CREEP IN JOINTED TRACK

CIVIL ENGINEERING

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This book is provided as a reference document for track staff and others who require an appreciation of the issues relating to railway track in cold weather.

The information contained is believed to be correct at the time of publication but standards and specifications do change. Readers must ensure that they refer to their latest instructions which this document does not supersede.

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The photograph on the cover shows chair shuffle at a bull head rail chair

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Contents

1. Glossary

anchor	a device which attaches to the rail and presses against the sleeper or chair to increase resistance to longitudinal rail movement.
coil	a spiral, usually of metal or plastic, to fit around a screw effectively increasing its diameter and thereby taking up any enlargement of the hole In a wooden sleeper
creep	longitudinal movement of the rail through its fastenings.
CX	cold expansion of bolt holes.
elastic spike	elastic or Macbeth spike, used to hold a Flat Bottom rail to a baseplate and onto the sleeper.
expansion bit or iron	a shaped piece of metal of 3, 6 or 10mm thickness, which is inserted into an open gap to act as temporary spacer when one rail Is closed against another during pulling back.
liner	thin metal plate to fit between a key and a chair jaw to take up wear of the latter.
packing piece	see liner.
pulling back	the process of adjusting expansion gaps to their correct dimensions for a particular temperature.
screw coil	see coil.
sleeve	shaped piece of metal or plastic which fits around a screw to increase its diameter. See also spikelock and coil.
spike	see elastic spike.
spikelock	a sleeve to fit around an elastic or Macbeth spike to take up wear or rot in the sleeper.

2. Introduction

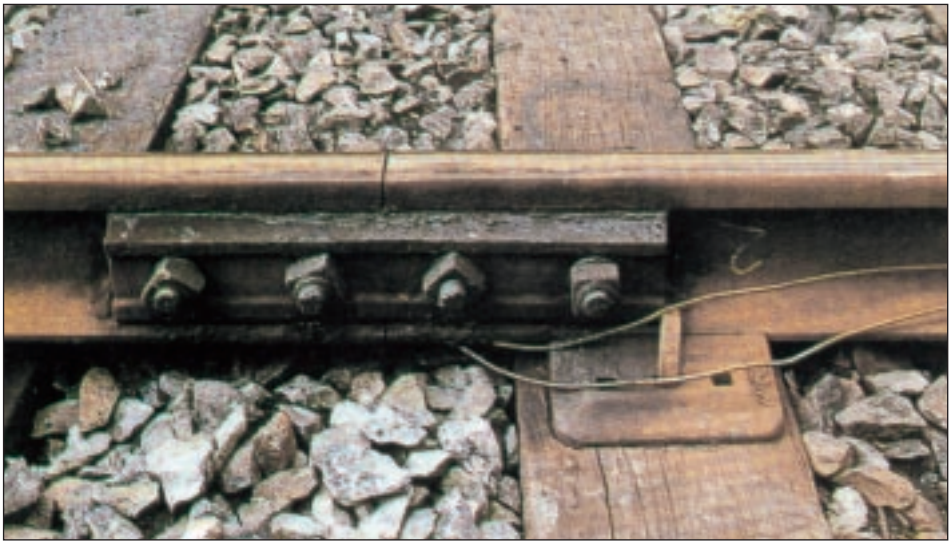
CREEP is the longitudinal movement of rails. Normally this is the rails moving through the fastenings. In this document only creep in jointed track is considered. It can vary from a little to a lot. In extreme cases joints may more onto adjacent sleepers.

Rail temperatures in the UK are normally taken to vary between -13C and +53C. On a 18.288m (60ft) rail this equates to a total movement of 14mm. If the rail is manganese then the expansion is 50% greater.

This expansion is the basic reason for the gaps at the rail ends in jointed track,

Most rails move in the direction of the predominant traffic, although on curves the low rail can move backward because of the effect of fixed wheels on a rigid axle. Creep can be accentuated by poor fastenings between the chairs/baseplates and the sleepers, or if the sleeper condition is poor.

Loose elastic spikes are usually caused by the wood around the spike becoming rotten, the spike becoming corroded or the hole becoming enlarged. When the spike is loose then the rail will not be held properly; this initially will permit creep to occur, and more seriously a tamper may lift the rail and spikes out of the baseplates. With this reduced resistance gauge spread is also more likely as is a track buckle in hot weather.



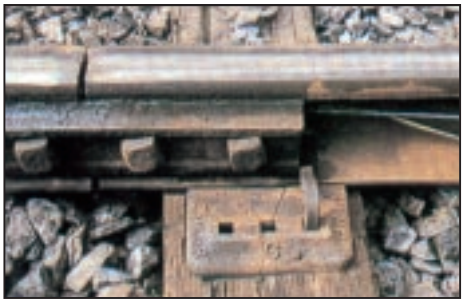
Creep is forcing the elastic spike to twist in baseplate hole

3. Expansion Gaps

The standard expansion gaps for Bull Head or Flat Bottom rail vary according to rail (not air) temperature:

Rail Temperature	Weather description	Gaps for 60ft rails	Gaps for 120ft rails
Below 10C	cold	10 mm	10 mm
10C to < 24C	cold to warm	6 mm	6 mm
24C to < 38C	warm to hot	3 mm	3 mm
over 38C	very hot	zero	zero

The maximum permitted expansion gap between two rails is 15mm.



The baseplate is cracked and the elastic spike is loose, the rail foot is clear of the base plate. There will be little resistance to creep

This is on the sleeper, the clips are missing or loose. When was the joint lubricated? The rail head wear marks indicate other problems.

