UGL REGIONAL LINX

RAIL ADJUSTMENT

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CRN CM 223

LINKING COMMUNITIES. CONNECTING CUSTOMERS.

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Document Control

Function	Position	Name	Date
Approver	A&E Manager	Lucio Favotto	30/01/2022

Revision	Issue Date	Revision Description
1.4	02/12/2021	UGLRL Operational Standards Template applied
2.0	20/01/2022	First approved and issued UGLRL version
3.0	30/01/2022	Issued for publish to intranet and webpage

Summary of changes made from previous version

Section	Summary of change
All	This document is based on the previous rail infrastructure maintainer (RIM). Full revision history is available on request from UGLRL.

Chapter 1 Introduction

C1-1 Purpose

This manual details the approved processes for the adjustment of rails.

It is structured in three main sections.-

Chapter 4: General Adjustment Requirements

This chapter details requirements that are common to the adjustment of both jointed and continuously welded rails. Some of the steps in the adjustment process need to be carefully detailed to aid understanding. In order to avoid repetition when the steps are nominated in each process, they are explained in this section.

Chapter 5: Adjustment of Jointed Rail

This chapter details the specific procedures necessary to measure and adjust jointed rail to achieve correct adjustment (a stress-free rail condition at a rail temperature of 35°C).

Chapter 6: Adjustment of Continuous Welded Rail

This chapter details the specific procedures necessary to adjust and weld rail to achieve correct adjustment of continuous welded track (a stress-free rail condition at the specified neutral temperature).

It includes methods for measuring and restoring adjustment in CWR as well as converting jointed track to CWR.

It also provides procedures for the repair of rail defects in CWR to ensure that rail adjustment is maintained.

C1-2 Context

The manual is part of UGLRL CRN's engineering standards and procedures publications. More specifically, it is part of the Civil Engineering suite that comprises standards, installation and maintenance manuals and specifications.

Manuals contain requirements, process and guidelines for the management of track assets and for carrying out examination, construction, installation and maintenance activities.

The manual is written for persons undertaking installation and maintenance activities.

It also contains management requirements for the Civil Maintenance Engineer, Area Manager and Superintendents needing to know what they are required to do to manage rail adjustment activities in their area, and production managers needing to know what they are required to do to manage the adjustment activity their teams are undertaking.

This manual is part of a series of seven (7) rail manuals:

- CRN CM 221 - Rail Installation and Repair
- CRN CM 222 - Rail Welding
- CRN CM 223 - Rail Adjustment
- CRN CM 224 - Rail Defects and Testing
- CRN CM 225 - Rail Grinding
- CRN CM 226 - Rail Defects Handbook
- CRN CM 227 - Rail Surface Defects

C1-3 How to read the Manual

The best way to find information in the manual is to look at the Table of Contents starting on page 4. Ask yourself what job you are doing? The Table of Contents is written to reflect work activities.

When you read the information, you will not need to refer to CRN Engineering standards. Any requirements from standards have been included in the sections of the manual and shown like this example:

> The following requirements are extracted from CRN Engineering Standard CRN CS 220 "Rail and Rail Joints"
>
> **Robel clamps**
>
> Robel rail clamps may be used on 41, 47, 53 and 60kg rail in lieu of 4-hole temporary joints for up to 7 days for all track structures unless approved by the Principal Track and Civil Engineer. The track must be
>
> [1] effectively tied, with elastic fasteners
>
> [2] inspected every 24 hours
>
> [3] have a maximum of 60km/h applied.

Throughout this manual reference is made to the following levels of Engineering Authority:

- Principal Track and Civil Engineer
- Civil Maintenance Engineer
- Area Manager
- Superintendent
- Supervisor

These are general descriptors only. For an explanation of the positions in the UGLRL CRN organisation that perform these functions, refer to CRN Engineering Manual CRN CM 001 "Civil Technical Competencies and Engineering Authority".

C1-4 References

C1-4.1 Australian and International Standards

Nil

C1-4.2 CRN Documents

CRN CS 200 – Track System

CRN CS 220 – Rail and Rail Joints

CRN CS 230 – Sleepers and Track Support

CRN CS 250 – Turnouts and Special Trackwork

CRN CM 001 – Civil Technical Competencies and Engineering Authority

CRN CM 203 – Track Inspection

CRN CM 221 – Rail Installation and Repair

CRN CM 222 – Rail Welding

CRN CP 201 – Measurement Gauges

Chapter 2 Management Requirements

C2-1 CWR

Rail adjustment Supervisor

It is the responsibility of the rail adjustment supervisor to plan adjustment tasks. This includes consultation with the RM Superintendent's representative to review and ultimately approve the plan. Planning includes consideration of Weld Track Stability Analysis (WTSA) implications, alignment and resurfacing requirements, and fastening changes (if any) at the completion of the adjustment.

The rail adjustment supervisor considers the following steps when creating the plan;

1. Before commencing the adjustment considers "What if…?" and has contingency plans in place (for uneven rail pull up, weld blow outs, rapid change to weather, rail pulling through anchors etc.).
2. Before Continuous Welded Rail (CWR) occurs, measures, records and assesses track alignment in curves in the area where CWR adjustment is planned.

   No alignment measurements are required on tangent track and therefore no tolerance limits apply.

   If curved track is found to be more than 15mm off correct alignment (or 25mm for curves >1000m radius) the track MUST NOT be adjusted without the written authority of the Civil Maintenance Engineer (refer to Section C6-4).
3. Ensures that anchor points are not located on bridges and track slabs with elastomeric bearings unless approved by the Principal Track and Civil Engineer.
4. Ensures that rail weld adjustment returns (Form RWA1) and the alignment measurement records are completed for all work.
5. Ensure that copies of all rail weld adjustment returns and alignment records are sent to the local Maintenance Superintendent within 7 days of completion of each adjustment.

The Civil Maintenance Engineer (or representative):

1. Review out-of-tolerance alignment measurements to determine suitability for adjustment.

   Although adjustment of rails that are not on correct alignment is permitted provided follow up re-alignment and re-adjustment is carried out, it should be avoided because of the potential for follow up works to be interrupted.
2. Determine if creep monitoring marks are required at significant points in addition to kilometre and half kilometre points.

The Maintenance Superintendent:

1. Reviews rail weld adjustment returns for discrepancies and defects.
2. Where the Civil Maintenance Engineer has provided approval to adjust out-of-alignment track, confirms with data custodian (survey or assets) that alignment offset records are updated.
3. Ensures that a copy of Rail Weld Adjustment Returns is sent to CRN Engineering Services for updating INFOR configuration.
4. For rail defect repair uses the "steel out = steel in" process, when requested. Reviews changes in ambient temperatures between the removal of the defect section and the repair and, if considered appropriate, gives approval for extension of the time limit beyond 3 hours.

C2-2 Assessment of Track Adjustment using the VERSE System

The Manager Routine Maintenance:

5. Shall determine the general location for the assessment of track adjustment using the VERSE system.
6. Is responsible for the appropriate use of the adjustment information.
7. Shall verify that the person carrying out the adjustment assessment has written authorisation from the Principal Track and Civil Engineer.
8. Shall maintain rail adjustment details within Infor.
9. May nominate a representative to undertake the activities in Steps (1) – (4) above

Chapter 3 Competencies

NOTE: These competencies may enable activities to be carried out in other manuals. For a comprehensive list of all activities that are covered by a given competency see CRN Engineering Manual CRN CM 001 – "Civil Technical Competencies and Engineering Authority".

To carry out this work	You need these competencies		
Adjust rails (continuously welded, long welded or loose rail).	TLIB3102 - Adjust rail	AND	The following **CORE** competencies ~ TLIB2085 - Apply track fundamentals ~ TLIS2034 - Install and repair rail fastening systems ~ TLIS2044 - Carry out rail installation ~ TLIB2091 - Measure and record track geometry
Check adjustment in CWR using the VERSE system.	**Adjust rail** competencies	AND	Training in use of VERSE equipment by the supplier
Maintain adjustment in CWR track for the repair of rail defects or broken rails, or for inserting closures.	**Adjust rail** competencies	OR	**Aluminothermic welding** competencies
Certify that rail adjustment has been undertaken correctly.	**Adjust rail** competencies		
Certify track during or after rail adjustment.	**Adjust rail** competencies	AND	TLIB3094 - Check and repair track geometry
Install Creep Pegs.	TLIB3102 - Adjust rail		
Monitor Creep.	**Track Examination** Competencies		

Chapter 4 General Requirements

C4-1 Introduction

This chapter details general requirements for rail adjustment that are common to both jointed and continuously welded rails.

Some of the steps in the adjustment process need to be carefully detailed to aid understanding. In order to avoid repetition when the steps are nominated in each process, they are explained in this chapter.

Information in this chapter is included in the general order in which adjustment is carried out to aid ready reference.

C4-2 Installation requirements

The following requirements are extracted from CRN CS 220
Rail Adjustment

The following requirements are extracted from CRN CS 220

- Rail (except in tunnels as detailed below) shall be installed and adjusted to be stress-free at a rail temperature of 35°C. This is the Neutral Temperature adopted for CRN track.
- Rail located more than 50m inside tunnels may be welded where it sits without further adjustment.
- Rail shall be installed as CWR, LWR or Loose Rail in accordance with configuration requirements.

Long Welded Rail (LWR) design and installation requirements

- Rails shall be longer than 27.4m.
- Maximum rail length shall be 110m in curves <600m radius and 220m lengths for tangents and curves ≥600m radius.
- Rail shall be fastened to sleepers with non-resilient fastenings and anchors or a mixture of non-resilient fastenings and resilient fastenings.
- Rails shall not be fitted with more than 1 in 3 resilient fastenings unless a management strategy has been approved by the Principal Track and Civil Engineer in accordance with the requirements detailed in CRN Engineering Standard CRN CS 230 “Sleepers and Track Support”.
- Mechanical joints in LWR track shall have a gap of 6mm at 35°C.
- An appropriate track configuration, capable of providing the required resistance for the rail stresses is required. This is detailed in CRN Engineering Standard CRN CS 200 “Track System”.
- Where non-resilient rail fastenings and “Fair” type rail anchors are specified in the design, the minimum anchoring requirements for LWR shall be as specified in CRN CS 220 (Section C4-17 in this manual).

Continuous Welded Rail (CWR) design and installation requirements

- Rails shall be >220m long.
- Rails shall be adjusted to be stress-free at a rail temperature of 35°C, except in tunnels as detailed above.
- Rails shall be installed in accordance with an approved alignment design. Track control marks shall be installed using survey control.
- CWR shall be installed using an approved process. Approved processes are documented in this manual.
- Creep monitoring points shall be installed within 14 days of adjustment. Creep monitoring facilities shall be located at every kilometre and half-kilometre post. Additional monitoring points may be specified.
- An appropriate track configuration, capable of providing the required resistance for the rail stresses is required. This is detailed in CRN CS 200.
- Rails may be fitted with resilient fastenings or non-resilient fastenings and anchors.
- Rails fitted with >1 in 4 resilient fastenings do not require supplementary anchoring.
- Where non-resilient rail fastenings and “Fair” type rail anchors are specified in the design or where ≤ 1 in 4 resilient fastenings are installed, the minimum anchoring requirements for CWR are as specified in CRN CS 220 (Section C4-17 in this manual).

Prohibited Configurations

The following track configurations, in which rail adjustment cannot be assessed with confidence, are prohibited:

- Rails longer than 220m which have not been adjusted.
- Rails longer than 220m with no creep marks or pegs.
- Rails longer than 220m with no alignment information available.

Rails longer than 27.4m with resilient fastenings more than 1 in 3 (unless the rails have been correctly adjusted in accordance with requirements for CWR, or a management strategy has been

The following requirements are extracted from CRN CS 220

approved by the Principal Track and Civil Engineer in accordance with the requirements detailed in CRN CS 230.)

C4-3 Measurement of adjustment

C4-3.1 Assessing rail adjustment in jointed rail

Assess rail adjustment in jointed rail by measuring rail temperature and rail gaps, then comparing these values to required values in the jointed rail gap chart.

This method is explained in Chapter 5.

C4-3.2 Assessing rail adjustment in CWR

There are three methods of measuring rail adjustment in CWR.

10. The 'rail creep method' - If CWR meets the installation requirements in Section C4-2, rail adjustment can be measured by assessing rail creep using creep control marks and alignment measurements.

    The "rail creep" method" is used for Welded Track Stability Analysis (WTSA) and is explained in CRN Engineering Manual CRN CM 203 "Track Inspection".

11. The 'cut and adjust' method - If CWR does not meet the installation requirements in Section C4-2, or if there is any doubt about the evenness of the stress in the rail length between creep control marks, measure rail adjustment by the "cut and adjust" method.

    The Cut and adjust method is also used to correct rail adjustment in existing CWR track and is explained in Chapter 6.

12. The "Verse method' - CWR Adjustment may also be assessed by using the VERSE rail stress measurement system. The method of using the equipment is detailed in Chapter 7.

C4-4 Method of adjustment

The method of adjustment of jointed rails is detailed in Chapter 5. The method of adjustment of CWR is detailed in Chapter 6.

C4-5 Adjustment temperatures

C4-5.1 Minimum rail temperature to adjust

The minimum rail temperature for adjustment depends on the rail length, rail size and how the rail is fastened. The procedures in this manual relate to standard rail lengths (220/250m in straights and large radius curves and 110/125m in sharper curves). These lengths cannot be adjusted with rail tensors at rail temperatures below 10°C.

These limits have been set for the following reasons:

- To ensure that the rail tensors are not over stressed. Adjusting outside these limits may overstress the tensors and lead to failure and serious injury.
- On curves where there will be large lateral forces near to the jacks or the potential for rail to roll.
- On long adjustments rails may not be evenly stressed.

If rail is adjusted below 15°C keep the rail tensors on the adjustment weld for additional time, as specified in Section C4-14.

If it is necessary to adjust rails below 10°C, the rail lengths MUST be shortened to a length that can be adjusted with safety.

C4-5.2 Maximum rail temperature to adjust

Above 35°C rail temperature, correctly adjusted CWR should be in compression. Since you cannot simulate compression by pushing the rails apart, the maximum rail temperature for adjustment to commence is 35°C.

In jointed rail the maximum rail temperature depends on the rail length. Since you cannot put the rails in compression by pushing them apart the maximum adjustment temperature will be the rail temperature at which the joint gaps will be zero in correctly adjusted rails e.g. 40°C in 110m lengths, 75°C in 13.72m lengths.

C4-5.3 Rising rail temperatures during adjustment

If rail temperature rises after adjustment has commenced, adjustment can be carried out up to a maximum of 37°C rail temperature.

If rail is cut and the rail temperature rises over 37°C you must stop adjustment. Free weld the joint and record all the details of gap and rail temperature measurements. The affected section must be re-adjusted when the rail temperature drops to 35°C or below.

C4-6 Adjustment length

The maximum length of track that can be satisfactorily adjusted is:

For timber-sleepered track

- 125m for curves < 600m radius (ie 63m each side of the adjustment weld)
- 250m for curves ≥ 600m radius or straights (125 m each side of the adjustment weld)

For concrete-or steel sleepered track

- 250m for all curves and straights (125 m each side of the adjustment weld)

Track that is partially timber sleepered and partially steel sleepered is be treated the same as timber sleepered track.

The adjustment lengths adopted in Chapter 5 for jointed track and Chapter 6 for CWR are based on the above figures and recognise the general configuration of track on which adjustment will be performed. For example 250m adjustments are not used when converting jointed track to CWR because the maximum jointed rail length is generally 110m, giving a 220m adjustment on straights. On existing CWR track, however, 250m adjustments are appropriate and even offer advantages in being able to readjust a 500m section between creep control marks in two adjustments.

Measure adjustment length to the nearest metre.

C4-7 Check alignment

The requirements for checking and recording alignment are different in jointed track and CWR. There is no requirement to check alignment in jointed track. See Chapter 6 for specific requirements for CWR track.

C4-8 Measuring rail temperature

Check rail temperature by placing a thermometer on the shady side of the rail. Rail thermometers, either analogue (dial) or digital, must be calibrated regularly. Calibration should be conducted by a registered organisation or by experienced personnel using calibration thermometers.

It is recommended that at least two (2) thermometers are used to establish rail temperature on the length being adjusted. The readings should be averaged. This process makes allowance for variations in the accuracy of thermometers, and for variations in actual rail temperature along the rail length. This is particularly important when part of the rail length is in direct sunlight and part is shaded by cuttings or buildings etc.

C4-9 Measuring rail gaps

Measure the gap with a rail-gap gauge or tape where rail ends are the closest.

C4-10 Anchor points

Anchor points isolate the area to be adjusted by stopping the movement of steel into or out of the section.

1. Create anchor points by installing anchors one each side of the sleeper on each rail for 32 sleepers outside the area to be adjusted i.e. at points A and C in Figure 1 (either side of joint B). In resilient fastened track, resilient fasteners are used instead of anchors.
2. DO NOT remove rail anchors or resilient fasteners between A and C before cutting the rail. In colder temperatures, (if the rail is very short of steel), the rail may “jump” back before the rail cut is complete, breaking the rail at the cut, and causing broken material to fly. It may also jump back through the anchor point

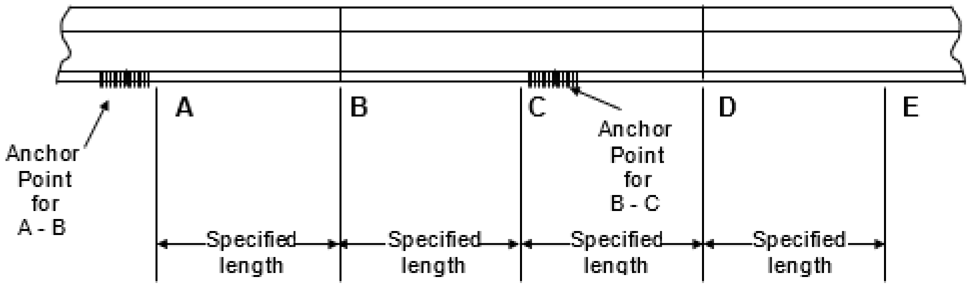


Figure 1 - Establishing anchor points

3. When an adjustment has been completed, the anchor points can be removed or reversed and the next section adjusted.
4. Remove the anchor point at the start of the first length adjusted, and reverse the anchor point at the other end, so that it becomes the starting point for adjustment of the next length.
5. Establish the new anchor point before removing the old anchor point. This is necessary to avoid the possibility of the unadjusted rail section being drawn into the adjusted rail section, destroying the adjustment.
6. DO NOT use common anchor points. In Figure 1 above DO NOT leave the anchor point on at C when adjusting the section C – E since this would result in short sections (20m) of unadjusted track.
7. DO NOT use track on bridges or other structures with elastomeric bearings, or similar, as anchor points, unless specifically assessed as being appropriate by the Principal Track and Civil Engineer.

