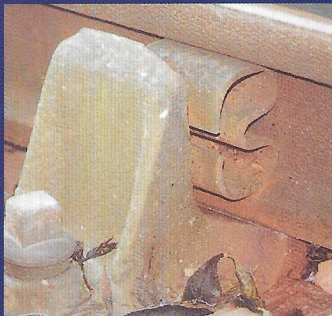
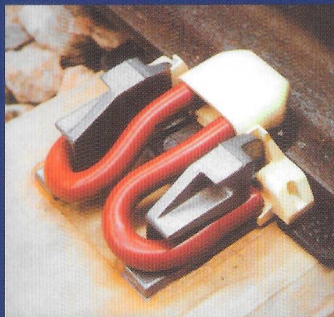


RAIL FASTENINGS



Produced by Civil Engineering Conference
For use by all Railway Civil Engineering Staff

CEC/DG/012

Issue 1

May 2003

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Produced for Civil Engineering Conference by:

AMEC Rail
AMEY Rail
Balfour Beatty Rail
Carillion Rail
First Engineering
GrantRail Ltd
Jarvis Rail
Serco Rail Maintenance Ltd
Mowlem Railways
Pandrol UK Ltd

In conjunction with Network Rail

Printed by Heron Press Limited, Rubery, Birmingham B45 9AL.
Telephone: 0121 457 4810 Fax: 0121 453 1541

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Scope

This booklet has been produced for the guidance of track staff at all levels. It is intended to give general information on the correct methods to be used for the insertion and removal of rail fastenings, reducing the risk of injury to staff and damage to rails and components.

Introduction

Rail fastenings perform a variety of important functions. Their installation and maintenance can have a fundamental effect on the track system as a whole.

Today's modern fastenings are designed to cope with traffic and track conditions that are different from those of a few generations ago. Fastenings have evolved to deal with the new demands placed upon them and have played a significant role in allowing the high speeds and high axle loads of today to be safely carried.

The aim of this **CIVIL ENGINEERING BLUE BOOK** is to provide a guide to the correct methods of installing and removing the different types of fastenings in use in the UK.

Many rail fastenings are essentially very powerful springs that clamp the rail to its support. If these springs are inserted or removed in an uncontrolled manner, then serious injury can result.

Injury is avoided by using

- CORRECT TOOLS (IN SAFE CONDITION)
- CORRECT SAFETY EQUIPMENT
- CORRECT TRAINING TO FOLLOW
- CORRECT TECHNIQUE

The information contained in this Blue Book gives clear advice on the first three subjects.

Training must be provided to staff on the correct use of hand and power tools prior to any attempt to insert or remove rail fastenings of any type.

What Is The Function of a Rail Fastening?

The rail fastening is designed to provide vertical and lateral resistance to ensure the rail is secured correctly to either the chair, baseplate or bearer.

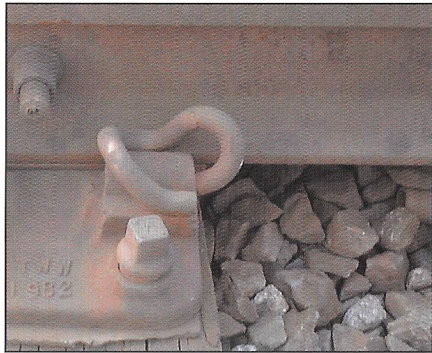
Fastenings are designed to prevent rail creep that can lead to track buckles and lateral movement of the rail, which may lead to rail gall. The loading of the fastening on the rail is not designed to prevent the expansion and contraction of the rail caused by changes in the rail temperature.

Incorrectly installed or inadequately maintained rail fastenings increase the risk of rail and component failures.

The addition of plastic insulators and rubber pads in flat bottom fastenings since the 1960's has improved the resistance to vertical and lateral movement whilst providing the electrical insulation on concrete and steel sleepers and bearers.



The correct use of rail fastenings



The incorrect use of rail fastenings



The operation of track circuits is totally dependant upon the quality of the pads and insulators. It is extremely important that the pads and insulators on steel sleepers track are fitted correctly, inspected regularly and maintained well.

Economy of Installation and Maintenance.

The modern fastening should be quick and easy to fit. It should allow economic distressing and rail renewal. It should have the ability to be applied mechanically to reduce labour costs.

Component durability (particularly pads and insulators) should be high to avoid expensive maintenance and replacement costs.

Working with Rail Fastenings

It is essential that whether undertaking the replacement of rail fastenings during maintenance or renewals that the correct fastening and any associated components (pads, insulators etc) are used for the specific rail/baseplate/sleeper combination. The components used should either be new or in satisfactory serviceable condition and inserted correctly as designed.

Prior to attempting to insert any form of rail fastening the chair, baseplate or sleeper must be lifted to the correct position on the rail to prevent possible damage to the components or injury to the persons performing the task. This can be achieved by using specifically designed tools for fastenings such as the Pansetter/Fastclip setter or by using rail jacks, bars or sleeper grabs.

It should also be ensured that the sleeper is square to the rail prior to inserting the fastening. This will prevent damage to the fastening and chair, baseplate or housing and any associated insulators and pads. Bullhead rail fastenings are particularly susceptible to falling out from chairs on sleepers that are out of square.

Rail fastenings should not be inserted in any way other than that for which they are designed as this will eventually lead to failures in the fastening, chair, baseplate or housing.

Before inserting a rail fastening, the housing, baseplate or chair should be examined for signs of damage. If damage is evident it must be ensured that the fastening can be inserted without causing further damage, and once inserted can perform its function correctly.

If this is not possible, the sleeper, baseplate or chair should be changed immediately where possible, if not then within 3 months.

When inserting and removing rail fastenings care must be taken not to cause injury to self or others, this can be done by using the correct tools which must be in a satisfactory condition. Tools should be checked visually and by using any available manufacturers gauge for signs of defects, any plant used should also be checked for worthiness and certification prior to use.

The correct protective clothing and equipment must be worn to prevent injury from any flying fastenings or debris and from injury to hands and fingers. These must be worn in addition to any mandated P.P.E and reference should be made to the individual's company safety literature and any specific method statements for the task to be undertaken.



Illustration of the problems faced on a section of Bullhead track where sleepers are only slightly out of square. The keys cannot be inserted in the correct manner (see Method of Insertion of Bullhead Keys), causing the steel keys in the photo to constantly fall out under the passing of trains. Sections of track with sleepers that are out of square often suffer from gauge variations which can lead to poor track quality.



*Examples of a correctly installed Bullhead rail fastening (left hand photo)
Flat Bottom rail fastening. (right hand photo)*

SECTION 1 - Bullhead Rail Fastenings

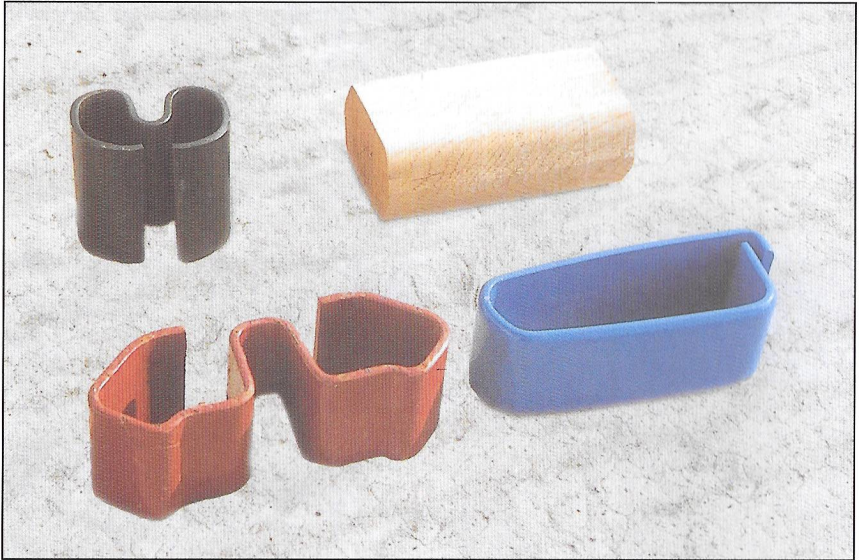
Bullhead rail was the most commonly used rail section in the UK from 1850-1960 and there is still a significant amount in the UK network, particularly in sidings.

Bullhead rail is secured within its cast iron chair by means of a key, of which there are only 4 types.

The key works by using its wedging action on the side of the rail to force the opposite side of the rail hard up against the inner face of the chair.

The rail must be correctly seated in the jaw of the chair before any attempt is made to insert a Bullhead rail key. Failure to seat the rail correctly can result in the jaw of the chair breaking either during key insertion or later under the passage of traffic.

There are no mechanical methods for the insertion or removal of Bullhead Keys



*The small range of Bullhead Keys
currently available for use.*

The Wooden Bullhead Key

Description

The Wooden Key is made from hardwood and is slightly tapered for ease of entry into the jaw of the chair. There are three types of wooden key: 95lb, 97 $\frac{1}{2}$ lb and 6R (reversible) for specific Bullhead rail sections.

The wooden key was originally used in all areas of Bullhead track, but is now found more commonly in check and wing rails of S & C layouts and in check rails on tight radius curves where it is more resilient to crushing than steel.

It is the only fastening in the Bullhead range that is recommended for use in tunnels.



The use of a rail bar to correctly position the rail in the jaw of the chair



Initial placing of the key prior to striking



Final position after driving into chair

Method of Insertion

The tapered end of the Wooden Key is placed into the edge of the jaw of the chair and tapped until it is in a position where the key can be firmly driven into its final position using a keying hammer.

When inserting keys into a length of rail, it may be necessary to place a rail bar into the jaw of the chair adjacent to where the wooden key is being inserted. Pressure is applied to the foot of the rail with the toe of the bar, using the jaws of the chair as a fulcrum. This positions the rail correctly into the jaw of the chair prior to the insertion of the key.

