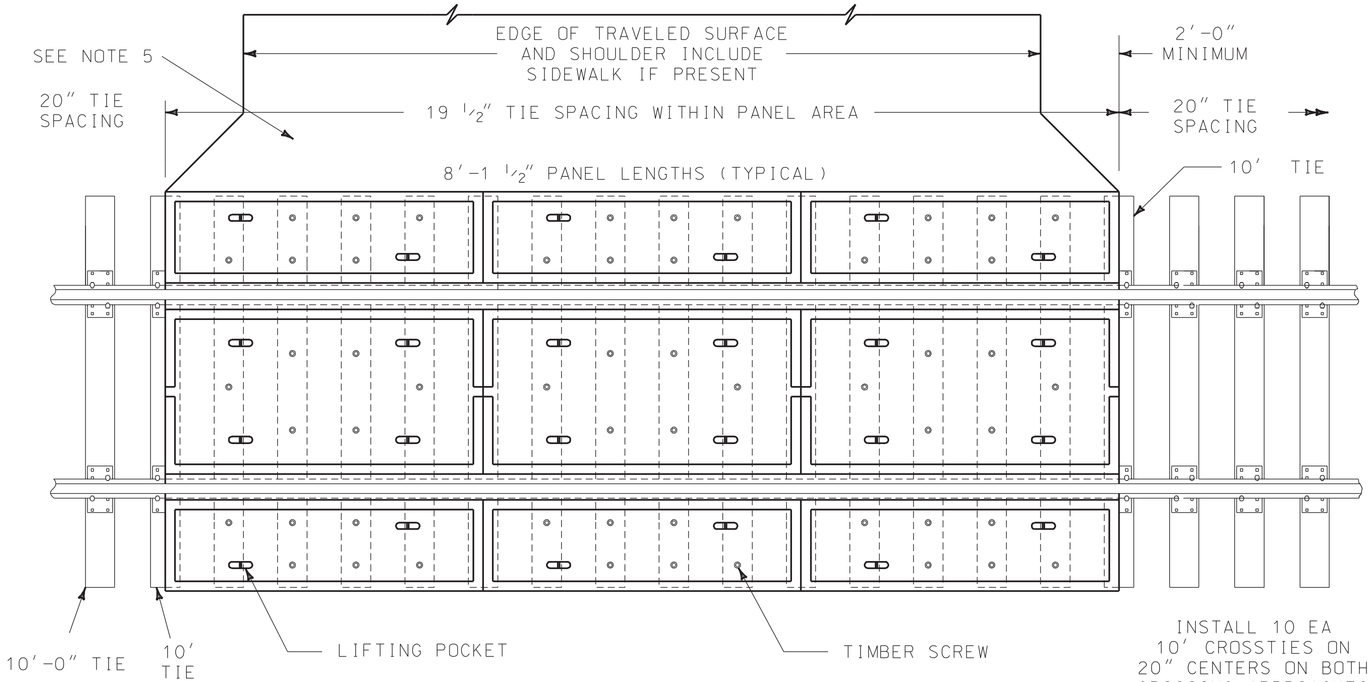


CROSSING PLAN VIEW

2527

NOTES

1. MWI 901 (LASTEST 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 NO 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 SPECIFICATIONS 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.

