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SIGNALLING REQUIREMENTS FOR INSULATED JOINTS

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1 Background

Insulated joints are required in trackwork to support the operation of signalling track circuits. Both track circuit currents (of a low current) and traction return currents from the train have to pass through the rails.

This document explains the reasoning behind positioning of the joints.

2 Traction Return Current

Traction return currents can be passed through either one rail or both rails. The first type is called a single rail return, the latter double rail return. As a general rule, the number of traction return rails is to be maximized. Thus on main lines both rails are usually used for traction return. This is due to the high levels of current required for operation of the trains. These currents can be of the order of 2000 amps per rail.

However, where there are sidings, with many parallel lines and few trains moving simultaneously, a single rail arrangement may be suitable. Single rail return saves on the number of insulated joints and other signalling equipment.

In all cases there must be two means for the traction return current to return to the substation, one at each end of every rail. This is to avoid a broken rail or defective bond from causing a dangerously high voltage to appear on the rails.

3 Plain Track

3.1 Double Rail Traction Return

Special track circuits that use a tuned loop have been developed for mainlines that does not use insulated joints.

However in some locations track circuits that use insulated joints still exist. To accommodate the traction return in two rails past the insulated joints, impedance bonds are used. To be able to install these impedance bonds, the two insulated joints need to be approximately opposite each other (ie within the same sleeper bay).

Usually track design does not need to show these on plans because they are sited to suit the signalling design onsite.

In these installations, there is no joint stagger requirements.
3.2 **Single Rail Traction Return**

Where insulated joints are used in conjunction with single rail traction return, they are usually installed only in the signalling rail. In some cases, it may be necessary to swap the signalling and traction rails. In such cases it is important that the wheels of the trains are continuously in contact with a traction rail.

To do this, the rail joints should be staggered to overlap the traction rail. There is no minimum amount of stagger, however the maximum permitted is 2.4m.

![Diagram of Traction Rail and Signalling Rail]

Track designers will not necessarily be aware of these situations. Advice on which joints need to be staggered will be shown on the signalling track insulation plans.

The requirements for overlapping traction rails is in ESG 100.17.3.6.

4 **Turnouts**

To permit the operation of track circuits over turnouts, insulated joints need to be provided to prevent the turnout rails from short circuiting the track circuit.

Where crossovers are provided, a separate track circuit is usually provided over each end.

4.1 **Double Rail Track Circuits Over Both Ends**

![Diagram of Track Circuit Over Both Ends]

A typical crossover is shown above.

The insulated joints in the switches can usually be provided approximately adjacent to each other.
The insulated joints between the two turnouts in the crossover leg often cannot be located adjacent to each other. It is permissible that they are located with a stagger of up to 2.4m. The stagger direction is not important.

The joints must not be located within the points where combined sleeper plates exist.

4.2 Double Rail Over One End and Single Rail the Other

Sometimes a double rail track circuit is required over one end of the points and a single rail over the other end.

As a single rail traction rail adjoins a double rail traction rail, there is no loss of the traction return path possible.

Hence the two insulated joints in the middle between the two crossovers can be staggered up to 2.4m, as in 4.1. The stagger direction is not important.

4.3 Single Rail Track Circuits Over Both Ends

4.3.1 Common Traction Rail

In this arrangement, only four insulated joints are needed.

In this case as a train traverses the crossover, the traction rail changes sides.

Accordingly, it is important that the insulated joints are staggered so that the traction rails overlap. There is no minimum overlap, however the maximum stagger is 2.4m.
This occurs within both turnouts.

Track designers will not be able to assess which rail is the traction rail. This is shown on the signalling track insulation plan.

However, all crossovers with only four insulated joints have this issue.

### 4.3.2 Separate Single Rail Track Circuits

These crossovers have a similar insulated joint arrangements as the double rail type (4.1) but have the traction rail stagger requirements, now on all 3 pairs at joints.

Track designers will not be able to assess which rail is the traction rail. This is shown on the signalling track insulation plan.

The traction rails must overlap so the joints need to be staggered, however there is no minimum stagger requirement. The maximum stagger is 2.4m.
One specific issue with this arrangement is that it may not be possible to stagger the joints within the crossover in the required direction. In such a situation it will be necessary for the signal designer to swap the traction rail and signalling rail. This may require alterations to other insulated joint positions.

5 Insulated Joints at Signals

Where insulated joints are required at signals, the signal project engineer will advise the precise position.

Generally, the joints can be installed directly adjacent to the signal, or up to 2.5m past the signal if a trainstop also has to be installed.

If a joint in each rail is needed, then they should be approximately adjacent as impedance bonds will need to be installed. There is no stagger requirements if either of the track circuits is double rail.

However, if both are single rail, the arrangements in Section 3.2 apply.

6 Basis of Dimensions

Where a stagger is required there is no minimum stagger requirement. As long as there is an overlap, the traction current has a path from the wheel to the rail.

The maximum stagger of 2.4m is specified to avoid the stagger impacting on the train detection capability of the track circuit. Within the staggered rail ends, no train detection is possible in that area.

Thus with 2.4m at least one axle of the bogie will be detected.