Continuous Welded Rail
Generic Plan

On January 24, 2014, the Federal Railroad Administration (FRA) revised the Continuous Welded Rail (CWR) plan requirements (*See 79 FR 4258*). Railroad CWR plans submitted prior to this date that do not comply with the revised requirements are required to be amended and resubmitted to FRA for review and approval by the Rail Integrity Division. CWR plans may be included in field reference materials, such as Maintenance of Way (MOW) engineering standards or any other MOW reference guidance for field use; however, per Title 49 Code Federal Regulations (CFR) §213.119(k) of the Track Safety Standards (TSS), the CWR plan must be available in a single, standalone document at every covered job site where personnel are assigned to install, inspect or maintain CWR. The CWR plan can be a tab or chapter in MOW field reference materials, so long as that tab or chapter contains only the complete CWR program. **Amendments should be outlined in a clearly identifiable manner within each revised Plan and on the Plans cover sheet.*

49 CFR §213.119 Continuous Welded Rail (CWR); Plan Contents - Under former paragraph (h) (7) (ii) (C) of this section; the requirement to submit a Joint Fracture Report to the FRA in Washington is cancelled. The contents of 49 CFR §213.119 (h) (7) (ii) relating to Joint Fracture reporting were removed March 25, 2014.

This document is intended to provide guidance to track owners in fulfilling the requirement of submitting a CWR plan as required by 49 CFR §§213.118 and 213.119. A track owner is not restricted to submitting a CWR plan exactly resembling this generic plan, as a number of different plans could conform to the plan content requirements of 49 CFR §213.119.

Any legal proceeding instituted against a railroad for failure to comply with the TSS must be based on 49 CFR Part 213. This document is not to be construed as a modification, alteration or revision of the published regulations.

Please submit all CWR plans by e-mail to Matthew.Brewer@dot.gov. If email is unavailable, mail to Matthew Brewer, Staff Director – Rail Integrity Division 500 E. Broadway, Suite 240 Vancouver, WA 98660 – (202) 385-2209.

49 CFR §213.118 Continuous welded rail (CWR); plan review and approval.

(a) Each track owner with track constructed of CWR shall have in effect and comply with a plan that contains written procedures which address: the installation, adjustment, maintenance, and inspection of CWR; inspection of CWR joints; and a training program for the application of those procedures.

(b) The track owner shall file its CWR plan with the FRA Associate Administrator for Railroad Safety/Chief Safety Officer (Associate Administrator). Within 30 days of receipt of the submission, FRA will review the plan for compliance with this subpart. FRA will approve, disapprove or conditionally approve the submitted plan, and will provide written notice of its determination.

(c) The track owner's existing plan shall remain in effect until the track owner's new plan is approved or conditionally approved and is effective pursuant to paragraph (d) of this section.

(d) The track owner shall, upon receipt of FRA's approval or conditional approval, establish the plan's effective date. The track owner shall advise in writing FRA and all affected employees of the effective date.

(e) FRA, for cause stated, may, subsequent to plan approval or conditional approval, require revisions to the plan to bring the plan into conformity with this subpart. Notice of a revision requirement shall be made in writing and specify the basis of FRA's requirement. The track owner may, within 30 days of the revision requirement, respond and provide written submissions in support of the original plan. FRA renders a final decision in writing. Not more than 30 days following any final decision requiring revisions to a CWR plan, the track owner shall amend the plan in accordance with FRA's decision and resubmit the conforming plan. The conforming plan becomes effective upon its submission to FRA.

XXXX Railroad CWR Plan

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

Sample Amendment Table

Chapter & Section	Amendment	Date
6 - 6.7	Deleted Fracture Report requirement	12/13/16

Procedures for the Installation, Adjustment, Maintenance and Inspection of CWR for (XXXX) Railroad

Chapter 1 CWR Installation Procedures

Chapter 2 Rail Anchoring Requirements When Installing CWR

Chapter 3 Maintaining a Desired Rail Neutral Temperature Range

Chapter 4 Monitoring Curve Movement Following Surfacing and Lining

Chapter 5 Placing Temporary Speed Restrictions Due to Track Work

Chapter 6 Rail Joint Inspections

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7.1 Hot Weather Inspections
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Chapter 8 Training

Chapter 9 Recordkeeping

9.1 Report of CWR Installations
9.2 Report Maintenance Work in CWR

Guidance and Example Appendices

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

This document details the (XXX) Railroad's policy on installing, adjusting, maintaining and inspecting Continuous Welded Rail (CWR) track. Each chapter details how the (XXX) Railroad applies its standards and procedures to comply with FRA standards.

Chapter 1 CWR Installation Procedures

Rail lengths welded together that exceed 400 feet are considered CWR. Rail installed as CWR remains CWR, regardless of whether a joint or plug is installed into the rail at a later time. Temperature variations affect rail length. Rail expands (lengthens) when heated and contracts (shortens) when cooled.

1.1 Desired Rail Neutral Temperature

Rail neutral temperature (RNT) is the temperature at which rail is neither in tension nor compression. Designated rail laying temperatures have been established based on geographic and average yearly ambient temperature to provide a specific Desired Rail Neutral Temperature (DRNT) to prevent track buckling. Rail installation temperatures may be slightly higher or lower than the DRNT, but are to be within the designated rail installation range. The XXX Railroad's DRNT is XXX degrees F. The designated rail neutral temperature safe range is from XX to XX degrees F (+/-20°F from DRNT).

1.2 Temperature Differential

The difference between the designated rail laying temperature and the actual rail temperature taken at the time of installation is called the temperature differential. CWR rail laying and adjusting procedures have been established in Chapters 1 and 3 of this CWR Plan to compensate for this temperature differential.

1.3 Installing CWR

Most commonly thought of as laying rail out-of-face; however, distances as short as a few hundred feet might be installed.

- The rail should be in a non-stress free state when laid in the bed.
- If fastened down at this time, the Rail Neutral Temperature (RNT) is established, and equal to the Rail Temperature (RT).
- If the RT is lower than the desired RNT, the temperature differential is calculated and the required expansion is determined based on the temperature differential and rail length.
- The rail is then uniformly expanded. The actual length and expansion are then used to determine the new RNT.

Follow these general requirements when installing CWR:

- Refer to the designated rail laying temperature in your geographical your area.
- Take the rail temperature and calculate the expansion required before making adjustments.
- Record the rail laying temperature, location and date on your railroads' approved forms. These records may be retained in an electronic format as per 49 CFR § 213.241.
- Use rail heaters or rail expanders (if necessary) to adjust the rail to the correct length when the actual rail temperature is less than the designated rail laying temperature.
- If the rail temperature exceeds the designated rail installation safe range. The installation must stop until the rail temperature returns within range, or provisions for later readjustment must be made before the arrival of cold weather.
- Heat the rail evenly and uniformly so that the rail expansion occurs evenly. The proper expansion must be achieved at each reference station throughout its length.
- Take the temperature at the location where the anchors or clips are being applied to restrain the rail.
- 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 of 25 mph must be placed prior to rail temperature above designated rail laying temperature.
- When tight rail conditions exist, be governed by Chapter 7.