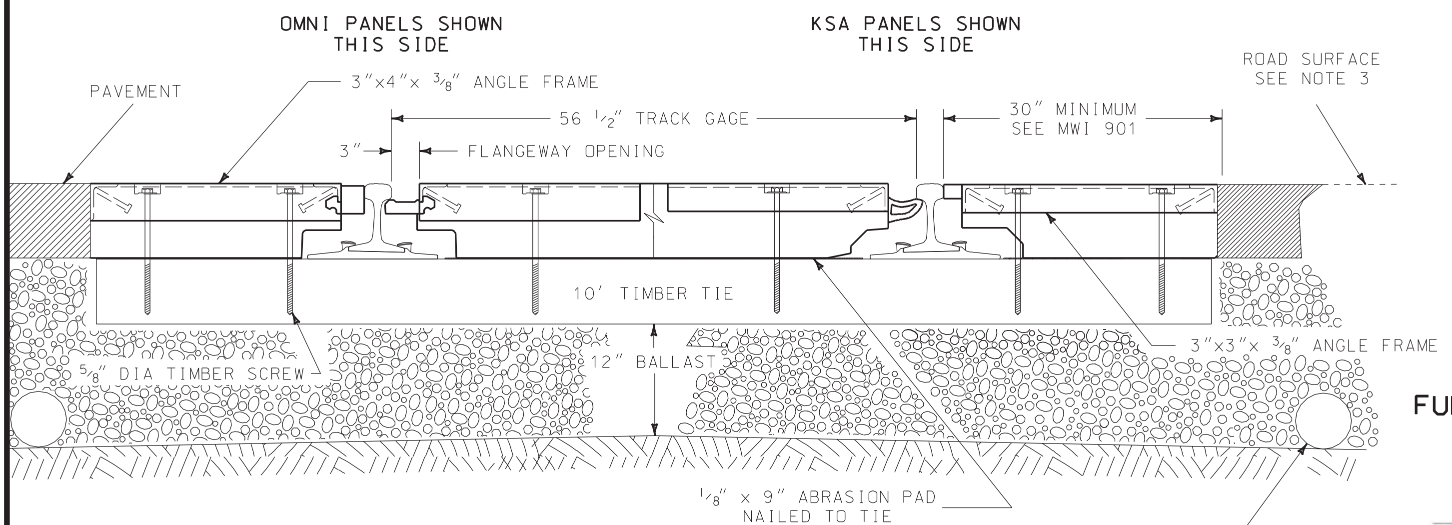
7. IF ROADBED STABLIZATION IS REQUIRED, EXTEND IT 10 FT. BEYOND EDGE OF CROSSING UNDER TRACK.

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.

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	



CROSS SECTION

CFRC
Central Florida Rail Corridor

