Procedures for the Installation, Adjustment, Maintenance and Inspection of CWR as Required by 49 CFR 213.118

Effective: May 26, 2022

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Chapter 9 Recordkeeping

Guidance and Appendices

Procedures for the Installation, Adjustment, Maintenance, and Inspection of CWR

This document details Watco's and all covered entities policy for installing, adjusting, maintaining, and inspecting Continuous Welded Rail (CWR) track. Each chapter details how the railroad(s) applies its procedures to comply with § 213.119 of the Federal Railroad Administration's (FRA) Track Safety Standards (TSS).

Chapter 1: CWR Installation Procedures

As defined in § 213.119, rail welded together to create a single continuous piece of rail that exceeds 400 feet in length is considered CWR. Track containing that piece of CWR is then designated as "CWR Track" and will remain as such, regardless of whether a rail joint or plug rail is later installed.

Temperature variations affect rail length causing it to expand (lengthen) when warmed and to contract (shorten) when cooled. When a rail is prevented from moving longitudinally, such as when CWR is properly installed and restrained, these thermal variations create compressive and tensile forces within the rail. The procedures outlined in this plan are designed to ensure that CWR is installed and maintained in a manner that effectively manages these thermal variations.

1.1 Desired Rail Neutral Temperature

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

Rail laying procedures are established based upon geographic considerations and annual temperature variations to achieve and maintain a specific Desired Rail Neutral Temperature (DRNT) that reduces the risk of both track buckles and broken rails. Rail Installation temperatures may be slightly higher or lower than the DRNT but are to be within the designated rail installation range. Rail installation should be completed at +/- 20°F Desired Rail Neutral Temperature (DRNT). (See Table 1.1 below for rail neutral temperature by geographical area).

Table 1.1-Desired Rail Neutral Temperature

State/Railroad	Desired Rail Neutral Temperature	Safe Range Lower End	Safe Range Upper End
Alabama – ABS, AUTR, BHRR	110°F	90°F	130°F
Arkansas – ARS	110°F	90°F	130°F
Florida – JXPT	110°F	90°F	130°F
Georgia – SVHO	110°F	90°F	130°F
Idaho – BVRR, EIRR	100°F	80°F	120°F
Illinois – DREI, CERR, EJSR	100°F	80°F	120°F
Kansas – KAW, KORR, SKOL	105°F	85°F	125°F
Louisiana – BRSR, LAS, DUSR, GOGR, TIBR	115°F	95°F	135°F
Michigan – GDLK	100°F	80°F	120°F
Mississippi - MSR, VSOR	110°F	90°F	130°F
New Mexico – TXNR	115°F	95°F	135°F
New York – ITHA	95°F	75°F	115°F
North Carolina – BLU	100°F	80°F	120°F
Ohio – AA	100°F	80°F	120°F
Oklahoma – SLWC	110°F	90°F	130°F
Oregon – PCC Condon	100°F	80°F	120°F
South Dakota - RWRR	100°F	80°F	120°F
Texas – AWRR, LBWR, PVS	115°F	95°F	135°F
West Virginia – KNWA	100°F	80°F	120°F
Washington – PCC	100°F	80°F	120°F
Wisconsin – WSOR, FOXY	100°F	80°F	120°F

1.2 Temperature Differential

The difference between two temperatures is called a temperature differential. When laying rail in accordance with Chapter 1, the required expansion is determined based upon the temperature differential between the Rail Temperature (RT) at the time of installation and the Desired Rail Neutral Temperature (DRNT).

1.3 Installing CWR

The following procedures shall be used to establish the proper Desired Rail Neutral Temperature (DRNT) while laying rail out-of-face, laying curve patch, or installing a long maintenance rail. These procedures do not apply to the installation of plug rails or short track panels. The amount of rail laid at any one time is not limited to any specific length; these procedures can be performed on rails as short as a few hundred feet or as long as 1,600 feet. The maximum installation length is essentially limited by what could be reasonably expected to expand uniformly. Excessively long rails can have considerable resistance to longitudinal movement during installation which can inhibit proper rail expansion and result in not achieving a uniform Desired Rail Neutral Temperature (DRNT).

Follow these procedures when installing CWR:

(a) Refer to Table 1.1-Desired Rail Neutral Temperature for the geographical area of the installation.

(b) Ensure the rail is in a stress-free state as it is laid in the track.

(c) Measure the RT at the center of the web on the shady side of the railand determine if the current RT is within the DRNT safe range +/- 20°F.

(d) If installed correctly, the RNT is established, and is equal to the RT.

(e) Determine the amount of adjustment required to achieve the DRNT.

(1) If the RT is within the DRNT safe range +/- 20°F, further adjustment may not be required. Measure the RT at the location where the anchors or clips are being applied to restrain the rail. If at any time the RT is no longer within the DRNT safe range +/- 20°F, stop fastening the rail and use the following procedures to ensure the appropriate expansion is achieved.

(2) If the RT exceeds DRNT + 20°F, the installation must stop until the rail temperature returns within range or provisions must be made for readjustment prior to the arrival of cold weather. After reviewing the pertinent records, the Engineering Department may determine no further adjustment is necessary.

(3) If the RT is lower than the DRNT safe range +/- 20°F, the temperature differential for the adjustment shall be calculated by subtracting the RT from the DRNT. Refer to one of the formulas below or the Thermal Expansion of Rail Table in Appendix 1 to determine the required expansion based upon the length of rail being installed and the temperature differential at the time of installation.

Adjustment length (inches) x temperature differential x 0.0000067

or use

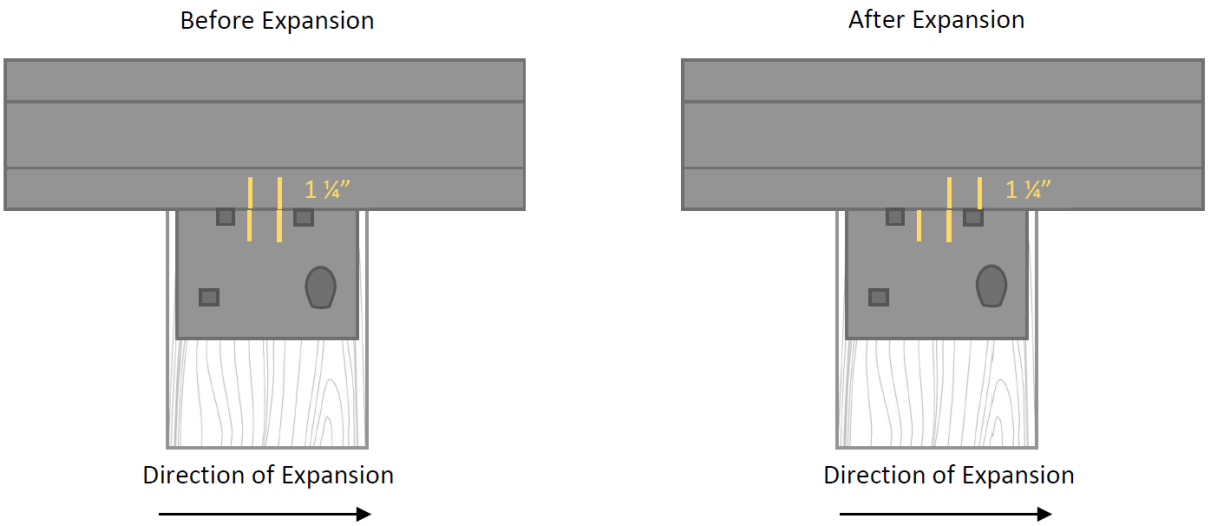
Adjustment length (feet) x temperature differential x 0.000078

If the rail is laid at a temperature more than 40°F below the DRNT, it must be adjusted, or a speed restriction of 25 miles per hour (mph) must be placed until adjusted to within the DRNT safe range +/- 20°F. When obvious tight rail conditions exist, or evidence that the lateral resistance of the track structure has been compromised, be governed by Chapter 7.

(f) As demonstrated in Figure 1-A below, apply match marks between the base of the rail and the tie, or tie plate, at stations located at the quarter, half, and three-quarter points along the rail being installed. Write the required expansion on the rail next to the match marks.

Rail Expansion Match Marks

Figure 1-A



(g) Adjust the rail uniformly.

(1) Heat the rail evenly so that the rail expansion occurs at each station (as identified by match marks) as required. If the expansion is not achieved at a station, return to the previous station and heat that segment evenly until the proper amount is achieved.

(2) If a rail puller is used for the adjustment, ensure the expansion is uniform and the required amount is achieved at each station. Gentle vibration of the tie plates may be required.

(h) Record all the rail installation information, location, and date on the appropriate rail installation form located in Appendix 2. Alternatively, these records may be retained in an electronic format as outlined per 49 CFR § 213.241(j).

Chapter 2: Rail Anchoring

Rail anchors prevent rail from moving longitudinally relative to the ties. Apply the following anchor requirements to all new and second-hand (SH) rail relays. Where the anchoring function is otherwise provided, such as resilient rail fasteners that restrain the rail, or bridges where the structure design precludes the use of anchors (e.g., bridges with rail expansion joints), rail anchors may be omitted. Anchor pattern may be varied as reasonable to avoid placing anchors against deteriorated ties.

Maintain anchors so they bear against the edge of either the tie or tie plate. Be careful to ensure that the anchor is fully driven but not overdriven. When inspecting, and rail movement is evident, ensure anchors are not defective, and verify proper size and dimension for rail section. If conditions warrant reset, replace, or apply additional anchors as needed. If

investigation reveals a poor tie condition exist, insufficient ballast, corroded rail base, or excessive longitudinal rail stress, correct these track conditions before deciding to add additional anchors.

Fully box anchor each tie that is adjacent to a field weld. Anchors shall not be applied where they will interfere with signal or other track appliances, where they are inaccessible for adjustment or inspection, or on a rail opposite of a joint.

Anchoring requirements apply to CWR installation on all classes of track.

Installation should be completed at DRNT safe range +/- 20°F (See Table 1.1)

2.1 Standard Box Pattern

When installing CWR, box anchor every other tie except as outlined in Section 2.2 or where resilient rail fasteners restrain the longitudinal forces. The anchor pattern must be boxed against the same ties on both rails. Alternating the anchor pattern on opposing rails may cause significant track damage.

2.2 Solid Box Pattern

When installing CWR, fully box anchor every tie at specific locations listed below to provide additional restraint against rail movement. This table does not apply to locations where rail is affixed with resilient fasteners on every tie.

Table 2.2-Solid Box Anchor Pattern Condition & Action

Condition	Action
Turnouts Rail crossings (diamonds) Permanent bolted joints where CWR abuts jointed rail Grades greater than 1.5% Curves sharper than 6 degrees	Anchor every tie throughout and 195 feet in each direction.
Bolted joint installed during CWR installation when using heater, rail stretcher or ambient temperature.	**Within 60 days,** Weld the joint, **OR** Install 6 bolts in the joint, **OR** Anchor every tie for 195 feet in each direction

2.3 Bridge Pattern

When installing CWR, follow these bridge anchoring requirements:

Ballast Deck

(a) Ballast deck bridges shall be anchored with the same pattern as the rail adjacent to the bridge, except where conditions apply in 2.2.

Open Deck

(a) Open deck bridges shall be solid box anchored across the bridge and 195 feet in each direction beyond headwall.

(b) On open deck timber bridges, apply anchors to all ties fastened to stringers.

(c) On open deck steel bridges 150 feet or less apply anchors to all ties fastened to the steel structure.

(d) On other structures, apply anchors as directed by Watco Manager of Bridges.

2.4 Legacy Patterns

On CWR installations completed before September 21, 1998, pre-existing railroad standard anchor patterns may remain if the rail is restrained to prevent track buckles, but rail must be

adjusted (by increasing or decreasing the length of rail or by lining on curves) or anchors added to the rail if restraint is insufficient.

