ARRC Track Stability Field Manual

October 2009

This field manual contains sections of the Engineering Instructions that are essential to preventing thermal track buckles. The purpose of this field manual is to provide a format for these requirements that can easily be carried and referenced in the field while performing track maintenance.
The history of thermal track buckles on the ARRC clearly indicate that when the Engineering Instructions contained in this manual are followed, all thermal track buckles are preventable.

Adherence to these instructions will ensure thermal track buckles will be prevented.

Track Buckle Prevention Basics

What does neutral temperature mean?

What is Rail Target Neutral Temperature (RTNT)?

Do you know what the RTNT is for your territory?

What is the hottest rail temperature you've measured or observed?

Track can buckle at rail temperatures of 60 degrees Fahrenheit higher than RTNT.

Did you know that adding ½" of rail to 800' length of rail can lower the neutral temperature by 10 degrees Fahrenheit?

- Think about the huge risk of making three thermite welds in an 800' segment that adds 1-1/2" of rail (1/2" per thermite weld).
- Rail neutral temperature had now been lowered by at least 25 degrees.
- If original neutral temperature was 90 degrees, it is now 65 degrees.
- 65 degrees neutral temperature on a hot summer day with rail temperature of 125 degrees has just moved the track into the buckle zone.

Did you know that lining a 3 degree curve in by 2" is the equivalent of adding 1" of rail to the track over a 1000' length?

- Curve could be lined in by a tamper or naturally due to a large drop in temperature.
- Adding 1" of rail over a 1000' segment results in a decrease in neutral temperature of approximately 13 degrees.
- There is a possibility that this decrease in neutral temperature could put the track in the buckle zone on a hot summer day.

Heating rail alone does not ensure success with regard to achieving the Target Neutral Temperature. You have to place match marks on the rail and tie plates (or shoulder if concrete ties) and observe rail movement to know that you have achieved the TNT.

Do's and Don't's of Track Stress Management

DO know the Rail Target Neutral Temperature for your territory.

DON’T add rail to the track without specific documentation and a plan to remove added rail.

DO use match marks on the rail and tie plate to ensure and observe rail movement.

DON’T line a cure inward during maintenance or surfacing operations without specific documentation and a plan to adjust for added rail that results from lining the curve in.

DO always remember that surfacing or raising track through a sag or low spot (including vertical curves) can have the same effect as lining a curve in, that is, the result can be the same as adding rail.

DON’T disturb the ballast without knowing how the condition will be protected.

DO always remember the influence of fixed objects such as bridges, road crossings and turnouts.

DON’T forget to ensure that all rail anchors associated with the job you’re working on are tight against the tie.

DO remember this rule of thumb:

- Half of the track’s stability is re-established by the appropriate number of qualifying tonnage trains.

- It takes approximately one million tons of traffic to re-establish the remaining half of the track’s stability.

DON’T lull yourself into believing that a full ballast shoulder and crib will prevent a buckle; if there’s too much rail then the bomb is already ticking.

DO always comply with procedures outlined in,Table 4-1, when placing or removing temporary speed instructions.

DON’T forget about the importance of transition anchoring, which cushions the effect of tying into a fixed object (example: locations where bolted rail ties into welded rail).

DO always remember that the rail neutral temperature decreases over time.

ARRC Track Stability Field Manual

Maintaining Track Stability is Essential in the Prevention
of Track Buckles and Safe Train Operation

The use of this manual will assist ARRC field forces on maintaining track stability.

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Track Inspection

Inspecting Track Repair and Renewals

Gang Supervisors inspect the track worked by their gang each day to be certain that the work was performed properly. When checking the quality of work, ensure the following:

- Alignment, gauge and surface appropriate
- Ballast properly dressing
- Ties up tight against the rail base and fully tamped
- Tie plates on and centered on the ties
- Rail properly seated in the tie plates
- Tie fasteners properly placed
- Joints tightly bolted with at least two bolts in each rail end
- Proper speed restriction in place
- Rail anchors properly placed, installed tight against the ties, and in the prescribed pattern

Special Instructions

Hot Weather

When rail temperatures are expected to reach 115 degrees or higher inspect the track between 1200 and 2000 hours or as instructed by the Roadmaster.
In addition, when the ambient temperature equals TNT, maximum track speed will be 40 mph for the areas affected. When the ambient temperature exceeds TNT, maximum track speed will be determined by the Superintendent of Maintenance.

1. Watch for:

- “Kinky” or “snakey” rail, or running rail
- Churning ties and ballast

2. Pay particular attention to:

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

3. Look for the following substandard conditions:

- Nonstandard ballast section. Pay particular attention to turnouts, crossings, and bridges.

- Nonstandard anchor pattern. Check the solid pattern at railroad crossings, at turnouts where CWR butts up to bolted rail, etc

- Tight rail conditions. Look for alignment deviations, gauge variations, rail rising out of plates, and joints that are tight during cool weather.

- Weak track conditions, such as a cluster of defective ties that will not hold alignment gauge and/or surface.

- Poor surface conditions, which can result from the previous substandard conditions.

If in doubt cut the rail and relieve the stress.

Tight rail and track buckling can appear where rail is replaced or field welded during cool weather. On warm days after the work is completed, inspect these locations closely. If symptoms of tight rail or track buckling appear, have maintenance personnel cut the rail and relieve the stress. Refer to Replacing Rail or Thermite Welding Below Target Neutral Temperature. Cold weather

Cold Weather

This guideline establishes the threshold temperatures that trigger special track inspections and reduction in train speeds.

Track inspections

During the first significant cold weather of the season (below 0 degrees) the track must be inspected for broken rails and/or pull-aparts. Additionally:

- Anytime the ambient temperature reaches -15 degrees, the primary duty of Maintenance of Way employees will be to inspect for broken rails and pull-aparts.
- Anytime the ambient temperature reaches -20 degrees, a daily track inspection will be performed over the affected territory.

On branch lines that do not have a daily service, a track inspection must be performed ahead of trains(s) on days service is provided. Also, Cold Weather Train Speeds must be observed until temperatures rise above the Low Temperature Threshold.

When performing inspections watch for:

- Broken rail
- Stripped joints

- Broken joint bars

Cold weather train speeds

When the ambient temperature reaches -35 degrees the maximum authorized track speed for the affected area will be 40 MPH for all trains.
Cold weather train speeds must be observed until temperatures rise above -35 degrees.

Repaired Track

Tight Rail
Destress tight rail. Cut out part of the rail immediately or place the proper temporary speed restriction until the rail is cut and the track has stabilized.

Service Interruptions – See Figure 6-4 for Additional Information

Derailments

Restoring Derailments
Laying Panels

When laying track panels:

When laying panels in a curve, align the panels properly as follows:

a. Pay particular attention to shortening the low rail and lengthening the high rail.

b. Shorten the low rail 3/8 inch per panel per degree of curvature.

c. If no reference marks or adjacent track is available to achieve the proper curvature, use stringlining.

Consider thermal expansion and contraction when adjusting the rail.

a. Record on the rail the rail temperature of panels when placed and tied in.

After restoring the track completely, periodically inspect the location. Adjust the rail as needed, especially if subsequent lining has moved a curve "in".

