

Information for users

The following document:

NR/L2/TRK/3011 Issue 7

 has had changes made to it.

Instructions for use

It is essential that you first read and understand each letter of instruction pertaining to the standard before proceeding to use the standard. You must then apply the requirements of each letter to the standard.

NR/BS/LI/154	Issue 1	18 January 2010	Proceed to letter ►
NR/L2/TRK/3011	Issue 7	1 December 2012	Proceed to standard ►

For further information, please contact:

[IHS Customer Support](#)

Ref	NR/L2/TRK/3011
Issue	7
Date	01 December 2012
Compliance Date	01 December 2012

Level 2

Continuous Welded Rail (CWR) Track

Endorsement & Authorisation

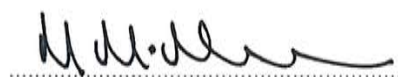
Endorsed by:


S Saxelby, Working Group Chair

Authorised by:

 7/11/12
A Jones, Track Steering Group Chair

Accepted for issue by:


M McManus, National Standards Manager

This document is the property of Network Rail. It shall not be reproduced in whole or part nor disclosed to a third party without the written permission of Network Rail.

© Copyright 2012 Network Rail.

Uncontrolled copy once printed from its electronic source.

Published and Issued by Network Rail, Kings Place, 90 York Way, London. N1 9AG.



Ref:	NR/L2/TRK/3011
Issue:	07
Date:	01 December 2012
Compliance Date	01 December 2012

Issue record

Issue	Date	Comments
4		Re-badge of RT/CE/S/011 into new numbering system
5	June 2006	Supersedes NR/L2/TRK/0011 Issue 4 with various minor amendments.
6	June 2008	Updated to reflect Phase 2A reorganisation and incorporate Letter of Instruction 46 (NR/BS/LI/046) issued 4 th April 2006. Renumbered NR/L2/TRK/3011 in line with Track documentation strategy
7	December 2012	Strikethrough version to indicate which sections of Issue 6 are now included in other documents. The new location of the requirement or guidance is indicated at the end of each section struck through.

Compliance

This Network Rail standard is mandatory and shall be complied with by Network Rail and its contractors if applicable from **01 December 2012**.

When this standard is implemented, it is permissible for all projects, which have formally completed GRIP Level 4, to continue to comply with the Issue of any relevant Network Rail Standards current when GRIP Level 4 was reached and not to comply with requirements contained herein unless the designated Standard Owner has stipulated otherwise in the accompanying Briefing Note.

Reference documentation

See section 18.

Disclaimer

In issuing this document for its stated purpose, Network Rail makes no warranties, express or implied, that compliance with all or any documents it issues is sufficient on its own to ensure safe systems of work or operation. Users are reminded of their own duties under health and safety legislation.

Supply

Copies of documents are available electronically, within Network Rail's organisation. Hard copies of this document may be available to Network Rail people on request to the relevant controlled publication distributor. Other organisations may obtain copies of this from an approved distributor.

Ref:	NR/L2/TRK/3011
Issue:	07
Date:	01 December 2012
Compliance Date	01 December 2012

Contents

1	Purpose	7
2	Scope	7
3	Definitions	7
4	Design of new plain line CWR	10
5	Design of plain line CWR converted from jointed track	10
5.1	Approval by Network Rail	10
5.2	Rails for conversion by re-railing	10
5.3	Rails for conversion by welding in-situ	10
5.4	Welds and insulated joints	11
5.5	Sleepers, rail pads and longitudinal timbers	11
5.6	Rail fastenings	12
5.7	Ballast	12
6	Design of plain line CWR: Use of CWR on curves	13
6.1	Minimum radius of curvature at which CWR may be installed	13
6.2	Alignment and longitudinal level	13
7	Design of plain line CWR: Adjustment switches	13
7.1	Provision, siting and expansion gap	13
7.2	Removal of adjustment switches	13
8	Design of switches and crossings for use In CWR	13
8.1	General	13
8.2	Switches	14
8.3	CWR trap and catch points	15
8.4	Fixed crossings	15
8.5	Swing-nose crossings	16
8.6	Switch diamonds	16
8.7	Use of adjustment switches	16
8.8	Short lengths (less than 180m) of plain line between items of S&C	16
8.9	Minimum rail lengths and location of joints in S&C	17

Ref:	NR/L2/TRK/3011
Issue:	07
Date:	01 December 2012
Compliance Date	01 December 2012

9	Stressing of CWR - Plain line	17
9.1	Person in charge of stressing	17
9.2	Stress free temperature	17
9.3	Temperature and curvature effects	18
9.4	Plain line stressing - General	19
9.5	Preliminary site survey	20
9.6	Anchors, tell tale points and pulling points	21
9.7	Cutting the rails	22
9.8	Rail supports during the stressing procedure	22
9.9	Movement of rails at the tell-tales	23
9.10	Measurement of rail temperature	23
9.11	Calculation of rail extension	24
9.12	Rail extension at reference points	24
9.13	Tensor stressing	25
9.14	Natural stressing	29
9.15	Thermal Stressing	30
9.16	Records	30
9.17	Review of SFT	31
9.18	Sites where no stressing records exist	31
9.19	Sites where the stress free temperature is known to have been disturbed	31
10	Replacement of broken, cracked or defective rails, welds or insulated joints	32
10.1.	General	32
10.2.	Replacement of a defective insulated joint or rail when the rail temperature is below 21C	33
10.3.	Replacement of a broken rail when rail temperature is below 21C	34
10.4.	Replacement of a defective rail within tensor extension bars	34
11	Stressing of S&C within CWR	35
11.1	General	35
11.2	Anchor lengths and tell tales	36
11.3	Preliminary survey and considerations	36