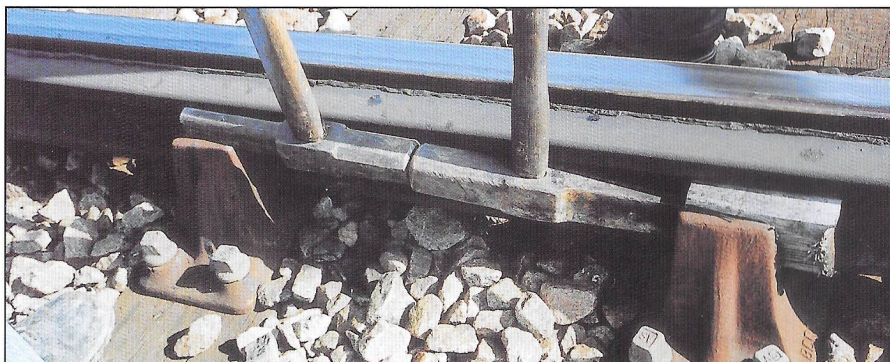
Care must be taken not to over drive the wooden key as this will reduce its life span. It can also place excessive pressure on the jaw of the chair causing it to break.

Care must also be taken to avoid striking the jaw of the chair with the hammer. This can lead to chair fracture, causing fragments of metal to fly into the air which may cause serious injuries.

Bullhead keys should normally be driven in the direction of traffic, except at joints, where the keys on each side of the joint should be driven towards the fishplate. On Bi-directional lines, keys should be driven either in the direction of the main weight of traffic or in the direction in which there is a tendency to creep or, if traffic is equal in both directions and creep is not present, in alternate directions on adjacent sleepers.

Method of Removal

The wooden key must be removed by using the tapered/thin end of the keying hammer to drive the key from the jaws of the chair. The wooden key should be struck carefully to avoid damage to the jaw of the chair and hit until it is free from the jaw of the chair. Wooden keys will become swollen during periods of wet weather and may become difficult to remove. In this case, the key should be removed by placing the tapered/thin end of one hammer on the wooden key and striking this hammer with another.



The use of two hammers to remove a seized wooden key

If this process is used it must be ensured that the person holding the first hammer is not in a position of danger from being struck by flying hammers, fragments of metal or the wooden key as it becomes displaced.

Hammers must be inspected for signs of damage, cracks or lipping. If any of these defects are evident the hammer should not be used and quarantined.



A correctly installed wooden Bullhead key



A wooden Bullhead key in poor condition providing insufficient hold on the rail

The Tapered Steel Bullhead Key

Description

The Tapered Steel Bullhead Key is designed so that the steel forms a spring, which can be used numerous times providing it is not overdriven during the insertion process. There is currently only one design available, the 95lb type, which can cause difficulties if fitted into the other Bullhead rail profiles and chair types.

Tapered Steel Keys are not approved for use in any check rail or parallel wing assemblies in either plain line or S & C or in tunnels.

Method of Insertion

The tapered end of the steel key is placed into the edge of the chair jaw and tapped until it is in a position where the key can be firmly driven into its final position using a keying hammer.

Care must be taken not to over drive the steel key as this will reduce its life span. It can also place excessive pressure on the chair jaw causing it to break.

Care must also be taken to avoid striking the chair jaw with the hammer. This can lead to chair fracture, causing fragments of metal to fly into the air which may cause serious injury.

When inserting keys into a length of rail, it may be necessary to place a rail bar into the jaw of the chair adjacent to where the wooden key is being inserted. Pressure is applied to the foot of the rail with the toe of the bar, using the jaws of the chair as a fulcrum. This positions the rail correctly into the jaw of the chair prior to the insertion of the key.

Bullhead keys should normally be driven in the direction of traffic, except at joints, where the keys on each side of the joint should be driven towards the plate. On Bi-directional lines, keys should be driven either in the direction of the main weight of traffic or in the direction in which there is a tendency to creep or, if traffic is equal in both directions and creep is not present, in alternate directions on adjacent sleepers.

Method of Removal

The tapered steel key must be removed by using the tapered/thin end of the keying hammer to drive the key from the jaws of the chair. The tapered steel key should be struck carefully to avoid damage to the jaw of the chair and hit until it is free from the jaw of the chair ensuring that it does not cause injury to self or others by striking it excessively hard.



A correctly installed Tapered Steel Bullhead Key



An incorrectly installed Tapered Steel Bullhead Key

The Panlock Key

Description

The Panlock Key is made from mild steel and is designed so that once inserted it can only be removed manually and will not fall out during the passage of traffic. This is entirely due to its unique shape, which has a double retaining ridge to "lock" it into position in the jaw of the chair. It is designed to include a spring effect that will ensure its repeated use and prevent it from being crushed under load. This fastening should only be installed and removed using the purpose made Panlock-Puller.

The Panlock Key are not approved for use in Bullhead CWR, areas of track with a tendency to creep or in tunnels

Method of Insertion

The Panlock fastening is placed in the edge of the jaw of the chair from the right hand side with the open curled end to rail web.

The Panlock Puller head is then placed against the railhead and on the top of the chair jaw with the lower arm of the Panlock Puller under the foot of the rail.

The curved toe of the handle of the must enter the leading curve of the Panlock fastening.

Place both hands on the Tee section of the handle and pull the Panlock Puller until the Panlock is fully installed when the Panlock Puller toe will disengage from the Panlock fastening. Ensure a correct stance is adopted, placing one foot in front of the other on the same side of the rail and not on sleepers before pulling.

The Panlock fastening must be checked to see that it is located centrally in the chair with both locking ridges showing.

Method of Removal

Place the Panlock Puller head against the railhead and on top of the chair jaw with the lower arm under the rail foot.

Ensure the curved toe of the handle enters the right hand curve of the Panlock behind the centre section.

Place both hands on the Tee section of the handle and pull until the Panlock is completely through the jaw of the chair. Ensure a correct stance is adopted, placing one foot in front of the other on the same side of the rail and not on sleepers before pulling.

Panlock Key Insertion Process



Stage 1



Stage 2

Panlock Key Removal Process



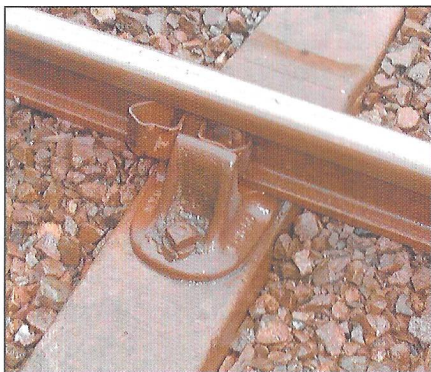
Stage 1



Stage 2



Correctly positioned Panlock Key



Incorrectly positioned Panlock Key

The John Bradley Bullhead Key

Description

The John Bradley Bullhead Key is the most recent addition to the small list of fastenings available for Bullhead rail.

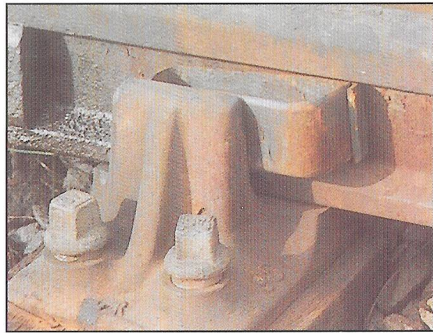
The John Bradley Bullhead Key is to be used as a replacement for other types of Bullhead fastenings. Its use faces the same restrictions as other types of steel keys when associated with use in tunnels, check rails and switches and crossing layouts.



John Bradley Bullhead Keys inserted incorrectly into a check rail



A new John Bradley Bullhead Key



Incorrectly fitting JBBH Key

Method of Insertion

There is no tool specially designed for inserting or removing the John Bradley Bullhead Key. The tapered (rounded) end of the steel key is placed into the edge of the jaw of the chair, positioned as in photo's, and tapped until it is in a position where the key can be firmly driven into its final position using a keying hammer.

Care must be taken not to over drive the steel key as this will reduce its life span, it can also place excessive pressure on the jaw of the chair causing it to break.

Care must also be taken to avoid striking the jaw of the chair with the hammer. This can lead to chair fracture, causing fragments of metal to fly into the air which may cause serious injuries.

When inserting keys into a length of rail, it may be necessary to place a rail bar into the jaw of the chair adjacent to where the wooden key is being inserted. Pressure is applied to the foot of the rail with the toe of the bar, using the jaws of the chair as a fulcrum. This positions the rail correctly into the jaw of the chair prior to the insertion of the key.

Bullhead keys should normally be driven in the direction of traffic, except at joints, where the keys on each side of the joint should be driven towards the plate. On Bi-directional lines, keys should be driven either in the direction of the main weight of traffic or in the direction in which there is a tendency to creep or, if traffic is equal in both directions and creep is not present, in alternate directions on adjacent sleepers.

Method of Removal

The steel key must be removed by using the tapered/thin end of the keying hammer to drive the key from the jaws of the chair. The steel key should be struck carefully to avoid damage to the jaw of the chair and hit until it is free from the jaw of the chair ensuring that it does not cause injury by striking it excessively hard.

SECTION 2 - Older Flat Bottom Rail Fastenings



Picture including some of the range of older Flat Bottom Rail Fastenings currently in use.

Introduction

British Rail began to use Flat Bottom Rail in quantity in the 1950's and until about 1956 it was used with jointed track on timber sleepers. Baseplates were used between the rail foot and the sleeper.

Fastenings at this time were of the 'spike' variety and used to hold both the baseplate and the rail to the timber sleeper.

When CWR was being introduced research and testing showed that the existing 'spike' fastenings were not adequate as they cannot provide long term creep resistance.

