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Technical Note - TN 043: 2016

Issued date: 08 June 2016

Effective date: 08 June 2016

Subject: Update to ESG 100 *Signal Design Principles* - withdrawal of ESG 100.31 *Automatic Train Protection*

This technical note is issued by the Asset Standards Authority (ASA) as an update to ESG 100 *Signal Design Principles*, version 1.32.

This technical note advises that section 100.31 *Automatic Train Protection,* version 1.4 is withdrawn.

Current automatic train protection (ATP) development under the AMS project (ETCS Level 1 LS Mode) shall be assured by the appropriate Authorised Engineering Organisation (AEO) through asset assurance processes, practices and procedures.

Any clarification regarding ATP requirements shall be obtained from the Lead Signals and Controls Engineer, ASA via email at standards@transport.nsw.gov.au.

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Technical Note - TN 007: 2016

Issued date: 09 February 2016

Effective date: 09 February 2016

Subject: Update of ESG 100.15 *Trainstops*

This technical note is issued by the Asset Standards Authority to notify updates to signal design principle ESG 100.15 *Trainstops,* Version 1.7. The amendments clarify trainstop types and the provision of European train control system (ETCS) trainstops in ETCS Level 1 LS Mode (limited supervision) fitted areas.

This amendment is applicable to new and retrofit installations.

Add the following new section after section 15.6:

15.7 Non-contact type – ETCS trainstops

For control, operation and proving requirements associated with ETCS trainstops, refer to T HR SC 10031 ST *ETCS Level 1 LS Mode*.

Section 15.1.1 is replaced by the following content:

15.1.1 Introduction

This principle addresses the requirements for the provision of trainstops at signals, fixed trainstops at specific locations, intermediate trainstops and their identification.

The term 'trainstop' shall refer to any of the following types of trainstop (unless specified):

- physical contact type
  - fixed trainstop
  - electro-hydraulic trainstop
  - electro-pneumatic trainstop
  - electric trainstop

- non-contact type
  - ETCS trainstop

The following text replaces Paragraph 3 of Section 15.1.2 Provision of trainstops:

All running signals on electrified running lines where passenger trains operate, and signals which control access of electric passenger trains to running lines, shall be provided with a trainstop. Where warranted by an identified hazard or risk assessment, other signals including shunt signals and running signals on non-electrified running lines which can be used by passenger trains, can be fitted with a trainstop.

In all cases, when selecting the type of trainstop the following shall be considered:

- the protection equipment fitted to the rolling stock which operates at that location
- constraints surrounding trackside installation

Section 15.2.1 is replaced by the following content:

15.2.1 Introduction

This principle addresses the requirements for the control, operation and proving of physical contact type trainstops; to ensure the correct and safe operation of the signalling system.

Section 15.3.1 is replaced by the following content:

15.3.1 Introduction

This principle addresses the requirements for providing suppression on physical contact type trainstops to facilitate the movement of trains in the wrong direction or over bi directional lines without initiating an unnecessary brake application or damaging trainstop equipment.

Section 15.4.1 is replaced by the following content:

15.4.1 Introduction

This principle addresses the method of control of intermediate trainstops provided no overlap exists or reduced overlap conditions apply. The control of intermediate trainstops principle does not apply to the city underground region and is only applicable to physical contact type trainstops.

The following content replaces Paragraph 1 of Section 15.6 Trainstop proving:

Following the passage of a train, trainstops (physical contact type) shall be proved to be raised before a signal is permitted to be cleared towards it.

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Technical Note - TN 002: 2016

Issued date: 27 January 2016

Effective date: 27 January 2016

Subject: **Removal of pre-indication requirement from Drivers Machine Interface on ETCS fitted rolling stock**

1. Background

This technical note is issued by the Asset Standards Authority as an update to ESG 100 *Signal Design Principles*, version 1.32 to amend ESG 100.3 *Braking Distance* to support the new ETCS Level 1 LS mode installations.

Under LS mode, no information shall be shown to the driver on the Drivers Machine Interface other than the following:

- the speed of the train
- any indication of an over speed

Information associated with the pre-indication location and permitted speeds are not supported under the ERA system requirements for limited supervision mode.

2. Deletions

Delete Section 3.4 Braking Distances applied to Signalling Layouts with ATP.

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Technical Note - TN 066: 2015

Issued date: 11 November 2015

Subject: Amendment to the principle on the placement of yard limits and the consolidation/definition of the boundaries

1. Background

This technical note is issued by the Asset Standards Authority to transport standard ESG 100 *Signal Design Principles*, Version 1.32, issued 7 June 2013. The technical note amends the principle on '*Placement of Yard Limit Signs*' with respect to the consolidation of the boundaries and the definition of yard limits.

This amendment is applicable to new installations.

2. New additions

New Section 23.1 Introduction

23.1 Introduction

The term 'yard limits', used in the context of this principle, refers to a defined area of track where the operation of rail traffic can be managed by a nominated Network Control Officer, using alternative means of control, where fixed signal routes are not available or during degraded mode situations.

Such degraded mode situations may be the result of signalling failure or other infrastructure failure, rolling stock breakdown, or an incident where the movement of rail vehicles is required to be made contrary to movement authorities granted from the signalling.

Yard limit boundaries shall be indicated by placement of trackside signage and associated labelling on network control officers panels.

The governance and requirements for operating train movements within yard limits shall be prescribed by the network operator and documented in the operational rules and procedures.

New Section 23.2 Purpose

23.2 Purpose

The purpose of this principle is to provide guidance for signalling designers when assessing and determining the placement of yard limit boundaries.

New Section 23.3 Scope

23.3 Scope

This document covers information on principles that shall be applied when assessing and determining yard limit boundaries, as well as mandating the style and placement of associated signage.

New Section 23.4 Application

23.4 Application

The yard limit requirements used in this principle apply to the heavy rail metropolitan rail area that is operated by Sydney Trains as the Rail Infrastructure Manager.

New Section 23.6 Principle of yard limits

23.6 Principle of yard limits

Yard Limits establish the portion of track that can be managed autonomously by a network controller, where fixed signalling routes are unavailable. Assessment and determination of yard limit boundaries shall be made by signalling designers and stakeholders (including the network operator). The assessment and determination shall usually take place during the signalling functional specification stage, but can also take place at any stage during the asset's operation.

In most cases, the yard limit boundary shall represent a separate interlocking. Yard limits shall apply to all running lines within the defined boundary and is applicable to both directions on each line.

The yard limit entry-point shall be generally located at the first controlled movement authority on the approach to an interlocking (usually the first controlled signal). The yard limit end-point shall be located at the end of the last controlled movement authority (usually the first automatic signal after the last controlled signal).

Where a request is made by stakeholders for yard limits to be extended over multiple interlockings, such that the yard limit boundary is effective over more than one interlocking, or includes one or more automatic signalling sections, the requirements stated in Section 23.8 shall be followed.

New Section 23.7 Yard limit signage

23.7 Yard limit signage

The yard limit entry-point shall be displayed by trackside signage displaying the letters ‘YL’. These letters shall be black on a white oval background.

The yard limit end-point shall be displayed by trackside signage displaying the letters 'EYL'. These letters shall be black on a white rectangular background.

YL and EYL signs may be of horizontal or vertical format. See Figure 1.

Figure 1 – Yard limit signage

New Section 23.7.1 Unidirectional double lines

23.7.1 Unidirectional double lines

On unidirectional double lines, the YL sign is usually mounted back to back with the EYL sign.

The signs are usually located as shown in Table 1, Table 2 and Figure 2.

Table 1 – Location of yard limit signage in normal direction of travel

Sign	**Location**
Yard limit (YL)	On the first controlled signal (usually the accept signal).
End yard limit (EYL)	On the first automatic signal after the last controlled signal.

Table 2 – Location of yard limit signage in reverse direction of travel

Sign	Location
Yard limit (YL)	On the rear of the signal fitted with the normal direction EYL sign.
End yard limit (EYL)	On the rear of the controlled signal fitted with the normal direction YL sign.

Note: Placement of the plates for the reverse direction of travel may be on the right hand (or 'wrong') side

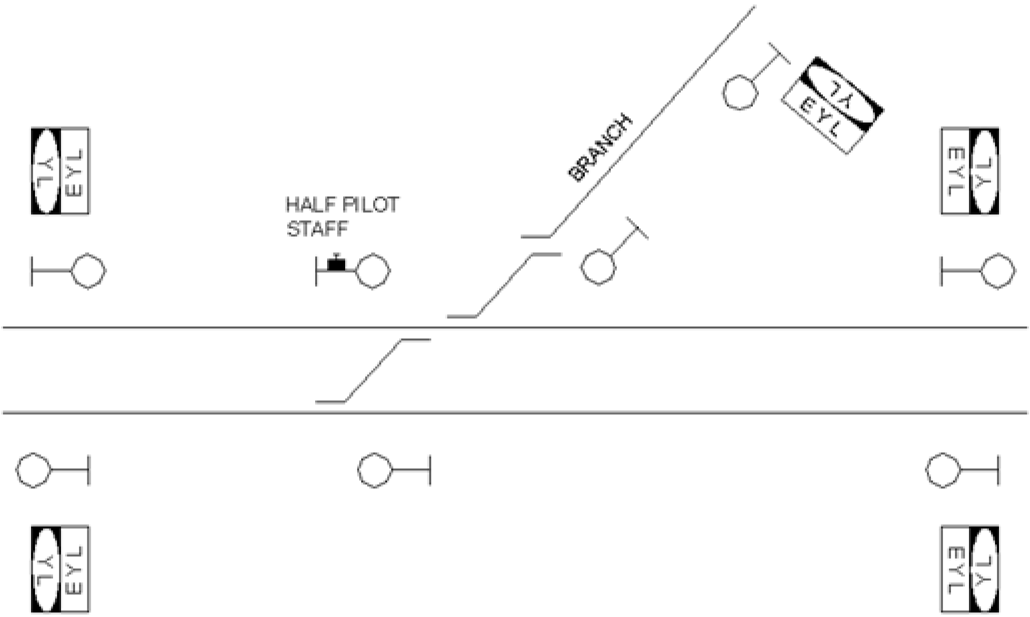

Figure 2 – Placement of YL and EYL signs at single line junction

New Section 23.7.2 Unidirectional multiple lines

23.7.2 Unidirectional multiple lines

On multiple lines, the placement of the YL and EYL shall be the same criteria as for double lines. However, plates shall be located on the left side in the direction of travel and shall be of the vertical format when located in the '6ft'.

This is to avoid misreading due to plates being located on the 'wrong' side.

New Section 23.7.3 Single line

23.7.3 Single line

On single lines, YL and EYL plates are not normally provided, as the yard limits are clearly defined by the location of the signals.

However, at certain locations where the provision of YL and EYL signs is requested, the signs shall be placed as shown in Table 3, Figure 3, Figure 4 and Figure 5.

Table 3 – Location of yard limit signage on single lines

Sign	Location
Yard limit (YL)	On the first controlled home signal.
End yard limit (EYL)	On the reverse of the first controlled home signal.

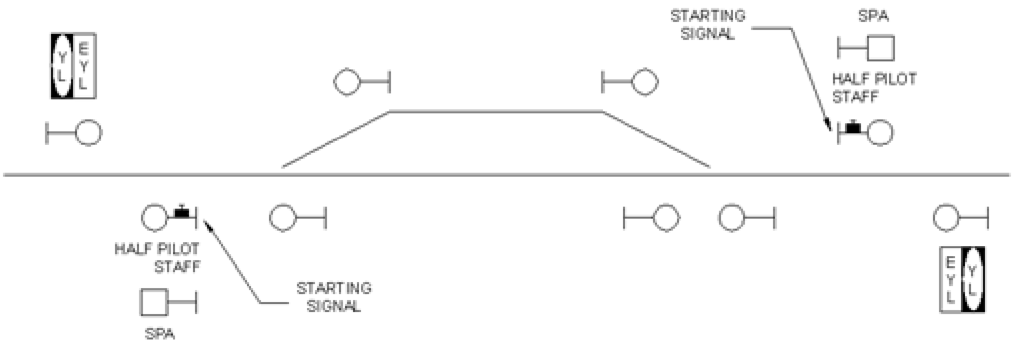

Figure 3 – Single line crossing loop with starting signal

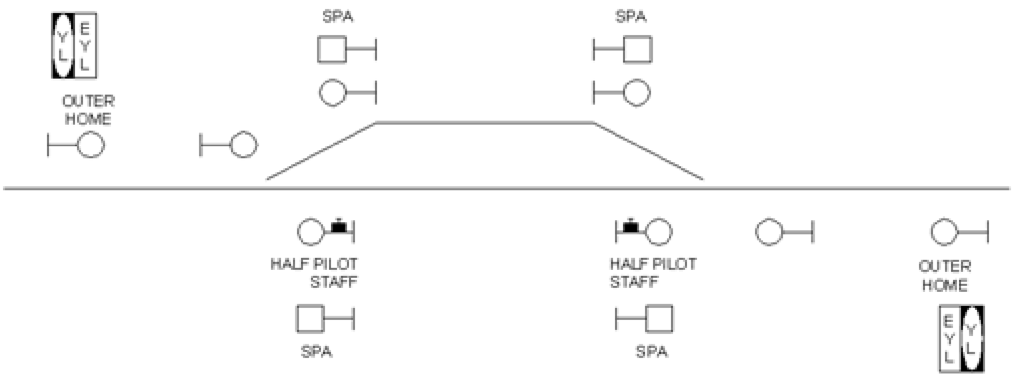

Figure 4 – Single line crossing loop with outer home

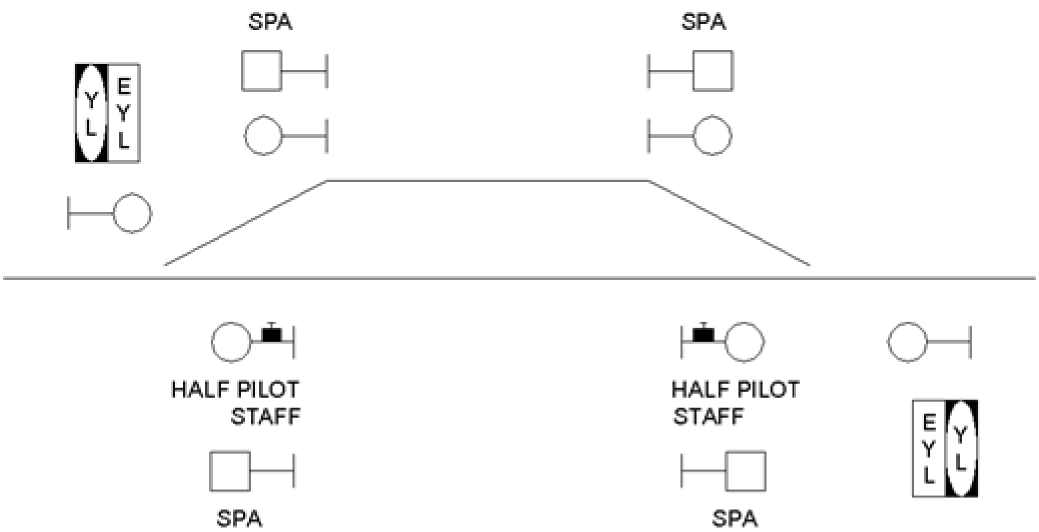

Figure 5 – Single line crossing loop

A special proceed authority (SPA) sign may be provided on these signals. The SPA signs may be mounted either on the signal post or separately adjacent to the signal. The inscription on the SPA sign shall read:

WHEN AUTHORISED TO PASS THIS SIGNAL AT STOP DRIVERS MUST NOT PROCEED BEYOND YARD LIMITS EXCEPT ON AUTHORITY OF A SPECIAL PROCEED AUTHORITY OR DURING PILOT STAFF WORKING

New Section 23.7.4 Bidirectional lines

23.7.4 Bidirectional lines

At simple bidirectional crossover locations, the YL and EYL signs shall be located on the first protecting outer home signal or home signal. See Figure 6 for simple arrangement and Figure 7 for complex arrangement.

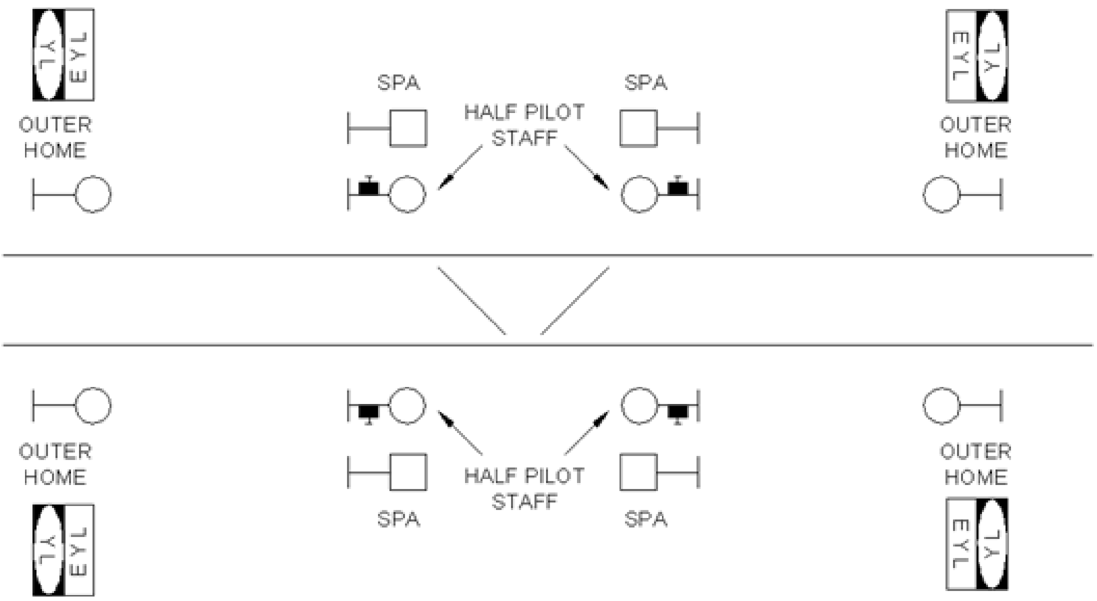

Figure 6 – Bidirectional lines – Crossover – Simple arrangement

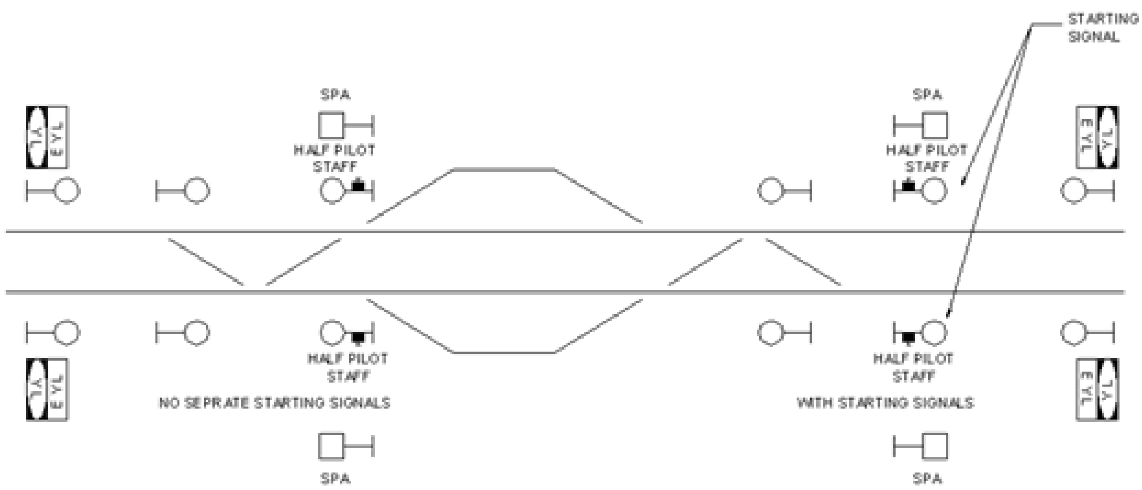

Figure 7 – Bidirectional lines – Crossover – Complex arrangement

The criteria shall be the same as for single lines in Section 23.7.3.