2.5 Anchor Pattern after Repair

When repairs result in a rail joint being added to CWR, the anchor pattern shall match the existing pattern in track. At least every other tie will be box anchored 195 feet in each direction unless anchoring is otherwise provided. When repairs are made to a stripped joint or failed joint bar, the adjustment or addition of anchors will be as prescribed in the following table. The adjustment or remedial action must be documented (Appendix 5) and retained.

Table 2.5-Anchor Pattern after Repair Condition & Action

Condition	Action
Bolted joint in CWR experiencing service failure (stripped joint) or failed bar(s) with *gap** present. **A gap exists if it cannot be immediately closed by drift pin.*	Weld joint **OR** Remediate conditions (per Chapter 6.5), replace bolts (new, in-kind, or stronger), and weld joint within 30 days, **OR** Replace failed bar(s), install 2 additional bolts, and adjust anchors, **OR** Replace failed bars, bolts (if broken or missing), and anchor every tie for 195 feet in both directions, **OR** Add rail, documenting provisions for later adjustments (if applicable), and reapply anchors.

Chapter 3: Maintaining a Desired Rail Neutral Temperature Range

Note: This section addresses § 213.119's requirement that each track owner has the responsibility to quantify the rail neutral temperature of all CWR track locations where rail has been installed, cut, broken, or adjusted. Use the following track maintenance procedures to properly maintain RNT and reduce the risk of buckles in hot weather as well as pull-aparts and broken rails in cold weather. These procedures include an RNT Readjustment Method outlined in Section 3.1 and, for cases when that method is not applicable or desirable, a De-stressing (conventional RNT adjustment) method outlined in Section 3.2. Additionally, Section 3.3 contains procedures for the limited cases where RNT may be restored by lining of curves.

The proper measurement of rail movement in CWR is critical in accurately tracking RNT changes. The use of reference marks, applied in the prescribed manner, is required for all work performed as described in this chapter and in the appendices.

Rail that has been cut or broken for any reason must be readjusted back to within the DRNT safe range +/- 20°F prior to becoming a buckle or pull-apart prone condition. If the rail has not been readjusted to at least DRNT - 20°F before the rail temperature exceeds the values in *Table 3* (the "70/70 Restriction Table"), either a 25 mph speed restriction, or a 40 mph speed restriction along with a required daily inspection made during the hottest part of the day(e.g., noon to 6 pm), must be imposed.

Track buckles can be extreme and, in some cases, may not be passable at any speed. Protecting buckle prone conditions as described in this chapter should not be confused with protecting known tight track conditions or locations that have evidence of the loss of lateral resistance between the ties and ballast. In such cases, the track should be taken out of service and the procedures of Chapter 7 govern.

70/70 Restriction Table

Table 3-70/70 Restriction Table

Rail break or cut temperature	Rail temperature at which to readjust or apply slow order
60°F	135°F
50°F	130°F
40°F	125°F
30°F	120°F
20°F	115°F
10°F	110°F
0°F	105°F
-10°F	100°F
-20°F	95°F
-30°F	90°F
-40°F	85°F

Table 3 uses the assumptions of what is often referred to as the 70/70 Rule. The table is based upon the assumptions that: only one rail has been cut, the uncut rail's RNT is 70°F, and the track structure can restrain against the forces of a rail temperature that is at least 70°F above the average RNT of both rails. If either of these assumptions are known to be overly conservative, the temperature at which to adjust or apply a speed restriction shall be reduced accordingly.

If both rails are cut (e.g., installing a short track panel), the above table will not apply. The adjustments, speed restrictions, and inspections described above will instead apply at a rail temperature no more than 70°F above the lowest rail temperature at the time of the separations.

At locations where the rail has separated, unless the reference marks are restored to their original position, the coldest rail temperature at which work is performed at the location shall be used. For example, if a plug rail is installed at a rail temperature of 40°F, and a joint later fails at 10°F, the appropriate line to reference on the table will be that for 10°F. If the reference marks are restored to their original position, the Pre-Break/Cut RNT may be used for applying the table.

3.1 Maintaining DRNT with A Readjustment Methodology

The procedures in this section apply only to certain rail separations occurring in CWR. These separations include the placement of a single weld or replacement of rail, which is usually less than 100 feet in length. Which procedure is used is determined by the ability to accurately measure the distance between the reference marks. In addition to planned cuts in the rail, this section may be applicable to broken rails and failures in permanent glued insulated joints.

For the readjustment methodology to work as intended, the expected thermal forces must be present prior to the rail separation. Thermal forces must also not be prevented from being released due to extraordinary resistance from the track structure. Therefore, this methodology must not be used when the separation occurs:

- within 400 feet of a fixed object (e.g., turnout, crossing, bridge).
- within 800 feet of a known location with unrestored RNT on the same rail.
- where there are other means of releasing the thermal force buildup (e.g., expansion joints); or
- where the thermal forces have been previously released.

In all of these scenarios where this readjustment methodology doesn't apply, and in cases where there are incomplete records, Section 3.2 must be used.

Readjustment Method Procedures:

(a) Prior to cutting the rail, apply reference marks (RM) with a permanent paint pen outside of the rail section to be removed and beyond where they may be damaged by the work or the application of joint bars. Reference marks should be placed a whole number of feet apart. Write the original reference mark distance to the outside of each reference mark.

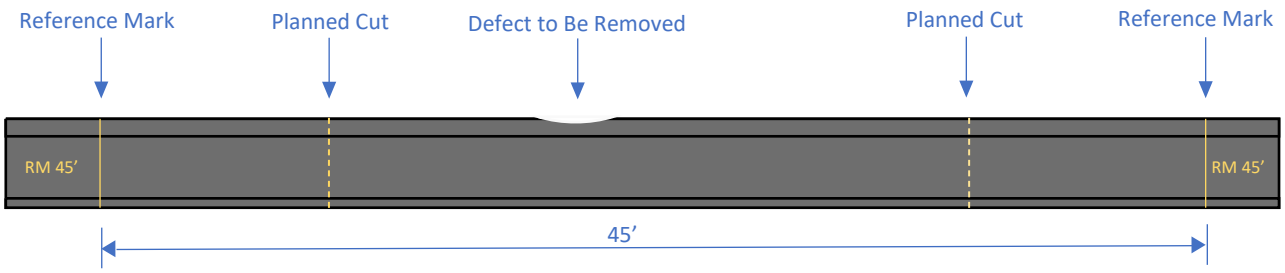


Figure 3-A

When applying reference marks at the location of a broken rail, do not include the gap between the rail ends as part of the reference mark distance.

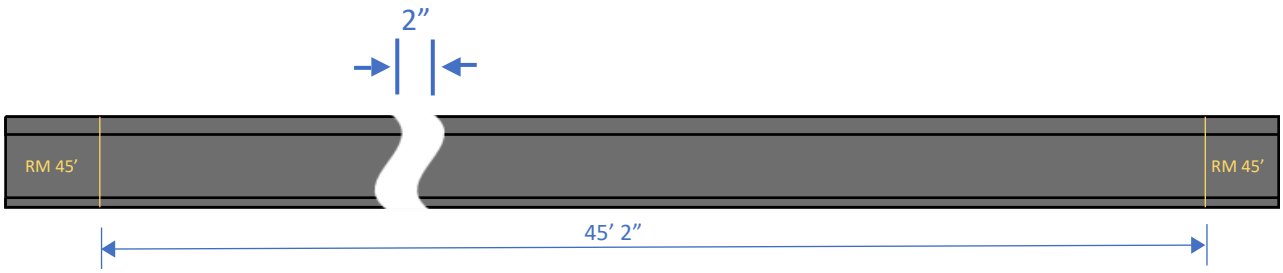


Figure 3-B

(b) Measure the RT in the center of the web on the shaded side of the rail.

(c) Cut the rail and measure the gap between the rail ends after the cut, or upon arrival in the case of a broken rail. If the rail ends move apart, the gap will be a positive (+) number; if the rail runs in, the gap will be a negative (-) number.

If there is a negative gap, remove anchors 195 feet in each direction and tap the tie plates to ensure the rail is in a stress-free state prior to measuring the gap.

If the RT is outside of the DRNT safe range +/- 20°F and the gap cannot be accurately measured for any reason, Section 3.1 does not apply, an adjustment must be made in accordance with Section 3.2.

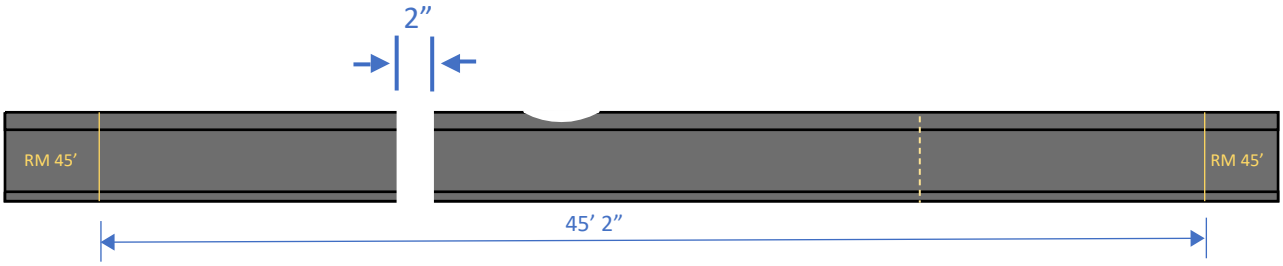


Figure 3-C

(d) Estimate the pre-break/cut RNT based on the measured gap and RT.

(1) If zero gap is observed, the pre-break/cut RNT is equal to the RT.

(2) If a positive gap is observed, refer to the appropriate Pre-Break/Cut Table in Appendix 3 for the rail size and fastener type.

(3) If a negative gap is observed, the current RNT is equal to the current RT. The rail run-in will be subtracted from the original reference mark distance when calculating any required adjustment.

(e) Refer to the area’s DRNT and determine the required adjustment from the pre-break/cut RNT (or current RNT for negative gaps).

(1) If within the DRNT safe range +/- 20°F, no adjustment is required and the reference marks may be restored to their original measurement; however, it is preferable to adjust to the DRNT.

(2) If outside the DRNT safe range +/- 20°F, subtract the pre-break/cut RNT (or current RT for negative gaps) from the DRNT to determine the required RNT adjustment. Refer to the Thermal Adjustment Table for 780 Feet of Rail in Appendix 4 to determine how much the reference mark distance needs to change to achieve the desired RNT adjustment.