If the gaps are not correct for a given temperature then problems can arise.

If the joints are closed up before the temperature reaches 38C then as the temperature rises the rail is in compression and there will be a greater risk of a buckle.

If the joints are too wide then in cold weather the fishbolts and plates will go into tension and there is a risk of one or other failing.

The expansion gaps for 120ft rails are the same as for 60ft ones; this is because of the physical dimensions which limit the movement between the fish bolt holes, the fishplates and the fishbolts.

Where there is jointed track throughout a long tunnel and provided the temperature is known to remain reasonably constant, special conditions can apply. The first four joints inside the portals should have the standard expansion gaps, whilst the remainder need only have 3mm gaps, to allow easy changing of rails when necessary.

4. Creep Symptoms

NB The use of the word “consecutive” in the items below means 3 or more

The following symptoms indicate creep is taking place:

- consecutive joints open in very hot weather, or consecutive joints closed in cold weather

- consecutive open or closed joints adjacent to a fixed point, such as S & C or a level crossing, unless the temperature is appropriate

- a single isolated open joint in very hot weather when adjacent ones are closed, or single closed joint in cold weather when adjacent ones are open

- joints out of square. One should not lead another by more than 60mm

- anchors digging into wooden sleepers or rotating

- joints not in the middle of the bed. In extreme cases the joint may be over a sleeper or baseplate, “opposite” joints in different beds,or the fishplate tight against the chair or baseplate.

The sleeper spacings are all wrong and there is a general shortage of ballast.

- on two track routes the cess rail may creep more than the six foot rail because of the differences in quantities of ballast at the sleeper ends. The sleepers will usually be all out of square

- sleepers out of square or moving bodily and piling up ballast ahead of them and leaving a gap behind

All spike holes have been used and an anchor, but the rail foot is still not firmly In the baseplate.

- adjustment switch closing or opening up excessively (see Item 13)

- signs of movement under fastenings, such as marks on the upper rail foot surface adjacent to or under the fastenings.

The marks on the top of the rail foot, to the left of the spike and to the right of the baseplate indicate that the rail has been pulled back at least twice.

5. Creep Causes

Creep can be caused by one or more factors:

5.1 GENERAL

- loose, poor or even incorrect fastenings

- high input forces at the running-on end of the rail end when struck by wheels, especially when the rail is under high thermal stress

- acceleration effects such as leaving stations or climbing rising gradients or al the end of a speed restriction

A steep gradient such as this will be a potential creep site especially since it is fitted with Panlocks.

- thermal movement of the rail

- loose or missing fishbolts

Two bolts in four hole fishplates, wet beds, lack of ferrules will all lead to creep.

- braking effects. The rail moves through the fastenings under the wheels, especially noticeable at approaches to signals or speed restrictions and on down hill gradients

- seized or overtightened fishplates not allowing expansion and contraction of individual rails.

- abraded concrete sleeper rail seat
- ballast shortages
- poor packing of sleepers
- corrugations on the rail head

Rail head corrugation and missing fastenings encourage creep.

- thinning of the rail foot or baseplate/chair due to gall, corrosion or wear

The edge of the foot of this rail has severe gall and the bright marks under the spikes indicate movement.

- insufficient anchors or poor anchor grip
- 'ironing out' of the rails with time.

A useless anchor, which has been rattling for some considerable time.

- active subsidence due to mineral extraction
- worn or poorly maintained joints

A panlock and a steel key showing the taper in the gap.

5.2 IN BH TRACK

- The chair jaws may be worn and/or corroded.

- steel keys may be corroded, worn or deformed. They may even be fitted sideways instead of longitudinally.

Steel keys must not be inserted this way up, a liner should be used to take up any wear or corrosion in the chair jaw or rail web.

- wooden keys may have rotted, been damaged by overdriving, or repeated driving, or have shrunk in a long period of dry weather.

- the ferrules between the screw and the chair casting may be rotten, damaged or missing.

- Panlocks may have been fitted. These have less creep resistance than keys, especially if the chair jaw is worn. They must not be used in CS1 chairs. Unlike other keys, Panlocks do not fall out when loose.

- the chair screw may have lost its hold in a sleeper if the wood has rotted.

This wooden key has almost totally disintegrated and will have no grip.

- the chair screw may be bent, broken or corroded.

- in through-bolted track the bolt may be loose because either the bolt head recess in the bottom of the sleeper has become worn or the hole through the sleeper has become enlarged.

- the chair may be broken. If the break is immediately under the rail seat it may not be obvious at first glance.

5.3 IN FB TRACK

• Elastic or Macbeth spikes may have lost their hold in the wood of the sleeper, due to corrosion of the spike, the wood becoming rotten, or repeated extraction and insertion of spikes when pulling back causing the spike hole to become enlarged

This sleeper is so rotten that the spike has no grip.However the anchor is working, the sleeper is bodily being moved to the right, since there is a lack of ballast at the left hand edge of the sleeper.

• Mills and Heyback clips may have suffered corrosion, and/ or wear in the housings

• broken or cracked baseplates

The gap between the baseplate edge and the rail foot indicates that the baseplate is broken under the rail. The fishplate is over the baseplate.

• BJB screws may have lost their grip when the beechwood ferrule in the concrete sleeper has rotted away, or the whole assembly becomes twisted

This BJB fastening has been fitted with maintenance parts.

• Incorrectly driven or corroded clips, wrong clips or the “right’ clips in the wrong housing all effect the toe load.