Chapter 2 Rail Anchoring Requirements

Where the anchoring function is otherwise provided, such as resilient rail fasteners that give the necessary toe load to restrain rail and bridges where the structure design precludes the use of anchors (e.g. bridges with rail expansion joints, track designed to transfer the axial forces to the bridge structure, etc.), rail anchors may be omitted. Anchors may not be applied where they will interfere with signal or other track appliances, where they are inaccessible for adjustment or inspection, or on rail opposite a joint. Anchor patterns may be varied as reasonable to avoid placing anchors against deteriorated ties.

Installation

The following anchoring requirements apply to CWR installation on all main track and sidings. These anchoring requirements also apply to all tracks other than main tracks or sidings operating at speeds above Class 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 axial forces.

2.2 Solid Box Pattern

When installing CWR, fully box anchor every sound (effective) 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.

Condition	Action
Turnouts Rail crossings Joints where CWR abuts jointed rail Severe grades, and Sharp curves	Anchor every tie for 195' in each direction.
Bolted joint installed during CWR installation when using heater, rail stretcher or sufficient ambient temperature.	Within 60 days, weld joint, **OR** Install joint with 6 bolts, **OR** Anchor every tie for 195' in each direction.

2.3 Bridge Pattern

When installing CWR, follow these bridge anchoring requirements:

1. Ballast desk bridges may be anchored with the same pattern as in Sections 2.1 and 2.2.

2. Open deck bridges should be anchored according to each railroad's standard design to be included in the Appendices.

Maintenance or Rail Repair

2.4 Legacy Patterns

On CWR installations completed before September 21,1998, pre-existing railroad standard anchor patterns may remain if 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 rail if restraint is not sufficient.

2.5 Anchor Pattern after Repair

When repairs result in a joint being added to CWR, the anchor pattern shall match the existing pattern in track. At least every other tie will be box anchored for a distance of 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 and retained.

Condition	Action
Bolted joint in CWR experiencing service failure (stripped joint) or failed bar(s) with gap* present *Gap exists if it cannot be closed by drift pin	Weld joint, **OR** Remediate joint 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' 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

The track owner has the responsibility to quantify the rail neutral temperature of ALL CWR track.

Using the following track maintenance procedures to properly maintain the RNT reduces the risk of buckles in hot weather as well as pull-a parts and broken rails in cold weather. These procedures include a RNT readjustment method outlined in Section 3.1 or in cases when that method is not applicable, a conventional RNT de-stress/adjustment method as outlined in Section 3.2.

The use of reference marks, applied in the appropriate manner as outlined in the appendices of this plan, are required for locations described in both Sections 3.1 and 3.2.

The proper method of measurement of rail movement in CWR is critical in correctly tracking RNT changes where work activities have been performed. The reference mark drawings (*See Appendices*) show how to correctly apply pre-cut/break reference marks and marking the distance for a rail cut verses a rail break. The objective is to reference the rail distance before the separation occurred.

Each reference mark location must be written on the web of the rail with a permanent paint marker; will include the following:

- Pre-cut/break reference marks and the distance (for a break subtract gap distance),
- Rail temperature at the time of separation,
- Length of gap caused by the rail pull back during the cut or break, and
- Date and milepost location.

When tight rail conditions exist, be governed by Section 7.1.

3.1 Maintaining DRNT through a Readjustment Methodology

Readjustment Methodology

This procedure applies to rail separations occurring in CWR where the replacement rail is usually 100' or less. It is important to understand, for this procedure to work as intended, the expected thermal forces must still be present prior to the rail separation. Meaning, if the rail has some other means of releasing the thermal force buildup or the thermal forces have been previously released by some other means, Section 3.2 would have to be used (*See the Additional Guidance for Chapter 3 in attached Appendices*).

- When rail is cut or breaks and the rail temperature is equal to or above the Pre-Cut/Break RNT, no gap will be produced and more rail may have to be cut out to remove the rail. In such cases the current RNT would be equal to the current rail temperature.
- When rail is cut or breaks and the rail temperature is below the Pre-Cut/Break RNT, the expected thermal forces will produce a gap. The Pre-Cut/Break RNT can then be calculated by referencing the Rail Temperature (RT) with the gap size, using the Pre-Cut/Break Chart appropriate for the location (*See Pre-Cut/Break Chart(s) in the Appendices*).
- The RT, gap size (if any), and the original reference mark length (prior to separation of the rail) must be placed on the web of the rail and recorded.
- Now that the estimated Pre-Cut/Break RNT is known, it can be determined if the location is within the prescribed rail installation safe range (DRNT +/-20°F) for the area.
- The amount of temperature differential between the estimated Pre-Cut/Break RNT and the Desired Rail Neutral Temperature (DRNT) for that geographic area, provides the information needed to calculate the amount of rail that needs to be added or removed for returning the location back to within the designated rail installation safe range (DRNT +/-20°F). The amount can be referenced in the Temperature Differential Chart (*See the Appendices*).

- If the location's estimated Pre-Cut/Break RNT is found to be within the designated rail installation safe range, then the amount of rail returned to the track and pulled together would be equal to the amount of rail originally removed. If the amount of rail pull necessary to close the gap distance is less than 1", it can be pulled though the anchors; however, if the pull is greater than 1", it would require anchor removal and reinstallation for the length of the estimated affected zone created by the initial rail separation pull back.
- If the location is found to be outside the rail installation safe range, additional rail will have to be added or removed to make the necessary adjustments back to within the rail installation safe range. These RNT adjustments can or cannot always be completed at the time of the initial rail repair. By accurately recording the needed information, proper adjustments can be applied later (prior to becoming pull-apart or buckle prone conditions).
- If possible, at the time of the initial rail replacement and the rail can be cut to a length that would allow for: closing the gap, the additional temperature differential amount, plus weld widths (if welded). This would be performing a completed RNT adjustment at the time of repair; many times all of these processes cannot be completed during the initial repair.
- Record all work performed on the proper form(s), noting the new reference mark distance, and thus, how those changes have affected the new calculated RNT based on the amount of reference mark distance change and the estimated Pre-Cut/Break temperature. A shorter distance increases the RNT, a longer distance will lower the RNT from that estimated Pre-Cut/Break RNT.
- If for any reason the amount of rail needed to make the proper adjustment cannot be removed during the initial work (such as in the case of cutting a rail that fills the gap), by recording the RT, the gap size produced by the cut/break and the original distance of the reference marks (prior to the rail being cut or broken); the proper adjustments can then be made later when returning to complete the work in a case such as this (assuming the gap was filled). The rail temperature at the time of the separation would be the new RNT. Locations such as this would have to be monitored and corrected prior to becoming a hazard for buckle or pull-apart prone conditions. A record of the rail neutral temperature changes must be maintained during all work activities to these locations up to and including the final adjustment process.
- Records will be maintained for one year after the final adjustment has been completed.