Temporary Speed Restrictions

Placing Temporary Speed Restrictions – General

Lengthening Restriction Limits

When necessary and when conditions could cause heavy braking too close to a temporary speed restriction, lengthen the temporary speed restriction limits by at least 0.2 mile before and at least 0.2 mile after the area of the speed restriction. Consider the following conditions:

- Rail temperatures at or above Target Neutral Temperature
- Recently disturbed track
- Descending grade
- Approaches to any fixed object
- Sharp curves

Placing Temporary Speed Restrictions on Track Not Meeting ARRC or FRA Standards)

Track Not Meeting ARRC Track Standards

When a qualified person determines that a track is not safe for trains to operate at authorized speed per ARRC standards or FRA Track Safety Standards, place an appropriate speed restriction per these instructions. Determine whether to place a temporary speed restriction on other substandard conditions based on inspection of the following conditions.

Note: For example, consider placing a temporary speed restriction when:

- Rail temperature is expected to rise over the target Neutral Temperature (85 degrees)
  and
- Any of the following conditions exists that may indicate tight rail or reduce the track structure's lateral resistance:

  - Poor tie condition
  - Floating or hanging ties
  - Inadequate ballast section to maintain surface and line
  - Sink holes
  - Rail running through anchors
  - Churning of ballast
  - Rail base not properly seated in tie plates
  - Line kinks in tangent
  - Short flat spots on curves
  - Rail added to the track through rail change-out but not properly adjusted as described in the Rail Adjustment Book

High Rail Temperatures

Track Replaced or Welded in Cold Weather

Tight rail and track buckling can appear where rail is replaced or field welded during cool weather. On warm days after the work is completed, inspect these locations closely. If symptoms of tight rail or track buckling appear, have maintenance personnel cut the rail and relieve the stress. Refer to Replacing Rail or Thermite Welding Below Target Neutral Temperature.

Repaired Track

Repairs and other events can affect the integrity of the track. The Roadmaster or designated employee records on the Rail Adjustment Record, (Form 1338-005P), where the integrity of the track has been or could have been affected by repairs or other events. If rail was added, cut it out before temperatures become warm.

Tight Rail

Destress tight rail. Cut out part of the rail immediately or place the proper temporary speed restriction until the rail is cut and the track has stabilized.

Temporary Speed Restriction Tables

Tables 4-1 and 4-2 contain the minimum requirements for temporary speed restrictions. If conditions warrant, use a more restrictive speed and/or duration. During the time of day when the sun cannot be a factor in elevating rail temperatures, the following exception will apply to Table 4-1 Temporary Speed Restrictions for Track Work:

EXCEPTION: If a disturbed track speed restriction is in effect and the rail temperature remains above the threshold temperature, adhere to the requirements of Table 4-1. However, if the rail temperature drops below 85 degrees before the required trains pass over the restricted area, you may modify or remove the speed restriction under the following conditions:

1. At least 2 trains have passed over the restricted area at 25 mph.

2. A qualified employee visually inspects the entire segment of restricted track to ensure that the track meets all standards required for higher train speeds.

The speed restriction may remain modified or removed if the required number of trains, as originally required in Table 4-1 have passed over the affected segment of track during the period of time the rail temperature dropped below the threshold.

If the rail temperature rises to or above the threshold and the number of trains originally required for compaction have not passed re-establish the speed restriction. The restriction must remain in place until the number of trains originally required by Table 4-1 to achieve required compaction have passed and a qualified employee has inspected the affected segment of track.

Note: As used in Table 4-1 “trains” refers to tonnage trains for stabilizing purposes. A tonnage train must have at least 30 cars. Stabilizing effects of passenger trains equate to 30-car tonnage trains on a per-car basis. For example, a 30-car passenger train equals one tonnage train or six 5-car passenger trains equal one tonnage train (5 x 6 = 30).

Note: When the track has been disturbed as outlined in Table 4-1 and you have not properly applied the anchors and restored the ballast section, protect the track with a 10 mph speed restriction.

Table 4-1. Temporary Speed Restrictions for Track Work.

Temporary Speed Restrictions For Track Work			
Type of Work	Maximum Speed	Minimum Duration to Stabilize Track After Repairs Completed	Notes and Definitions
Rail Laying (Curves)	25 MPH	1 train @ 25 MPH. If OK, then max. auth. speed Note – Rail must be lubricated on gage face of high rail and running surface of low rail prior to the first train.	This table outlines only the minimum requirements. If conditions warrant, temporary speed

<table>
<tr><td>Less than four (4) per 39’ (more than 2 together)</td><td>25 MPH</td><td>2 trains @ 25 MPH. If OK, then max. auth. speed</td><td rowspan="6">Duration of Stabilization – A track repair is considered complete when all joints have at least two properly tightened bolts in the end of each rail. All ties are spiked. Anchors applied and ballast dressed to a standard section.

OK – Track is considered OK if it has not moved or settled and otherwise meets all other standards.</td></tr>
<tr><td>Five (5) or more per 39’</td><td>25 MPH</td><td>5 trains @ 25 MPH. If OK, then max. auth. speed</td></tr>
<tr><td>Spot Surfacing: Less than 10’ surfaced in any 39’ distance</td><td>25 MPH</td><td>2 trains @ 25 MPH. If OK, then max. auth. speed</td></tr>
<tr><td>Out-of-Face Surfacing:
10’ or more surfaced in any 39’ distance</td><td>25 MPH</td><td>5 trains @ 25 MPH. If OK, then max. auth. speed</td></tr>
<tr><td>Bridge Approach Surfacing:
(Does not apply to major bridge rehab. work)</td><td>25 MPH</td><td>5 trains @ 25 MPH. If OK, then max. auth. speed</td></tr>
<tr><td>Undercutting:</td><td>10-25 MPH</td><td>2 trains @ 10 MPH, And
5 trains @ 25 MPH. If OK, then max. auth. speed</td></tr>
</table>

*Whichever is less.
**Note: For spot work activities not exceeding 500 track feet only one-half of the minimum number of trains are required for stabilization purposes when the foreman in charge knows that neither rail is in compression at the TNT. In bolted rail territory, loosen the joint bars and observe that the expansion gaps are present between the rail ends.

Rail

Laying Rail

Proper Longitudinal Stresses in Continuous Welded Rail (CWR)

Rail expands (lengthens) when heated and contracts (shortens) when cooled. The temperature of rail in track exposed to weather can vary from as high as 145^{o}F to as low as -35 F. When restrained from moving during temperature changes rail develops longitudinal (lengthwise) compressive or tensile forces.

Rail maintained at Target Neutral Temperature (TNT)

Alaska Railroad Corporation (ARRC) requires that CWR be laid and maintained at the target neutral temperature (TNT) of 85 degrees.

When rail is laid and maintained at the TNT it will not be in compression until the rail temperature is greater than the TNT. Well-maintained track can with stand compressive forces in the rail up to the maximum temperature the rail will attain.

Amount of Rail Length Adjustment to Change in Temperature

Table 6-3 calculates the change in rail length for a given amount of temperature change from the formula 0.0000065 x TD x L x 12 where:

0.0000065 = Coefficient of the expansion of steel

TD = Temperature differential (TNT – existing neutral temperature)

L = Total length of unrestrained (unanchored or unclipped) rail

Table 6-3. Change in length of Welded Rail to Change Neutral Temperature.