C4-11 Vibrating rails

1. Remove resilient fastenings/anchors between anchor points

   Anchors or resilient fastenings restrict or stop longitudinal movement (creep) of rails i.e. lock rails to sleepers, therefore they must be removed (or 'parked' in the case of Fastclip assemblies) - not just loosened.

2. On curves with elastic fastenings, to prevent the rail from rolling in, reinstall or leave one clip on the outside of the curve on both rails every 25 sleepers (see Figure 2). Install this clip without the shoulder insulator in place. Alternatively, zero load restraint fastenings may be used in a sequence of 1 in 10 to provide additional protection from rail roll over without creep resistance.

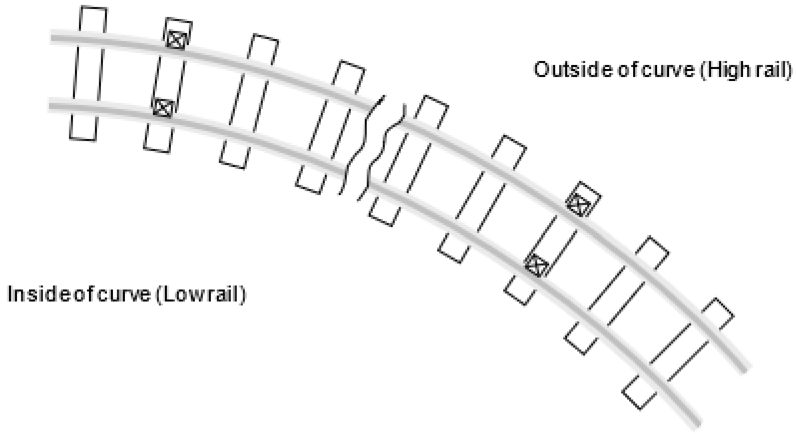


Figure 2 - Placement of fastenings when adjusting on curves

3. Vibrate the rail from anchor point to anchor point to relieve the stresses and to make the rails stress free, ready to be adjusted. Extra vibration may be needed to make sure rail movement occurs through the temporarily restored elastic fastenings.

   The rail is vibrated by a number of men (minimum of 1 man per 40m of rail) hammering the WEB of the rail with hammers between anchor points (DO NOT hit the FOOT or the HEAD). Continue vibrating until there is no more movement. Special on-rail vibrating machines may also be used.

   The recommended hammer is the standard utility spiking hammer.

   (Hitting the head of the rail may cause fractures in the rail)

4. Whilst vibrating, check to see that the rail is not locking up. If it is, the rail will not be stress free. To prevent locking up, make sure:
   - all anchors and resilient fastenings are OFF,
   - sleepers and sleeper plates are square to the rail and not allowed to twist.
   - welds are not jamming against sleeper plates.
   - there is no binding of the rail to sleeper plates in curves.

5. If the joint or oxy-cut gaps close during the vibrating, open them further by cutting the rail out, to allow de-stressing to continue.

C4-12 Calculating correct gap

C4-12.1 Jointed track

In the instance of jointed track, calculate the correct gap required using either the Rail Gap Chart in Appendix 5.2 or Gap Table in Appendix 5.3. For rail lengths not shown in the graph or table, it will be necessary to use the formula in Appendix 5.1.

Use the Jointed Rail Gap chart as follows:

1. Determine the exact rail temperature and rail length.
2. From the exact temperature, trace a line vertically upwards towards the exact rail length.
3. At the point of intersection, trace a line to the left, which will tell you the exact expansion gap (or tension) required.

C4-12.2 CWR

To calculate the exact gap required in CWR track to adjust rail to neutral temperature, use the CWR Rail Adjustment Graph in Appendix 6.2 or the CWR Rail Adjustment Table in Appendix 6.3

For rail lengths not shown in the graph or table, it will be necessary to use the formula in Appendix 6.1.

Use the CWR rail adjustment graph as follows:

1. Determine the exact rail temperature and rail length.
2. From the exact temperature, trace a line directly upwards until you reach the line that tells us the rail length.
3. From this point, trace a line to your left which will give you the exact expansion gap (or tension) required.

Note: . When calculating expansion gaps, a Rail Gap Dial Calculator may also be used. These are more practical to use in the field and give the same readings as the graph, chart or formula. A detailed specification of the Rail Gap Dial Calculator is provided in CRN Engineering Specification CRN CP 201– “Measurement Gauges”.

C4-13 Field welding and recording of welds

1. Weld the track in accordance with the procedure laid down in CRN Engineering Manual CRN CM 222- “Rail Welding”.

   When tensors are used, special precautions must be taken to prevent damage to the tensors by weld, metal or slag.

2. Record and report details of welding on the rail weld adjustment return (Form RWA1) as shown in CRN CM 222 or in section ______ of this manual.

C4-14 Using rail tensors with welding

When welding is carried out within the adjustment length, DO NOT operate rail tensors to pull the rail ends at the joint together until at least 20 minutes after the excess head metal has been removed from any new welds. This will apply when a closure is installed at the adjustment point.

When tensors are used to maintain rail adjustment while a weld is being installed at rail temperatures between 15°C and 35°C, DO NOT release the tensors until at least 20 minutes after the excess head metal has been removed from any new welds.

When rail adjustment is being carried out below 15°C, the tensors MUST be kept on for a longer time after the excess head metal has been removed, as follows:

- Normal weld (25 tonne axle loads) - 30 mins.
- Wide Gap weld (25 tonne axle loads) - 35 mins.

C4-15 Installing and measuring punch marks

Punch marks are installed in rails to allow measurement of rail movement. They need to be placed accurately to avoid damage to rail and to allow accurate repeatable measurement.

C4-15.1 Installing punch marks

1. Place a punch mark on the outside head of the rail (as near to the top of the face as possible) at least 300mm beyond one end of the section of rail to be removed.
2. Place one end of a non-conductive measuring tape on the top of the rail head as close to the punch mark as possible.
3. Stretch the tape along the rail head, keeping it as straight and flat as possible.
4. Place a second punch mark on the outside head of the rail (as near to the top of the face as possible) at least 300mm beyond the other end of the section of rail to be removed. For ease of measurement and recording, put it at the nearest ½ metre or 1 metre measurement (e.g. 3.000m, 3.500m etc., depending on the length of rail you are removing.

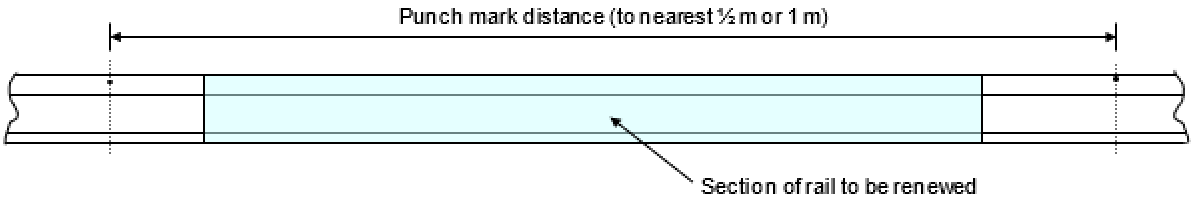


Figure 3 - Location of punch marks

5. Use a paint pen to mark a white circle around each punch mark to help locate the punch marks in the future (see Figure 4).

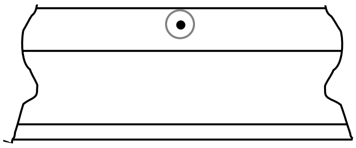


Figure 4 - Paint marking punch marks

C4-15.2 Measuring punch marks

1. Locate the punch marks. They should be on the outside head of the rail near the top of the face about 300mm either side of the closure and be marked with a white paint circle.
2. Place one end of a measuring tape (non-conductive in circuited area) on the top of the rail head as close to one of the punch marks as possible.
3. Stretch the tape along the rail head to the second punch mark keeping it as straight and flat as possible.
4. Measure the distance between the 2 marks to the nearest mm and record the measurement.

C4-15.3 Tolerances on punch marks

When the STEEL OUT = STEEL IN process (detailed in Chapter 6) is being used to maintain rail adjustment in CWR track during rail defect or broken rail repair, the allowable tolerances relating to before and after measurements of the punch marks are as follows:

Rail defect repair: At the completion of the work, the punch marks should be within ±3mm of the distance they were apart before work commenced.

Broken rail repair: At the completion of the work, the punch marks should be within □3mm of the distance they were apart before work commenced, minus the gap caused by the break.

Where this tolerance is exceeded a readjustment may be required. Any uncorrected locations must be advised to the Maintenance Superintendent because of welded track stability implications.

C4-15.4 Punch marks and tensors

If tensors will be installed with saddle (yoke) over the rail head, and adjustment is being maintained using punch marks (the Steel Out = Steel In method), measurement of the distance between punch marks may be difficult. If required, the welder or adjusting supervisor can transfer punch marks from outside tensors to inside the tensors as follows:

1. Establish punch marks.
2. Measure and record the distance between the punch marks before removing the rail section.
3. Remove the rail section.
4. Measure and record the distance between punch marks after removing the rail section.
5. Insert the closure rail.

6. Weld one end of the closure.
7. Set up rail tensors at remaining gap. DO NOT pull rail.
8. Transfer the change in measurement to new punch marks across the remaining gap and within the tensors. (See Figure 5).

Example: Original distance between punch marks 5 000mm

- Distance after removing rail section 5 023mm
- Change in distance +23mm
- Transfer to new punch marks 200mm +23mm = 223mm
- Operate the tensors to bring the measured distance between the punch marks to 200mm 3mm
- At the end of the process confirm that the original distance (5000mm) has been maintained (± 3mm)

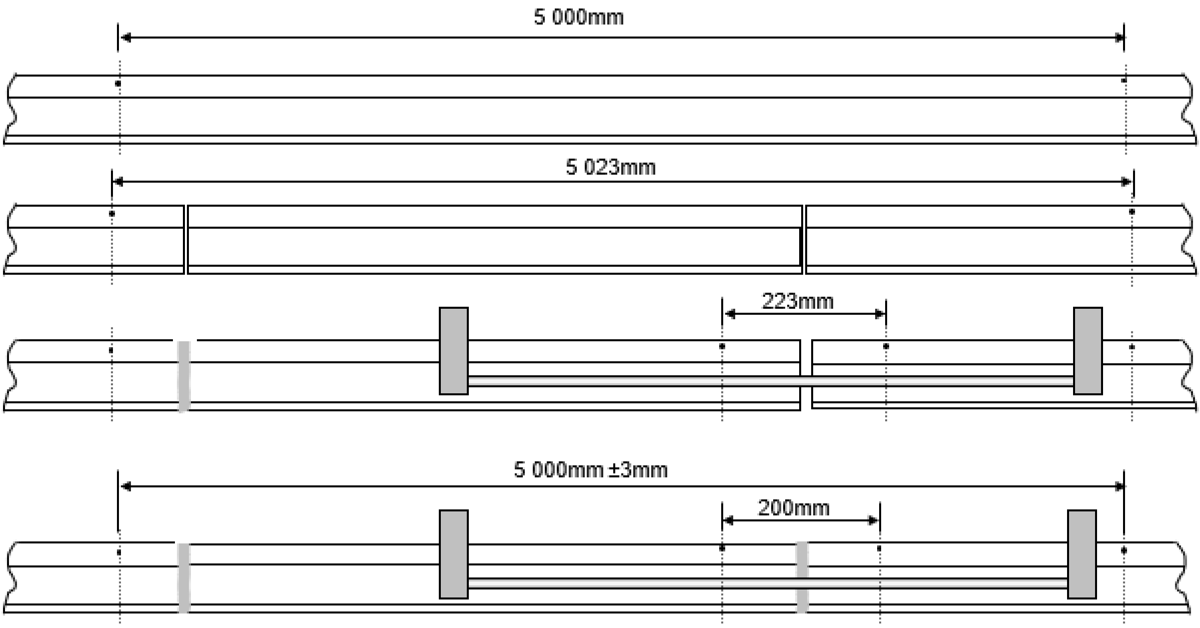


Figure 5 - Adjustment around rail tensors

C4-16 Checking rail movement

Quarter points are established to ensure even tensioning when "pulling up" the rail.

1. Establish quarter points ¼, ½ and ¾ of the distance from each anchor point towards the adjustment point using a measuring wheel and placing reference marks on the rail foot and sleeper plates (or sleepers) with chalk or permanent marker.

   In addition place reference marks at each anchor point.

   If the rail length between anchor points is less than 80m, it is only necessary to mark anchor points and ½ points.

2. Check progress of tensioning along the rail by comparing the movement against the reference marks at the anchor points and quarter points.

   The fully tensioned length will have moved ¾ of the appropriate extension for the length at the first marker from the tensor, ½ at the next and ¼ at the third.

   The correct extension for the length between the tensor and one anchor point is half of the specified adjustment gap.

There should be no movement at the anchor points.

3. Give more vibration to any section that doesn't show the correct amount of movement at the quarter points, until correct adjustment is achieved as near as is practically possible.

Important
If ¼ points do not show the similar movement on both sides, check for reasons why and fix. i.e. sleepers twisted, plate lock, weld jamming on sleepers, or anchors on, then continue vibrating till an even result is obtained. DO NOT bump rails into position by striking the rail end or by driving a wedge in the expansion gap.

C4-17 Replacing anchors and fastenings

Replace fastenings/anchors to the required pattern.

The following requirements are extracted from CRN CS 220

Welded tracks shall meet the following minimum anchoring requirements.

- Double (or box) anchor every fourth sleeper except at mechanical joints.
- Double anchor every second sleeper for a distance of 32 sleepers either side of mechanical joints, starting at the second sleeper from the joint.
- Basic anchoring is to be so that, sleepers are anchored on both sides on each rail (double or box anchor), except for steep grades, as detailed below.
- On tracks with a falling grade steeper than 1 in 80 in the direction of traffic, or at other locations where considered necessary to control rail creep, the anchoring shall be increased by adding single anchoring each second sleeper (or on every sleeper, if necessary) throughout the welded rail length, to prevent rail creep.

Insulated Joints in Welded Track

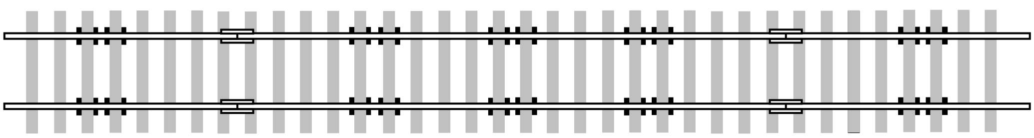
- At mechanical insulated joints EVERY sleeper shall be double anchored for a distance of 32 sleepers on each side of the joint.
- Bonded Insulated joints are treated as if they were plain track, and anchored in the same pattern as the track in which they are placed (e.g. 1 in 4 when laid in 110m rails or CWR, or every 2nd if within 32 sleepers of a turnout).

Anchoring of short rails

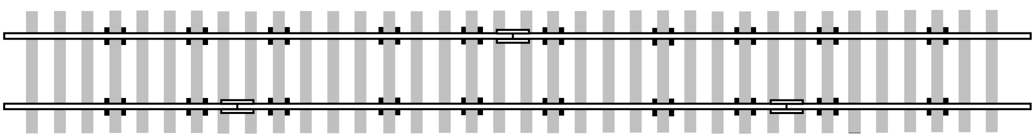
Lengths shorter than 23m

- The anchoring for these with square and staggered joints on ballasted track and bridges shall be as shown in Figure 6. Using these patterns, all anchored sleepers have anchors on both rails.

12m rails - square joints -	6 double anchored sleepers per rail length, placed 5th, 6th, 10th, 11th, 15th and 16th from each joint.
12m rails - staggered joints -	6 double anchored sleepers per rail length, placed 2nd, 5th, 9th, 12th, 15th and 19th from each joint.



SQUARE JOINTS - 12m Rails – Angle Fishplates



STAGGERED JOINTS - 12m Rails – Angle Fishplates

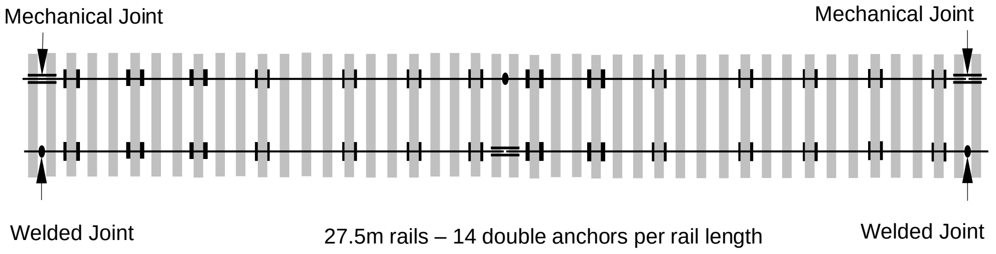
Figure 6 – Anchoring requirements for rail lengths <23m

23m and 27m lengths

- The anchoring for these on open ballasted tracks and on bridges shall be as shown in *Figure 7*..