A special proceed authority (SPA) sign may be provided on these signals. The SPA signs may be mounted either on the signal post or separately adjacent to the signal. The inscription on the SPA sign shall read:

WHEN AUTHORISED TO PASS THIS SIGNAL AT STOP DRIVERS MUST NOT PROCEED BEYOND YARD LIMITS EXCEPT ON AUTHORITY OF A SPECIAL PROCEED AUTHORITY OR DURING PILOT STAFF WORKING

New Section 23.7.5 Adjoining locations

23.7.5 Adjoining locations

There may be cases where two locations are adjacent such that the signals are dual controlled, or the signal past the 'starting' signal is the 'accept' signal of the next location.

In this context, the EYL of the previous location and the YL of the next are located on the same signal. When this occurs, the location name is added to the YL and EYL signs to distinguish the location to which each sign applies. See Figure 8.

On horizontal format signs, the name is located immediately above the sign. On vertical format signs, the name is placed vertically down the left side of the sign.

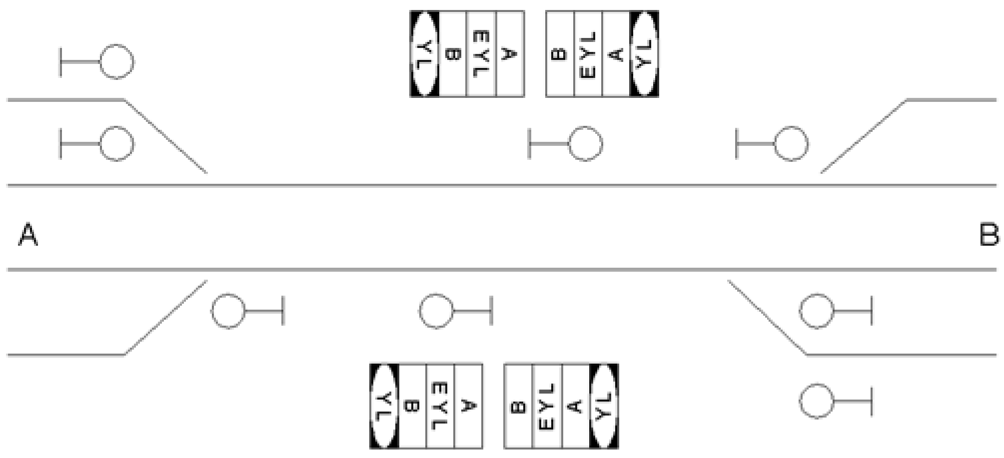

Figure 8 – Adjoining locations – Double track

In rare cases, where shunting occurs within the dual control area, and separate hazards protected by each signal box individually exist, the signs may be located at the Shunting Limit sign. See Figure 9.

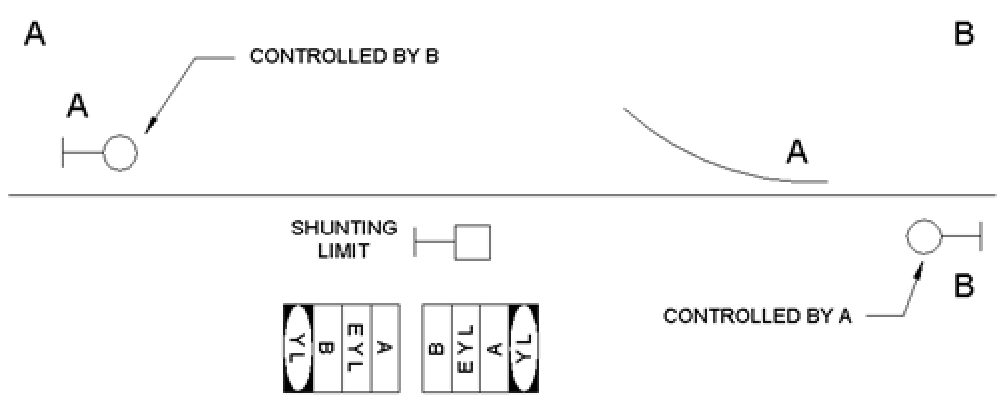

Figure 9 –- Adjoining locations – Single track

Where dual signs are fitted, the EYL sign is placed above the YL sign, purely for consistency.

New Section 23.8 Determination for consolidated yard limits

23.8 Determination for consolidated yard limits

Individual yard limits are generally established for each interlocking.

However, consideration may be given to extending yard limit boundaries over multiple interlockings and automatic sections where the signals are controlled/indicated from the same signal box. This would provide one single yard limit for a number of interlockings, referred in this principle as a 'consolidated yard limit'.

When assessing and determining the suitability of a Consolidated Yard Limit, a risk assessment shall be carried out by the signalling designer with input provided by relevant stakeholders (including the network operator). The risk assessment shall ensure all risks associated with the consolidated yard limits are mitigated. The risk assessment shall consider the following elements, but not limited to:

- amount of interlockings to be included in the Consolidated Yard Limit boundary
- length and amount of signals in the intervening automatic signalling sections (between interlockings) to be included in the consolidated yard limit boundary
- line speeds and track gradients involved
- location of any intermediate sidings or crossovers, especially where points are not operated or released from the operator's control panel
- location of any level crossings
- involvement of any local control panels
- task load of intending network control officers
- availability of track circuits indicated on network controller's panel

Consolidated yard limits should not extend into an area operated by more than one network control officer. However, an exception to this requirement is permissible where yard working could expedite the unsignalled movement of trains in the event of an emergency. An example of this exception is the City Underground.

The exception shall be conditional of any additional risks pertaining to these circumstances being mitigated prior to approving such consolidated yard limit boundary.

The establishment of consolidated yard limits over an area operated by more than one network control officer shall only be permitted where the following conditions are met:

- There is a demonstrable operational benefit.
- The network control officers adjacent to the consolidated yard limit boundary are all located in the same physical location and can communicate freely and easily to each other (unless a suitable process or protocol is in place between the separate locations).

- There is an uninterrupted display of track circuit indications within the controlling signal box.
- A demonstrable safety argument satisfies that all the additional safety risks have been effectively mitigated and managed.

New Section 23.9 Additional yard limit requirements

23.9 Additional yard limit requirements

The area contained in the yard limit boundary shall always be able to be protected by the controlled signals at that interlocking or control area.

Under no circumstances shall the protecting signal be an unusually long distance (not exceeding three kilometres) without special approval from the ASA Lead Signals and Control Systems Engineer.

Difficulties may exist in areas signalled with two aspect (automatic and distant) signals. In this case, the YL or EYL should be at the starting signal or home signal, rather than the 'accept' signal or the first automatic signal past the 'starting' signal.

Starting signals on bidirectional single and double lines should be provided with a plate advising that

WHEN AUTHORISED TO PASS THIS SIGNAL AT STOP DRIVERS MUST NOT PROCEED BEYOND YARD LIMITS EXCEPT ON AUTHORITY OF A SPECIAL PROCEED AUTHORITY OR DURING PILOT STAFF WORKING

3. Amendments

N/A

4. Deletions

The following sections have been removed:

- Section 23.1 Scope
- Section 23.2 Application of 'Yard Limit' Signs
- Section 23.3 Application of 'YL' & 'EYL' Signs
- Section 23.4 Determination of the Yard Area Extent

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Technical Note - TN 065: 2015

Issued date: 12 October 2015

Subject: Amendment to the principle on points – Locking of facing points, additional SPAD protection at catchpoints and the provision of maintenance isolation switches for points

1. Background

This technical note is issued by the Asset Standards Authority as an update to ESG 100 *Signal Design Principles*, Version 1.32, issued 7 June 2013.

The technical note amends the principle on points with respect to the following elements:

- detection requirements for installed facing points pending commissioning or removal, and not connected to the interlocking – applicable to forthcoming situations
- additional signal passed at danger (SPAD) mitigation associated with signals protecting catchpoints in European train control system (ETCS) Level 1 limited supervision (LS) mode fitted areas – applicable to new and retrofit installations
- the provision of points maintenance isolating switches for privately maintained sidings and balloon loops – applicable to new installations

2. New additions

New section 14.19 Points maintenance isolation switches:

14.19 Points maintenance isolating switches

14.19.1 Application

Where a privately maintained siding or balloon loop is connected to a main line, an isolating system may be provided to permit the private maintainer to lock the points entering the siding or loop while maintenance is being performed within the private facility.

14.19.2 Form of switch box

The key switch is mounted in a lockable box secured by an SL lock.

The switch shall be a key operated type. The key shall be held by the maintainer when in use.

Also mounted in the box is a yellow LED. The yellow LED is illuminated when the points are 'normal'. See Figure.

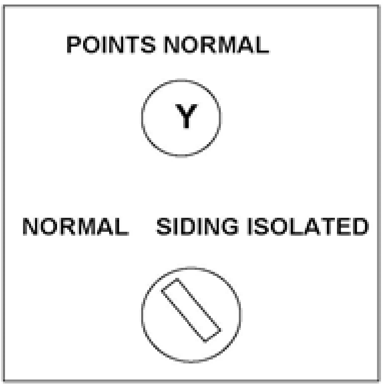

Figure – LED and key operated switch

14.9.3 Switch box functions

The yellow LED shall be illuminated when the points are detected 'normal' (the position where the trains cannot enter the siding/loop or for normal running movements),

When the key switch is in the 'normal' position, the points are not locked by the key. When the key switch is in the 'siding isolated' position, the points will become locked in the 'normal' position.

The key can be removed in either the 'normal' or 'siding isolated' positions.

Where more than one switch box is provided for a common private owner, the key combinations may be the same.

14.9.4 Circuit arrangements

Where the key switch is installed on existing (usually relay interlocked) points, the switch operation may disable the isolating relay.

In new computer based interlocking (CBI) situations, the key switch shall disable the points free function in the interlocking.

Additionally, an indication of the points key switch normal position shall be sent to the logger and control systems.

14.9.5 Method of operation

To lock out the private siding or loop, the maintainer must observe that the 'points normal' lamp is illuminated. After obtaining permission from the signaller, the key can be inserted and the switch operated to the Siding Isolated position. The key may be removed, and work commence.

At the completion of work the key can be inserted and the switch operated to the 'normal' position. The points shall then respond to the signaller controls.

3. Amendments

Section 14.2.4 section is replaced by the following content:

14.2.4 Additional safeguards which may be provided

Over and above the previous requirements, additional safeguards shall be provided as follows:

- double-blade catchpoints or full lead run-offs where there is a likelihood that a single bladed catch will result in inadequate or unsafe deflection of the derailed vehicle

  Note: This is especially important where the run off area is uneven and there is a risk of overturning a vehicle.

- full run-off points onto a separate length of track or into a sand drag arrangement where approaching trains may be braking from the full service speed to a stand immediately in rear of the catch points. Refer to Figure 7 and Figure 8
- use of a guard rail in lieu of a throw-off rail to direct a derailed vehicle when required
- if warranted in trainstop (mechanical or electro-mechanical) territory, intermediate trainstop(s) may be provided where the speed of an approaching train can be adequately checked prior to it stopping immediately in rear of the catch points. Refer to Figure 9
- For retrofit installations in ETCS Level 1 LS mode fitted areas, ETCS shall be used to control the speed of a train approaching a signal at stop that is protecting a set of catchpoints. Where catchpoints exist in ETCS Level 1 LS Mode fitted areas, a risk assessment shall be carried out against the risk of a SPAD and subsequent derailment consequence against any existing mitigation and appropriate methods shall be taken in lieu of providing ETCS.
- Where approach speeds may be high, facing catch points are best avoided. Where this is not possible, additional mitigation against derailment should be considered. These include intermediate trainstops or other speed proving, good signal sighting, and space to assist drivers to regain control and so prevent derailment in the event of a minor overrun.

Section 14.16.5 section is replaced by the following content:

14.16.5 Detection of points not in use

Installed facing points that are pending commissioning or removal, and are isolated from the interlocking shall have electrical detection provided for the point switches. The loss of detection shall place to stop the signals that immediately lead over the facing-end of points.

For newly installed points, a period of 16 weeks without detection is permitted for emergency situations only. In such cases, track standards may require additional risk mitigation to be provided, such as the removal of switches and the straight railing of some components.

Where a catchpoint is provided to protect the main line, the electrical detection shall prove the catchpoint in the open position.

Where a set of trailing only points is provided, electrical detection is not required. Electrical detection is also not required where points are wholly located in yards and the speed limit is 13 km/h or less.

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Technical Note - TN 057: 2015

Issued date: 03 September 2015

Subject: Amendment to ETCS level 1 Transition Border Signs

1. Background

This technical note amends ASA Engineering Standard: ESG 100.6 – 'Notice Boards', Version 1.6, issued on February 2012 to support the new ETCS Level 1 LS Mode installations.

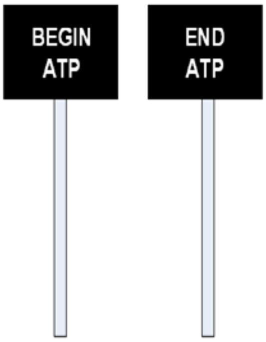
This amendment is applicable to new and retrofit ETCS Level 1 LS Mode installations.

2. New additions

New Section 6.3.8.3 'Type of ETCS Level Transition Border Signs'

The sign for an ETCS Level Transition Border shall be defined as per the following:

(Sign is white on black background)



3. Amendment

Section 6.3.8 is replaced by the following:

6.3.8 Provision of ETCS Level Transition Border Signs

At locations where ETCS Level 1 coverage begins or ends, ETCS Level Transition Border signs shall be provided.

ETCS Level Transition Border signs apply to fitted rolling stock entering ETCS Level 1 areas from ETCS Level 0, and vice-versa.

Section 6.3.8.2, Figure 12, Figure 13 and Figure 14 are replaced by the following figures:

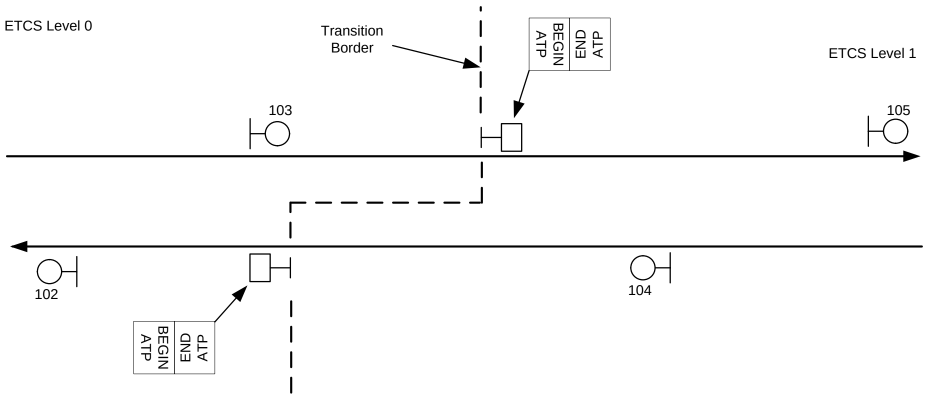


Figure 12 – ETCS Level Transition Border Sign – Unidirectional Double Line

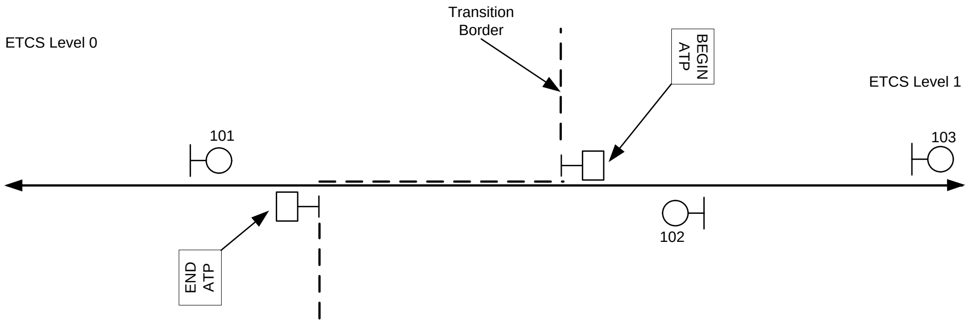


Figure 13 – ETCS Level Transition Border Sign – Single Line

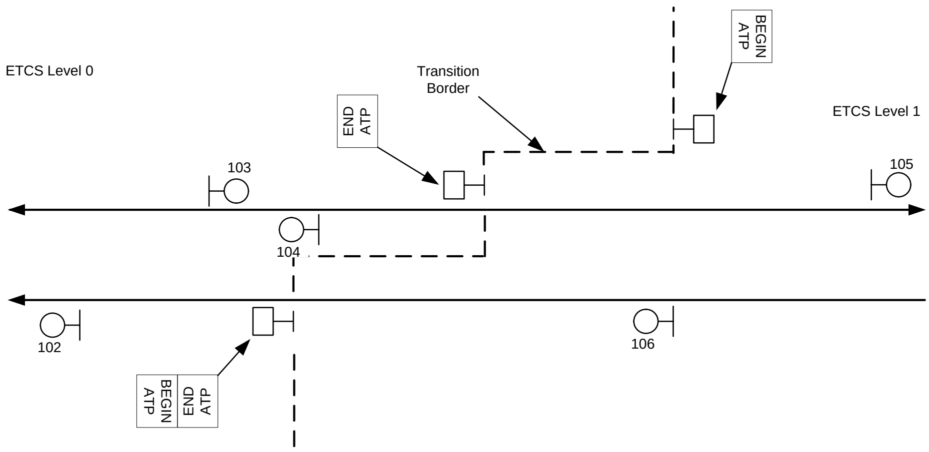


Figure 14 – ETCS Level Transition Border Sign – Bi-directional Double Line

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Technical Note - TN 055: 2015

Issued date: 03 September 2015

Subject: Amendment to the principle on overlaps in ETCS Level 1 LS Mode fitted areas

1. Background

This technical note is issued by the Asset Standards Authority to transport standard ESG 100 'Signal Design Principles', version 1.32, issue 7 June 2013. The technical note amends the principle on the provision of overlaps (and the management of existing deficient overlaps) where ETCS Level 1 LS Mode (Limited Supervision) is provided.