Record all activities and any other required information on the designated paper or electronic form(s) for determining the Pre-Cut/Break RNT, the temperature differential required for returning the location back to within the designated RNT safe range, and the new calculated RNT after each work activity.

Rail that has been cut or broken for any reason must be readjusted within the designated rail neutral temperature (DRNT+/-20°F) safe range. If the rail has not been readjusted to at least DRNT-20°F before the rail temperature exceeds the values in Figure 1 below, a speed restriction of 25 mph will be placed or a speed restriction of 40 mph will be placed with a required daily inspection made during the heat of the day.

Understand that track buckles can be extreme and in some cases not passable at any speed. When protecting buckle prone conditions as described in this Chapter, it 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 (*See Chapter 7*).

Note: Supplemental documents including forms, diagrams, RNT tables, and procedures applying to the Rail Neutral Temperature (RNT) readjustment methodology must be submitted as part of this and/or your plan.

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

Note: If both rails are cut (e.g. installing a short track panel), the above table will not apply. The adjustments, slow orders, and inspections described above will instead apply at a rail temperature 70°F above the lowest rail temperature at the time of the separations.

Locations not adjusted to back to within the rail installation safe range (DRNT +/-20°), must be adjusted prior to becoming a buckle or pull-apart prone condition; however, no location shall exceed 365 days from its initial installation.

When welding rail ends together, the weld gaps and rail consumption during all associated work must be taken into consideration when determining the amount of rail added or removed to return the location back to within the designated rail neutral temperature safe range.

3.2 Conventional De-Stressing/Adjusting Rail

Rail can be de-stressed by removing rail, it is primarily performed in unison with both rails, but in a few limited cases (when the opposite rail is known to be properly adjusted) it can be performed on one rail. This procedure can be further used to re-establish the RNT back to within the rail installation safe range (DRNT +/- 20°F).

- Use a designated safe procedure to cut the rail, with at least two tie checks between the opposing rail cuts. It is possible that the rail is under extreme compression and may move unexpectedly both vertically as well as laterally. Cut rail to be de-stressed and/or adjusted.
- Remove or reposition anchors or clips for a minimum of 390 feet in both (10 rail lengths) directions from the cut or up to a restriction that prevents rail movement (i.e., bridge, switch). Make sure the rail can move freely though the plates so that all the thermal forces are released.

Method #1 is performed at a rail temperature that is within the designated rail installation safe range.

- The section of track (both rails) to be destressed/adjusted is cut; the anchors and any other restraints have been removed for the minimum distance in each direction until the rail stops expanding (tapping the rail along its length to assure that the rail is moving freely through the plates).
- After all thermal forces have been released and the movement has stopped, the rails can then be rejoined and the anchors reinstalled. This restores both rails to a RNT equal to the rail temperature at the time of the rails being rejoined.

Method #2 is performed at a rail temperature that is outside the rail installation safe range (DRNT +/- 20°F).

- Referencing the current rail temperature with the amount of change needed to reach the desired rail neutral temperature, the temperature differential is found; then the required expansion is determined based on the temperature differential amount and the total rail length amount being adjusted (a minimum of 390’ each way would be a total of 780’).
- The rail is then uniformly expanded by heating or pulling the required amount of distance needed to return the location back to within designated rail installation safe range.
- After the expansion is completed and the rails are joined back together, the anchors are reinstalled.
- Record the location and new RNT on the prescribed de-stressing/adjustment form.

Locations designated for RNT conventional adjustment and not brought into the safe range will be governed by the remedial actions as described in the Section 3.1 table. However, if 100 feet or more of rail has been installed, de-stressed or adjusted below the safe range, the remedial actions in Section 1.3 will apply.

Chapter 4 Monitoring Curve Movement Following Track Surfacing and Lining

4.1 Staking of Curves

Before surfacing and lining a curve on main tracks, stake curve if it is 3° or more and the rail temperature is more than 50°F below the designated rail laying temperature (or is forecasted to be in the next 24 hours).

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 no more than 200 feet apart. Refer to your railroad's engineering standards for guidance when staking curves that are miles in length.

4.2 Inspecting for Curve Movement

Inspect for curve movement periodically after the work, especially during periods of large temperature changes. Where curve has been staked per Section 4.1 and curve has shifted inward more than a maximum of 3 inches, the curve must be lined out prior to ambient temperatures above or forecasted above the designated temperature in Table XX. If curve is not lined out or de-stressed, a speed restriction of 40 mph or less must be placed. When tight rail conditions exist, be governed by Section 7.1.

Chapter 5 Placing Temporary Speed Restrictions Due to Track Work

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 or when mechanical dynamic stabilization is used.

5.1 General Requirements

Speed restrictions ensure safe train operations until the affected track stabilizes. Restrictions need to stay in place to allow the ballast to consolidate, rail compressive forces to equalize, and the sub grade 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:

- Gage, surface and alignment have been established,
- Crib and shoulder ballast is in place or lateral constraint is otherwise provided,
- The rail is anchored per Sections 2 or 3.

5.3 Speed Restriction Length

To minimize running rail and other dynamic forces, trains must have time to brake and adjust slack before entering the disturbed track. For heavy grades, sharp curves or substandard track conditions, extend speed restrictions farther from the work limits, if 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. When temperature is above or forecasted above railroad designated temperature for the next 24 hours.

Activity	Maximum Speed	Minimum Duration
Out-of-face installation of ties Undercutting Laying track/switch panels Constructing track Out-of-face surfacing and lining	30 mph freight 40 mph passenger	8 freight trains or 16 passenger trains OR an equivalent combination*
Spot Maintenance Installing ties (no more than 5 ties in 39 ft. and no more than 3 consecutive ties) Surfacing/lining (maximum length of 19'6")	30 mph freight 40 mph passenger	1 train
Mechanically-stabilized track performed after any of the activities listed above	30 mph freight 40 mph passenger	1 train

*2 passenger trains are equivalent to 1 freight train

When rail temperature is below and is forecasted to remain below railroad designated temperature within the next 24 hours per adjustment or addition of anchors will be as prescribed in the following table.