A joint on top of the sleeper. When was it last lubricated or pulled back?

• Pandrol track may have missing, wrong or worn pads and/or insulators which can reduce the load.

6. Correction Of Creep Problems

6.1 GENERAL

Fishplate lubrication, rail adjusting (including adjustment switches) and making up ballast should be finished before 1 May.

Lubrication of the fishplate surfaces permits freer expansion and contraction of the rails and also reduces the wear on both the fishplates and the rail ends.

Each joint should be lubricated in alternate years; a sprayable lubricant enables the fishplate to be slackened but not removed, thereby saving time.

When creep is first discovered the initial action should be to renew and/or fit additional fastenings. If creep continues then fit anchors and if there is still a problem use maintenance clips or spikelocks.

When correcting creep, assuming the expansion gaps can be corrected, there are always other problems that will need to be remedied at the same time.

Dipped joints.

Undertake shimming for minor dipped joints, rail end straightening will be necessary for severe dipping.

Dipped joints such as this will cause the rails to be driven forward.

Renewal of fishplates will probably be needed at the same time. Spot resleepering at the joints will also help.

If a patroller finds an isolated open (“frozen”) joint when the adjacent ones are closed, it can often be cured by slackening off the fishbolts and easing the plates.

Corrugated rails

Undertake rail grinding.

The heel joint at a cast AMS crossing. No TJ plates and a mixture of bolts, permitting the plain rails to move.

The sleeper spacings are wrong, one tight and open joint indicates frozen fishplates.

6.2 BULL HEAD TRACK

Cause	Remedy
No obvious defect	Fit rail anchors
	Change wood keys to steel
Worn or damaged keys	Replace keys/ fit liners
Worn chair jaws	Fit liners
Loose chair screws	Fit coils
Broken chair screws	Fit HT screws
Loose chairs	Renew ferrules/screws
Ferrules rotten or missing	Replace

This BH fishplate has been driven hard against the chair by the creep.

A Panlock key correctly fitted. A ferrule is visible and at correct height above the chair casting.

MAINTENANCE MATERIALS AND CATALOGUE NUMBERS.

KEYS		
Wooden	for 95 BH	57/48455
Wooden	for 00 rail	57/486461
Steel	for 95 BH	57/48451
Panlock	for 95 BH	57/48450
LINERS		
1/16” steel liner	for worn chair jaws	57/48501
1/8” steel liner	for worn chair jaws	57/48502
1/4” steel liner	for worn chair jaws	57/48503
3/16” steel liner	for worn chair jaws	57/48504
ANCHORS		
BRR	for 95lb BH	57/48001
VORTOK COILS		
coils	standard	57/48034
coils	large	57/48298
insertion tool		57/48035
gauge/ extraction tool		57/48036
ferrule extractor		57/48266
FERRULES AND COACHSCREWS		
coach screw AS, 6 3/8” long	for 1 3/4” baseplates and 5 and 6” timbers	57/48781
coachscrews, as above but for maintenance	as above	57/48785
coachscrews, high tensile		57/48195
coachscrews LS, 8 1/8” long	for timbers greater than 6” deep	57/48194
ferrules, polypropylene	for above screws	57/48415
ferrules, flanged	for throughbolts and Pan 9 baseplates	57/48416

6.3 FLAT BOTTOM TRACK

Cause	Remedy
Elastic spikes	Fit rail anchors Fit AL 23 maintenance spikes Fit additional spikes in unused baseplate holes Fit spikelocks*, for use when the wood around the spike has rotted Fit LC clips.
Macbeth spikes	Fit rail anchors Change baseplates Fit spikelocks*, for use when the wood around the spike has rotted Fit LC clips.
Mills clips	Fit rail anchors Fit “toe shoes”* to the clip to increase toe load
Pandrol clips	Fit alternative clips or use other housing with appropriate clip. See Appendix, or the Pandrol booklet Change pads and/or insulators Pan 1,2,3,5 and 8 baseplates can be fitted with LC clips Glue in loose housings
BJB clips	Fit maintenance screws, “etc” Fit maintenance gauge retaining plates if the shoulder is spalled
SHC	Fit new clips and insulators If hoops are damaged/broken, new ones can be glued in
RNB	Convert to Pandrol
Heyback	Fit LC clips Convert to Pandrol
baseplate screws loose	Fit coils/sleeves to screws

MAINTENANCE MATERIALS AND CATALOGUE NUMBERS.

ELASTIC SPIKES		
Normal spike, AL1	for BR1/BR3 baseplates	57/48781
Maintenance spike, AL23	replacement for A1	57/48785
PANDROL insulators, pads and clips		
See Civil Engineering Conference Standard CEC/C/0005, Track Maintenance Handbook or "The Guide to Pandrol Brand Track Fastening Systems used by British Rail" (1993)		
ANCHORS		
MF	for 98, 109, 110 or 113A FB rail	57/48007
FERRULES AND SCREWS		
see under BH materials (page 14)		
LOW COST (LC) CLIPS		
clip		57/48753
coachscrew		57/48191
spring washer		57/48136
MILLS TOE SHOES		
See Item 16		
BJB		
Heel pad	neoprene	57/48704
toe pad	neoprene	57/48705
support washer		57/48706
nut for stud screw		57/48707
spring bar clip		57/48724
stud screw maintenance		57/48708
gauge retaining plate	maintenance, 2 1/2"	57/48709
ditto	ditto, 6"	57/48710
ditto	ditto, 6" x 1/16" wide	57/48717
ditto	ditto, 6" x 1/8" wide	57/48718
ditto	ditto, 6" x 1/16" tight	57/48719
ditto	ditto, 6" x 1/8" tight	57/48720
gauge retaining plate	pads 2 1/2"	57/48711
ditto	pads 6"	57/48712