23m rails - staggered joints - 12 double anchored sleepers per rail length, placed 2th, 5th, 8th, 12th, 15th, 18th, 21st, 24th, 27th, 31st, 34th and 37th from each joint.

27.5m rails - staggered joints - 14 double anchored sleepers per rail length, placed 2th, 5th, 8th, 11th, 15th, 18th, 21st, 24th, 27th, 30th, 34th, 37th, 40th and 43th from each joint.



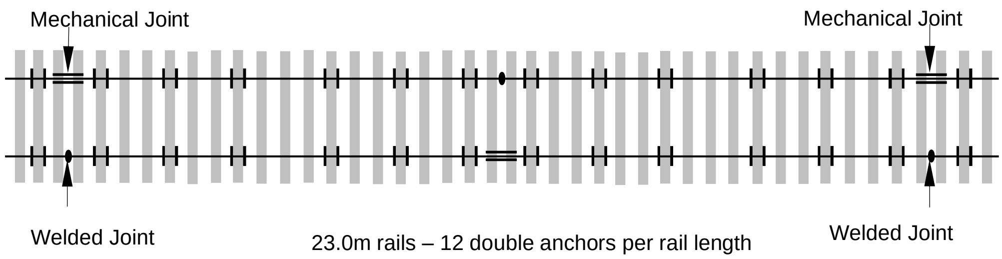


Figure 7 – Anchoring requirements for 23m and 27m rail lengths

The following requirements are extracted from CRN Engineering Standard CRN CS 250 "Turnouts and Special Trackwork"

Turnouts

- Double anchor every second sleeper for 32 sleepers (i.e. a total of 16 anchored sleepers) in front of the switch, commencing from the first sleeper from the switch.
- Double anchor every second sleeper/timber for 32 sleepers/timbers (i.e. a total of 16 anchored sleepers/timbers) behind the crossing, commencing from the first timber after the crossing that has plain track fastenings.
- Double anchor every second timber on the through rails and turnout rails between the heel of the switch and the front legs of the crossing.

Catchpoints

- Double anchor the catchpoint rail, every second sleeper for 32 sleepers (i.e. a total of 16 anchored sleepers) in front of the switch, commencing from the first sleeper from the switch.
- Double anchor the catchpoint rail, every second sleeper/timber for 32 sleepers/timbers (i.e. a total of 16 anchored sleepers/timbers) behind the heel commencing from the first timber after the heel that has plain track fastenings.

m CRN CS 220

Anchoring of Welded Track on Bridges

Transom top openings with spans <18m

- Standard anchoring for welded rails on open LWR track, as detailed above, shall be used on welded rails on these bridges, except as specified below.
- Anchors shall not be applied on timber bridges where:
  - transoms are not fixed to the girders with bolts drilled through both the transom and girder.

- transoms are fixed to steel girders by cast iron clip washers, except where an old rail or timber is bolted to the outer ends of the transoms.
- In this case anchoring as in Bullet point 1 shall apply, but if there is a series of spans giving a total bridge length greater than 30m, then Bullet point 1 of "Transom top openings with spans ≥18m long but < 80m" below, shall also apply.
- On bridges where resilient fastenings are installed in CWR track, normal resilient fastenings are to be installed on the entire length of each span.

Transom top openings with spans ≥18m long but < 80m.

- For a distance of 60m from a bridge end, the track shall be double anchored on every second sleeper.
- On the bridge the track shall be double anchored to every second transom for half the span length, commencing at the fixed end except as indicated in Bullet point 2 of "Transom top openings with spans <18m".
- Anchors shall not be applied to transoms that are not fixed to steel or timber girders by bolts drilled through both the transom and girder.
- On bridges where resilient fastenings are installed in CWR track, normal resilient fastenings shall be installed on one third of the span from the fixed end and Zero Toe Load resilient fastenings installed on the remaining two thirds of the span. Where spans are located on curves <400m radius, Zero Toe Load fastenings cannot be used.

Ballast top openings with spans ≥ 4.27m long but <80m

- Standard anchoring for LWR on ballasted track as detailed above shall be used on welded rails on these bridges.

Transom top or Ballast top openings with spans ≥80m

- Expansion switches are to be provided at the expansion end of the span(s).
- For a distance of 60m from a bridge end, LWR track shall be double anchored on every second sleeper.
- Between expansion switches the rails shall be double anchored to every fourth transom.
- On bridges where elastic fastenings are installed in CWR track, normal resilient fastenings are to be installed on the entire length of each span.

Structures with Rail Bearing Girders

As the rail on a longitudinal girder cannot be anchored, the number of anchors that cannot be correctly located shall be added to sleepers on each end of the structure.

1. Once rails are pulled evenly, and the correct welding gap has been obtained, reinstall anchors or elastic fastenings. Start at the weld, and work towards anchor points as the welder is starting to line up the weld. The welder may have to wait a short time until installation no longer causes vibration at the weld.

   This allows work to proceed on preparation for the next adjustment.
2. In tracks with resilient fastenings, reapply all resilient fastenings, re-installing the shoulder insulators of the clips that were left in, to prevent the rail from rolling in (or remove ZLR clips if they were used).
3. At locations with a history of rail creep, additional anchoring should be provided.
4. At locations where additional anchoring has previously been fitted it should be restored.

C4-18 Bonded Insulated Joints

Where Bonded Insulated Joints are present in tracks that have been adjusted, check the condition of the joint (for pull-apart) after the adjustment has been completed.

Joint failure by pull-apart may become an issue if the track is adjusted at low temperatures.

For new adjustment work, replace suspect BIJs as part of the work.

C4-19 Buckle prevention

During summer it is always better to have NOT ENOUGH steel rather than TOO MUCH.

To prevent a misalignment where you know or suspect there is too much steel, (e.g. when Welded Track Stability Analysis (W.T.S.A) identifies a location as being unstable and all you want to do is make it more stable) and you don't have sufficient resources to carry out a full adjustment, you may cut steel out if you have documented approval from the Maintenance Superintendent.

This is called BUCKLE PREVENTION but is not classed as rail adjusting!

Follow the procedure below and any additional requirements documented in the approval to undertake the work.

BEWARE
If you do this you MUST punch mark the rail either side and measure and record the distance before you cut, then measure and record the distance after the cut to determine how much steel you have removed and at what rail temperature. You MUST also inform your Superintendent.

Cutting steel out may leave the track short of steel. This will lead to curve "pull-ins", breakaways or broken rails when cooler weather returns.

Rail MUST be correctly adjusted once the track has stabilised or the danger period has passed, and in any case, before cooler weather returns.

Chapter 5 Adjustment of Jointed Rail

C5-1 Introduction

This chapter details the procedures necessary to measure and adjust jointed rail to ensure track is in correct adjustment to provide a stress-free rail condition at a rail temperature of 35°C.

Some of the steps in the procedures are common to both jointed and CWR tracks. To avoid repetition these have not been included here but are detailed in Chapter 4.

C5-2 Measurement of adjustment

The method of measurement of adjustment of jointed track, including JWR and loose rails is detailed in Section C5-6.

The amount of expansion or contraction of rail depends on its length as well as changes in temperature. Mechanical joints are constructed with a gap of 6mm between rail ends at design neutral temperature of 35°C. They will be fully open at 13mm and closed at 0mm. The longer the length of rail between joints, the smaller the change in temperature required for the joints to become fully opened or close completely. A 110m length will expand or contract by 6mm with a rail temperature change of only 5°C, whilst a 55m length will move 6mm with a rail temperature change of 10°C.

Different rail lengths, therefore, have a different stress-free range.

e.g.	220m	–	32°C to 37°C rail temperature
	110m	–	30°C to 40°C rail temperature
	55m	–	24°C to 45°C rail temperature

1. Use the rail gap charts detailed in Appendix 5.2 and Appendix 5.3 to establish stress free ranges for all rail lengths.
2. Remember not to try to measure rail gaps outside the recommended temperature range.

Example

If for you tried to measure gaps in 110m rails at 45°C, all the gaps should be closed. What rail temperature did they close at? They might have closed at 35°C, in which case there would be too much steel. They might have closed at 43°C, which means there would not have been enough steel, or they might have closed at 40°C, which means they have the right amount of steel.

On the other hand, if you were measuring the same gaps in 110m rails at 25°C rail temperature all the gaps should be 13mm open. They might have been fully open at 27°C rail temperature (too much steel), 32°C rail temperature (not enough steel) or have just enough steel and become fully open at 30°C rail temperature.

If the mechanical joint has a gap of between 1mm and 12mm we can determine if the rail is in the correct adjustment. When the joint gap is in this range the rails are in a “Stress Free” condition. i.e. there is no compression or tension being applied to the rails.

C5-2.1 Measurement considerations

C5-2.1.1What gaps are to be measured?

Measure gaps at ALL rail joints, including mechanical insulated joints (end post not to be counted as part of gap). DO NOT measure bonded insulated joints or joints within a turnout.

C5-2.1.2What is the best temperature for measurement of rail gaps?

Rail gaps must be open (more than zero) but not fully open (less than 13mm) to be sure that the measurement is correct. The best temperature to measure at will depend on the rail length.

For example, correctly adjusted 110m rails with a 6mm gap at 35°C will have zero gap at 40°C rail temperature and be fully open at 29°C rail temperature. Shorter 13.72m rails, however, will still have a gap until the rail temperature reaches 73°C, and will not be fully open until the rail temperature falls below 9°C.

C5-2.1.3What happens if the rail gaps are closed?

If the rail gaps are closed and cannot be measured, you have no way of knowing how far the rail is out of adjustment.

If this happens, you must return when the rail temperature is lower, when there is a gap, and measure and record the rail gaps and the rail temperature again.

C5-2.1.4What happens if the rail gaps are open?

If the rail gaps are fully open (13mm or more if bolts are bent and bolt holes worn), you have no way of knowing how far the rail is out of adjustment. You must return when the rail temperature is higher, when the gap is less than fully open, and measure and record the rail gaps and the rail temperature again.

This is the only way the rail adjustment can be correctly assessed.

If joints are worn and it can be established that the joints will open more than the current gap then the wider gaps can be used (to a maximum of 19mm).

C5-2.1.5What about frozen or incorrectly bored joints?

The joints may be frozen (i.e. not moving) and so it would not be possible to measure the gaps correctly. The joint needs to be repaired before the gap can be measured.

It is very important that the gaps are measured correctly for adjustment analysis.

Where it is obvious that the joints never fully open or fully close, it may be because they have not been correctly bored. Check the bolthole spacing. Incorrectly bored joints MUST be replaced.

C5-3 Adjustment methods

The following processes provide methods to control the adjustment of rail in the installation and maintenance of jointed track:

Method of adjustment of LWR at single joints

This is the standard method for the adjustment of LWR track by measurement and adjustment at a single joint. The method is also used when increasing rail lengths by free welding intermediate joints. The process is detailed in Section C5-7.

Method of adjustment of LWR at more than one joint

This is the standard method for the adjustment of LWR track by measurement and adjustment at multiple joints. The process is detailed in Section C5-8.

Method of adjustment of loose rails

This is the standard method for the adjustment of loose rail by measurement and adjustment at single or multiple joints. The process is detailed in Section C5-9.

C5-4 Adjustment length

Adjustment is restricted to 220m on straights and shallow curves and 110m on curves sharper than 600m radius. This is restricted because 110m rail length is the standard configuration for LWR track.

C5-5 Field welding of long welded track into longer rail lengths

Whenever it is necessary to convert shorter lengths of rail to longer lengths, up to and including the maximum length of 220m for standard LWR the following requirements must be met:

C5-5.1 Method of welding

Welding into long welded lengths is carried out on a face in one direction.

- Generally, both Up and Down rails should be welded as the welders work along the face.
- Free welding must be carefully staged to address any variations in temperature in order to prevent misalignment of unadjusted track.

C5-5.2 Temperature restrictions

Welding into long lengths must not be carried out if the rail temperature is higher than the rail temperature at which the rail length you are welding will close (e.g. if the final rail length will be say 55m do not weld above 44°C)

If the rail temperature is lower than 10°C, adjustment is only possible in short lengths. Welding into 220m lengths (110m in sharp radius curves) must not be carried out if the rail temperature is lower than 10°C.

C5-6 Measurement of rail adjustment in jointed rail

C5-6.1 At one joint in LWR

1. Check the rail temperature.
2. Measure the gap.

If the joint gap is not the same as the required theoretical gap, the rails are not in correct adjustment.

Important
Only measure gaps at rail temperatures at which the joints are open between 1 and 12mm (See Section C5-2.1).

C5-6.2 At more than one joint

This process is carried out to determine the state of the adjustment of longer sections of rail with more than one joint in the section, e.g. a 500m section of rail with 5 joints.

You can measure the state of the adjustment of the complete 500m.

C5-6.2.1Where joints are equally spaced

The principles are the same as measuring one joint, but now you must:

1. Count the number of joints.
2. Measure how far apart the joints are (length of adjustment).
3. Take the rail temperature and measure actual joint gaps.
4. Add the actual joint gaps.
5. Multiply the number of joints by the theoretical gap (refer to the Rail Gap Chart).
6. Compare the total actual joint gaps to the total theoretical gaps to find out if the rails are:
   - correctly adjusted,
   - incorrectly adjusted, or
   - cannot tell the state of the adjustment (if the gaps are closed or fully open).

C5-6.2.2Where joints not equally spaced

Where odd lengths of rail exist in the section you are measuring for adjustment, the best way to measure the state of adjustment is as follows:

1. Determine the number of joints in the section of rail being measured
2. Take the rail temperature and measure actual joint gaps.
3. Add the actual joint gaps.
4. Determine the theoretical gap for one (1) joint (that is assume the section of rail you are measuring has only one joint) (refer to the Rail Gap Chart).
5. Add 6mm for every joint after the first to calculate total theoretical gaps required.
6. Compare the total actual joint gaps to the total theoretical gaps to find out if the rails are:
   - correctly adjusted,
   - incorrectly adjusted, or
   - cannot tell the state of the adjustment (if the gaps are closed or fully open)

C5-7 Method of adjustment of LWR at single joints

1. Check Rail temperature to ensure it is within allowable range for adjusting rail

In LWR, the rail length determines the maximum rail temperature at which adjustment can take place. You cannot adjust after the joint closes up.

For example

- 220m rail cannot be adjusted if the rail temperature is more than 37°C
- 110m rail cannot be adjusted if the rail temperature is more than 40°C
- 50m rail cannot be adjusted if the rail temperature is more than 45°C

2. Determine adjustment point and mark anchor points.
3. Create anchor points at points A and C (110m either side of joint B) (See Figure 8)

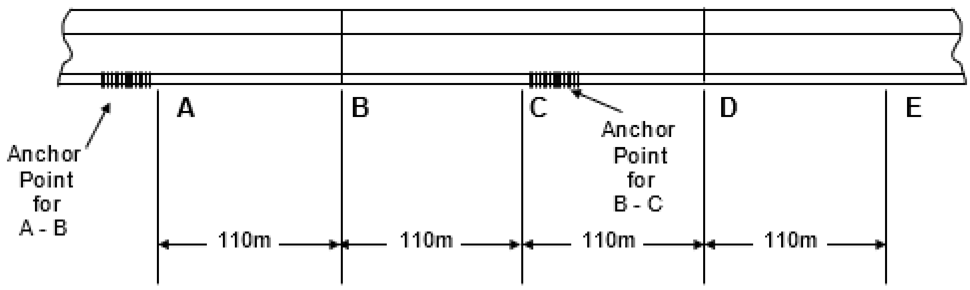


Figure 8 - Anchor points

4. Remove fishbolts and check joint for condition and free movement. Replace bolts in one end only so the rail can move freely (i.e. butterfly the joint).

   Remember - the joint will be left in the track so the joint must be broken apart and inspected for any defects, i.e. elongated holes, cracked rail, cracked plates, bent bolts. If necessary, renew the joint. (See CRN Engineering Manual CRN CM 221- "Rail Installation & Repair" for procedures).

5. Oxy cut the rail a minimum of 2.2m from the joint (See Figure 9).

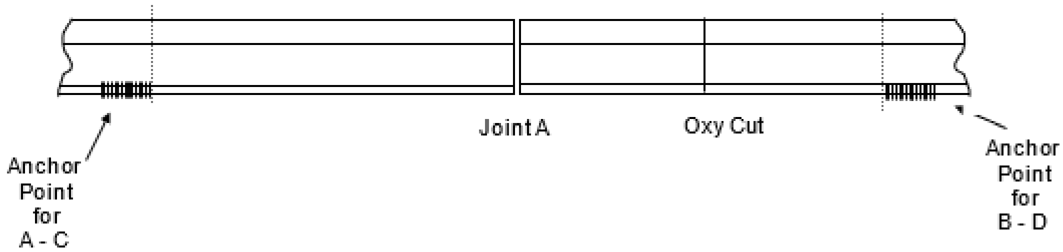


Figure 9 - Oxy cut adjustment joint

6. Remove any resilient fastenings/anchors between anchor points.
7. Vibrate rail, anchor point to anchor point to relieve the stresses and to make the rails stress free, ready to be adjusted.
8. Measure the rail gaps at the joint and at the oxy cut after vibrating is complete and record the figures.
9. Measure the rail temperature.
10. Calculate and record correct total gap required for LWR.
11. Cut the rail to achieve the correct gap.

    Note: If, after vibrating the rails, the rail ends have opened up to more than the required gap (+ the welding gap), steel must be added by welding in another closure.