Activity	Maximum Speed	Minimum Duration
Out-of-face installation of ties Out-of-face surfacing and lining Undercutting Laying track/switch panels Constructing track Exception: Spot maintenance does not require a speed restriction.	30 mph freight 40 mph passenger	1 train
Mechanically-stabilized track performed after any of the activities listed above	40 mph freight	1 train

When the ambient temperature is less than 50°F, a speed restriction is not required. An inspection must be conducted before releasing the speed restriction to ensure the track is safe for higher speeds.

Chapter 6 Rail Joint Inspections

CWR Joint means any joint directly connected to CWR.

6.1 Class of Track

All CWR joints within the following classes must be inspected on foot:

- Class 2 on which passenger trains operate, and
- Class 3 and higher

6.2 Frequency of Inspections

CWR joints shall be inspected on foot at the following minimum frequencies:

Minimum Number of Inspections Per Calendar Year[1]					
	Freight Trains operating over track with an annual tonnage of:			Passenger Trains operating over track with an annual tonnage of:	
	less than 40 mgt.	40 to 60 mgt.	greater than 60 mgt.	less than 20 mgt.	greater than or equal to 20 mgt.
Class 5 & above	2x	3x [2]	4x [2]	3x [2]	3x [2]
Class 4	2x	3x [2]	4x [2]	2x	3x [2]
Class 3	1x	2x	2x	2x	2x
Class 2	0	0	0	1x	1x
Class 1	0	0	0	0	0
Excepted Track	0	0	0	n/a	n/a

4x = 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 bat least 60 calendar days.
3x = Three times per calendar year, with one inspection in each of the following periods: January to April, May to August, and September to December; and with consecutive inspections separated by a least 90 calendar days
2x = 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.
1x = 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 Joints

Each CWR 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.).

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

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 monthly during the required monthly walking inspection of these devices.

Therefore, inspect these locations on a minimum monthly basis and include in the inspection and report the following:

At switches:

- 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 switch location, include as a minimum all joints from the point of the switch to the heel of the frog.

At cross-overs:

- All joints in track between switches.

At track crossings:

- 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.

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

- 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 watch for (but not be limited to) the following rail joint conditions outlined in the table below. When such conditions are found, they must be noted on an inspection report and the appropriate action must be taken as outlined.

Rail Joint Condition	Action
Visible cracks in joint bar	Replace bar
Loose bolts	Tighten bolts
Bent bolts	Replace bolts OR Re-inspect as per 6.2
Missing bolts [2]	Replace bolts
Tie(s) not effectively supporting joint	Tamp tie(s) Replace or repair tie(s) OR Conduct follow-up inspections every other week until repaired/removed
Broken or missing tie plate(s)	Replace tie plate(s) OR Conduct follow-up inspections every other week until repaired/removed
Deteriorated insulated joint	Replace/repair joint OR Conduct follow-up inspections every other week until repaired/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 repaired/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, add or remove rail at appropriate time OR Conduct follow-up inspections every other week until repaired/removed
Wide rail gap greater than 1.5"	Adjust rail gap and secure joint OR Conduct follow-up inspections every other week until repaired/removed
Joint vertical 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 repaired/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 repaired/removed

1. Action 1 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

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., where ballast or similar material is in the middle of the track and along the track) and therefore unavailable for inspection. Where CWR joints are buried (e.g., by ballast), wait for the completion of the track work before conducting joint bar inspections. Locations that have been buried for an extended period of time must still be inspected.

6.7 Inspection Records

On-Foot Periodic and Follow-up Inspection Reports

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

- Date
- Limits of the inspection
- Location and nature of CWR joint conditions specified in Section 6.5
- Corrective or remedial action taken by the person making the inspection
- Name and signature of inspector

Track subject to inspections under 49 CFR § 213.119, must comply with:

- Track Inspections (49 CFR § 213.233),
- Inspections of switches, turnouts, track crossings, lift rail assemblies or other transition devices on moveable bridges (49 CFR § 213.235), if applicable,
- Periodic and follow-up CWR Joint Inspections (49 CFR § 213.119 (g)).

Chapter 7 Extreme Weather Inspections

For purposes of forecasting or initiating extreme weather inspections and conversions of rail temperature in relation to ambient temperatures, use the following conversions:

- In hot weather, rail temperature is equal to the ambient temperature plus 30°F.
- In cold weather, rail temperature is equal to the ambient temperature.

7.1 Hot Weather Inspections

On main tracks, hot weather inspections must be performed and documented as directed by the **XXXX** when the temperature is forecast to exceed the temperature for the territory per **table TO BE INSERTED.**

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.

Inspectors will inspect for signs of tight rail conditions, including:

- Lateral or vertical movement (i.e., “kinky” or “wavy” rail
- Improperly seated rail; rail canting or lifting out of the tie plates
- Shiny marks on the base of the rail indicating that the rail is running through the anchors and spikes
- Gaps in ballast at the ends of ties
- Churning ballast and ties.

Inspectors will pay special attention to the following locations:

- Recently disturbed track
- Track at the bottom of sags
- Locations where heavy braking occurs
- Fixed track structures, such as turnouts and bridges
- Locations where rail has been repaired or welds made.

7.2 Cold Weather Inspections

On main tracks and sidings, cold weather inspections must be performed as directed when the rail temperature is forecast to drop 100°F below the rail laying temperature.

Inspectors will inspect for:

- Broken rails
- Pull-a parts
- Curve movement
- Wide gap between rail-ends
- Bent bolts
- Cracked or broken joint bars (conventional and insulated)
- Canted rail.

Chapter 8 Training

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

Training programs will address, but not be limited to, the following:

- CWR installation procedures
- Rail anchoring requirements when installing CWR
- Maintaining a desired rail neutral temperature range
- Preventive maintenance on existing CWR track
- Monitoring curve movement following track surfacing and lining
- Placing temporary speed restrictions account track work
- Rail joint inspections
- Insufficient ballast

- Extreme weather inspections
- Recordkeeping

Chapter 9 Recordkeeping

9.1 Report of CWR Installations

Records necessary to provide an adequate history of installing (Chapter 1) and achieving rail neutral temperatures using this procedure will be maintained for at least one year. These records will include the date of installation, location, rail and length, initial rail temperature, designated RNT, expansion, and adjusted RNT. (*FORMS WILL BE PROVIDED BY THE RAILROAD*)

The adjusted rail neutral temperature, rail temperature, expansion performed, location, and date, of CWR installations must be recorded on the prescribed form and must be retained for at least one year after installation.