Ref:	NR/L2/TRK/3011
Issue:	07
Date:	01 December 2012
Compliance Date	01 December 2012

11.4	Tensor equipment	36
11.5	General site procedure for stressing S&C with stress transfer blocks	37
11.6	General site procedure for stressing S&C with creep monitors	38
11.7	Procedure for stressing common S&C units	38
11.8	Sequence for stressing common S&C layouts	51
~~12~~	~~Work which reduces the stability of CWR~~	~~52~~
12.1	General	52
12.2	Reduction in SFT	52
12.3	Reduction in lateral resistance	54
~~13~~	~~Precautions to be taken before the onset of hot weather~~	~~56~~
13.1.	Track condition and buckling	56
13.2.	CWR with incorrect or unknown stress-free temperature	56
13.3.	Specific items to be checked and rectified	57
14	Critical rail temperature	58
14.1	Definition of three levels of CRT	58
14.2	Assessment of CRT	58
15	Precautions during hot weather	62
15.1	Watchmen	62
15.2	Speed restrictions	62
15.3	Additional precautions during exceptionally hot weather	63
15.4	Limits on work during hot weather	63
~~16~~	~~Preparation for and precautions during cold weather~~	~~63~~
16.1	Insulated joints	63
16.2	Monitoring alignment	63
16.3	Limits on work during cold weather	63
~~17~~	~~Track buckling~~	~~64~~
17.1	Definition of a track buckle requiring formal reporting	64
17.2	Track safety at buckle sites	64
17.3	Hazard reporting	64
18	Reference documentation	65

Ref:	NR/L2/TRK/3011
Issue:	07
Date:	01 December 2012
Compliance Date	01 December 2012

Appendix A: Minimum competence requirements for person in charge of stressing	66
Appendix B: Extension table	67
Appendix C: Relationship between temperature difference, rail weight, pull force and tensor gauge pressure reading	69
Appendix D: Stressing and stress restoration forms	70
Appendix E: CWR disturbance and Verse test forms	71
Appendix F: ~~Stressing priority for locations with unknown SFT~~	72

Ref:	NR/L2/TRK/3011
Issue:	07
Date:	01 December 2012
Compliance Date	01 December 2012

1 Purpose

This specification defines the requirements for the design, installation and maintenance of continuous welded rail (CWR) track (for the purposes of this specification “design” means “configuration”). It also specifies the methods to be used when stressing CWR in plain line and switches and crossings.

2 Scope

This specification applies to all continuously welded rail track whether:

- designed and installed as such (including any subsequent re-railing) or
- converted from jointed track by **either** in-situ welding of the existing rails **or** re-railing, in both cases using existing sleepers and ballast.

3 Definitions

Adjustment switches

Joints with overlapping rail ends, allowing longitudinal rail movement and so dissipating thermal forces when CWR abuts jointed track or other features not designed to withstand thermal forces. Also used when thermal forces, additional to those in CWR, may be encountered, such as at long underbridges which are themselves subject to thermal movement.

Anchor (length)

The length of CWR track that is left clipped down during the stressing operation to prevent any movement occurring at the fixed ends of the length being stressed.

Certificate of competence

Held by the Person in Charge of Stressing. There are three levels:

1. **Level i (Basic)** is the ability to replace plain rails/insulated joints in existing CWR including restoring stress.
2. **Level ii (Intermediate)** includes **Level i**, plus stressing plain line lengths of CWR including longitudinal timbers and tunnels, but excluding natural or thermal stressing.
3. **Level iii (Advanced)** includes **Level ii**, plus stressing through S&C layouts and natural and thermal stressing.

The Certificate of Competence is valid for five years (**Note:** the correct assembly, operation and care of the tensor equipment is subject to separate training and certification). For minimum competence requirements for stressing certification see Appendix A

Ref:	NR/L2/TRK/3011
Issue:	07
Date:	01 December 2012
Compliance Date	01 December 2012

Continuous welded rail (CWR)

Comprises rails welded together to form a single rail length over 37m (120ft), or 55m (180ft) in tunnels with a limited temperature range.

Creep monitor

A device for monitoring creep of the heel of the switch blades on switches so fitted. The type in normal use is known as “ball and claw”. These are not a stress transfer devices.

Crimp ended steel sleepers

A type of steel sleeper, now obsolete, where the sleeper end was formed by pressing down the centre of the top surface of the sleeper, thus giving the end profile a characteristic “M” shape when viewed from the end. (see also spade ended steel sleepers)

Critical rail temperature (CRT)

The rail temperature to which CWR may be allowed to rise before measures to protect traffic shall be taken. The CRT will depend on the stress-free temperature of the rail and the quantity and degree of consolidation of the ballast.