7. Pulling Back

7.1 PLANNING

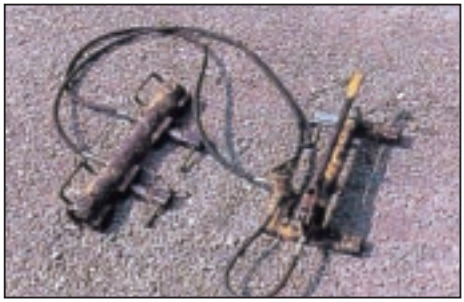
Appropriate precautions to protect traffic must be taken. This will normally involve Rule Book TII or TIII possessions being taken.

The use of a hammer and sett or the chisel end of a bar to move the rails is prohibited, as is any bar in a bolt hole. An ordinary fishbolt through a hole and pushed or pulled by two bars is not recommended, because of the risk of uneven loading from the bars twisting the bolt and damaging the bolt hole in the rail. Any of these methods can damage the rail/bolt hole leading to increased risk of cracks.

This fishplate has crept so much that the elastic spike has been reversed and only holds the baseplate in position. The baseplate is shuffling badly. The vee gap at the rail foot suggests that a sett has been used to adjust the rails.

The hydraulic rail adjuster is the most efficient tool and permits up to five rails to be moved simultaneously.

There is however a risk in cold expanded bolt hole that the “spigot” will crush the CX nib in the 3 or 9 o’clock position.



Expansion bits corresponding to the 3, 6 and 10mm gaps can easily be made from pieces of steel of appropriate thickness and are helpful when used with the hydraulic adjuster.

Where a gap is wide the appropriate expansion bit is dropped in, the rails can be closed up by the adjuster onto the bit, the rail fastened down and the bit knocked out. If a number of gaps have bits placed in them then one position of the adjuster can be sufficient to correct all of them at the same time.

Wherever possible cutting of rails should be avoided. If this is unavoidable then spare rail, together with a rail saw or disc cutter, drill and CX equipment should be available on site.

It is essential that a preliminary survey is made of the site. This will indicate the length of the track requiring adjustment as well as giving an idea of other resource requirements. Follow up work such as fitting new anchors and packing the ballast must be included in the time required and the necessary manpower allowed.

A detailed survey must be made shortly before the planned work date to finalise the measurements of the gaps.

Arrangements must be made for the S & T to be present to replace any loose or damaged bond wires on completion of the work.

7.2 SURVEY AND CALCULATIONS

Just before the date of work, a detailed survey must be carried out as follows:

Record the location details, rail temperature and type of track (see Appendix A for a sample sheet).

Find a place where two joints are square across the four foot, in the middle of the crib and outside any creep area. When hydraulic or mechanical adjusters are to be used the adjacent length of track not to be disturbed must be secure enough to act as an anchor.

Record the gaps on both the six foot and cess rails, having made a careful note of the starting joint (e.g. miles and yards) and continue beyond the apparent end of the creep problem. This allows for running out the gaps rather than cutting a rail.

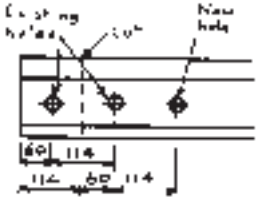
Calculate on a running total basis the amount of gap that will occur. At some stage this should become zero and the joints have the correct gaps. If this does not happen or is not within a reasonable distance that can be covered in the required time then it will be necessary to insert an appropriate length of closure rail, to last until the next shift.

The total number of gaps multiplied by the gap at that temperature gives a figure which can then be compared with the actual total measured along that rail. This will determine if any special rails are required to make good.

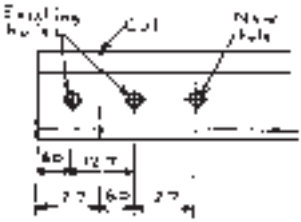
Appendix B shows a sample sheet of readings and calculations.

Where it is known that rails are not 18.288m (60ft) long, e.g. on tight curves or where cutting rails has occurred in the past then actual rail lengths must be checked to ensure that joints remain in the middle of the crib. It should not be forgotten that the manufacturing tolerance on the length of a new drilled 18.288m (60 ft) rail is +/- 5mm and on a blank ended rail +/- 25mm, which can cause problems if a number of rails have tolerances all the same way.

When it is necessary to cut the rail every effort should be made to cut 114mm off a BH rail and 127mm off FB. This will enable the back hole to become the new end hole.



Method of shortening
B.H. rail to retain one hole



Method of shortening
F.B. rail to retain one hole

7.3 WORK

N.B. Whilst undertaking pulling back it is advisable to take the opportunity to check visually that fishplates and rail ends are not cracked, broken or otherwise defective and to lubricate fishplates and bolts.

