AUSTRALIAN RAIL TRACK CORPORATION LTD

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Discipline

Engineering Standard – NSW

Category

Signalling

Title

Track Circuits

Reference Number

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About This Standard

This Principle addresses the requirements for providing track circuits and a means of identifying them in the signalling system.

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List of Amendments –

ISSUE	DATE	CLAUSE	DESCRIPTION
1.1	01/09/2004		▪ Reformatting to ARTC Standard
1.2	14/03/2005	Disclaimer	▪ Minor editorial change ▪ Footer reformatted

Contents

17 Track Circuits

17.1 Principle No. 17.1 - Provision And Identification Of Track Circuits

17.1.1 Introduction

This Principle addresses the requirements for providing track circuits and a means of identifying them in the signalling system.

17.1.2 Requirements - Provision of Track Circuits

Track circuits shall be provided as the fundamental means of train detection and control on regularly used passenger and freight lines.

17.1.3 Requirements - Identification of Track Circuits

A consistent approach to the identification of track circuits shall be adopted to complement the style of signalling for which they are provided.

All track circuit identifications shown on plans, diagrams and written in documents shall end with an upper case letter T.

17.1.4 Running Lines

Wherever possible a track circuit identification shall be based on the identification number of the running signal which leads over it.

For each track circuit past a running signal the identification number shall be suffixed by an alphabetic character. Each alphabetic character shall be allocated sequentially in the normal direction of travel always commencing with the letter A with the exception of the letters E, I and O.

Refer to figure 1.

If a running signal reads over a diverging junction, then in the absence of any other running signal numbers on the diverging line a separate series of alphabetic suffixes shall be allocated sequentially in the normal direction of travel commencing with an appropriate letter.

For example X, Y, Z if there are not more than three track circuits on the diverging line. Refer to figure 2.

17.1.4.1 Non Running Lines - Terminal Platforms, Sidings, Yards, & Shunting Necks, etc.

Wherever possible a track circuit identification shall be based on the identification number of a signal which leads over it. However where this approach does not ideally suit the track arrangements or there are no suitable signal numbers an identification comprising two or more alphabetic characters describing the particular line shall be allocated.

For each track circuit on its particular line the track circuit identification letters shall be suffixed by an alphabetic character. These shall be allocated sequentially in the direction of travel always commencing with A. Refer to figure 3.

17.1.4.2 Single Lines

Wherever possible an "in section" track circuit identification shall be based on kilometrage (or mileage) distances from Sydney.

Refer to figure 4.

Track circuits approaching Distant signals shall be identified as UAT and DAT for the up and down directions respectively with sequential alphabetic suffixes if required. For example UBT and UCT.

Refer to figure 4.

Isolated level crossing track circuits shall be identified as UXT, XT, and DXT for the up direction control, crossing control and down direction control track circuits respectively. Refer to figure 5.