Crossings

Suitable for incorporation in CWR are of two types:

1. **Cast:** are manufactured from cast steel either as a complete unit (i.e. monobloc) or as a cast centre bloc crossing with welded-on leg ends.
2. **Part-fabricated (or semi- or part-welded):** have welded or cast vees, or cast noses. An electro-slag welded vee is produced by machining rolled rails and electro-slag welding them together. The wing rails are produced from rolled rail and bolted or MGL-pinned to the vee.

Pull force

The force applied to a rail in order to extend it.

Pulling point

The location at which the rail is to be cut, tension applied and extension calculated.

Rail tensors

Hydraulic devices for extending CWR during stressing. In this specification a set of tensors refers to sufficient equipment to tension both rails at the same time.

Reference points

Marks on each rail in line with a suitable reference mark on an adjacent unclipped sleeper at equal intervals, e.g. 100m, in order to monitor and remeasure that the calculated extension is obtained uniformly throughout the length of free rail being stressed. They are numbered 1, 2, 3, etc. consecutively from the inner tell tale point towards the pulling point (see diagram in para. 9.6).

Ref:	NR/L2/TRK/3011
Issue:	07
Date:	01 December 2012
Compliance Date	01 December 2012

Rollers

Devices used to support CWR clear of the sleepers so as to allow its free longitudinal movement during stressing.

Side rollers

(Support arms) are devices used to prevent lateral movement of CWR during stressing. Their design varies to suit the sleeper and fastening type.

Spade ended steel sleepers

Steel sleepers where the whole sleeper end is forged down forming a broad "spade" end that projects below the sleeper bottom. These are replacements for the now obsolete crimp ended sleepers (which see).

Stress-free temperature (SFT)

The rail temperature at which the rail is the same length as it would be in an unrestrained state and at which, therefore, there is no thermal force present. The permitted range of SFT is 21C to 27C (27C to 32C for crimp ended steel sleepers).

Tensor stressing

The process of stretching CWR with hydraulic tensors so that the stress-free temperature of the rails is at the upper permitted limit for SFT.

Stressing naturally

The clipping down of CWR, without tensors being used, when the rail temperature is within the permitted limits for SFT.

Stress restoration

The process of stretching CWR so that the SFT of the rails is the same as it was before the CWR was disturbed.

Stress transfer blocks

In a switch, the cast iron blocks fitted between the stock rail and the switch rail for the purpose of transferring stress from the former into the latter during the stressing process. To be classed as stress transfer block the blocks must be secured to both stock rail and switch rail by a minimum of two bolts.

Stress transition length

The length of track at each end of a length of CWR between the point of zero stress (the Adjustment Switch) and the point of full stress (i.e. stress free when the rail temperature equals the SFT). **Note:** a stress transition length may be used as an anchor for stressing purposes but shall not contain any S&C even if that S&C is CWR-compatible.

S&C

Switches and crossings, either individual built-up components or complete layouts.

Ref:	NR/L2/TRK/3011
Issue:	07
Date:	01 December 2012
Compliance Date	01 December 2012

Tell-tales

Marks made on each rail in line with a suitable reference mark on an adjacent unclipped sleeper, in order to monitor the effectiveness of the anchor length. A tell-tale is required at each end of each anchor length: that adjoining the free rail is the *inner tell-tale*, the other is the *outer tell-tale* (see diagram in para. 9.6).

Thermal stressing

Method of stressing where the rails are heated to the upper permitted limit for stress free temperature and secured.

Watchman

A person appointed to monitor the track when the rail temperature exceeds the CRT(W). He shall be equipped and competent to block the line in an emergency.

4 Design of new plain line CWR

New CWR track shall comprise materials selected according to Track Category, in accordance with [NR/L2/TRK/2102](#) *Track construction standards*

5 Design of plain line CWR converted from jointed track

5.1 Approval by Network Rail

All proposals to convert jointed track to CWR shall be subject to approval by the Network Rail Principal Maintenance Support Engineer (Track) (PMSE(T)). Such approval will depend on adequate arrangements being made for anchor lengths and lateral stability.

5.2 Rails for conversion by re-railing

The requirements are as in [NR/L2/TRK/2102](#).

5.3 Rails for conversion by welding in-situ

5.3.1 Rail depth, gall and sidewear

Jointed rails may be converted to CWR only if

- the rail depths are at least 2mm greater than the minimum shown in [NR/L2/TRK/001](#) *Inspection and maintenance of permanent way* and
- there is no measurable gall, and
- the rail has a residual life based upon sidewear considerations of at least 5 years.

5.3.2 Rail defects

The history of rail defects within the length concerned shall be taken into account prior to taking the decision to convert the length. Prior to

Ref:	NR/L2/TRK/3011
Issue:	07
Date:	01 December 2012
Compliance Date	01 December 2012

conversion, rails shall be visually and ultrasonically examined to assess whether they are free from defects which would require replacement within 13 weeks following conversion (see [NR/L2/TRK/001](#)). Such defective rails shall be replaced prior to conversion.