HEAVY DUTY ROAD CROSSING
FULL WIDTH CONCRETE ON WOOD TIES

APPROVED - GERRY WOODS
CFRC MAINTENANCE OF WAY MANAGER

APPROVED - EDWARD CONNOLLY
CFRC CHIEF OPERATING OFFICER

PREPARED BY:
R.M. WHITE

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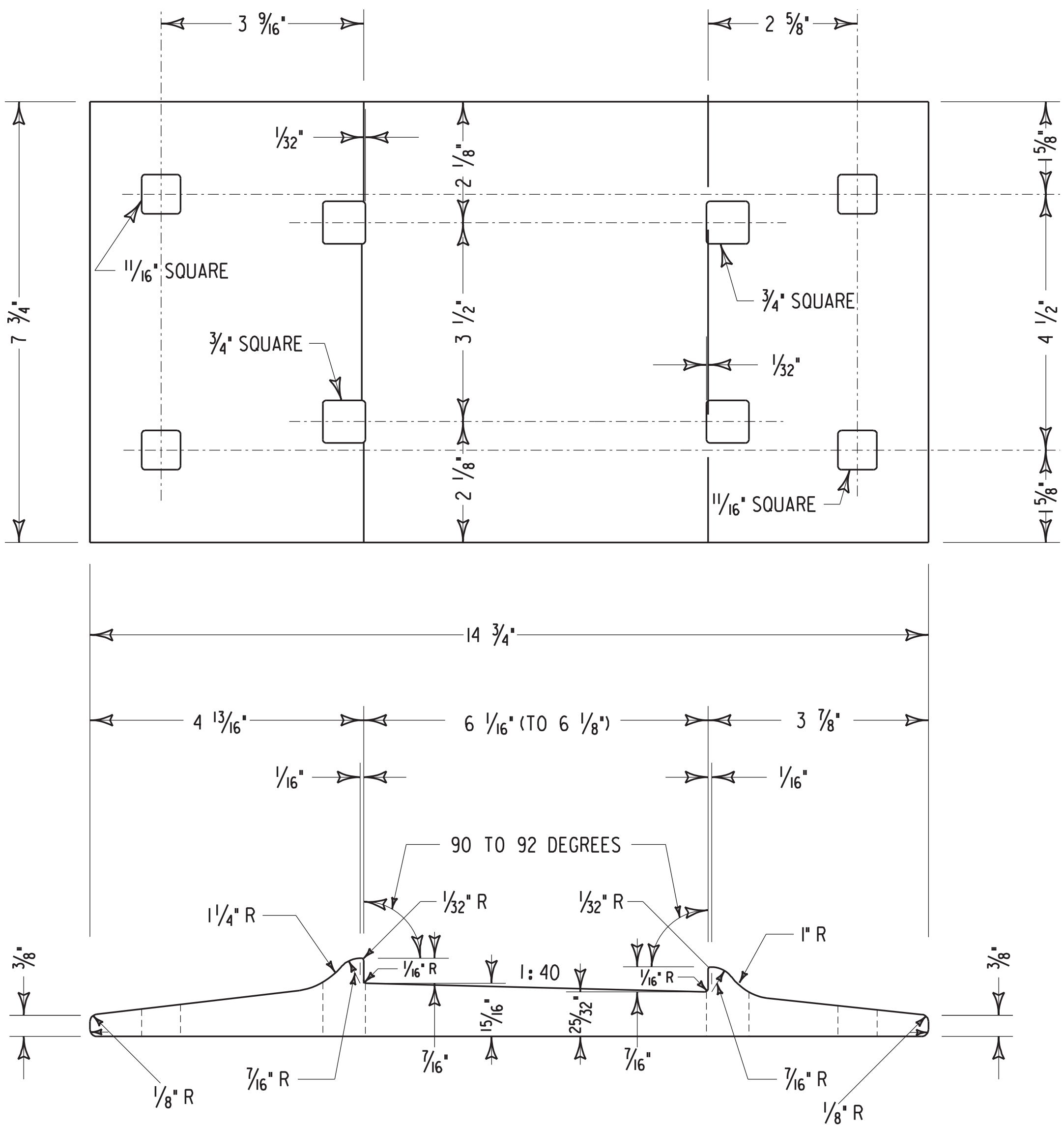