It is important to remember that 'spike' fastenings are banned where CWR is used or line speeds are higher than 75mph.

In the early days of CWR many new fastening designs were tried and used. Many stretches of this track are still in use today.



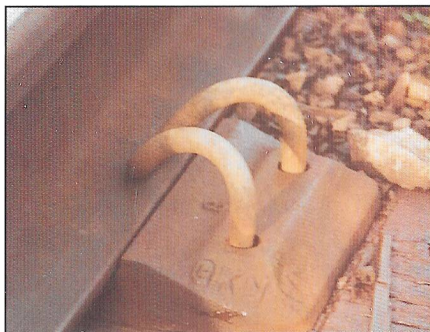
Some of the range of tools for use with Flat Bottom rail fastenings

- 1) Keying Hammer. 2) Rail Bar. 3) Spike Extractor 4) T-Spanner. 5) T-Bar. 6) Swan Neck Bar
- 7) Panpuller.

AI Elastic Rail Spike and Macbeth No. 3 Spring Spike Fastenings



AI Elastic Rail Spike



Macbeth Spike

Description

The AI Elastic Rail Spike and the Macbeth Spike can only be used with wooden sleepers and require small diameter holes to be drilled through the sleeper prior to their insertion.

For AI Elastic Rail Spikes 12mm diameter holes are drilled.

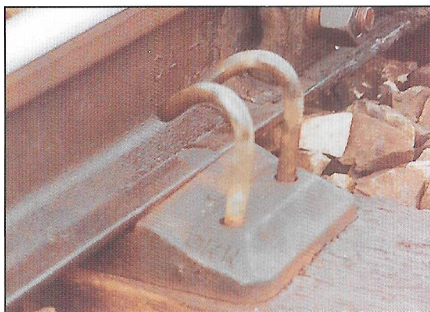
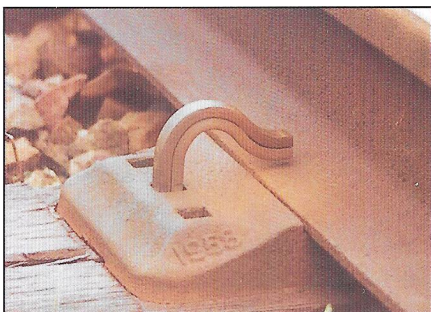
For Macbeth Spikes 11mm diameter holes are drilled.

Type AI Elastic Rail Spikes were used with 3 types of baseplate:-

1. BRI This is made of cast-iron and has six square holes, three on each side of the rail. Only three holes are used initially, the rest being used if required.
2. BRI-S The same design as the BRI but made from rolled steel
3. BR3 This had a lip to restrain the outside of the rail foot. An ASI screwspike holds the baseplate down on the outside.

On each baseplate the holes were drilled through the full depth of the sleeper and spikes are installed through the baseplate by hammer.

These fastenings are not to be used in switch and crossing layouts, on CWR or where the linespeed is more than 75mph.



An AI Elastic Rail Spike and Macbeth Spike providing no toe loading on rail

Method of Insertion

Once the correct diameter holes have been drilled in the wooden sleeper the AI or Macbeth spike is placed into the correct hole in the baseplate and driven into the sleeper with a hammer. This is done until the end of the hook for AI spikes or the toe of the curved centre section of the Macbeth spike is firmly in contact with the foot of the rail. Care must be taken not to over drive the spikes on to the foot of the rail as this will reduce the effectiveness of the fastening and may also cause damage to the rail foot. Every effort should be taken to ensure that the baseplate and the rail are not struck as this could cause permanent damage to the baseplate and rail which could ultimately lead to failure.

Method of Removal

The removal of the spikes should be carried out using the specifically designed manual tools to break the tension or corrosion on the fastening. If sleepers, rails or baseplates need changing then rail bars can be used to fully extract the spikes. Rail adjustment or sleeper squaring however can be carried out with the fastenings simply loosened.

AL 23 Maintenance Spike

This spike is only to be used as a replacement for the AI Elastic Rail Spike when the original spike or the hole drilled in the sleeper becomes worn.

It is not to be used in newly drilled holes in sleepers as it may snap causing injury to staff carrying out the insertion process.

The AL 23 Maintenance Spike, is supplied in red and black single sections. The black section fits inside the red, prior to insertion into the sleeper.



The AL 23 Maintenance spike

Low Cost (LC) Clip Fastenings

Description

The low cost clip was introduced to reduce rail creep in older sections of spiked track. This was done by drilling an extra, larger diameter, round hole into the baseplate and the sleeper. An ASI chair screw was then inserted into a steel plate and tightened down, which provided an additional grip to the rail foot and baseplate.

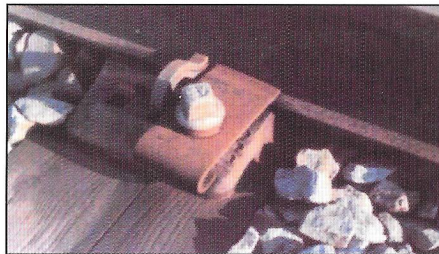
This proved an expensive and time consuming method of extending the life of the track. It required the pre-drilling/machining of a quantity of baseplates off site and then the changing of all the baseplates to be re-fastened using this method. It is no longer used, although stretches still remain in track.

Method of Insertion

A 17mm diameter hole was drilled into a softwood sleeper (19mm for hardwood sleepers) and the steel plate placed over the baseplate, with the curved sprung section on the baseplate and the flat end on the foot of the rail. The ASI screw was then placed through the hole in the steel plate and located into the hole in the sleeper. It should be tapped into a position in the sleeper where it can be tightened fully by the use of an ASI T-Spanner or Impact Wrench. It must not be fully driven into the hole in the sleeper as this will remove the effectiveness of the ASI screw in providing the additional toe loading to the rail and may split the sleeper.

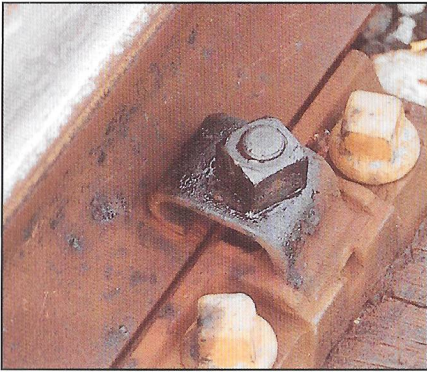
Method of Removal

The ASI screw is removed by the use of an ASI T-Spanner, or Impact Wrench.



A Low Cost Clip fitted to a BRI baseplate spike

ST Clips and KT Clips and Bolts



An ST Clip assembly



A KT Clip assembly

Both the ST and KT Clip rely on the use of a T-Bolt and steel spring clip or plate to secure the rail to the baseplate. These two types of clip assembly are mainly found in inclined Switch and Crossing layouts and are reliant on the bolt being correctly located into the specially designed housing in the baseplate. The baseplate is fixed to the sleeper by ASI screws.

The only difference between the ST and KT Clip is that the ST Clip has one curved steel clip and the KT Clip has two clip components that are fitted to secure the rail to the baseplate.

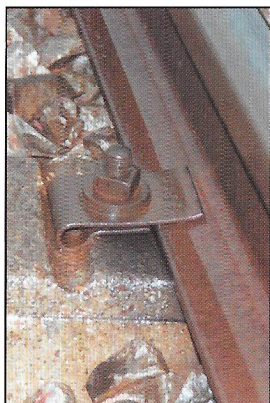
Method of Insertion

The bolt should be separated from the single or double clip and the T-shaped head of the bolt should be inserted into the baseplate housing. The bolt should then be turned through 90 degrees until it can not be lifted vertically from the housing. Prior to the fitting of the "saddle" section of the fastening it is recommended to provide some lubrication to the thread of the bolt to prevent future seizure of the bolt. Once this has been done the "saddle" section can be fitted over the bolt thread and the nut can be fitted to the bolt ensuring that it is not cross threaded. The nut is then tightened using a T-Clip Spanner, or Impact Wrench.

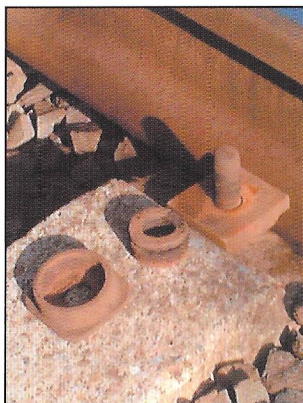
Method of Removal

To extract the clip and bolt the reverse of the insertion process is followed using the same tools or plant. Following the removal of the T-shaped section of the bolt, the nut should be re-attached to the bolt to prevent damage whilst not in use.

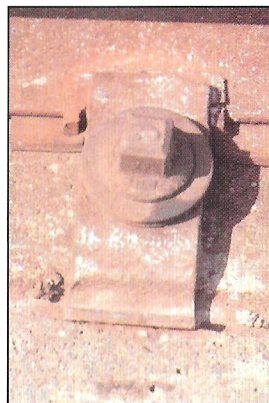
RNB, AD and RD Type Fastenings



RNB Fastening



AD Fastening



RD Fastening

The RNB, AD and RD fastenings were British Rail experimental fastenings and are now virtually obsolete. Replacement components are not now included in the NRS catalogue and spares can only be obtained by local manufacture.

Description (RNB and AD Fastening)

The RNB and AD fastening is similar to the KT or BJB fastening in that a bolt is pre-installed into the concrete sleeper and a combination of steel plate, steel and rubber washers and a nut are then used to secure the foot of the rail to the sleeper. The AD fastening provided only a limited toe loading as the contact area between the foot of the rail and the sleeper was small.