5.3.3 Existing bolted joints: preparation for alumino-thermic welding

In Track Categories 1A, 1, 2 and 3, existing bolted joints shall be removed by cutting back beyond the bolt holes. In Track Categories 4, 5 and 6, bolt holes may be left in position as long as any rail-end dip or batter will not prevent the weld geometry requirements of [NR/L2/TRK/032](#) being achieved. If bolt holes are left in position they shall not be within 30mm of the rail end.

Bond holes are not permitted within 30mm of the rail end.

5.3.4 Existing bolted joints: preparation for site flash-welding

Existing bolted joints shall be removed by cutting back beyond the bolt holes. Minimum distances between bond holes or any other bolt holes, and the weld, shall comply with [NR/L2/TRK/130 and NR/L2/TRK/131](#).

5.3.5 Rail lengths

CWR produced by in-situ welding may be formed initially from rails of any length over 12m (**Note:** this allows for the cropping of existing 45-ft rails).

5.4 Welds and insulated joints

The requirements are as in [NR/L2/TRK/2102](#). Where existing rails are to be welded in-situ, flash-welding is to be used in preference to alumino-thermic.

5.5 Sleepers, rail pads and longitudinal timbers

Softwood sleepers for FB rail, spaced at a minimum of 24 per length, are acceptable in Track Categories 4, 5 and 6, subject to:

- CRT being appropriately assessed (section 14);
- all sleepers being free of internal decay and of splits extending into the baseplate area.

Ref:	NR/L2/TRK/3011
Issue:	07
Date:	01 December 2012
Compliance Date	01 December 2012

Decayed or ineffective sleepers and concrete sleepers with cracking or damage in the rail seat area shall be replaced prior to conversion. The replacement sleepers and fastenings shall be of the same general type as those remaining in the track, unless approved otherwise by the Principal Maintenance Support Engineer (Track). Sleepers existing or installed into jointed track prior to conversion shall be capable of retaining the fastenings listed in para. 5.6.

The two sleepers each side of a weld (i.e. four in total) shall be of the same material and depth.

Rail pads shall be renewed.

The requirements for longitudinal timbers are as in [NR/L2/TRK/2102](#).

5.6 Rail fastenings

The fastenings approved for the conversion of jointed track to CWR are shown in Table 1.

Table 1 : Fastenings approved for conversion of jointed track to CWR
Concrete sleepers
- cast-in housings 'shop' converted F10 sleepers, with PR401A or e clips - Pan9 conversion of E1 sleepers, with PR401A clips - converted F16 sleepers, with PR401A or e clips - E1 sleepers with BH chairs and steel keys (but use wood keys in tunnels) See RT/CE/S/062 for restrictions on use of serviceable concrete sleepers
Wood sleepers and longitudinal timbers
- screw-fastened Pandrol baseplates with appropriate pads and clips (e clips may be used in SG iron baseplates) - BH chairs in tunnels with wood keys
Steel sleepers
- All spade ended steel sleepers are suitable for use in CWR - Crimp ended sleepers require special precautions and their use is subject to approval by the Principal Maintenance Support Engineer (Track)

Note: Certain Pandrol-type clips are now supplied by other manufacturers: these may be used where Network Rail product acceptance has been granted.

5.7 Ballast

Prior to conversion, the ballast quality and depth shall be verified. If these do not comply with [NR/L2/TRK/2102](#) for the Track Category concerned, remedial work may be required, e.g. ballast cleaning, excavation or track lifting.

Ballast shoulders shall be provided as for new CWR track: see [NR/L2/TRK/2102](#).

Ref:	NR/L2/TRK/3011
Issue:	07
Date:	01 December 2012
Compliance Date	01 December 2012

All ballast, including shoulder ballast, must be free of wet beds and able to permit free drainage.

Voided sleepers shall be hand tamped/packed or hand held stoneblown prior to welding, or as soon as practicable after, to remove voids and to increase the track's resistance to buckling. Follow-up tamping shall be undertaken as soon as practicable after completion of welding.

6 Design of plain line CWR: Use of CWR on curves

6.1 Minimum radius of curvature at which CWR may be installed

See [NR/L2/TRK/2102](#).

6.2 Alignment and longitudinal level

CWR shall be installed and maintained to a designed alignment and longitudinal level. Records of these designs shall be kept up to date.

7 Design of plain line CWR: Adjustment switches

7.1 Provision, siting and expansion gap

See [NR/L2/TRK/2102](#).

7.2 Removal of adjustment switches

When an adjustment switch is removed stressing shall be carried back 180m into the existing CWR beyond the welded joint on the CWR side of the adjustment switch rail.

8 Design of switches and crossings for use in CWR

8.1 General

Any S&C unit to be incorporated in CWR shall be capable of withstanding longitudinal thermal tensile and compressive forces. Approved CWR-compatible designs are shown in para. 8.2.

CWR-compatible S&C designs are of two types:

1. With stress transfer blocks and bolts connecting the switch to the stock rail. Eight 25mm (1in) diameter High Tensile Steel (HTS) bolts, tightened to a torque of 880 Nm (650 lb-ft), allow transfer of 70-tonne thermal force. (**Note:** only those heel blocks with two bolts, or two pairs of bolts, are deemed to be stress transfer blocks; they are supplemented in DV-HV and EVS-HVS switches by single-bolt distance blocks which do not transfer significant longitudinal force.) This design is also found in some RT60 & NR60 C switches.