9.2 Report Maintenance Work in CWR

Because track maintenance can disturb the lateral and longitudinal resistance of the track, records of the following must be kept for at least one year after corrections or adjustments are made:

- Record of each designated cut or break location using the Readjustment Methodology including the items as indicated on the paper or electronic form required in Section 3.1 and within 365 days the final RNT.
- Record of each designated cut or break location using conventional adjustment in Section 3.2 including the rail temperatures and within 365 days the final RNT.
- Rail added or removed at locations above.
- Where a curve has been staked and has shifted inward more than a maximum of 3 inches.
- CWR installation or maintenance work that does not conform to these written procedures.

XXXX must monitor these records to ensure necessary remedial actions and/or corrections and adjustments are made.

Guidance and Example Appendices

Additional Guidance for Chapter 3

The methodology of calculating Rail Neutral Temperatures (RNT) is a straightforward procedure. In practice, there are a few application issues that will need to be specifically addressed; a few of these issues are summarized below:

- When measuring the rail break/cut gap, measure the gap accurately.
- At the time of a rail separation, cut or break, record the precise location, gap size, rail size, rail temperature, curvature, anchor/fastener type and ballast condition, in order to determine the proper RNT changes and potential necessary adjustments needed.
- If the complete adjustments and closeouts are not made during the initial work, record and monitor any interim repairs or procedures including any rail amount of rail added or removed. These changes will affect the current RNT during each interim event. The railroad must track these changes to protect against both buckle and pull-apart prone conditions.
- Note locations that were temporally repaired by cutting in a rail plug to fit (when a gap is produced). The rail temperature, at the time of the rail separation, will be used in determining the return rail temperature that must not be exceeded before a RNT readjustment or proper track protection is applied.
- Prioritize return readjustments based on the lowest rail break or cut temperatures for locations where the adjustments have not completed or locations with the lowest current calculated RNT; correct the worst or lowest RNT first.
- It is important to recognize if “special conditions” apply. There are cases in which the methodology of calculating the RNT is “NOT” directly applicable. These include locations near switches, crossings, bridge approaches; also, locations where other rail plugs or joints exist in close proximity on the same or both rails. In these cases, refer to the adjustment guidelines outlined in Section 3.2, because the expected forces may have already released or dissipated by other means. Therefore, the rail pullback responses for a given rail temperature may not occur as expected.
- Accurately record all the readjustment information including: the readjustment temperatures, the total rail length unfastened, the amount of rail added or removed and the expansion method used such as rail heating or stretching, etc.
- When using ambient temperatures to dictate when to return for RNT adjustments or when predicting hot or cold weather inspections, understand the difference between the rail temperature and the ambient temperature. In predicting what the rail temperatures will be for a given area and time, the rail temperature will be approximately 30°F higher than the

ambient temperature due to radiant heating from the sun. In addition, the rail temperature will be equal to the ambient temperature (with the exception of any artificial heating) without that radiant heating at night.

- Excessive thermal forces in curves can be temporarily relived by lining the track outward, but without knowledge of the pre-existing RNT of both rails, the amount of adjustment made by lining the track will be unknown. Therefore, a traditional adjustment outlined under Section 3.2 would be required to properly adjust the location back to within the designated rail installation safe range (DRNT +/-20°F). Over elevating the RNT will only exacerbate the problem.

- Track work such as tie installation and surfacing that does not move the track in significant amounts from its pre-work position or a misalignment caused solely by the work process, that can be restored during the heat of the day, Is basically a process of re-establishing the holding power of the ballast by either mechanical or time/tonnage means as outlined in the CWR plan. However, when significant alinement or surface changes are made, they directly affect rail length. Therefore, these significant changes must be addressed as it relates to RNT changes so that the new RNT is known to be within the designated rail installation safe range (DRNT +/-20°F). This may be accomplished by use of a mechanical RNT measurement process or by performing a RNT adjustment as outlined under Section 3.2. The railroad must know that the location has been properly adjusted to a RNT within the rail installation safe range (DRNT +/-20°F).

- Performing RNT re-adjustments before the onset of warm temperatures is paramount to preventing track buckling. Track buckling prevention is very much dependent upon the track structure type and its condition. An average strength track structure can safely handle a 60°F to 80°F temperature swing from its RNT before becoming prone to track buckling. Within the continental US the highest rail temperature (with few exceptions) a track will experience is 140°F. Therefore, the return adjustment chart in Section 3.1 is calculated to assist in returning to readjust the RNT before reaching that critical 70°F (average between 60°F and 80°F) buckle prone rail temperature. It is important to understand that the chart assumes that the opposite rail has at least a 70°F RNT or weak condition; with the understanding that the opposite rail has somewhat of a holding restraint for the lowered RNT side in question. This means the track structure can handle the return rail temperatures that are shown in the chart. If the opposite rail's RNT is higher, it could handle a higher return temperature; but for locations with lower RNT's, the return temperature would be lower. In the vast majority of cases the 70°F temperature for the opposing rail is very conservative. In the cases where both rails are cut and have the same lowered RNT the chart is no longer effective at calculating a return rail temperature. Therefore, in those cases returning at a temperature that is 70°F above the rail temperature that both rails were separated is critical.

- Turnouts in CWR track should be treated as contiguous with CWR. They experience similar thermal forces, especially through the stock rails where CWR is connected on each end. Due to their rigid physical make-up, turnouts have a greater resistance to buckling within the long ties than the regular track structure. However, if turnouts are installed at low rail temperatures, very high thermal forces can develop, especially if the tracks connected on the ends have not been readjusted. This will create buckling prone conditions ahead of and behind the turnout.

- Properly installing and maintaining rail neutral temperatures contiguous with turnouts in CWR is important. When installing turnouts in CWR track and the rail temperature is substantially below the designated rail installation safe range, later adjustments must be performed as soon as feasible or a slow order issued.

- When rails are changed out in existing turnouts, it is important to recognize that locations in the turnout such as the stock rails with CWR extending in each direction, can develop substantial stresses and must be adjusted as would be applicable. Section 3.1-Readjustment Methodology will likely not apply. Typical CWR forces do not exist between the frog and points of switch and may not need adjusting.

Placing Rail Reference Marks

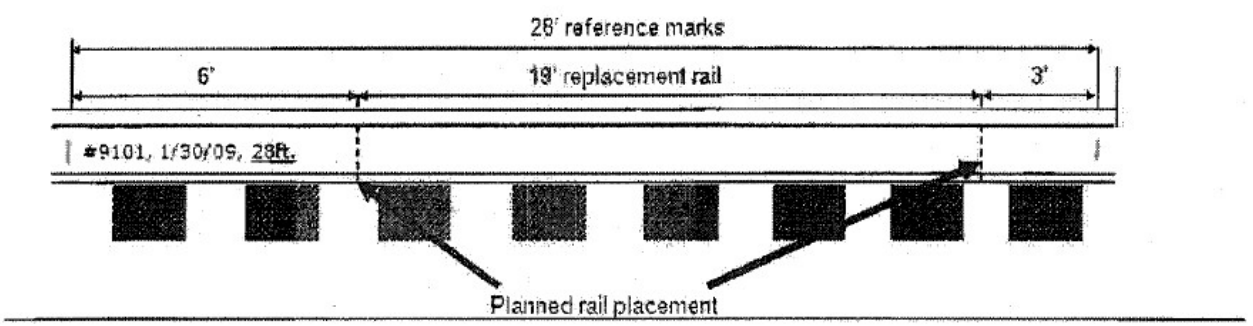
Placing rail reference marks is a method of correctly and accurately measuring the amount of rail added or removed in CWR territory.