ORDERING INFORMATION		
DESCRIPTION	UNITS	
PLATE, TIE, 7 3/4"X 14 3/4" FOR 6" BASE RAILS	EACH	

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.

CFRC
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7 3/4" X 14 3/4" TIE PLATE FOR 6" BASE RAIL SECTIONS

APPROVED - GERRY WOODS
CFRC MAINTENANCE OF WAY MANAGER

APPROVED - EDWARD CONNOLLY
CFRC CHIEF OPERATING OFFICER

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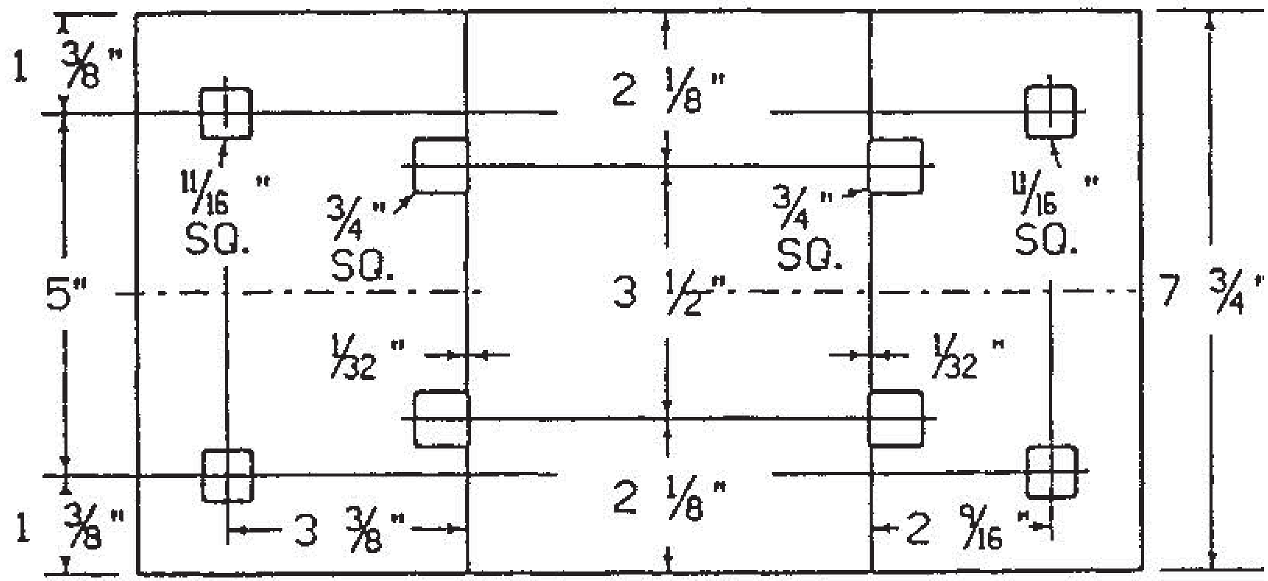
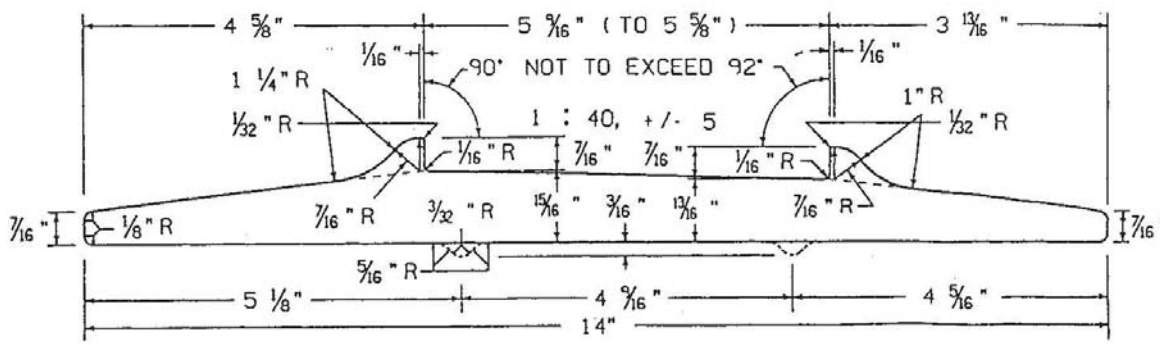