Ref:	NR/L2/TRK/3011
Issue:	07
Date:	01 December 2012
Compliance Date	01 December 2012

2. With creep monitors. Thermal forces in the stock rails are accommodated as in plain rail, and those in the closure rails are deemed to dissipate in the same manner as at the free end of a length of CWR. Longitudinal thermal movement occurs at the heel of the switch rail; this is indicated by a “ball-and-claw” creep monitor device, which is not intended to transfer thermal force.

CWR-compatible S&C shall be welded or fitted with tight-joint or insulated fishplates approved for use in CWR. Where practicable, crossings shall be welded in preference to tight-jointed. Units installed with tight-joint fishplates may be subject to limited expansion and contraction but shall be assumed to experience the same thermal forces as units that are welded in.

S&C shall not be present within the stress transition length at the end of a section of CWR. S&C not isolated from CWR by adjustment switches must be fully stressed and any stress transition length must commence clear of the S&C. All unstressed S&C must be isolated from CWR by adjustment switches.

S&C units not approved (see following paragraphs) for use in CWR, because they have not been designed to withstand the longitudinal forces produced by CWR, shall be isolated from adjacent CWR by adjustment switches positioned not more than 40m distant, or replaced by CWR-compatible units.

8.2 Switches

8.2.1 Designs suitable for use in CWR

The following designs of switch are suitable for use in CWR:

- 113A FB vertical design, full depth:
 - BV reinforced
 - CV to HV inclusive
- Catch points (strengthened)
- 113A FB vertical design, shallow-depth:
 - BVS to HVS inclusive
- 113A FB inclined design catchpoint
- 110A/109 FB inclined design catch point.
- All RT60 B to H switches
- All NR60 C to H switches

Older inclined FB switch designs are not suitable for use in CWR, neither are single and double slips nor any bull head designs.

8.2.2 Construction and installation

Switch and stock rails are intended to be kept together as a half-set. Units incorporating stress transfer blocks shall therefore be either

Ref:	NR/L2/TRK/3011
Issue:	07
Date:	01 December 2012
Compliance Date	01 December 2012

- installed as pre-assembled half-sets, or
- trial-assembled, without glue, then separated and subsequently reassembled at site, again without glue, with gluing and final tightening of the heel block bolts being done only when line and level are fully established (**Note:** this method is suggested as a means of minimising misalignment in the area of the heel blocks).

Units without heel blocks shall be strapped together until installation.

The lateral resistance of short (BV, CV and DV) full depth timbered switches should be supplemented, e.g. either by fitting lateral resistance end-plates to each end of each timber over the length of the stock rail from the first heel block to two timbers beyond the stock rail front or by the installation of castellated beams. This requirement is compulsory for these switches when installed in lines with a speed of 100mph or higher.

8.3 CWR trap and catch points

Trap points in CWR shall comprise a standard CWR-compatible facing switch.

Catch points that require renewal, shall be to the CWR-compatible BV or CV design, with concrete bearers or hardwood timbers 170mm deep. Trailing, unworked catch points shall be strapped in accordance with drawings (worked catch points are subject to less lateral thrust and need not be strapped).

8.4 Fixed crossings

See [NR/L2/TRK/2102](#) for the selection of fixed crossings.

When a crossing is replaced, any adjacent rails which are head-worn should be replaced at the same time, since the use of lift-plates may induce bending in the bearers.

8.4.1 Cast crossings

All cast common or obtuse monobloc crossings or crossings with a cast centre and welded-on legs are suitable for use in CWR.

Unless the crossing has welded-on legs, the joints between the casting and the adjacent rails shall be formed by tight-joint fishplates with four 29mm (1 1/8") diameter HTS fishbolts torqued to 1020 Nm (750 lb-ft). These joints shall not be lubricated.

Ref:	NR/L2/TRK/3011
Issue:	07
Date:	01 December 2012
Compliance Date	01 December 2012

8.4.2 Part-fabricated common crossings

These types of common crossings shall have extended wings with each wing rail being secured to the adjacent vee rail by at least eight 25.4mm (1") diameter MGL pins or HTS bolts when used in CWR.

The materials of the crossings shall be compatible with the material to which they are being welded and the correct welding process must be used.

8.4.3 Fully-fabricated crossings

Fully-fabricated common crossings are not suitable for use in CWR. Fully-fabricated obtuse crossings are suitable if strengthened for the purpose.

8.5 Swing-nose crossings

Mk VI and VII types and all RT60 types are suitable for use in CWR.

8.6 Switch diamonds

Types of switch diamonds that are not CWR-compatible shall be protected by adjustment switches on all sides, not more than 40m from the knuckle.

(Note: If a switch diamond not approved for use in CWR is not protected by adjustment switches, installed within 40m of the knuckle, then thermal forces will alter the position of the knuckle or setting of the point rails causing failure of the switch detection.)

Switch-diamond point rails shall be of the correct length so that the toes are 115mm from the knuckle when the rail temperature is 20C.

8.7 Use of adjustment switches

The requirements for adjustment switches between CWR-compatible S&C and plain line are given in [NR/L2/TRK/2102](#). The length of the stress transition adjacent to adjustment switches shall be taken as 180m for standard and low resistance situations or 90m for high resistance situations (as detailed in table 2).