Temp. Diff. In Deg. F	Length of Unrestrained Rail						
	400’	600’	800’	1000’	1200’	1400’	1600’
5°	¼”	¼”	¼”	½”	½”	½”	½”
10°	¼”	½”	½”	¾”	1”	1”	1 ¼”
15°	½”	¾”	1”	1 ¼”	1 ½”	1 ¾”	1 ¾”
20°	½”	1”	1 ¼”	1 ½”	1 ¾”	2 ¼”	2 ½”
25°	¾”	1 ¼”	1 ½”	2”	2 ¼”	2 ¾”	3”
30°	1”	1 ¾”	2 ¼”	2 ¾”	3 ¼”	3 ¾”	4 ¼”
35°	1”	1 ¾”	2 ¼”	2 ¾”	3 ¼”	3 ¾”	4 ¼”
40°	1 ¼”	1 ¾”	2 ½”	3”	3 ¾”	4 ¼”	5”
45°	1 ½”	2”	2 ¾”	3 ½”	4 ¼”	5”	5 ½”
50°	1 ½”	2 ¼”	3”	4”	4 ¾”	5 ½”	6 ¼”
55°	1 ¾”	2 ½”	3 ½”	4 ¼”	5 ¼”	6”	6 ¾”
60°	1 ¾”	2 ¾”	3 ¾”	4 ¾”	5 ½”	6 ½”	7 ½”
65°	2”	3”	4”	5”	6”	7”	8”
70°	2 ¼”	3 ¼”	4 ¼”	5 ½”	6 ½”	7 ¾”	8 ¾”
75°	2 ¼”	3 ½”	4 ¾”	5 ¾”	7”	8 ¼”	9 ¼”
80°	2 ½”	3 ¾”	5”	6 ¼”	7 ½”	8 ¾”	10”
85°	2 ¾”	4”	5 ¼”	6 ¾”	8”	9 ¼”	10 ½”
90°	2 ¾”	4 ¼”	5 ½”	7”	8 ½”	9 ¾”	11 ¼”
95°	3 “	4 ½”	6”	7 ½”	9”	10 ¼”	11 ¾”
100°	3”	4 ¾”	6 ¼”	7 ¾”	9 ¼”	11”	12 ½”

Note: The above amounts do not allow for rail that will be added during thermite welding nor rail that will be removed in upset during flash-butt welding.

Use Table 6-3 to determine how much to shorten or lengthen a known rail length to adjust it from its current neutral temperature to the TNT.

- Rail thermometers are used to measure the rail’s current neutral temperature to be used with Table 6-3.
- The left column (Temperature Differential in degrees F) is the difference between the current rail temperature and the TNT in degrees Fahrenheit.
- Values in the remaining columns are the rail length adjustment (in inches) required for the length of unrestrained rail (in feet) indicated at the top of each column.

- The rail length adjustment required to achieve the target neutral temperature is the intersection of the row containing the appropriate temperature differential and the column containing the appropriate unrestrained rail length.

Adjust the known rail length by the number of inches determined above using a rail heater or a rail expander.

Laying CWR

When laying welded rail ensure that the neutral temperature of the rail at the time it is anchored in the track is at above the TNT.

Making Accurate Rail Temperature Measurements

Determine the current neutral temperature of the rail by accurately measuring the rail temperature soon after the rail is threaded into the plates. The temperature of the rail when the rail string is threaded into the plates is its current neutral temperature. Measure the rail temperature as follows:

1. Obtain two approved rail thermometers from the foreman in charge of rail laying.

2. Check the accuracy of the thermometer at least once per day by reading both thermometers placed side by side on the rail. If the readings vary by more that 2^{o}F compare a third thermometer to the first two.

3. When using a magnetic rail thermometer place the thermometer on the shaded side of the rail near the bottom of the web. Leave the thermometer in place at least 10 minutes before reading the temperature.

   Note: Use other temperature-measuring devices such as infrared heat guns according to the manufacturer’s recommendations.

4. Determine the best location along the side of the rail string to measure the rail temperature. The temperature may not be constant throughout the length of rail. If necessary, take measurements at more than one location along the string to determine the most representative rail temperature.

Adjusting Rail length

Determine whether to adjust the rail length from the current neutral temperature.

- If the current neutral temperature of the rail is greater than the TNT, anchor the rail without adjusting its length.

  or

- If the current neutral temperature of the rail is less than the TNT, adjust the length of the rail so that the neutral temperature when the rail is anchored is at least equal to the TNT.

To adjust the rail length:

1. Rail Length Adjustment Marks

   After laying the first 400 feet of rail in the tie plates mark that location as follows:

   a. Spray paint a mark on the web of rail and tie plate where you will put growth marks (hash marks) on the field side of rail.

   b. Take the temperature of rail at that location. Mark it on the web of rail.

   c. Use Table 6-3 to figure the amount of rail movement required.

      1) Mark that measurement on the web of rail at the 400-foot mark

      2) Also mark the measurement oat the base of rail, field side, at the edge of the tie closest to the 400-foot mark.

   d. Maintain this location during the installation process to confirm the appropriate rail growth by an assistant foreman or rail heater operator.

   Repeat steps a through c every 400 feet of the rail string being installed until you reach the end of the string or until you reach the Target Neutral Temperature. At this point the only marks at the 400-foot locations should be the rail temperature marked on the web of rail.

2. Rail Length Adjustment Amount

To find the rail movement measurement required to be marked at each 400-foot interval of rail:

a. Subtract the measured rail temperature from the TNT on Figure 6-1.

b. Find that temperature differential in the left column of Table 6-3.

c. In the row opposite that temperature differential find the match-mark offset for each 400 feet.

Note: For example, assume that you are laying a CWR string at Montana that is 1,440 feet long and the rail temperature as measured with a rail thermometer is 55 F. Since the neutral temperature when the match marks were made was 55^{o}F and the TNT is 85^{o}F (see Figure 6-1) the temperature differential is:

85 – 55 = 30 degrees

- At 400 feet from the beginning of the string the match mark must move 1 inch.
- At 800 feet it must move 1-3/4 inches.
- At 1,200 feet it must move 2-3/4 inches.
- At 1,440 feet form the interpolation between 1,400 feet and 1,600 feet movement at the end of the string must be about 3-3/8 inches.

3. Rail Heating

Progressively heat the rail while monitoring the expansion at the match mark and anchor the rail.

a. Provide the rail with one free end that is neither attached to nor butting against another rail.

b. Start the rail heater at the beginning of the string behind the gauge spike and uniformly heat the rail while moving the heater toward the first match mark.

c. While heating the rail vibrate the rail or tap the tie plates ahead of the rail heater to lessen the amount of friction between the rail and plates. Lessening the friction ensures that the rail can expand without binding in the tie plates or spikes. Never strike the rail with a maul.

c. Heat the rail evenly and uniformly throughout its length.

4. Rail Anchoring

Examine the first match mark to determine if the rail is being expanded by the right amount. If it is, begin anchoring behind the rail heater, wait until after the rail heater passes the first match mark to preserve the expansion that has been achieved.

Note: When this procedure is performed properly the rail will be anchored at its target neutral temperature of 85^{o} F and it will not have thermal compressive forces until its temperature reaches 85^{o} F.

Recording Rail Laying Temperatures

When laying CWR record rail laying temperatures as follows:

1. Use a paint stick to write “laid” followed by the date and rail laid temperature on both sides of the web of the rail near both ends of the string.
2. Complete the following form in Figure 6-2.

.