NOTES

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 – 22.90 LBS.



ORDERING INFORMATION	
DESCRIPTION	UNITS
PLATE, TIE, 7-3/4" X 14" FOR 5.5" BASE RAILS	EACH

Central Florida Rail Corridor

7-3/4" x 14" TIE PLATE
FOR 5.5" BASE RAIL SECTIONS

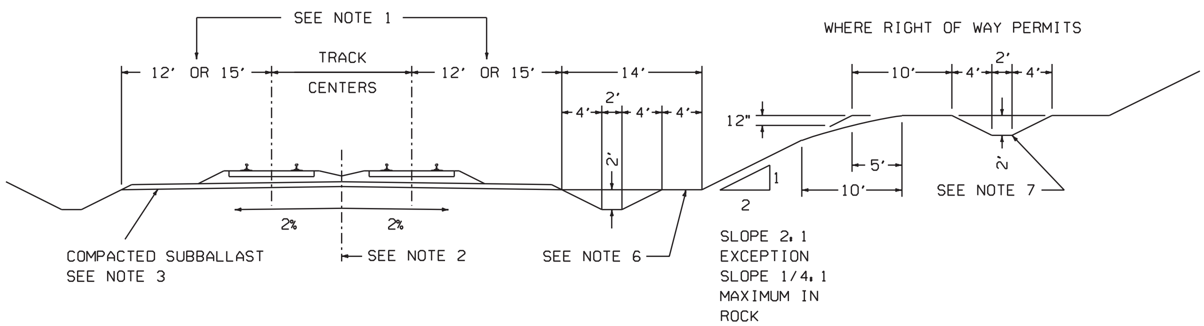
APPROVED - GERRY WOODS
CFRC MAINTENANCE OF WAY MANAGER

APPROVED - EDWARD CONNOLLY
CFRC CHIEF OPERATING OFFICER

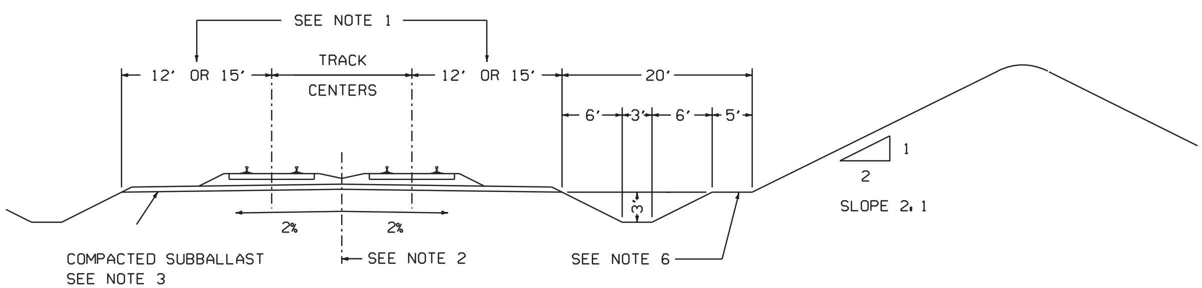
PREPARED BY:
R.M. WHITE

ISSUED: DECEMBER 9, 2013
REVISED: SEPTEMBER 26, 2104

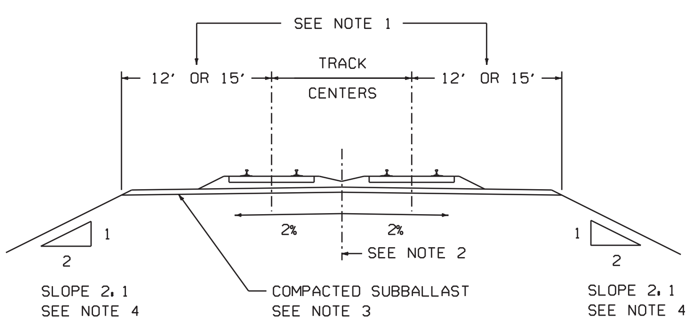
2601



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 STANDARD SLOPE ON FILL SECTIONS MAY BE INCREASED TO A MAXIXMUM OF 1 ½ 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.

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ROADBED SECTIONS

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PREPARED BY:
R.M. WHITE

ISSUED: DECEMBER 9, 2013
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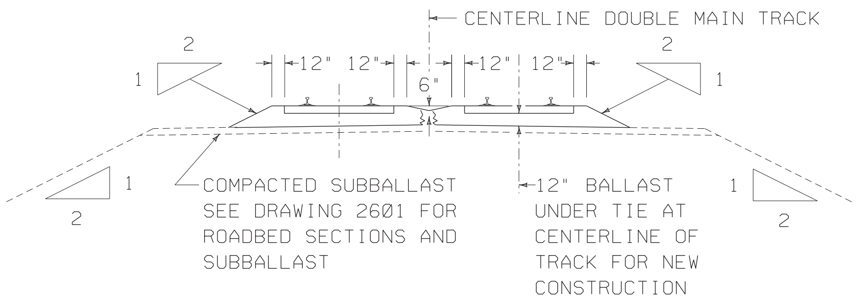
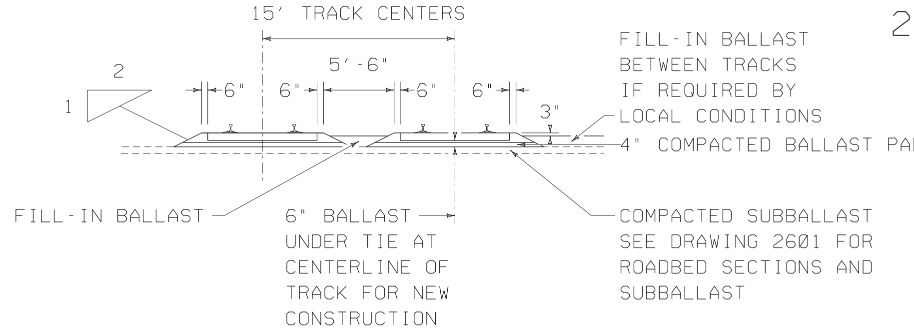
2602