This amendment is applicable to new installations and retrofit installations where ETCS Level 1 LS mode is provided.

2. New additions

New Section 4.1.4.1 'Management of deficient overlaps in ETCS Level 1 LS Mode fitted areas'

For retrofit installations, where an existing overlap distance is deficient against the permissible line speed, a risk based approach shall be adopted when assessing the deficiency. Alterations to the existing infrastructure or ETCS shall be used as SPAD mitigation. Where ETCS is used, the approach speed of the train shall be controlled to ensure that the emergency braking distance from the signal is less than or equal to the overlap distance, based on the more conservative brake curve applicable to that section of line.

3. Amendments

Section 4.8 title is replaced by the following content:

Principle No 4.8 – 'Overlaps where ETCS Level 1 LS Mode is provided'

Section 4.8.1 is replaced by the following content:

This principle addresses the requirements for the provision of overlaps in ETCS Level 1 LS Mode fitted areas.

For new works, the principle on overlap distance shall be maintained.

Section 4.8.1 is replaced by the following content:

Refer to the Signal Design Principle – 'ETCS Level 1 LS Mode' for details of supervised locations with relation to ETCS danger points and overlaps.

Section 4.8.3, paragraph 1 is replaced by the following content:

Where ETCS Level 1 LS Mode is utilised, the overlap distance shall be defined as per the requirements of this principle. Limited Supervision mode will not be used to reduce overlap distance or the removal of conditional overlaps

4. Deletions

Section 4.8.3, paragraph 2 is deleted.

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ESG 100

SIGNAL DESIGN PRINCIPLES

Version 1.32

Issued 7 June 2013

Engineering Standard

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Design Principles

These Signalling Design Principles outline the railway signalling standards to be use as the basic design principles for railway signalling on the New South Wales rail network.

The Signalling Design Principles include the following parts detailing the signalling design principles associated with the various railway design aspects.

Document No	Title	Version	Date
ESG 100.0	Introduction	1.2	22 August 2012
ESG 100.1	Signals	1.15	5 February 2013
ESG 100.2	Headway	1.1	May 2010
ESG 100.3	Braking Distance	1.8	7 June 2013
ESG 100.4	Overlaps	1.7	6 March 2012
ESG 100.5	Speed Restrictions	1.2	September 2011
ESG 100.6	Notice Boards	1.6	7 February 2012
ESG 100.7	Single Line Sections	1.1	May 2010
ESG 100.8	Bi-Directional Signalling	1.2	May 2010
ESG 100.9	Time Releases	1.2	July 2010
ESG 100.10	Locking Arrangements	1.3	May 2010
ESG 100.11	Approach Locking	1.4	March 2011
ESG 100.12	Route Holding	1.2	January 2011
ESG 100.13	Local Control and Override	1.4	12 February 2013
ESG 100.14	Points	1.16	4 December 2012
ESG 100.15	Trainstops	1.7	8 March 2013
ESG 100.16	Controls and Indications	1.4	7 June 2013
ESG 100.17	Track Circuits	2.2	7 June 2013
ESG 100.18	Level Crossings	2.1	6 March 2013
ESG 100.19	**Principle Withdrawn**		
ESG 100.20	Warning Lights	1.4	February 2011
ESG 100.21	Placing Signals to Stop to Protect Work Site	1.4	May 2013
ESG 100.22	Measurement of Distances on Signalling Plans	1.1	May 2010
ESG 100.23	Placement of Yard Limit Boards	1.3	May 2010
ESG 100.24	**Principle Withdrawn**		
ESG 100.25	Compressed Air Systems	2.7	7 March 2012
ESG 100.26	Berth Signs	1.2	February 2011
ESG 100.29	Naming of Locations, Track & Signals	1.4	22 August 2012
ESG 100.30	Automatic Track Warning System	1.0	September 2011
ESG 100.31	Automatic Train Protection	1.4	7 June 2013
ESG 100.32	Circuit Nomenclature	1.0	6 November 2012

ESG 100.0

INTRODUCTION

Version 1.2

Issued August 2012

Document control

Version	Date	Summary of change
1.0	March 2006	Replaced *SC 00 13 01 00 SP Introduction – v3* of May 2003.
1.1	May 2010	Application of *TMA 400* format
1.2	22 August 2012	Amend section 1.2 RailCorp Signalling Configuration Standards.

Contents

1 Introduction

1.1 Basic Signalling and Safeworking Principles

A signalling system provides for the safe and efficient movement of trains. While the method of implementation has changed over the years, the purpose remains the same, namely to:-

a) provide a reliable means of communicating information to the driver so that the driver may control the train safely according to the track and traffic conditions ahead

b) maintain a safe distance between following trains on the same line so that, irrespective of train frequency, a train can not collide with a preceding train which has stopped or is running more slowly

c) maintain a safe distance between opposing trains and provide interlocking between proceed authorities for opposing train movements

d) provide interlocking between points and proceed authorities so that conflicting movements are prevented and points are held in the required position until the train has safely passed over them

e) provide adequate warning of the approach of trains to road users and pedestrians where active level crossing warning systems are provided

f) allow trains to run at the frequency demanded by the timetable to meet commercial requirements

g) be reliable but fail-safe such that any predictable type of failure of an item of signalling equipment will lead to a more rather than less restrictive operating condition.

The principles assume trains will be driven within authorised speeds but where additional risks are identified, high-speed supervision and/or braking enforcement systems may be included in the signalling system.

The following basic principles cover the fundamental requirements in operating trains. Various systems may be developed to fulfil these requirements. The RailCorp Signalling Standards are one such solution.

The signalling principles are to be consistent with the requirements of *AS4292.4 "Railway Safety Management. Part 4 Signalling and telecommunications systems and equipment"*

1.1.1 Handsignalling

1.1.1.1 Movements Over Facing Points

Train movements must be made over facing points only after they have been visually observed to be in position. Movements conveying passengers must only be over facing points, which have been secured or locked

1.1.1.2 Speed of Trains

Speeds of trains must be regulated so as to be able to stop at points or other obstruction on sighting.

1.1.1.3 System to Ensure Points Secured

If not feasible due to the speed of traffic, then a system needs to be enforced to ensure points are locked in the correct position for the movement. This may be procedural, or by signalling equipment

1.1.2 Safeworking

1.1.2.1 Authority to Proceed

An Authority to Proceed must only be given after adequate assurance is given that the route of the train is safe and will not be obstructed.

1.1.2.2 Only Authorised Personnel to Control

Safeworking systems must be controlled only by authorised personnel and any indications or orders given are to be rigidly controlled to prevent confusion or acting on unauthorised instructions.

1.1.2.3 Safety Devices to Give Protection

Safety devices must be used to prevent unattended wagons or vehicles in sidings from running away and fouling running lines.

1.1.2.4 Level Crossings

Level crossing protection is to be provided in accordance with *AS1742* and RailCorp standards.

1.1.3 Signalling

1.1.3.1 Operator to Observe Equipment

Signalling equipment must be within good visibility of the person operating the equipment.

1.1.3.2 Equipment Beyond Visible Range

Equipment beyond the visible range of the operator or where viewing is obstructed must be enhanced with appropriate interlocking and indicators to give the operator clear understanding of the states of the equipment and/or train location and to prevent the operation of points under a train.

1.1.3.3 Design to be Fail Safe

All signalling must be designed in accordance with accepted railway fail safe principles for both mechanical and electrical equipment, e.g., the failure of any component is not to present an unsafe condition.

1.1.3.4 Equipment to be Secured

Signalling equipment is to be secured against unauthorised interference.

1.1.3.5 Equipment to be Interlocked

Signalling equipment is to be interlocked to prevent conflicting and unsafe movements and signals must separately detect the correct position and locking of facing points

1.1.3.6 Equipment to be Correctly Located

Fixed signals must be correctly located to avoid misunderstandings as to their purpose. The distance between the first warning signal and the stop signal to which it applies must be such that a train travelling at its highest authorised speed can be stopped before the stop signal.

1.1.3.7 Design, Installation, Maintenance and Testing Standards to be Defined

The design, installation, maintenance and testing of any signalling equipment must be in accordance with nominated minimum written standards. Maintenance is to be regularly done on those safety critical items where an unsafe situation could develop as a result of deterioration or adjustment of the equipment.

1.1.3.8 System to be Documented

The system is to be comprehensively documented. This documentation must be promptly updated with any changes to the system.

1.1.3.9 Alterations to be Tested and Certified

Any changes to the signalling system are to be comprehensively tested and certified before being used for train movements.

1.1.3.10 Staff to be Qualified

Staff involved in signalling installation, maintenance and testing are to be appropriately trained and qualified for the tasks they perform.

1.1.3.11 Faults to be Corrected Without Undue Delay

When a failure occurs in a component, which is essential to the safe operation of trains, the fault shall be corrected without undue delay.

1.2 RailCorp Signalling Configuration Standards

Item	Requirement	Applies To
Type of Signalling Indications	Double Light Signalling	Area within Berowra, Emu Plains, Loftus, Macarthur and Braodmeadow to Newcastle
	Single Light Signalling	Areas beyond Berowra, Emu Plains, Loftus, Macarthur and Broadmeadow to Newcastle
Modifications to existing installations	New works to be operationally consistent with existing control arrangements	Existing Installations
Braking Distances	To meet longest braking distance train that normally operates on the line at the maximum permitted speed for the train type.	All areas

Item	Requirement	Applies To
Overlaps for full Caution aspect on running signals in power signalling areas	Trip braking distance of suburban trains Minimum 300m – below 60km/h 400m - 60-79km/h 500m –80km/h & above or braking distance, if less. A distance to suit the release speed.	Train stop fitted areas Non train stop fitted areas ATP areas
Conditional Overlaps	Overlap length to be trip braking distance for conditional timing applied	Trainstop fitted areas
Headway	Defined for full clear aspects for a specified train on the particular line to meet operational requirements	All areas
System Robustness	The measure of system response to permit the return to on time running after a delay, as defined by operational requirements, and which may result in the provision of additional or conditional aspects	All areas
Train Detection	Audio Frequency Jointless track circuits Impulse track circuits Axle Counters DC track circuits -Impulse track circuits Coded track circuits - Audio Frequency Jointless track circuits Axle Counters Impulse track circuits	D.C. Electrified Areas Non-Electrified Areas Track circuits over points, in coal loops, and infrequently used tracks
Method of Control from Major Control Location	Entrance - Exit Route Setting One Control Switch (OCS) Route Setting	Complex layouts and multiple tracks Simple layouts/single lines generally without point sequencing
Emergency Facilities	Emergency Releasing Locks Emergency Switch Machine Locks or Emergency Operation Locks	Ground Frames at unattended remote interlockings Power operated point mechanisms Electropneumatic point mechanisms

Item	Requirement	Applies To
	Half Pilot Staffs Emergency Local Control Panels and/or Override	Single line sections Remote locations
Level Crossing Protection	AS1742.7 Type F lights Type F lights & booms Pedestrian	Single Lines Single/Multiple Tracks
Interlocking	All signals and points to be interlocked to prevent conflicting movements	All signalled areas.

ESG 100.1

SIGNALS

Version 1.15

Issued 05 February 2013

Document control

Version	Date	Summary of change
		Replaced *SC 00 13 01 01 SP Signals – v9.5* of 06 December 2005
1.1	3 October 2006	1.19.2.5 added
1.2	10 October 2006	Amendment to paragraph 'Should turnout repeater fail.." and added new last paragraph of 1.6.2.8
1.3	26 February 2007	1.19.5 - typo corrected and 'that' added to line 2 of second paragraph
1.4	31 July 2007	Arrangement of Repeater, Co-acting & Distant signal plates altered such that number precedes description – 1.2.6.3, 1.2.6.4, 1.2.6.5 & 1.2.7.4
1.5	18 December 2007	Amendments to Note 1 in 1.6.2.8 and reference on Figure 6
1.6	1 July 2008	1.12.2.3 - Reword air gap and OHW clearance requirement; 1.13.2 - new second paragraph 1.6 - Fig 10 layout 1.12.4.1 – Fixed trainstops @ Bufferstops Table 1.12.1 moved to sect 1.12.2.3
1.7	24 September 2008	Sect 1.2.2 General Method of Numbering Figure 1 signal number 214 changed to 209. Table 1.12.1 moved from 1.12.4.1 to end of 1.12.2.3. Section 1.12.4.1 renumbered to section 1.12.5 'Buffer Stop Lights'.
1.8	10 March 2009	Sect 1.23.3.5 – arrangement of sample text corrected
1.9	20 October 2009	1.6.2.7 – amend comments about aspects leading to a signal with restricted braking distance, add comment about fitting of repeaters Add 1.19.2.6
1.10	May 2010	Application of *TMA 400* format
1.11	1 June 2010	1.23.3.5 Black/white of sign inverted for Guards Indicator.
1.12	10 Aug 2010	Section 1.1.3 – delete reference to Shunt Ahead signals; Deleted 1.5.33, 1.5.10 & 1.6.3.3
1.13	7 June 2011	1.25.1 New section for Turnout Repeaters
1.14	2 October 2012	1.5.2.1 new section – "double Light colour signals; 1.5.2.2 – revised single light colour signals; 1.5.10 defined Distant signals; 1.11.2.2 added to include Distant signals; 1.12.4.1 Co-Acting & Repeating signal & 1.12.4.2 Landmarks
1.15	5 February 2013	Amended Figure 95.

Contents

1 Signals

1.1 Principle No. 1.1 - Form of Signals

1.1.1 Introduction

This Principle addresses the form of signals referenced throughout these Principles and with regard to the descriptions and definitions currently accepted and in use.

1.1.2 Running Signals

If a signal controls the movement of trains in the normal direction of traffic over a section of line at their normal operating speeds (or where bi-directional running is applied, in either direction) then it shall take the form of a running signal and display full size single or double light colour light aspects to the driver of a train ensuring the best possible visibility.

Exceptionally, smaller size aspects may be used in special circumstances or in sections of underground railway.

Depending on the application a running signal may be controlled or automatic.

Depending on its specific purpose a controlled running signal may be further designated an Outer Home, Home, Starting or Accepting Signal.

Depending on its mode of operation a Distant Signal may be either a controlled or an automatic signal.

1.1.3 Subsidiary Signals

If a signal controls the movement of trains over a section of line at specifically restricted speeds and is mounted on the same post, or within the same cage, as a running signal then it shall take the form of a subsidiary signal beneath the running signal and display a single small size colour light aspect to the driver of a train in addition to the full size stop aspect.

Depending on its specific purpose a subsidiary signal may be further designated a Low Speed, Call On or Shunt. The Low Speed aspect is to be considered a running signal aspect although it may be time approach cleared and not part of the running aspect sequence. The subsidiary Call On signal is utilised for a call on movement on the same route as the running signal when it is necessary to pass the running signal at stop, eg. when the running signal has failed.

The term 'Call On' is no longer preferred and 'shunt' shall be used in new work.

Shunt Ahead indications are no longer used.

1.1.4 Shunting Signal

If a signal controls the movement of trains in the normal or opposite direction of traffic over a section of line at restricted speed for shunting or non-running movements only then it shall take the form of a shunting signal and display small size colour light aspects in either horizontal or vertical form to the driver of a train.

The preferred form shall be the horizontal form.

Exceptionally, the vertical form shall be used where clearance prevents the installation of horizontal form.

1.1.5 Co-acting Signal

A signal provided to co-act with and repeat the indications of an adjacent signal for sighting purposes.

1.1.6 Repeater Signal

A signal provided to indicate the condition of a running signal in advance with restricted sighting.

1.1.7 Shunt Repeater

A subsidiary signal provided to indicate the proceed indication of the subsidiary shunting signal next in advance.

1.1.8 Low Speed Repeater

A subsidiary signal provided to indicate the proceed indication of a low speed subsidiary signal next in advance.

1.1.9 Point Indicator

A form of signal (similar to a shunt signal) provided to indicate that a set of points are in position and locked.

1.1.10 Other Signals

If a signal is used for purposes not described under one of the above forms of signal then it shall constitute another form of signal.

1.2 Principle No. 1.2 - Numbering of Signals and Points and Provision of Identification Plates

1.2.1 Introduction

This Principle addresses the requirements for systematically numbering signals on track plans, control tables and related documents and drawings, the need to provide prefixes and/or suffixes to these numbers and the characters to be shown on signal identification plates for the various forms of signals in colour light territory.

1.2.2 General Method of Numbering

Generally odd and even numbers shall be used for the down and up directions respectively with low numbers always commencing at the Sydney end and ascending towards the Country end.

Wherever possible the numbering of the signals on each track whether even or odd should be correlated to ensure that the numbers are systematically sequenced across any adjacent track and along the track in ascending number order from top to bottom and left to right respectively when Sydney is to the left of the track plan. Refer to Figure 1.

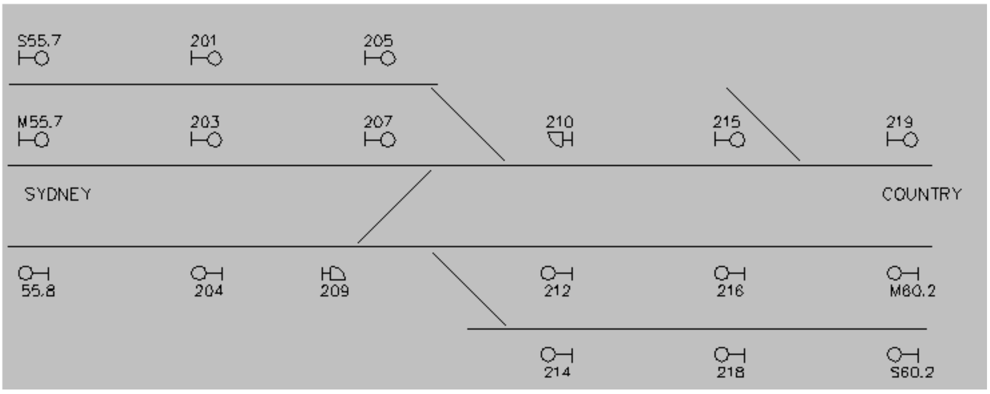


Figure 1

It is expected that some spare numbers will arise from this approach which will be available for any future needs, particularly at the low and high ends of the numbering sequence.

1.2.3 Points

All points are to have a distinctive number not exceeding four digits. For power operated points the number is to be followed by an 'A', 'B' or 'C' either as per the track plan to indicate the end or as follows:

A End nearest to Sydney

B End furthest from Sydney (country end)

C Catchpoint (only used for triple ended set)

Eg. 530A for the A end of 530 points. 17 for either single ended power or mechanically operated 17 points.

Also identify which way the points failed to go in characters 9 and 10. Eg. 530A NR 530A points failed to go from normal to reverse.