Record of Neutral Temperature
Of Welded Rail as Laid

Division________________________ Subdivn_______________________ Line Segment________________

Relay Between___________________ and __________________________ Recorded by_________________

Target Neutral Temperature = 85° F

Date Rail Laid	Curve No And/or MP loca	Position		Track Number	Actual Rail Temp.	Temp Diff	Distance to Match mark	Expansion at Matchmark		Length of String	Remarks
		E Rail	W Rail					Required	Actual		

3-part form to be distributed as follows: White – Division Engineer, Canary – Roadmaster, Pink – Foreman.

Note: Be familiar with the following definitions when recording the temperature reading:

1.1.1.1 Term	1.1.1.2 Definition
Rail Temp	Rail temperature in degrees Fahrenheit taken when the rail is anchored
Time	When rail temperatures are taken
Date	Date rail is laid
Location/Description	Notes about special items (such as weather, curve number, high or low rail, east or west rail, near turnout, road crossing, etc.)

In-track Welding

When cropping and continuously welding conventional bolted rail by an in-track welding process anchor the rail at a neutral temperature greater than or equal to the TNT. Follow this procedure:

1. Using an accurate rail thermometer, measure the rail temperature six rails lengths behind the welder.

2. If the rail temperature is greater than the TNT anchor the rail immediately per ARRC standards for continuous welded rail.

3. If the rail temperature is less than the TNT:

   a. Allow the welder to progress until there is approximately 500 feet of unanchored rail between the last anchored rail and the welder.

   b. Measure the rail temperature at the beginning of the unanchored length of rail and simultaneously make a match mark across the rail base and a tie plate 400 feet from the beginning of the unanchored rail.

   c. Subtract the measured rail temperature form then TNT; refer to Table 6-3.

   d. Determine the required match mark offset by finding the value directly opposite the temperature differential in the column headed “400 Feet.”

   e. Move the rail heater ahead so that the proper expansion occurs at the match mark. Anchor the rail.

   f. Continue to monitor the rail temperature behind the welder and repeat the above process whenever the rail temperature is less than the TNT.

4. Complete the form "Record of Neutral Temperature of Welded Rail as Laid" (see Figure 6-2).

De-stressing CWR

Refer to existing policies and procedures contained in the Engineering Instructions for specific information on managing rail stress and slow orders in conjunction with disturbed track.

De-stressing means adjusting the neutral temperature of rail in track by cutting the rail to adjust the amount of rail in a given length of track. De-stressing is removing anchors or clips for a minimum total length of 400 feet and adjusting the rail to the TNT. Cutting out rail, including rail that was previously added, without removing anchors for minimum total length of 400 feet and adjusting the rail is "removing rail," but it is not "de-stressing". Replace or reset anchors after removing rail or de-stressing.

A. Conditions that Require De-stressing CWR

Conditions that cause incorrect neural temperature in the rail are as follows.

1. Rail Laid Cold

   a. If very cold rail is laid or an operable rail heater is not available, the rail may have to be laid and anchored at a low neutral temperature. This often occurs with concrete tie renewal and new track construction. When laying rail at a rail temperature below the TNT and not properly adjusting the length, protect the track with an appropriate slow order (when conditions warrant) until the rail can be de-stressed.

   b. Rail laid below the TNT will have anchors applied to the field side of the string for 30 feet on each end. When the form "Record of Neutral Temperature of Welded Rail as Laid" (see Figure 6-2) is completed the word "cold" must be entered in the "Remarks" column.

2. Rail Laid Hot

   Rail laid while hot will have a high neutral temperature. At certain locations the rail can develop tensile forces that, in cold weather, can shear bolts in joints and turnout components and can cause curves to realign inward.

These excessive tensile stresses may have to be de-stressed later when the rail temperature is lower than when it was laid.

3. Longitudinal Rail Movement Due to Traffic

Rail creepage has the following characteristics:

- On tracks where gross tonnage is not directionally balanced expect the rail to move in the direction of the heavyset tonnage, except when the heaviest tonnage ascends long grades.

- Expect the rail to move where trains are required to apply brakes such as on grades and in approach to permanent speed restrictions (such as siding switches, yard limits, railroad crossings, restricted curves, or bridges, and other locations where trains routinely decelerate).

- At certain track fixtures such as road crossings, open-deck bridges, turnouts, etc., expect the rail to be more resistant to gradual longitudinal creeping than rail in open track. Rail with excessive longitudinal forces is often found adjacent to these fixtures.

4. Lateral Rail Movement on Curves

Curved track tends to move laterally in response to temperature. Since rail on a curve may line in (shorten) in cold weather expect that curved rail may have a low neutral temperature and therefore develop high compressive forces as the rail temperature increases. If needed, set offset stakes at 50-foot intervals around a curve and use the offset measurements to monitor any lateral movement of the track that might change the neutral temperature. Surfacing track through curves will always adjust the neutral temperature of the rail in the curve toward the existing rail temperature at the time of the surfacing.

5. Longitudinal Stresses Caused by Maintenance Activities

Many maintenance activities can alter the neutral temperature of the rail.

- Significantly disturbing the ballast section (undercutting, surfacing, performing heavy tie renewals, installing concrete ties, etc) along a segment of track can make the rail shift in response to imposed thermal and mechanical forces.
- Lining curves and surfacing over crests and through sags can change the amount of rail present in a given length of track and therefore change the neutral temperature of the rail.
- Breaking the continuity of the rail (while installing repair plugs, insulated joints, track panels, turnouts, etc.) can allow the rail to move longitudinally.

6. Maintenance Performed Near Fixed Objects

Certain maintenance activities significantly disturb the ballast section and can alter or lower the neutral temperature. These activities include:

- Undercutting
- Performing tie renewal activities
- Lining a curve inward
- Surfacing track in a sag
- Correcting a sharp alignment on a segment of tangent track

Give special attention to work performed within 400 feet of a fixed object such an open deck bridge, turnout, railroad crossing, road crossing, or bottom of a grade. Excessive longitudinal forces often exist near these areas.

a. When performing the above work be sure to de-stress rail for a distance of 400 feet away from a fixed object when:

    - Track is on or near the bottom of a grade of 2 percent or greater and traffic exceeds 10 MGT per year.

- A curve is lined in within 400 feet of a fixed object.
- Chronic subgrade problem areas exist.

b. When de-stressing rail near fixed objects, de-stress each rail to a temperature that is 10 degrees higher than the TNT.

c. Pay particular attention to fixed objects near locations that are routinely subjected to changes in train handling. Longitudinal rail stresses can concentrate in these areas. Examples are turnouts with a diverging route speed that is lower than the normal route speed, and locations with permanently posted speed restrictions.

d. If there is reason to believe, through observations or otherwise, that the current neutral temperature had been significantly lowered then de-stress the rail after completing the surface correction and before removing the temporary speed restriction.

e. If the location has been de-stressed within the last year or work had been performed within the last year such as a rail relay, you may not need to de-stress the rail.

f. Refer to existing policies and procedures contained in the Engineering Instructions for specific information on managing rail stress and temporary speed restrictions in conjunction with disturbed track.

7. Concrete Tie Installation

De-stress rail in conjunction with concrete tie installation as follows:

a. Determine whether to de-stress the rail.