(f) If the final adjustment and welds are not completed at this time, complete the designated form (Appendix 8) and record the following on the rail in permanent paint pen:

(1) Milepost location
(2) Supervisor/Foreman Initials
(3) Date
(4) Original reference mark distance
(5) Rail temperature from step (b)
(6) Gap size

(7) Change to reference mark distance, in parentheses

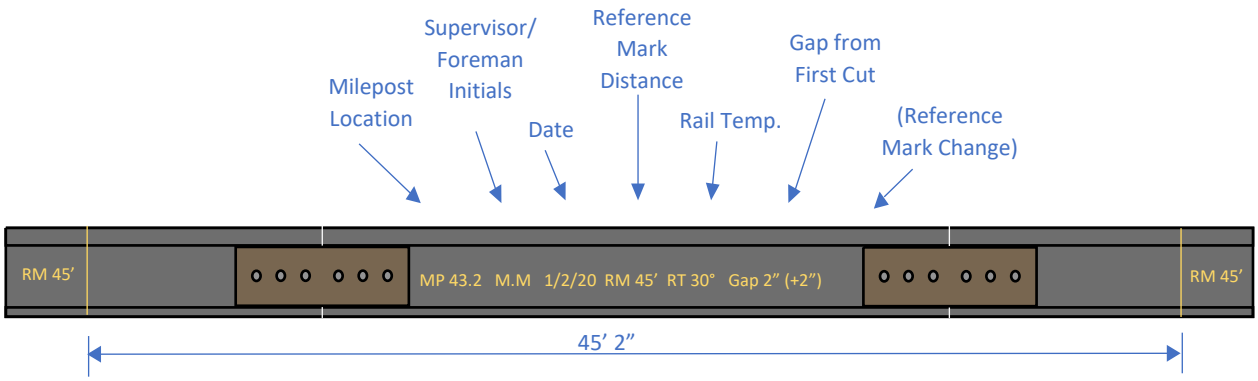


Figure 3-D

(g) All follow-up work at this location prior to the final adjustment and closure weld shall be considered part of a single disturbance. For follow-up work, complete the designated form Appendix 8 and record the following on the rail in permanent paint pen:

(1) Supervisor/Foreman Initials
(2) Date
(3) Rail temperature at the time of the follow-up work
(4) Change to reference mark distance, in parentheses

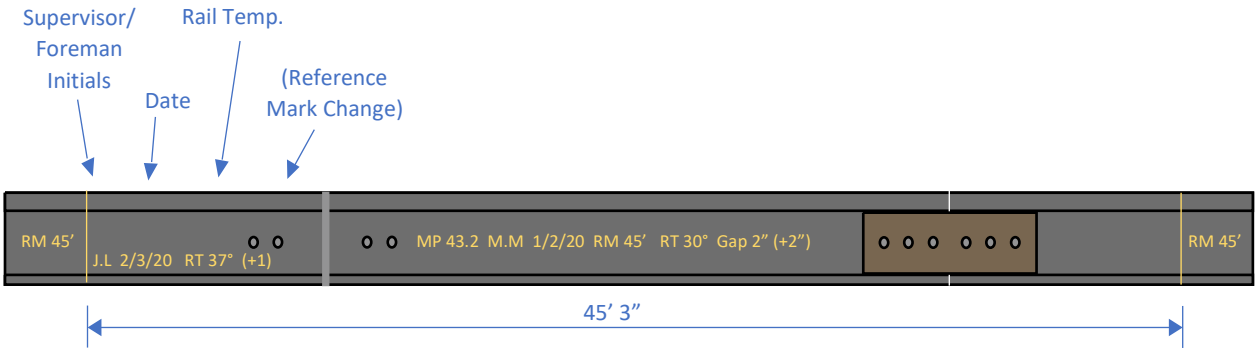


Figure 3-E

(h) When making the final closure weld at the location, ensure to compensate for the weld material, or rail consumption, so the desired final reference mark distance determined in Step (e) is achieved.

(i) Remove anchors for 195 feet in each direction to create a more uniformly adjusted RNT.

(j) Complete the final closure weld and reposition or reapply the anchors.

(k) Complete the designated form for the final repair and record (Appendix 8) the following on the rail in permanent paint pen:

(1) Milepost location (unless documented during Step (f))
(2) Supervisor/Foreman Initials
(3) Date
(4) Original reference mark distance (unless documented during Step (f))
(5) Rail temperature
(6) Gap size (unless documented during Step (f))
(7) Change to reference mark distance after work is complete, in parentheses

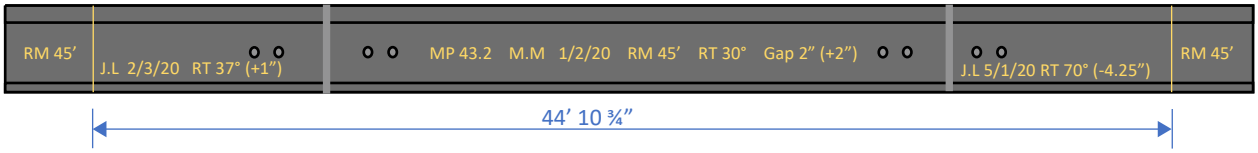


Figure 3-F

3.2 De-Stressing/Traditional Rail Adjustments

Rail can be restored to the DRNT safe range +/- 20°F through destressing, also referred to as a traditional or conventional adjustment. This process is used at locations that are shorter than those applicable under Section 1.3 and those locations where Section 3.1 are not applicable. If there is any doubt that the opposing rail's RNT is within the DRNT safe range +/- 20°F, such as indications of running or tight rail, both rails must be de-stressed.

Rail being destressed may be under extreme compression and may move unexpectedly either vertically or laterally, especially in warmer weather. Use a designated safe procedure to cut the rail prior to removing anchors. When cutting both rails, stagger rail cuts on opposing rails by at least 3 ties.

De-stressing/Traditional Adjustment Procedures:

(a) Prior to cutting the rail, apply reference marks with a permanent paint pen outside of the rail section to be removed and beyond where they may be damaged by the work or the application of joint bars. Reference marks should be placed a whole number of feet apart. Write the original reference mark distance to the outside of each reference mark.

(b) Cut the rail using designated safe procedures or remove the joint bars.

(c) Remove anchors in both directions from the cut for a minimum of 390 feet, or up to a restriction that prevents rail movement such as a turnout, crossing, bridge, etc. Ensure the rail can move freely, tapping tie plates as needed, so all thermal forces are released.

(d) Measure the gap after the rail has been cut and unfastened. If the rail ends move apart, the gap will be a positive (+) number; if the rail runs in, the gap will be a negative (-) number.

(e) Take the rail temperature and reference against the area's DRNT.

(1) If the RT is above the DRNT, proceed to Step (j).

(2) If the RT is below the DNRT but within the DRNT safe range +/- 20°F, it is preferable to continue to Step (f), but acceptable to proceed to Step (j).

(3) If the RT is below DRNT - 20°F, proceed to Step (f).

(f) Use one of the formulas below or reference the Thermal Expansion of Rail Table in Appendix 1 to determine the required adjustment for the length of rail being adjusted and the temperature differential between the RT and DRNT.

Adjustment length (inches) x temperature differential x 0.0000067

or use

Adjustment length (feet) x temperature differential x 0.000078

(g) When trimming the rail ends, ensure to compensate for the weld material, or rail consumption, so the desired adjustment is achieved.

(h) Apply match marks between the base of the rail and the tie, or tie plate, at stations located at the midpoints of the rail being de-stressed. Write the required expansion on the rail next to the match marks.

(i) Verify the expected movement at the match marks to ensure the rail has expanded uniformly. Tap the tie plates, as needed, to facilitate uniform rail expansion.

(j) Weld the rail or apply joint bars with provisions to ensure the adjustment is retained once welded.

(k) Reapply the anchors.

(l) Measure the reference marks to determine the RNT after the adjustment by referencing the Thermal Expansion of Rail Table in Appendix 1 using one of the formulas in Step (f).

(m) Complete the designated form Appendix 8 and record the following on the rail in permanent paint pen:

(1) Milepost location
(2) Supervisor/Foreman Initials
(3) Date
(4) Reference mark distance after rail is cut and de-anchored
(5) Rail temperature
(6) Gap after anchor removal
(7) Change to reference mark distance after work is complete, in parentheses
(8) “Adjusted” or “Adj.” and the length of rail de-anchored
(9) Final RNT after the adjustment

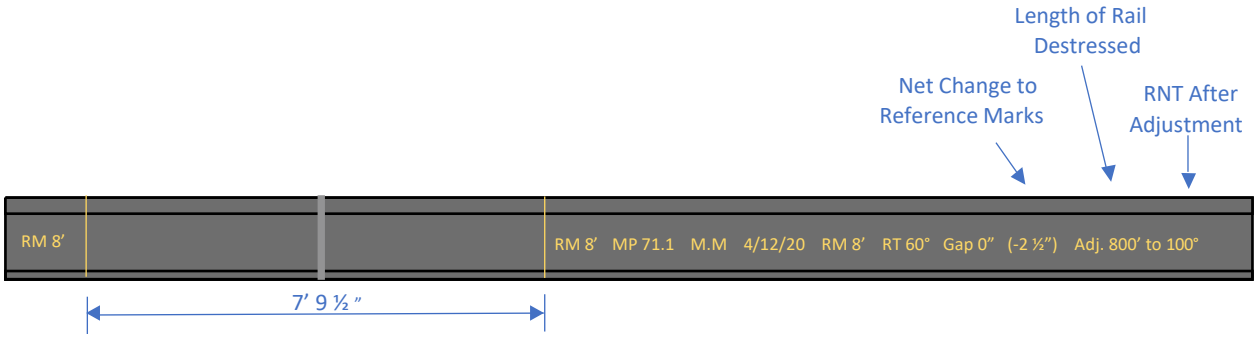


Figure 3-G

3.3 Lining Curves to Adjust Rail Neutral Temperature

Under certain circumstances, lining of curves may be utilized to restore rails to the DRNT safe range +/- 20°F. This procedure is only applicable on curves that have been staked, with at least 3 stakes placed every 200 feet through the length of the curve and had a known RNT on both rails prior to any track shifts or mechanical lining. If a staked curve that has a known RNT and has shifted, the curve may be realigned to the original stake distances to restore the RNT. If a rail separation has occurred and resulted in a change to the RNT, this section will not apply, and Section 3.1 or Section 3.2 must be employed.

In emergency situations, a curve may be lined outward to alleviate excessive compressive forces, but the RNT will need to be reestablished via one of the procedures outlined in this chapter.

Chapter 4: Monitoring Curve Movement (§ 213.119(e)).

4.1 Staking of Curves

Before surfacing and lining a curve on main tracks or sidings, stake the curve if it is 3° or sharper and the rail temperature is more than 50°F below the area's DRNT (or is forecasted to be in the next 24 hours). Use the prescribed form (Appendix 6) when staking curves.

To stake a curve prior to surfacing and lining, place at least 3 reference points uniformly spaced around the curve. These reference points shall be placed no more than 200 feet apart.

4.2 Inspecting for Curve Movement

Inspect for curve movement periodically after the work, especially during periods of large temperature changes. Where a curve has been staked per Section 4.1 and the curve has shifted inward more than 3 inches, the curve must be lined out or destressed prior to becoming a buckle prone condition. If the curve is not lined out or de-stressed, a speed restriction shall be applied as designated by someone qualified under 49 CFR § 213.7. Tight rail conditions are governed by Section 7.1.

Chapter 5: Placing Temporary Speed Restrictions Due to Track Work (§ 213.119(f)).

Place a temporary speed restriction anytime the roadbed or ballast section is disturbed as required in Section 5.4, except where the maximum authorized speed of the track is equal to or less than the required restriction.

5.1 General Requirements

Speed restrictions facilitate safe train operations until the affected track stabilizes. Restrictions need to stay in place to allow the ballast to consolidate, rail compressive forces to equalize, and the subgrade to compact. Take more restrictive measures when conditions warrant.

5.2 Responsibility for Placing Speed Restrictions

During the work or before returning the track to service, the supervisor or foreman in charge must ensure that the track speed does not exceed 25 mph until the following conditions have been met:

(a) Gage, surface, and alignment have been reestablished.

(b) Crib and shoulder ballast are up to standards, or lateral restraint is otherwise provided; and

(c) The rail is anchored as outlined in Chapter 2.

5.3 Speed Restriction Length

To minimize running rail and train-induced forces, trains must have time to brake and adjust slack before entering the area of disturbed track. For heavy grades, sharp curves or substandard track conditions, extend speed restrictions farther from the work limits, as needed.

5.4 Speed Restrictions for Track Work

When the following track work has been performed, place a speed restriction that complies with the guidelines below.

Table 5.4-Speed Restrictions for Track Work

Activity	Max. Rail Temp in Next 24 Hours	First, Restrict to Class 1 Speeds for[1]:	Then, Restrict to Class 2 Speeds for[1]:	Then, Restrict to Class 3 Speeds for[1]:
Out-of-face tie installation Undercutting Laying track/switch panels Constructing track Out-of-face surfacing/lining	DRNT and above	1 Train[2] or 5,000 tons	5 Train[2] or 25,000 tons	10 Trains[2] or 50,000 tons
	Between DRNT and DRNT - 20°F	1 Train[2] or 5,000 tons	2 Trains[2] or 10,000 tons	10 Trains[2] or 50,000 tons
	Below DRNT - 20°F	1 Train[2] or 5,000 tons	1 Train[2] or 5,000 tons	N/A
Spot Maintenance Installing ties (no more than 5 ties in 39 feet and no more than 3 consecutive ties) Surfacing/lining (maximum length of 19 feet 6 inches)	DRNT and above	N/A	1 Train[2] or 5,000 tons	2 Trains[2] or 10,000 tons
	Between DRNT and DRNT - 20°F	N/A	1 Train[2] or 5,000 tons	N/A
	Below DRNT - 20°F	N/A	N/A	N/A
Mechanically stabilized track performed after any of the activities listed above	DRNT and above	N/A	2 Trains[2] or 10,000 tons	N/A
	Between DRNT and DRNT - 20°F	N/A	1 Trains[2] or 5,000 tons	N/A
	Below DRNT - 20°F	N/A	1 Trains[2] or 5,000 tons	N/A

[1] Speed restrictions must remain in effect until the train count/tonnage requirement is met and an inspection is conducted prior to increasing the speed per the next column.