12. Open the joint using wedges to achieve the required tension gap at the joint and the required welding gap at the oxy cut rail ends.
13. Weld the oxy cut rail ends.
14. Establish quarter points.
15. Attach rail tensors around the joint and pull the rail ends at the joint together while vibrating.
16. Check progress of tensioning along the rail.
17. When the bolts will fit through the plates, replace bolts and tighten.
18. Replace fastenings/anchors.
19. Remove rail tensors.

20. Remove anchor points.

C5-8 Adjustment at multiple joints

It is possible to adjust more than one joint at a time as long as the maximum adjustment length is not exceeded.

This method is used for rail lengths between 24.7m and 110m.

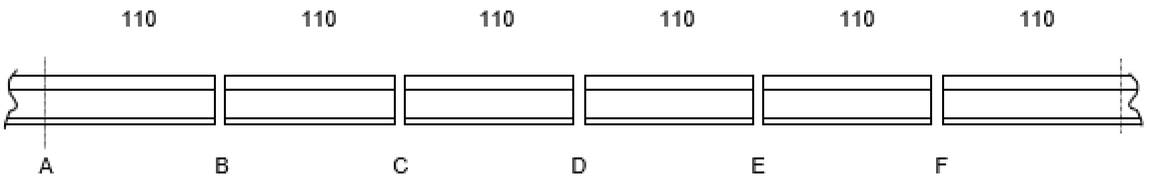


Figure 10 - Adjustment of equal lengths

In Figure 10 above Joints “B” and “C” can be adjusted together.

1. Check Rail temperature to ensure it is within allowable range for adjusting rail.
2. Determine the adjustment point and mark anchor points. The adjustment point will be halfway between the anchor points.
3. Create anchor points on either side of the area to be adjusted i.e. at points AP midway between “A” - “B” and “C” - “D” giving us a 220m length with 2 joints to adjust (See Figure 11).

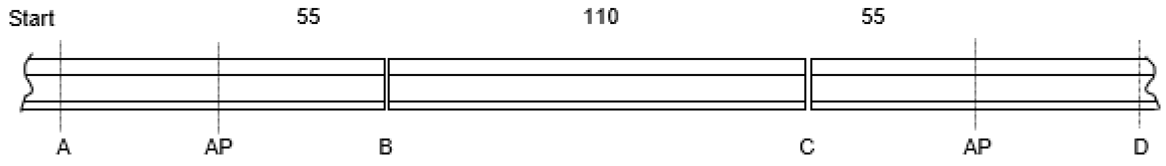


Figure 11 - Anchor points for multiple lengths

4. Check joints for condition and free movement. Replace bolts in both ends of joints but do not tighten.

   Remember - the joints will be left in the track so the joints must be broken apart and inspected for any defects, i.e. elongated holes, cracked rail, cracked plates, bent bolts. If necessary, renew the joints. (See CRN CM 221 for procedures)

5. Oxy cut the rail midway between joints “B” and “C” - this will be the adjustment point. (See Figure 12)

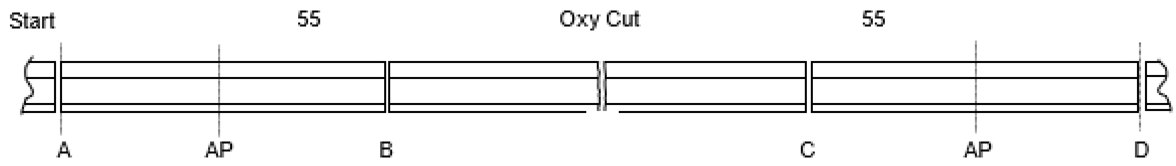


Figure 12 - Oxy cut adjustment point

6. Remove fastening/anchors between anchor points
7. Vibrate rail, anchor point to anchor point to relieve the stresses and to make the rails stress free, ready to be adjusted.
8. Measure the rail temperature.
9. Measure the rail gaps at the joints and at the oxy-cut, after vibrating is complete and record the figures.
10. Calculate and record correct gap required.

To calculate the total gap required, remember that the rail gap chart only takes into account one joint in the total length to be adjusted. We have to add 6mm for every joint being adjusted after the first.

11. Cut the rail to achieve the correct gap.
12. Attach rail tensors around the oxy-cut rail ends and pull to required welding gap while vibrating and checking quarter points to ensure even movement.
13. Install an aluminothermic weld at the oxy-cut rail ends.
14. Reinstall fastenings/anchors to minimum standard anchor pattern, and ensure bolts are tight at joints “B” & “C”.
15. Remove rail tensors.
16. Anchor points can now be removed, or reversed and the next 220m section adjusted.

C5-9 Adjustment at loose joints

1. Check existing adjustment

Before attempting any work, the existing adjustment must be checked. This can only be done accurately between rail temperatures where the rail joints are not closed up completely nor opened up completely.

2. Determine adjustment point and mark anchor points
3. Install anchors at anchor points

To adjust loose rail, it becomes a simple matter of isolating the section of rails to be adjusted using standard anchor points at each end of the adjustment area.

4. Check all joints for defects i.e. cracked plates, bent bolts, cracks in rail, battered rail ends etc. Reconstruct the joints, leaving the bolts loose.
5. Remove fastening/anchors between anchor points
6. Vibrate rail, anchor point to anchor point to establish stress free condition
7. Measure and record, rail temperature and gaps
8. Calculate and record correct gaps required

To calculate the total gap required, remember that the rail gap chart only takes into account one joint in the total length to be adjusted. We have to add 6mm for every joint being adjusted after the first.

9. Using rail tensors, move the rails about until the joint gaps are correct and even.
10. Add or remove steel at end of job if there is too little or too much steel using the aluminothermic welding process OR by establishing another rail joint.
11. Tighten all bolts
12. Reinstall fastenings/anchors. The minimum standard anchor pattern for short lengths of rail is different to lengths of rail 110m or longer. Refer to Section C4-17 for the correct patterns.
13. Remove anchor points.

Appendix 5.1 Rail Gap Calculation neutral temp 35°C

For rail lengths not included in the LWR extension/rail temperature graph (Appendix 5.2) or Table (Appendix 5.3), the theoretical gap can be calculated from the following formula:

Rail gap(mm) = 6mm + [(35 rail temperature(°C)) x 0.0115 x rail length(m)]

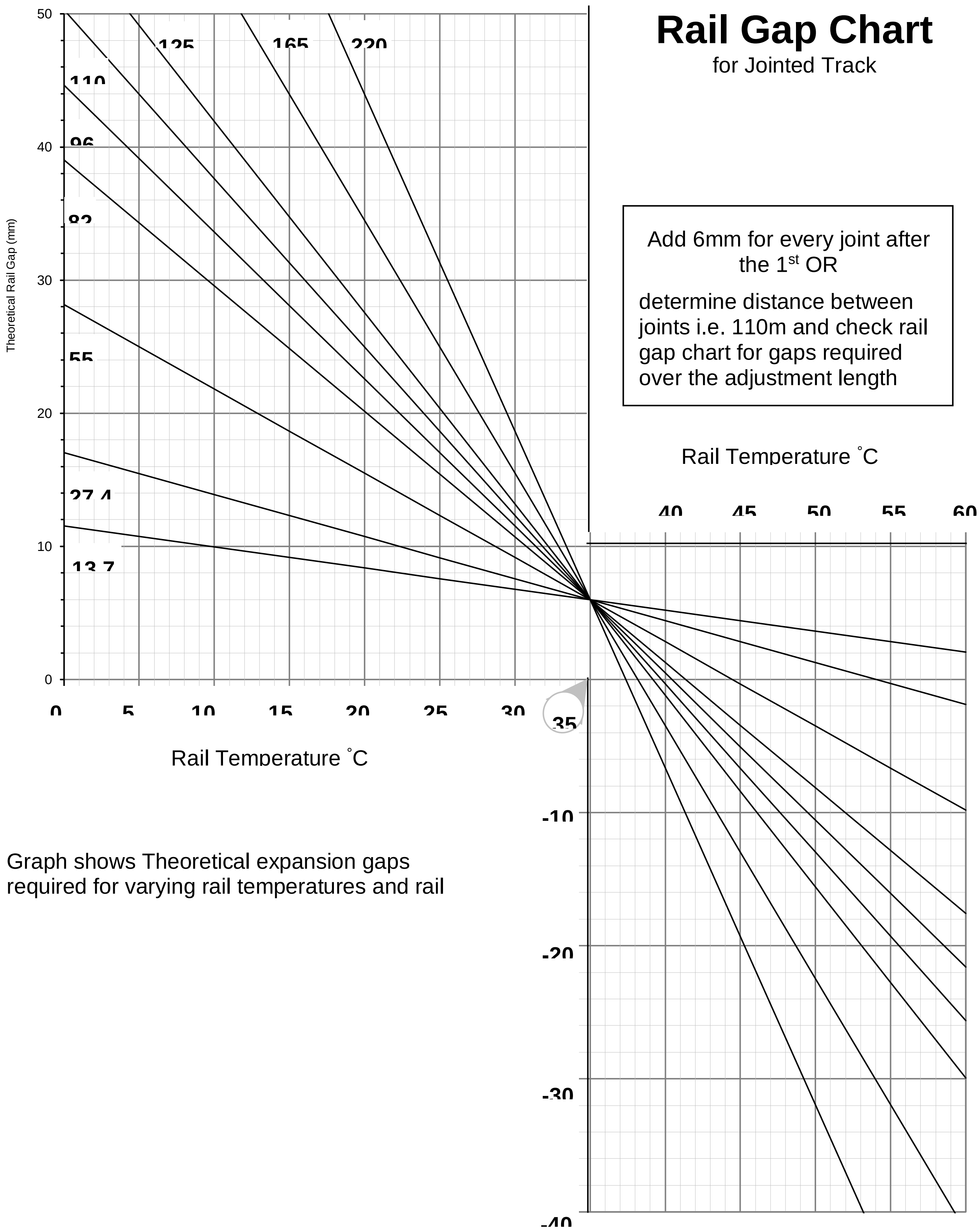
Appendix 5.2 Rail Gap Chart

Rail Gap Chart

for Jointed Track

Add 6mm for every joint after the 1st OR

determine distance between joints i.e. 110m and check rail gap chart for gaps required over the adjustment length



Graph shows Theoretical expansion gaps required for varying rail temperatures and rail

Appendix 5.3 Rail Gap Table

JWR & LOOSE RAIL - ADJUSTMENT GAP SIZE (mm) Neutral temp 35										
		Rail Length (m)								
		13.7	27.4	55	82	96	110	125	165	220
Rail Temperature °C	0	12	17	28	39	45	50	56	72	95
	1	11	17	28	38	44	49	55	71	92
	2	11	16	27	37	42	48	53	69	89
	3	11	16	26	36	41	46	52	67	87
	4	11	16	26	35	40	45	51	65	84
	5	11	15	25	34	39	44	49	63	82
	6	11	15	24	33	38	43	48	61	79
	7	10	15	24	32	37	41	46	59	77
	8	10	15	23	31	36	40	45	57	74
	9	10	14	22	31	35	39	43	55	72
	10	10	14	22	30	34	38	42	53	69
	11	10	14	21	29	32	36	41	52	67
	12	10	13	21	28	31	35	39	50	64
	13	9	13	20	27	30	34	38	48	62
	14	9	13	19	26	29	33	36	46	59
	15	9	12	19	25	28	31	35	44	57
	16	9	12	18	24	27	30	33	42	54
	17	9	12	17	23	26	29	32	40	52
	18	9	11	17	22	25	28	30	38	49
	19	9	11	16	21	24	26	29	36	46
	20	8	11	15	20	23	25	28	34	44
	21	8	10	15	19	21	24	26	33	41
	22	8	10	14	18	20	22	25	31	39
	23	8	10	14	17	19	21	23	29	36
	24	8	9	13	16	18	20	22	27	34
	25	8	9	12	15	17	19	20	25	31
	26	7	9	12	14	16	17	19	23	29
	27	7	9	11	14	15	16	18	21	26
	28	7	8	10	13	14	15	16	19	24
	29	7	8	10	12	13	14	15	17	21
	30	7	8	9	11	12	12	13	15	19
	31	7	7	9	10	10	11	12	14	16
	32	6	7	8	9	9	10	10	12	14
	33	6	7	7	8	8	9	9	10	11
	34	6	6	7	7	7	7	7	8	9
	35	6	6	6	6	6	6	6	6	6
	36	6	6	5	5	5	5	5	4	3
	37	6	5	5	4	4	3	3	2	1
	38	6	5	4	3	3	2	2	0	
	39	5	5	3	2	2	1	0		
	40	5	4	3	1	0	0			
Ra il Te	41	5	4	2	0					
	42	5	4	2						

JWR & LOOSE RAIL - ADJUSTMENT GAP SIZE (mm) Neutral temp 35									
	Rail Length (m)								
	13.7	27.4	55	82	96	110	125	165	220
43	5	3	1						
44	5	3	0						
45	4	3	0						
46	4	3							
47	4	2							
48	4	2							
49	4	2							
50	4	1							
51	3	1							
52	3	1							
53	3	0							
54	3	0							
55	3	0							
56	3								
57	3								
58	2								
59	2								
60	2								
61	2								
62	2								
63	2								
64	1								
65	1								
66	1								
67	1								
68	1								
69	1								
70	0								
71	0								
72	0								
73	0								

Chapter 6 Adjustment of Continuous Welded Rail

C6-1 Scope

This chapter details the procedures necessary to adjust and weld rail to ensure continuous welded track is in correct adjustment to provide a stress free rail condition at a rail temperature of 35°C.

It includes methods for measuring and maintaining adjustment in CWR as well as converting jointed track to CWR.

It also provides procedures for the repair of rail defects in CWR to ensure that rail adjustment is maintained.

Some of the steps in the procedures are common to both jointed and CWR track. To avoid repetition these have been detailed in Chapter 4.

C6-2 Adjustment and repair methods

The following processes provide methods to control the adjustment of rail in the installation and maintenance of continuously welded track:

C6-2.1 Measuring and maintaining adjustment in existing CWR

This is the standard method for measuring rail adjustment in existing CWR by cutting the rail to assess rail movement. The method also includes re-adjustment of existing CWR. The process is detailed in Section C6-11.

When the adjustment of existing CWR is measured using Creep Control Marks, and it is determined that the total creep into (or out of) the section (normally 500m) is sufficient to require adjustment, the full section between Creep Control Marks MUST be adjusted.

As an alternative, if you think you can isolate a shorter section where the full amount of creep has occurred, you can limit adjustment to the shorter section. You MUST, however, account for the TOTAL amount of creep in the shorter adjustment length, or you MUST continue adjusting until you have accounted for the full amount of creep.

For example:

Total creep into a 500m section is measured as 60mm. You do a short adjustment (say 110m) and find that for the correct adjustment of the 110m section, 60mm must be removed. In this case you have accounted for the full amount of creep and no further adjustment is necessary. The 500m section must be re-punched to zero.

If, however, your 110m adjustment requires removal of only 20mm of rail, you MUST move to the adjacent 110m length and continue adjusting until you have found and adjusted the full 60mm.

Removing 60mm of steel randomly in the section is NOT rail adjustment.

C6-2.2 Installing CWR in straights and curves

This is the standard method for the installation and adjustment of CWR on open track. The process is detailed in Section C6-12.

C6-2.3 Installing CWR near fixed installations

If adjusting towards a fixed installation, special processes are required to ensure correct adjustment. These are detailed in Section C6-13.

1.1.1 C6-2.4 Rail defect repair - "Rail Out = Rail In" method

It is preferable to check and correct rail adjustment whenever welding operations are undertaken in CWR track. When this, however, is not practical it is essential that rail adjustment is not changed. In its simplest terms this means:

RAIL OUT = RAIL IN.

The procedures necessary to achieve this are detailed in Section C6-15 for the repair of rail defects.

C6-2.5 Repair of broken rail in CWR track " Rail Out = Rail In" method

Similarly when repairing broken rails, and it is not practical to check and correct rail adjustment, the method detailed in Section C6-16 should be adopted.

C6-2.6 Installing or adjusting CWR at neutral temperature

When rails are at neutral temperature, rail tensors are not required for the adjustment process. The simplified method is described in Section C6-18.

C6-2.7 Adjustment of rails in tunnels

Rails are continuously welded and adjusted to create a balance between compressive and tensile forces at the extremes of temperature experienced by the track environment. Track located within tunnels (that is more than 50m away from a portal) is exposed to a limited temperature range and may be welded where it sits without further adjustment. The adjustment method is described in Section C6-19.

C6-3 Beginning and end of work

Where rail is to be removed from the track and replaced (e.g. rerailing or reconditioning) follow the special requirements of CRN CM 221.

C6-4 Check and record alignment

14. Measure and record the track alignment BEFORE adjusting any rail on curved track.

    If the alignment changes, the adjustment will be incorrect.

15. Take the alignment measurements NO MORE than 1 week before track adjusting (12 hours in colder weather or if the track has been resurfaced in the preceding month).
16. Take the alignment measurements every 20m (or as many reference points as possible, or as determined by the Civil Maintenance Engineer). Where, however, permanent alignment markers are located at larger intervals they may be used up to a maximum spacing of 50m.
17. Record the measurements on a print-out of the Infor Track Alignment Form for the section being adjusted and attach it to the Rail Weld Adjustment Return (Form RWA1).
18. In curves, if the track is found to be more than 15mm off correct alignment (or 25mm for curves >1000m radius), the track MUST NOT be adjusted without the written authority of the Civil Maintenance Engineer. Although adjustment of rails that are not on correct alignment is permitted provided follow up re-alignment and re-adjustment is carried out, it should be avoided because of the potential for follow up works to be interrupted.

    On straight track no alignment measurements are required.