1.2.4 Track Circuits

All track circuits are to have a distinctive number not exceeding four digits plus letters and a decimal point as required, or a name consisting purely of letters, as indicated on the track plan.

Every track circuit name is to end with a 'T'.

Location id letters are not to precede the identification number as is standard in new route setting installations, but where they indicate the line and are an essential part of the identification, they are to be included. E.g. 376AT, M13.4BT, MUCT.

The kilometerage of a track circuit is to be taken from the relay end blockjoint.

1.2.5 Train Stops

Naming of train stops will be identical to its signal. Train stops without signals (intermediate trains stops etc) are to be named and shown on the circuit book or track plan.

1.2.6 Signals

1.2.6.1 Automatic Running Signals

If an automatic signal controls up direction movements towards Sydney then it shall be given an even identification number related to its distance from Sydney. Refer to Figure 2.

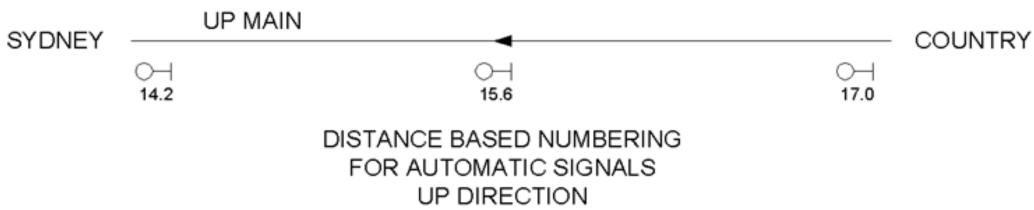


Figure 2

If an automatic signal controls down direction movements away from Sydney then it shall be given an odd identification number related to the distance from Sydney. Refer to Figure 3.

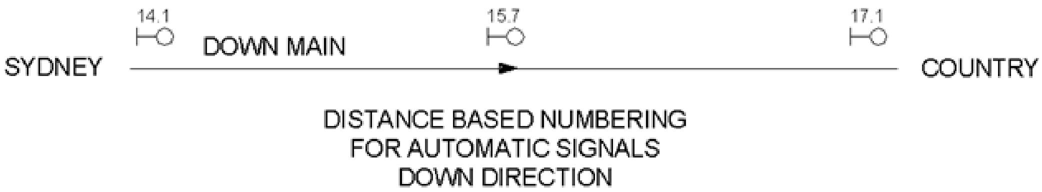


Figure 3

Either mileage or kilometerage based distances shall be used to determine the identification number which shall be expressed in miles or kilometres to the nearest one tenth of a mile or kilometre.

Consideration shall be given to the basis for determining a new numbering sequence where conflict with an existing numbering sequence could arise.

If there is more than one running line in the same direction then an alphabetic prefix not exceeding two characters shall be appended to the number to identify the particular line to which the automatic signal applies. Refer to Figure 4.

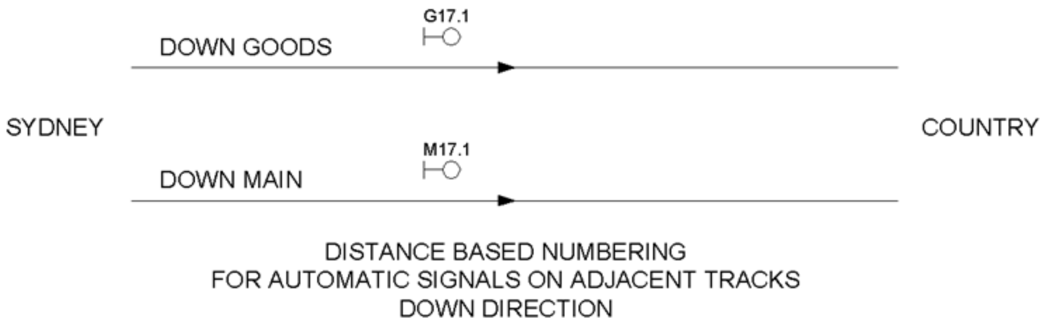


Figure 4

1.2.6.2 Controlled Running Signals

If a controlled signal controls up direction movements towards Sydney then it shall be given an even identification number unique to the interlocking area in which it is located. Refer to Figure 5.

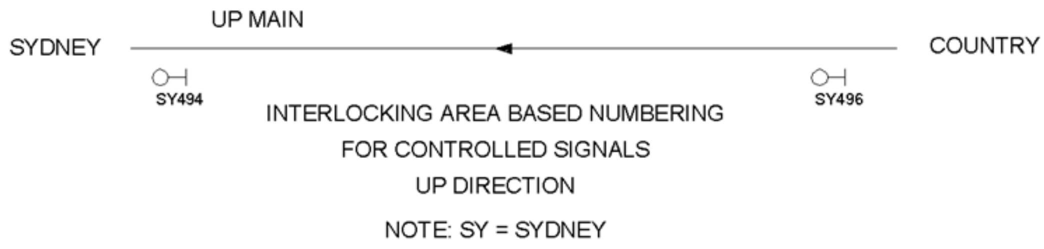


Figure 5

If a controlled signal controls down direction movements away from Sydney then it shall be given an odd identification number unique to the interlocking area in which it is located. Refer to Figure 6.

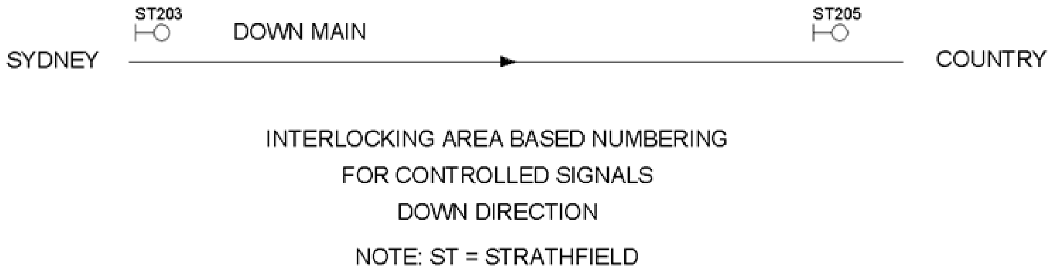


Figure 6

In addition an alphabetic prefix not exceeding two characters shall be appended to the number to identify the supervising control centre, signal box or interlocking. Refer to Figure 5 and Figure 6.

If necessary an alphabetic suffix not exceeding two characters shall be appended to the number to identify the particular line to which the controlled signal applies. Refer to Figure 7.

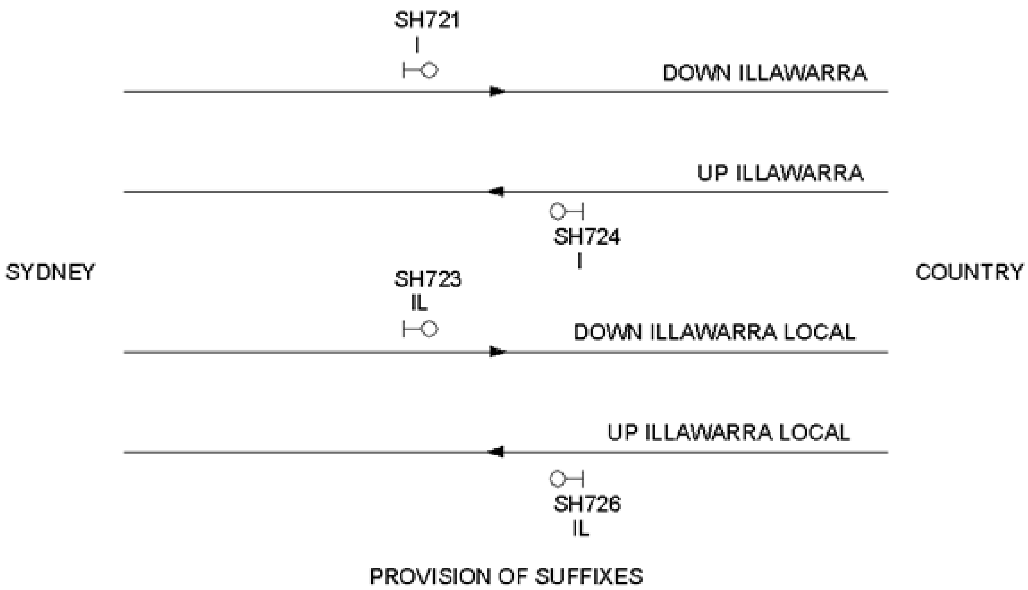


Figure 7

*Note: The prefix or suffix shall not generally be used on control tables or in circuit books unless describing a running signal in an adjacent interlocking area.

1.2.6.3 Co-acting Signals

If a situation arises which requires the provision of a co-acting signal then it shall take the number of the signal to which it applies but in addition the number shall be followed by 'CO-ACTING'.

Note: On Drivers Diagrams the co-acting signal reference shall be "Co-acting for" followed by the signal number to which it applies.

1.2.6.4 Repeating Signals

If a situation arises which requires the provision of a repeating signal then it shall take the number of the signal to which it applies, but, in addition, the number shall be followed by 'REPEATER', which may be abbreviated to 'REP' if space does not permit. (refer to 1.2.7.4)

Note: On Drivers Diagrams the Repeating Signal reference shall be "Repeater for" followed by the signal number to which it applies.

1.2.6.5 Isolated Distant Signals

If a situation arises which requires the provision of an isolated distant signal then it shall be numbered with the same number as the stop signal to which it applies but in addition the number shall be followed by 'DIS'.

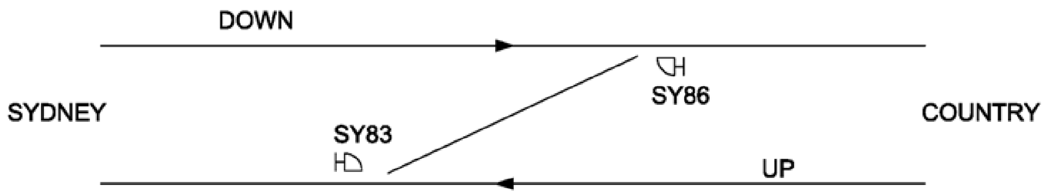
Note: On Drivers Diagrams the Distant Signal reference shall be "Distant for" followed by the number of the signal to which it applies.

1.2.6.6 Shunt Signals

If a shunt signal controls up direction movements towards Sydney it shall be given an even identification number unique to the interlocking area in which it is located.

If a shunt signal controls down direction movements away from Sydney it shall be given an odd identification number unique to the interlocking area in which it is located.

In addition to the identification number an alphabetic prefix of not more than two characters shall be given to identify the supervising control centre, signal box or interlocking. Refer to Figure 8.



INTERLOCKING AREA NUMBERING FOR SHUNTING SIGNALS

Figure 8

1.2.7 Identification Plates

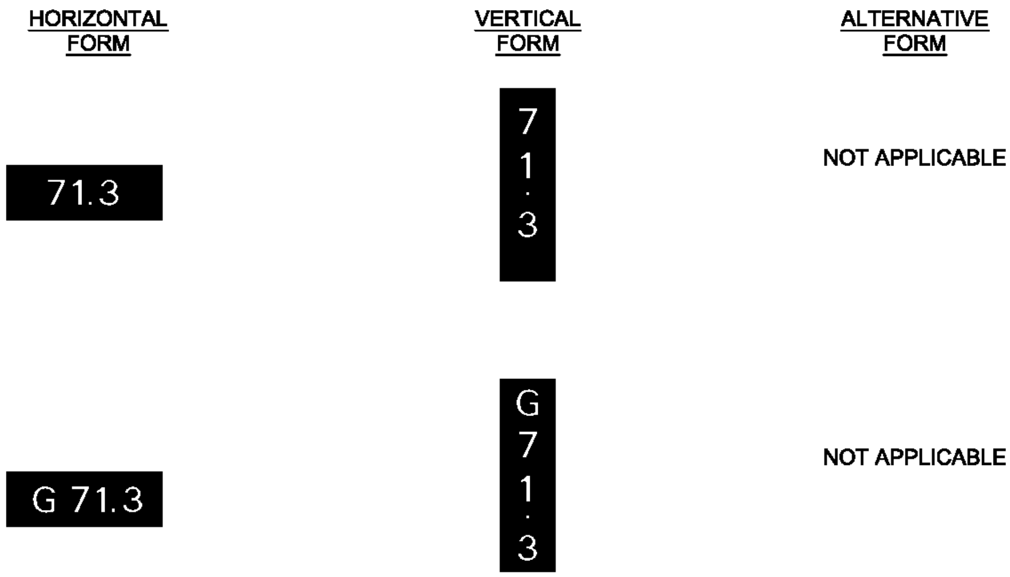
Generally if a signal is capable of displaying a stop aspect then it shall be provided with an identification plate.

The alphanumeric characters to be displayed on an identification plate shall be retroreflective white (silver) on a black background.

1.2.7.1 Identification Plates For Automatic and Controlled Running Signals

Identification plates displaying alphanumeric characters as described in Principle No. 1.2.1 and 1.2.2 and reading from left to right or top to bottom on horizontal and vertical plates respectively shall be provided on running signals.

Refer to Figure 9 and Figure 10.



WITH LINE DESIGNATION

Figure 9

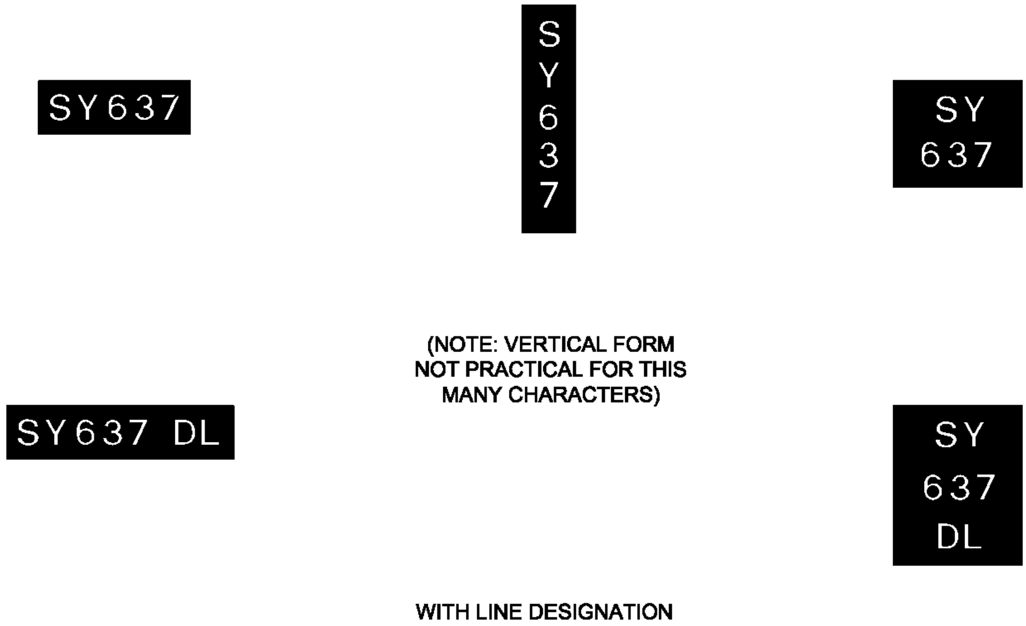


Figure 10

In either case, if a suffix is required, a space equivalent to one character shall be inserted between the number and the suffix. Refer to Figure 10.

The vertical form of identification plate shall only be used where tight clearance occurs and the horizontal form would infringe the clearance requirements.

If necessary the prefix may be displayed above the number and the suffix below the number. Refer to Figure 10.

1.2.7.2 Fixed Reds Aspects

No form of identification plate shall be provided.

1.2.7.3 Identification Plates for Co-acting Signals

Small size identification plates displaying the word CO-ACTING below the number of the running signal to which it applies shall be provided on co-acting signals. Refer to Figure 11.

Figure 11

1.2.7.4 Identification Plates for Repeating Signals

Identification plates displaying 'REPEATER' below the number of the running signal to which it applies shall be provided on repeating signals (refer to Figure 12). If space does not permit, the abbreviation 'REP' may be used (refer to Figure 13).

Figure 12

Figure 13

1.2.7.5 Identification Plates for Isolated Distant Signals

If an isolated Distant Signal shows a stop aspect then an identification plate displaying the word DISTANT below the number of the running signal to which it applies shall be provided on the Distant Signal. Refer to Figure 14.

Figure 14

1.2.7.6 Identification Plates for Shunt Signals

Small size identification plates displaying a series of alphanumeric characters as described in Principle No. 1.2.6 and reading from left to right shall be provided on shunt signals. Refer to Figure 15.

Figure 15

In addition, if a shunt signal is located on the wrong side of the track then in addition an arrow plate pointing to the track to which the signal applies shall be fitted. Refer to Figure 16.

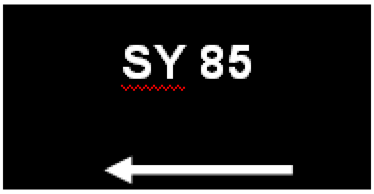


Figure 16

1.2.7.7 Identification Plates for Shunt Repeaters

Small size identification plates displaying the words SHUNT REPEATER shall be provided above the shunt repeater signal. Refer to Figure 17.

Figure 17

1.2.8 Fitting Identification Plates to Signals

It is important that identification plates are fitted in a consistent manner to enable drivers to easily identify the type and location of any signal at which they are stopped.

1.2.8.1 Fitting Identification Plates to Running Signals

If the horizontal form of identification plate is fitted to a single light colour light signal then it shall be positioned immediately below the running aspects but above any subsidiary signal or associated equipment if fitted to the signal. Refer to Figure 18.

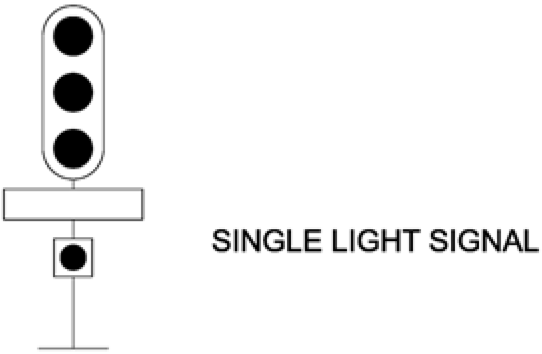


Figure 18

If the horizontal form of identification plate is fitted to a double light colour light signal then it shall be positioned between the two running aspects. Refer to Figure 19.

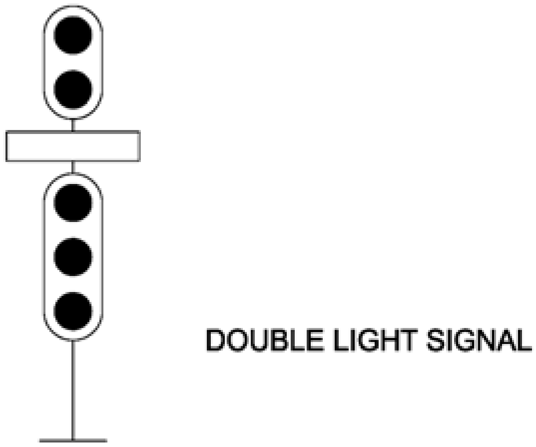


Figure 19

If there is insufficient space or the form of the signal does not allow then it shall be fitted to an adjacent structure, typically a tunnel wall, such that it is readily visible to a driver.