Reference marks must be utilized when rail separations occur in CWR for any reason.

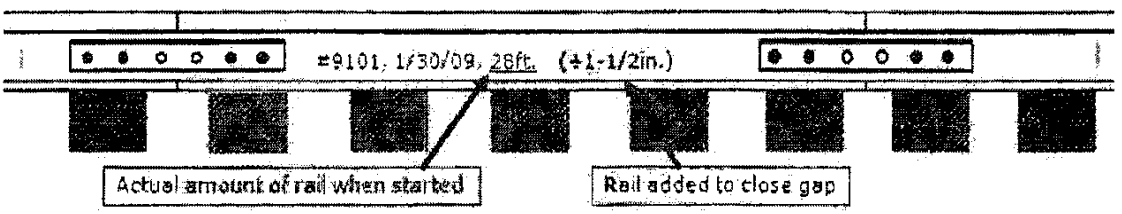
Use the following guidelines when placing reference marks.

- Use a permanent white metal marker or paint stick (not soapstone or chalk) to record reference marks. The markings must also be legible and clearly understood.
- Reference marks should be at least 3' from where the cut is made so that joint bars will not cover the marks.
- The distance between reference marks, the gang number, and the date must be written on the web of the rail in a railroad wide uniform manner.
- Perform the calculations outlined in section 3 of the CWR plan for determining the Pre-Cut/Break RNT.
- In this example, the adjustment could not be made, so the gap was filled by adding rail, lowering the RNT. The RT, the Gap Size, and Reference Mark distance will have to be maintained so that a proper adjustment can be performed at a later date. The new RNT is equal to the current RT in this case.
- Document the location through production reporting and arrange for later adjustment if needed.
- Any lowered RNT temporary repairs must be corrected when making permanent repairs.

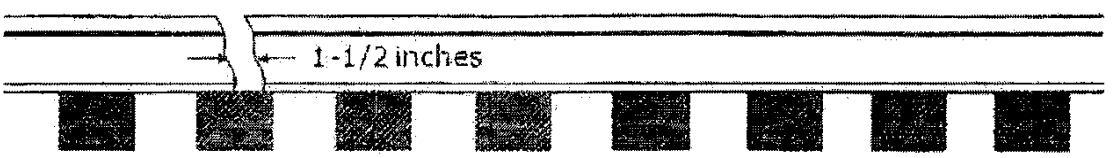
When adding a replacement rail that has not separated, decide where to cut the rail to ensure that the cuts align with the tie cribs. Measure at least 3 feet from each rail cut mark, before the rail is cut, and place reference marks on the web of the rail to record the total distance between the reference marks.



In the example below, when the rail was cut, the rail gapped open 1 ½". The replacement rail was installed as a temporary repair and after the joint bars were applied the distance between the reference marks is now 28 feet 1-1/2 inches. Document the 1½" added as a (+) measurement.

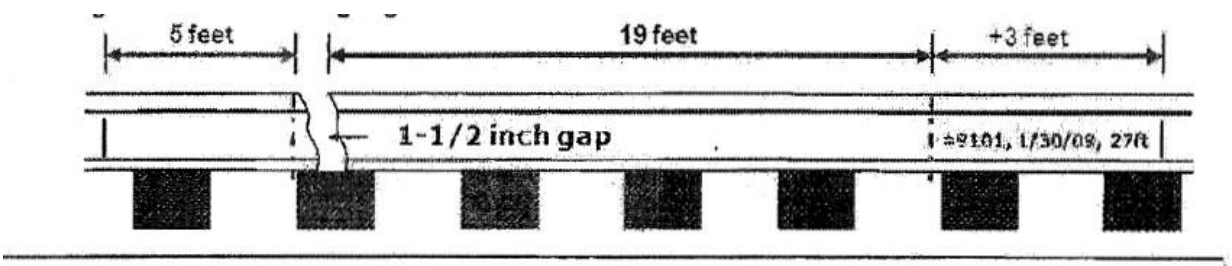


In cases of pull-a-parts and service failures where the rail has gapped open, the distance of reference marks on the web of the rail must not include the gap in the rail. The reference marks should always indicate the original distance, (amount of rail) between the marks before the break or pull-apart occurred. In this example the gap Is 1 ½" wide and the break is crooked.

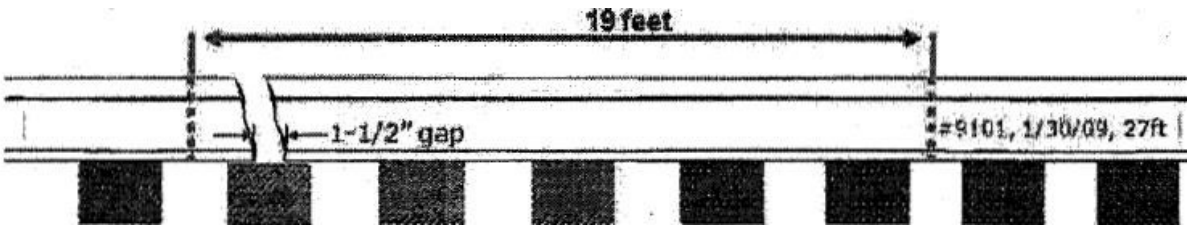


Decide where to make saw cuts (preferably away from the break). Measure back from those cuts at least 3', and make the reference marks. Measure the reference mark distance, and then subtract the amount of gap to get the original reference mark distance.