Method of Insertion (RNB and AD Fastening)

The RNB and AD fastening again used a combination of steel plate, washers and nut to secure the rail foot to the sleeper. The nut was tightened manually by use of a T-Spanner or Impact Wrench or other mechanised powered machinery. To assist with future maintenance the bolt should be lubricated prior to installation and at frequent intervals or during routine maintenance to prevent seizure of the fastening.

Method of Removal (RNB and AD Fastening)

The insertion process is reversed for removing the fastening and the nut should be replaced on the bolt to prevent damage to threads when maintenance is being undertaken, re-lubricating the bolt before re-use.

Description (RD Fastening)

The RD fastening was similar to the RNB fastening in the use of steel plates and washers as part of the fastening system. Instead of a pre-inserted bolt and nut, an ASI chair screw was inserted into a pre-inserted wooden dowel. The decay of the dowel caused the loosening and eventual failure of the fastening.

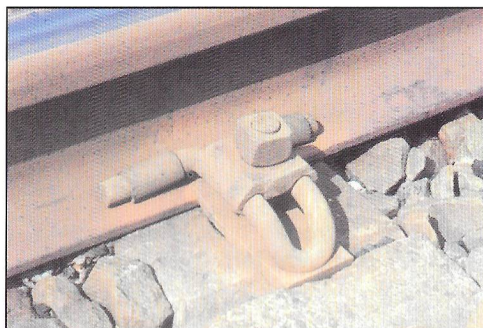
Method of Insertion (RD Fastening)

The RD fastening is a combination of an AS I chairscrew, washers and a plate that secure the rail to the sleeper. The washers are placed onto the chairscrew and this is inserted into the plate. The plate is located onto the sleeper with a rubber pad at either end to provide additional toe loading to the rail and sleeper. The chairscrew is then tightened manually using a T-Spanner or Impact Wrench.

Method of Removal (RD Fastening)

The fastening is removed from the sleeper using the same tools or plant as used during the insertion process in the reverse manner, ensuring no debris falls into the screw location as this may prevent refastening.

BJB Type Fastenings



BJB Fastening

Description

BJB fastenings again make use of a pre-assembled nut and bolt inserted directly into a concrete sleeper. A sprung steel clip, nylon ferrules, nylon insert and securing clamp are combined to provide the means of fastening the rail to the sleeper. It was fitted to F10 concrete sleepers. The sleeper dowel was made of wood and over time eventually rotted. In the 1970's many BJB sleepers were converted to a Pandrol System by drilling out the dowel and glueing in a special Pandrol Shoulder.

This conversion is no longer available.

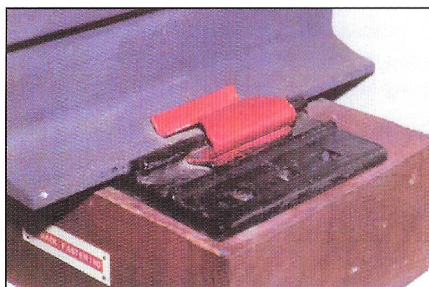
Method of Insertion

The nylon insert is placed over the bolt and the sprung steel clip with nylon ferrules and securing plate are fitted onto the bolt. The nut is then placed onto the end of the thread and this is manually tightened using a T-Spanner or can be mechanical tightened using an impact wrench or other powered plant. The thread of the bolt should be lubricated to prevent seizure and lubricant should also be applied to any exposed threads following tightening.

Method of Removal

The insertion process is reversed for removing the fastening and the nut should be replaced on the bolt to prevent damage to threads when maintenance is being undertaken, re-lubricating the bolt before re-use.

Heyback Clip Fastenings



A Heyback Rail Fastening

Description

The Heyback Clip is a mild steel plate formed into a sprung section that provides the toe loading.

Method of Insertion

The Heyback Clip is tapped into the grooves in the baseplate until it is in the final position in the centre of the baseplate, ensuring that both edges of the clip are located correctly in the grooves.

When inserting the Heyback Clip care must be taken not to damage the baseplate or the rail

Method of Removal

The Heyback Clip is removed by striking the clip in the opposite direction taking care not to damage the rail or baseplate during the removal process.

SHC Range of Fastenings

Description

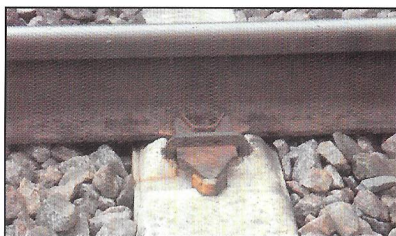
The Skull Hoop Clip range includes the Rectangular, CS3 and Chevron type of metal plate clip. The three types of clip offer the same method of toe loading on the rail and only the design of the sleeper housing is different. The system was fitted to F19 and F19A concrete sleepers.

Method of Insertion

The SHC is inserted over the outer sleeper housing and under the inner and on to a nylon insulator. The clip is then tapped into position and then driven onto the plastic insulator seated on the rail foot.

The clip cannot be over driven, though great care must be taken not to damage fastening, rail or sleeper.

Rectangular and Chevron clips are interchangeable. However, new Rectangular clips should be used in preference to Chevron clips.



CS3



Chevron



Rectangular

Method of Removal

The clip must be removed from the rail using one or two rail bars. A Swan Neck, T-Bar or Chisel Ended bar should be inserted between the rail foot and the toe of the fastening and the head of the rail is used as a lever to prise the fastening off the rail foot. Where fastenings prove difficult to remove a second "pinch" or "heel" bar can be used to lift the heel of the clip from the rear housing to assist with the removal.

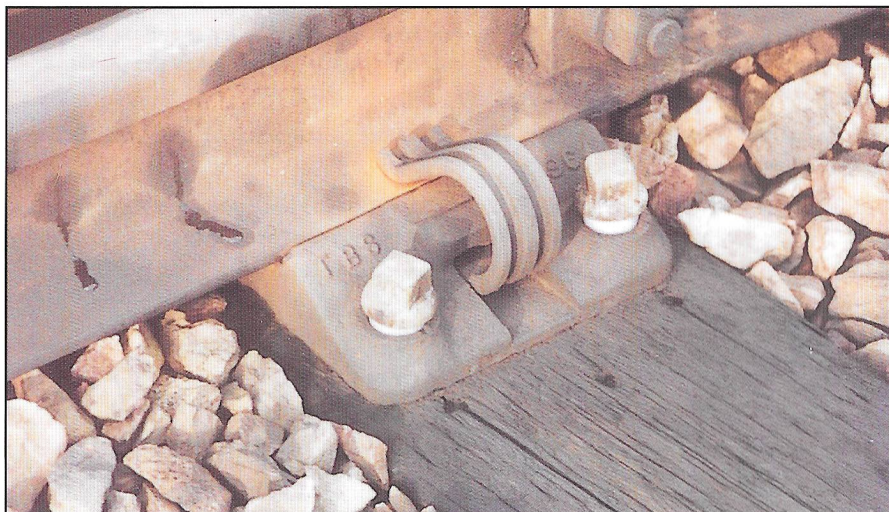
When using a bar to remove the fastening the correct stance of placing both legs apart one in front of the other on the ballast must be adopted. The bar should be pulled towards the body using the rail as a fulcrum

Mills Clips

Description

The Mills Clip is a sprung curved steel fastening and is fitted to E4 and F7 concrete sleepers using an MRC 613 baseplate.

A plastic sleeve was developed to be fitted over the end of the Mills clip to provide additional toe loading when the fastening or baseplate clip housing became worn.



A Mills clip inserted into a baseplate

Method of Insertion

The Mills Clip is placed into the baseplate housing and onto the foot of the rail. It should then be tapped into a position where it can be driven into its final location using a keying hammer. During insertion care must be taken not to damage the baseplate or rail, as this can cause injury.

Method of Removal

A T-Bar, Swan Neck or chisel ended bar should be placed between the foot of the rail and the end of the Mills clip and the head of the rail is used as a lever to remove the clip from the housing.

When using a bar to remove the fastening the correct stance of placing the legs apart, one in front of the other on the ballast, must be adopted. The bar should be pulled towards the body using the rail as a fulcrum.

LI Lock Spikes

Description

The LI Lock Spike is different to the other spikes described in this section as it does not come into contact with the rail and is only used to secure the Pan 5 or Pan 8 baseplate to the wooden sleeper.

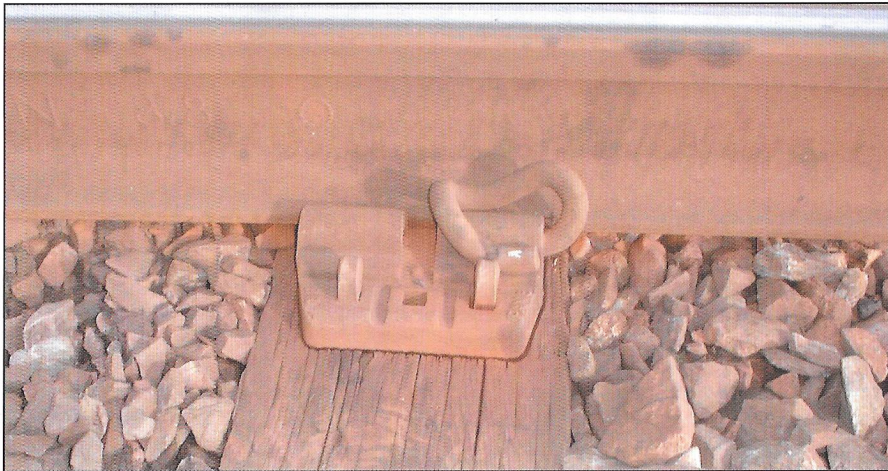
The design of the Lock Spike resembles that of a needle and the top of the shaft is compressed as the spike is inserted into the baseplate to secure it.

The following locations are particularly susceptible to failure.

1. Track with hardwood sleepers
2. Curves sharper than 800m
3. Track in wet and damp environments e.g. tunnels and cuttings

The management of such track is of high priority and reference should be made to Permanent Way Special Instruction No.11.