[2] A train in this table means a freight train with at least 20 cars or 4 passenger trains.

Chapter 6: Rail Joint Inspections

6.1 Class of Track

As required by 213.119(h)(6)(i), all CWR joints within the following classes of track must be inspected on foot:

(a) Class 2 on which passenger trains operate; and

(b) Class 3 and higher.

6.2 Frequency of Inspections

At a minimum, CWR joints must be inspected at the minimum frequencies specified in 49 CFR § 213.119(h)(6)(i) as follows:

Table 6.2-CWR joints inspected on foot

CWR joints shall be inspected on foot at the following minimum frequencies[1]:					
	Freight Trains operating over track with an annual tonnage of:			Passenger Trains operating over track with an annual tonnage of:	
	less than 40mgt	40 to 60 mgt.	greater than 60 mgt	less than 20 mgt	greater than or equal to 20 mgt
Class 5 & above	2	3[2]	4[2]	3[2]	3[2]
Class 4	2	3[2]	4[2]	2	3[2]
Class 3	1	2	2	2	2
Class 2	0	0	0	1	1
Class 1	0	0	0	0	0
Excepted Track	0	0	0	N/A	N/A

4 = *Four times per calendar year, with one inspection in each of the following periods: January to March, April to June, July to September, and October to December; and with consecutive inspections separated by at least 60 calendar days.*

3 = Three times per calendar year, with one inspection in each of the following periods: January to April, May to August, and September to December; and with consecutive inspections separated bya least 90 calendar days

2 = Twice per calendar year, with one inspection in each of the following periods: January to June and July to December; and with consecutive inspections separated by at least 120 calendar days.

1 = Once per calendar year, with consecutive inspections separated by at least 180 calendar days.

[1] *Where a track owner operates both freight and passenger trains over a given segment of track,and there are two different possible inspection interval requirements, the more frequent inspection interval applies.*

[2] When extreme weather conditions prevent a track owner from conducting an inspection of a particular territory within the required interval, the track owner may extend the interval by up to 30 calendar days from the last day that the extreme weather condition prevented the required inspection.

6.3 Identification of CWR Rail Joints as required by 213.119(h)(7)

Each CWR rail joint requiring action as outlined in section 6.5 shall be identified in the field with a highly visible marking. In addition, such joints shall also be identified as to location by specifying the subdivision, milepost, track number, and rail (north, south, etc.) in Appendix 10-Walking Joint Bar Inspection Form.

6.4 Switches, Track Crossings, Lift Rail Assemblies or Other Transition Devices on Moveable Bridges

CWR rail joints within or adjacent to switches, track crossings, lift rail assemblies or other transition devices on moveable bridges are exempt from the periodic joint inspection requirements, provided they are inspected on foot at least monthly in accordance with the requirements in 49 CFR § 213.235.

Inspect joints at these locations at least monthly and include the following in the inspection and report:

(a) At switches:

  (1) All joints, from and including the insulated joints at the signals governing movement entering and leaving the control point or interlocking.

  (2) If there are no signals at the switch location, include as a minimum all joints from the point of the switch to the heel of the frog.

(b) At cross-overs:

  (1) All joints in track between switches.

(c) At track crossings:

  (1) All joints, from and including the insulated joints at the signals governing movement entering and leaving the control point or interlocking. If there are no signals at the track crossings, include as a minimum all joints that are between or connected to the crossing frogs.

(d) At lift rail assemblies or other transition devices on movable bridges:

  (1) All joints immediately attached to the rail assembly or transition device.

6.5 Rail Joint Conditions

When inspecting CWR joints on foot on track listed in Section 6.1, inspectors must, at a minimum, watch for the rail joint conditions outlined in the table below. When such conditions are found, they must be noted on an inspection form and the appropriate action must be taken as outlined.

Table 6.5- Rail Joint Conditions

Rail Joint Condition	Action[1]
Visible cracks in joint bar	Replace bar
Loose bolts	Tighten bolts
Bent bolts	Replace bolts **OR** Re-inspect as per Section 6.2
Missing bolts [2]	Replace bolts
Tie(s) not effectively supporting joint	Tamp, replace, or repair tie(s) **OR** Conduct follow-up inspections every other week until the condition is repaired, or joint is removed
Broken or missing tie plate(s)	Replace tie plate(s) **OR** Conduct follow-up inspections every other week until the condition is repaired, or the joint is removed
Deteriorated insulated joint	Replace/repair joint **OR** Conduct follow-up inspections every other week until the condition is repaired, or the joint is removed
Rail end batter (More than 3/8" in depth and more than 6" in length measured with a 24” straight edge)	Repair by welding joint or removing rail **OR** Conduct follow-up inspections every other week until the condition is repaired, or the joint is removed
Rail end mismatch reaches limits specified by 49 CFR § 213.115	Weld or grind
Longitudinal rail movement greater than 2"	Add or adjust rail anchors, tighten bolts, and add or remove rail at appropriate time **OR** Conduct follow-up inspections every other week until the condition is repaired, or the joint is removed
Wide rail gap greater than 1.5"	Adjust rail gap and secure joint **OR** Conduct follow-up inspections every other week until the condition is repaired, or the joint is removed
Vertical joint movement (profile) that exceeds 75% of the allowable threshold for the designated class of track[3]	Surface joint **OR** Conduct follow-up inspections every other week until the condition is repaired, or the joint is removed
Joint lateral movement (in a curve or spiral) that reaches 3/4"[3]	Correct lateral movement **OR** Conduct follow-up inspections every other week until the condition is repaired, or the joint is removed

[1] Action may also consist of placing a speed restriction or removing the track from service.

[2] A minimum of two (2) bolts per rail must be in place at each joint.

[3] Joint lateral and vertical movement is the apparent visible movement measured at the joint.

6.6 Embedded Joints (49 CFR § 213.119(h)(4))

Permanently Embedded Locations

Where such locations exist, it is not necessary to disassemble or remove the track structure (e.g., remove pavement or crossing pads) to conduct an inspection of CWR joints. Make every effort, to the extent practicable, to inspect the visible portion of joints in these structures.

Temporarily Embedded Locations

Joints may sometimes be temporarily buried (e.g. by snow, ballast, or other material) and therefore unavailable for inspection. Where CWR joints are buried temporarily, wait until they become visible before conducting joint bar inspections. Locations that have been buried for an extended period of time must still be inspected as required by Section 6.2.

6.7 On-Foot Periodic and Follow-up Inspection Records (49 CFR § 213.119(h))

Document each on-foot periodic and follow-up inspection on the date of the inspection, noting the following information:

(a) Date

(b) Limits of the inspection

(c) Location and nature of identified CWR joint conditions specified in Section 6.5

(d) Corrective or remedial action taken by the person making the inspection

(e) Name and signature of inspector

Track subject to inspections under 49 CFR § 213.119, must comply with §§ 213.233, 213.235, and 213.119(g).

Chapter 7 Extreme Weather Inspections (49 CFR § 213.119(g))

For purposes of forecasting or initiating extreme weather inspections, use one of the following estimated conversions:

(a) In hot weather, rail temperature is equal to the ambient temperature plus 30°F.

(b) In cold weather, rail temperature is equal to the ambient temperature.

7.1 Hot Weather Inspections

On main tracks and sidings, hot weather inspections must be performed and documented as directed by the Roadmaster or Division Engineer when the ambient temperature is forecast to exceed 90°F. After 7 consecutively days of temperatures exceeding this threshold, inspect each day that ambient temperature is forecast to exceed 100°F. An inspection must also be conducted when there is an ambient temperature change exceeding 50°F in 24 hours.

Perform inspections during the heat of the day, primarily between 12 noon and 6 p.m. When tight rail conditions exist, a speed restriction of 10 mph or less must be placed or the track must be removed from service until repair or adjustment is made.

When conducting hot weather inspection, inspectors should:

(a) Pay special attention to areas that are prone to excessive compressive forces such as:

(1) Areas of recently disturbed track;

(2) At the bottom of sags;

(3) Locations where heavy or frequent braking occurs;

(4) Fixed objects; or

(5) Locations where rail has been recently cut or adjusted.

(b) Look for evidence of lateral or longitudinal movement such as:

(1) Kinky or wavy rail;

(2) Improperly seated rail; rail canting or lifting out of the tie plates;

(3) Shiny marks on the base of the rail indicating that the rail is running through the anchors and spikes;

(4) Gaps in ballast at the ends of ties; or

(5) Churning ballast and ties.

7.2 Cold Weather Inspections

On main tracks and sidings, cold weather inspections must be performed as directed by the Roadmaster or Division Engineer when the rail temperature is forecast to drop 100°F below the DRNT.

Inspectors will inspect for:

(1) Broken rails;

(2) Pull-a-parts;

(3) Curve movement;

(4) Cracked or broken joint bars (conventional and insulated); and

(5) Canted rail.

Chapter 8 Training (49 CFR §§ 213.7 & 213.119(i))

All employees responsible for the inspection, installation, adjustment, or maintenance of CWR track must complete training specific to Watco CWR procedures every calendar year. In addition, they shall be provided a copy of these procedures and all accompanying documents. Each covered entity will maintain lists of those employees qualified to supervise restorations and inspect track in CWR territory. The lists of qualified employees will be made available to the FRA upon request.

Training program will address, but is not limited to, the following:

(a) CWR installation procedures;

(b) Rail anchoring requirements;

(c) Maintaining a desired rail neutral temperature range;

(d) Preventive maintenance on CWR track;

(e) Monitoring curve movement;

(f) Placing temporary speed restrictions;

(g) Rail joint inspections;

(h) Standard ballast section requirements;

(i) Extreme weather inspections; and

(j) Recordkeeping.

Chapter 9 Recordkeeping

9.1 Report of CWR Installations (49 CFR § 213.119(j)(1)_

Records necessary to provide an adequate history of installing rail (Chapter 1) and achieving the DRNT will be maintained for at least one year following final adjustment.

These records will be maintained on the prescribed form (Appendix 2) and include the date of installation, location, rail size and length, initial rail temperature, desired RNT, expansion achieved, and adjusted RNT.

9.2 Report Maintenance Work in CWR

Maintenance performed on CWR track can affect the compressive and tensile forces within the rail, as well as the track's lateral and longitudinal resistance. To adequately comply with the procedures outlined in this plan, records shall be kept for at least one year after final corrective adjustments and must include the following:

(a) Record of each rail separation and all subsequent work or adjustments associated with that initial separation.

    (1) For rail separations that were not immediately de-stressed, include:

        (i) Milepost location;

        (ii) Supervisor/Foreman Initials.

        (iii) Date(s);

        (iv) Original reference mark distance;

        (v) Rail temperature(s) at the time each task was performed;

        (vi) Gap observed from the initial separation;

(vii) The estimated pre-cut/break RNT (except where not applicable);

(viii) Change(s) to reference mark distance for each task performed; and

(ix) Estimated RNT after each task or adjustment.

(2) For locations where Section 3.2 was utilized for final adjustment, include:

(i) Milepost location;

(ii) Supervisor/ Foreman Initials;

(iii) Date;

(iv) Reference mark distance after rail is cut and de-anchored;

(v) Rail temperature at the time of the adjustment;

(vi) Change to reference mark distance after work is complete;

(vii) Length of rail de-anchored; and

(viii) Estimated RNT after the adjustment.

