

INSULATED RAIL JOINTS (IRJS)

CIVIL ENGINEERING



Produced by Civil Engineering Conference
For use by all railway civil engineering staff

CEC/DG/009
Issue 1
April 2001

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Produced for Civil Engineering Conference by:

AMEC Rail
AMEY Rail
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In conjunction with Railtrack plc

Printed by Heron Press, Kings Norton, Birmingham. Telephone: 0121 433 5100



Contents

SUBJECT	PAGE
Introduction	2
The Track Circuit Failures	2,3,4,5,6
Types of Insulated Joints and location applications	7,8
Handling Prefabricated Joints	9
Installation of Joints	10,11
Maintenance of Insulated Joints	12
Periodic Inspections	17
References	17

Introduction

Track circuits are provided to enable the signalling system to detect the presence of trains. The majority of track circuits employ Insulated Rail Joints (IRJs) that provide electrical isolation between the ends of two track-circuited rails. IRJs are an integral part of track circuits.

Track Circuit Failures

Failure of a Track Circuit can occur due to IRJs not providing electrical isolation. This will cause the two rails to be electrically connected and the Track Circuit will fail. This may prevent a signal from clearing or the signaller from operating a set of points

Lipping of the rail due to **‘rail end batter’**. This causes the two rails to make electrical contact via the lip. This is usually not a problem in the winter months when the joints tend to open due to thermal contraction. Expansion of the rails and consequent closure of the joint during the summer months could cause the two rails to make electrical contact. This causes the track circuit to fail.



Figure 1 Lipping of the rail ends due to normal traffic.

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Also note the plastic pieces that have been inserted into the top of the fishing surface to lift the rail end on the left-hand side because of the differing rail profiles. In this case Insulated lift plates should be used.

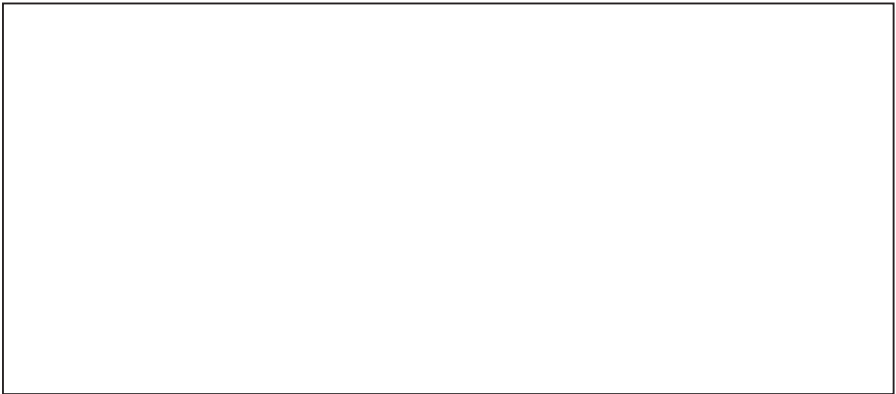


Figure 2 ‘T Piece’ (End Post) Broken and damaged insulation.

T-piece (end post) broken (see Fig 2). On rail expansion, should this be missing or damaged, the two rails could make an electrical connection causing a track circuit failure. The Vortock rail clip (Fig 4) if fitted will help to prevent a broken end post from falling completely out thus reducing the likelihood of this happening.

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If it is not possible to renew a standard end post due to the stress in the rail a temporary two piece end post is available that may be of use in this situation. (Fig 3)



Figure 3 Cooper & Turner Temporary (T Piece) End post



Figure 4 Vortock Rail clip

Failure of fishplate shells / liners / insulation (see Fig 5). If these become worn/damaged electrical contact can occur between each rail and the fishplate.



Figure 5 failure of fish-plate shells / liners - insulation's

If the bolt ferrule / insulation is missing or failed, electrical contact can occur between one rail and a fishplate without causing a track circuit failure. However further bolt insulation failure on the adjacent rail will cause electrical contact to be made between the two rails and give rise to a track circuit failure.



Figure 6 Incorrect sleeper spacings, note that the spare housings look correctly positioned. Pan 14 baseplates would alleviate this problem.



Figure 7 Benkler 4 Hole Nylon Encapsulated Joint.

The fitting of undersized bolts as a replacement for broken bolts in cold weather leads to increased internal clearance within the joint. During the subsequent warmer weather a combination of thermal expansion of the rails and increased internal clearance leads to end post crushing and ultimately a track circuit failure. Also note the slight bulging of the plate on the running off side which may indicate an internal fracture in this type of plate.

Some IRJ's have insulation ferrules through both fishplates, other IRJ's have insulation ferrules in the rails.

The insulation through the bolt hole ferrules may become cracked or damaged as a result of vibration or over tightening. Should moisture ingress into the joint, a current leakage path may occur to short out the rails, causing the track circuit to fail.