Use the following guidelines to assess curve alignment for adjustment purposes. For adjustment to be undertaken, a curve is considered “on line” if any of the following exist:

19. Alignment measurements are taken at all Track Control Marks (TCM) and all are within tolerance 15mm (or 25mm for curve >1000m radius)

    OR

20. At least 80% of TCM are measured and within tolerance, and, no more than two consecutive TCM are missing (up to a maximum 50m) or outside tolerance

C6-5 Associated trackwork

When converting jointed track to CWR, the condition of the track structure is important.

- Ballast profile must be to standard.
- Fastenings (dogspikes, anchors, resilient fastenings, insulators and sleeper plates) must be in good condition and correctly applied.
- Sleepers must be in good condition to hold the track in position when interacting with the ballast and to hold track to correct gauge.
- “Creep Pegs” must be in place so creep control marks can be established as soon as possible after adjusting. Install creep control marks in accordance with the requirements in Chapter 8.

C6-6 Method of welding

Weld in a face in one direction, whenever it is possible, and adjust the rails ahead of the continuously welded section to the welded-up section.

Free welding must be carefully staged to address any variations in temperature in order to prevent misalignment of unadjusted track. This is particularly important when free welding is carried out in cooler temperatures and the adjustment is not carried out before rail temperatures rise. Extra steel will have been inserted in cooler temperatures. If it has not been adjusted when the rail temperature rises, a misalignment may occur.

C6-7 Both rails to be adjusted

Generally when converting long welded track to CWR, both Up and Down rails should be welded and adjusted as the welders work along the face. The extent of the "welding face" and "adjusting face" on both rails should match at the end of each welding day.

When readjusting existing CWR track, only adjust the rail that requires adjustment.

C6-8 Adjustment length

The maximum length of track that can be adjusted is as follows:

For timber sleepered track and partially steel sleepered track

- 125 m for curves < 600m radius
- 250 m for curves ≥ 600m radius or straights.

For concrete or steel sleepered track

- 250 m for all curves and straights

The adjustment lengths adopted recognise the general configuration of track on which adjustment will be performed. For example 250m adjustments are not used when converting jointed track to CWR because the maximum jointed rail length is generally 110m, giving a 220m adjustment on straights. On existing CWR track, however, 250m adjustments are appropriate and even offer advantages in being able to readjust a 500m section between creep control marks in two adjustments.

A maximum variation of 5 metres off centre is allowed when adjusting. For example on a 250 metre adjustment the pull each side of the adjustment weld can be varied up to a maximum of 130m on one side and 120m on the other side.

Situations will arise, particularly when adjusting up to fixed points, where the rail lengths either side of the joint chosen as the adjustment point are unequal by more than 5m. In this case the joint should be welded out by inserting a closure and a new adjustment joint cut at the midpoint of the length. If, however, the adjustment is undertaken at Neutral Temperature and no pull is needed, you can place the adjustment weld near one end of the adjustment length.

C6-9 Recording adjustment

Record the following information about CWR adjustment work on the Rail Weld Adjustment Return (Form RWA1 See Appendix 6.4). The fields on the form are explained in Table 1.

C6-10 Reporting adjustment

The person in charge of the rail adjustment is required to complete the appropriate sections of a Rail Weld Adjustment Return Form RWA1 for all CWR rail adjustment.

A copy of each completed Form RWA1 shall be forwarded to the local Maintenance Superintendent within 7 days of the completion of the adjustments documented on the form (or as otherwise agreed before the commencement of work).

	Adjustment Impact	**Completion required**			
	FW = Free Weld / RR = Rail Repair using rail out = rail in, CA = new CWR adjustment / RA = Re-adjustment	**F**	**RR**	**CA**	**RA**
General Information					
Area	Insert-Area where the work was done (e.g. Bathurst)	Y	Y	Y	Y
Track section	Insert track section (e.g. Blayney to Bathurst)	Y	Y	Y	Y
Section adjusted	Insert from and to kilometres of the adjustment work.			Y	Y
Location details					

		Adjustment Impact	Completion required			
		FW = Free Weld / RR = Rail Repair using rail out = rail in, CA = new CWR adjustment / RA = Re-adjustment	**F**	**RR**	**CA**	**RA**
Weld date		Insert date of completion of the weld.	Y	Y	Y	Y
Infor Asset No		Asset Number from Infor for the track concerned	Y	Y	Y	Y
Track		Insert track (e.g. UP Main)	Y	Y	Y	Y
Rail		UP or DOWN rail	Y	Y	Y	Y
Km		Km of weld	Y	Y	Y	Y
Weld details						
Weld Number			Y	Y	Y	Y
Weld Type		Weld process code from list (see CRN CM 222)	Y	Y	Y	Y
Track Condition		Insert appropriate code from list (see CRN CM 222)	Y	Y	Y	Y
Weather Condition		Insert appropriate code from list (see CRN CM 222)	Y	Y	Y	Y
Rail temperature		Temperature of rail at time of weld	Y	Y	Y	Y
Rail Size		Rail size e.g. 60HH, 60, 53, 47 Include both rail sizes if it is a junction weld	Y	Y	Y	Y
Weld Reason		Insert code from list (see CRN CM 222)	Y	Y	Y	Y
Weld Condition		Insert appropriate code from list (see CRN CM 222)	Y	Y	Y	Y
Batch Number		Batch number from the weld portion bag	Y	Y	Y	Y
Adjustment details						
Anchor points		Location of anchor point on each side of the adjustment			Y	Y
Adjustment length (metres)		Distance between anchor points			Y	Y
Punch mark before cut	**PM1**	Measurement between punch marks before any work		Y		Y
Punch Mark (cut and relaxed rail)	**PM2**	Measurement when rail is stress free at current rail temperature			Y	Y
Rail Gap (Broken Rail only)	**G**	Distance between rail ends of broken rail		Y		
Adjustment gap required	**AGR**	Calculated gap required at measured rail temperature			Y	Y
Punch Mark target to adjust	**PMT**	Required punch mark after adjustment (not including weld gap)			Y	Y
Punch mark after adjustment	**PM3**	Measurement between punch marks after adjustment		Y	Y	Y
Rail Tensors used?		Have tensors been used to maintain adjustment or pull rail to correct adjustment?		Y	Y	Y
Alignment checked?		Has alignment been checked and record attached			Y	Y
Sign-off						
Welder		Welder's signature	Y	Y	Y	Y
Adjustment officer		The person in charge of the adjustment to sign for adjustment welds ONLY			Y	Y
Creep Mark Details						
Creep Measurements before adjustment		Take measurements of creep on each rail at each end of the section to be adjusted before commencing work.				Y
Have creep marks been re-established		When CWR track adjustment is completed have creep marks been re-established or installed. Additional information if required.			Y	Y

	Adjustment Impact	Completion required			
	FW = Free Weld / RR = Rail Repair using rail out = rail in, CA = new CWR adjustment / RA = Re-adjustment	F	RR	CA	RA
	Location of NEW creep control marks and whether single or double punch marks are used should be written in the comments column.				
Associated Work					
Comments	Write down any comments relevant to the work	Y	Y	Y	Y
Superintendent Review	Maintenance Superintendent to review the adjustment return	Y	Y	Y	Y

C6-11 Measuring and maintaining adjustment in existing CWR

C6-11.1 Measuring adjustment

21. Check that the rail temperature is more than 10°C and at or below 35°C for work to commence.
22. The rail length can be any length up to 250m (or 125m in curves less than 600m radius).
23. Check and record alignment for adjustment suitability
24. Establish anchor points at each end of the section being measured. (See Figure 13).

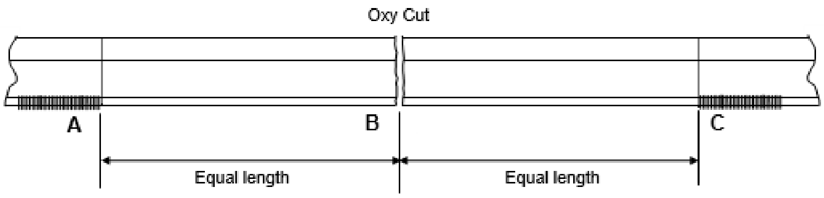


Figure 13 - Anchor Points for CWR

25. Mark, measure and record two punch marks (PM1) approximately 200mm apart either side of the point you have chosen to cut, using the method described in Section C4-15.1.
26. Cut the rail using a rail saw or oxy. If it is suspected that there is too much steel, use oxy to cut the rail, since a rail saw is likely to jam as the rail continues to expand.
27. Remove anchors/clips between A and C.
28. Establish a gap of approximately 6mm

    If the rail continues to move toward the oxy cut, remove more rail by oxy-cutting. Since you don't know how much the rail will move up, do not remove too much. Keep the gap less than the welding gap of 25mm (say 6mm) – just in case there are locked in stresses elsewhere and it moves back when vibrating, which could leave you short of steel and requiring a closure rather than a single weld.

29. Vibrate the rail along the length between A – B and B – C.

    Note: Since you are measuring adjustment at less than 35°C rail temperature, rail should always move apart if there isn't too much steel. If steel needs to be cut out there is definitely too much steel.

30. When the rail stops moving measure and record the distance between the two punch marks (PM2).
31. Calculate the actual rail adjustment as follows:

    If steel has been removed,

    Punch mark change = Final distance between marks (PM2) – Initial distance between marks (PM1).

(Note this will generally be a negative number)

Example

Initial distance between marks (PM1) 204mm

Final distance between marks (PM2) 194mm

Punch mark change = Final distance between marks (PM2) – Initial distance between marks (PM1)

= 194 – 204

= 10mm

Remember in this case the gap remaining is not relevant for calculation of adjustment.

If rail moves away from the cut,

Punch mark change = Final distance between marks (PM2) – Initial distance between marks (PM1).

32. Check the rail temperature and calculate the correct gap (AGR) for the rail length (length between A and C).
33. Determine the adjustment error by subtracting the actual gap from the gap required

From the example above, for adjustment length of 110m, Rail Temperature = 30°C

Adjustment gap required (AGR) = 6mm

Punch mark change = 10mm

Adjustment error = 6 – (10) = 16mm

i.e. 16mm too much steel

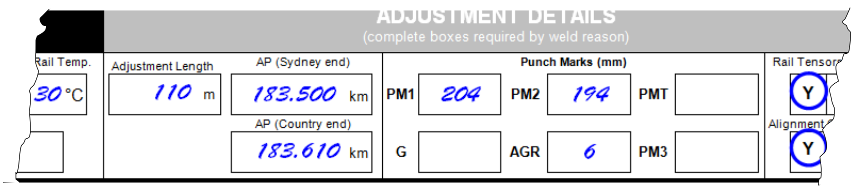


Figure 14 - Recording adjustment required

C6-11.2 Re-adjusting

To adjust the rail, since the anchor points are already established and the rail has been vibrated, continue with the following steps:

34. Check the rail temperature again.
35. Calculate the correct gap (adjustment gap (AGR) + weld gap) for the adjustment length (length between A and C).

In the previous example the adjustment was calculated from the difference in measurement between punch marks, not the gap remaining. There will, however be a gap remaining. Its size depends on how much is progressively cut out, and it needs to be less than total gap required.

Example:

Measured gap in rail = 8mm (say)

Calculated Adjustment required (AGR) = 6mm

Welding Gap = 25mm

Amount of steel to be cut out = Adjustment Gap (AGR) + Weld Gap – Measured gap

= 6 + 25 -8

= 23mm

Important
If the gap remaining is more than the total gap required (Welding gap + Adjustment gap), you have to insert a wide gap weld or a closure.

36. Determine the punch mark measurement required at the end of the work.

    Punch mark measurement required (PMT) = Initial distance between marks (PM1) Adjustment error.

    Example:

    Initial distance between marks (PM1) = 204mm

    Adjustment error = 16mm

    Punch mark measurement required (PMT) = 204 – 16

    = 188mm

37. Place a tensor on the rail, mark anchor points and half points (use ¼ points as well if rail length between anchor points is more than 80m) and cut the required gap.
38. Pull the rail while vibrating.
39. Check progress of adjustment by measuring ¼ points.
40. Pull the rail until the Punch mark measurement required (PMT) is achieved.
41. Check that the required welding gap for the aluminothermic welding process being used. Do not vibrate while weld is being set up.
42. Complete the field weld.
43. Remove the tensor and install resilient fastenings or anchoring.
44. Measure and record the distance between the punch marks using the procedure described in C4-15.2.
45. Remove the anchor points.

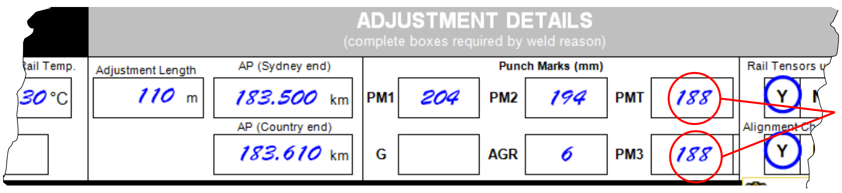


Figure 15 - Recording final adjustment

C6-11.3 Measuring and re-adjusting long sections

When measuring the adjustment of and re-adjusting longer sections it is necessary to repeat the process in Sections C6-11.1 and C6-11.2 above, as shown in Figure 16.

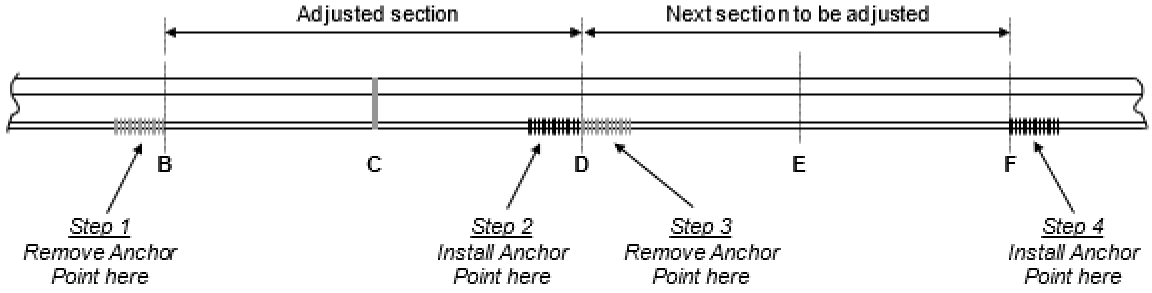


Figure 16 - adjusting long sections

C6-12 Free weld and then cut in Adjustment joints

C6-12.1 Preparation

46. Walk the rail length and “mark out” adjustment into appropriate lengths (starting at a fixed installation if possible) using a measuring wheel for accuracy.
47. Record and assess alignment for adjustment suitability.
48. Record the location of existing joints.
49. Determine joints to be free welded (if any).
50. Determine placement of anchor points and adjustment points, remembering that there are limits on the distance between welds and between new welds and joints and that there are limits on the location of welds adjacent to bolt holes.

The following requirements are extracted from CRN CS 220

- Rail ends or Aluminothermic welds may not be located closer than 1.2 m from the centre of a bonded insulated joint.
- Aluminothermic welds shall not be placed within 2.2 metres of any weld (flashbutt or aluminothermic) or mechanical joint on plain track (main line or siding)
- Aluminothermic welds may be installed opposite each other on adjacent rails as long as gauge side of each weld is ground prior to passage of trains.
- DO NOT install both welds at the same time
- Aluminothermic welds are not permitted on a sleeper.
- Aluminothermic welds should not be located within 4m of the approach end of a transom top bridge, nor within 8m of the departure end.
- Aluminothermic welds should not be located between sleepers of different types
- Aluminothermic welds should not be located in areas adjacent to slab track and level crossings with rigid surfaces.
- Rail ends which have been part of mechanical joints in service in the track are to be removed and replaced with a closure where rail ends have wear >0.3mm or any indication of damage.
- Bolt holes that are being, or have been, used in track to form a mechanical joint must be closely examined and if there is any damage, no matter how slight, then all the bolt holes must be removed. If there is no damage then they may be treated as if they were unused.
- Bolt holes that have not been used in track to form a mechanical joint shall be dealt with as follows:
  - ~ 4 hole pattern - Rails with the 4 hole pattern where only the outer 2 holes are bored on each rail end can be welded straight into track provided that the first bolt hole is maintained at a minimum of 80mm from the weld.
  - ~ 6 Hole Pattern - Rails which have all 3 holes bored on each rail end must be cut behind the first bolt hole so that a minimum of 80mm is achieved from the weld to the first bolt hole (see Figure 17).

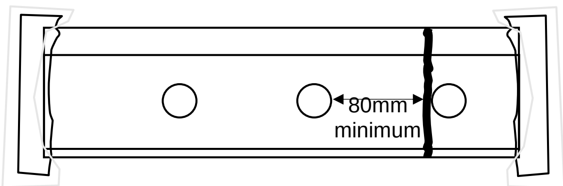


Figure 17 - Minimum distance of bolt hole from weld

Welding near signal bonding holes

- Aluminothermic welds may not be placed within 80mm of any holes drilled in the rail web for attachment of signalling bonds. This includes holes currently in use, those no longer in use and those that have been plugged.

51. When moving from 220m adjustment lengths on straights or shallow curves to 110m lengths on sharper curves, the changeover point may be at any point on the track. The maximum length of adjustment will be governed by the sharpest curvature in the length being adjusted.

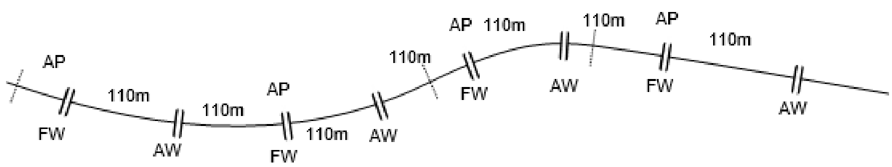


Figure 18 - Planning adjustment

FW = Free Welds

AP = Anchor Points

AW = Adjustment Welds

C6-12.2 Free welding

This activity applies only when rail lengths of 220m can be adjusted

52. Starting from rail lengths of 110m, weld into 220m lengths by cropping the end off each rail at every second joint (B, D, F etc.) to remove the bolt holes and free weld (no rail tensor) closures of 2.2m or longer. In some cases removal of the bolt holes may not be necessary (See Section C6-12.1).