1) If the rail temperature is a least 10^{o}F above the TNT during surfacing, do not de-stress the rail.

or

2) If the rail temperature is less that 10^{o}F above the TNT during surfacing de-stress the rail behind the final surfacing.

b. Immediately following the final pass of the surfacing gang, record the rail temperature at the very end of every continuous welded rail string or approximately every 1,400 feet.

B. Estimating Limits of De-stressing

Estimate the amount of rail to de-stress by considering what initially created the tight rail condition as follows:

1. Inspect the track for evidence of rail movement. Consider grades, curvature, track fixtures, and traffic conditions to estimate the limits of rail with low neutral temperature.

   Note: For instance, if the rail is tight because of a cold weather emergency rail repair several weeks ago probably not as much rail will need to be de-stressed than if the rail was tight because of track creepage under traffic over a period of months or years.

2. If de-stressing behind a steel gang or a concrete tie gang obtain the records of those operations to determine the limits of de-stressing.

3. Determine how many track feet of rail to de-stress at a time by considering the size of the work force, available track time, rail temperature, and track conditions.

   a. Do not cut rail more often that necessary. However, avoid de-stressing long distances per cut, which reduces the chances of achieving a uniform neutral temperature.

   b. Recognize that it is more difficult to adjust rail of track filled with ballast, track with rough surface or alignment, curved track, concrete tie track, and so forth.

> When evidence of compressive stress in the rail indicates that the track may buckle (“snaky rail”), an emergency exists. Immediately cut the rail to relieve the stress. Do not consider whether the rail can be de stressed properly according to these instructions.

C. Cutting Rail

After determining the amount of rail to be de-stressed in the first pull, cut the rail at the midpoint of that length as follows:

1. Before cutting the rail, use a paint stick to make two marks on top of the trail where the marks will not be removed during de-stressing.

2. Measure and record the distance between these two marks to enable you to measure the total length adjustment after the de-stressing is complete.

3. Determine whether to saw cut or torch cut the rail as follows:

    a. If the rail temperature is cool and the rail is likely to be in tension, saw cut the rail.

    or

    b. If the rail temperature is hot and the rail is likely to be in compression, torch cut the rail. Be extra careful when cutting tight rail.

D. Eliminating Longitudinal Stress in Rail

To neutralize the thermal forces in the rail:

1. Remove the anchors from the rail over the entire length being de-stressed.

Note: If the rail is restrained by elastic fasteners the term “anchors”, as used here, means the same thing as “clips”.

a. If the rail was cool and in tension when cut the rail ends will gap wider as the anchors are removed.

or

b. If the rail was hot and in compression when cut the rail ends will run toward each other and must be offset or the gap cut wider so that the rail can expand freely.

2. Minimize the frictional resistance on the base of the rail by vibrating the rail or tapping the plates.

WARNING: Never strike the rail with a maul.

3. After the rail has moved as much as it will move determine the rail temperature. This is the rail’s new current neutral temperature.

E. Measuring Rail Temperature to Properly Adjust Length

After eliminating the stress in the rail accurately measure the rail temperature.

Refer to Table 6-3 to determine the length adjustment required.

Note: For example, if the rail temperature in Healy is 65 F, the temperature differential is 20^{o}F (85^{o} – 65^{o}F). With a temperature differential of 20^{o}F for an unrestrained rail length of 1,000 feet, the adjustment amount is the value under the column heading “1,000 Feet” and across from 20^{o}F in the temperature differential column or 1-1/2 inches.

1. To shorten the rail 1-1/2 inches as indicated in the above example:

a. If the rail was saw cut initially, cut it again so that the overall rail-end gap is 1-1/2 inches.

or

b. If the rail was torch cut initially crop the torch-cut rail ends and, if necessary, install a rail plug that meets the minimum length requirements for repair rail. Saw cut the rail-end gap 1-1/2 inches wider than the length of the plug.

2. To add or subtract metal by field welding (which is not indicated in the above example):

a. If using a 1-inch gap thermite weld to rejoin the rail ends cut the rail-end gap 1 inch wider (per weld) than shown on Table 6-3.

or

b. If using an electric flash-butt welder to rejoin the rail ends cut the rail-end gap 2 inches narrower (per weld) than shown on Table 6-3.

F. Using a Hydraulic Rail Expander

Close the rail-end gap as follows so that a bolted joint or field weld can be installed:

1. Apply a rail expander to the rail ends.

2. Vibrate the rail or tap on the tie plates while stretching the rail to permit the longitudinal force in the rail to equalize over the unanchored length.

3. On long pulls, make match marks across the rail base and tie plates to monitor the rail movement to verify uniform expansion.

4. If possible, do not de-stress rail with the expander adjacent to a turnout, railroad crossing, or other special track work, which can be adversely affected by the high tensile stresses.

5. After de-stressing a continuous welded rail in track do not assume the opposite rail will require the same amount of adjustment at the same location.

6. Re-apply rail anchors according to ARRC standards. Properly record the total amount of length adjustment on a “Rail Adjustment Record” (Form 1338-005P See Figure 6-3) as follows:

   a. Determine the total amount of rail removed from (or added to) the track, not the rail-end gap determined from Table 6-3. The amount is the difference in the distance between the two paint marks made on the ball of the rail at the beginning and at the end of de-stressing before the rail was cut.

   b. On the web of the rail near where the rail expander was applied write “Adjusted” followed by the date.

Figure 6-3 ARRC Form 1338-005P

MWC 2 RAIL ADJUSTMENT RECORD

Division:	Line Segment:	Date
Adjusted by (Signature)		

A. Reason for adjustment ______________________
1) Service failure, broken rail ______________________
2) Detector Car defect ______________________
3) Open joint ______________________
4) Adjustment due to heat ______________________
5) Other (explain) ______________________

____

B. Milepost where adjustment occurred ______________________
C. Curve or tangent ______________________
D. Weight of rail ______________________
E. Adjustment made to which rail ______________________
F. Rail temperature at time of adjustment ______________________
G. Amount of rail added or subtracted ______________________
H. Rail was cut in, out, or welded ______________________
I. Show specific data recorded on rail ______________________

____

____

If rail was added, indicate date follow-up rail adjustment is made ______________________

Laying Bolted Rail

Controlling longitudinal forces in bolted rail is not as critical as controlling them in continuous welded rail. Still follow the proper procedure for laying and maintaining bolted rail.

Lay bolted rail of a 39-foot length so that expansion gaps exist between the ends of adjacent rails according to Table 6-4 below.

Use standard expansion shims on bolted rail and leave them in place until the bolts are tightened. Measure the rail temperature at least once per hour or more often if weather dictates.

Table 6-4. Expansion Gaps for Bolted Rail

EXPANSION GAPS FOR BOLTED RAIL	
• RAIL TEMP. (F)	• RAIL END GAP
• -20 to 0	• 3/8”
• 0 to 25	• 1/4”
• 25 to 50	• 3/16”
• 50 to 75	• 1/8”
• 75 to 100	• 1/16”
• Over 100	• Laid tight

Observing Longitudinal Stress in Bolted Rail

Anchoring Rail

Rail anchors prevent rail from moving longitudinally relative to the ties. Be careful to ensure that the anchor is fully driven but not overdriven. Apply the following anchor policy to all new and second-hand (SH) rail relays. You are not required to apply additional anchors to rail currently in track to comply with this standard unless conditions warrant.