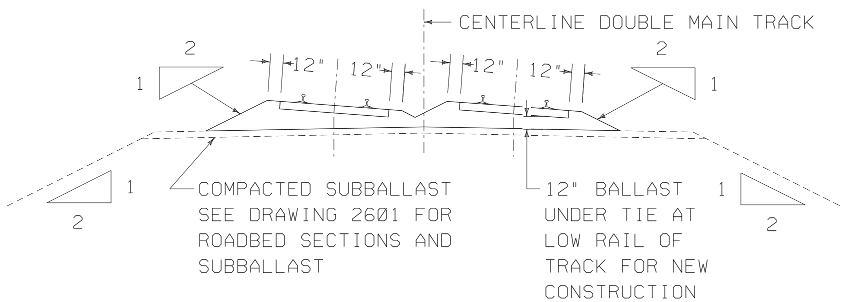


MAIN TRACK, SIDINGS AND HEAVY TONNAGE TRACKS

TANGENT TRACKS

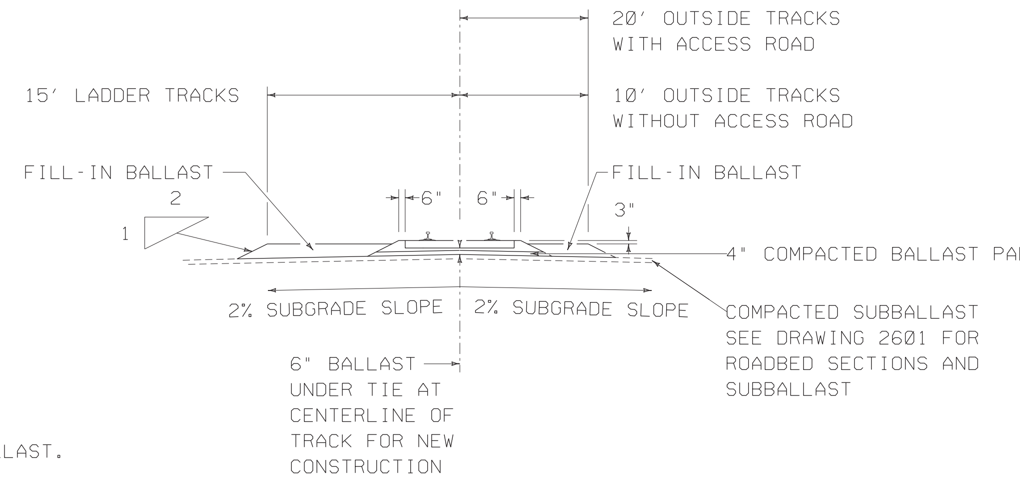


INTERIOR YARD TRACKS



MAIN TRACK, SIDINGS AND HEAVY TONNAGE TRACKS

SUPERELEVATED TRACKS



LADDER AND OUTSIDE TRACKS

NOTES.