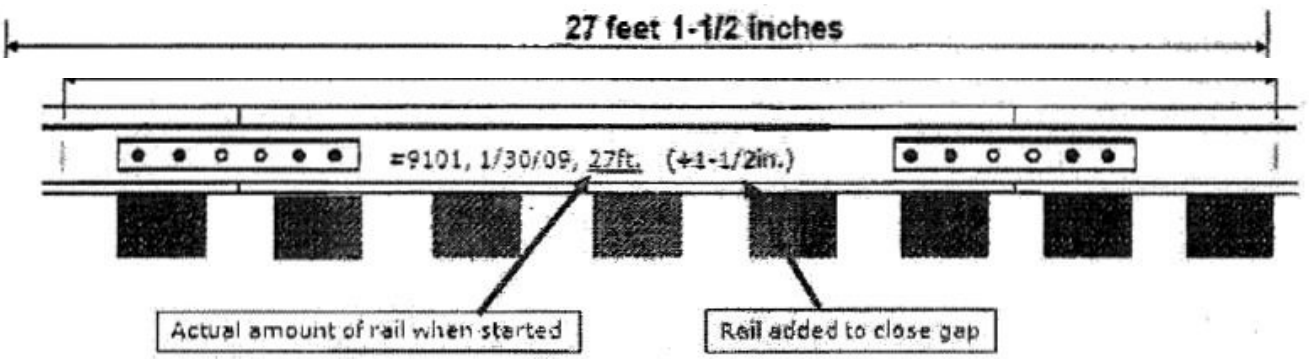
In the example below you can see that the reference mark was moved the additional gap distance amount on one end, so that the distance measurement would be an even number. This makes tracking changes a little easier; either way the objective is to record the original rail distance by "not including" the gap distance. Distance 27' 1-1/2", subtract Gap 1-1/2", the amount to write on rail and record as the before distance, is 27', no inches.



Mark the rail to place the saw cuts for the replacement rail in the cribs.



Once the temporary repair (filled the gap) is completed, measure the distance between the reference marks and record the amount of change on the web of the rail.



When returning to correct the lowered rail neutral temperature or making the welds for a rail plug that was calculated to be within the rail installation safe range, the information on the rail provides the information needed to close out the location correctly. The original reference mark length, gap distance, and rail temperature at the time of separation, are needed to make these adjustments.

If the information is not available, a traditional adjustment as outlined in Section 3.2 would be required to properly adjust the location back to within the designated rail installation safe range.

TRACK DISTURBANCE REPORT

Date of Disturbance:_____ Railroad Name:_____

Track Name: _____

Location: from MP_____ to MP _____

Alignment: (T/C)_____ Degree of Curve _____

Side of Rail (facing ascending milepost) (L, R, B) _____

Temperature: Ambient Rail Desired Rail Neutral _____

Type of Disturbance: Rail Layed: (fill out Rail Laying Report)_____

Rail Plug Installed: (Gap produced by rail pullback) _____

Reference Mark Length before: _____

Reference Mark Length after: _____

Welds Made (Y/N) (how many) _____

Weld Made (rail separation) (Gap produced by pullback) _____

Reference Mark Length before: _____

Reference Mark Length after: _____

Turnout Installed: _____

Track Panel Installed: _____

Ties Installed: _____

Surfacing out-of-face or spot surfacing _____

Track cribbed, undercut, washout _____

Track Buckle: _____

Pull-apart: _____

Other: (describe) _____

Disturbance Corrected:

Adjusted Rail: Date_____ Rail Temperature_____ Adjusted RNT _____

Reference mark distance: Before_____ After_____ Rail Temperature _____

Ballast Restored: Date _____

Ballast Compacted: Mechanical_____ Time and Tonnage _____

Alinement restored: Date_____ Stakes Monitored:_____ RNT Adjusted: _____

Restored Anchor pattern to standard or added to prevent movement: _____

Other: _____

Speed Restriction place: (date and speed) Speed Restriction removed: (date) _____

Name:_____ Date: _____

Rail Neutral Temperature at Pull Apart or Break Chart (Pre-Cut/Break Chart)

Example only. A different chart for each track type (wood or concrete) and rail size (136 or 115) used. The chart must start at the DRNT.

RAIL NEUTRAL TEMPERATURE AT PULL APART OR BREAK

RAIL GAP (INCHES)

RAIL TEMP (F)	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0
100	124	134	142	149	154	159	164	169	173	177
95	119	129	137	144	149	154	159	164	168	172
90	114	124	132	139	144	149	154	159	163	167
85	109	119	127	134	139	144	149	154	158	162
80	104	114	122	129	134	139	144	149	153	157
75	99	109	117	124	129	134	139	144	148	152
70	94	104	112	119	124	129	134	139	143	147
65	89	99	107	114	119	124	129	134	138	142
60	84	94	102	109	114	119	124	129	133	137
55	79	89	97	104	109	114	119	124	128	132
50	74	84	92	99	104	109	114	119	123	127
45	69	79	87	94	99	104	109	114	118	122
40	64	74	82	89	94	99	104	109	113	117
35	59	69	77	84	89	94	99	104	108	112
30	54	64	72	79	84	89	94	99	103	107
25	49	59	67	74	79	84	89	94	98	102
20	44	54	62	69	74	79	84	89	93	97
15	39	49	57	64	69	74	79	84	88	92
10	34	44	52	59	64	69	74	79	83	87
5	29	39	47	54	59	64	69	74	78	82
0	24	34	42	49	54	59	64	69	73	77
-5	19	29	37	44	49	54	59	64	68	72
-10	14	24	32	39	44	49	54	59	63	67
-15	9	19	27	34	39	44	49	54	58	62
-20	4	14	22	29	34	39	44	49	53	57

THERMAL ADJUSTMENT CHART **Rail expansion based on a 780' effected zone length (390' or 10 rail lengths each side of separation)**

Change in Temperature	Change in Length
5	1/4"
10	1/2"
15	7/8"
20	1-1/8"
25	1-3/8"
30	1-5/8"
35	1-7/8"
40	2-1/8"
45	2-1/2"
50	2-3/4"
55	3"
60	3-1/4"
65	3-1/2"
70	3-7/8"

RNT = 100 Degrees

Example:

1) If the rail temperature is 25 and pulls apart 1-1/2" it has a RNT of 67 Degrees.

2) If the territory requires a RNT of 100, an additional 33 degrees or 1-3/4" must be removed for proper adjustment.

3) Remove or adjust anchors on both sides of cut or joint.

4) Heat or pull rail 1-1/2" to close gap plus the additional 1-3/4" to adjust CWR to 100 degrees.

5) Remove additional rail to account for weld width if welding.

All numbers populating this form are used as examples only. The railroad must determine the expansion rate best used for their particular situation, but it must be within industry accepted best practices.