This may require the identification plate to be mounted at a suitable angle.

1.2.8.2 Fitting Identification Plates to Shunt Signals and Colour Light type Point Indicators

Generally identification plates shall be fitted beneath shunt signal and point indicator aspects.

Refer to Figure 20.

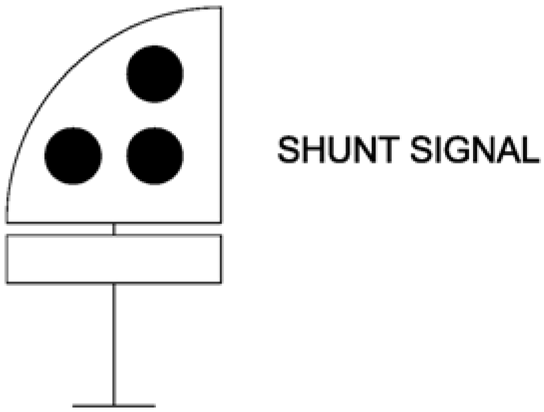


Figure 20

1.2.9 Deleted

1.2.10 Signals Located on the Wrong Side of the Track

Where necessary, an arrow plate pointing to the track the signal applies to may be fitted if the signal is positioned on the wrong side of the track. Refer to Figure 16.

1.3 Principle No 1.3 – Designation of Class and Direction of Routes

1.3.1 Introduction

This Principle addresses the requirements for designating the class and/or direction of routes as applicable to running signals, running signals fitted with subsidiary and shunting signals in colour light territory.

1.3.2 Class of Route

1.3.2.1 Main Routes

If a route is associated with a controlled running signal then it shall be classified as a main route and designated (M).

To identify a particular main route the class designation shall appear as a first suffix to the running signal number. Refer to Figure 21.

1.3.2.2 Subsidiary Routes

If a route is associated with a subsidiary signal then it shall be classified as a subsidiary route and designated (S).

To identify a particular subsidiary route the class designation shall appear as a first suffix to the running signal number. Refer to Figure 22.

1.3.2.3 Shunt Routes

If a route is associated with a shunting signal then it shall be classified as a shunt route and designated (S).

To identify a particular shunting route the class designation shall appear as a first suffix to the shunting signal number. Refer to Figure 23.

1.3.3 Direction of Route

If a route is associated with a signal which controls diverging movements then the route applicable to each possible divergence shall be allocated a route direction designation in addition to the class designation.

The route direction designation shall be a unique alphabetic character.

The alphabetic characters shall be allocated such that the most left-hand diverging route is designated A. Refer to Figure 24.

If there is a divergence ahead of a signal to which no signalled move exists then a reserved route direction shall be allocated for future use. Refer to Figure 24.

If the direction of a main and subsidiary class of route is coincidental they shall be allocated the same route designation character. Refer to Figure 24.

To identify a particular diverging route the route designation character shall appear as second suffix to the signal number and class of route. Refer to Figure 24.

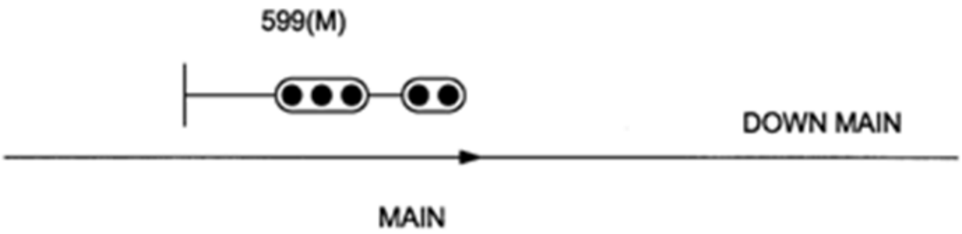


Figure 21 - Route Classification

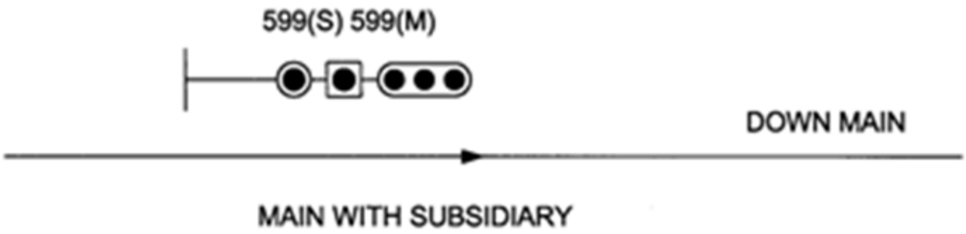


Figure 22 - Route Classification – Principle No 1.3

Figure 23 - Route Classification

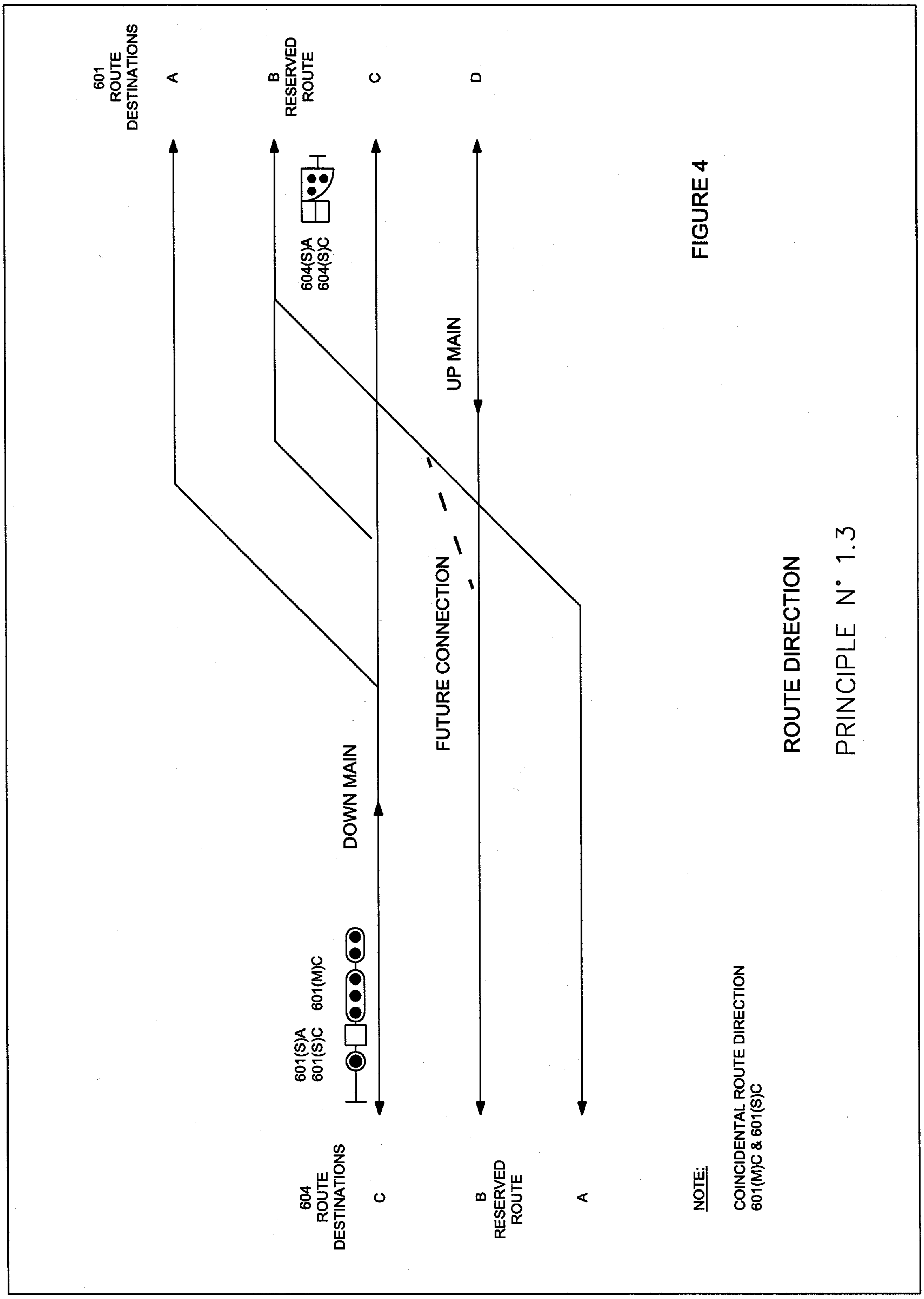


Figure 24 - Route Direction

1.4 Principle No. 1.4 - Route Indicators and Turnout Repeaters

1.4.1 Introduction

This Principle addresses the requirements for providing route indicators and turnout repeaters on running signals and route indicators on subsidiary signals and shunting signals in colour light territory to supplement the proceed aspect by displaying an indication of the route destination.

1.4.2 Route Indicators Fitted To Running Signals

1.4.2.1 Double Light Colour Light Signals

If a double light colour light signal applies to more than one diverging route then it shall be fitted with a main line route indicator to supplement the turnout indication. Refer to Figure 25 and Figure 26**Error! Reference source not found.**.

1.4.3 Single Light Colour Light Signals

If a single light colour light applies to more than one diverging route to the left or the right then it shall be fitted with a main line route indicator to supplement the turnout indication. Refer to Figure 27 and Figure 28.

1.4.4 Colour Light Signals Reading to Several Terminal Roads

If a colour light signal is the last signal which applies to several terminal roads then it is permissible to provide a main line route indicator to supplement the caution indication.

1.4.5 Position of Main Line Route Indicators

Generally the main line route indicator shall be mounted immediately above the top most running aspect unless:

a) Sighting would be impaired typically for example in the vicinity of station structures.

b) Space is restricted typically for example in a gantry cage or beneath an overhead bridge.

c) Refer to Figure 29.

1.4.6 Route Indicators Fitted To Subsidiary Signals

1.4.6.1 Subsidiary Signals

If a subsidiary signal applies to more than one route or the route leads to a “wrong road” situation then it shall be located directly beneath the main aspect and be fitted with a route indicator to supplement the proceed indication. Where the subsidiary shunt signal applies only to a turnout route then the signal may be bracketed to the side of the post in the direction of the turnout and no route indicator is required. Refer to Figure 30, Figure 31 and Figure 32.

1.4.6.2 Position of Stencil Route Indicator

Generally the route indicator shall be mounted immediately above the subsidiary aspect to which it applies unless space is restricted typically in a gantry cage. Refer to Figure 33.

1.4.7 Route Indicators Fitted To Shunting Signals

1.4.7.1 Shunt Signals

If a shunting signal applies to more than one route or the route leads to a “wrong road” situation then it shall be fitted with a route indicator to supplement the proceed indication. Refer to Figure 34 and Figure 35.

1.4.7.2 Position of Stencil Route Indicators

The route indicator shall be mounted immediately above the shunt signal to which it applies. Refer to Figure 34 and Figure 35.

1.4.7.3 Restricted Clearance

If a shunting signal is located such that there is insufficient clearance to fit for example, a stencil type route indicator then a miniature multilamp type route indicator shall be fitted. Refer to Figure 36.

1.4.8 Characters To Be Displayed In Route Indicators

These shall be alphanumeric and preferably limited to a single alphanumeric character.

1.4.9 Turnout Repeaters Fitted to Running Signals

Where it is required to provide advance warning that the turnout route is set at a junction, a turnout repeater shall be fitted on the first warning signal in the rear of the turnout signal. Refer to Figure 37 and Principle 1.6. Turnout repeaters provide drivers of trains an early warning that a turnout route through the junction is set for the train and enables train speed to be more readily controlled to the turnout speed.

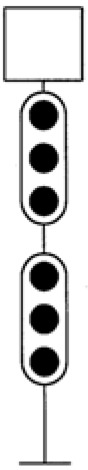


Figure 25 - Route Indicators

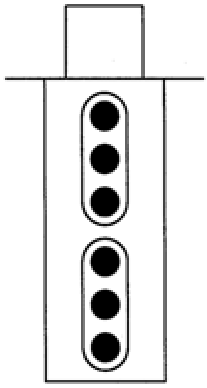


Figure 26 - Route Indicators

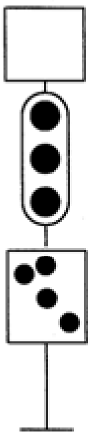


Figure 27 - Route Indicators

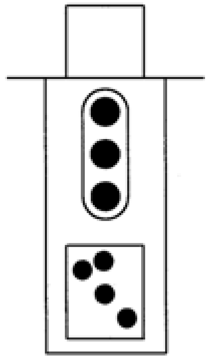
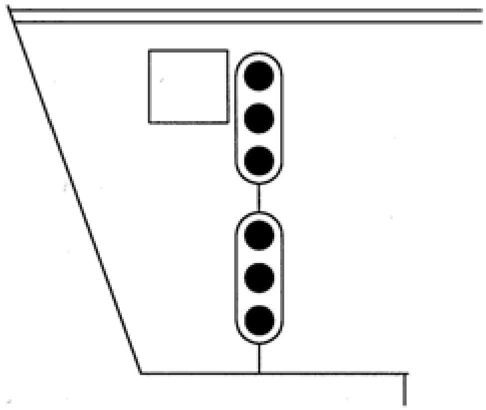
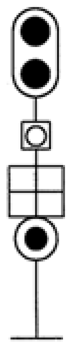


Figure 28 - Route Indicators



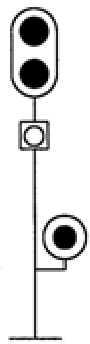
MAIN LINE R.INDR ADJACENT
TO TOP HEAD DUE TO
RESTRICTED CLEARANCE

Figure 29 - Route Indicators



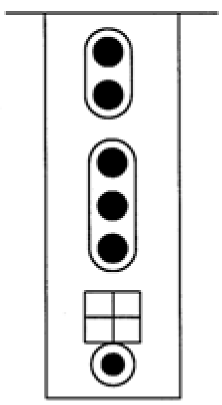
POST MOUNTED
SUBSIDIARY

Figure 30 - Route Indicators

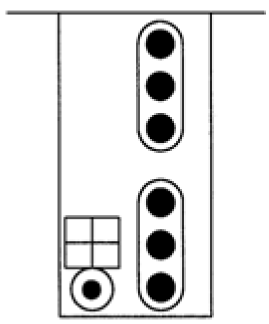


POST MOUNTED
SUBSIDIARY

Figure 31 - Route Indicators



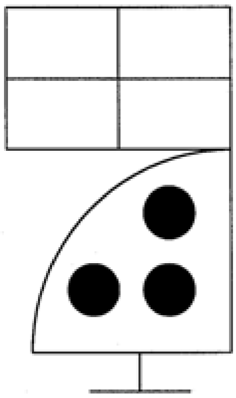
GANTRY MOUNTED
SUBSIDIARY



STENCIL MOUNTED ABOVE SUBSIDIARY
SIGNAL, ADJACENT TO LOWER HEAD, DUE TO
RESTRICTED CLEARANCE

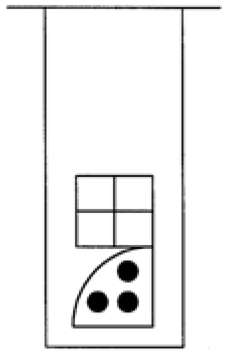
Figure 32 Route Indicators

Figure 33 - Route Indicators



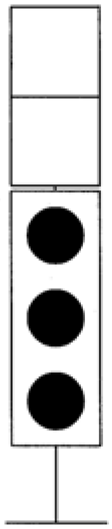
HORIZONTAL FORM OF
SHUNT SIGNAL

Figure 34 Route Indicators



GANTRY MOUNTED
SHUNT

Figure 35 Route Indicators



VERTICAL FORM OF SHUNT SIGNAL FOR RESTRICTED
CLEARANCE SHOWN FITTED WITH A SINGLE MINIATURE
MULTILAMP UNIT

Figure 36 - Route Indicators

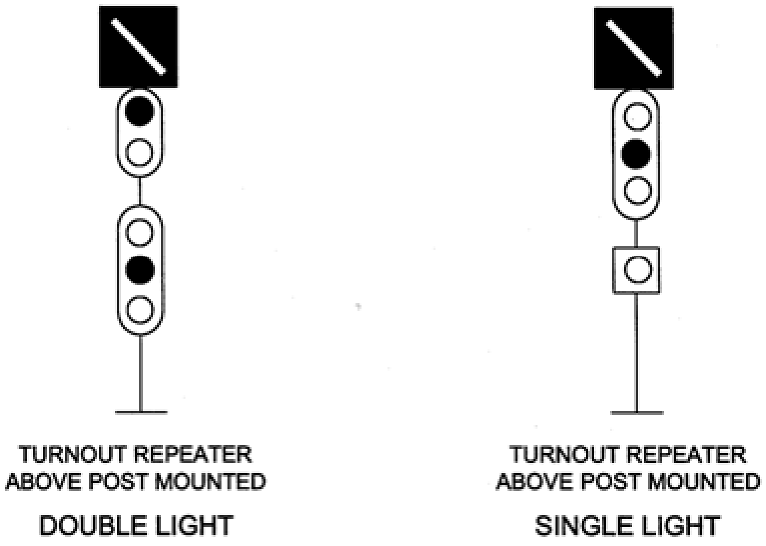


Figure 37 - Turnout Repeaters

1.5 Principle No. 1.5 - Form of Aspects

1.5.1 Introduction

This Principle addresses the form of colour light signal aspects displayed to drivers as referred throughout these principles.

1.5.2 Running Signal Aspects

These forms of aspects for running signals other than the stop aspect shall authorise running movements at the appropriate operating speed.

1.5.2.1 Double Light Colour Lights

a) The form of the Stop aspect shall be Red over Red.

b) The form of the Caution aspect shall be Green over Red.

c) The form of the Medium aspect shall be Green over Yellow.

d) The form of the Preliminary Medium aspect shall be Green over Pulsating Yellow.

e) The form of the Clear aspect shall be Green over Green.

f) The form of the Caution Turnout shall be Yellow over Red.

g) The form of the Medium Turnout shall be Yellow over Yellow.

h) The two running signal aspects on controlled double light colour light signals shall be vertically aligned on the centre line of the signal. Refer to Principle No. 1.11.

i) The two running signal aspects on automatic double light colour light signals shall be vertically staggered with the lower aspect to the right of the top aspect. Refer to Principle No. 1.11.