Types of Insulated Joints

The following lists of glued insulated joints are currently in use on Railtrack's Infrastructure. The joints are listed in strength order (if assembled correctly).

Glued Joints

- MkIII 6 hole prefabricated joint
- MkIII 4 hole prefabricated joint

Non Glued Joints

- 6 hole nylon encapsulated
- Burns (fitted without adhesive)
- Treble Six Nylon
- 4 hole nylon encapsulate
- Permalli Laminated Hardwood



Figure 8 Treble Six Nylon Joint (In a poor condition).

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New & Replacements joints

The recommended type of joints for all plain line (CWR) applications on new installations are:

The six-hole Shop produced BR MK III glued insulated rail joint.

- Note: On curves less than 600m they should be pre-curved.

In jointed track and Switches & Crossings the Burns, Benkler, Treble six or Permali joint may be used.

- Note the Permali joint should not be used in CWR and strengthened S&C.



Figure 9 6-Hole prefabricated joint replaced using a 4-Hole Benkler
The above practice should only be used as a temporary repair. The increased flexibility in the 4 hole joint in relation to 6 hole may lead to the generation of a twist.

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Four-hole dry joints may be installed as a temporary maintenance expedient in CWR when a glued joint is not available (See fig 9). In this case they must be replaced by the glued six-hole type at the earliest opportunity. The Burns MKII, Benkler & Treble Six insulated rail joints fitted without adhesive are all suitable.

- Note 4 hole insulated joints are only permitted in plain line for line speeds up to 90mph.
- The use of 4 hole IRJ are not permitted in CEN 60 rail.

It should be noted that if a dry joint replaces a glued joint using the existing rails, then the rail ends must be thoroughly cleaned as lumps of old adhesive will lead to premature joint failure, due to a poor fit.

In switch and crossing work four hole joints may be used where bearer or baseplate design prevents the use of six-hole glued joints. The Burns MkII, Benkler or Treble Six insulated rail joints fitted without adhesive are all suitable in this situation.

Handling of Prefabricated Insulated Joints (MkIII 4 & 6 Hole Glued)

Prefabricated insulated joints can be damaged prior to installation if handled incorrectly. Upon receipt from the manufacturer, the joints must be adequately supported during handling using a **rail lifting beam** and stored on **timber battens or blocks** which allow a free flow of air around the joint.

Joints should only be lifted using a rail beam during loading and unloading on delivery to site. When the joint is on or close to site then rail scooters / ironmen etc. may be used, provided that the joint is lifted at the designated lifting points as marked.

Installation of Insulated Joints

Code of practice (CEC/C/0005) Track Maintenance Handbook Part 1 Plain Line onwards advises on the installation of prefabricated insulated joints. Installation will be more easily achieved if: -

- A) Prior to the installation of the joints (i.e. when the previous joint is still in track) five sleepers either side of the proposed new joint centreline are renewed and re-spaced to the correct position and packed.
- B) The joint is moved at least two sleeper bays from its original position. This needs to be agreed in advance and signalling arrangements approved by the Signal Engineer responsible.
- C) Prior to installation the joint should be tested to determine its electrical resistance. If the joint fails the test, it shall be clearly marked as such and **on no account** must this joint be used in the track.

Note: Care should be taken when using tools, shovels, steel measuring tapes or any other conductive materials in the vicinity of IRJs not to accidentally short circuit the joint causing the signal in the rear to change aspect.

Site made joints

All joints should be fitted in accordance with the manufacturer's instructions.

When renewal of the end post becomes necessary, it must be trimmed off to the existing railhead profile, failure to do so will result in damage to the new end post.

When installing a pair of new joints or a new joint opposite an existing, they should be as square as possible. (See Fig 11)

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It is essential that all bolts are correctly tightened to a torque of (650 ft/lbs) in the order described in Fig 10. It is also essential that they are check tightened within 7 days as part of planned maintenance. At this stage a proprietary thread-locking product may be applied. These joints are particularly prone to bolt loosening during the initial bedding in period. This can reduce the life of the joint if left unchecked.