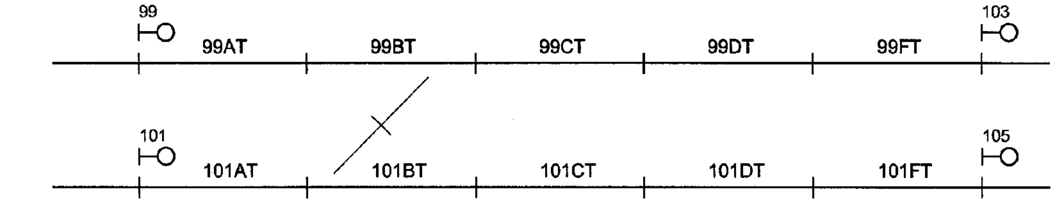


FIGURE 1

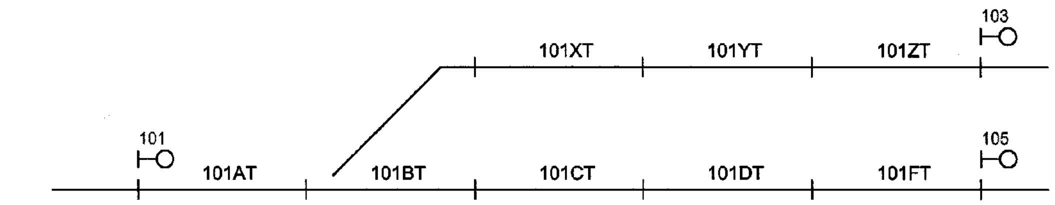


FIGURE 2

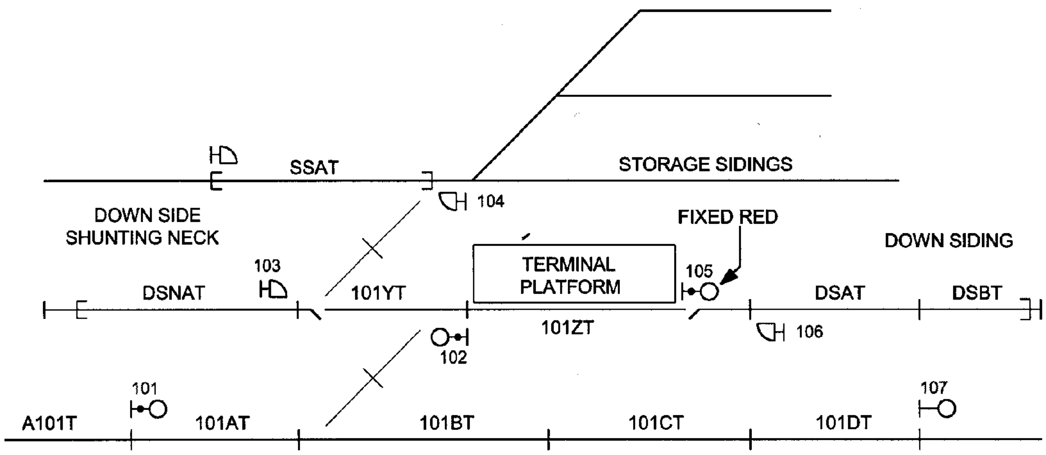


FIGURE 3

IDENTIFICATION OF TRACK CIRCUITS

PRINCIPLE N° 17.1

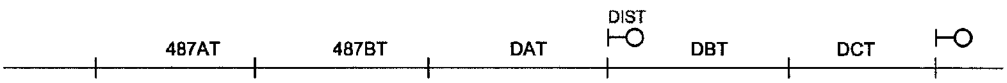


FIGURE 4

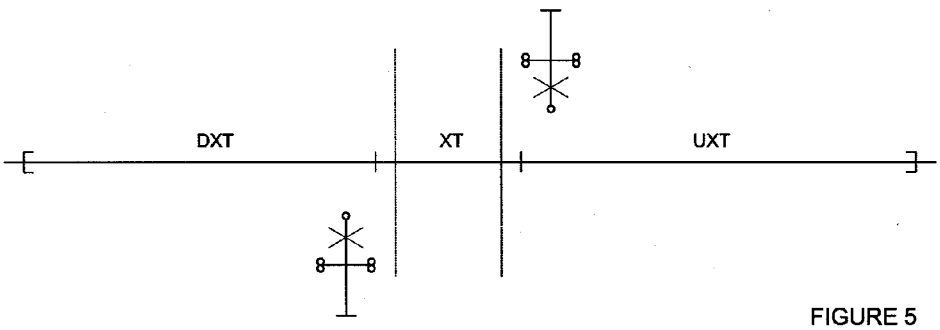


FIGURE 5

IDENTIFICATION OF TRACK CIRCUITS

PRINCIPLE N° 17.1

17.2 Principle No. 17.2 - Track Circuit Limits And Clearance Points

17.2.1 Introduction

This Principle addresses the requirements for establishing track circuit limits and clearance points between track circuits.

17.2.2 Requirements - Track Circuit Limits

Sufficient track circuits shall be provided to ensure that no track circuit is operating outside its specified engineering limits and track circuits shall be split where necessary to accommodate these limits.

In addition to this engineering requirement track circuits shall be split at all running signals and shunting signals and at sets of points where it is necessary for train movements to be able to pass clear.

Track circuits may also require to be split for specific functions within the signalling system, typically overlaps, level crossings and various forms of approach control arrangements. These track circuit limits shall be determined from other principles and/or by calculation depending on the functionality to be provided.

17.2.3 Requirements - Clearance Points

Where train movements are to pass clear through points and crossings the minimum distance between adjacent rails at which a track circuit limit shall be placed is 3 meters outside the surveyed clearance point.

This point shall be also considered with respect to the maximum length of vehicle overhang and the possibility of vehicles sagging back when the brakes of the train are released. Refer to figure 1.

Where standing room in a loop or siding is not critical or where rail head corrosion is likely to occur due to infrequent use, the insulated joint should be placed 23 metres beyond the clearance point to enable the longest wagon to stand between the insulated joint and the clearance point and also remain clear of the junction. This reduces reliance on one wheel set providing a good track shunt in these circumstances. This arrangement is not necessary for points operated by a ground frame located adjacent to the points. Refer to figure 2.