(b) Record of each curve that has been de-stressed in accordance with Section 3.3.

(c) Record of each curve has been staked and has shifted inward.

(d) Record of each buckling incident and subsequent remedial action and repairs.

(e) Record of each pull-apart with a gap present and subsequent repairs.

(f) Record of CWR installations or maintenance work that does not conform to any of the written procedures of this plan.

Engineering Department must monitor these records to ensure necessary remedial actions and/or corrections and adjustments are made in accordance with this plan. Where field verifications of the records are performed, the Readjustment Field Verification form located in Appendix 5 may be utilized.

Appendix 1-Thermal Expansion of Rail

The table below describes the amount of rail that needs to be added or removed to effect a change in the rail neutral temperature (RNT) over a specific length of rail. This table will be used when installing CWR per Chapter 1 and performing adjustments per Section 3.2.

Rail Adjustment (in inches) Required to Change the RNT Over a Specific Distance

Change in RNT (°F)	Rail Length (in feet)												
	400	**500**	**600**	**700**	**800**	**900**	**1000**	**1100**	**1200**	**1300**	**1400**	**1500**	**1600**
5	1/8	1/4	1/4	1/4	1/4	3/8	3/8	3/8	1/2	1/2	1/2	5/8	5/8
10	1/4	3/8	1/2	1/2	5/8	3/4	3/4	7/8	7/8	1	1 1/8	1 1/8	1 1/4
15	1/2	5/8	3/4	7/8	7/8	1	1 1/8	1 1/4	1 3/8	1 1/2	1 5/8	1 3/4	1 7/8
20	5/8	3/4	7/8	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
25	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
30	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
35	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
40	1 1/4	1 4/8	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
45	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
50	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
55	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
60	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
65	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
70	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

The table above contains adjustments rounded to the nearest 1/8 inch based on the following formula that may be used instead for more precise calculations.

Adjustment length (feet) x temperature differential x 0.000078

Appendix 2-Rail Installation & Adjustment Form

Supervisor/ Foreman:_____ **Date:**_____

Subdivision:_____ **Recording Employee:**_____

Date	Start MP	End MP	Track	Side (L/R)	RT	DRNT	Temp. Differ.	Needed Adj.	Adj. at Station 1	Adj. at Station 2	Adj. at Station 3	Adj. at Station 4	Total Actual Adj.	New Adjusted RNT	Rail Information & Length

Appendix 3-Pre-Break/Cut RNT Tables

The following tables provide an estimated pre-break/cut rail neutral temperature (RNT) for certain rail separations based upon the rail size, fastener type, observed gap, and the rail temperature at the time of the break or cut.

For the readjustment methodology behind these tables to work as intended, the expected thermal forces must be present prior to the rail separation and therefore, must not be used when the separation occurs:

- Within 400 feet of a fixed object (e.g., turnout, crossing, bridge);
- Within 800 feet of a known location with unrestored RNT on the same rail;
- On rail that has some other means of releasing the thermal force buildup; or
- At locations where the thermal forces have been previously released by some other means.

In all of these scenarios where the readjustment methodology does not apply, and in cases where there are incomplete records, Section 3.2 must be used.

Elastic fasteners provide longitudinal restraint to the rail and are considered anchors, so track constructed entirely of ties with elastic fasteners shall be considered to have anchors on every tie.

Note: The numbers provided in the following tables have been derived assuming a longitudinal resistance of 20 lbs./in. for every other tie anchored and 30 lbs./in. for every tie anchored. The cross-sectional areas have been estimated at 11.3 in.^{2} for 5.5" base rail and 13.5 in.^{2} for 6" base rail.

Appendix 3-Pre-Break/Cut RNT Tables

Pre-Break/Cut RNT for 6" Base Rail & Every Other Tie Anchored

Estimated Rail Neutral Temperature (°F) Prior to a Break or Cut

Rail Temp (°F)	Rail Gap (in inches)														
	0	0.5	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6	6.5	7
125	125	149	159	167	173	179	184	189	193	198	201	205	209	212	215
120	120	144	154	162	168	174	179	184	188	193	196	200	204	207	210
115	115	139	149	157	163	169	174	179	183	188	191	195	199	202	205
110	110	134	144	152	158	164	169	174	178	183	186	190	194	197	200
105	105	129	139	147	153	159	164	169	173	178	181	185	189	192	195
100	100	124	134	142	148	154	159	164	168	173	176	180	184	187	190
95	95	119	129	137	143	149	154	159	163	168	171	175	179	182	185
90	90	114	124	132	138	144	149	154	158	163	166	170	174	177	180
85	85	109	119	127	133	139	144	149	153	158	161	165	169	172	175
80	80	104	114	122	128	134	139	144	148	153	156	160	164	167	170
75	75	99	109	117	123	129	134	139	143	148	151	155	159	162	165
70	70	94	104	112	118	124	129	134	138	143	146	150	154	157	160
65	65	89	99	107	113	119	124	129	133	138	141	145	149	152	155
60	60	84	94	102	108	114	119	124	128	133	136	140	144	147	150
55	55	79	89	97	103	109	114	119	123	128	131	135	139	142	145
50	50	74	84	92	98	104	109	114	118	123	126	130	134	137	140
45	45	69	79	87	93	99	104	109	113	118	121	125	129	132	135
40	40	64	74	82	88	94	99	104	108	113	116	120	124	127	130
35	35	59	69	77	83	89	94	99	103	108	111	115	119	122	125
30	30	54	64	72	78	84	89	94	98	103	106	110	114	117	120
25	25	49	59	67	73	79	84	89	93	98	101	105	109	112	115
20	20	44	54	62	68	74	79	84	88	93	96	100	104	107	110
15	15	39	49	57	63	69	74	79	83	88	91	95	99	102	105
10	10	34	44	52	58	64	69	74	78	83	86	90	94	97	100
5	5	29	39	47	53	59	64	69	73	78	81	85	89	92	95
0	0	24	34	42	48	54	59	64	68	73	76	80	84	87	90
-5	-5	19	29	37	43	49	54	59	63	68	71	75	79	82	85
-10	-10	14	24	32	38	44	49	54	58	63	66	70	74	77	80
-15	-15	9	19	27	33	39	44	49	53	58	61	65	69	72	75
-20	-20	4	14	22	28	34	39	44	48	53	56	60	64	67	70
-25	-25	-1	9	17	23	29	34	39	43	48	51	55	59	62	65

Pre-Break/Cut Table A

Appendix 3-Pre-Break/Cut RNT Tables

Pre-Break/Cut RNT for 6" Base Rail & Every Tie Anchored

Estimated Rail Neutral Temperature (°F) Prior to a Break or Cut

Rail Temp (°F)	Rail Gap (in inches)														
	0	0.5	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6	6.5	7
125	125	155	167	176	184	191	198	203	209	214	219	223	228	232	236
120	120	150	162	171	179	186	193	198	204	209	214	218	223	227	231
115	115	145	157	166	174	181	188	193	199	204	209	213	218	222	226
110	110	140	152	161	169	176	183	188	194	199	204	208	213	217	221
105	105	135	147	156	164	171	178	183	189	194	199	203	208	212	216
100	100	130	142	151	159	166	173	178	184	189	194	198	203	207	211
95	95	125	137	146	154	161	168	173	179	184	189	193	198	202	206
90	90	120	132	141	149	156	163	168	174	179	184	188	193	197	201
85	85	115	127	136	144	151	158	163	169	174	179	183	188	192	196
80	80	110	122	131	139	146	153	158	164	169	174	178	183	187	191
75	75	105	117	126	134	141	148	153	159	164	169	173	178	182	186
70	70	100	112	121	129	136	143	148	154	159	164	168	173	177	181
65	65	95	107	116	124	131	138	143	149	154	159	163	168	172	176
60	60	90	102	111	119	126	133	138	144	149	154	158	163	167	171
55	55	85	97	106	114	121	128	133	139	144	149	153	158	162	166
50	50	80	92	101	109	116	123	128	134	139	144	148	153	157	161
45	45	75	87	96	104	111	118	123	129	134	139	143	148	152	156
40	40	70	82	91	99	106	113	118	124	129	134	138	143	147	151
35	35	65	77	86	94	101	108	113	119	124	129	133	138	142	146
30	30	60	72	81	89	96	103	108	114	119	124	128	133	137	141
25	25	55	67	76	84	91	98	103	109	114	119	123	128	132	136
20	20	50	62	71	79	86	93	98	104	109	114	118	123	127	131
15	15	45	57	66	74	81	88	93	99	104	109	113	118	122	126
10	10	40	52	61	69	76	83	88	94	99	104	108	113	117	121
5	5	35	47	56	64	71	78	83	89	94	99	103	108	112	116
0	0	30	42	51	59	66	73	78	84	89	94	98	103	107	111
-5	-5	25	37	46	54	61	68	73	79	84	89	93	98	102	106
-10	-10	20	32	41	49	56	63	68	74	79	84	88	93	97	101
-15	-15	15	27	36	44	51	58	63	69	74	79	83	88	92	96
-20	-20	10	22	31	39	46	53	58	64	69	74	78	83	87	91
-25	-25	5	17	26	34	41	48	53	59	64	69	73	78	82	86

Pre-Break/Cut Table B

Appendix 3-Pre-Break/Cut RNT Tables

Pre-Break/Cut RNT for 5.5" Base Rail & Every Other Tie Anchored

Estimated Rail Neutral Temperature (°F) Prior to a Break or Cut

Rail Temp (°F)	Rail Gap (in inches)														
	0	**0.5**	**1**	**1.5**	**2**	**2.5**	**3**	**3.5**	**4**	**4.5**	**5**	**5.5**	**6**	**6.5**	**7**
125	125	151	162	171	178	184	190	195	200	204	209	213	217	220	224
120	120	146	157	166	173	179	185	190	195	199	204	208	212	215	219
115	115	141	152	161	168	174	180	185	190	194	199	203	207	210	214
110	110	136	147	156	163	169	175	180	185	189	194	198	202	205	209
105	105	131	142	151	158	164	170	175	180	184	189	193	197	200	204
100	100	126	137	146	153	159	165	170	175	179	184	188	192	195	199
95	95	121	132	141	148	154	160	165	170	174	179	183	187	190	194
90	90	116	127	136	143	149	155	160	165	169	174	178	182	185	189
85	85	111	122	131	138	144	150	155	160	164	169	173	177	180	184
80	80	106	117	126	133	139	145	150	155	159	164	168	172	175	179
75	75	101	112	121	128	134	140	145	150	154	159	163	167	170	174
70	70	96	107	116	123	129	135	140	145	149	154	158	162	165	169
65	65	91	102	111	118	124	130	135	140	144	149	153	157	160	164
60	60	86	97	106	113	119	125	130	135	139	144	148	152	155	159
55	55	81	92	101	108	114	120	125	130	134	139	143	147	150	154
50	50	76	87	96	103	109	115	120	125	129	134	138	142	145	149
45	45	71	82	91	98	104	110	115	120	124	129	133	137	140	144
40	40	66	77	86	93	99	105	110	115	119	124	128	132	135	139
35	35	61	72	81	88	94	100	105	110	114	119	123	127	130	134
30	30	56	67	76	83	89	95	100	105	109	114	118	122	125	129
25	25	51	62	71	78	84	90	95	100	104	109	113	117	120	124
20	20	46	57	66	73	79	85	90	95	99	104	108	112	115	119
15	15	41	52	61	68	74	80	85	90	94	99	103	107	110	114
10	10	36	47	56	63	69	75	80	85	89	94	98	102	105	109
5	5	31	42	51	58	64	70	75	80	84	89	93	97	100	104
0	0	26	37	46	53	59	65	70	75	79	84	88	92	95	99
-5	-5	21	32	41	48	54	60	65	70	74	79	83	87	90	94
-10	-10	16	27	36	43	49	55	60	65	69	74	78	82	85	89
-15	-15	11	22	31	38	44	50	55	60	64	69	73	77	80	84
-20	-20	6	17	26	33	39	45	50	55	59	64	68	72	75	79
-25	-25	1	12	21	28	34	40	45	50	54	59	63	67	70	74