The sequence of work shown below is only for guidance.

a) Set up a safe system of work.

b) Select a suitable anchor length depending on site conditions at the start of the job.

c) Slacken off or remove the fastenings for the next few lengths.

d) Remove any rail anchors for those lengths.

e) Slacken off fishplates for those joints.

f) Insert correct expansion bits where appropriate.

g) remove a pair of fishplates at a suitable place, fit and operate the adjuster to correct those gaps.

h) Fasten down those lengths and tighten the fishbolts, ensuring that any shims are refitted; refit anchors as necessary.

i) Move forward and repeat from c).

j) Continue until a pre-determined joint or the rail cutting stage has been reached.

k) Square or respace any sleepers as necessary.

l) Correct the sleeper spacing at joints as necessary.

m) Fit additional or renew any anchors as necessary, if not done in h)

n) Undertake any other work necessary, e.g pack and consolidate ballast.

o) assist the S & T in replacing of bond wires, if necessary. In certain parts of the country the bond wires are positioned between the rail and one fishplate.

p) Where substantial movement of sleepers has occurred then it is advisable to follow up with ballast packing by either kango or preferably by tamper, to ensure the ballast is consolidated.

8. Anchors

A number of different anchors are still to be found in track, although they may not be in production

Drive with firm blow so that Notch engages opposite edge of the Foot of Rail

Fair V

Fair V. Drive with firm blow so that Notch engages opposite edge of Flange

For many years the Fair V and the Fair T were used in FB track and the Phillips in BH and will still be found in many places. The Mills Unit anchor was also tried for a while in FB track, but it proved to only to have an effective hold on relatively new rail; any foot gall or corrosion of the rail foot seriously reduced its effectiveness. A long handled bar was also required to fit the Unit anchors, which proved a problem in restricted places such as platforms. It was not unknown for the rail to overturn if the elastic spikes were not tight in the sleepers when heavy men hung on the bar.

Fair T

Fair T. Drive with firm blow so that Notch engages opposite edge of Flange

Some SNCF anchors were imported for use on FB track. Generally they proved to be effective even on worn rail, but to fit them required a 8 ft. long bar, weighing 50lbs. They were also overstrong, an unnecessary waste of metal and therefore costly. BR Research then undertook an investigation into anchors and came up with the MF (modified French), which is now recommended for any FB- rail regardless of the foot condition. There is also a BRR (British Rail Research) anchor for BH which again can be used on a worn or corroded rail foot.

Rail section	Materials Catalogue no. 57/	Anchor type
95 lb BH	Obsolescent	Fair V
98lb, 109lb, 110A and 113A FB	Obsolescent	Fair T
95lb BH	48001	BRR
98lb, 109lb, 110A and 113A FB	48007	MF
150lb conductor rail	49008	Fair

BRR rail anchor

MF rail anchor

A number of other anchors are available, especially in the USA; however they are untested in the UK.

Anchors grip the rail and press against the chair or sleeper. This means any longitudinal movement of the rail is resisted by not only the friction of the rail to chair or baseplate fastening but also the sleeper in the ballast.

BH anchors must be fitted tight against the chair whilst all FB anchors fit against the sleeper itself.

Fair T and Phillips anchors are fitted by knocking on with a hammer. Unit, SNCF, MF and BRR anchors have to be fitted with special tools.

Anchors must not be over driven; the notch must fit property on the rail foot, where applicable.

Anchors must be fitted in pairs to a sleeper, one to each rail. If only one is fitted or gripping then the sleeper will be forced out of square as the creep occurs. Anchors must not be fitted to joint sleepers.

The anchor pattern to be used is dependent on the severity of the creep (See Item 8.1).

Back-up anchors should be fitted as shown in the patterns to prevent any reverse creep that might occur. On bidirectional or single lines then more back up anchors than shown will be required.

Anchor has been attempted but only one is effective.

An MF anchor correctly fitted and working properly. Gall on the side of the rail foot to the left of the baseplate indicates past creep problems.

Where spikes are fitted then repeated easing and re-driving into the wood can weaken their hold and it is therefore worth fitting additional anchors to make up for the lost grip.

This spike is ineffective; the rail is not tight in the baseplate and the baseplate is shuffling.

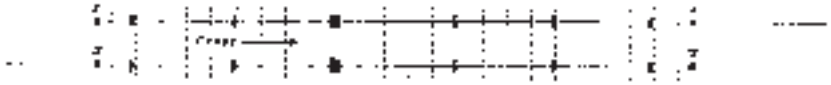
If creep is still occurring when the severe creep pattern of anchors has been used then the fitting of LC clips on elastic spike track or anchors on every sleeper except the joint may be the only cure.

Anchors must be applied immediately after rail adjustment has taken place.

An anchor has been fitted but it does not bear properly against the concrete sleeper.

8.1 ANCHOR PATTERNS

Slight Creep

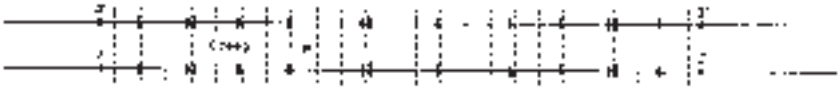


6 Forward, 1 Back-up Anchors per 60ft Rail
N.B. Assumes fastenings to be in good condition

Medium Creep

8 Forward, 2 Back-up Anchors per 60ft Rail
N.B. Assumes fastenings to be in good condition

Major Creep



10 Forward, 3 Back-up Anchors per 60ft Rail
N.B. Assumes fastenings to be in good condition

9. Bull Head Keys

There are three types of BH keys: wood, steel and Panlock.

Wooden keys have been used for many years and are easy to fit. However they are prone to shrinkage in prolonged dry weather and are known to fall out.

Steel keys avoid the shrinkage problem but in damp conditions they can corrode and break.

Panlocks stay within the chair jaws and will not fall out. They are good in plain line check rails, but have least creep resistance of the three types.

Wooden and steel keys are normally inserted in the direction of traffic so that any forward movement of the rail wedges the key more tightly.