A - B is previous or future work (Figure 19).

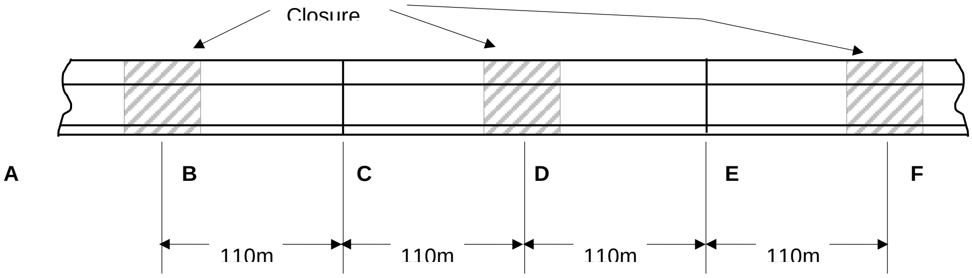


Figure 19 - Free welding

C6-12.3 Adjustment

53. Check that the rail temperature is more than 10°C but not greater than 35°C for adjustment to commence.
54. Establish anchor points B and D to ensure no movement.
55. At joint C, crop the end of each rail to remove bolt holes and free weld, at one end only, a closure of 2.2m or longer. In some cases removal of the bolt holes may not be necessary (see CRN CM 222). The rail is now ready for adjustment (Figure 20).

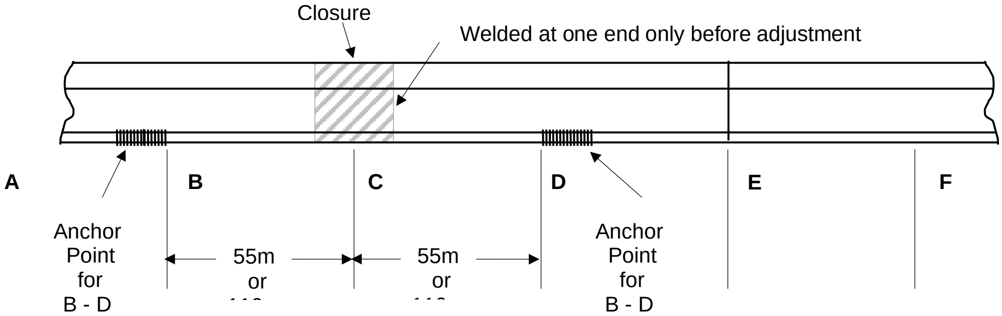


Figure 20 - Adjustment

56. Remove all rail anchors/resilient fastenings between B and D.
57. Ensure the ends of the rail at the adjustment point are free. Vibrate the rail along the length between B, C and C, D.
58. Install punch marks 200mm apart either side of the gap in the rail ends
59. Measure and record the “cut and relaxed” distance between the punch marks (PM2).
60. Check the rail temperature and calculate the correct gap (AGR) for 220m (or 110m) rail length (length between B and D) plus Welding Gap.

    Example

    Rail Temperature = 20°C.

    Rail Length = 220m

    Adjustment gap required (AGR) = 38mm.

Welding Gap = 25mm.

Therefore, the total gap to be cut at 20°C is 38 + 25 = 63mm.

61. Determine and record the punch mark measurement required at the end of the work.

    Punch mark measurement required (PMT) = "Cut and relaxed" distance between the punch marks (PM2) - Adjustment gap required (AGR).

    Example

    "Cut and relaxed" distance between the punch marks (PM2) = 202mm

    Adjustment gap required (AGR) = 38mm.

    Punch mark measurement required (PMT) = 200 – 38

    = 164mm

62. Place a rail tensor on the rail.
63. Cut the required gap.
64. Pull the rail while vibrating.
65. DO NOT vibrate while weld is being set up.
66. Check progress of adjustment by marking and measuring the anchor points and quarter points.
67. Continue vibrating the rails until the punch mark measurement required (PMT) is achieved

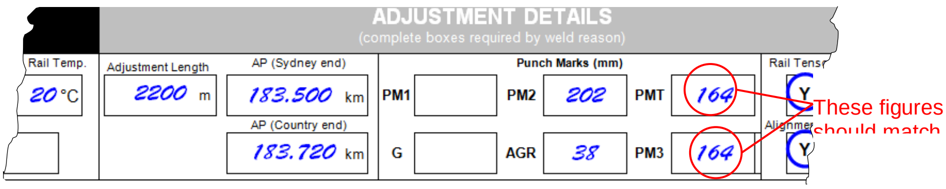


Figure 21 - Recording new CWR adjustment

68. Reinstall anchors or elastic fastenings.
69. Complete the weld.
70. Remove the tensor.

C6-12.4 Adjusting long sections

The process can now be repeated by free welding joint F and adjusting to joint E as described for joint C.

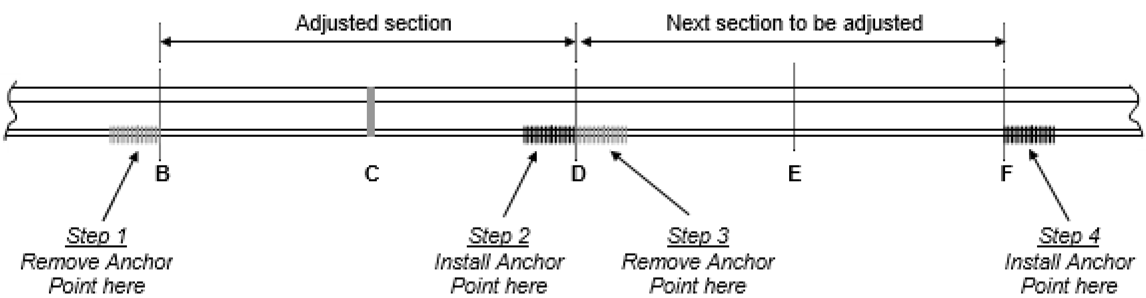


Figure 22 - Adjusting long sections

C6-13 Installing CWR near fixed installations

If adjusting towards a fixed installation (i.e. a turnout or level crossing), this is to be de-stressed separately using the following method (See Figure 23):

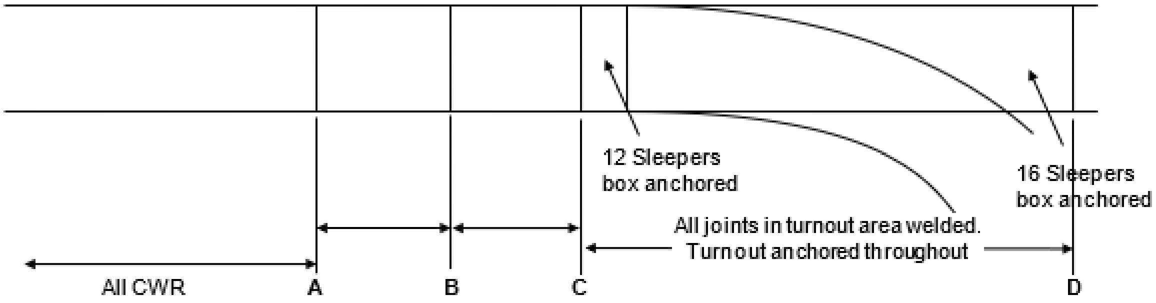


Figure 23 - Installing CWR near turnouts

1. Weld all joints within the turnout, using closures if necessary, to remove bolt holes, by the free welding method. (If the crossing has short legs and can't be welded, log the site as a defect to flag site for crossing replacement at next refurbishment)
2. Box anchor or install elastic fastenings on all bearers from 12 sleepers in front of points, through the turnout to 16 sleepers behind the crossing.
3. The anchor point at the fixed end is not as long as a normal anchor point. To reduce the possibility of movement of the points, install extra anchors on the 12 sleepers and bearers in front of the points (even on resilient fastened track).
4. Using the end of the previous adjustment (A) as one anchor point, and the turnout area C-D as the other anchor point, adjust A   C and weld the joint B as described above, but with the correct extension for rail length involved.

To reduce the force necessary to pull the rail, the adjustment should be undertaken as close to Neutral Temperature (35°C) as possible, and in any case, at a rail temperature no lower than 10°C. At temperatures between 10°C and 26°C, install additional anchors, and mark and check the anchor point for movement.

Example

Rail temperature = 28°C.

Rail length A, B = say 55m

Rail length B, C = say 55m

5. From the CWR adjustment graph,

    read 110m = 9mm gap required

    Welding Gap = 25mm.

    Therefore, the total gap to be cut at joint B is 9 + 25 = 34mm.

6. Repeat for the other end of the turnout, then continue with the normal method.

Note: Both corresponding Up and Down rails should be adjusted during the same day when welding rails into a continuous length. In any case, both rails should be adjusted.

7. Make arrangements for points interlocking to be checked after adjustment.
8. When the adjustment of the next section has been completed, the anchor points can be removed and standard anchoring or resilient fastening pattern can be re-instated.

When adjusting adjacent to Level Crossings, anchor through the level crossing at installation or renewal to ensure that the crossing remains a fixed point.

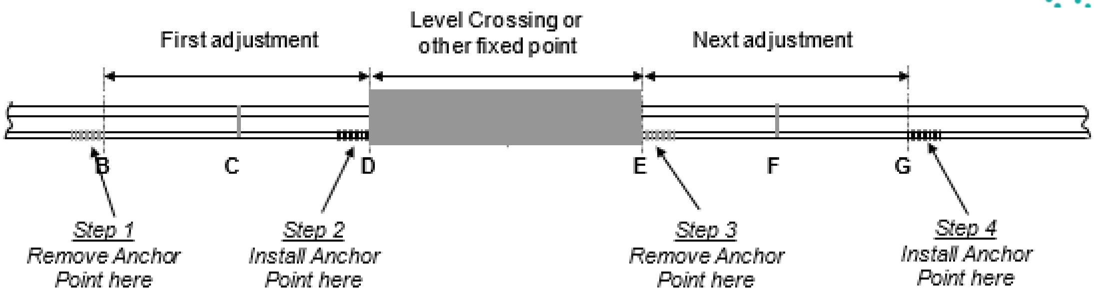


Figure 24 - Installing CWR near Level Crossings

When adjusting adjacent to Level Crossings, for example between B and D in Figure 25 establish the anchor point at the opposite end of the level crossing (E). This will ensure that rail is adjusted right to the fixed point. Before commencing adjustment on the opposite end of the level crossing, (EG) install a new anchor point at D then remove the old anchor point.

C6-14 Adjustment control for turnout component replacement

When replacing turnout components it is important that rail adjustment is controlled. Where the component is joined to a section of plain track (e.g. crossing leg, front of stockrail) control of adjustment in the plain track may be lost.

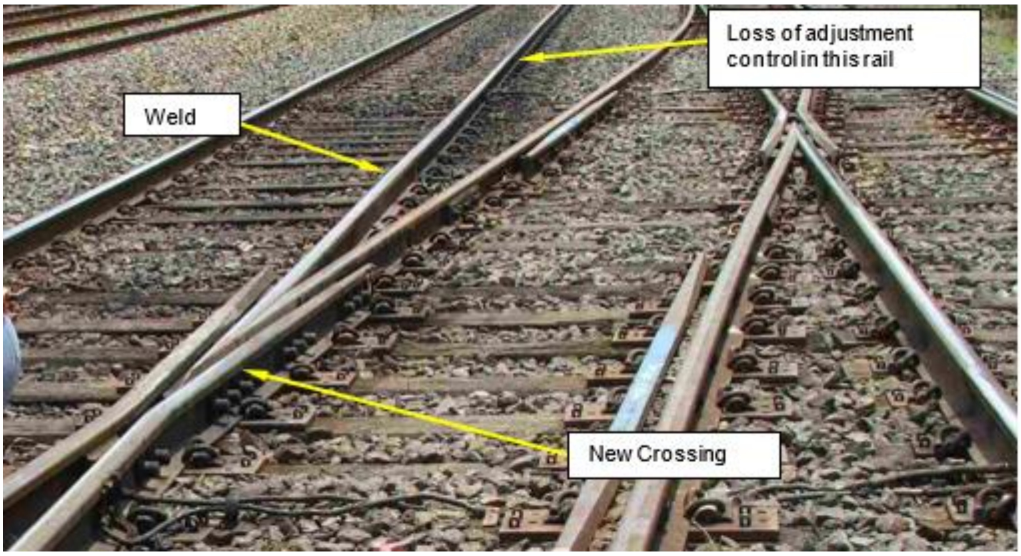


Figure 25 - Area where adjustment control is lost

Take the following steps when replacing components in turnouts or special trackwork:

1. Assess the potential for loss of adjustment control

   If any welding is required on the end of a turnout or nest of turnouts adjoining a length of plain track, there is potential to lose control of adjustment in the plain track.

2. Restrain affected rail(s)

   Where practical, rails in plain track, which adjoin the component being replaced, should be restrained against movement. Extra resistance to rail movement can be provided, by using additional fair type anchors to supplement the existing fastenings.

3. Monitor movement in affected rail(s)

   Rails in plain track, which adjoin the component being replaced, must be monitored for movement. The following processes may be used:

   – Establish creep control marks on the affected rail next to the component being replaced, or;

- Place, measure and record punch marks on the rail head either side of the component being replaced, as outlined in the procedure for “rail in = rail out” defect repairs, in Section C6-15.1.

4. Maintain adjustment in plain track

“Steel Out = Steel In” procedures can be used to ensure that no steel is added. Otherwise, the adjustment of the rail(s) in plain track should be restored. The best way of doing this is to adjust the affected rail, using the procedure outlined for adjusting rails near fixed installations, in Section C6-13.

Care should be taken to avoid excessive force in rails near turnouts. Where practical, undertake the work at rail temperatures close to neutral temperature. Check turnout components for dimensional tolerances and signs of movement during and after any rail tensioning.

Where rail adjustment cannot be restored, assess and manage the associated risks. Report details to the Civil Maintenance Engineer, assess welded track stability and implement protective measures as needed.

5. Record and report details

Record any changes to rail adjustment and report them to the Civil Maintenance Engineer.

C6-15 Removing rail defects in CWR track using "Rail Out = Rail In"

This section sets out the procedures necessary to remove defective rail from CWR track when the rail temperature is ≤ 35°C.

This method of removing defects from CWR track does not check that the track is in correct adjustment. It only retains the previous adjustment of the track before the defect was removed.

The time between cutting a closure out, and reinstalling without adjustment should not exceed 3 hours, unless otherwise approved by the Maintenance Superintendent.

Important
This method relies totally on replacing the SAME AMOUNT OF STEEL THAT WAS REMOVED

C6-15.1 Removing rail defects using a closure

1. Place and measure two punch marks on the outside head of the rail, one each side of the section of rail to be removed using the method described in Section C4-15.1.
2. Record the distance between the 2 marks (PM1).
3. Only remove anchors or resilient fastenings from the section of rail that is to be removed.
4. Establish the length of defective rail to be removed.
5. Extra anchoring around the defect may be used to reduce “jump back” of the rail.
6. Cut the rail and remove the defective section. Measure and record the distance between the punch marks after the cut (PM2).
7. Cut the new closure to the length that was recorded in step 4 less 1.5 times the gap required for welding.

   Keeping the gap less than the total welding gap gives you an allowance just in case there are locked in stresses elsewhere and it moves back, which could leave you short of steel and requiring a closure rather than a single weld.
8. Insert the closure and free weld one end.
9. Place the rail tensors on the rail around the remaining gap.
10. If required, transfer the “cut and relaxed” punch marks (PM2) inside the tensors using the method described in Section C4-15.4.

11. Pull the rails together until the 2 punch marks on the rail are again the measured distance apart (PM1).
12. Whilst holding the marks at the correct distance (PM1) trim the free end of the closure to establish the correct welding gap.
13. Weld the free end of the closure.
14. Remove the rail tensors.
15. Replace all fastenings on the closure.
16. Accurately measure the distance between the two punch marks (PM3) using the method described in Section C4-15.2 and record the result on the Rail Weld Adjustment Returns (see Appendix 6.4).

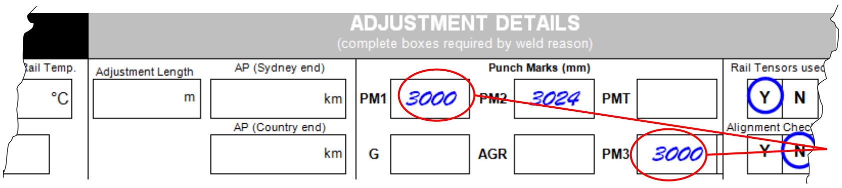


Figure 26 - Recording rail defect removal with "Rail out=Rail" in process

C6-15.2 Removing rail defects when rail temperature > 35°C

If the rail temperature is above 35°C and a rail defect is to be removed, then rail tensors cannot be used to maintain adjustment. When such cases arise, and it is not practical to wait for the rail temperature to fall before removing the defective rail, then:

1. Carry out Steps (1) – (7) above.
2. Trim the free end of the closure to establish the correct welding gap. Keep removing steel until rail movement stops.
3. Weld the free end of the closure.
4. Replace all fastenings on the closure.
5. Accurately measure the distance between the two punch marks (PM3) using the method described in Section C4-15.2 and record the result on the Rail Weld Adjustment Returns (see Appendix 6.4).
6. Inform the Superintendent for arrangement of follow up adjustment.

C6-15.3 Removing rail defects using wide gap welds

This method can be used when it is known the defective portion of the rail does not exceed 65mm.