8.8 Short lengths (less than 180m) of plain line between items of S&C

Plain line between S&C may be welded or fitted with tight-joint or insulated fishplates and as such shall be stressed. S&C suitable for use with CWR may be used as part of an anchor length (but not within a stress transition length) for stressing the length of plain line. If the recommended anchor lengths are not available the length of track shall be stressed naturally (see para. 9.14 & 9.15).

Ref:	NR/L2/TRK/3011
Issue:	07
Date:	01 December 2012
Compliance Date	01 December 2012

8.9 Minimum rail lengths and location of joints in S&C

See [NR/L2/TRK/2102](#).

9 Stressing of CWR - Plain line

Except for para. 9.1 and the requirements for cutting of CWR in 9.7, the requirements of this section do not apply to the localised replacement of defective or broken rails or insulated joints (not exceeding 36m in length), where the provisions of section 10 shall apply.

9.1 Person in charge of stressing

All stressing shall be supervised by the Person in Charge of Stressing who, immediately on completion of the work, shall complete and sign a stressing certificate (Appendix D) recording details of the work done, in particular highlighting any failure to carry out the correct stressing procedure. Where the stress condition is restored without resort to the full stressing procedures, the Person in Charge of Stressing shall complete a stress restoration certificate which shall be kept with the original stressing certificates for record purposes.

The Person in Charge of Stressing shall be in possession of a valid Certificate of Competence.

9.2 Stress free temperature

9.2.1 Track not in tunnel, or in tunnels less than 180m long

Except on crimp-ended steel sleepers, CWR shall be stressed so as to achieve an SFT of 27C. However, natural stressing is permitted if the rail temperature at clipping down is within the range 24C and 30C.

On crimp-ended steel sleepers, CWR shall be stressed to an SFT of 32C, with natural stressing permitted within the range 27C and 32C.

9.2.2 Track in tunnels more than 180m long

Rollers shall be used in tunnels more than 180m long unless the rail has time to acclimatise to the tunnel temperature in advance of the work. The rail temperature at which the rail was clipped down shall be taken as the SFT. CWR stressed to this temperature shall be confined to the length between two points each of which is 40m inside the tunnel portals.

9.2.3 Equality of SFT between rails

The SFTs of the two rails of the track shall be within the range given in the definition of SFT. Where only one rail is being replaced but the other rail has a history of disturbance or stress restoration then both rails shall be re-stressed. If, however, the SFT of the other rail can be measured in

Ref:	NR/L2/TRK/3011
Issue:	07
Date:	01 December 2012
Compliance Date	01 December 2012

advance of the work, and shown to be within the specified limits, then the other rail need not be re-stressed.

9.2.4 Failure to achieve or restore SFT within permitted limits

When the SFT of a length of CWR is or has been disturbed then, in the event of failure to achieve or restore a stress free temperature within the permitted range, a CWR disturbance form shall be completed.

9.2.5 Track with SFT above specified values

If there is evidence to suggest that the SFT is above 30C (or 32C for crimp ended steel sleepers), then the section of track concerned should be re-stressed before the onset of cold weather.

9.3 Temperature and curvature effects

9.3.1 High installation temperature

In summer, the rail temperature may rise fairly early in the day, and it is desirable to complete stressing before 10.00 hours. If, however, the rail temperature does rise above the upper limit given in 9.2.1 before fastening down, the work should be completed in the usual way, the temperature recorded and arrangements made for re-stressing when the temperature has fallen sufficiently and before the onset of cold weather.

9.3.2 Low installation temperature and/or low SFT

If any portion of CWR track has an SFT below 21C (whether because of failure to stress, low temperature, or track curvature (see below)) it shall be re-stressed before the onset of hot weather.

9.3.3 Stressing of CWR on curves

Stressing of rail on curves may induce a lateral shift of the track and for this reason the maximum pull applied shall be limited as follows:

- **Curves of radius 600 -500m**
Maximum pull not to exceed 58 tonnes – equivalent to raising the SFT by 34C for 113A or 31C for CEN60 rail.
- **Curves of radius below 500m**
Maximum pull not to exceed 46 tonnes – equivalent to raising the SFT by 27C for 113A or 25C for CEN60 rail.
Note: lateral resistance end plates shall also be fitted at radii below 400m.

In cold weather these limits may preclude the achievement of the desired SFT, in which case the rail shall be re-stressed in warmer weather.

Ref:	NR/L2/TRK/3011
Issue:	07
Date:	01 December 2012
Compliance Date	01 December 2012

- **Reverse curves - any radius**

Stressing should be carried out in stages, and ideally with the length of rail being pulled at any time contained fully within one curve or the other, not straddling the point of reversal (i.e. when “pulling both ways” from a central pulling point, the pulling point shall be located at the point of reversal). Side rollers shall be used on both sides of the rail.

9.4 Plain line stressing - General

The term “stressing pull” applies to the stressing operation whether carried out using hydraulic tensors or by other approved methods.

During the stressing pull, simple under rollers will displace by an amount equal to half the extension effective at their position. In order to avoid those nearest the pulling point rolling off the sleeper top, it may be necessary to limit the maximum extension by limiting the length of pull.