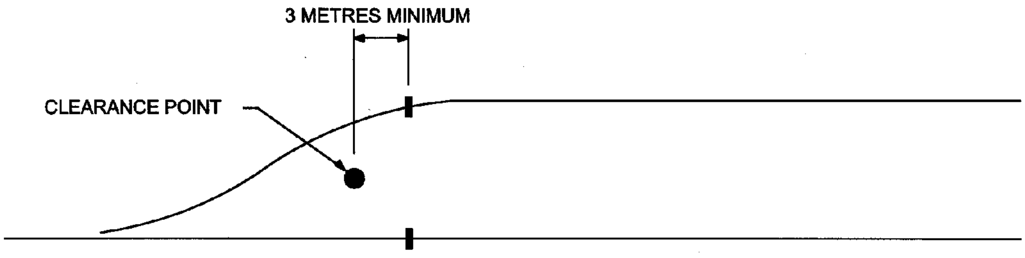


FIGURE 1

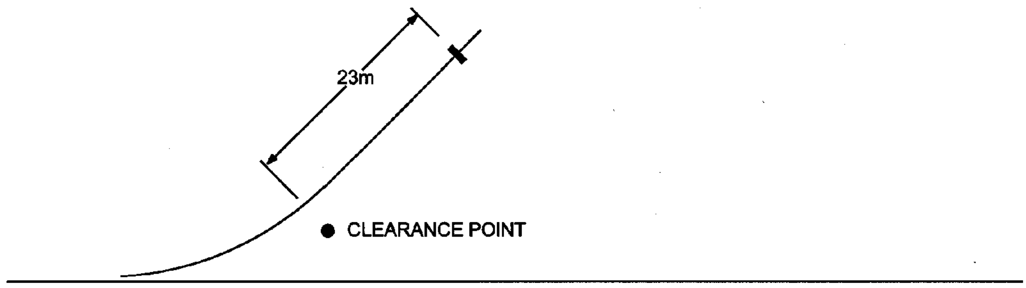


FIGURE 2

LOCATION OF INSULATED BLOCK JOINTS

PRINCIPLE N° 17.2

17.3 Principle No.17.3 - Location Of Insulated Joints

17.3.1 Introduction

This Principle addresses the recommendations for locating insulated joints for various purposes.

17.3.2 Location of Insulated Joints at Signals without Trainstops

Ideally the insulated joints shall be located directly in line with the signal to which they apply and preferably not more than 2m past the signal. Refer to figure 1.

17.3.3 Location of Insulated Joints at Signals with Trainstops

Ideally the insulated joints shall be located 1.5 to 2.5 m past the trainstop to avoid premature normalisation of the trainstop arm in front of an approaching train and not more than 4m past the signal to which they apply. Refer to figure 2.

Exceptionally insulated joints may be placed more than 4m past the signal but only where the permanent way layout prevents closer location. If wrong direction movements require train stop suppression, then the trainstop must be located within 2.5 m of the blockjoint irrespective of the blockjoint's relationship to the signal..

17.3.4 Location of Insulated Joints in Points

Wherever possible insulated joints shall be located in the turnout rails of points unless the turnout rails are in the most used route. Refer to figure 3. The insulated joint stagger in crossovers shall be the minimum permitted by the type and angle of V crossing and the track centres at the particular location. Care must be taken that any length of rail that will not shunt is minimised.

Exceptionally in heavy haul areas such as the Hunter Valley, insulated joints may be placed in the straight rails of points where the turnout rails are subject to heavy side loadings.

17.3.5 Location of Insulated Joints at Level Crossings

Wherever possible the insulated joints at which level crossing warning controls cease to operate shall preferably not be located more than 5 m from the edge of the roadway. This is to minimise delays to road users, notwithstanding the minimum length of track circuit.

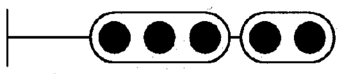
17.3.6 Location of other Insulated Joints

These shall be located in accordance with the position shown on the signalling arrangement drawings which shall be clearly dimensioned.

Note that no track circuit is to be shorter than 15m to avoid being bridged by long vehicles.

In open track, the maximum permitted stagger between insulated joints where there are no impedance bonds is 2.4 metres. Refer to figure 4.

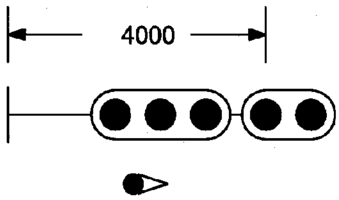
Where there are impedance bonds, either with double rail track circuits or with double to single rail track circuits, the maximum stagger shall not exceed 100 mm so that, under failure conditions, the possibility of a feed from one track circuit to the next through a train axle is minimised.