1. BALLAST TO CONFORM TO THE CURRENT CFRC SPECIFICATION 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.

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BALLAST SECTIONS

APPROVED - GERRY WOODS
CFRC MAINTENANCE OF WAY MANAGER

APPROVED - EDWARD CONNOLLY
CFRC CHIEF OPERATING OFFICER

PREPARED BY:
R.M. WHITE

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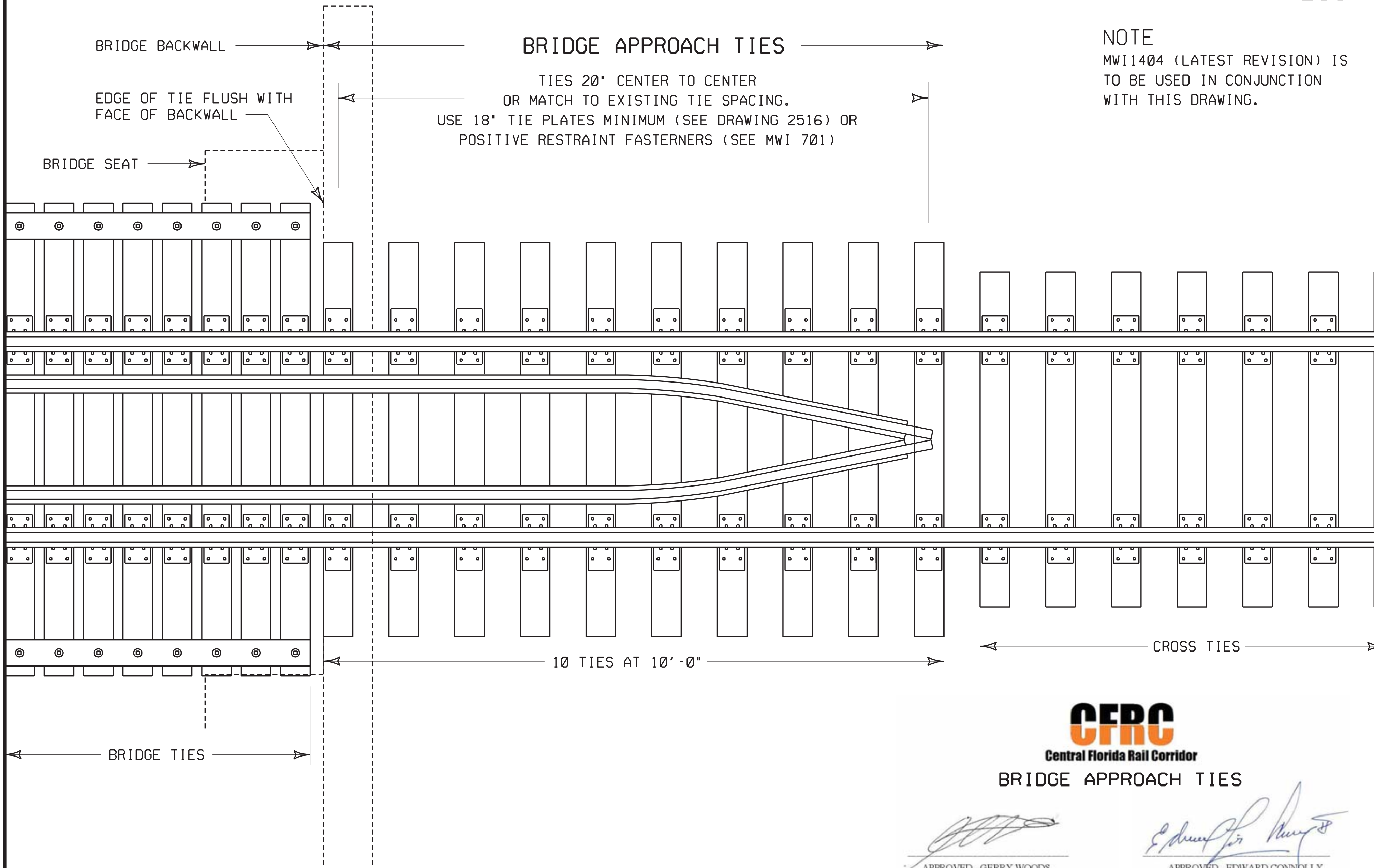
2607



NOTE
MWI1404 (LATEST REVISION) IS
TO BE USED IN CONJUNCTION
WITH THIS DRAWING.