At joints the key on the running-on end of the fishplate is driven in the reverse direction, On very sharp curves where the low rail is being driven backwards it may be worthwhile fitting the keys against the direction of traffic.

On steep uphill gradients both rails may need keys driven in alternate directions. Similar remarks apply to single or bi-directional tracks.

Keys correctly driven in alternative directions

Steel keys must not be driven sideways. If the chair is worn then a liner of the appropriate thickness can be used.

Wood keys must be used in tunnels. The wet conditions found in most tunnels would cause steel keys to rust away very quickly and could in some instances lead to the rails being unrestrained.

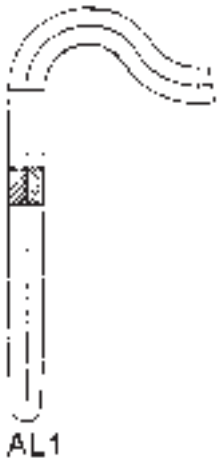
Steel keys are tapered to indicate the direction of insertion and wooden keys have an ‘S’ stamped in the thin end.

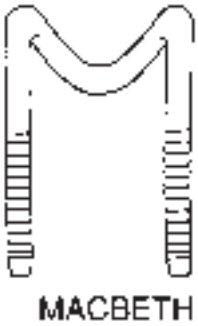
This steel key does not fit correctly. The ballast is very dirty.

Split sleepers, a mixture of keys and from chalk numerals a badly dipped joint all encourage creep.

10. Elastic Spike Types

Spike fastenings shall not be used where the line speed is more than 90mph or where the track type is CWR.





N.B. It is now not possible to purchase replacement L1 Lockspikes. Therefore stocks of these spikes should be used with care.

11. Spikelocks

These are a form of sleeve which was designed to take up any loss of wood through rotting around an elastic spike or loss of section of a spike through corrosion. The version in most recent use was the Arthur Railroad spikelock, made in the USA and imported into the UK.
Whilst they do not appear to be still made some stocks may be still available, although they did not meet with universal approval.

Spikelocks are normally only used where creep is severe and when fitted should be one of the last methods of dealing with a creep problem.

Spikelocks should only be used in old sleepers, not new ones.

Two different types of spikelocks were used; one required the removal of the baseplate to enable fitting and the other was driven through the baseplate.

A special tool should be used for installation of the spikelock and care must be taken only to drive the spikelock down until flush with the top of the sleeper. The tool had a limited life since the cantilevered head tended to break off after some time. For this reason during installation the use of goggles is essential. An alterative insertion method was to use half an AL 23 maintenance spike.

The spikelock must be inserted with the leaves parallel with the rail, to reduce the risk of splitting open the wood along the grain.

Only AL1 spikes can be fitted in conjunction with spikelocks. If AL23s are used the spikelock will be driven right through the base of the sleeper.

11.1 SPIKELOCK PATTERNS

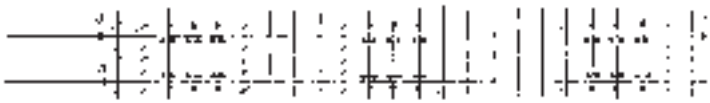
Installation of Arthur Railroad Spike Locks (B.R.1 Elastic Spike Track)

Spike lock insertion pattern
(no resleepering having taken place)

54 number installed per length

Installation of Arthur Railroad Spike Locks (B.R.1 Elastic Spike Track)

Spike lock insertion pattern
(Resleepering Two Joint and 1 in 4 having taken place)



54 number installed per length

12. Screw Coils / Sleeves

Where the wood around the screw hole has only slightly rotted and the screw is showing signs of looseness a screw coil/sleeve can be used to increase the grip. This fits around the screw and in effect increases the diameter.

In the past various means such as wooden plugs, Philplug (an asbestos filler) and VV coils have been used.

Vortok coils may be used to restore the grip of chairscrews in holes which are moderately enlarged.

The fitting of Hilti Rehabilitation Sleeves (HRS) to chairscrews will increase their effective diameter and help restore their grip in screw holes which are slightly enlarged. It is a plastic sleeve with perforations on opposite sides, which when screwed into a hole can split and fill any gap between the wood and the screw. If the hold is still inadequate then further sleeves can be inserted.

Vortok Coils.

Hilti Rehabilitation sleeves.

13. Vortok Coils

This is a brief summary or their use. See manufacturer's literature for full details.

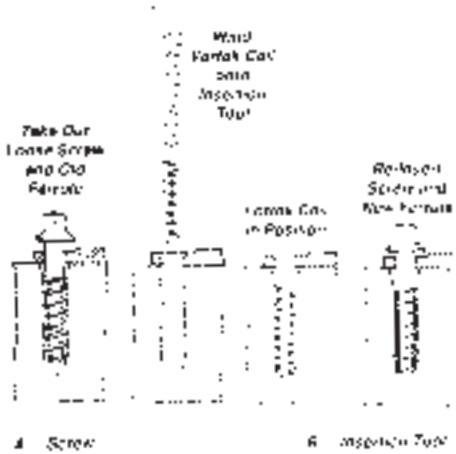
The lack of screw grip can be assessed either visually or by means of the Vortok International Torque Tester. The screw and the ferrules are then removed and the special gauge is inserted into the hole to ascertain which of the two Vortok coil is required.

The appropriate coil is screwed onto the insertion tool, which is then screwed into the hole and finally unscrewed to leave the coil in place.

A new ferrule is inserted, the screw replaced and tightened down, leaving between 4-6mm of ferrule above the housing.

