INSULATED RAIL JOINT

1. INTRODUCTION

It is well known that with the increase in passenger traffic there is increased reliance on the Railways as a mode of travelling. Since the traffic has increased to gigantic proportions it has become necessary to run more number of trains, for longer distances. Therefore it becomes essential that safety in running trains have also to be given due attention.

Failure to give due importance to safety considerations proves to be disastrous. Complete safety is achieved by employing improved signalling techniques and adopting various safety devices.

Track circuiting is one of the proven and simple signalling techniques employed for this purpose. In a track circuit, a portion of rail track is electrically isolated from adjoining rails and included in a circuit to energise a relay. The occupation or vacancy of the track portion is detected by the condition of track relay. The length of the track confined within one track circuit depends on its working feasibility and the required separation between two running or stalled vehicles on the track.

A schematic diagram of a DC Track Circuit is shown in figure No.1 below:

![Fig No. 1]
As shown in figure 1, the components of a DC Track Circuit are:

(a) Battery
(b) Adjustable Resistance
(c) Track Relay
(d) Track Lead Cables
(e) G.I. wires connecting cables to the rails
(f) Continuity Rail Bonds
(g) Insulated Rail Joints

The track portion to be detected has to be electrically isolated from adjoining rails so as to block the track circuit current, within its boundaries by providing “Insulated Rail Joints or Block Joints” at each end of the track circuit.

In general Insulated Rail Joints or Block Joints are required at the boundaries of the Track Circuit and at Point & Crossings where the polarity of Track Circuit is to be changed.

Note: Insulated Rail Joints are not required in case of Coded Track Circuits such as ‘Audio Frequency Track Circuits’ and High frequency Track circuits.

2. TYPES OF INSULATED RAIL JOINTS

Three types of Insulated Rail Joints or Block Joints are presently in use as given below:

(a) Insulated Rail Joints Class ‘A’
(b) Insulated Rail Joints Class ‘B’
(c) Insulated Rail Joints Class ‘C’

2.1. INSULATED RAIL JOINT CLASS “A”

These Insulation Joints are made of a special type of wood and used in Yards where the speed of trains are slow.

2.2. INSULATED RAIL JOINT CLASS “B”

These Insulation Joints are made up of Nylon 66. These are also called as NYLON INSULATED RAIL JOINT.

2.3. INSULATED RAIL JOINT CLASS “C”

These are also called as GLUED INSULATED RAIL JOINTS. These are procured or manufactured by Engineering department and mostly used in main line for high-speed trains.
3. NYLON INSULATED RAIL JOINTS

In this type, insulation components are supplied by the S&T department, which have to be inserted in the rail joint by Engineering department when track circuit is being installed and also during replacement whenever they get crushed under traffic resulting in insulation failure. To prevent failures of track circuit under normal conditions block joint insulation is checked electrically by means of a meter by the S&T staff according to a time schedule.

The metallic components of the rail joints as supplied by the Engineering department for this purpose are not the usual ones. The fish plates are planed so as to accommodate insulation liners between the rails and themselves. The fish bolts have to be of 140mm length instead of 115mm. Also four steel backing plates have to be provided for support over the nylon backing plates held by fish bolts.

3.1 COMPONENTS

The following insulation components are required for one Nylon Insulated Rail Joint:

<table>
<thead>
<tr>
<th>Sr.</th>
<th>COMPONENT</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Fish bolt &amp; Nut</td>
<td>4 Nos</td>
</tr>
<tr>
<td>2.</td>
<td>Bush</td>
<td>8 Nos</td>
</tr>
<tr>
<td>3.</td>
<td>Backing Plate</td>
<td>4 Nos</td>
</tr>
<tr>
<td>4.</td>
<td>Insulating Plate</td>
<td>4 Nos</td>
</tr>
<tr>
<td>5.</td>
<td>End Post</td>
<td>1 Nos</td>
</tr>
<tr>
<td>6.</td>
<td>Right Hand Side Channel</td>
<td>2 Nos</td>
</tr>
<tr>
<td>7.</td>
<td>Left Hand Side Channel</td>
<td>2 Nos</td>
</tr>
<tr>
<td>8.</td>
<td>Fish Plate</td>
<td>2 Nos</td>
</tr>
</tbody>
</table>

COMPONENTS OF A JOINT
Fig. No. 2
CROSS SECTION OF AN INSULATION JOINT

Fig. No. 3

COMPLETE NYLON INSULATED RAIL JOINT

Figure – 4
These insulation components are available in different sizes to suit different sections of rails viz, 60 kg, 52 kg, 90R, 75 R.

Proper components only shall be used according to rail sections. Even left hand side channels and right hand side channels shall not be interchanged after locally sizing them up to avoid insulation breakdown on these joints.