Anchoring CWR

Anchor continuous welded rail as follows:

1. Box anchor the rail anchors for 184 ties on each side of permanent bolted joints, railroad crossings, and open-deck bridges. Do not apply anchors opposite of joint bars.

2. Box anchor the rail anchors for 184 ties ahead of a switch point and behind the heel of a frog on both the main track and the turnout side.

3. Elsewhere box anchor every second tie.

4. Maintain the anchors so that they bear against the edge of either the tie or the tie plate.

Anchoring Bolted Rail

Anchor conventional bolted rail as follows:

1. On all bolted rail track:

   a. Box anchor every tie for 184 ties on each side of rail crossings and open-deck bridges.

   b. Box anchor every tie for 184 ties ahead of a switch point and behind the heel of a frog on both the main track and the turnout side.

2. On bolted rail track box anchor every third tie except those locations specified above.

3. When anchoring rail as specified above and the anchors would fall at a rail joint do not box anchor that tie, box anchor the tie next to the joint.

Transition anchoring

Where conventional bolted rail joins continuous welded rail box anchor the rail on every tie for 184 ties from the joint in both directions.

Anchoring Turnouts

Where possible, anchor a turnout with eight anchors on each switch tie. Apply this pattern to both welded and bolted turnouts except where elastic fasteners are used.

Anchoring Bridges

Anchor rail on bridges as follows:

1. Anchor rail on ballast deck bridges with the same pattern as the rail adjacent to the bridge.

2. On open-deck timber bridges apply anchors only to ties that are bolted to the bridge stringers.

3. On open-deck steel bridges should be individually reviewed and any anchoring plan approved by Engineering Services.

4. On all other structures apply anchors as directed by Engineering Services.

Maintaining Anchors

Maintain anchors as follows:

1. When anchors are applied in the prescribed pattern and rail movement is evident:

    a. Inspect the anchors to ensure that they have full bearing against the side of the ties, are the proper size and dimension for the rail section, and are not defective or weakened by over-driving.

    b. If any of the above conditions exist, reset the anchors, replace the anchors, or apply additional anchors as needed.

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

Removing Rail Defects

Using Match Marks

Use match marks any time you cut or repair rail such as when repairing or replacing rail or grade crossings, installing turnouts, etc. Make match marks with a permanent marker across the base of the rail and tie plate.

To measure rail movement with match marks:

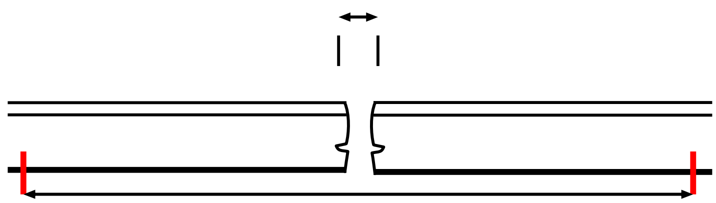
1. If a gap exists due to the rail contracting from a service failure measure and record the gap distance.

2. Place match marks on the parent rail outside of the rail section to be repaired or replaced.

Note: Using predefined lengths such as 22 feet or 44 feet simplifies the final calculation.

3. Measure and record the distance between the match marks before cutting the rail or removing angle bars. This is your initial measurement.

MEASURE AND RECORD ANY EXISTING GAP



Initial Measurement. Place match marks outside of the rail section to be repaired or removed. Record distance between match marks.

4. Repair or replace the rail and re-measure the distance between the parent rail match marks.

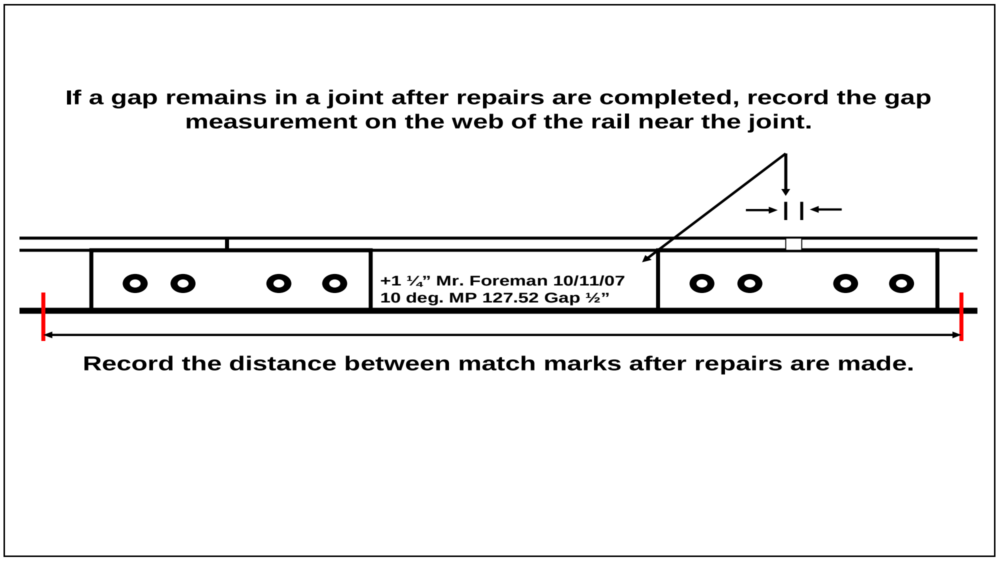
   a. If there was a gap add the gap measurement to the result. This is your final measurement.

5. Calculate the difference between the initial and final measurements.

   a. If the final measurement is larger than the initial measurement record the difference as rail added.

   b. If the final measurement is smaller than the initial measurement record the difference as rail removed.

6. If a gap exists in a rail joint after a rail section has been repaired or replaced record that measurement next to the joint as “Gap x” replacing x with the actual measurement.



7. Record the following information with permanent marker on the web of rail:

- Foremen name (or person in charge)
- Date
- Rail temperature
- Amount of rail added or removed
- Mile post of the location to be reported

8. Report the rail adjustment as required.

Replacing Rail or Thermite Welding Below Target Neutral Temperature

When replacing rail and the rail temperature is below the target neutral temperature use the following procedure:

1. Before cutting rail or removing joint bar, make marks across the base of the rail that will remain in track and tie plates or in concrete tie shoulders. Make marks approximately 2 feet from each location where the rail will be cut or joint bar removed in both directions from the rail cut or joint bars.

2. Use rail expander to avoid or minimize adding rail while replacing rail or making a weld.

3. After installing replacement rail and/or thermite welding or joint barring observe match marks. If marks on rail no longer line up with marks on tie plates or concrete tie shoulders and mark on rail has moved away form replacement rail or weld location you have added rail and lowered neutral temperature and you must document rail added. Measure the distance between marks on rail and marks on tie plates or concrete tie shoulders after replacement to determine amount of rail added. Add together the movement on both sides of replacement rail or weld to determine total rail added.

4. Using a paint stick write this information on the web of the rail field side:

   - Welder's full last name and initials
   - Year-to-date consecutive weld number
   - Weld date (month/year)
   - Rail temperature
   - Rail added or subtracted
   - Grinder's full last name and initials

5. If rail is added apply rail anchors to field side of replacement rail including replacement rail in concrete tie or Pandrol fastener territory (see Figure 6-6).

6. If repairing a service failure and rail was broken before match marks were on the rail and tie plates or concrete tie shoulders, measure the rail gap at the break and consider that the amount of rail added unless a rail expander is used during the repair to stretch the rail by at least the amount of the gap.