NOTE:
This location approximates the point at which an audio frequency track circuit with the start of the tuned loop at the signal will shunt.

MAXIMUM DISTANCE BETWEEN SIGNAL & INSULATED JOINT SUBJECT TO ANY RESTRICTIONS IMPOSED BY PER WAY LAYOUT 4000mm

FIGURE 1



NOTE:
This location approximates the point at which an audio frequency track circuit with the start of the tuned loop at the signal will shunt.

TRAINSTOP ARM NOT LESS THAN 1500mm FROM INSULATED JOINT TRAINSTOP OPPOSITE SIGNAL OR UP TO 2500mm IN ADVANCE

FIGURE 2

FIGURE 3

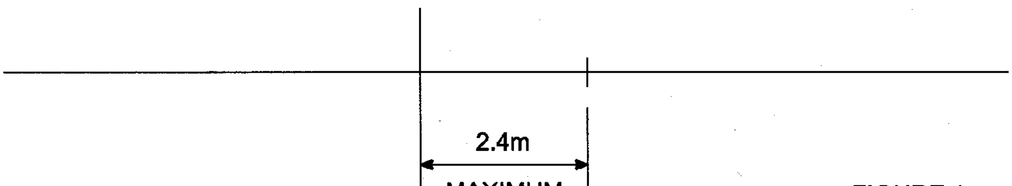


FIGURE 4

LOCATION OF INSULATED BLOCK JOINTS

PRINCIPLE N° 17.3

17.4 Principle No. 17.4 –Section Intentionally Left Blank

17.5 Principle No. 17.5 - Section Intentionally Left Blank

17.6 Principle No. 17.6 - Track Circuit Bonding In Non Electrified Territory

17.6.1 Introduction

This Principle addresses the requirements for the provision of track circuit bonding in non electrified territory.

Track circuit bonding is provided to ensure train detection and where practical to provide broken rail detection on main lines and high speed turnouts. The configuration of the bonding at turnouts and crossovers shall be such as to maintain the essential train detection capability when there are broken rails or otherwise shall be such as to ensure those broken rails fail the track circuit.

17.6.2 Turnouts

Insulated joints situated in points (leads) shall be located in the least used or lowest speed leg of the points which will usually be the turnout.

To provide for broken rail and broken bond protection two relays/receivers are to be provided as shown in figure 1, as required in 17.6.6.

Bonding would only be applied at the one end of the turnout extremity and would in effect be a series bond.

Contacts of the second track relay are to be wired in series with contacts of the first track relay in the relevant circuits or in a track repeat relay circuit.

Track stick proving of signal control relays would only be included in one of the track relays.

Where the extremities of the track circuit beyond the points are of widely different lengths then it may not be possible to maintain the relays in fine adjustment and the full parallel bonding arrangement shown in figure 2 may be adopted.

The parallel bonds shall be connected back along the main line as shown to provide maximum broken rail protection on the main line.

17.6.3 Crossovers

Full parallel bonding on crossovers in non-electrified areas shall be provided as shown in figure 3.

The parallel bonds shall be connected back along the main line to provide maximum broken rail protection on the main line.

17.6.4 Connection of Bonds to Rails

All series and parallel bonds shall be connected to the rails as close as possible to the insulated joints. This shall be clearly depicted on the track insulation plans.

17.6.5 Polarity of Adjacent Track Circuits

To prevent the incorrect operation of an adjacent track circuit relay due to an insulated joint failure, track circuits of the same type which abut at an insulated joint shall be of opposite polarities. Refer to figure 4.

This requirement may be relaxed if at the abutting joints there is:

(I) a track feed on either side, or

(II) in cut section tracks the de-energised track relay isolates the adjacent track feed, or

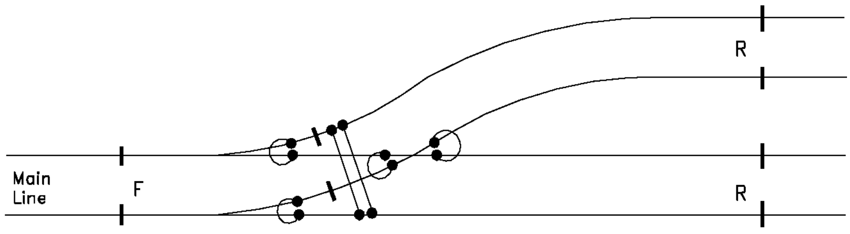
(III) at crossovers with single rail track circuits the failure of a blockjoint applies a short circuit across the tracks.

Polarity reversal does not apply to audio frequency jointless track circuits.