Certain precautions have to be taken while installing and maintaining these block joints as detailed below:

1. The Rail ends at these joints shall be cut straight as otherwise, the nylon end post may break very quickly.
2. All the holes on the rails shall be drilled at the same height.
3. The holes in the rails and in the fish plates shall be in correct alignment. Bolt shall not be forced in to the rail. Bolt shall not be bent and pushed in as the bushes can thus get crushed.
4. Rail chairs are replaced by steel bearing plates on one sleeper each holding rails on either side of the joint. These plates shall be fixed sufficiently clear of rail ends to avoid their short-circuiting.
5. Dog spikes that hold the bearing plates on to the sleepers shall not touch the fish plates and they shall be driven tightly in the sleepers.
6. Packing of at least three sleepers on either side of these joints shall always be good and no water logging shall be allowed near them.
7. The fish bolts of these joints should not roll due to swing under the traffic. For this, the steel backing plates shall be properly bent on this side to hold the nuts and bolt heads.
8. At least one rail length on either side of insulated rail joint should be provided with anti-creep devices.
9. Special type pandrol clips (‘J’ type) shall be provided at insulation joints to avoid touching of pandrol clips with the fish plate.
10. Pandrol clip should be provided in reverse position. The small part of pandrol should be towards fish plate.
11. If top portion of end post is above the Rail head, the extra portion should be removed by using hack saw. It should never be clipped off by using hammer.

3.2 TESTING

Since the Insulated Rail Joints are inserted to break electrical continuity of the Rail, the joints should ideally offer infinite resistance. Practically it is not possible so that continuity test is performed with the help of a multimeter. Multimeter should not show continuity across the joint, between fish plate & bolt and between fish plates. Resistance of a joint should not be less than **1000 ohm.**
3.3 CAUSES OF FAILURE

Failure of insulated rail joints are mainly due to following reasons:

- Crushing of bushes
- Crushing or Jamming of end posts
- Damage of side channels
- Short circuiting of insulation block joints by Permanent Way Keys, Dog spikes, Bearing plates, chairs or washers of anchor bolts on girder bridges.
- Short circuiting of the insulation joints due to deposition of iron filings/dust fallen from brake shoes.

4. GLUED INSULATED RAIL JOINTS

Glued joints are being increasingly provided on Railways to avoid failures of insulation joints particularly those in long welded rails.

There are two types of glued joints as given below:

1. G3(L) types : It has six bolts.
2. G3(S) types : It has four bolts

These glued joints can be manufactured from different rail sections as per drawing numbers given below:

<table>
<thead>
<tr>
<th>End Post Thickness</th>
<th>Rail Section</th>
<th>Drawing No.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>G3 (L) Type</td>
</tr>
<tr>
<td>6mm</td>
<td>1. 75R</td>
<td>RDSO/T-1283</td>
</tr>
<tr>
<td></td>
<td>2. 90R</td>
<td>RDSO/T-1276</td>
</tr>
<tr>
<td></td>
<td>3. 52 kg</td>
<td>RDSO/T-671</td>
</tr>
<tr>
<td></td>
<td>4. 60 kg (UIC)</td>
<td>RDSO/T-2572</td>
</tr>
<tr>
<td>10mm</td>
<td>1. 52 kg</td>
<td>RDSO/T-5361</td>
</tr>
<tr>
<td></td>
<td>2. 60 kg (UIC)</td>
<td>RDSO/T-5843</td>
</tr>
</tbody>
</table>

4.1 DIMENSIONAL CHECK

Every fabricated/assembled joint shall be checked for vertical and lateral alignment with 1.0 meter long straight edge. The tolerance permitted shall be as under:
i. **VERTICAL ALIGNMENT**

Variation at the joint shall be within +1mm and -0 mm measured at the end of 1 meter straight edge placed at the top of the rail-head.

ii. **LATERAL ALIGNMENT**

Variation at the joint shall not be more than ±0.5mm measured at the centre of 1.0 meter straight edge placed along the gauge face.

Other tests shall only be carried out after checking the joints for their dimensions.

**GLUED INSULATED RAIL JOINT**

Fig. No. 5
4.2 **INSULATION RESISTANCE TEST**

**DRY CONDITION**

By using megger, a voltage of 100 V DC is applied across the joint. The value of insulation resistance shall not be less than 25 MΩ (Mega ohms).

![Fig. No. 6](megger-set-to-100-volt-glued-joint)

**WET CONDITION**

The joints are immersed in water for 48 hours in suitable clean water tank and resistance is measured immediately after taking out the joint from the water.

For measuring insulation resistance, we apply a 100 V DC across the joint with the help of a megger and measures current by an ammeter. The ammeter should be capable to measure current up to micro-amperes. The insulation resistance is calculated by the ratio of voltage to current (in amperes). Insulation Resistance shall not be less than 3 K (kilo-ohms) for each of the joint.