If rail laid in an earlier shift is to be stressed, it is possible that the SFT of the existing adjacent rail may have fallen in the vicinity of the join as a result of movement at the join. Where the inner tell tale from stressing the adjacent rail is available and can be returned to zero the multiple pull method in 9.13.4 may be used. Where no tell tale is available the stressing length shall include at least an anchor length of the adjacent rail.

9.4.1 Method of stressing

The normal method of stressing is by the use of hydraulic tensors.

During warm/hot weather periods stressing work should be planned for completion in early morning, before rail temperatures approach the required SFT, or in the evening after rail temperatures have fallen below the SFT.

Where, during warm/hot weather periods, it is not physically possible to plan the work for completion during times of lower rail temperature, then the natural stressing process may be employed.

Where the required anchor lengths cannot be achieved then stressing should be planned for warmer weather and the natural stressing process employed.

Where it is physically difficult to accommodate hydraulic tensors or in other approved situations natural stressing or an approved process of thermal stressing may be used.

For alternative methods the maximum length of free rail shall be limited to that given for a single pull when stressing with tensors.

Ref:	NR/L2/TRK/3011
Issue:	07
Date:	01 December 2012
Compliance Date	01 December 2012

9.4.2 Stressing of plain line adjacent to switches

The plain line within one anchor length of the toes of switches shall be treated as S&C for the purposes of stressing.

When stressing plain line adjacent to switches the anchor length shall not extend into the switches and at least one anchor length from the toes of the switches shall remain fully clipped down.

9.5 Preliminary site survey

Before the planned date for stressing the following shall be checked through the length to be stressed and the anchor lengths (in some cases the items may be attended to during the stressing operation, rather than beforehand):

- that the track is to the appropriate construction standard and fully ballasted;
- rail fastening type(s) shall be identified, any seized fastenings freed and any missing or defective fastenings replaced;
- worn pads and insulators shall be renewed;
- any potential obstruction to the free movement of the unclipped rail and rollers shall be removed;
- the correct high tensile steel bolts (to insulated joints, stress transfer blocks, etc.) shall be fitted and tightened to the correct torque;
- defective rails or defective insulated joints shall be replaced;
- expansion gaps in adjoining jointed track shall be adjusted;
- adjustment switches shall be checked for lubrication and overlap.

The position of anchor lengths, lengths of rails to be pulled and the location of closing welds shall be selected. Account should be taken of the influence which cuttings, embankments, the period of the year and the time of day, may have on rail temperatures during the stressing operation.

Ref:	NR/L2/TRK/3011
Issue:	07
Date:	01 December 2012
Compliance Date	01 December 2012

9.6 Anchors, tell tale points and pulling points

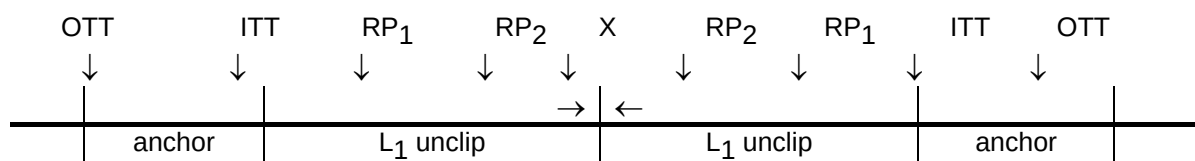
The minimum length of CWR to be fastened down to form an anchor shall be as in Table 2:

Table 2 : Anchor lengths	
Track conditions	Minimum anchor length
High resistance - where all fastenings are new e2000-series, e-plus, Fastclip or Vossloh, all present, installed with the correct tools and in good condition with all pads and insulators in place and good consolidated ballast conditions	30m or three sleepers per degC temperature difference from the proposed SFT, whichever is greater
Standard resistance - other sleepers with integral housings and good consolidated ballast conditions	90m
Low resistance – baseplated sleepers and early designs with screw fastenings, or where ballast conditions poor or where adjustment switches exist (Note: para. 9.5 requires inadequacies in fastenings, rail pads or insulators to be made good prior to stressing)	135m
Cast common or obtuse crossing welded or tight jointed to its adjacent rails	Anchor point

No inner tell tale shall be located within a stress transition length .

Tell tale points shall be marked (on both rail and sleeper) at each end of each anchor length in order to monitor the effectiveness of the anchor. The sleepers used shall be freed from all rails.

The relationship between the pulling point, the length of free rail to be pulled and the anchors is shown below.



OTT = outer tell-tale ITT = inner tell-tale RP = reference point X = pulling point

L_1 = 90m minimum, but 180m minimum if adjustment switches have been removed at X.

= 900m maximum on straight track (but less on curves - see para. 9.13.4)

Anchor: see table above.

The pulling point shall be at least 4.5m from another weld or joint, mid-way between two sleepers and where possible should be the mid-point of the length of rail being stressed.

Ref:	NR/L2/TRK/3011
Issue:	07
Date:	01 December 2012
Compliance Date	01 December 2012

9.7 Cutting the rails

The first cut into CWR shall be by **flame cutting**. Subsequent cuts shall be made by a method approved for the rail steel concerned.