17.6.6 Long Turnouts and Crossovers

On long motor worked turnouts and crossovers where main aspects are provided for both routes, notably high speed turnouts, an additional receiver/relay shall be provided at the blockjoint(s) in the turnout path where the distance from the “V” crossing to the blockjoint(s) exceeds 30 metres. Because of this additional load on the points track circuit the length of the track circuit may need to be limited for reliable operation. Where this distance is less than 10 metres surface run parallel bonding may be installed, and for distances between 10 and 30 metres parallel bonding should be used with the bonds from the blockjoint end buried and connected back along the main line to maximise broken rail detection on the main line.

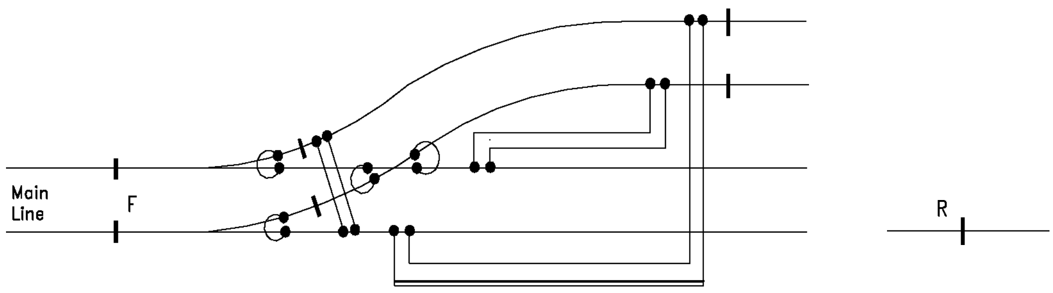
Non electrified



Two Relays

figure 1

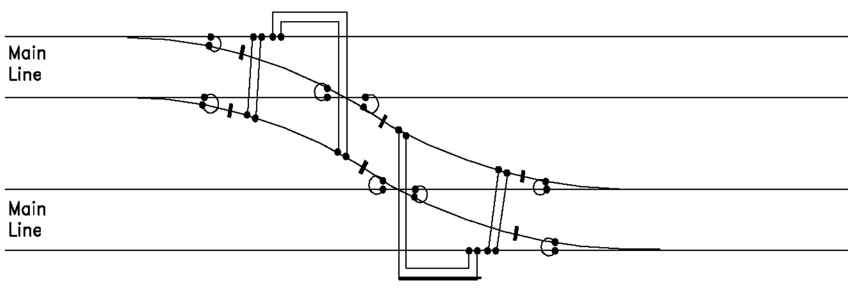
Non electrified - Where the extremity of the track circuit in the turnout does not align with the extremity of the track circuit in the main line, and it is not practical to place the two track relays in separate locations.



Parallel bonds connected back along the main line

figure 2

Non electrified crossover



Parallel bonds connected back along the main line

figure 3

PRINCIPLE 17.6

Track Circuit Bonding in Non-Electrified Territory

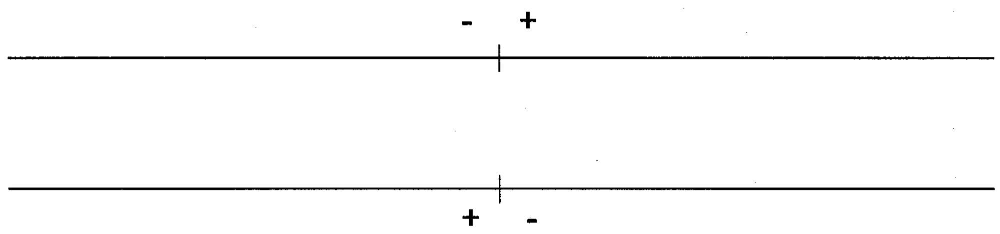


FIGURE 4

POLARITY OF ADJACENT TRACK CIRCUITS

PRINCIPLE N° 17.6

17.7 Principle No.17.7 - Track Circuit Bonding In DC Electrified Territory

17.7.1 Introduction

This Principle addresses the requirements for the provision of track circuit and/or traction return bonding in DC electrified territory.

Track circuit bonding is provided to ensure train detection and where practical to provide broken rail detection on main lines and high speed turnouts. The configuration of the bonding at turnouts and crossovers shall be such as to maintain the essential train detection capability when there are broken rails or otherwise shall be such as to ensure those broken rails fail the track circuit.

17.7.2 Turnouts - Single Rail Track Circuits

If the traction return is designed for single rail return then, to provide for the broken rail and broken bond protection at the turnouts, two track relays/receivers shall be provided as shown in figure 1. Bonding should only be applied at one end of the turnout extremity and will in effect be a series bond.