4.3 **PULL OUT TEST**

This test is conducted by P. Way staff by suitably gripping the two rail pieces at either end of the joint and subjecting the joint to axial tension.

One method of conducting the test is to hold one end of the glued joint with the help of fish plates as fixed end. The other end is held to a moving frame with the help of a wedge inserted in slots cut in the glued joint through the moving frame bracket.

This test shall be considered acceptable if there is no visible indication of separation between end posts and rail ends to the naked eye. Pull out load values is given in the table on next page.
### Minimum pull out load in tonnes

<table>
<thead>
<tr>
<th>Sr</th>
<th>Rail Section</th>
<th>Minimum pull out load in tonnes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>G2 (L) Type</td>
</tr>
<tr>
<td>1</td>
<td>75 R</td>
<td>110</td>
</tr>
<tr>
<td>2</td>
<td>90 R</td>
<td>125</td>
</tr>
<tr>
<td>3</td>
<td>52 Kg</td>
<td>150</td>
</tr>
<tr>
<td>4</td>
<td>60 Kg (UIC)</td>
<td>170</td>
</tr>
</tbody>
</table>

5. **INSTALLATION AND MAINTENANCE**

5.1 **PRE-INSTALLATION MEASURES**

- Ensure that sleeper spacing under glued joint is same as that of intermediate sleepers.
- Ensure that at least ten sleepers on either side of the joint are properly packed to the correct level.
- Proper care shall be taken in transporting the joints to the site of laying to avoid damages caused during loading, unloading and transportation.
- Before the glued insulated rail joints are put at site by P. Way Branch, tests are to be carried out by the Sectional Signal Inspector. It is advantageous if the testing is carried out at PWI’s Store where such joints are being stocked.
- The Glued Joints tested and passed for installation should be marked with paint and entered in a register. The serial No. should be painted on the web of the respective glued joint.

For example: If the inspecting official is SE(S) Sh. A. K. Mishra and serial number of the joint is 8, than the marking should be “SE(S)/AKM/TC/8”.
- P. Way staff should be advised to use only those joints which have been passed.

5.2 **INSTALLATION OF GLUED JOINTS**

The installation work is carried out by Engineering Staff. For installation of joint following procedure is adopted:

1. Cut and remove the suitable length of rails according to the length of joint to be inserted.
2. Placed the glued joint in proper position and weld at both ends by an approved method.
3. For replacement of a defective joint similar method as mentioned above is to be adopted.
4. Insulation Resistance test for each glued joint shall be carried out in association with concerned Engineering staff before insertion in track.

5.3 **MAINTENANCE OF GLUED JOINT**
• The ballast in track in the vicinity of the glued joints shall be clean to ensure proper packing and efficient drainage. It shall be ensured that the ballast is clear of rails and rail-fastening. The clearance from the underside of rail to ballast shall normally be not less than 50mm.

• For the upkeep of insulating properties of the glued joint, assistance should be provided by Engineering staff as and when required by S&T staff.

• The metal burrs/flow at the ends of the rails shall be removed from time to time to avoid short-circuiting. The burrs/flow shall be removed with care avoiding damaging the end-post.

• The iron dust/chips fallen on the rail joint must be brushed off from time to time to avoid short-circuiting of the joint.

• Normally no relative movement shall occur between rails and fish plates at the glued joint. In case, failure of the joint occurs by separation of the rails/fish plates surfaces with consequent relative movement, the damaged glued joint may be replaced as early as possible by a new joint.

• Any variation in the parameters should be immediately brought to the notice of concerned SSE(P.WAY) and ASTE/DSTE of the division.

• JE/SE/SSE and ASTE should check the electrical parameters of each and every joints used in Track Circuited zone during their visit to the station for inspection.

• For proper maintenance of records, the various insulation joints of each station should be numbered serially like IJ-1, IJ-2, IJ-3, etc.

• The serial number of the joint should be painted on the web of rail and each inspector & supervisor should have a sketch in his diary.

• Separate statement should be maintained indicating type of joint provided as shown below:

  IJ - 1 : Regular Nylon Insulation Joint
  IJ - 2 : Glued Joint
  IJ – 3 : Glued Joint etc.

This will enable to identify faulty joints and take remedial action. This will also have a clear cut record of the performance of each joints.
6. **PRECAUTIONS WHILE INSERTING A GLUED JOINT**

- At least 10 sleepers on either side of the joint must be well packed before the joint is inserted to avoid damage/fatigue of the joint.

- No damage shall be caused to the joint while inserting.

- While welding the joint with adjoining rails, the heat shall not spread to the joint. Heating appliances shall not be used at a distance of less than 1 meter from the joint.

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