1.5.2.2 Single Light Colour Light Signals

j) The form of the Stop aspect shall be Red. (A red marker light shall also be shown except a distant signal where no marker will be shown where that signal displays a stop).

k) The form of the Caution aspect shall be Yellow.

l) The form of the Medium aspect shall be pulsating Yellow. Refer to Principle No. 1.5.8.

m) The form of the Clear aspect shall be Green.

n) The form of the Caution Turnout shall be a band of three yellow lights appropriately inclined at 45° to indicate if turning out to the left or the right of the straight line. This shall be displayed in addition to the Stop aspect but without the marker light. Refer to Principle No. 1.11.

o) The form of the Medium Turnout shall be a band of three pulsating yellow lights as described in (v) above. This shall be displayed in addition to the Stop aspect but without the marker light. Refer to Principle No. 1.5.8.

p) The form of the Normal Authority aspect shall be a pulsating white.

q) The form of the marker light on a distant signal shall be yellow.

1.5.3 Subsidiary Signal Aspects

These forms of aspects for subsidiary signals shall authorise movements at the appropriate restricted operating speed past the running signal to which they are fitted and only if the running signal is displaying a Stop aspect.

1.5.3.1 Low Speed Signal

The form of the proceed aspect shall be green.

1.5.3.2 Shunt Signal

The form of the proceed aspect shall be yellow.

1.5.3.3 Deleted

1.5.4 Shunt Signal Aspects

These forms of aspects for shunt signals other than the Stop aspect shall authorise movements at the appropriate restricted speed for shunting or other non-running move purposes.

1.5.4.1.1 Horizontal Form

r) The form of the Stop aspect shall be two Reds.

s) The form of the Proceed aspect shall be a Yellow.

t) The Proceed aspect shall be located immediately above the Stop aspect in the horizontal form of shunt signal.

1.5.4.1.2 Vertical Form

u) The form of the Stop aspect shall be two Reds.

v) The form of the Proceed aspect shall be a Yellow.

w) The Proceed aspect shall be located between the two red aspects in the vertical form of Shunt signal.

1.5.5 Shunt Repeater Signal Aspect

The subsidiary aspect for indicating that the next subsidiary shunting signal is displaying a proceed indication is two white diagonal lights. A notice board “Shunt Repeater” is displayed above the subsidiary signal.

1.5.6 Low Speed Repeater Signal Aspect

The subsidiary aspect for indicating that the next subsidiary low speed signal displaying a proceed indication is two diagonal white lights.

1.5.7 Co-Acting Signal Aspects

These forms of aspects shall be as far as possible the same as the main signal, although using smaller lampcases.

Where a double light co-acting signal cannot be installed due to space limitations, then it will be permissible to use a single light type co-acting signal. When necessary, caution, medium, caution turnout and medium turnout can be displayed via a single yellow in the co-acting signal together with a route indicator.

Shunt aspects on co-acting signals shall be visibly separate from main aspects.

1.5.8 Repeater Signal Aspects

These forms of aspects shall be a horizontal band of white light when the next signal is at stop, or displaying any subsidiary aspect, and a vertical band of white light, when the next signal is cleared to any running aspect.

1.5.9 Pulsating Aspects

If the form of aspect required is to be pulsating then it alternately switches the lamp for periods of 640 (on) and 200 milliseconds (off) respectively. This produces a pulse rate of approximately 70 per minute.

1.5.10 Distant signals (single Light Type)

The marker light on a single light distant signal shall be yellow.

The marker light shall only illuminate if the main light fails.

Where a red aspect is provided, the distant shall display red (no marker light) when the track between the distant and the next controlled or automatic signal, or the overlap is occupied. No marker light shall display if the main head red fails.

1.5.11 Turnout Repeater Aspect

The form of the turnout repeater is a band of white inclined at 45º in the direction of the turnout. Refer to Principle 1.11.

1.5.12 Main Line Indicator Aspects

Main Line Indicators (MLIs) may be used in Train Order, Electric or Ordinary Train Staff and other systems where approved.

Main Line Indicators can display the following aspects:

Aspect	Indication	Meaning
RED	STOP	Stop-points are unlocked or out of position and/or level crossing protection is qualified.
YELLOW	CAUTION	Drivers may proceed in accordance with their authority, prepared to stop at the indicator ahead.
PULSATING LUNAR WHITE	NORMAL AUTHORITY	Drivers may proceed in accordance with their authority.
RED OVER INCLINED LUNAR WHITE BAND OF LIGHTS	TURNOUT AUTHORITY	Points set for turnout. Drivers may proceed in accordance with their authority.

A white retro-reflective diamond is provided on the post as a marker in the event of the indicator lights failing, to identify the structure as a Main Line Indicator.

The indicator name is displayed in black letters on the white retro-reflective diamond.

Main Line Indicators are used for their longer sighting distance where it is desirable to maintain higher train speeds than would be possible due to the restricted sighting of mechanical point indicators, and where electrical protection is necessary in conjunction with motor worked points or level crossings.

Main Line Indicators are normally lit but can be approach lit or time cleared if required.

A landmark, location board or repeater must be provided prior to a Main Line Indicator.

A Main Line Repeater conveys to the driver the indication displayed by the indicator ahead. The train movement itself is made on the authority of the train order.

Main Line Repeaters can display the following aspects:

Aspect	Indication	Meaning
PULSATING LUNAR WHITE	NORMAL AUTHORITY	Drivers may proceed in accordance with their authority.

Aspect	Indication	Meaning
YELLOW	CAUTION	Drivers may proceed in accordance with their authority, prepared to stop at the indicator ahead.
PULSATING YELLOW	MEDIUM	Drivers may proceed in accordance with their authority, the next indicator is displaying a turnout authority.

A white retro-reflective diamond with the indicator ahead name and the word “REPTR’ in black letters is provided on the post as a marker in the event of the repeater lights failing, to identify the structure as a Main Line Repeater.

Main Line Repeaters are normally lit but can be approach lit if required.

Main Line Repeaters may negate the need for a landmark or location board.

(NOTE: Location boards are always required in Train Order areas to ensure drivers are aware of the name of the location).

If there is insufficient braking distance between the Main Line Repeater and the Main Line Indicator, then the landmark or location board must be provided prior to the Main Line Repeater at a minimum of braking distance to the Main Line Indicator.

A diagram of the indications is shown in Figure 38 and Figure 39.

1.5.13 Point Indicator Aspects

The form of the point indicator aspects shall be:

- Two red lights for a stop aspect.
- A white arrow pointing to the track for which the indicator applies.

A position light or dwarf colour light form may be used.

The forms of the aspects are shown in Figure 40. Note one red light is permissible for a facing point indicator with two routes.

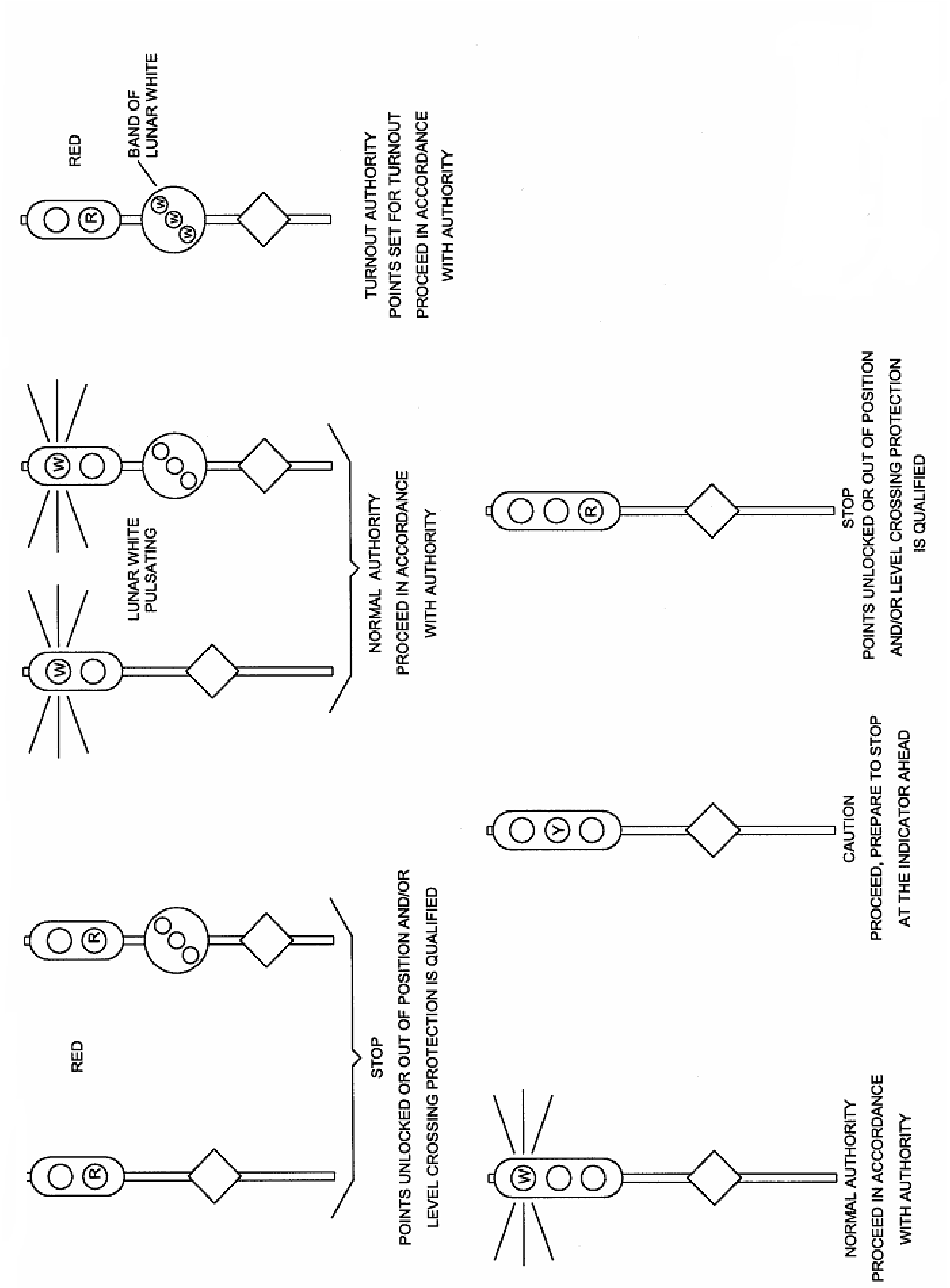


Figure 38 - Main Line Indicators Figure

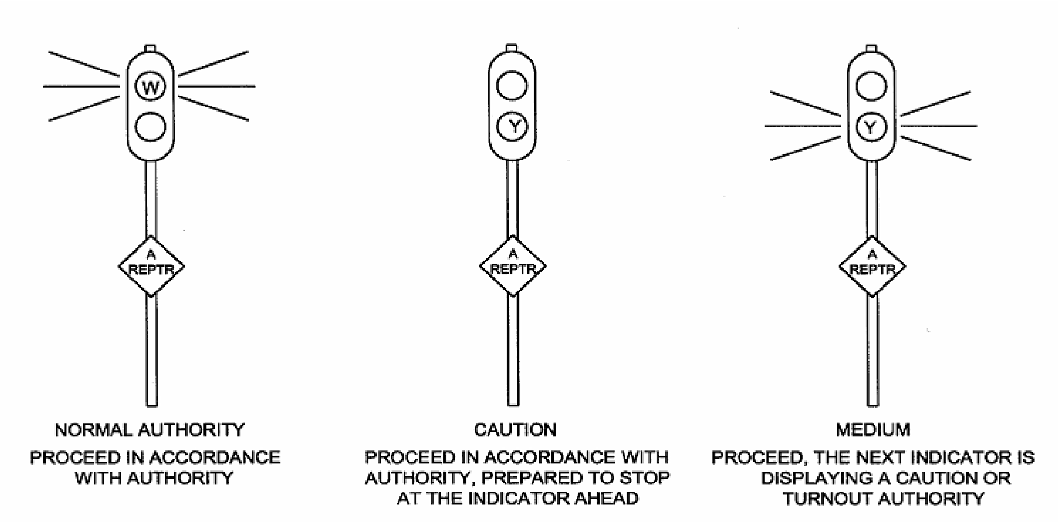


Figure 39 - Main Line Repeaters

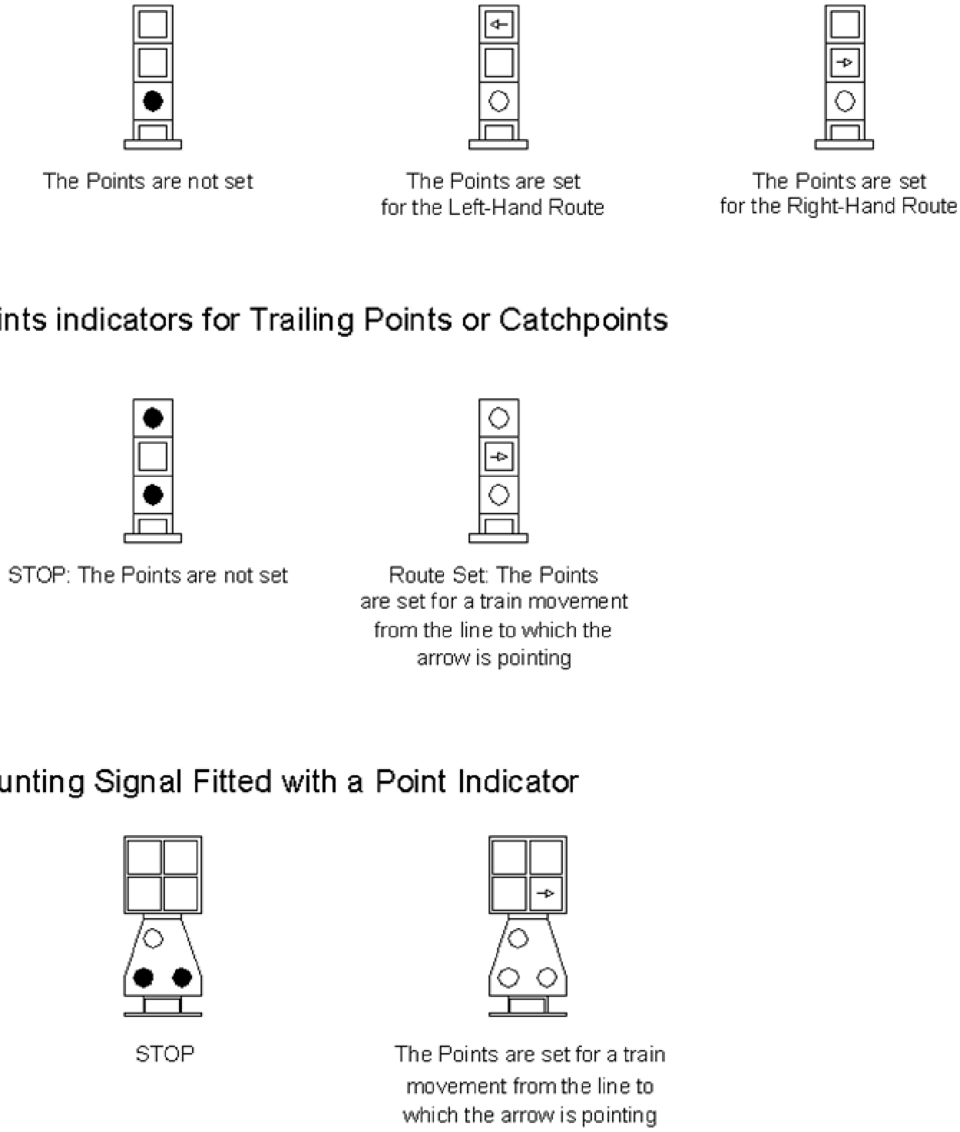


Figure 40 – Point Indicator Aspects

1.6 Principle No. 1.6 - Application of Aspects

1.6.1 Introduction

This Principle addresses the requirements for the provision of particular aspects for specific applications.

1.6.2 Running Signals

1.6.2.1 Caution Aspect

If it is required to clear a running signal as far as the buffer stop on a platform line at a terminal station then a caution aspect shall be displayed. Refer to Figure 41.

1.6.2.2 Conditional Caution Aspect

If it is required to clear a running signal and a full overlap is not available but a reduced overlap has been provided and is available then a conditional caution aspect shall be displayed.

The conditional caution aspect shall be cleared after the berth track circuit has been occupied for an appropriate period of time to ensure that the train speed has been reduced commensurate with its approach to the reduced overlap. Refer to Principle No. 4.7.

1.6.2.3 Caution Turnout Aspect

If it is required to clear a running signal to show a running turnout and the running signal in advance is displaying a stop aspect then the running turnout signal shall display a caution turnout aspect.

A caution turnout shall also be displayed if the braking distance from the next signal to the signal beyond that is not sufficient for a train to approach at the turnout speed. Refer to Figure 50.

1.6.2.4 Medium Aspect

If it is required to clear a running signal to show a caution aspect and the caution aspect is less than braking distance from the stop signal to which it applies then the running signal immediately in rear of the signal required to show the caution aspect shall display a medium aspect. Refer to Figure 42.

The signal required to display the medium aspect shall be at or at greater than braking distance from the stop signal to which it applies.

1.6.2.5 Preliminary Medium Aspect

Where multiple aspects are required for braking distance, approaching the stop or turnout signal, the signals up to the medium before the caution or turnout aspect, may display preliminary medium.

1.6.2.6 Medium Turnout Aspect

If it is required to clear a running signal to show a running turnout and the running signal in advance is displaying a caution aspect with sufficient braking distance at the turnout speed or any higher aspect or if no signal is provided but the block section in advance is clear then the running turnout signal shall display a medium turnout aspect.

1.6.2.7 Medium Aspect with Turnout Repeater

If it is required to clear a home signal to show a caution turnout or medium turnout aspect then the running signal immediately in rear, if it is at sufficient braking distance from the home signal[1] shall display a medium aspect with turnout repeater. Refer to Figure 43.

[1] The braking distance required to reduce the train speed from line speed to turnout speed.

Where multiple medium aspects are required in the rear of the turnout signal due to the braking distance required, the signal immediately in the rear of the turnout signal shall display a medium, and any further signals before that shall display a preliminary medium indication. The first preliminary medium shall be provided with a turnout repeater.

It will also be permissible for a turnout repeater to be provided on subsequent preliminary mediums or medium should a number of signals be provided between the first turnout warning signal and the signal at the turnout. Situations where additional turnout repeaters should be considered are:

x) Where drivers may normally approach the turnout signal at stop and the signal may be cleared on approach.

y) Where a platform exists after the first turnout repeater is displayed.

z) Where there are possible sources of distraction for drivers.

aa) Where the speed differential from line speed to turnout speed is high.

In new works, all medium or preliminary medium signals leading to a turnout shall have turnout repeaters fitted.

Refer to Figure 46.

1.6.2.8 Turnout Aspects – Combinations

Where equal 80 Km/h or higher medium/high speed junctions exist (ie track speed is equal for all routes), the following indications are displayed on the approach and home signals leading up to the medium/high speed junction. The home signal is fitted with a main line route (M.L.R) indicator. Refer to Figure 44.