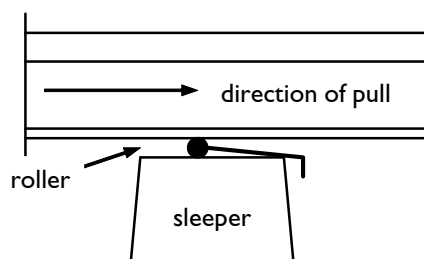
When cutting the rails for the extension, the required total extension shall be marked on the rail at the pulling point and allowance made for

- the calculated extension;
- a working gap between the extended rails of 5mm (the correct welding gap should be cut after the correct extension has been achieved);
- any movement of the rail at the inner tell tale away from the pulling point.

If, on making the first cut into installed CWR, an unexpectedly large gap opens, then the reason for this shall be thoroughly investigated and action taken accordingly.

9.8 Rail supports during the stressing procedure

Fastenings shall be released commencing from the cut or free end and the rails lifted clear of all obstructions and placed on solid rollers positioned at intervals not exceeding 12 sleepers. Correct positioning of the rollers between the rail foot and the rail seat is shown below:



The rail pads on the sleepers where the rollers are located must be temporarily removed to reduce resistance to rolling.

Side rollers or support arms shall be used on the inside of curved track at the intervals in Table 3. They should be staggered so that there is only one roller per sleeper.

Table 3 : Side roller intervals (maxima)			
Radius (m)	Interval	Radius (m)	Interval
> 2000	12 sleepers	800 - 601	6 sleepers
2000 - 1001	10 sleepers	600 - 400	4 sleepers
1000 - 801	8 sleepers	< 400	2 sleepers

Ref:	NR/L2/TRK/3011
Issue:	07
Date:	01 December 2012
Compliance Date	01 December 2012

When natural or thermal stressing, side rollers shall be used on alternate sides of the rail throughout the length of pull.

When tensor stressing, consideration shall be given to the risk of tipping of the rail. Where such a risk exists, side rollers shall be fitted on both sides throughout.

9.9 Movement of rails at the tell-tales

Any movement of the rail at the tell-tales, when the fastenings are released, shall be noted.

Movement at the outer tell-tale indicates that the anchor is not satisfactory and a new anchor length shall be established.

Movement of the inner tell-tale may be towards or away from the pulling point, depending upon the SFT of the anchor. Movement towards the pulling point should be ignored; movement away shall be added to the calculated extension (see Appendix B).

9.10 Measurement of rail temperature

9.10.1 Thermometers

Thermometers shall be of magnetic dial or contact reading digital display types with individual serial numbers. They shall be checked visually for condition on each occasion of use, and shall be verified annually for accuracy to within $\pm 2^{\circ}\text{C}$ against a master thermometer.

9.10.2 Taking readings with thermometers

Rail temperature will vary according to location (cutting or embankment) and weather conditions. Readings should be taken at as many locations as necessary to allow for these variations.

Thermometers shall be placed at the centre of the rail web on the shaded side of each rail. At least three thermometers (3 reading locations for digital thermometers) should be used on each rail, located

- near to the pulling point;
- at the mid-point of the free rail;
- near to the anchor length.

Sufficient thermometers shall be used to achieve a maximum spacing of 200m between readings.

Ref:	NR/L2/TRK/3011
Issue:	07
Date:	01 December 2012
Compliance Date	01 December 2012

When the readings of all thermometers are reasonably uniform, and after not less than ten minutes (except for the digital contact type), an average shall be taken. If any reading is obviously inconsistent with the remainder a check should be made by changing the thermometer(s) concerned. The readings used to calculate the extension shall be taken at the last possible moment before marking the reference points.

9.11 Calculation of rail extension

The calculation of rail extension shall be based on the average rail temperature over the length of the rail to be stressed or re-stressed. The rail extension required, to produce a stress free condition at the rail temperature specified below, shall be calculated by the formula $e = 1000 LXt$, where

e = extension in millimetres

L = the length of free rail in metres

X = coefficient of expansion of steel (0.0000115 per °C for normal grade rail)

t = difference between actual average rail temperature and required SFT.

Calculated extensions for various lengths of free rail for rail temperatures in the range -8C to 27C, and examples showing how extensions are calculated, are given in Appendix B.

Where rail temperatures are changing rapidly it will be necessary to repeat the calculations unless they differ by no more than 2C from the previous reading.

The SFT shall be 27C except for crimp ended steel sleepers which shall be stressed to 32C, and rail in tunnels more than 180m long where the SFT shall fall within the ambient temperature range of the tunnel in question.

9.12 Rail extension at reference points

The full calculated extension shall be marked accurately at the free end (pulling point) and the proportional movement marked at regularly-spaced (e.g. 100m apart) intermediate reference points so that the rail movement may be monitored during tensioning. The marking shall be carried out in such a way that the movement can be measured to an accuracy of one millimetre. At the reference points any sticking pads shall be freed in order to prevent movement of the sleeper with the rail.

The intermediate extensions should be within 5% or 1mm of the correct figure. If this is not achieved then the cause shall be investigated and any identified problems corrected. If the figures still cannot be achieved then this fact shall be recorded and arrangements made for a detailed analysis to determine a further course of action.