7. Report the amount of rail added when you report the detected defect removed or service failure repaired.

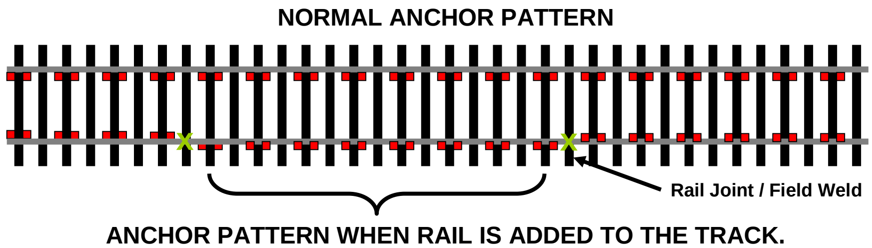
8. As soon as possible adjust the rail by removing the rail added using a rail expander and field welding joints.
9. Return anchors to the gage side of the rail.

   Note: Anchors added in concrete tie and Pandrol fastener territory do not need to be applied to the gage side of the rail after adjustment.

10. Record adjustments to rail in the Rail Adjustment Record (Form 1338-005P; see Figure 6-3). Maintenance Support will enter the remedial action information into the rail record database to fulfill FRA rail inspection record requirements. Include remedial action information with your weekly work reports.

Figure 6-6 Anchor Pattern and Rail Marking When Adding Rail

Anchor pattern and rail marking procedures when adding rail.



NOTE: At a defect or broken rail location. If you add more rail than you take out, apply anchors to the field side of the rail until the added rail has been removed and the joints have been welded. Date of installation, rail temperature at installation, amount of rail added and foreman's name should be marked on the web of the rail cut in with a paint stick.

Ties

- Be careful not to jack the track excessively or leave swinging ties.

.

- The Supervisor in charge or designated representative must perform a walking inspection over track to ensure that the above guidelines are complied with before resuming train operations.

Other Tie Renewal Requirements

If the rail begins to show signs of being tight – such as kinking in the line, tipping out of the tie plates or lifting in tie plates – cut the rail and relieve the stress. Place an appropriate slow order.

Have the Supervisor inspect the entire day's work area.

When possible, schedule work during the cool of the day.

Inserting Ties

Immediately behind tie renewal regulate the ballast to fill the track in and to maintain full ballast shoulders.

a. Dress ballast to a uniform toe line and section according to the Standard Plans.

b. Unload additional ballast as needed.

Ballast

General Ballast Section Requirements

When building new track or re-ballasting or surfacing existing track ensure that the ballast section complies with the ARRC standard Plan. The following table list general ballast shoulder requirements. For more specific requirements refer to -the Standard Plan.

BALLAST SHOULDER REQUIREMENTS FOR THE ARRC ARE: 12" OFF END OF TIE ON BOTH SIDES OF THE TRACK AND AN ADDITIONAL 3" ON THE HIGH SIDE OF CURVES.

General Requirements

Follow these general requirements during surfacing operations:

1. Do not make major changes to the alignment or grade profile unless the changes have first been approved by the Director of Maintenance or AVP Maintenance.

2. Avoid damaging signal equipment. Keep the Signal Maintainer informed of the daily work.

3. If there are indications of tight rail de-stress the rail as soon as possible.

4. When tamping:

   a. Tamp ballast uniformly so that if settles evenly.

   b. Tamp only 16 inches on either side of rail.

   c. To prevent center binding ties, do not tamp the center of the ties.

5. When out-of-face surfacing:

   a. Except on curves use the same rail as the reference rail.

   b. On curves use the low rail as the reference rail.

6. When surfacing on curves maintain the approved superelevation and spiral.

7. Surface concrete tie track in conjunction with shoulder ballast cleaning to prevent center binding ties.

8. Replace any anchors removed according the ARRC Standards.

9. Do not allow excess ballast on the shoulder or in the track highway and railroad crossings or at signal installations. Immediately remove excess ballast from bridge walkways, abutments, curbs, and station platforms.

10. Do not allow brooming operations to damage adjacent property, especially at highway underpasses.

Raising Track

During track surfacing and ballast rehabilitation programs:

1. Maintain vertical curves.

2. Avoid extremely high raises. If they are necessary, carry them out in successive lifts.

Using Offset Stakes in Curves

When surfacing curves at a rail temperature of 45^{o}F or more below Target Neutral Temperature:

1. Place a minimum of three offset reference stakes before the track is surfaced.
    a. Place one stake at each PCS (point of spiral to curve) and place at least one stake in the main body of the curves.
    b. On long curves, place stakes no more than 400 feet apart.
2. Record and check offset measurements again after the curve has been surfaced. Notify the Road master when a curve has been lined in.

    Note: When a curve is lined in the Roadmaster will use the recorded information and ensure that the curve rail is adjusted by lining the curve out or adjusting the rail to the proper neutral temperature.
3. Use Figure 8-2 (Rail Added to Curves that Line In During Cold Temperatures) to determine the amount of rail added as well as the new Target Neutral Temperature.

Figure 8-2 shows the amount of rail added to a curve per 1,000 feet when the rail is lined in. The amount of rail added is calculated for each ½ inch of line-in from ½ inch to 6 inches.

Figure 8-2 Rail Added to Curves that Line In During Cold Temperatures

DEG. CURVE	RAIL ADDED TO CURVES THAT LINE IN DUE TO COLD TEMPERATURES.											
	1/2"	1"	1 1/2"	2"	2 1/2"	3"	3 1/2"	4"	4 1/2"	5"	5 1/2"	6"
0-30-00	0	1/8"	1/8"	1/8"	1/4"	1/4"	1/4"	3/8"	3/8"	3/8"	1/2"	1/2"
0-45-00	1/8"	1/8"	1/4"	1/4"	3/8"	3/8"	1/2"	1/2"	5/8"	5/8"	3/4"	3/4"