Contacts of this track relay/receiver re to be wired in series with contacts of the first track relay and preferably switch a common track repeat relay which then controls the relevant circuits.

Track stick proving of signal control relays would only be included in one of the track relays.

17.7.3 Turnouts - Double Rail Track Circuits

17.7.3.1 50hz AC Track Circuits

If the traction return is designed for double rail return where 50hz AC track circuits are used, then for broken rail and broken bond protection, two track relays shall be provided as shown in figure 2, as required in 17.7.8.

Where the extremities of the track circuit beyond the points are of widely different lengths then it may not be possible to maintain the two relays in fine adjustment and full parallel bonding may be adopted as shown in figure 3. This arrangement does not provide broken rail protection and should be avoided where practical.

17.7.3.2 Jeumont Track Circuits with 4 Wire Receiver

Where Jeumont 4 wire receivers are used full parallel bonding may be adopted as shown in figure 4. This arrangement does not provide broken rail protection and should be avoided where practical.

17.7.3.3 Jeumont Track Circuits with 2 Wire Receiver

The arrangement in figure 5, with two receivers is preferred for Jeumont track circuits as it provides for broken rail protection.

17.7.4 Crossovers - Single Rail Track Circuits

The full parallel bonding arrangement shown in figure 7 shall be adopted for single rail tracks on crossovers in electrified areas.

The parallel bond on the signalling rail shall be connected as close as possible to the points crossing to provide maximum broken rail protection on the main line.

17.7.5 Crossovers - Double Rail Track Circuits

The full parallel bonding arrangement shown in figure 6 shall be adopted for double rail tracks on crossovers in electrified areas.

17.7.6 Connection of Bonds to Rail

All bonds connecting parallel sections of track circuit shall be connected to the rails as close as possible to the insulated joints as indicated on the track insulation plans to ensure that the track circuit shunts satisfactorily at all extremities.

The cross sectional area of all parallel bonds and double-relay Y bonds connecting traction return rails must be sufficient to pass the traction return currents in the area.

17.7.7 Polarity or Phasing of Adjacent Track Circuits

To prevent the incorrect operation of an adjacent track circuit relay due to an insulated joint failure, track circuits of the same type which abut at an insulated joint shall be of opposite polarities.

This requirement may be relaxed if at the abutting insulated joints there is :

(I) a track feed on either side, or

(II) in single rail track circuiting over points where an insulated joint failure always shorts the signalling rail to the common traction rail.

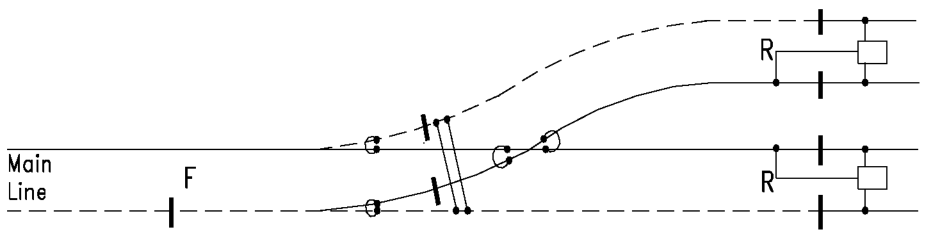
(III) in cut track sections where the de-energised track relay isolates the adjacent track feed.

Polarity reversal does not apply to audio frequency track circuits.

17.7.8 Long Turnouts and Crossovers

On long motor worked turnouts and crossovers where main aspects are provided for both routes,notably high speed turnouts, an additional receiver/relay shall be provided at the blockjoint(s) in the turnout path where the distance from the “V” crossing to the blockjoint(s) exceeds 30 metres. Because of this additional load on the points track circuit the length of the track circuit may need to be limited for reliable operation. Where this distance is less than 10 metres surface run parallel bonding may be installed, and for distances between 10 and 30 metres parallel bonding should be used with the bonds from the blockjoint end buried and connected back along the main line to maximise broken rail detection on the main line.