Pre-Break/Cut Table C

Appendix 3-Pre-Break/Cut RNT Tables

Pre-Break/Cut RNT for 5.5" Base Rail & Every Tie Anchored

Estimated Rail Neutral Temperature (°F) Prior to a Break or Cut

Rail Temp (°F)	Rail Gap (in inches)														
	0	0.5	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6	6.5	7
125	125	157	171	181	190	197	204	211	217	222	227	232	237	242	246
120	120	152	166	176	185	192	199	206	212	217	222	227	232	237	241
115	115	147	161	171	180	187	194	201	207	212	217	222	227	232	236
110	110	142	156	166	175	182	189	196	202	207	212	217	222	227	231
105	105	137	151	161	170	177	184	191	197	202	207	212	217	222	226
100	100	132	146	156	165	172	179	186	192	197	202	207	212	217	221
95	95	127	141	151	160	167	174	181	187	192	197	202	207	212	216
90	90	122	136	146	155	162	169	176	182	187	192	197	202	207	211
85	85	117	131	141	150	157	164	171	177	182	187	192	197	202	206
80	80	112	126	136	145	152	159	166	172	177	182	187	192	197	201
75	75	107	121	131	140	147	154	161	167	172	177	182	187	192	196
70	70	102	116	126	135	142	149	156	162	167	172	177	182	187	191
65	65	97	111	121	130	137	144	151	157	162	167	172	177	182	186
60	60	92	106	116	125	132	139	146	152	157	162	167	172	177	181
55	55	87	101	111	120	127	134	141	147	152	157	162	167	172	176
50	50	82	96	106	115	122	129	136	142	147	152	157	162	167	171
45	45	77	91	101	110	117	124	131	137	142	147	152	157	162	166
40	40	72	86	96	105	112	119	126	132	137	142	147	152	157	161
35	35	67	81	91	100	107	114	121	127	132	137	142	147	152	156
30	30	62	76	86	95	102	109	116	122	127	132	137	142	147	151
25	25	57	71	81	90	97	104	111	117	122	127	132	137	142	146
20	20	52	66	76	85	92	99	106	112	117	122	127	132	137	141
15	15	47	61	71	80	87	94	101	107	112	117	122	127	132	136
10	10	42	56	66	75	82	89	96	102	107	112	117	122	127	131
5	5	37	51	61	70	77	84	91	97	102	107	112	117	122	126
0	0	32	46	56	65	72	79	86	92	97	102	107	112	117	121
-5	-5	27	41	51	60	67	74	81	87	92	97	102	107	112	116
-10	-10	22	36	46	55	62	69	76	82	87	92	97	102	107	111
-15	-15	17	31	41	50	57	64	71	77	82	87	92	97	102	106
-20	-20	12	26	36	45	52	59	66	72	77	82	87	92	97	101
-25	-25	7	21	31	40	47	54	61	67	72	77	82	87	92	96

Pre-Break/Cut Table D

Appendix 4-Thermal Adjustment Table for 780’of Rail

The table below describes the amount of rail that needs to be added or removed to effect a change inthe rail neutral temperature (RNT) of 780 feet of rail. This table will be used when performing adjustments per Section 3.1 for determining how much the reference marks need to be changed to adjust the RNT as desired and can also be used in the calculation of the RNT after adjustments.

Thermal Adjustment Tablefor 780' of Rail	
Change in RNT (°F)	**Adj. (in inches)**
5	1/4
10	5/8
15	7/8
20	1 1/4
25	1 1/2
30	1 7/8
35	2 1/8
40	2 3/8
45	2 3/4
50	3
55	3 3/8
60	3 5/8
65	4
70	4 1/4

The table above contains adjustments rounded to the nearest 1/8 inch based on the following formulathat may be used instead for more precise calculations.

Adjustment length (feet) x temperature differential x 0.000078

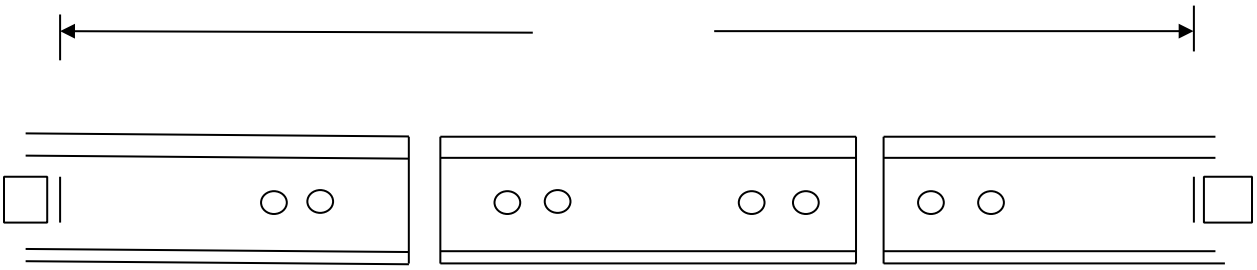
Appendix 5-Readjustment Field Verification Form

Type of disturbance:_____ **Subdivision:**_____

Milepost:_____ **Side:**(Left / Right / Both)

Track:(Single M1 M2 M3 SDG) **Other-**_____

Disturbance date:_____ **Observation date:**_____



Original break/cut gap:_____ **Break/cut rail temperature**:_____

Anchor pattern:(Every Other Tie / Every Tie) Other-_____

Anchor condition:(Weak / Average / Strong) **Estimated pre-break/cut RNT:**_____

Anchors removed/adjusted:(Yes / No) **Estimated distance each way:**_____

Observed change to reference mark distance:_____" **Is it equal to break/cut gap:**(Yes / No)

Does the field measurement match the record:(Yes / No)

Difference in measurements:_____

Estimated current RNT (If using 780' adjustment table, 1" = 16°F)**:**

Pre-break/cut RNT ± (Observed change to reference marks x 16°F) = Est. current RNT

_____ ± (_____ x 16°F) = _____

Is the current RNT within the safe range (DRNT + / - 20°F): (Yes / No)

Supervisor/ Foreman:_____

Appendix 6-Curve Alignment Reference Form

Subdivision:_____ **Track:**_____

Degree of Curve:_____

Beginning Mile Post:_____ **Ending Mile Post:**_____ **Prefix**:(N S E W)

Work Direction:(Increasing MP / Decreasing MP)

Supervisor/Foreman:_____

Type of work performed:_____

Date:					
Rail Temperature:					
Team Member:					
Stake No.	**Description**	**Measurement 1 Before Work**	**Measurement 2 After Work**	**Measurement 3 Follow-up**	**Measurement 4 Follow-up**

Notes:

1. *References should be marked on large stationary objects or with stakes.*
2. *Number reference points in sequence in the direction of work.*
3. *In "Description," note the TS, SC, CS, ST, and fixed objects with reference marks.*
4. *Reference stakes must be clear of maintenance activities, walking areas, and the reference trackand any adjacent track.*

Appendix 7-Effective Change in Rail Length Due to Curve Shifts

The table below provides an estimation of the effective amount of rail expansion per 1,000 feet of a curve that has shifted laterally. Numbers have been rounded to the nearest ¼ inch.

Effective Rail Length Added to Curve/1,000 Feet of Curve(Inches)

Curve Degree	Distance Curve Has Chorded Inward (Inches)					
	1	**2**	**3**	**4**	**5**	**6**
1/2	0	1/4	1/4	1/4	1/2	1/2
1	1/4	1/4	1/2	3/4	1	1
1 1/2	1/4	1/2	3/4	1	1 1/4	1 1/2
2	1/4	3/4	1	1 1/2	1 3/4	2
2 1/2	1/2	1	1 1/4	1 3/4	2 1/4	2 3/4
3	1/2	1	1 1/2	2	2 3/4	3 1/4
3 1/2	1/2	1 1/4	1 3/4	2 1/2	3	3 3/4
4	3/4	1 1/2	2	2 3/4	3 1/2	4 1/4
4 1/2	3/4	1 1/2	2 1/4	3 1/4	4	4 3/4
5	1	1 3/4	2 3/4	3 1/2	4 1/2	5 1/4
5 1/2	1	2	3	3 3/4	4 3/4	5 3/4
6	1	2	3 1/4	4 1/4	5 1/4	6 1/4
6 1/2	1 1/4	2 1/4	3 1/2	4 1/2	5 3/4	6 3/4
7	1 1/4	2 1/2	3 3/4	5	6 1/4	7 1/4
7 1/2	1 1/4	2 3/4	4	5 1/4	6 1/2	7 3/4
8	1 1/2	2 3/4	4 1/4	5 1/2	7	8 1/2
8 1/2	1 1/2	3	4 1/2	6	7 1/2	9
9	1 1/2	3 1/4	4 3/4	6 1/4	7 3/4	9 1/2
9 1/2	1 3/4	3 1/4	5	6 3/4	8 1/4	10
10	1 3/4	3 1/2	5 1/4	7	8 3/4	10 1/2
10 1/2	1 3/4	3 3/4	5 1/2	7 1/4	9 1/4	11
11	2	3 3/4	5 3/4	7 3/4	9 3/4	11 1/2
11 1/2	2	4	6	8	10	12
12	2	4 1/4	6 1/4	8 1/2	10 1/2	12 1/2

ΔS (in) = δ (in) x Deg x 0.175 x curve length(ft)/1000(ft)ΔS (in) = Effective rail length added to curve (inches)
δ (in) = Maximum distance curve has chorded inward (inches)
Deg = Degree of curvature

Appendix 8-CWR Track Disturbance Form

Report #_____

The report # is the (Date) + (Supervisor/Foreman Initials) + (Job #)

☐ **Initial**

☐ **Interim**

☐ **Final**

Supervisor/Foreman:_____

Date:_____/_____/_____ **Time:**_____ **Job #:**_____

Subdivision:_____ **Mile Post (with Prefix):**_____

Track:(Single M1 M2 M3 SDG) **Other-**_____

Disturbance Type:_____

Rail Weight (lbs.):_____ **Alignment:**(Tangent / High / Low) **Rail Side:** (Left / Right / Both)

Ballast Standard:(Yes / No) **Frozen:**(Yes / No)

Initial Gap Distance (+/- inches):_____"

Ambient Temperature:_____**°F** **Rail Temperature:**_____**°F**

Anchor Pattern:(Every Other Tie / Every Tie) **Other-**_____

Anchor Condition:(Weak / Average / Strong) **Estimated Pre-Break/Cut RNT:**_____**°F**

Desired Rail Neutral Temperature for area:_____**°F**

Required Adjustment to Return to DRNT:_____

Reference Mark Measurements Before Task:_____**ft.**_____**in.**_____**fractions**

Reference Mark Measurements After Task:_____**ft.**_____**in.**_____**fractions**

New Estimated Rail Neutral Temperature:_____**°F**

Action(s) Performed:_____

Number of Joints Added:_____ **Number of Joints Removed:**_____

Location Complete:(Yes / No)

Comments:_____

_____

_____

Follow-up Work Required:_____

_____

_____

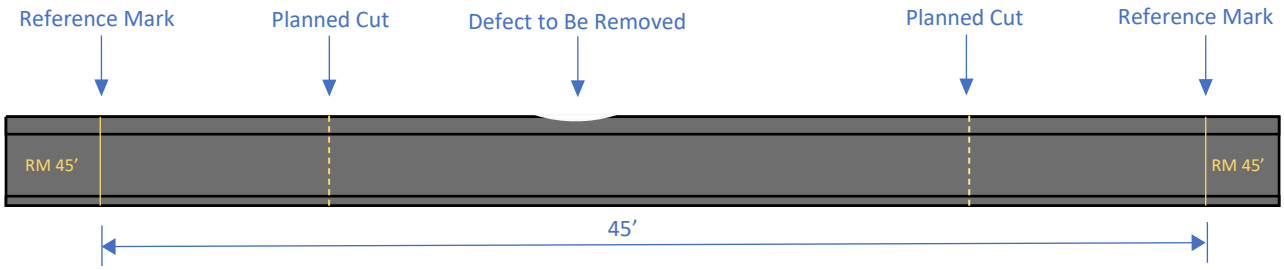
Appendix 9 – Use of Reference Marks

The proper use of reference marks is critical in accurately maintaining CWR and ensuring work locations are adjusted to within a designated RNT safe range. All work should be measured from these reference marks to determine the net effect of all the work at a given location. For these reference marks to be most effective they should be made neatly with permanent paint pen, in whole-foot increments, and at least 3 feet beyond all intended cuts.