If fastening failure occurs, the remaining spike should be driven level with the sleeper and the sleeper 'pushed through' and the new baseplates and fastening types fitted.



LI Lock spikes securing a Pan 8 baseplate

Method of Insertion

As with AI and Macbeth spikes holes must be drilled through the sleeper before the LI Lock Spike is inserted. The holes are of 15mm diameter for hardwood and 12mm diameter for softwood. The LI is placed into position in the baseplate and located into the hole in the sleeper and then driven into position using a keying hammer. There is no specialised tool design for the Lock Spike and care must be taken not to strike the baseplate or the rail as damage can be caused and injury may occur from flying fragments of metal. The Lock Spike cannot be overdriven without damaging the baseplate and must be inserted until the shaft is no longer visible outside the hole in the baseplate.

Method of Removal

There is no tool designed specifically for the removal of the LI Lock Spike and great caution must be taken when removing the spikes from the baseplates as the fastenings are often corroded and seized into the holes. The most common practice used for the removal of the lock spike is for the rail to be unclipped from the baseplate and the rail jacked up. Two heel bars are then placed between the sleeper and the baseplate and the baseplate is levered up from the sleeper until the baseplate is free. This is repeated until all the Lock Spikes and baseplates are free from the sleeper. The baseplate can then be turned upside down and placed on the ballast where the spikes can be driven out of the baseplate, again taking care not to strike the baseplate.

There is no maintenance type replacement for the Lock Spike. If it is corroded, severely worn or unable to grip, the sleeper should be pushed through and re-gauged using new Lock Spikes.



*A severely corroded Lock Spike removed from a baseplate.
(Note the normal appearance of the head of the spike)*

The Lock Spike can be susceptible to shear failure beneath the baseplate. As failure occurs beneath the baseplate, it cannot be seen.

Titgmeyer Screws

Description

The Titgmeyer screw is used to provide additional baseplate security by inserting them into the spare baseplate holes. There is no need to pre-drill the sleeper and the screws are inserted or removed by using the special adaptor supplied with the screws and a T-spanner or an impact wrench. The Titgmeyer screw cannot be used in place of the Lock Spike.

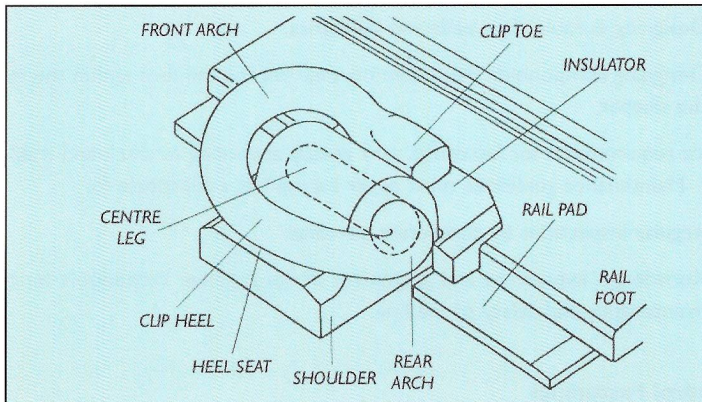


A Titgmeyer Screw

SECTION 3 - Modern CWR Fastenings

By the mid 1960's the SHC and the Pandrol fastening were the most commonly used for CWR track. In the early 1960's the Pandrol fastening was adopted as standard by the then BR.

A Pandrol clip is essentially a spring. When the clip is installed, the clip heel is deflected. This deflection generates a force, which clamps the rail, in modern Pandrol fastenings of about 10KN (or equivalent to 1 tonne). The diagram below shows a Pandrol eClip assembly and shows the names given to each part of the assembly.



Fastening Terms

With such a high clamping force being produced by a relatively small deflection, any small variation in clip dimension or shoulder height dimension has the potential to significantly change the toe load. Failure to control these dimensions means that clips will be difficult to install on site and/or correct toe load will not be achieved.

Other dimensions that affect toe load:

- (i) Compressed rail pad thickness
- (ii) Rail foot thickness
- (iii) Insulator blade thickness.

These dimensions will reduce over time due to wear and in the absence of maintenance, toe load will therefore reduce also.

Research work carried out by BR in the UK and overseas has consistently concluded that for CWR to function effectively the minimum toe load requirement from a fastening should be approximately 4KN. Action should be taken to restore the lost toe load.

Fastening designs ensure that the toe load stays in excess of 4KN for as long as possible by:

1. Beginning with a very high toe load.
2. Designing durable clips, pads and insulators.
3. Designing components that minimise wear on the rail foot and in the rail seat of the sleeper.

Maintenance requirements for fastenings vary greatly according to track and traffic conditions. Maintenance guidelines must never be used as a substitute for:

1. Regular inspections by competent personal.
2. Knowledge, experience and judgement of the Engineer responsible for the maintenance and safety of the line.

Early Pandrol Fastenings

The first Pandrol fastening used in the UK, the PR303, was made from 19mm diameter steel bar with a round toe. They were first used in 1959, in baseplates on timber as described in the table .

Baseplate	Seat Depth	Pad	Rail Pad Thickness	No + Type of Clip	Housings	Usage
PAN 1	33	YES	5.5MM EVA	2x303	2	plain line CWR on timber
PAN 2	35	YES	No Pad	2x303	2	plain line jointed track on timber
PAN 3	33	YES	5.5mm EVA	2x303	2	plain line on concrete sleepers
PAN 4	35	YES	No Pad	2x303	2	plain line on concrete sleepers
PAN 5	35	NO	No Pad	2x303	2	plain line track on timber

None of these baseplates will accept insulators. Where the baseplates had 4 housings, the left handed PR304 clips could be used at rail joints or where the housing had become worn or broken.

Maintenance of PAN1 - PAN5 Baseplates

These baseplates and clips are now upto 40 years old and will be showing signs of wear. These signs will be:

1. The round toe of the PR303 will have worked flat. The centre leg may have reduced in diameter.
2. The baseplate shoulder is likely to be galled.
3. The top of the inside of the housing will have worn.
4. The heel seat of the shoulder will have worn.
5. Rail foot gall will be present if the original rail is still fitted. The rail foot thickness will be reduced.
6. The seat of the baseplate will be worn where no pad has been used.

If the baseplate shoulder is badly galled then a new PAN 6 baseplate should be fitted.

If the baseplate can be reused then:

- PR303 clips should be replaced by flat toe PR427A clips (Mauve).
- Left hand PR304 clips should be replaced by flat toe PR428A clips (Green).
- 5mm thick EVA pads should be fitted to PAN2, PAN4 and PAN5 plates.
- 7.5 mm thick EVA pads should be fitted to PAN1 and PAN3 baseplates.

The Pandrol PR Clip

The PR401 / PR401A clip was in use on plain line from 1960 until 1984. Its most common application was on F23 and F27 sleepers along with their shallow depth equivalents.

Design toe load at installation was 6.5KN (or 650kgf equivalent)

Orange nylon insulators, designed by British Rail with 5.0mm EVA rail pads were used.

Maintenance of the Pandrol PR401 Clip

The original PR401 clip had a round toe. It was found that the round toe wore through the orange insulator relatively quickly and so it was replaced by the flat toe PR401A in 1970.



Pandrol PR Assembly for F27 Sleeper

Some PR40I clips still exist in track having been installed between 1960-1968. Unless the track has been exceptionally well maintained with the insulators replaced on a frequent basis, the round toe will have worn to a flat. Combined wear of Pandrol clips and rail seat will result in a toe load of less than 4KN.

Where PR40I clips still exist in concrete sleepers it is recommended that:

- They are removed
- New 5mm pads fitted
- Black GRN insulators fitted (Pandrol Part. No 2433 NRS Cat. No. 57/48436)
- High toe load e200I clips (mauve) fitted.

Pad and Insulator Life Expectancy for F23-F27 Sleepers

On the F23-F27 range of sleepers the orange insulator and hard 5mm EVA pads should be expected to be changed every 7-10 years. Soft pads are often installed on these sleepers but will only last 5-7 years.

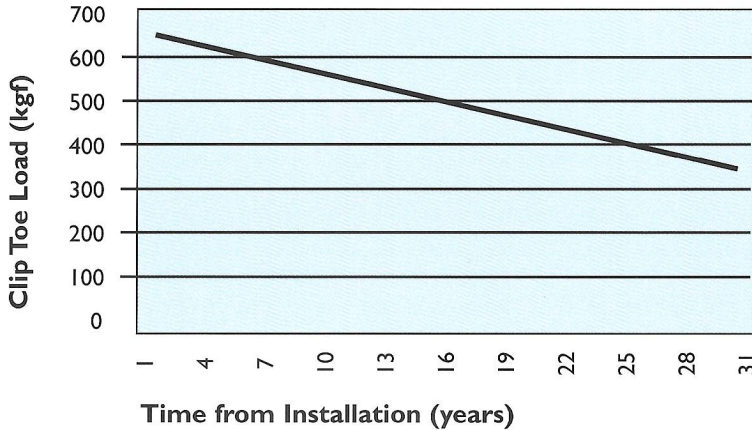
Close attention should therefore be paid to the condition of pads and insulators during track inspections. Periodically, pads and insulators should be removed for inspection. Soft pads will fail by the wearing of a large oval shaped hole in the middle of the pad. If left in, the rail will abrade the surface of the rail seat of the concrete sleeper and will lead to permanent loss of toe load. If this has happened on F23 - F27 sleepers then 7.5mm thick replacement pads should be fitted.