Holes visible on gauge	Softwood sleeper	Hardwood sleeper
three	no coil required	no coil required
two	standard coil	standard coil (greased)
one	large coil	standard coil
none	two coils	large coil

Vortok gauge in baseplate screw hole, one hole visible on gauge.



14. Adjustment Switches

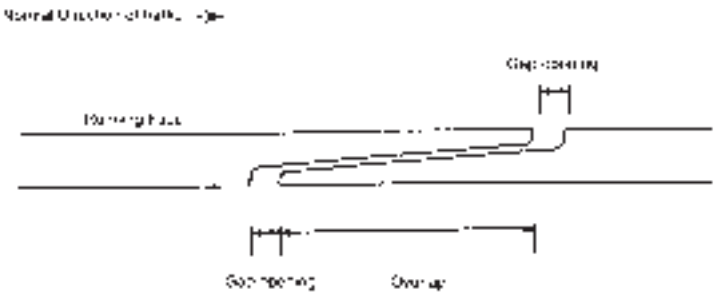
These allow for the expansion at the end of the CWR, in the Stress Transfer Zone. They are not intended to allow jointed track to creep.

Care must be taken to ensure the full width of the rail foot rests on a baseplate; if not then there is the risk of the reduced section of the rail breaking. Alternatively if the full rail section comes off the baseplate then when the rail expands again the rail may catch on the baseplate and force the sleeper out of square.

Civil Engineering Conference Standards CEC/C/0005, Line Standard RT/CE/S/011 and CEC Guidelines for hot weather give further details on adjustment switches.

If there are straps in the four foot they must be screwed down tightly to stabilise the adjustment switch timbers.

Where the jointed track is causing closure of the adjustment switch then the cause of the problem must be identified and remedied.



Rail temperature	Overlap of switch rails	Gap opening
-4 to 2C	635mm	125mm
2 to 7C	641mm	119mm
7 to 13C	648mm	112mm
13 to 18C	654mm	106mm
18 to 27C	660mm	100mm

The old practice of “summer” and “winter” rails adjacent to adjustment switches is not recommended. This was used where creep problems in the jointed track closed up the switches in hot weather but left them wide open in winter.

The first pair of rails behind the adjustment switches were changed when necessary by using another pair of rails of different length. Whilst this minimised the work required to reset the adjustment switch gaps and overlaps, it did not cure the underlying cause of the creep.

15. Low Cost Clips (LC)

The Low Cost clip is a solution to solve the problem of loose elastic and Macbeth spikes in BRI, BR2 and BR3 baseplates, loose lockspikes in PAN 5 and 8 baseplates and corroded/broken Heyback fastenings.

The above method is suitable only where the sleeper is good enough to provide a secure fixing for the screws.

The LC clip is a shaped steel plate which holds the foot of the rail onto the baseplate, using a sprung washer and a screw passing through a hole drilled in the baseplate and into the wooden sleeper.

To install an LC clip the spikes are first removed from the baseplate, a hole is drilled through the middle spike hole of the baseplate using a special jig and cutting tool. A chair screw hole is then drilled through into the wooden sleeper.

A lubricated chair screw with a washer and LC clip is inserted through the new baseplate hole and screwed down until the spring washer does not have any gaps between the coils, indicating that the correct torque has been attained.

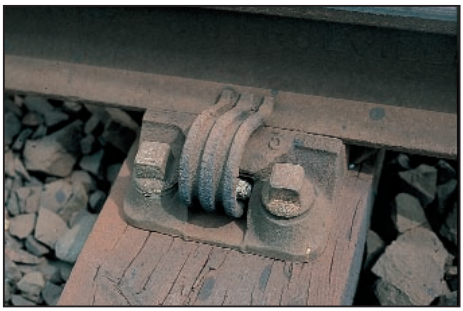
Certain baseplates may require raised casting marks to be ground off to ensure a proper fit of the clip and to obtain the correct toe load.
BR1 baseplates were originally drilled for 27mm diameter holes. This however stopped the use of normal Vortok coils later in the sleeper's life and a special coil was produced. It is now suggested that 28mm holes be drilled in the first place so that a standard coil can be used later. A normal ferrule may then be required to avoid any looseness between the hole and the screw. A number of companies are producing drilling equipment and parts for the LC clip. Whilst the idea of conversion is basically simple, care is necessary in the selection of the drilling machine and tool and the exact method to be used.

Railtrack Line Code of Practice RT/CE/C/014 contains further information on the components and fitting procedures for LC clips.

A LC Clip just fitted, the elastic spike could be removed.

16. Mills Clip Toe Shoe

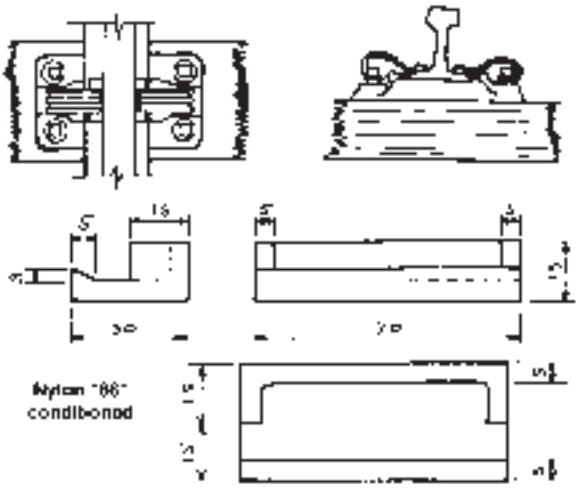
After many years in the track Mills Clips can become loose in their housings, due to wear or corrosion.