1. Place and measure two punch marks on the outside head of the rail, one each side of the section of rail to be removed using the method described in Section C4-15.1.
2. Record the distance between the 2 marks (PM1).
3. Extra anchoring around the defect may be used to reduce "jump back" of the rail.
4. Cut the rail and remove the defect.
5. Record the distance between the 2 marks (PM2).
6. Place rail tensors on the rail.
7. Pull the rails together until the 2 punch marks on the rail are again the measured distance apart (PM1).
8. Weld with wide gap weld.

9. Accurately measure the distance between the two punch marks (PM3) using the method described in Section C4-15.2 and record the result on the Rail Weld Adjustment Return (see Appendix 6.4).

C6-16 Repairing broken rails in CWR track using "Rail Out = Rail In"

This method of repairing broken rails in CWR track does not check that the track is in correct adjustment. It only retains the previous adjustment of the track before the broken rail occurred.

It should only be used where the track adjustment is known to be correct or for the emergency repair of a broken rail.

Important
If there is any doubt that the track is in correct adjustment then it MUST be readjusted in accordance with Section C6-10

C6-16.1 Repairing a broken rail using a closure

To remove broken rails using a closure the following procedure must be followed:

1. Accurately measure and record the distance between the 2 broken rail ends (the rail must be measured from the head to head) (G)
2. Place and measure two punch marks on the outside head of the rail, one each side of the section of rail to be removed using the method described in Section C4-15.1
3. Record the distance between the 2 marks (PM1)
4. Using a rail template mark the rail with chalk where it is to be cut to insert new closure. (the minimum distance between the marks is to be 2.2 metres + distance G which is the length recorded between the 2 broken rail ends)
5. Accurately measure and record the distance between the two chalk marks
6. Cut and remove the broken sections
7. Cut the new closure to length

Closure Length = Distance between trimmed rail ends – **G** – 1.5 X **WG**			
Where	**G**	=	Original gap between rail ends
	WG	=	Single weld gap

8. Insert the closure and free weld one end
9. Place the rail tensors on the rail around the remaining gap
10. If required, transfer the punch marks inside the tensors using the method described in Section C4-15.4
11. Determine and record the correct distance between punch marks (**PMT**)

Correct distance between punch marks (PMT) = **PM1** – **G**			
Where	**PM1**	=	original distance between the punch marks
	G	=	the original gap recorded in the broken rail

12. Pull the rails together until the 2 punch marks on the head of the rail are at the correct distance apart (**PMT**)
13. Whilst holding the marks at the correct distance, trim the free end of the closure if necessary, to establish the correct welding gap
14. Weld the remaining gap
15. Remove rail tensors
16. Replace all fastenings on the new closure

17. Accurately measure the distance between the two punch marks (**PM3**) using the method described in Section C4-15.2 and record the result on the Rail Weld Adjustment Return (see Appendix 6.4)

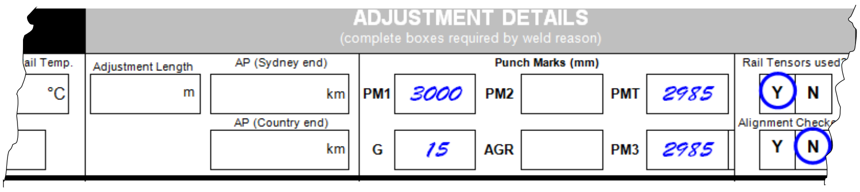


Figure 27 - Recording broken rail removal with "Rail out = Rail in" process

C6-17 Removing a broken rail using a wide gap weld

Removal of a broken rail using wide gap welds can only be performed if the rail has cracked vertically or when the total horizontal distance of the break when pulled together is less than 65mm.

1. Accurately measure and record the distance between the 2 broken rail ends (the rail must be measured from head to head) (G)
2. Place and measure two punch marks on the outside head of the rail, one each side of the rail break (nominally 200mm apart) using the method described in Section C4-15.1
3. Record the distance between the 2 marks (PM1)
4. Determine and record the correct distance between punch marks (PMT)

Correct distance between punch marks (PMT) = **PM1** – **G**		
Where	**PM1**=	original distance between the punch marks
	G =	the original gap recorded in the broken rail

5. Place rail tensors on the rail and pull the broken rails together to close the gap until the 2 punch marks on the head of the rail are at the correct distance apart (PMT).
6. Trim one end of the rail so that the end is square and vertical.
7. Measure 65mm from the trimmed rail end and mark the other end of the broken rail.
8. Cut the rail to establish a 65mm gap at the rail ends.
9. Weld with wide gap weld.
10. Remove rail tensors.
11. Accurately measure the distance between the two punch marks (PM3) using the method described in Section C4-15.2 and record the result on the Rail Weld Adjustment Return (see Appendix 6.4).

C6-18 Installing and adjusting CWR at neutral temperature

1. Determine placement of anchor points and adjustment points. The length of adjustment is limited by the curve radius. (See Section C6-12)
2. Check that the rail temperature is at neutral temperature (35°C).
3. Check and record alignment for adjustment suitability
4. Add additional anchors at anchor points to ensure no movement.
5. At adjustment points, crop the end of each rail and free weld at one end only, a closure of 2.2m or longer. The rail is now ready for adjustment.
6. Remove all rail anchors/resilient fastenings between anchor points.

7. Ensure the ends of the rail at the adjustment point are free. Vibrate the rail along the length between anchor points.
8. Check the rail temperature is still 35°C.
9. Cut the welding gap.
10. Complete the weld.
11. Reinstall anchors or resilient fastenings.

C6-19 Installing and adjusting CWR in tunnels

Rail in tunnels is not exposed to the same range of temperatures as rail in open track. Expansion and contraction, and therefore, compressive and tensile forces are very small and will not lead to misalignment or broken rail conditions.

For track located outside of tunnels and for 50m into the tunnel from the portals, adopt the specified neutral temperature. . It is not necessary to establish a neutral rail temperature for track further inside the tunnel than 50m. If the total length of the tunnel is less than 200m adjust the entire length of the tunnel (portal to portal) at the specified neutral temperature.

C6-19.1 Adjusting newly laid rail

DO NOT undertake this method until rail has been inside the tunnel for at least 2 hours in an unrestrained state. This will allow rail to adjust to tunnel ambient temperature.

DO NOT undertake this method if the rail temperature is outside the range 10°C to 25°C. This is only likely to be a problem for shorter tunnels.

1. Lay rail, leaving welding gaps (25mm) at each joint.
2. Check and record alignment for adjustment suitability.
3. Install anchors or resilient fastenings.
4. Place an anchor point 50m inside the mouth of the tunnel at each portal.
5. Adjust outside the tunnel to these anchor points at neutral temperature of 35°C using the method detailed in Section C6-12.
6. Weld the rails between the anchor points at each portal.
7. Remove anchor points.
8. Install creep control points at the first anchor points inside each portal and at other intervals through the tunnel as detailed in Chapter 8.

Appendix 6.1 Rail Gap Calculation

For rail lengths not included in the CWR extension/rail temperature graph (Appendix 6.2) or Table (Appendix 6.3), the theoretical gap can be calculated from the following formula:

Rail gap(mm) = (35 rail temperature(°C)) x 0.0115 x rail length(m)

Alternative formulae:

Rail gap(mm) = [35 – rail temperature] x (5/2) for 220m rail

Rail gap(mm) = [35 – rail temperature] x (5/4) for 110m rail

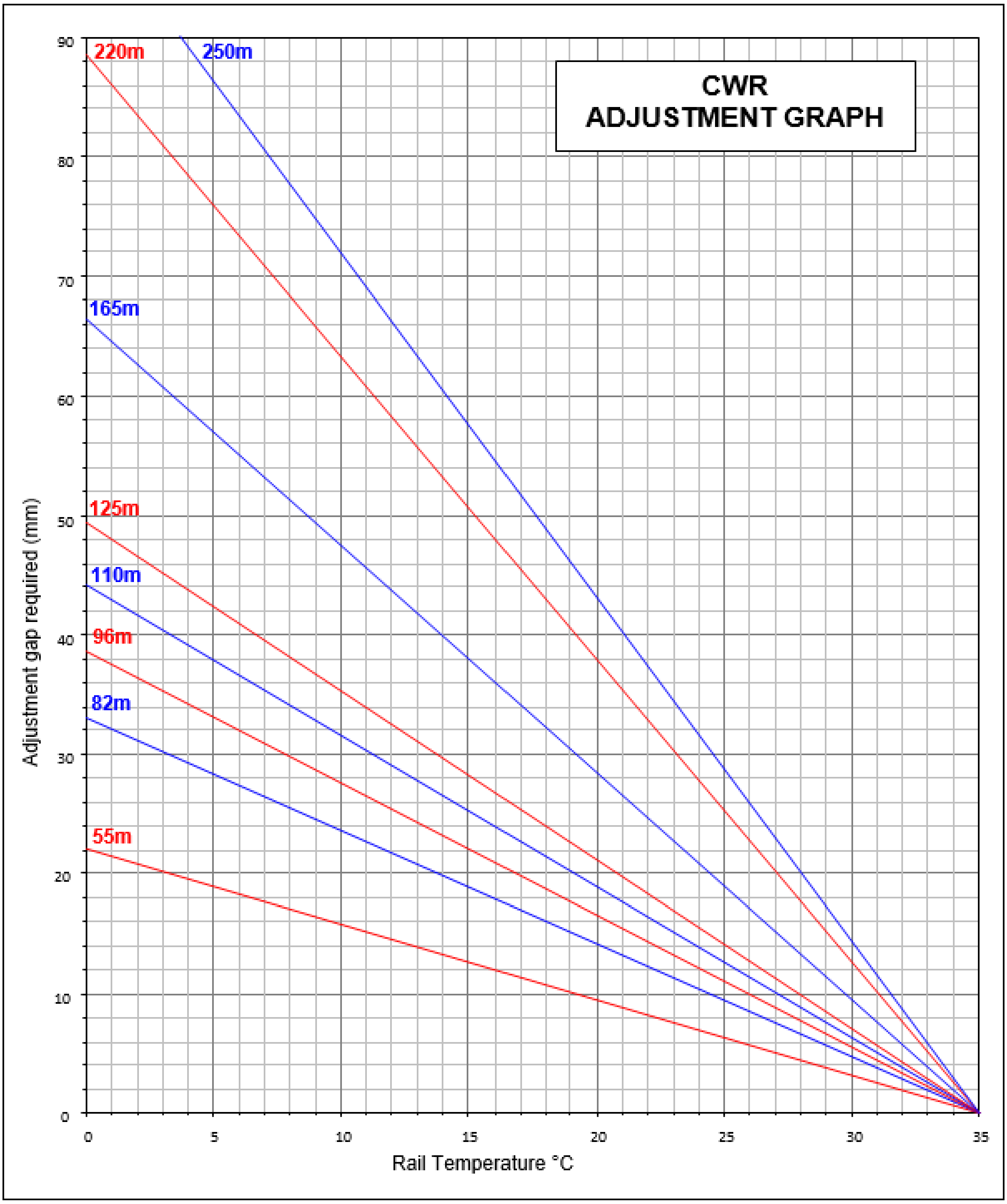
For an 87m rail length the rail expands or contracts 1mm for every 1°C change in temperature.

Rail gap(mm) = [35 – rail temperature] for 87m rail

This allows you to divide any rail length by 87 to determine gap or variation to neutral temperature.

Extension for any rail length = extension for 87m X rail length / 87.

Appendix 6.2 CWR Adjustment Graph



Appendix 6.3 CWR Adjustment Table (35 deg)(1)

CWR ADJUSTMENT GAP SIZE (mm)

Rail Temperature °C	Rail Length (m)							
	55	**82**	**96**	**110**	**125**	**165**	**220**	**250**
0	22	33	39	44	50	66	89	101
1	21	32	38	43	49	65	86	98
2	21	31	36	42	47	63	83	95
3	20	30	35	40	46	61	81	92
4	20	29	34	39	45	59	78	89
5	19	28	33	38	43	57	76	86
6	18	27	32	37	42	55	73	83
7	18	26	31	35	40	53	71	81
8	17	25	30	34	39	51	68	78
9	16	25	29	33	37	49	66	75
10	16	24	28	32	36	47	63	72
11	15	23	26	30	35	46	61	69
12	15	22	25	29	33	44	58	66
13	14	21	24	28	32	42	56	63
14	13	20	23	27	30	40	53	60
15	13	19	22	25	29	38	51	58
16	12	18	21	24	27	36	48	55
17	11	17	20	23	26	34	46	52
18	11	16	19	22	24	32	43	49
19	10	15	18	20	23	30	40	46
20	9	14	17	19	22	28	38	43
21	9	13	15	18	20	27	35	40
22	8	12	14	16	19	25	33	37
23	8	11	13	15	17	23	30	35
24	7	10	12	14	16	21	28	32
25	6	9	11	13	14	19	25	29
26	6	8	10	11	13	17	23	26
27	5	8	9	10	12	15	20	23
28	4	7	8	9	10	13	18	20
29	4	6	7	8	9	11	15	17
30	3	5	6	6	7	9	13	14
31	3	4	4	5	6	8	10	12
32	2	3	3	4	4	6	8	9
33	1	2	2	3	3	4	5	6
34	1	1	1	1	1	2	3	3
35	0	0	0	0	0	0	0	0

Appendix 6.4 Rail Weld Adjustment Return

Rail Weld Adjustment Return

Form RWA1

1.1.1.1.1.1 From CRN CM 223
V1.3
July, 2016

Area		Track Section:		Section adjusted:	Km from:		Km to:	

LOCATION DETAILS (complete all boxes)	WELD DETAILS (complete all boxes)	ADJUSTMENT DETAILS (complete boxes required by weld reason)	SIGN OFF
Weld Date / Infor Asset No / Track / Rail / Km	Weld Number / Weld Type / Track Condition / Weather / Rail Temp. °C / Rail Size / Weld Reason / Weld Condition / Batch No.	Adjustment Length m / AP (Sydney end) km / AP (Country end) km / Punch Marks (mm): PM1 / PM2 / PMT / G / AGR / PM3 / Rail Tensors used? Y N / Alignment Checked? Y N	Welder / Adjustment Supervisor
Weld Date / Infor Asset No / Track / Rail / Km	Weld Number / Weld Type / Track Condition / Weather / Rail Temp. °C / Rail Size / Weld Reason / Weld Condition / Batch No.	Adjustment Length m / AP (Sydney end) km / AP (Country end) km / Punch Marks (mm): PM1 / PM2 / PMT / G / AGR / PM3 / Rail Tensors used? Y N / Alignment Checked? Y N	Welder / Adjustment Supervisor
Weld Date / Infor Asset No / Track / Rail / Km	Weld Number / Weld Type / Track Condition / Weather / Rail Temp. °C / Rail Size / Weld Reason / Weld Condition / Batch No.	Adjustment Length m / AP (Sydney end) km / AP (Country end) km / Punch Marks (mm): PM1 / PM2 / PMT / G / AGR / PM3 / Rail Tensors used? Y N / Alignment Checked? Y N	Welder / Adjustment Supervisor
Weld Date / Infor Asset No	Weld Number / Weld Type / Track Condition / Weather / Rail Temp.	Adjustment Length / AP (Sydney end) / Punch Marks (mm) / Rail Tensors used?	Welder
Weld Date / Infor Asset No / Track / Rail / Km	Weld Number / Weld Type / Track Condition / Weather / Rail Temp. °C / Rail Size / Weld Reason / Weld Condition / Batch No.	Adjustment Length m / AP (Sydney end) km / AP (Country end) km / Punch Marks (mm): PM1 / PM2 / PMT / G / AGR / PM3 / Rail Tensors used? Y N / Alignment Checked? Y N	Welder / Adjustment Supervisor

Punch Mark coding	PM1	Punch Mark Before Cut	PM2	Punch Mark (cut and relaxed rail)	PMT	Punch Mark target to adjust	G	Measured gap if broken rail	AGR	Adjustment gap required	PM3	Punch Mark measure after adjust

CREEP MARK DETAILS

Creep Measurements before adjustment

	Down Rail	Up Rail
Sydney End		
Country End		

Have Creep Marks been established / re-established?

Sydney End	Yes	No
Country End	Yes	No

If No Give Reason

COMMENTS

Superintendent Review	Name:		Signature:		Date	

Chapter 7 Assessment of Track Adjustment using the VERSE System

The VERSE System may be used for the determination of track adjustment once Welded Track Stability Primary Analysis has been completed or where track stability cannot be assessed with confidence.

The system can be used to assess an area of localised concern such as a bunching point, or to assess a 500m section (or smaller section between creep points) where creep points have been lost or are otherwise suspect.

The system MAY NOT be used to assess track that was never adjusted, unless each rail length of 110m is separately assessed as a localised concern (See Section C7-2.1).

The VERSE testing must be overseen by a person competent in the VERSE process.

C7-1 Authority to use VERSE

The site specific track adjustment determination may ONLY be made by a person with appropriate competencies who has been authorised by the Principal Track and Civil Engineer.

C7-2 Location selection

The system is best suited to elastic fastened track on tangents and wide radius curves.

C7-2.1 For localised concerns

The test location should be chosen to reflect the area where the concentration of steel is likely to be greatest. The location must not be on track with curvature sharper than 500m radius.

C7-2.2 For 500m sections (or smaller sections between creep points)

If the track stress is expected to be homogeneous, i.e. no bunching points; no major changes in grade; no changes from elastic to non-elastic fastenings etc. it can be treated as a single unit provided it does not contain any curves less than 500m radius.

In this case the test location should be roughly in the middle of the section. Track which is not able to be treated as homogeneous may still be able to be assessed by reviewing each area of localised steel concentration using C7-2.1 above.

C7-3 Test sites

The test sites:

- MUST NOT be closer than 30m from any turnout, diamond, catch-point, expansion switch etc.
- MUST be uniform and free of aluminothermic welded joints or BIJs.
- MUST NOT be where the rail is rapidly undergoing changes in rail temperature more than 1°C in 15 minutes.
- MUST only be where the rail is expected to be in tension.
- Tests MUST NOT be undertaken if the rail temperature is lower than 5°C.