Central Florida Rail Corridor

BRIDGE APPROACH TIES

APPROVED - GERRY WOODS
CFRC MAINTENANCE OF WAY MANAGER

APPROVED - EDWARD CONNOLLY
CFRC CHIEF OPERATING OFFICER

PREPARED BY:
R.M. WHITE

ISSUED: DECEMBER 9, 2013
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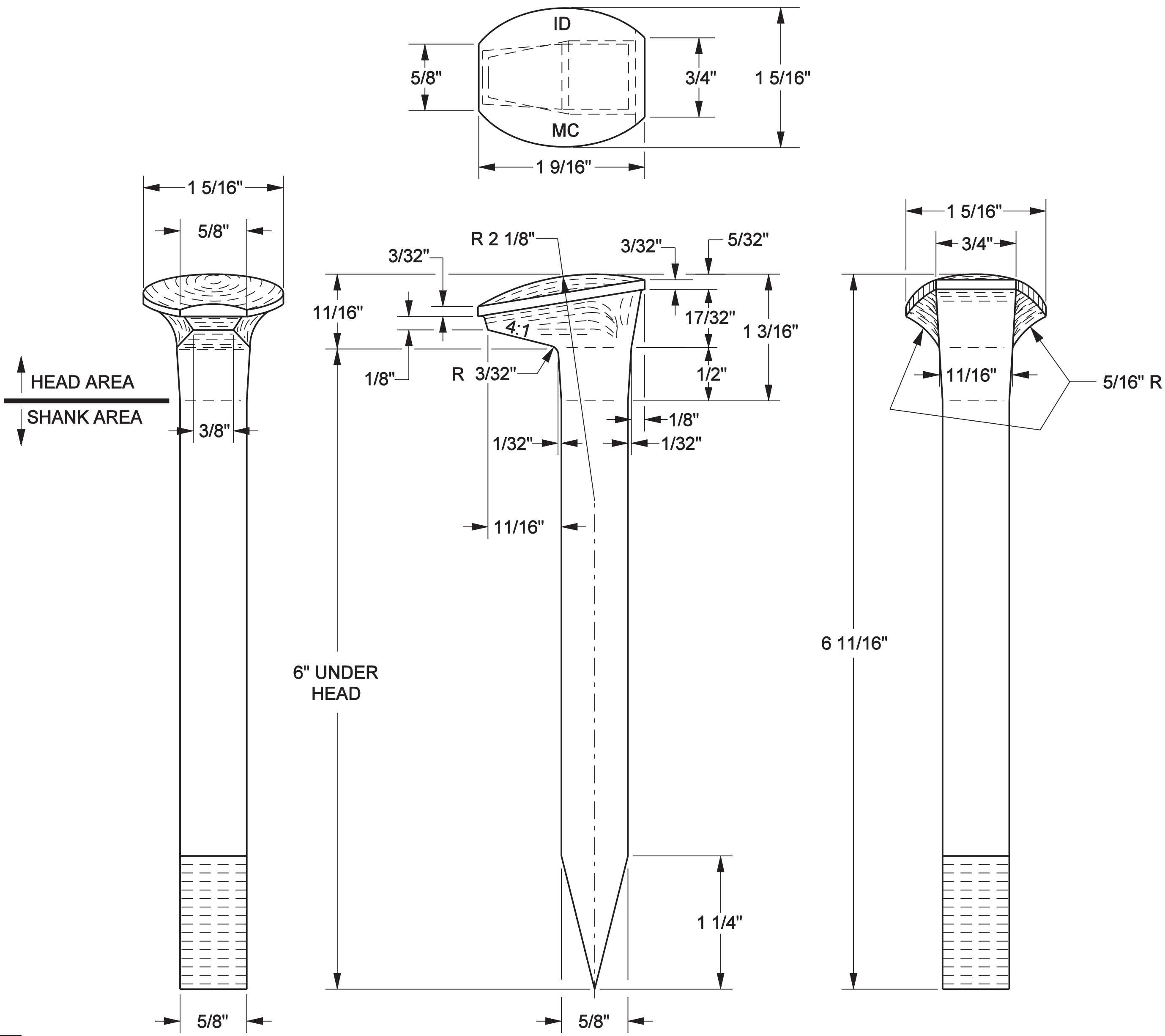
Volume III:

Common Standards



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.

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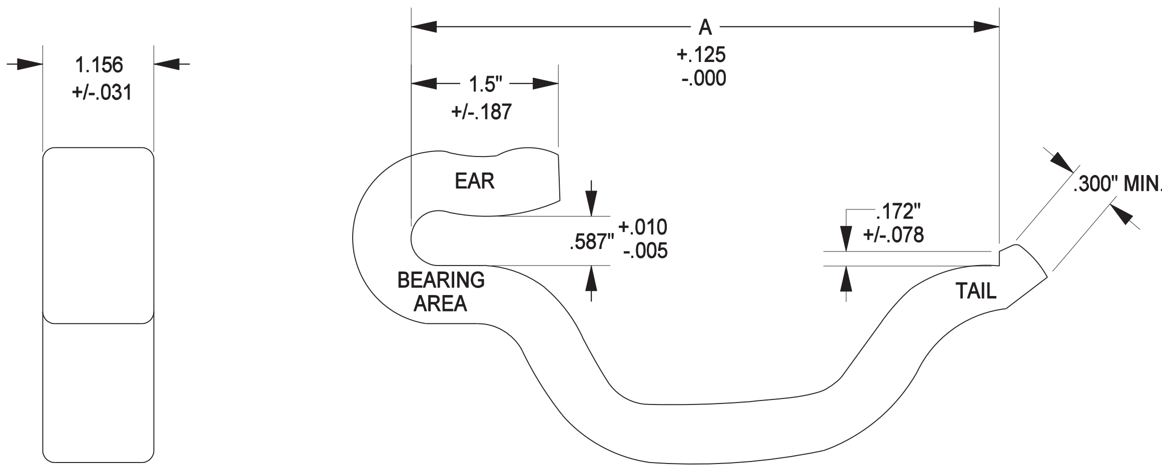
COMMON STANDARDS

6" TRACK SPIKE

FILE OWNER: CFRC	DATE: 9/26/2014
REV. NO.: 2	DWG NO: 130005

130005



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

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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