Orange insulators often fail by the wearing of an oval shaped hole in the top surface of the blade. Again, this reduces toe load but if it happens over a long length of track then track circuit integrity may be compromised. On tighter curves with heavy axle loads or curves with high cant deficiency the sidepost of the orange insulator is prone to crushing. Gauge is widened as a result and it is widened permanently if shoulder gall is allowed to develop. In these circumstances the insulators should be replaced with black GRN insulators (Pandrol Part No. 2433, NRS Cat No. 57/48436) and high toe load e200I clips fitted.

PR40IA Clip Life Expectancy for F23 - F27 Sleepers

Research undertaken in the 1980's by Pandrol UK and British Rail into toe load loss over a period of time shows that after approximately 26 years the toe load may have reduced to less than 4KN for a PR40IA clip (see graph opposite). Therefore clip replacement should be planned before this limit is reached. When rail is changed it is an ideal opportunity to install new clips, pads and insulators.

Clip Toe Load Reduction Over Time



Pandrol PR401A Clips for baseplates

Baseplates with PR401A clips are used in many situations.

- (i) On adjustment switches.
- (ii) On timber sleepers.
- (iii) On vertical 113A S & C
- (iv) Longitudinal bridge timbers

Poorer quality 'Grey' iron is used to make these baseplates. This type of iron tends to be very weak and therefore brittle. Many different companies manufacture the baseplates and there is variation in the dimensions of the finished items. This variation can significantly influence the toe load, ability to insert clips and may even result in the clips constantly working out of the housings under traffic.

Baseplate Component Requirements

Baseplate	Fixing	Ferrules	Baseplate Centre Line Depth mm	Rail Seat Pad	Type of Pandrol RAILCLIPS	Number of Pandrol Housings	BRB Drawing	Normal use of Baseplate
PAN 1	3-AS screws	3	33	YES	PR303 x2	4	172	Plain Line CWR wood
PAN 2	3-AS screws	3	35	NO	PR303 x2	4	173	Plain Line jointed wood
L - PAN 2	2-AS screws	2	49	NO	PR303 x2	4	62-LP-108	Plain line longitudinal timber
PAN 3	2-CS screws	2	33	YES	PR303 x2	2	174	Plain line concrete sleepers
PAN 3 A	2 Thro-bolts	None		YES	PR303 x2	2	SC-61-139-F	F type concrete sleepers
PAN 3A	2-AS screws	2		YES	PR303 x2	2	1419-61	Plain line concrete sleepers
PAN 4	2-CS screws	2	35	NO	PR303 x2	2	175	Plain line concrete sleepers
PAN 4A	2-CS screws	2		NO	PR303 x2	2	1420-61	Plain line jointed concrete
PAN 5	2-L6 Lockspikes	None	35	NO	PR303 x2	2	62-LP-37	Plain line recessed Jarrah
PAN 6	3-AS screws	3	44	YES	PR401A x2	4	255	S & C & CWR on wood
PAN L 6	3-AS screws	3	44	YES	PR401A x2	4	259	As PAN 6 but one short end for limited clearances
PAN M 6	2-AS screws	2	44	YES	PR401A x2	4	269	As PAN 6 but two short ends for limited clearances
PAN 7	3-AS screws	3	35	NO	PR401A x2	4	270	Plain Line, jointed wood for special locations and curves flatter than 800 metre radius
PAN 8	3-LI Lockspikes	None	35	NO	PR401A x2	4	252	Plain Line, jointed wood for special locations and curves flatter than 800 metre radius
PAN9/ PAN 9J	2 Thro-bolts	2 flanged	35	YES	PR401A x2	2	254 & 256	Plain Line lower category lines, CWR, recovered EI type concrete sleepers

Baseplate Component Requirements

Baseplate	Fixing	Ferrules	Baseplate Centre Line Depth mm	Rail Seat Pad	Type of Pandrol RAILCLIPS	Number of Pandrol Housings	BRB Drawing	Normal use of Baseplate
PAN9/ PAN 9J	2-SC screws	2	35	YES	PR303 x2	2	254 & 256	As above, but recovered E4 type concrete sleepers with inserts
PAN9/ PAN 9J	2-AS screws	2	35	YES	PR303 x2	2	254 & 256	Plain Line lower category on wood
CCX PAN 9-44	2 Thro-bolts	2 flanged	35	YES	PR303 x2	2	285	Plain Line continuous checking concrete (EF 30 or 31 sleeper). Flangeways 44,51,57mm available
PAN 10/10A	2-AS screws	2	35	NO	PR401A x2	4	286	Plain Line jointed wood replacement baseplates for BR1/BR3 track respectively
PAN 11	3-AS screws	3	35	YES	PR401A x2	4	287	Plain Line jointed/CWR wood as PAN 7 but with rail seat pad.
PAN 12/12A	2-AS screws	2	35	YES	PR401A x2	4	288	Plain Line jointed wood as PAN 10/10A but with rail seat pad.
CC PAN 1-44		4	40	YES	PR401Ax1 PR402Ax1	2	273	Plain Line, continuous checking wood. Flangeways 44,51,57,64mm available.
HO-PAN	2-AS screws	2	44	NO	PR401Ax1 PR402Ax1	2	276	S & C wood, half baseplate
V	3-AS screws	3	44	YES	PR401A x2	4	605	For vertical S & C.
VN	3-AS screws	3	44	YES	PR401A x2	4	710	For vertical S & C. Holes as for PAN 6
CV	3-AS screws	3	44	YES	PR401A x2	4	613	For vertical S & C. Check rails.
RCV	3-AS screws	3	44	YES	PR401A x2	4	705	For vertical S & C. Raised check rails.
PAN 14	4-A5 screws	4	35	YES	PR401A x2	2	281	Used with 6 hole IBJ's on timber
NRS 1	3-A5 screws	3	18	YES	E2007 x2	2	252	For use with CEN 60 or 113A rail

If clips work out under traffic it is usually the baseplate itself that is at fault

E-clips, however, **MUST NOT** be used in these baseplates for two reasons:-

1. The shoulder dimensions can allow the front arch of the clip to contact and cause fretting failure.
2. The high toe load of the e-clip has been known to cause sudden shoulder failure.

PAN type baseplates are not insulated and can cause problems when used on electrified lines in moist environments. Stray return current leakage can lead to severe corrosion and interference with track circuits. The use of epoxy coated S.G.I baseplates is recommended. These are fitted with substantial High Viscosity Nylon insulators and sheradised e-clips.

The Pandrol e Clip System

This system was introduced by Pandrol in the mid 1970's, the benefits are:

- (i) It was lighter and therefore easier to handle on site.
- (ii) It generated a much higher toe load of 9.5KN (compared to the 6.5KN of the PR401A)
- (iii) It was substantially cheaper

The F40 sleeper was introduced to replace the F27 sleeper because of increased linespeeds and tonnages and offered the following improvements:

1. The sleeper was strengthened to withstand the high forces produced by the wheels of higher speed trains.
2. The dynamic forces were absorbed by a 10mm thick rail pad.
3. Thicker, more durable insulators were fitted (Blue Glass Reinforced Nylon).
4. The Pandrol e-clip was fitted as standard.



*Clip Fastening assembly
as used on the F40 Sleeper*

Resilient Rail Pads

Resilient rail pads are generally used at line speeds in excess of 60mph, where forces generated by vehicles are higher. Below 60mph, 10mm thick hard EVA pads may be used. These are much more economic than the 10mm soft pads. RT/CE/S/052 gives further advice on this subject.

Soft pads on concrete sleepers allow the rail to move up and down more as the train wheels travel over the sleepers. If the wrong clip is used the extra movement may cause the clip to break through fatigue after a short period of time, especially with higher vehicle loads.

The use of soft pads in tracks with higher tonnage's and speed have been known to cause corrugation on the rail head at a faster than expected rate. The insulators are also prone to wear and fail at an exaggerated rate.

Track staff should be aware that the re-use of corrugated rail in locations with F40 sleepers and soft pads may lead to the early and catastrophic failure of the clips. This is due to the increased vertical movement of the rail as the wheels of the train pass over the sleepers. If these sites are not rapidly identified the sleeper itself may become damaged.

Therefore badly corrugated rail should never be fitted onto sleepers with soft pads.

Maintenance of the Pandrol e CLIP fastening on F40 Sleepers

The most important items with this sleeper are the pad and insulator. Previously pads from different suppliers were used with the pads lasting between 5-15 years. The Pandrol studded rubber pads have shown greater durability.

Close attention should therefore be paid to the condition of pads and insulators during track inspections. Periodically, pads and insulators should be removed for inspection. Soft pads will fail by the wearing of a large oval shaped hole in the middle of the pad. If left in, the rail will abrade the surface of the rail seat of the concrete sleeper and will lead to permanent loss of toe load.

There are no thicker maintenance pads available, therefore the avoidance of rail seat gall on F40 sleepers is particularly important.

The Blue Glass Reinforced Nylon Insulator has proven to be durable. Some are occasionally prone to brittle failure when being installed in very cold weather.

The e-clip has proven to be very durable and has a design life of 55 years before toe load reduces to 4KN.

Gauge Conversion of F40 Sleepers

F40 sleepers at 1432mm gauge can be converted to the 1436mm gauge. This is done by removing the two standard blue insulators. The field side insulator on each rail is replaced with a WHITE insulator (Pandrol Type 6924). The gauge side insulator on each rail is replaced with a BROWN insulator (Pandrol Type 7583).

Insertion and Removal of Pandrol PR and eClip Fastenings

Method of Insertion

The Pandrol PR and e clips must be inserted using a Panpuller. Using a hammer may cause damage to the rail or sleeper.

The Panpuller should be examined prior to its use and checked, at least twice a year, by using a Panpuller Hook Gauge. Pandrol hooks touching the gauge surfaces 'A' and 'C' with a gap at 'B' are suitable for use. Those only touching the gauge at 'B' and 'C' are unsuitable and should be removed from use. This check ensures that the hook of the Panpuller has a suitable flat end, which will prevent it slipping from the Pandrol clip. The results of each check should be recorded.