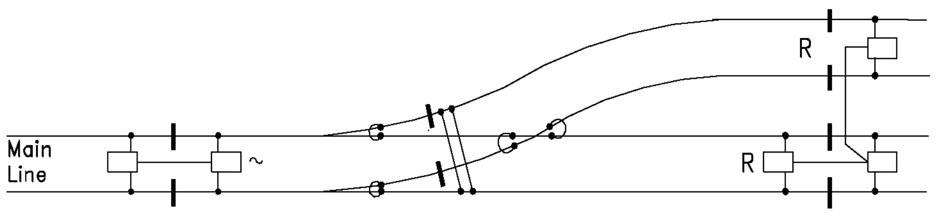
Single Rail Electrified



Two Relays

figure 1

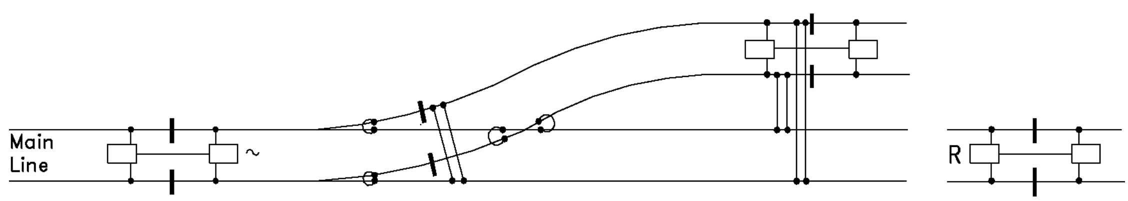
Double Rail Electrified - AC Track Circuit



Two Relays

figure 2

Double Rail Electrified - Where the track circuit extremity on the turnout does not align with the extremity of the track circuit on the main line. (AC track circuit only)



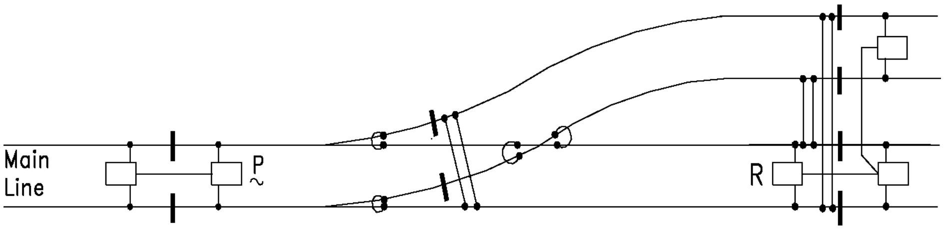
Parallel bonds - Avoid this arrangement where practical to provide for broken rail protection

figure 3

PRINCIPLE 17.7

Track Circuit Bonding in DC Electrified Territory

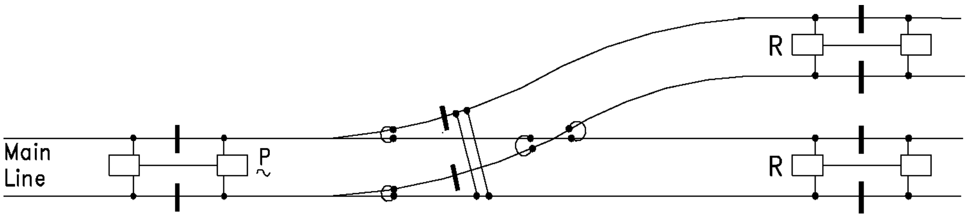
Double Rail Electrified: Jeumont with 4 wire Receiver



Parallel Bonds - Avoid this arrangement where practical to provide for broken rail detection(2 wire receiver preferred)

figure 4

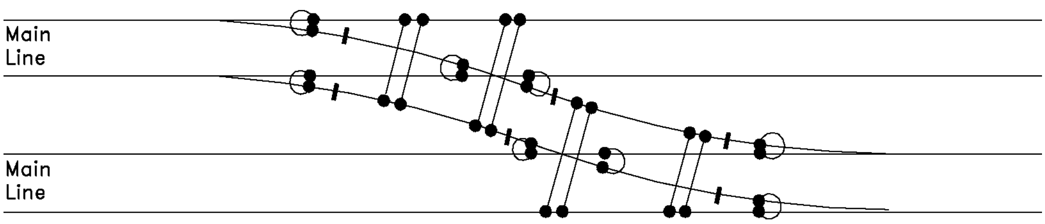
Double Rail Electrified: Jeumont with 2 wire Receiver



Two Relays

figure 5

Double Rail Electrified Crossover

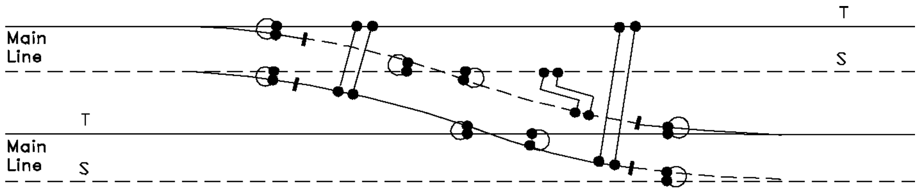


Parallel Bonds

figure 6

PRINCIPLE 17.7

Track Circuit Bonding in DC Electrified Territory



Single Rail Electrified Crossover

Parallel Bonds

figure 7

PRINCIPLE 17.7

Track Circuit bonding in DC Electrified Territory

17.8 Principle No. 17.8 - Tie-In Traction Bonding In DC Electrified Territory

17.8.1 Introduction

This Principle addresses the requirements for the provision of tie-in traction bonds in electrified territory either between adjacent running lines or where it is necessary to connect the traction return to a sectioning hut or substation.