Approach Signal Indication	HOME SIGNAL INDICATION
Caution	Stop
Medium with Turnout Repeater	Caution with M.L.R. Indicator
Clear with Turnout Repeater	Medium with M.L.R. Indicator
Clear with Turnout Repeater	Clear with M.L.R. Indicator

For all other applications where the speed through the turnout is lower than the main route speed, the home signal is only fitted with a main line route indicator if there is more than one turnout route or where special circumstances exist and are approved by the Chief Engineer, Signals. Refer to Figure 45.

Approach Signal Indication	HOME SIGNAL INDICATION
Caution	Stop
Medium	Caution
Medium with Turnout Repeater	Caution Turnout
Clear	Medium
Medium with Turnout Repeater	Medium Turnout
Clear	Clear

For all other applications, *in double light signalled areas only*, where the speed through the turnout is lower than the main route speed and there is insufficient braking distance between the home signal and the signal in the rear, the following indications are displayed on the two (2) approach signals and the home signal leading up to the turnout. The home signal is fitted with a main line route indicator if there is more than one turnout route or where special circumstances exist and are approved by the Chief Engineer, Signals. Refer to Figure 46.

1st Approach Signal Indication	2nd Approach Signal Indication	Home Signal Indication
Medium	Caution	Stop
Preliminary Medium	Medium	Caution
Preliminary Medium with Turnout Repeater	Medium – (refer to Note 1)	Caution Turnout
Clear	Clear or Preliminary Medium	Medium
Preliminary Medium with Turnout Repeater	Medium – (refer to Note 1)	Medium Turnout
Clear	Clear	Clear

Note 1: Turnout repeaters may also be provided on these signals.

Should the turnout repeater fail to illuminate when required, the aspects on that signal shall be consistent with the junction signal at stop, (or at low speed, if the low speed is part of the aspect sequence).

If a junction signal is cleared after the train has passed the signal with the turnout repeater, then the aspect approaching the junction must not step up unless turnout repeaters are provided on the other signals.

For new works, turnout repeaters shall be provided on each signal from the first warning aspect to the signal prior to the turnout signal.

1.6.3 Subsidiary Signals

1.6.3.1 Low-Speed Aspect (in Trainstop Territory)

If it is required to clear a running signal fitted with a low speed subsidiary and no overlap or a reduced overlap is available then a low speed aspect shall be displayed. Refer to Figure 47.

The low speed aspect shall be cleared after the berth track circuit has been occupied for an appropriate period of time to ensure that the train speed has been reduced commensurate with its approach to the running signal in advance without the safety margin provided by a full overlap.

The low speed aspect shall only clear in conjunction with the clearing of the trainstop at the signal.

The form of this aspect shall be a green light. Refer to Principle No 1.5.

Note: The existing low speed aspects on the City Underground, Eastern Suburbs Line, Sydney-Strathfield and some other areas are an exception to the above requirement.

1.6.3.2 Low-Speed Aspect (Single Light Signals in CTC Territory)

If it is required to clear a home signal fitted with a low speed subsidiary and the main line or loop starting signal is at stop and no overlap or a reduced overlap is available then a low speed aspect shall be displayed. Refer to Figure 48.

If the Stop aspect of the home signal is proved to be alight then the clearing of the low speed aspect shall not be subject to berth track circuit occupancy control.

If the Stop aspect of the home signal is proved to be out then the clearing of the low speed aspect shall be delayed until the train is closely approaching the signal. Refer to Principle 1.17.4 rrr).

The form of this aspect shall be a green light. Refer to Principle No. 1.5.

1.6.3.3 Deleted

.

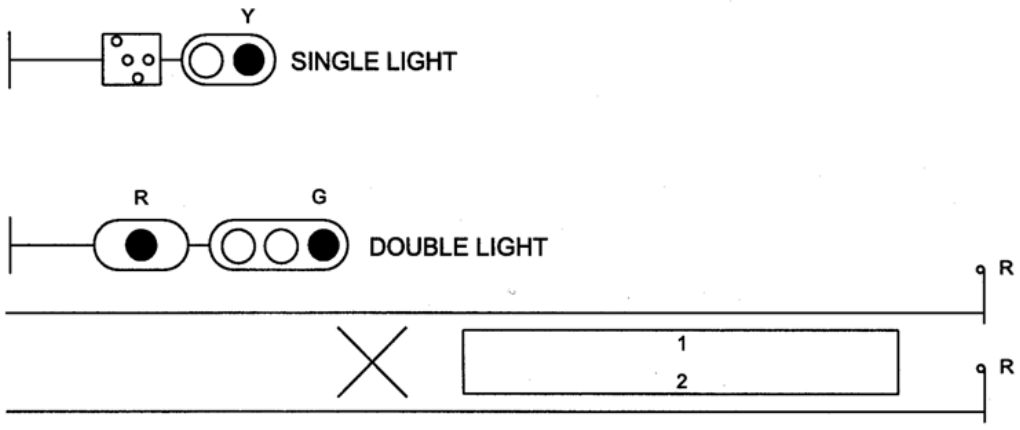
1.6.4 Point Indicators

When a route is required to be set for shunting purposes in a siding and it is desired that the signaller does not have to set and reset the route for each movement, a point indicator aspect may be displayed on the shunting signal.

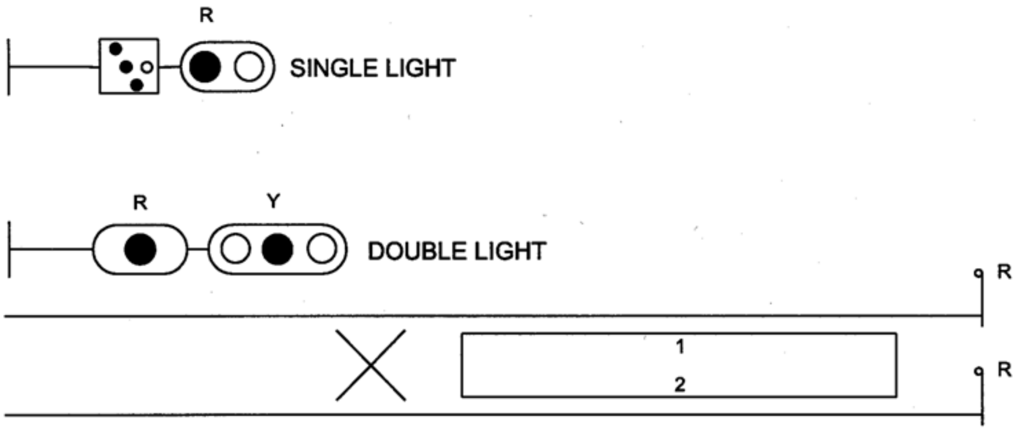
The point indicator within the siding and the opposing shunt signal point indicator aspects may be displayed simultaneously.

As the movements may take place into non track circuited areas, an approach locking time release must expire after the indicators have returned to stop and before the route is normalised.

The point indicator does not, in itself, authorise a movement, but provides an assurance that the points are set and locked so that a shunter may authorise the actual movement.



PROVISION OF CAUTION ASPECT INTO TERMINAL PLATFORM 1



PROVISION OF CAUTION ASPECT INTO TERMINAL PLATFORM 2

Figure 41 - Application of Aspects

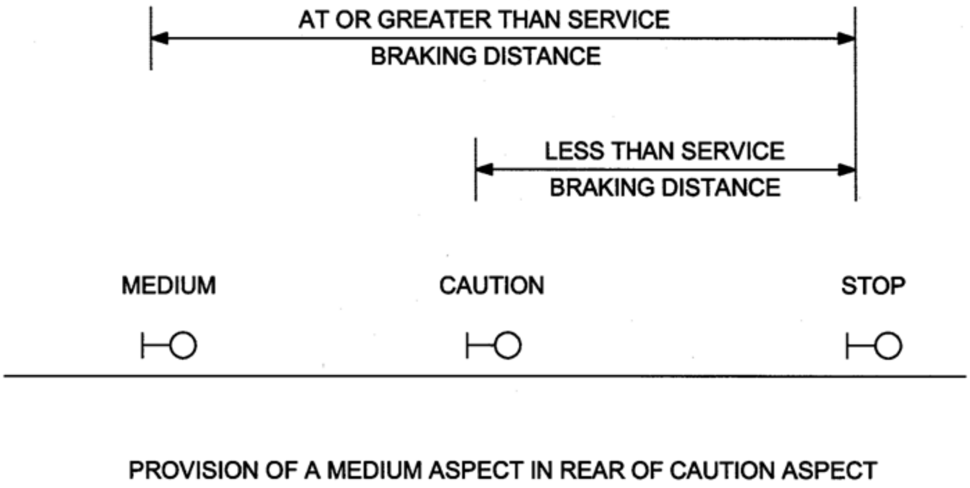


Figure 42 - Application of Aspects

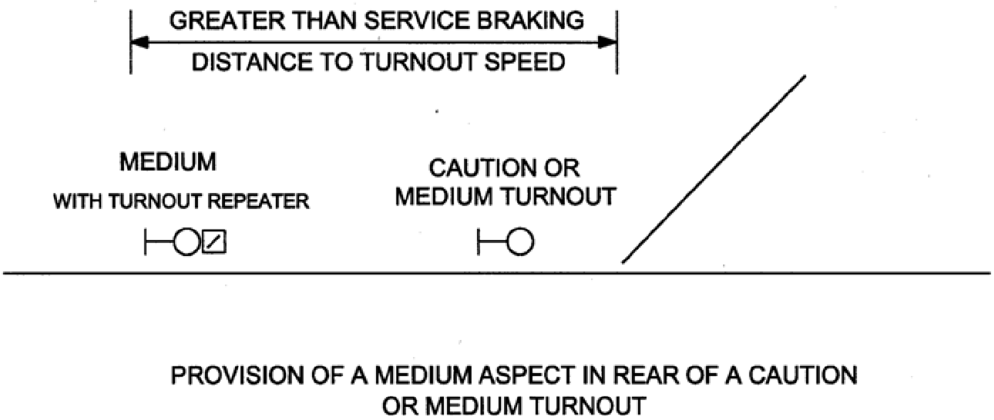
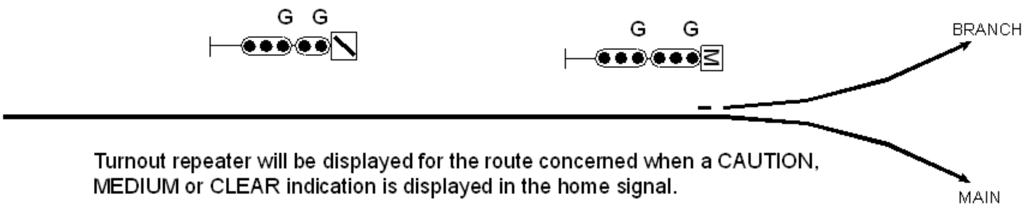


Figure 43 - Application of Aspects

EQUAL MEDIUM / HIGH SPEED JUNCTION

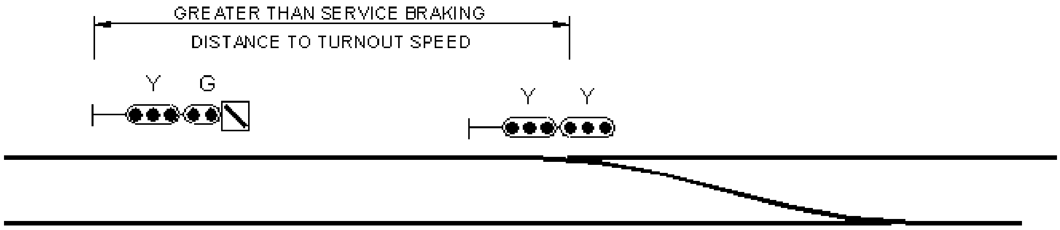


Turnout repeater will be displayed for the route concerned when a CAUTION, MEDIUM or CLEAR indication is displayed in the home signal.

APPROACH SIGNAL INDICATION		HOME SIGNAL INDICATION		
Lampcase:- Bottom	Top	Lampcase:- Bottom	Top	
R	G	R	R	
Y	G /	R	G	B
Y	G \	R	G	M
G	G /	Y	G	B
G	G \	Y	G	M
G	G /	G	G	B
G	G \	G	G	M

Figure 44 - Application of Aspects

OTHER TURNOUTS



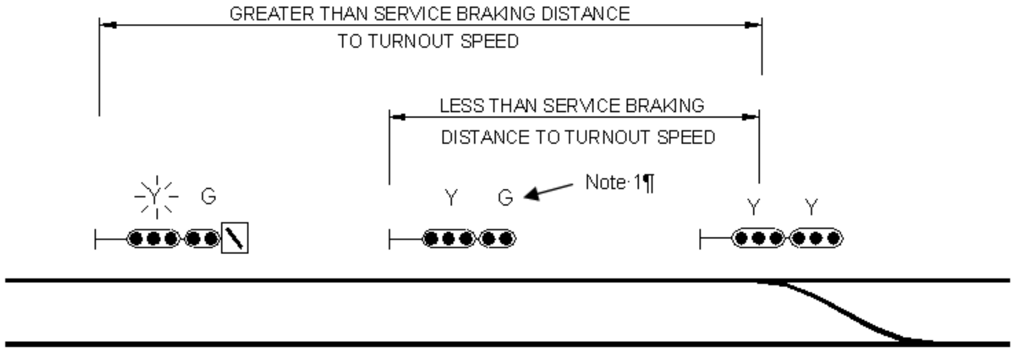
Turnout repeater will be displayed for the turnout route when a CAUTION turnout or MEDIUM turnout indication is displayed in the home signal.

APPROACH SIGNAL INDICATION			HOME SIGNAL INDICATION	
Lampcase:- Bottom	Top		Lampcase:- Bottom	Top
R	G		R	R
Y	G	STRAIGHT ROUTE	R	G
Y	G \	TURNOUT ROUTE	R	Y
G	G	STRAIGHT ROUTE	Y	G
Y	G \	TURNOUT ROUTE	Y	Y
G	G	STRAIGHT ROUTE	G	G

Figure 45 - Application of Aspects

DOUBLE LIGHT SIGNAL AREAS ONLY

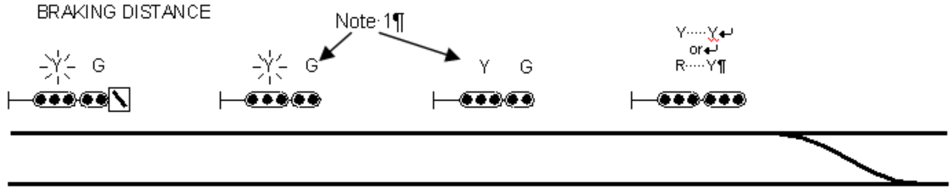
SECOND WARNING SIGNAL AT LESS THAN BRAKING DISTANCE FROM HOME SIGNAL



Junction repeater and preliminary medium indication will be displayed for the turnout route when a CAUTION turnout or MEDIUM turnout indication is displayed in the home signal.

1st APPROACH SIGNAL INDICATION Lampcase:- Bottom	Top		2nd APPROACH SIGNAL INDICATION Lampcase:- Bottom	Top		HOME SIGNAL INDICATION Lampcase:- Bottom	Top
Y	G		R	G		R	R
G	G	Note 1¶	Y	G	STRAIGHT ROUTE	R	G
Y	G		Y	G	TURNOUT ROUTE	R	Y
G	G	Note 1¶	Y	G	STRAIGHT ROUTE	Y	G
Y	G		Y	G	TURNOUT ROUTE	Y	Y
G	G		G	G	STRAIGHT ROUTE	G	G

ASPECT PROGRESSION WHERE THREE WARNING INDICATIONS ARE NECESSARY TO OBTAIN REQUIRED BRAKING DISTANCE



In this situation, if the turnout repeater does not illuminate, both the first and the second approach signals are to step back to MEDIUM and the third approach signal is to step back to CAUTION.

Note 1: Turnout repeaters may also be provided on these signals. (refer to 1.6.2)¶