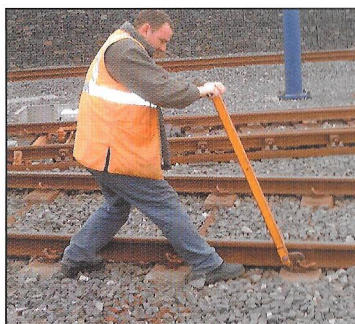
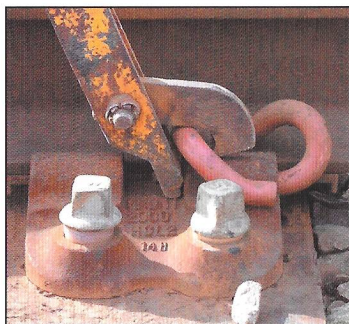
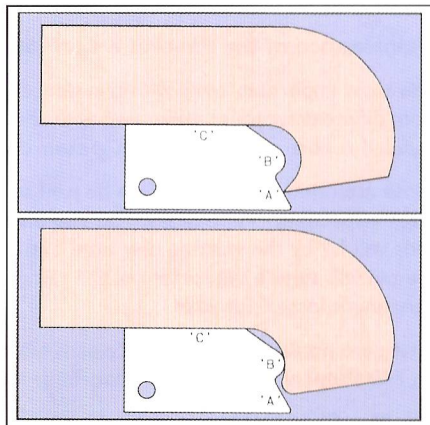
Before inserting the clip check that the insulators are correctly seated between the rail foot and Pandrol housing. This ensures that the correct toe load is achieved, correct gauge is maintained and insulators and clips will not be damaged by insertion process.

A Pansetter is used to centralise the rail and to lift the sleeper before installing a clip.

The centre leg of the Pandrol should be placed into the fastening shoulder. The Panpuller hook should be placed onto the fastening and the foot of the Panpuller behind the clip housing ensuring that both are seated correctly before applying pressure.

The correct stance should be adopted this is done by placing both legs apart, one in front of the other, on the ballast on the same side of the rail and placing both hands on the handle of the Panpuller ensuring that the feet are not liable to slip on loose ballast or other debris.

The handle is pulled towards the chest until refusal, this is the correct position of the fastening and no attempt should be made to over tension the fastening as this will reduce the effectiveness of the fastening assembly.



Inserting a Pandrol Clip

Method of Removal

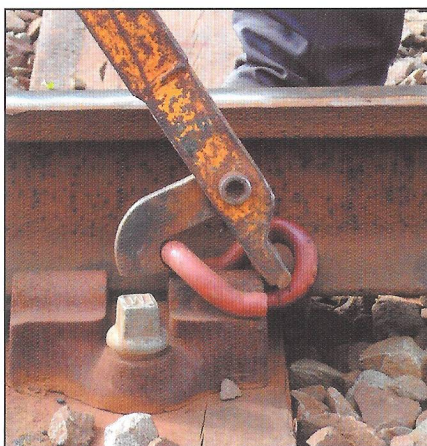
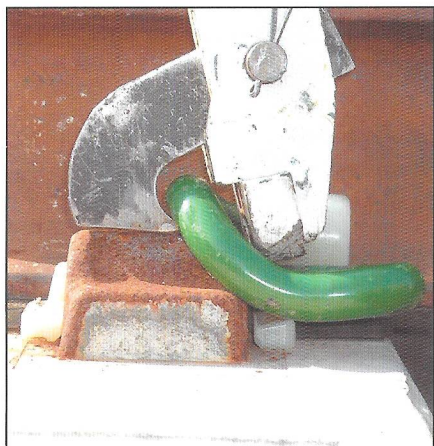
Under normal circumstances the only authorised tool for the removal of Pandrol PR and e clips is the Panpuller.

The process for the Removal of the clips is the reversal of the Panpuller. The hook is placed over the front arch of the clip and the foot of the Panpuller placed on the edge of the housing above the centre leg of the clip.

Ensure that the hook and foot of the Panpuller are securely located and adopt a stance with the legs apart one in front of the other on the ballast on the same side of the rail on firm ground to steady the balance and both hands placed on the handle of the Panpuller.

The Panpuller is then pulled towards the body until the clip is removed.

The removal of difficult or seized Pandrol fastenings is covered in Section 3



Removal of Pandrol e-Plus clip (left) and conventional PR401 clip (right)

Pandrol FASTCLIP

The Pandrol FASTCLIP was developed as a fully automated pre-assembled system using the lessons learnt from the traditional Pandrol system and it could be used with mechanised track renewals.

The first track trials of Pandrol FASTCLIP took place in Norway in 1992.

In the UK, F40 sleepers were adapted to accept FASTCLIP and the first UK installation was in the Severn Tunnel in 1993.

The first UK commercial installations were made in 1997 using sleepers designated F41 and EF36.

In 1998, the sleepers were redesignated 5F41 and 5EF36 (shallow depth).

In 1998, FASTCLIP for steel sleepers was introduced with the Corus Series 500 sleeper.

In 2000, a range of 30 tonne axle loads, dual rail sleepers was introduced. These were designated G44 and EG47 (shallow depth) for concrete sleepers and Corus Series 600 for steel.

In 2002 the FASTCLIP system for the TTS range of steel sleepers was introduced featuring pre-assembly, factory fitted hook in FASTCLIP assemblies.

Method of Insertion

The Fastclip Installation Tool should be placed with the jaws over the shoulder of the housing and the foot of the Installation Tool seated on the sleeper.

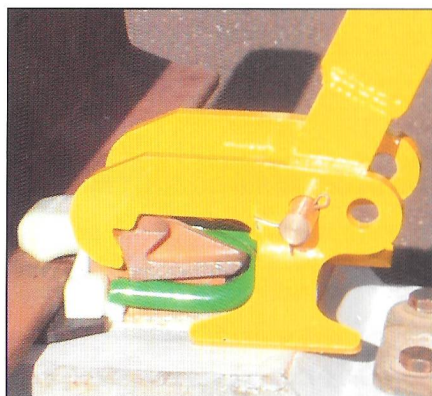
Before insertion check to ensure insulators are correctly seated between the rail foot and the sleeper. This ensures that correct toe landing will be achieved, insulators will not be damaged and clip can be inserted correctly.

The correct stance should be adopted this is done by placing both legs apart, one in front of the other, on the ballast and placing both hands on the handle of the FASTCLIP Installation Tool ensuring that the feet are not liable to slip on loose ballast or other debris. The handle is then pulled towards the chest until refusal, this is the correct position of the fastening and no attempt should be made to over tension the fastening as this will reduce the effectiveness of the fastening assembly.

Installation of FASTCLIP



FASTCLIP Installer in ready position



FASTCLIP Installed

The fully driven position allows the outer limbs of the clip to touch the insulator, as shown, or within 3mm of this position.

Clipping in Teams

When clipping long lengths of track a five man team should be used. Firstly, the sleeper is lifted at both ends. This allows both four foot clips to be installed. Both cess side clips are then installed.

Method of Removal

A Pandrol FASTCLIP Extractor must be used to remove the clip correctly.

The Extractor is placed over the FASTCLIP with the jaws located on the shoulder of the housing, the handle held back from the rail as shown, and the nose of the tool forward of the toe of the insulator.

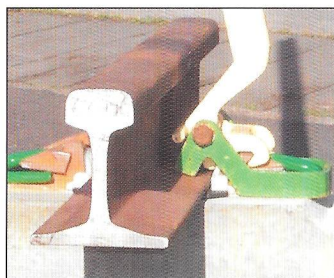
Once it is ensured that the tool is correctly located on the FASTCLIP the correct stance should again be adopted with the legs apart to steady the balance.

The handle should then be pushed until the clip reaches the backstop (parked position). This position will allow stressing or rail removal to take place.

To remove the FASTCLIP completely, continue to push on the handle. The backstop lifts and the FASTCLIP will be in a position to remove the insulator. Push further and the FASTCLIP can be completely removed from the housing.



FASTCLIP removal tool in first position



FASTCLIP in "parked position"



FASTCLIP totally removed



FASTCLIP sleeper lifter: used for lifting sleepers to rails



Staff using FASTCLIP installation equipment in a five man team

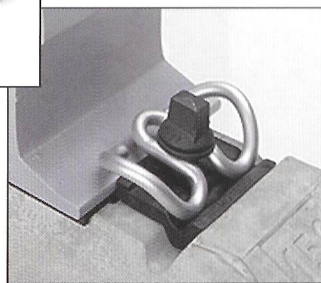
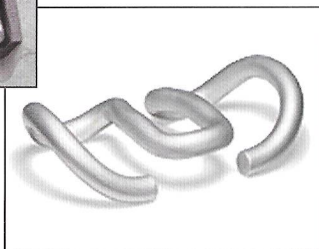
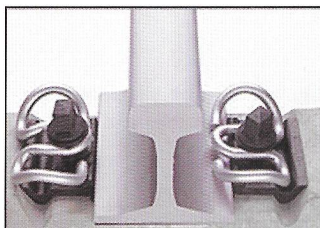
Vossloh Range of Fastenings

Description

Vossloh fastenings are the latest addition to the range of Flat Bottom fastenings used in the railway industry in the UK. Vossloh fastenings have been used in the construction of the Channel Tunnel Rail Link and have also been used in the construction of some of the Tramways in the country.

The Vossloh range covers concrete and wooden sleepers and bearers for both plain line and S&C and are also used in slab track applications.

The Vossloh fastening is a 'W' shaped sprung steel design that is made to act as a tension clamp that secures the foot of the rail to the rail pad and the guide plate.