Mills rail clips fit into a pocket cast into the baseplate and whilst the clip may be retained in the pocket, it is possible that some or all of the clip toe load can be lost and the clips rattle during the passage of a train. In these circumstances it will be necessary to either fit toe shoes (wedges) to the clips or to replace the clips.

Method of installation:

- remove existing clip and fit shoe under top end of clip.
- insert clip into housing, ensuring that it fits properly against the rail foot.
- gently tap the clip into the housing until the grip is sufficient to retain it.
- make sure the baseplate is tight against the rail foot, tightening the baseplate screws or packing the sleeper as necessary.
- drive the clip fully home to clamp the toe shoe between the rail foot and the clip.



17. Creep Resistance Figures

Below is a summary of various tests used to determine creep resistance. Whilst not strictly comparable since the tests were made under different circumstances and at different times, they do give an idea of the differences between the various items.
The resistance between a wooden sleeper and the ballast is between 10 and 20kN. Therefore any anchor with a creep resistance of more than l0kN or 5kN if applied to both rails would cause the sleeper to move under creep conditions.

The creep resistance of various anchors:

Chair condition	Minimum creep resistance over one chair (kN)				
	Panlock	Wooden key		Steel key	
		New	Used	New	Used
New	9.2	13.2	11.1	18.3	12.0
Worn	5.8	10.5	9.1	12.2	9.2

The creep resistance of various anchors:

	Static creep resistance (kN)	
Anchor	New rail	Old rail
Mills Unit	19	0
SNCF	20	14
MF	9	7
BRR	not tested*	10

* Not tested at the time since it was considered that the resistance would be much greater than 10 kN and the sleeper would move through the ballast.

The creep resistance of a single fastening.

Fastening	resistance (kN)
Good elastic spike	3
Pandrol clip	12
LC clip on BR1	12
LC clip on BR3	6

APPENDIX A Sample sheet for calculations of pulling back.

Zone ..... Track Engineer ..... RSM .....

Route..... Line..... Mileage from .....

Temp..... ..... Mileage to .....

Joint No.	Cess rail actual	Cess total	REQUIRED GAP	6ft rail actual	6ft total
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					
23					
24					
25					
26					
27					
28					
29					
30					

APPENDIX B Sample sheet for calculations of pulling back.

Zone *HAPPYLAND* Track Engineer *NORTH* RSM *MIDDLE*

Route *SEA BRANCH* Line *UP* Mileage from *6 M 326 Y*

Temp *16C* Mileage to *6 M926 Y*

Joint No.	Cess rail actual	Cess total	REQUIRED GAP	6ft rail actual	6ft total
1	12		6	11	
2	11	23	12	12	23
3	12	35	18	11	34
4	11	46	24	13	47
5	13	59	30	12	59
6	10	69	36	9	68
7	11	80	42	10	78
8	13	93	48	11	89
9	12	105	54	8	97
10	10	115	60	13	110
11	5	120	66	13	123
12	4	124	72	0	123
13	5	129	78	0	123
14	3	132	84	0	123
15	0	132	90	0	123
16	0	132	96	0	123
17	0	132	96	0	123
18	0	132	108	0	123
19	0	132	114	0	123
20	0	132	120	0	123
21	3	135	126	0	123
22	4	139	132	8	131
23	7	146	138	6	137
24	8	154	144	5	142
25	6	160	150	6	148
26	2	162	156	8	156
27	2	164	162	6	162
28	6	170	168	7	169
29	6	176	174	5	174
30	5	181	180	6	186

Method of calculation:

1 Add the actual gaps together to give a total gap figure at each joint No.

2 List the required gaps by the same method, using the gap for a joint for a given temperature.

3 Look for joints where the actual and the required gaps more or less correspond or for a suitable cutting point.

Example:
Assume a rail temperature of 18C

For the cess rail the actual gaps total and the required match at joint No. 28, so this should be the limit of the pulling back.

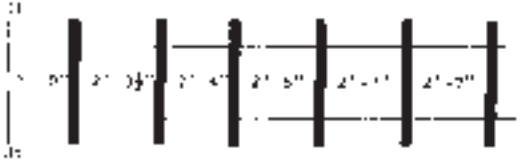
For the 6ft. rail, they nearly correspond at joint No. 22, or exactly at joint No.26, so either place could be used.

BULL HEAD RAIL

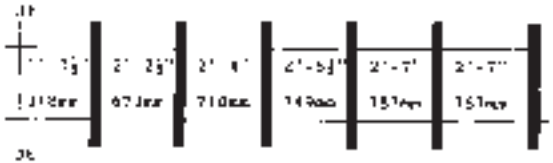
FLAT BOTTOM RAIL

STRAIGHT TRACK OR CURVES FLATTER THAN 800M (40ch)

24 Sleepers per 18.288m (60ft)



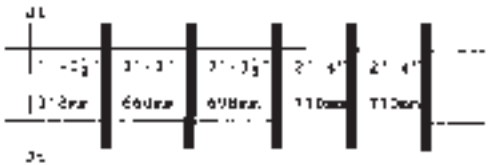
24 Sleepers per 18.288m (60ft)



CURVES SHARPER THAN 800M (40ch)

26 Sleepers per 18.288m (60ft)

26 Sleepers per 18.288m (60ft)



AREAS WITH FORMATION DIFFICULTIES ETC

28 Sleepers per 18.288m (60ft)

28 Sleepers per 18.288m (60ft)