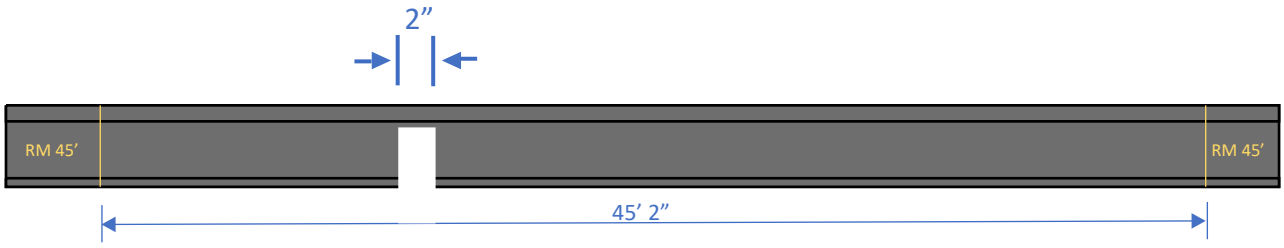
The following examples depict how reference marks are used in a variety of scenarios in accordance with the procedures outlined in this CWR Plan. They are not all inclusive of every scenario one may encounter; however, they illustrate the more common situations.

Example 1:

A section gang plans to install a plug rail to remove a rail defect. Before cutting the rail, they place the appropriate reference marks. These reference marks are placed and labeled far enough beyond the planned cuts to avoid being covered by joint bars or getting damaged by a rail puller.

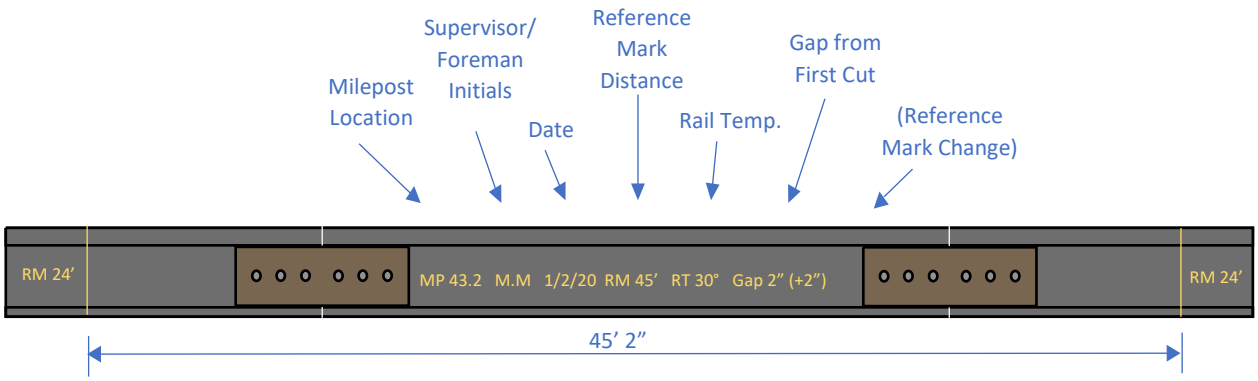


They cut the rail, and it gaps open 2 inches. This is recorded as a positive (+) 2" gap on the appropriate form. Referencing the appropriate pre-break/cut table, it's determined this location had an RNT of 78°F prior to cutting the rail. The total distance now between the reference marks is 45' 2".

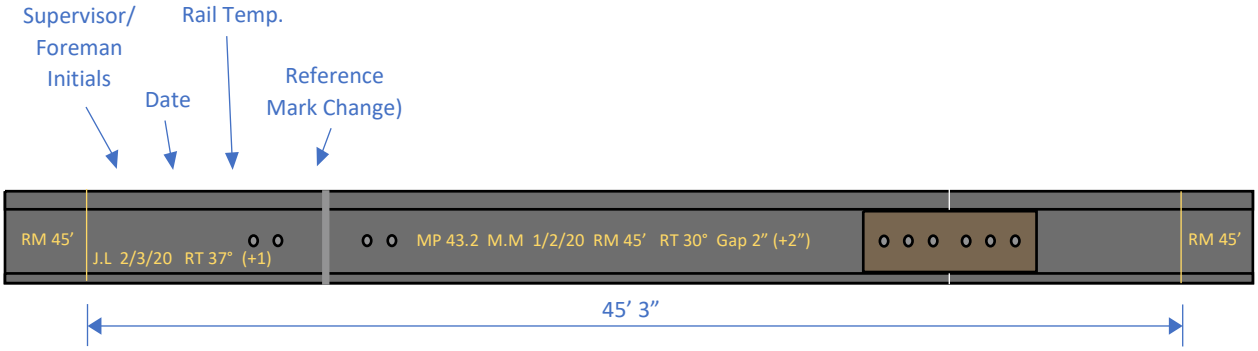


The defective rail is removed, and a plug rail is installed to fit the opening. The pertinent details are written on the rail and note the addition of 2" of rail from the plug rail installation.

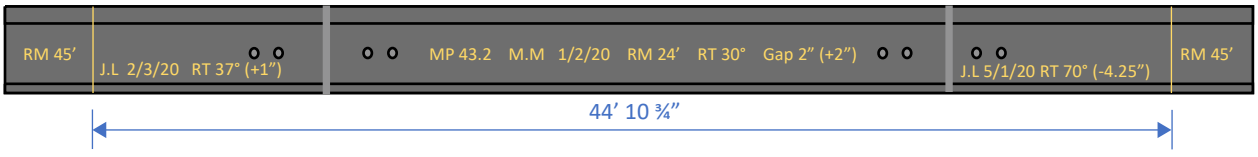
Appendix 9 – Use of Reference Marks



Later, the welders remove the joint bars on the first of the two joints and there is a 1" gap between the rail ends. They make a thermite weld without the use of a rail puller, resulting in 1" of rail being added. The welders record the information for their work on the rail. After this work, the reference marks are now 45' 3" apart.



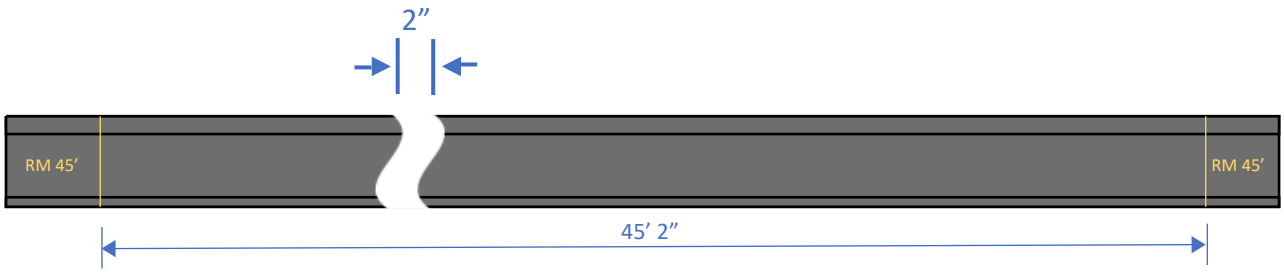
Another welding gang returns to make the final adjustment at this location with an electric flash-butt welder. The DRNT at this location is 100°F and the pre-break/cut RNT was 78°F. The welders note the reference marks were at 45' 3" when they arrived at the work location. To return the RNT to 78°F, they need to remove 3". They reference their railroad's adjustment table and see that to increase the RNT by 20°F they need to remove an additional 1 ¼", which is 4 ¼" in total. Since their flash-butt weld will consume 1 ½" of rail, they remove 2 ¾" and make the weld. The final reference mark distance after the work is 44' 10 ¾" and the resulting RNT is approximately 98°F.



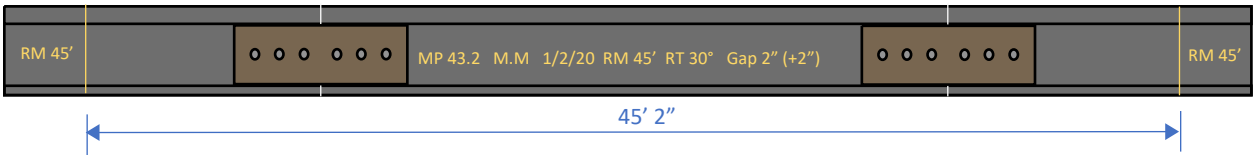
Appendix 9 – Use of Reference Marks

Example 2:

A section gang is called out to a broken rail. In this scenario, reference marks could not be placed before the break in the rail but should be placed as if they had. The crew measures the gap between the rail ends and will place the reference marks that much further apart than the whole-foot increment chosen for this work. They hook a measuring tap on one rail end place one mark at 4', and then hook onto the other rail end and measure out 45' to place that mark. The gap was 2", so they placed the reference marks 45' 2" apart but label it as 45'. This is recorded as a positive (+) 2" gap.



The crew installs a plug rail that fits and records the details on the rail noting the gap observed when broken rail was first identified.



The remainder of the adjustments are completed as illustrated in Example 1.

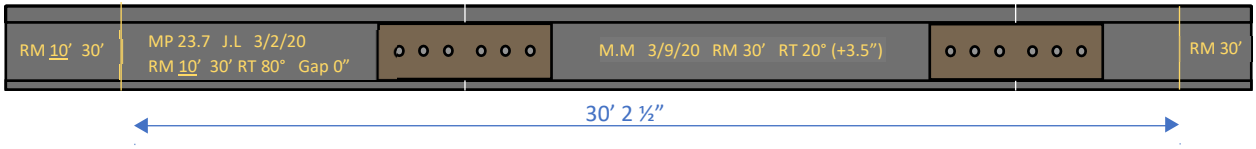
Example 3:

After placing the appropriate reference marks, a crew makes a saw cut to remove a rail defect when the rail temperature is 80°F. No gap was observed, indicating that the RNT is 80°F. They cut out a 1" section of rail containing the defect without installing a plug rail and pull the rail ends together tightly to apply joint bars. They record their work as Gap 0" (-1").

On a colder day that month the joint fails at a rail temperature of 20°F and gaps open 3 ½". The crew decides to install a plug rail to fit that gap to reduce the likelihood of another pull-apart. Since this location had not been fully repaired, the crew maintains the reference to the original rail disposition from before the initial work. The original reference marks were only 10' apart and are not sufficient to span the plug rail they plan to install. Prior to cutting the rail, they measure off one of the reference

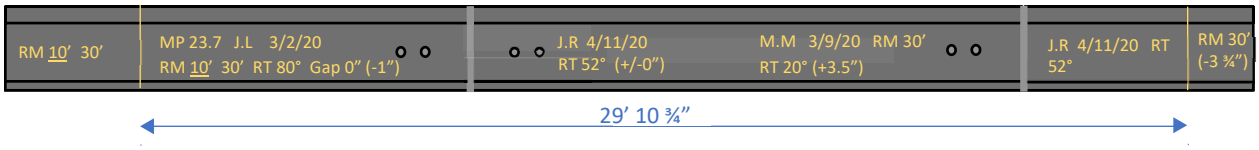
Appendix 9 – Use of Reference Marks

marks to add 20’ and make a new reference mark. As installing the plug rail removed one of the 10’ reference marks, they then strike through the mentions of 10’ and write 30’ on the rail.