17.8.2 Requirements For The Provision of Tie-In Bonding

In multiple track sections to minimise return rail resistance effects it is necessary to distribute the traction return current causing it to flow through all return rails including those on adjacent lines. Tie-in bonding shall be provided for this purpose at suitable intervals along the track, normally between 800m and 1500m.

17.8.3 Method of Providing Tie-In Bonding

For double rail track circuits this shall be achieved by the provision of impedance bonds linked together with cables of the appropriate cross sectional area.

Refer to figure 1.

For single rail track circuits this shall be achieved by connecting the traction return rails together at the extremities of the single rail to avoid the effects of circulating currents should a break occur in a return rail.

17.8.4 Tie-In Bonding to Form Connections to Sectioning Huts or Substations

If it is required to connect the traction rails of double rail track circuits to sectioning hut or substation bus bars then tie-in bonding shall be provided as described in Sections 17.8.2 and 17.8.3 above.

In addition the tie-in bonding shall be extended to form a connection to the sectioning hut or substation bus bars.

Refer to figures 2 and 3.

17.8.5 Cross Bonding

As a general rule, cross bonding should be applied at either end of an interlocking, or group of turnouts, where the double rail traction return on both (or more) tracks changes to a mix of single / double rail through the interlocking or group of turnouts.

17.8.6 Track Insulation Plans

Full details of all tie-in bonding and all other connections to sectioning huts or substation bus bars together with cable types and sizes shall be shown on the track insulation plans.

17.8.7 Danger Signs

Danger signs shall be provided at sectioning huts and substations warning against the disconnection of tie in bonding.

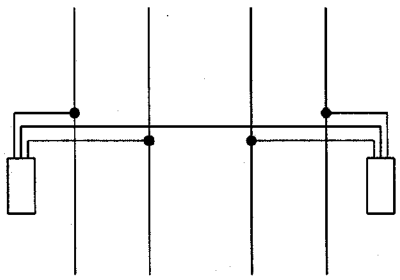


FIGURE 1

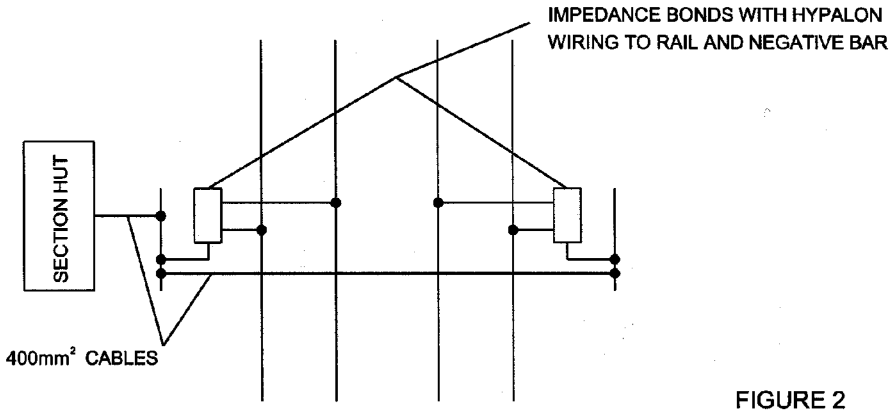


FIGURE 2

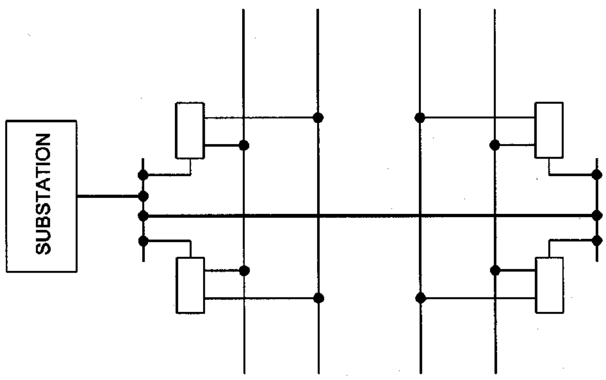


FIGURE 3

TIE-IN TRACTION BONDING IN DC ELECTRIFIED TERRITORY

PRINCIPLE N° 17.8