1-00-00	1/8"	1/8"	1/4"	3/8"	1/2"	1/2"	5/8"	3/4"	3/4"	7/8"	1"	1"
									1	1	1	1
1-30-00	1/8"	1/4"	3/8"	1/2"	5/8"	3/4"	7/8"	1'	1/8"	1/4"	1/2"	5/8"
							1	1	1	1	1	2
2-00-00	1/8"	3/8"	1/2"	3/4"	7/8"	1"	1/4"	3/8"	1/2"	3/4"	7/8"	1/8"
					1	1	1	1	1	2	2	2
2-30-00	1/4"	3/8"	5/8"	7/8"	1/8"	1/4"	1/2"	3/4"	7/8"	1/8"	3/8"	5/8"
					1	1	1	2	2	2	2	3
3-00-00	1/4"	1/2"	3/4"	1"	1/4"	5/8"	7/8"	1/8"	3/8"	5/8"	7/8"	1/8"
				1	1	1	2	2	2	3	3	3
3-30-00	1/4"	5/8"	7/8"	/1/4"	1/2"	7/8"	1/8"	1/2"	3/4"	1/8"	3/8"	5/8"
				1	1	2	2	2	3	3	3	4
4-00-00	3/8"	3/4"	1"	3/8"	3/4"	1/8"	1/2"	3/4"	1/8"	1/2"	7/8"	1/4"
			1	1		2	2	3	3	3	4	4
4-30-00	3/8"	3/4"	1/8"	5/8"	2"	3/8"	3/4"	1/8"	1/2"	7/8"	3/8"	3/4"
			1	1	2	2		3	3	4	4	5
5-00-00	1/2"	7/8"	1/4"	3/4"	1/8"	5/8"	3"	1/2"	7/8"	3/8"	3/4"	1/4"
			1	1	2	2	3	3	4	4	5	5
5-30-00	1/2"	1"	1/2"	7/8"	3/8"	7/8"	3/8"	7/8"	1/4"	3/4"	1/4"	3/4"
			1	2	2	3	3	4	4	5	5	6
6-00-00	1/2"	1"	5/8"	1/8"	5/8"	1/8"	5/8"	1/8"	5/8"	1/4"	3/4"	1/4"
		1	1	2	2	3		4		5	6	6
6-30-00	5/8"	1/8"	3/4"	1/4"	7/8"	3/8"	4"	1/2"	5"	5/8"	1/4"	3/4"
		1	1	2		3	4	4	5	6	6	7
7-00-00	5/8"	1/4"	7/8"	1/2"	3"	5/8"	1/4"	7/8"	1/2"	1/8"	3/4"	3/8"
		1		2	3	3	4	5	5	6	7	7
7-30-00	5/8"	1/4"	2"	5/8"	1/4"	7/8"	5/8"	1/4"	7/8"	1/2"	1/4"	7/8"
		1	2	2	3	4	4	5	6		7	8
8-00-00	3/4"	3/8"	1/8"	3/4"	1/2"	1/4"	7/8"	5/8"	1/4"	7"	5/8"	3/8"
		1	2		3	4	5	5	6	7	8	8
8-30-00	3/4"	1/2"	1/4"	3"	3/4"	1/2"	1/4"	7/8"	5/8"	3/8"	1/8"	7/8"
		1	2	3	3	4	5	6		7	8	9
9-00-00	3/4"	1/2"	3/8"	1/8"	7/8"	3/4"	1/2"	1/4"	7"	7/8"	5/8"	3/8"
		1	2	3	4		5	6	7	8	9	
9-30-00	7/8"	5/8"	1/2"	3/8"	1/8"	5"	3/4"	5/8"	3/8"	1/4"	1/8"	10"
10-00-		1	2	3	4		6		7	8	9	10
00	7/8"	3/4"	5/8"	1/2"	3/8"	21/4"	1/8"	7"	3/4"	3/4"	5/8"	1/2"

EFFECTIVE RAIL ADDED PER 1000 FEET OF TRACK (IN INCHES)

EVERY 1/2 INCH OF RAIL ADDED IN 1000 FEET DECREASES THE NEUTRAL TEMPERATURE BY 6.5 DEGREES F.

Repairing Subgrade (Fill Sections)

General

These instructions govern the repair of embankments or side-hill fills (fills constructed on a slope) that have settled developed geometry defects or in which cracks have been observed.

The first priority is to assess the safety of the track and apply speed restrictions if necessary. The ideal situation is to immediately restore the track geometry using properly tamped and compacted ballast.

The Director Maintenance determines the nature and extent of the planning and repairs required to reconstruct the roadbed and remove any speed restrictions. You should jointly decide with the Director Maintenance when and whether to make repairs at a particular site other than adding and tamping ballast. Consider consulting a geotechnical engineer or engineering geologist before implementing repairs on embankments that:

- Are greater than 10 feet high
- Have cracks in them
- Have settled more than 1 inch at a time
- Require raising or cross-level adjustment more than once over 4 months
- Have shifted horizontally
- Have heaved
- Have heaved ground adjacent to the tracks

  or

- Cross a known or suspected landslide

Track geometry defects may also be caused by railhead defects ballast breakdown, fouled shoulders, low joints, and other non-subgrade related factors. In some cases track geometry defects caused by these problems may be difficult to distinguish from defects caused by track subgrade problems.

Records

Keep a record of the performance history of the fill that has or continues to experience occasional or frequent settlement or track geometry defects. Use the record to determine the probable cause(s) of the problem and to select an appropriate repair method. The Roadmaster and Track Inspector should maintain a joint written record of repairs, settlement, or track shifts. Information recorded should include:

- Exact location
- Date and time of observation of condition
- Length of track affected
- Measurement of track settlement, cross-level rotation, or horizontal movement, e.g. number of inches of settlement or horizontal shift.
- Notes describing ground disruption such as cracking, plowing, heave, etc.
- Weather during the 2-week period preceding observation of the settlement. In particular, note snow melt or rain including number of inches and intensity of storms.
- Last date of repairs and this location
- Description of repairs undertaken

Repairs (Drainage)

Backfill settling

Trench drain backfill will settle under train loads for a short time after the trench is backfilled and train traffic resumes.
Follow these recommendations:

a. If needed, implement speed restrictions and tamp once a day or once every few days for the first week or two after the drains are completed.

b. Inspect repairs at least once daily until they are stable and a slow order is no longer required.

c. If the embankment and subgrade continue to settle or continue to experience track geometry defects implement additional stability improvement measures as needed. These measures are discussed in the following section.

Other Drainage Methods

Depending on the situation, additional drainage measures or other stability improvement measures may be required.

Welding and Grinding

Identifying and Marking Thermite Field Welds in Track

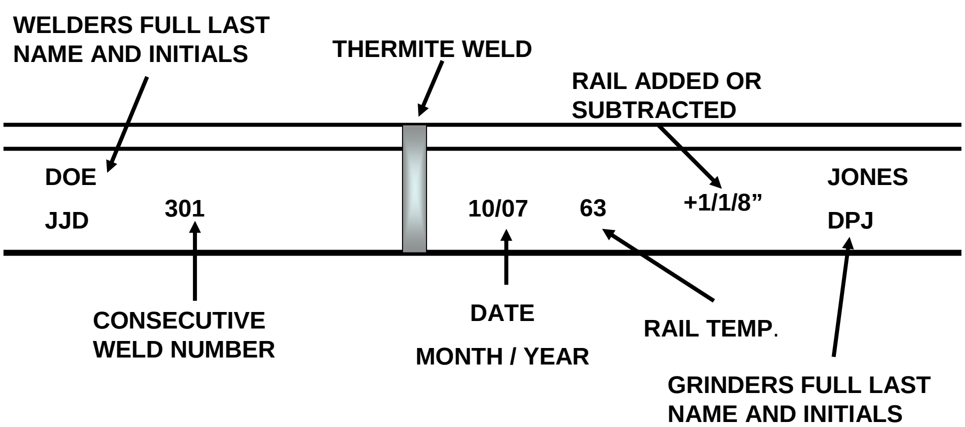
The employee in charge of the welding crew is responsible for ensuring that completed thermite welds are marked and identified correctly.

Use the label plate provided with the welding kit and fix it to the field side web of rail.

If no label plate is provided, use a ball-point paint marker to legibly print the following information in the web on the field side of the rail on each thermite weld installed (see Figure 11-5):

- Welder’s full last name and initials
- Year-to-date consecutive weld number
- Weld date (month/year)
- Rail temperature
- Rail added or subtracted
- Grinder’s full last name and initials

Figure 11-5 Marking Thermite Welds



Reporting Rail Attributes

Any time a defective rail section is replaced or repaired detailed rail attributes (ARRC form ARR 1105) must be reported by the Foreman and included with weekly work reports and time cards.