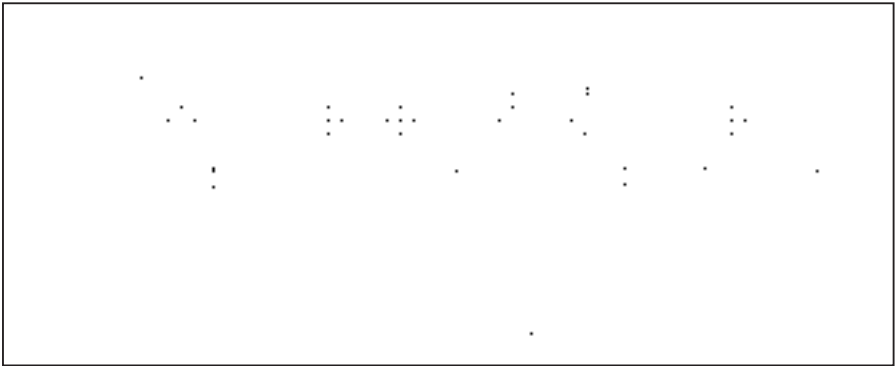


Figure 10 Torque tightening sequence

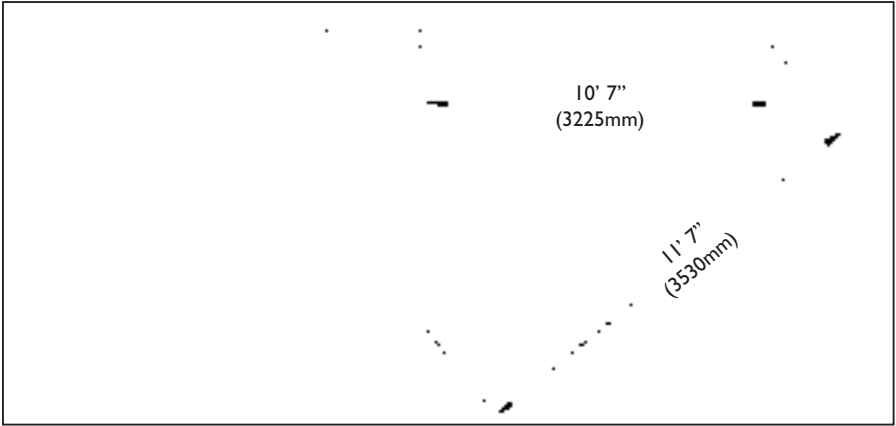


Figure 11 Method for squaring off a joint

Maintenance of Insulated Joints

The presence of the insulating liner in all insulated joints makes the joint less stiff than a conventional fishplated joint and considerably less stiff than the adjacent rail. This leads to more rapid deterioration of the ballast in the vicinity of the joint than occurs in plain line. If those effects are to be minimised, joints must be inspected regularly and the operations described in the following sections carried out when found necessary.

Rail End Lipping

Rail end lipping is the largest single cause of insulated joint failure during the summer months. All insulated joints must have any lipping removed prior to the onset of the hot weather period (e.g. January to April) leaving a chamfer on each rail end. Care should be taken to prevent any metal particles from entering the joint (See Fig 12 & 13).

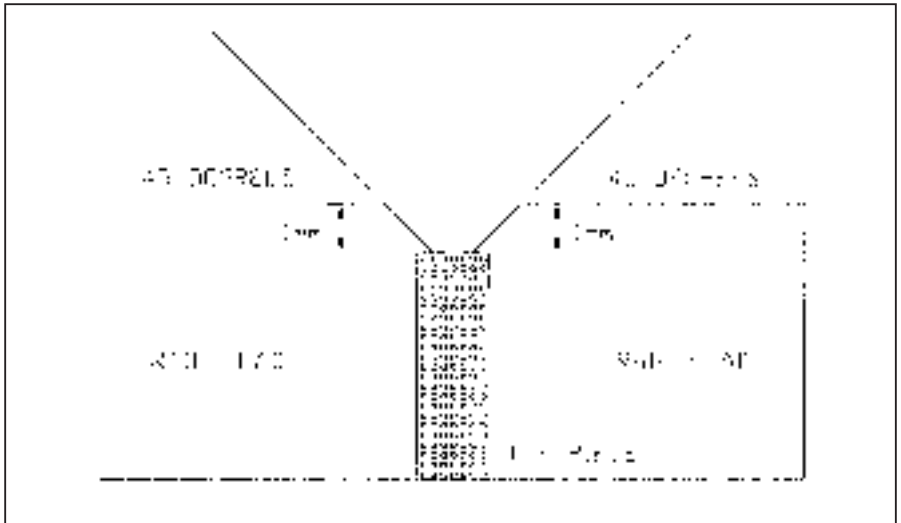


Figure 12 Rail end lipping removal.