Screw fastening assemblies of W14 and 300 systems

Vossloh W14 System (Skf 14 tension clamp) and Vossloh 300 System (Skf 15 tension clamp)

Method of Insertion

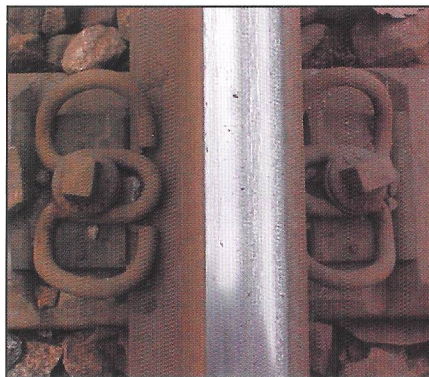
The Vossloh W14 Rail Fastening System arrives ready assembled on the concrete sleeper for improved re-laying processes whereas the 300 system does not. With the W14 the rail screw used for securing the clamp is loosened to allow the rail tension clamp to be slid forward into its correct position against the foot of the rail and the guide plate.

It must be ensured that the middle bend of the tension clamp is in contact with the rib of the angled plate prior to applying the correct tension of 200Nm to the rail screw.

The 300 system requires the screw, tension clamp and pad to be assembled on site, with the tension clamp positioned the same way on the rail and the same torque of 200Nm required .

Method of Removal

The insertion process is reversed for the removal of the tension clamp from the rail for both W14 and 300 system. The clamp should be slid back into its withdrawn position and the screw re-tensioned to 50Nm if other than minor maintenance is to take place. This will protect the fastening against damage and ensure that no debris falls into the screw insert rendering the sleeper as defective.



The Vossloh KS system is a fastening combined with a baseplate that is used on wooden sleepers and timber bearers. A screw and spring washer are required to secure the baseplate to the bearer and a ribbed section is provided to hold the rail to the correct gauge.

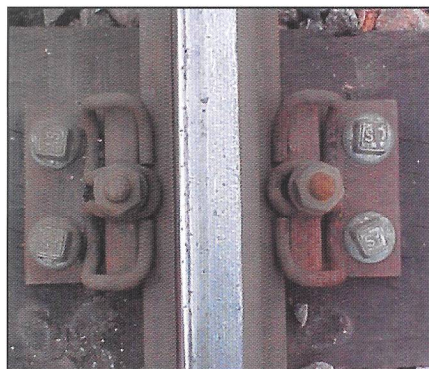
Vossloh KS System (Sk112 tension clamp)

Method of Insertion

The bolts are inserted into the ribbed section of the baseplate and the Sk112 tension clamp is then positioned correctly on the rail foot. The securing nut and washer are then fitted and tensioned to the required torque of 200Nm.

Method of Removal

The nut and washer are removed from the bolt by loosening by hand or machine. The tension clamp can then be removed fully and the nut and washer replaced on the bolt and slightly re-tensioned to prevent damage occurring during maintenance or renewals work.



SECTION 4 - Approved Manual Rail Fastening Insertion and Removal Tools

Fastening Type	Rail Type	Manual Insertion Tool	Manual Removal Tool	Mechanised Tools Available
Bullhead				
Wooden Key	BH	Keying Hammer	Keying Hammer	No
Steel Key	BH	Keying Hammer	Keying Hammer	No
Panlock Key	BH	Panlock Puller	Panlock Puller	No
JBH (SNCF)	BH	Keying Hammer	Keying Hammer	No
Flat Bottom				
BRI Spike	FB	Keying Hammer	Spike Extractor Pinch Bar	Yes (removal)
Macbeth Spike	FB	Keying Hammer	Pinch Bar	Yes (removal)
SHC Clip	FB	Keying Hammer	T-Bar	No
SHC 'V' Clip	FB	Keying Hammer	T-Bar	No
Heyback Clip	FB	Keying Hammer	Keying Hammer	No
Mills Clip	FB	Keying Hammer	T-Bar	No
Vossloh Screw/Nut	FB	T-Spanner with Torque check	T-Spanner with Torque check	Yes
ST/KT Bolt	FB	T-Spanner	T-Spanner	Yes
Pandrol PR Clip range	FB	Pandrol Panpuller	Pandrol Panpuller	Yes
Pandrol 'e' Clip range	FB	Pandrol Panpuller	Pandrol Panpuller	Yes
Pandrol Fastclip	FB	Pandrol Fastclip Insertion Tool	Pandrol Fastclip Extraction Tool	Yes

SECTION 5 - Mechanised Methods

Fastening Type	Mechanised Insertion Plant	Mechanised Removal Plant
Bullhead Fastenings	none	none
Spike	none	Hydraulic Spike extractor
Low Cost (LC) clip	Impact Type Wrench	Impact Type Wrench
ST & KT clips	Impact Type Wrench	Impact Type Wrench
AD & RD fastenings	Impact Type Wrench	Impact Type Wrench
BJB fastening	Impact Type Wrench	Impact Type Wrench
Heyback Clip	none	none
SHC fastenings	none	none
Mills Clip	none	none
Pandrol PR & e-clips	Enerco P5 clipping machine. Permaquip clipping machine	Enerco P5 clipping machine. Permaquip clipping machine
Pandrol Fastclip	Range of machinery	Range of machinery
Vossloh fastenings	Impact Type Wrench	Impact Type Wrench

Machines for Pandrol FASTCLIP

Pandrol FASTCLIP can easily be clipped and unclipped by machine.

Training and certification is required in order to operate each machine.

The types of machine available are described below:

Attachments for High Output Renewal Trains

These are mounted behind the rail threading units of High Output Track Renewal Trains. They automatically sense the presence of a sleeper and drive all four clips simultaneously. For maximum effectiveness the unit should be placed as close to the axle as possible. The axle load will then push the rail fully home into the railseat.



Self Propelled Machines

These are wanderlead operated. They lift up low sleepers with a powerful centrally mounted clamp and paddles will drive all four clips simultaneously.



Single Rail Machines

Machines such as the Geismar API I will clip and unclip sleepers and are used for stressing.



Road/Railer Attachments

These machines will clip and unclip and are also fitted with sleeper lifting grabs. They are used on renewal and stressing operations.



SECTION 6 - Insertion and Removal of Pandrol Clips in Problem Sites

The removal of difficult or seized Pandrol PR and e clips has been a constant problem in certain areas :-

- Station approaches
- Platforms
- Tunnels
- Coastal areas.
- Areas of heavy train braking
- Heavy dust pollution
- Level Crossings

The improvement in design from the original round shaped Pandrol housing to an elliptical shape has in some ways reduced the risk of fastening seizure and the development of a sheradised coating for Pandrols has reduced the risk further. This has not fully removed the problem of the seizure of fastenings and other preventative methods can be used.

Method of Removal

In isolated cases where the removal of Pandrol clips can not be carried out by the use of the Panpuller, it is recommended that the Pandrol be removed using one of the tools below.

- PANDROL Rusty Clip Extractor
- Panther Impact Tool
- Factaire Impact Tool

If these fail, as a last resort the Pandrol clip may be loosened with a hammer prior to the final extraction using the approved Panpuller.

Under normal circumstances the use of hammers for the removal for Pandrol fastenings is prohibited (PWSI 7) and a hammer must only be used as a last resort using the guidelines set out below.

Staff performing the task must wear full face protection in addition to the P.P.E. normally required on site.

All other staff must stand a minimum of 20 metres clear of the removal process to prevent the risk of injury from clips 'flying' unexpectedly from the housing.

In cases where the Pandrol clip can not be removed by this method the clip should be cut off at the rear arch and the remaining centre leg removed using a drift hammer.

If this can not be done the sleeper(s) or baseplate(s) should be changed at the first opportunity to allow the rail to be re-fastened correctly.

Repetitive hammering on the clip will cause the sleeper to split or the baseplate to shatter.

In known problem areas the Pandrol clip / housing edge should be treated with an approved corrosion penetrant prior to the work.

Method of Insertion

When inserting or replacing clips in known problem areas preventative methods should be used to avoid a re-occurrence of corrosion. Sheradised coated clips are available for all standard Pandrol clip fastenings and can be used as a replacement.

Approved lubricants, freeing agents and sealants are also available from many of the industry's leading suppliers and can be applied prior to or following insertion of the clip to assist with the prevention of the onset of corrosion..

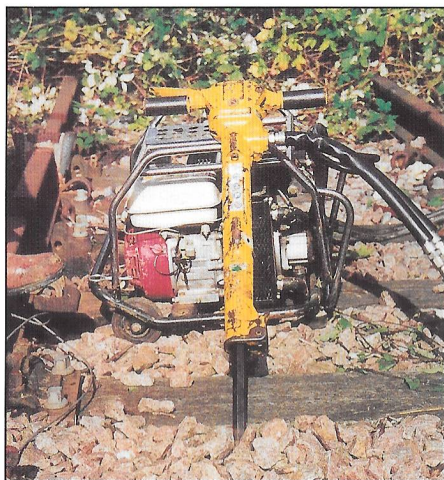
In the most contaminated areas both treatments are recommended to remove the risk of future problems arising with seized fastenings.



*The Pandrol Rusty Clip Extractor
for removal of frozen clips from concrete
sleepers*



The Factaire Impact Tool in use



The Panther Impact Tool and Generator

References

- Track Maintenance Handbook - Part 1 - Plain Line CEC/C/005
- Track Construction Standards - RT/CE/S/102
- Track Maintenance Requirements - RT/CE/S/104
- PWI British Railway Track Volume 4 (Plain Line Maintenance)
- PWI British Railway Track Volume 5 (Switch and Crossing Maintenance)
- Permanent Way Special Instruction - PWSI 7
- Permanent Way Special Instruction - PWSI 11
- PANDROL Track Fastenings User Guide
- PANDROL FASTCLIP Track Installation Guide
- PANDROL Wallchart for Dual Rail Sleepers

Notes