C7-4 Test method and results

The VERSE methodology is detailed in Section C7-6 to give an indication of the work required.

The person overseeing the testing must advise the Superintendent of the adjustment findings at each test location in a mini report. These results may be used to reassess the track adjustment for the location concerned (nominally as a secondary analysis).

Copies of the adjustment details and any Track Stability reassessments must be forwarded to the Principal Track and Civil Engineer.

C7-5 Checking fixed points using the Verse system

Track staff should consider checking rail adjustment at bunching points at the interface of concrete and timber or steel sleepers. This can be done as the opportunity arises in possessions and closedowns during the winter. It can be carried out without cutting the rails by using the Verse system in conjunction with the procedure below.

To check the rail adjustment of fixed points where dogspiked track abuts elastic fastened track using the Verse System,

1. Unclip the first 30m of the elastic fastened track (immediately abutting the dogspiked track).
2. Remove the anchors for the last 30m of the dogspiked track.
3. Vibrate the rail in the dogspiked track and make sure there are nothing restricting free movement of rail (e.g. aluminothermic weld up against sleeper, skewed sleeper etc.)
4. Check the 30m of elastic fastened track using the normal Verse process (see Section C7-6.).
5. Multiply the Temperature Error found from the application of the Verse system by 2 to account for the dissipation of steel.
6. Feed the result into the WTSA calculation to determine if the location becomes a priority for attention.
7. Note that the restrictions otherwise specified in Section C7-3 above (e.g. the limit on curvature) still apply.

C7-6 Methodology for VERSE®

The following work procedure is to be followed to ensure accurate results are obtained from VERSE®:

1. Prior to accessing the site, verify that the VERSE® recording equipment operates and is properly calibrated and the batteries in the apparatus are fully charged and of the correct type. Review equipment certification sheet to ensure the calibration of the equipment applies to the serial numbered components included with the kit, i.e. the computer, the transducers, and the hydraulic lifting frame are the same components that were calibrated as a unit.
2. At the work site, identify flashbutt and/or aluminothermic welds within the selected 30m test site. Finalise the lift point based on this information, ensuring that any welds are greater than 20m from the lift point. Record exact location of the lift.
3. Determine (by reading the brand marks on the rail web, measuring the rail height with rail gauge and the callipers) and record the rail section.
4. Place a calibrated thermometer on the rail web or foot as appropriate to the type of thermometer, out of direct sunlight, near the lift point and at one other location. Leave for a minimum of 15 minutes before taking a temperature reading. Record thermometer calibration numbers and temperatures.
5. The 30m of rail to be unclipped should be clearly marked.
6. Ensure excess ballast is removed from around the rail, sleepers and clips in the 30m section so the equipment can be properly set up, does not impede the results and does not obstruct re-clipping the rail.
7. Unclip the 30m length of rail.
8. Insert the 'T-pieces' at 10m on either side of the lift point.
9. Remove all insulators from the rail in the unclipped section.
10. Measure and record (to the nearest mm) each leg (from lift point to T-piece and from T-piece to anchor) of the unclipped rail.

11. Install the VERSE® equipment and perform lifts, gather data, as per approved procedure.
12. Verify 'T-pieces' are removed upon completion of VERSE®.
13. Verify all insulators have been re-installed correctly.
14. Verify that the 30m of track is properly clipped before leaving the site.

Chapter 8 Creep Control

This chapter describes the method for establishing, marking and monitoring creep points in CWR track.

C8-1 Where monitoring points are required

The following requirements are extracted from CRN CS 220
Continuous Welded Rail (CWR) design and installation requirements. – Rails shall be >220m long. – Creep monitoring points shall be installed within 14 days of adjustment. Creep monitoring facilities shall be located at every kilometre and half kilometre post. Additional monitoring points may be specified

C8-2 Type of monitoring points

Monitoring points are to be provided as punch marks on the outer sides of both rail heads. The punch marks are to be recovered by means of nails or punch marks in suitable fixtures such as posts on each side of the track in such locations that a check string can be stretched above the rails between the recovery points.

C8-3 Installing creep pegs

The standard creep peg is a stub post of old rail. Alternatively, a SHS ~ 100mm x 100mm x 4mm.

To install creep pegs, place the post at least 500mm into the ground, preferably with the foot facing towards Sydney, and at sufficient height above ground to allow the check string to be stretched without touching the rail.

Locate the post clear or access roads, ballast regulator operating areas and drains, etc.

C8-4 Installing punch marks

C8-4.1 Single punch marks vs Double punch marks

Note - single punch marks are only acceptable for newly converted CWR. Double punch marks must be used for all subsequent re adjustment of full sections between creep marks.

Single punch marks are placed on the field side of the head of each rail, in line with the "Sydney" end of each creep peg. To install punch marks:

1. Stretch a stringline between the two opposing creep pegs and accurately mark the rail with a fine marker.
2. Place a small punch mark on the field side of the head of each rail. Use a centre punch for creep punch marks, NOT a cold chisel.

   This single mark is the measurement point for the end of one section of track and the start of another.

C8-4.2 Double punch marks

Double punch marks must be used when readjustment occurs. This is because the effect of re-punching or zeroing on neighbouring section can result in incorrect measurement of creep in the adjacent sections.

Where used, place the second series of punch marks in line with the "Country" end of each creep peg.

In this case the mark on the "Sydney" end is the measurement point for the end of the previous section and the mark on the "Country" end is the measurement point for the start of the next section of track. (See Figure 29).

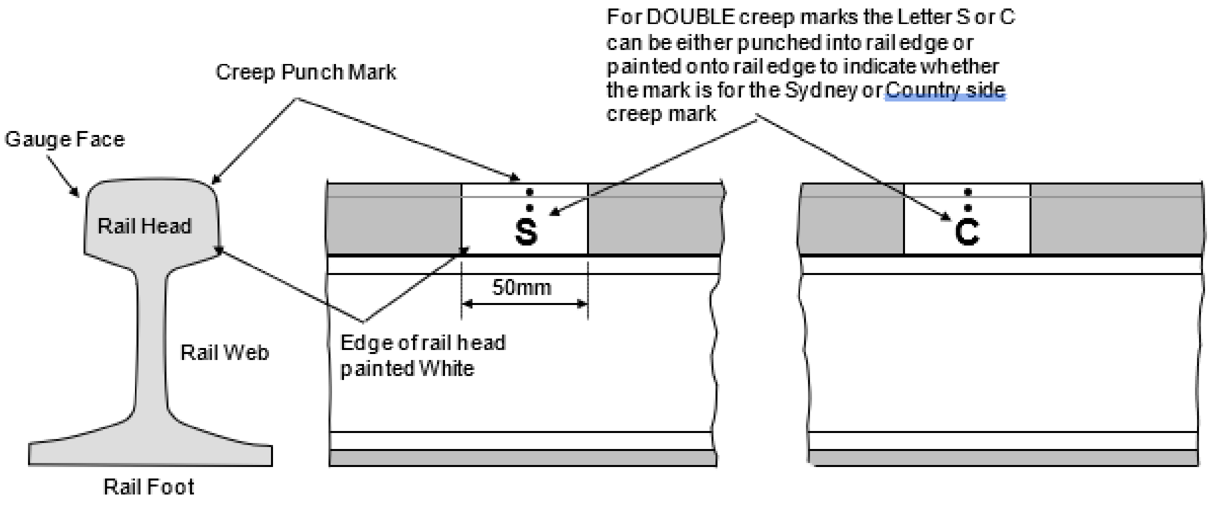


Figure 28- Double punch marking

C8-5 Method of monitoring

Monitoring is to be carried out by periodic inspection as part of the WTSA examination (See CRN CM 203).

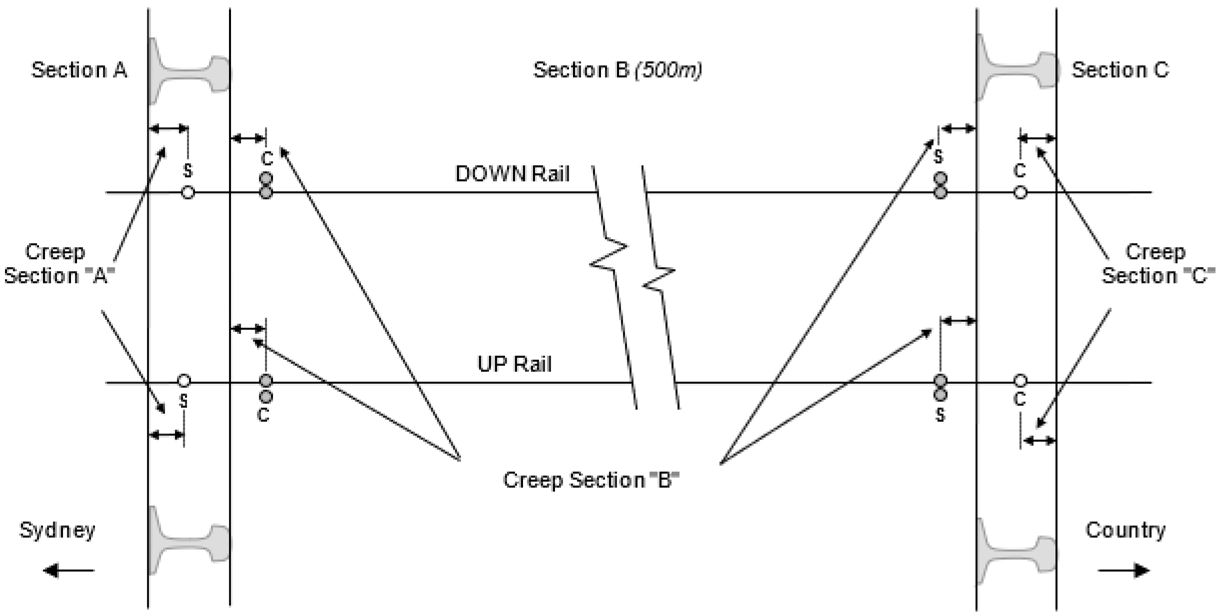


Figure 29 - Typical situation

C8-6 Rectification of creep

Re-establish punch marks after the WTSA section of track between creep marks (generally 500m) has been adjusted.

In double punch marked track, grind off the punch marks at the beginning and end of the section which has been adjusted and punch new zero marks.

If the sections either side of the adjusted section have not been adjusted, their punch marks can remain untouched.

DO NOT re-zero punch marks applying to the WTSA sections either side of the work unless they have been fully re-adjusted. (Refer to Section C6-2.1 for details of shorter adjustments that enable WTSA sections to be re-punched or zeroed)

In single punch marked track, when a section is readjusted, install double punch marks at this time. Care is required in punching new marks. Whilst the marks for the re-adjusted section will be established at zero, the existing creep on the next and previous sections must be transferred to the new punch marks. (see Figure 32 to Figure 37)

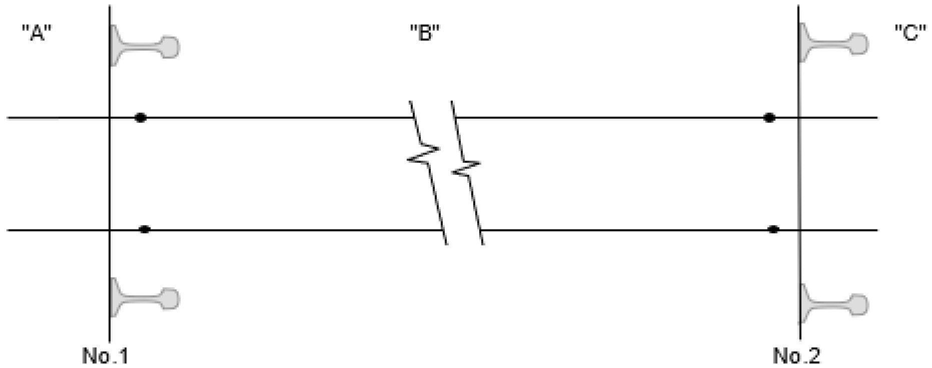


Figure 30 - Potential situation with Single punch marking

Figure 30 shows a potential situation with single punch marking. Rail creep has occurred into both ends of Section "B". It has been established that adjustment of Section "B" is required. To maintain original punch marks for Sections "A" and "C" and install new punch marks for Section "B", use the following process:

Step 1

i) Measure the creep from stringline on Sydney side of No.2 creep peg.
ii) Establish stringline on Country side of No. 2 creep peg.
iii) Mark zero point for Country side creep on each rail at No. 2 creep peg.

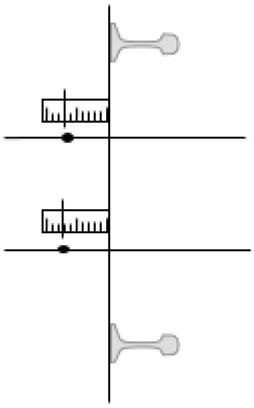


Figure 31

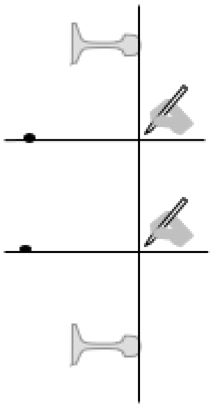


Figure 32

iv) Transfer the measured creep from (i) to the Country side zero mark.

v) Install transferred punch mark. Use a centre punch for creep punch marks, NOT a cold chisel.

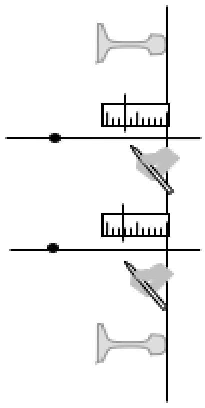


Figure 33

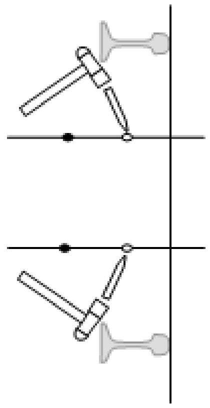


Figure 34

Step 2

Adjust Section "B" between Creep peg No.1 and No.2 to remove steel.

Step 3

Grind off old punch mark on Country end of Section "B".

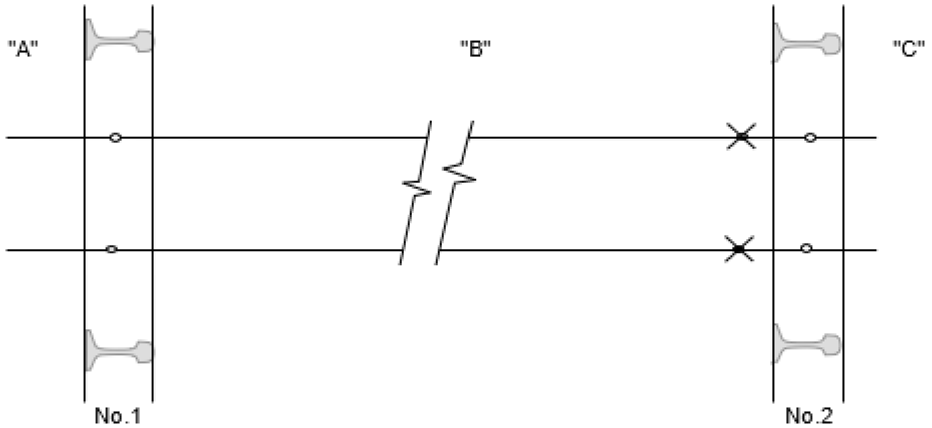


Figure 35 - Removal of redundant punch marks for Section "B"

Step 4

i) Install new zero punch marks for Section "B" on Country end of No.1 creep peg
ii) Install new zero punch marks for Section "B" on Sydney end of No.2 creep peg

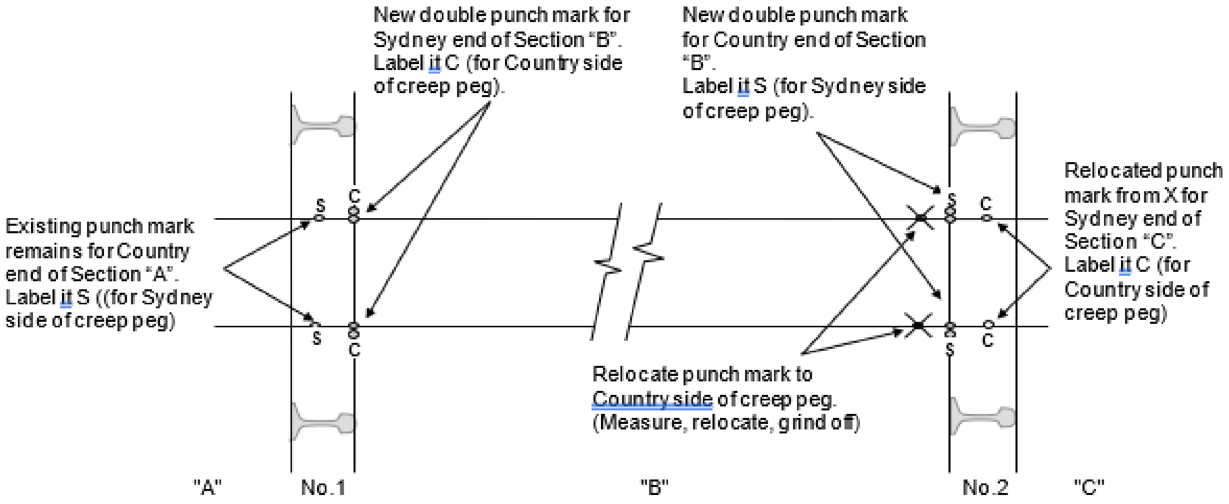


Figure 36 - Final position of double punch mark