Rail Installation Adjustment Report

Division:_____ Subdivision:_____ Track Segment: _____

Track Supervisor:_____ Force or Gang:_____ Employee taking measurements: _____

Date	Mile Post Location	Side , ,	Track	Actual Rail Temp.	Desired Rail Temp.	Temp. Differential	Required Adjustment	Adj. at Station 1	Adj. at Station 2	Adj. at Station 3	Adj. at Station 4	New Adjusted RNT	Rail information

Walking Joint Bar Inspections

Railroad:_____

Division:_____

Track Supervisor:_____

Subdivision	Track	MilePost	Side (L or R)	Joint Identifier	Rail Size	Joint Type	Date inspected	Conditions found

Curve Alignment Reference Form

CURVE ALIGNMENT REFERENCE FOI M

TRACKID:
MILEPOST BEGIN:
MILEPOST END:

TEAM NAME:

WORK DIRECTION
(LOW TO HIGH MP)
(HIGH TO LOW MP)

DEGREE OF CURVE:

TYPE OF FASTENERS
Rail Anchors
Pandrol Platers
Other

		DATE:			
		RAIL TEMPERATURE:			
		RECORDER:			
No.	**DESCRIPTION**	**MEASUREMENT 1 BEFORE WORK**	**MEASUREMENT 2 AFTER WORK**	**MEASUREMENT 3 FOLLOW UP**	**MEASUREMENT 4 FOLLOW UP**

NOTES:

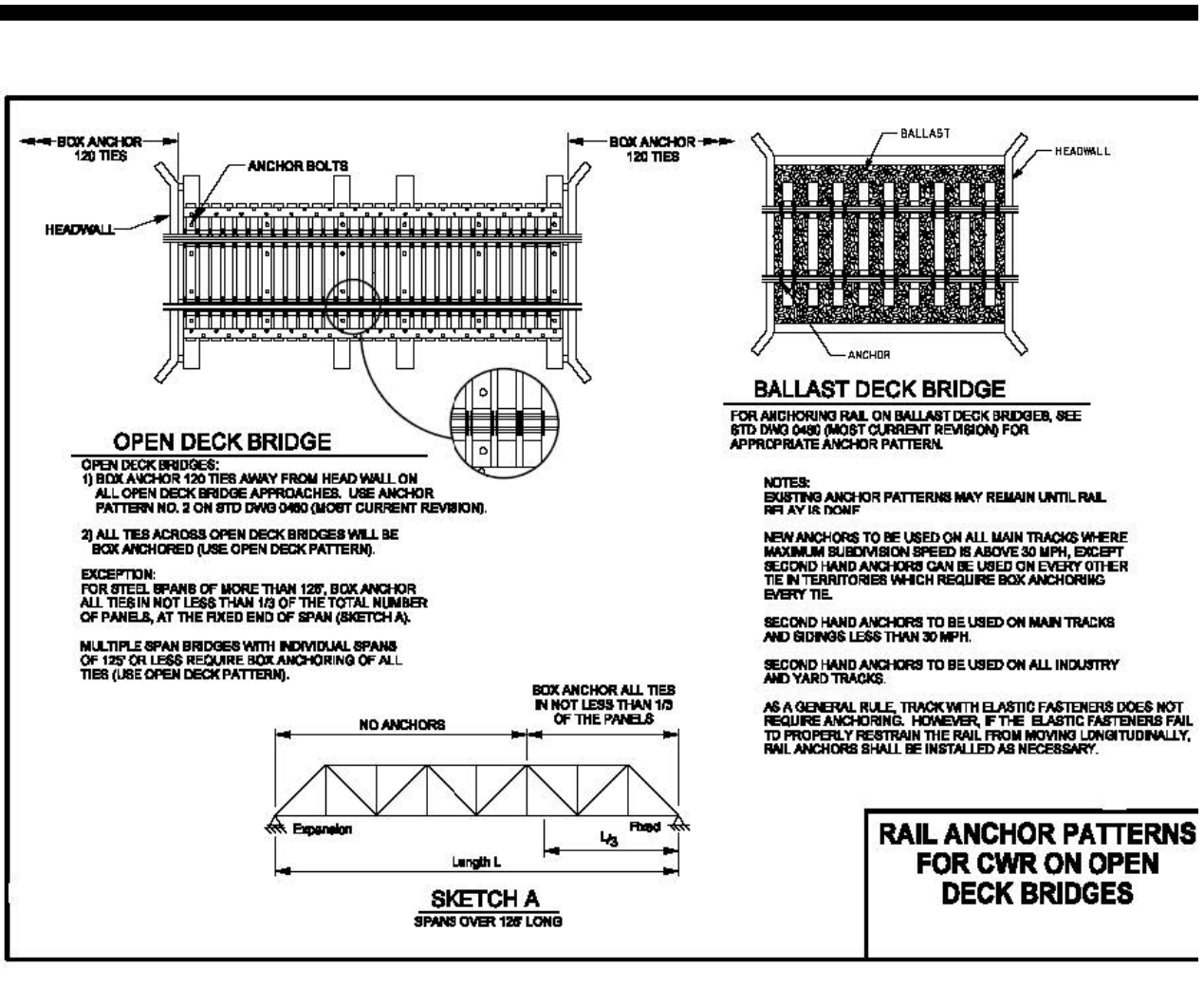
References should be marked fixed objects or wood stakes if practicable. Number reference points in sequence in the direction of work. In "Description", note TS, SC, CS, ST, and identify reference.

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.

Track Standard Drawing Example
Rail Anchor Patterns for CWR on Open Deck Bridges



CWR Rail Adjustment Chart Example

C=12 X0.0000065LT

C=CHANGE IN LENGTH IN INCHES
LENGTH OF RAIL IN FEET
T=CHANGEIN TEMPERATUREIN DEGREES

CHANGEIN RAILLENGTHDUE TOCHANGEIN TEMPERATURE

CHANGEIN TEMPERATURE IN DEGREES FAHRENHEIT

LENGTHOFRAL - 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-S/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-S/8	0-3/4	0-7/8	1	1	1-1/8	1-1/4	1-3/8	1-1/2	1-S/8	1-3/4	1-7/8
400	0-1/8	0-3/8	0-1/2	0-S/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-S/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-S/8	1-1/4	1-7/8	2-2/1	3-1/8	3-3/4	4-3/8	S	5-S/8	6-1/4	6-7/8	7-1/2	8-1/8	8-3/4	9-3/8	10

All continuous welded rail with a rail temperature below the rail installation safe range will be adjusted.

Example: When laying a rail 1300 feet long, with a rail temperature of 45°F. Reference the desired rail neutral temperature for the area in which it will be installed (in this example we will use 100°F).

The desired Temperature = 100°F The
Rail Temperature = 45°F
The difference between the two = 55°F
Cross-reference the line with 1300' with the column with 55° = 5-5/8 inches

Divide the rail length into four equal parts (325') and place a plate/base reference marks (make sure the plate is secured to prevent movement). Expand the rail making sure that the required amount is achieved at each station (1-13/32" per station).

Station 1 = 1-13/32", Station 2 = 2-13/16", Station 3 = 4-7/32", Station 4 = 5-5/8"

Be sure that the rail is headed, or expanded evenly throughout its length. Also, allow for weld additions or consumption when calculating cuts. Record all information on the proper form(s).