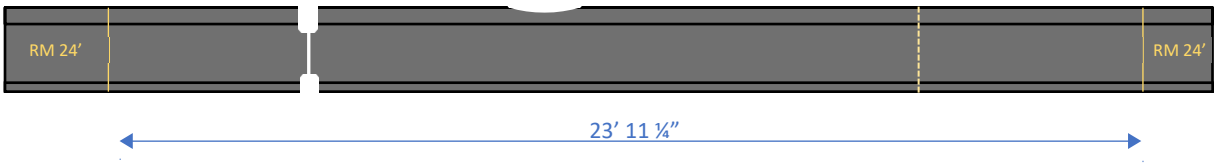
The crew knows that since this work was done at a colder temperature than the initial work that they must now use this lower temperature when referencing Section 3.1 of their CWR Plan to determine the rail temperature that a slow order must be placed if the location has not been adjusted to within the designated safe range to minimize the risk of a track buckle.

When the welders arrive to make the final repairs and adjustment, they have to trim an inch off at the first joint for the thermite weld material. Since the pre-break RNT before the initial work was at 80°F, and within 20°F of their DRNT of 100°F, the welders were only required by their CWR Plan to return the reference marks to where they were originally by removing 2.5” of rail. However, they choose instead to adjust to the DRNT which, per their CWR Plan, requires an additional 1 ¼” to be removed. The welders cut a gap of 4 ¾”, including the 1” to accommodate for the weld material and make the weld. The final reference mark distance after the work is 29’ 10 ¾”.

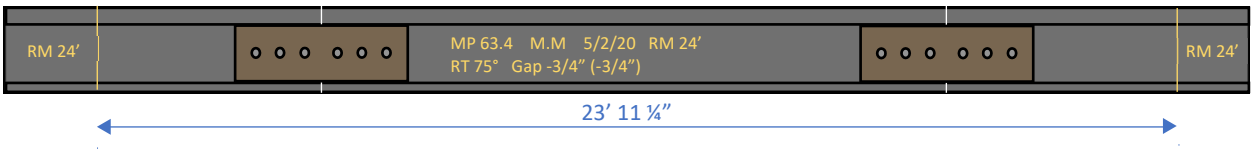


Example 4:

A crew plans to remove a rail defect when the rail temperature is 75°F and place reference marks on the rail. As they try to make the first cut the rail saw binds up, indicating the RNT is below the current rail temperature. They torch cut the rail according to their railroad’s procedures by notching out the ball and the base and slowly remove the web until the rail stops moving. They measure the reference marks after this and observe that the reference marks have moved inward ¾”.



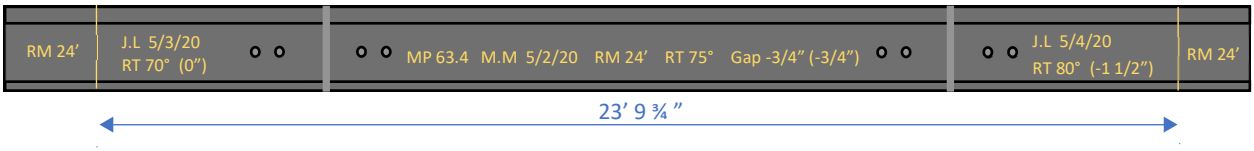
The crew removes the defective rail and installs a plug rail to fit. Because the rail ran inward during the first cut, the gap will be recorded as a negative (-) gap and notated as -¾”.



Since the railroad’s pre-break/cut tables can’t be applied when there is a negative gap, the crew cannot calculate what the pre-break/cut RNT was. However, once the rail stopped moving, the RNT at that time at the location of the cut is equal to the rail temperature of 75°F, and the reference marks are 23’ 11 ¼”

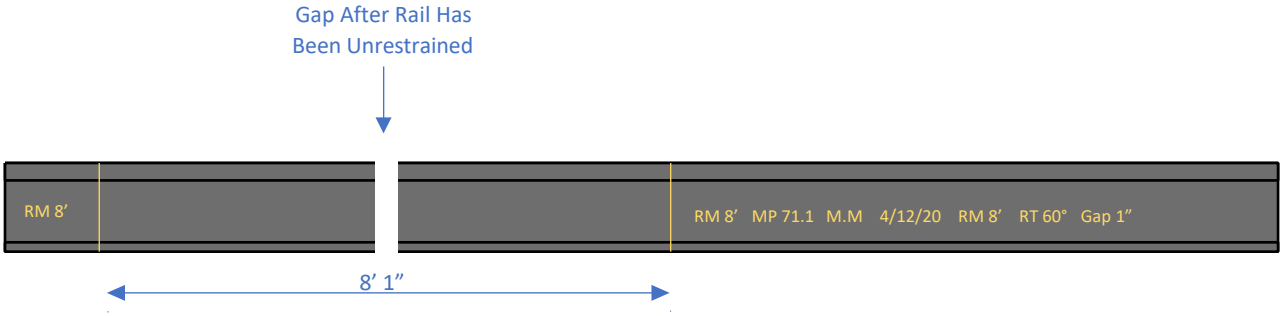
Appendix 9 – Use of Reference Marks

apart. To adjust the rail to the DRNT of 100°F, the welders review their railroad's adjustment table and see they need to remove an additional 1 ½". Since the RNT was estimated at 75°F after the rail ran in ¾", they know that needs to be considered. To adjust to the DRNT of 100°F, they take the initial reference mark distance and include the negative gap and subtract the amount for the adjustment to determine that the final reference mark distance should be 23' 9 ¾". They remove 2 ½" to account for the 1" for their thermite weld and complete the adjustment.



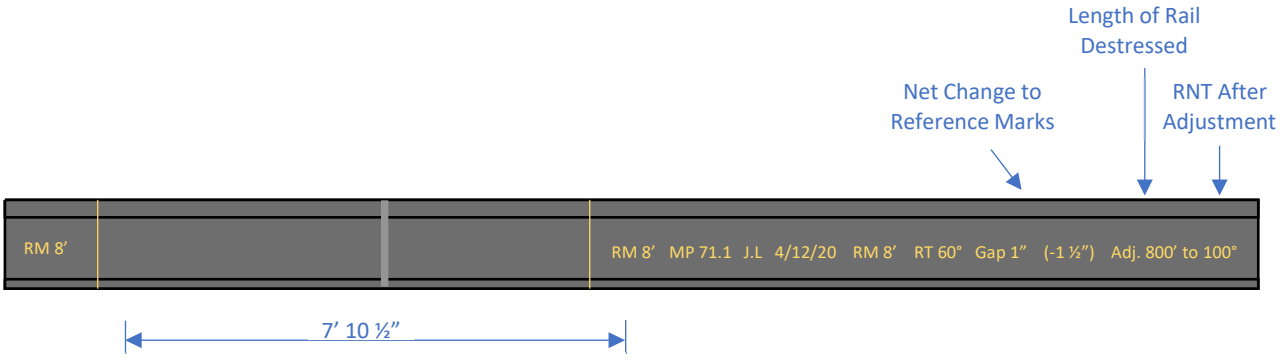
Example 5:

A crew needs to de-stress/perform a traditional adjustment at a location where there is concern about a reduced RNT. They have decided that this traditional adjustment will be 800' in length. The crew applies the reference marks that will span their planned cut. The rail temperature is 60°F so they make a saw cut and remove the anchors 400' in each direction of the cut. After the rail has stopped moving, the crew measures the reference marks on the rail to determine the gap is 1". Since a traditional adjustment is an adjustment to the DRNT from the current rail temperature of unrestrained rail instead of from a calculated pre-break RNT, the gap created by the saw cut is not used for a calculation but is useful for understanding the whole picture of a location. At this point, the reference marks are 8' 1" apart.



Appendix 9 – Use of Reference Marks

The crew references the thermal expansion table to determine how much of an adjustment is need to bring 800’ of rail from the current rail temperature of 60°F up to the DRNT of 100°F. They note that it will require 2 ½” to compensate for the 40°F temperature differential. They consider the additional 1” for the thermite weld material and trim the rail ends to have a 3 ½” gap. Since the adjustment will be split evenly between the two rails, each will be expected to move inward 1 ¼” at the cut. The crew divides that number by two to determine there should be 5/8” of movement at the match marks they place at the midpoints on each de-anchored section of rail. They pull the rails together and make the weld, ensure the proper expansion was occurred at the match marks and reapply the anchors. Since the rail gapped open 1” initially and required 2 ½” of adjustment, the final reference mark distance reads 7’ 10 ½”. They record on the rail the amount of adjustment that occurred, over what distance, and the RNT to which the rail was adjusted based on the change to the reference marks.



Appendix 10 – Walking Joint Bar Inspection Form

Subdivision:______________________________________

Inspector (print):__________________________________

Inspector (sign):___________________________________

Track	Mile Post	Side (L / R)	Joint ID	Rail Size	Joint Type	Date Inspected	Conditions Found	Action Taken

Appendix 11-DRNT by Geographical Area

State/Railroad	Desired Rail Neutral Temperature	Safe Range Lower End	Safe Range Upper End
Alabama – ABS, AUTR, BHRR	110°F	90°F	130°F
Arkansas – ARS	110°F	90°F	130°F
Florida – JXPT	110°F	90°F	130°F
Georgia – SVHO	110°F	90°F	130°F
Idaho – BVRR, EIRR	100°F	80°F	120°F
Illinois – DREI, CERR, EJSR	100°F	80°F	120°F
Kansas – KAW, KORR, SKOL	105°F	85°F	125°F
Louisiana – BRSR, LAS, DUSR, GOGR, TIBR	115°F	95°F	135°F
Michigan – GDLK	100°F	80°F	120°F
Mississippi - MSR, VSOR	110°F	90°F	130°F
New Mexico – TXNR	115°F	95°F	135°F
New York – ITHA	95°F	75°F	115°F
North Carolina – BLU	100°F	80°F	120°F
Ohio – AA	100°F	80°F	120°F
Oklahoma – SLWC	110°F	90°F	130°F
Oregon – PCC Condon	100°F	80°F	120°F
South Dakota - RWRR	100°F	80°F	120°F
Texas – AWRR, LBWR, PVS	115°F	95°F	135°F
West Virginia – KNWA	100°F	80°F	120°F
Washington – PCC	100°F	80°F	120°F
Wisconsin – WSOR, FOXY	100°F	80°F	120°F

Appendix 12-Covered Entities

Listed individual railroads managed by Watco which have adopted these procedures.

- Alabama Southern Railroad (ABS) November 2005
- Ann Arbor (AA) January 2013
- Arkansas Southern Railroad (ARS) October 2005
- Austin Western Railroad (AWRR) October 2015
- Autauga Northern Railroad (AUTR) April 9, 2011
- Baton Rouge Southern Railroad (BRSR) November 2008
- Birmingham Terminal Railway (BHRR) February 2012
- Blue Ridge Southern (BLU) July 2013
- Cicero Central Railroad (CERR) September 2015
- Decatur and Eastern Illinois Railroad (DREI) September 2018
- Dutchtown Southern Railroad (DUSR) January 2021
- Eastern Idaho Railroad (EIRR)
- Elwood Joliet and Southern Railroad (EJSR) October 2020
- Fox Valley Lake Superior (FOXY) January 2022
- Geaux Geaux Railroad (GOGR) May 2021
- Grand Elk Railroad (GDLK) March 2009
- Ithaca Central Railroad (ITHR) December 2018
- Jacksonville Port Railroad (JXPT) March 2017
- Kanawha River Railroad (KNWA) July 2016
- Kansas & Oklahoma Railroad (KORR)
- Kaw River Railroad (KAW) June 2004
- Louisiana Southern Railroad (LAS) September 2005
- Lubbock and Western Railroad (LBWR) July 2015
- Mississippi Southern Railroad (MSR) April 2005
- Palouse River & Coulee City Railroad (PCC)
- Pecos Valley Southern Railway (PVS) September 2012
- Ringneck & Western Railroad (RWRR) May 2021
- Savannah and Old Fort Railroad (SVHO) August 2019
- South Kansas & Oklahoma Railroad (SKOL)
- Stillwater Central Railroad (SLWC)
- Texas and New Mexico (TXNR) July 2015
- Timber Rock Railroad (TIBR)
- Vicksburg Southern Railroad (VSOR) January 2006
- Wisconsin & Southern Railroad Co. (WSOR) January 2012