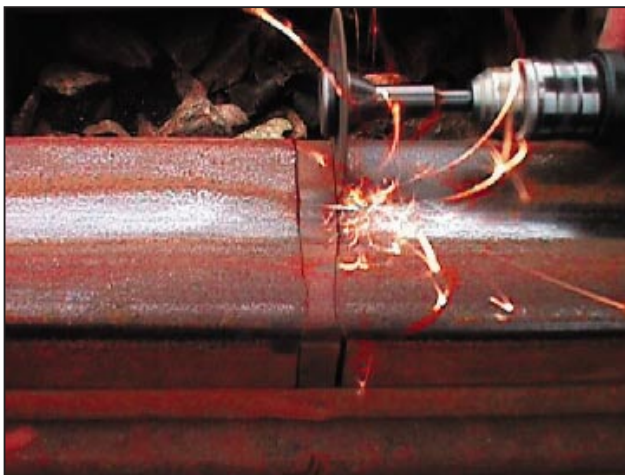


Figure 13 Votok IRJ Trimmer

Fishbolt Tightening

All fishbolts must be checked for tightness at every inspection particularly at the onset of spring and at the end of summer. This will help prevent closure in summer and pulling apart in winter. Burns & Treble six joints have nylon insulating liners that are prone to creep under load leading to bolt relaxation and are therefore particularly troublesome. It is essential that the bolts are kept tight. The use of locking washers like the Nord-Lock or Vibro-Lock washers will help prevent bolts becoming loose.

Fastenings / Pads / Insulators

Sleeper fastenings, Pads and Insulators at joints (i.e. three sleepers on either side) are subjected to higher vibration than the rest of the rail. In some cases this can give rise to premature failure. It is recommended that these components are changed more frequently.

Sleeper Packing

Insulated joints require attention to rail top level at a higher frequency than other locations in the track. Restoration of rail top to acceptable standards should be achieved by sleeper packing. All ballast used must be clean and following work must be properly consolidated and the cribs and shoulders restored to the correct profile. Rail end lipping, insulation failure and local ballast failure are all caused by poor rail top and sleeper voiding. Early intervention will help to avoid rail end lipping.

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Where joints require constant attention due to dipping, consideration should be given to repositioning of the joint, local reballasting five sleepers either side of the joint and complete renewal of the IRJ. (Note Rail joint straightening must not be carried out on prefabricated joints).

Broken / Cracked IRJ

With encapsulated joints a slight bulging at the top of the fishplate area associated with a dip in the joint may indicate an internal fracture, if this is suspected the joint should be observed under traffic. It may be possible to detect fractures of encapsulated fishplates using non-destructive techniques i.e. using (Eddy Current). *Note this would require the removal of the fishplates.*

The minimum action to be taken upon the discovery of broken or cracked fishplates in a running line are as follows, further information can be found in RT/CE/S/104. Track Maintenance Requirements.

Defect	Minimum Action
One fishplate Broken	● Impose 20mph ESR ● Replace both fishplates within 24 hours
Both fishplates broken	● Impose 5mph ESR until emergency emergency clamp plates are fitted ● Replace both fishplates within 24 hours
One or both fish plates cracked	● Replace both fishplates within 24 hours

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Notes

1. These minimum actions apply to all types of fishplates between all rail sections.
2. Where there is any doubt as to the ability of the two sleepers or bearers either side of the joint to hold the rail(s) to line and level and gauge where the fishplates are broken, it will be necessary to either
 - provide additional or alternative support to the rails, or
 - block the line until the fishplates are changed and any defective sleepers or bearers are replaced.
3. All other components used in the affected joint(s), e.g. insulating liners, must be replaced at the time the fishplates are changed.
4. Where present, the joint in the opposite rail must be complete, well supported and with intact fishplates to enable trains to be passed over the joint. If both joints have broken fishplates the line must be blocked until the fishplates are replaced.
5. The cause of the broken or cracked fishplates should be ascertained and action taken to prevent a recurrence.



Figure 14

Sleeper Spacing

The joint sleepers (three sleepers either side of the joint) should be correctly spaced. Sleepers should be of the same type (incorporating the same type of fastenings and rail pads) on each side of the joint. Special attention must be given to this when repositioning joints. The following distances from the centre of the joint to the centre of the first sleeper should be employed.

Distances from centre of joint to centre of first sleeper.

Jointed Track

Bull Head 24 sleepers per 60ft	305mm
Bull Head 26 sleepers per 60ft	318mm
Flat Bottom 24 sleepers per 60ft	318mm
Flat Bottom 26 sleepers per 60ft	318mm

CWR

Flat Bottom 26 sleepers per 60ft	315mm
Flat Bottom 28 sleepers per 60ft	315mm

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Glue Failure

Any gap in a prefabricated glued joint (between the liner and rail or liner and fishplate) indicates a glue failure and should be reported to the local supervisor/manager who should arrange for its replacement at the earliest opportunity.

Periodic Inspection

Joints should be specifically inspected at least once per year by a competent person (between Jan & Apr) the results of such inspection should be recorded. From this process, the joints can be prioritised and changed as necessary. It may also be appropriate to carryout an additional inspection (between July & Sept) as part of cold weather preparations.

References

Line Standard RT/CE/S/104: Track Maintenance Requirements.

Code of Practice CEC/C/0005: Track Maintenance Handbook. (Part 1 & 2)

Line Standard RT/CE/S/102: Track Construction Standards.

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