Figure 46 - Application of Aspects

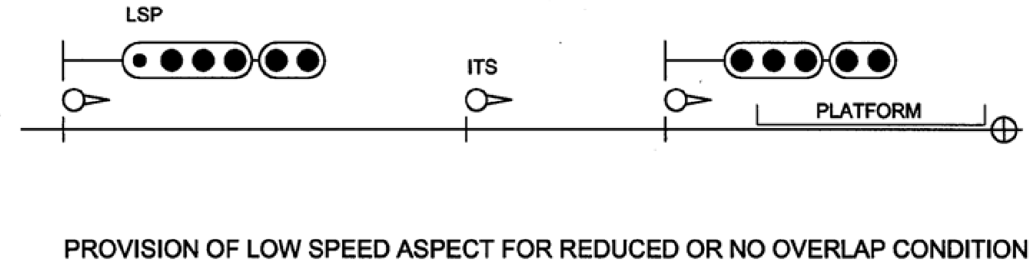


Figure 47 - Application of Aspects

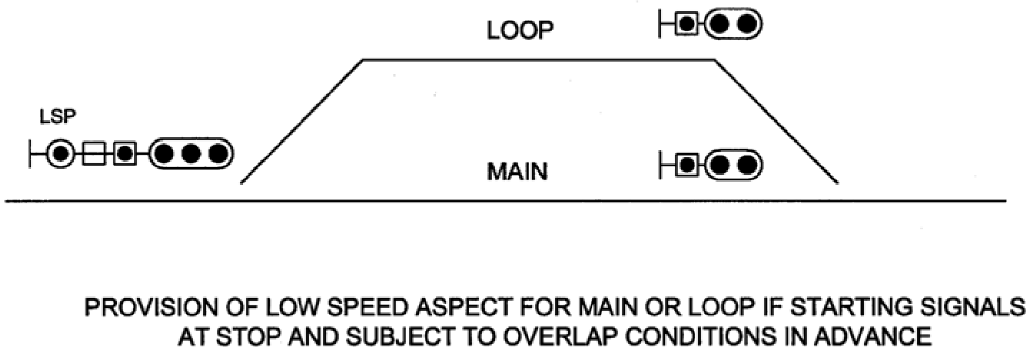


Figure 48 - Application of Aspects

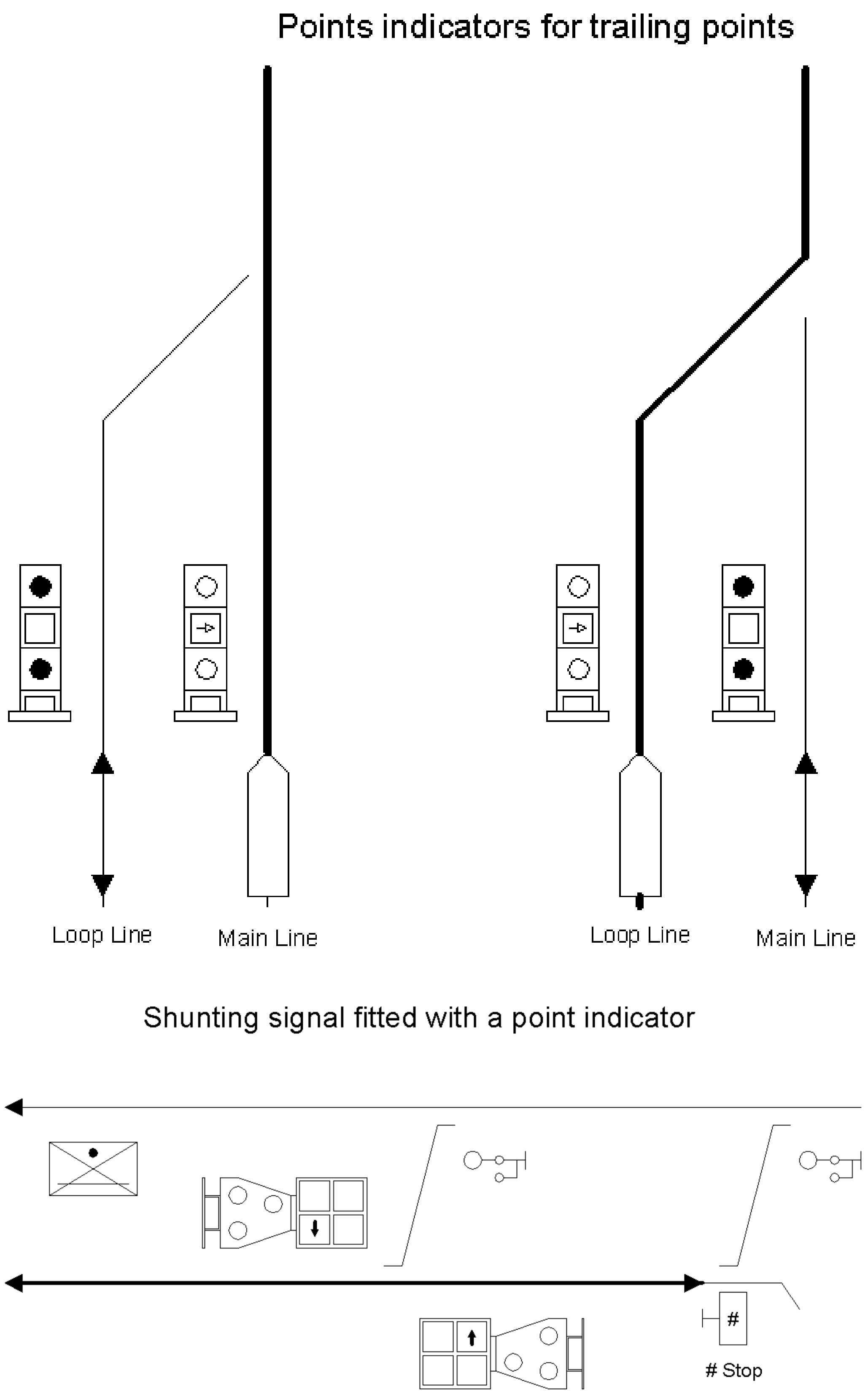


Figure 49 - Point Indicators

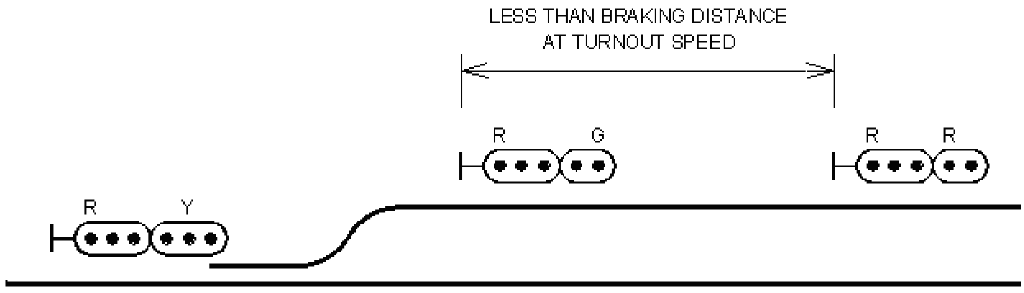


Figure 50 – Principle 1.6

1.7 Principle No. 1.7 - Signals Displaying Fixed Red Aspects

1.7.1 Introduction

This Principle addresses the requirements for providing signals that display fixed red running aspects where a line continues but running movements terminate.

1.7.2 Provision of Signals Displaying Fixed Red Aspects Where the Line Continues.

If it is necessary to terminate all running movements at a specific point on a line which continues onwards then a signal displaying one red running aspect and a red marker light or two fixed red running aspects shall be provided in single light and double light areas respectively.

1.7.2.1 Typical Arrangements

The following typical arrangements should be taken as guidelines for the application of this Principle.

1.7.2.1.1 In Platforms where all running movements terminate and the train reverses out

All running movements entering a platform must terminate within the limits of the platform and must leave the platform in the opposite direction of travel. Refer to Figure 51.

1.7.2.1.2 In platforms where all running movements terminate but the train may move forward in the same direction under subsidiary signals.

All running movements entering a platform must terminate within the limits of the platform and must leave the platform in the opposite direction of travel or proceed in the original direction under the control of a subsidiary signal. Refer to Figure 52.

1.7.2.1.3 At locations where all running movements terminate but where the train must then move forward on to a line under the control of shunting or some other form of signalling.

All running movements into a balloon loop arrangement must terminate and then proceed under the control of a subsidiary signal. Refer to Figure 53.

1.7.3 Where The Line Does Not Continue

Where it is necessary to terminate a running movement on a line, which does not continue onwards the usual arrangements regarding the provision of buffer stops and buffer stop lights shall apply.

Where the provision of a red buffer stop lamp may be mistaken as a stop signal by the driver of a train travelling on an adjacent line a white light shall be fitted above the red light.

Refer to Figure 52 and Figure 54.

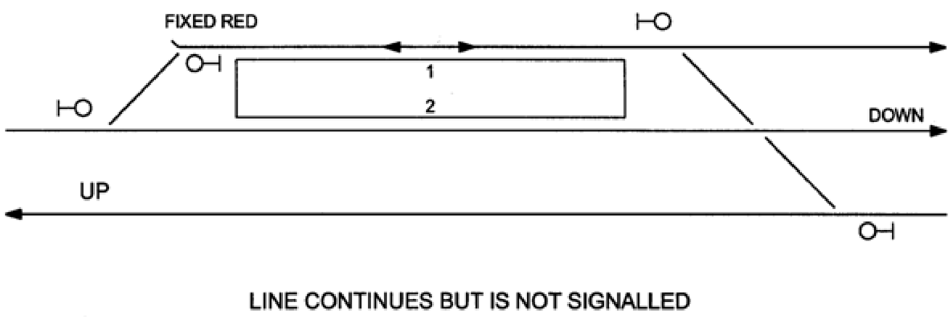


Figure 51 - Provision of Fixed Red Aspects

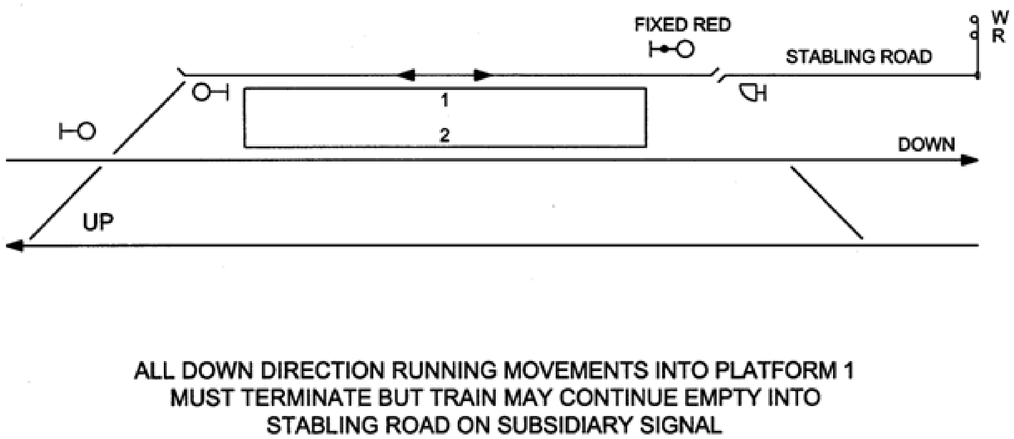


Figure 52 - Provision of Fixed Red Aspects

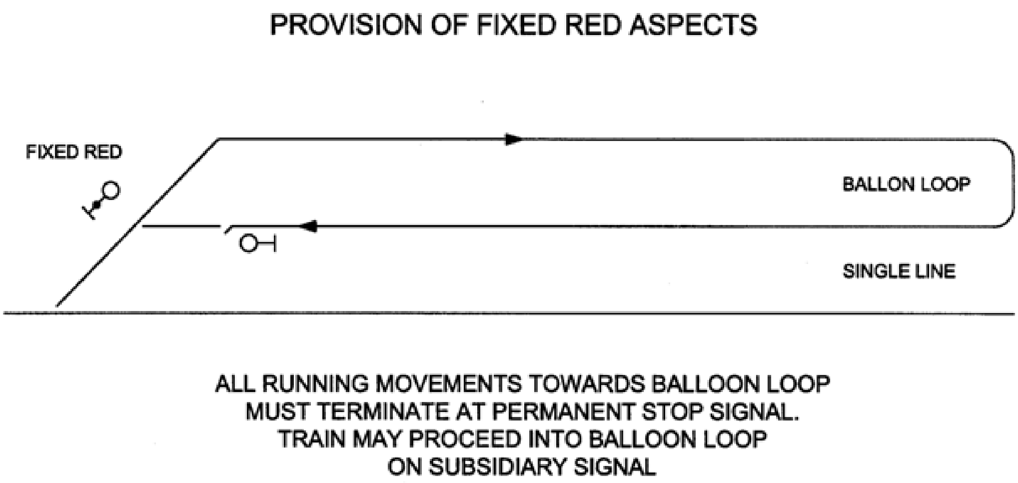


Figure 53 - Provision of Fixed Red Aspects

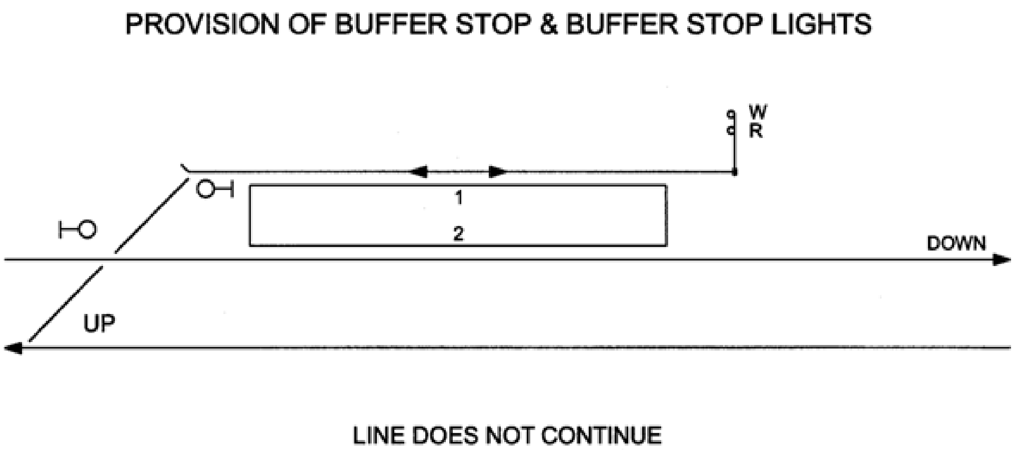


Figure 54 - Provision of Fixed Red Aspects

1.8 Principle No. 1.8 Emergency Replacement of Signals

1.8.1 Introduction

The Principle addresses the requirements for the provision of a facility for the purpose of restoring an automatic signal or group of automatic signals to stop should an emergency situation arise.

1.8.2 Risk Assessment

The provision of a facility for the emergency replacement of one or a group of signals is subject to an assessment of the hazards at the specific site. Hazards that must be considered include:

bb) The reliability of the method of replacement (arrangements that lack reliability increase system risk where trains may be directed to pass signals at stop)

cc) The particular hazard that the facility is to protect

dd) The potential for a hazard itself (such as a fire) to impact on the facility

ee) The configuration of any group facility

ff) The effectiveness of an emergency replacement facility to address the hazard.

gg) The potential for a train to be tripped at speed

1.8.3 Automatic Signals Assessed As Requiring Emergency Replacement Facility

If an automatic signal leads into:

hh) An underground section of line from an underground platform,

ii) An underground section of line from an above ground section of line,

jj) A bridge or viaduct longer than the length of the passenger train that does not have good facilities for emergency exit from the train.

Then an Emergency Replacement facility is required for that signal unless another equivalent facility to hold trains is available.

1.8.4 Visual Indication of Replacement Action

A visual indication shall be provided for each individual emergency replacement switch in the supervisory signal box or main control centre to bring to the operator's attention the fact that the emergency replacement has been initiated.

1.8.5 A Lights

Automatic signals provided with emergency replacement switches shall be fitted with "A" lights which shall be extinguished if the signal is replaced. A notice board inscribed "When the 'A' light is out, this signal must not be passed at stop without authority of the signaller" shall be provided.

1.8.6 Group Replacement of Controlled Signals

Where a risk assessment has identified that group replacement of controlled signals is appropriate, then an additional facility may be provided in the control system for this function. Grouping of the signals, the number of groups and the function of the group (ie up signals, down signals, station entry signals, station exit signals, signals in a specific area or on a specific line) is to be determined in conjunction with the user requirements and the risk assessment.

1.8.7 Implementation of Group Cancels

Group cancels are to act upon the individual route normalising controls. Interlocking functionality and diagram indications of the area are not to be affected by the operation of this facility.

1.8.8 Operation Under Power Interruption

A loss of power to the signalling system shall ideally not result in a change to signal aspects providing the duration is less than that for which the no break power

arrangements have been designed. Signallers must be able to reset controls without delay if the period exceeds the period for which the no break power arrangements apply.

Any type of failure of the control system shall cause no change in the status of the Emergency Replacement facility. This means that if the Control System has failed then the Emergency Replacement will not be held at stop and another means is required to restrain or hold train at signals with emergency replacement.

1.9 Principle No. 1.9 - 'A' Lights

1.9.1 Introduction

This Principle addresses the concepts and requirements for fitting 'A' lights to both controlled and automatic running signals to advise the driver of a train the status of the signal which may operate in either controlled or automatic mode.

1.9.2 'A' Light - Concept

To provide operating flexibility it is sometimes desirable to work a controlled signal in automatic mode and an automatic signal in controlled mode.

Such circumstances typically arise when a controlling signal box is switched-out in which case the controlled signals operate in automatic mode or when shunting is taking place at an intermediate siding in an automatic section in which case one or more automatic signals effectively operate in controlled mode when providing protection for the shunting movements at the siding.

By illuminating or extinguishing a letter 'A' fitted to these particular signals their operation, either in automatic or controlled mode, can be indicated to the driver of a train who will then apply the appropriate rules and regulations.

The failure of an 'A' light indicating that a signal is operating in automatic mode will logically result in the driver of a train applying the rules and regulations for a controlled signal which are more restrictive than those for an automatic signal.

1.9.3 'A' Light - Definition

An indication in the form of a letter 'A' which when illuminated instructs the driver of a train to treat the signal to which it applies as an automatic signal.

1.9.4 'A' Light - Description and Fitting

A light unit located on the centre line of a signal post which when illuminated displays the letter 'A'. Refer to Figure 55.

If provided on a double light running signal then it shall be positioned either immediately beneath the lower running aspects which shall be in line with the upper aspect or, if fitted, beneath any subsidiary signals. Refer to Figure 56.

If provided on a single light running signal then it shall be positioned either immediately beneath the marker light which shall also be located on the centre line of the signal post or, if fitted, beneath any subsidiary signals. Refer to Figure 57.

1.9.5 Provision of 'A' Lights on Controlled Signals

If it is required to switch-out a signal box controlling one or more running signals, then each running signal which is required to be clear when the signal box is switched out shall be fitted with an 'A' light. Refer to Figure 58.

The 'A' light shall not be illuminated before the "switching out" mechanism has been operated.

The 'A' light shall be extinguished immediately the "switching in" mechanism has been operated.

If the 'A' light is located at mechanical interlocking then it shall detect all facing points up to the next running signal.

If the 'A' light is located in power signalled area it shall detect all sets of electrically operated points up to the next running signal.

1.9.6 Provision of 'A' Lights on Automatic Signals

If an automatic signal is provided with an emergency replacement facility or reads directly over trailing, facing or flat crossing connections or any combination thereof forming part of an intermediate siding arrangement then it shall be fitted with an 'A' light. Refer to Figure 59 and Figure 60.

If all the following conditions are satisfied then the 'A' light shall be illuminated.

kk) The releasing switch proved normal and locked.

ll) The ends of all points providing trapping protection detected normal.

mm) Facing points in the main line, if any, including the Facing Point Lock detected normal.

Note: Mechanically operated trailing points in the main line shall not be detected in 'A' lights.

If any one of the above conditions is not satisfied, then the 'A' light shall be extinguished immediately.

1.9.7 Provision of 'A' Lights - Special Cases

In some cases it may be necessary to fit 'A' lights in automatic signals in rear of the signal protecting the intermediate siding due to the nature of the train movements made at the siding. Eg A wrong direction propelling movement out to the main line which passes beyond the signal protecting the siding. Refer to Figure 61.

Each case shall be considered and the appropriate measures taken to provide the necessary degree of protection to all train movements involved.

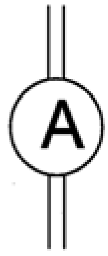


Figure 55 - Fitting of "A" Lights

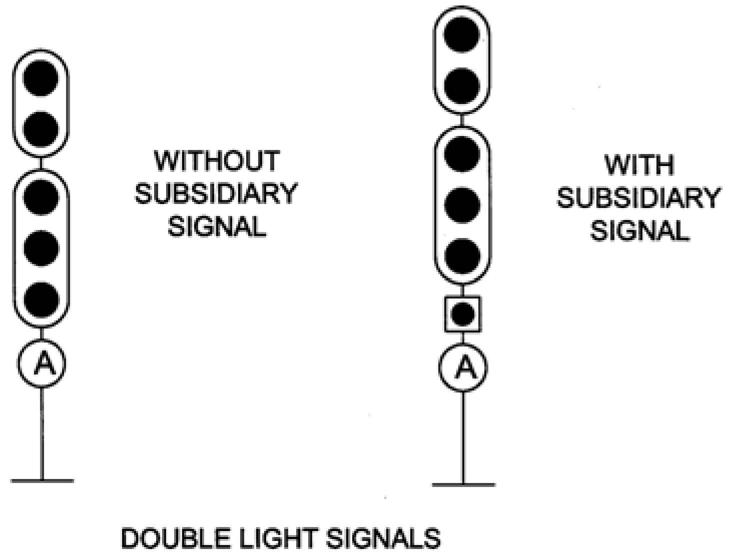


Figure 56 – Fitting of "A" Lights

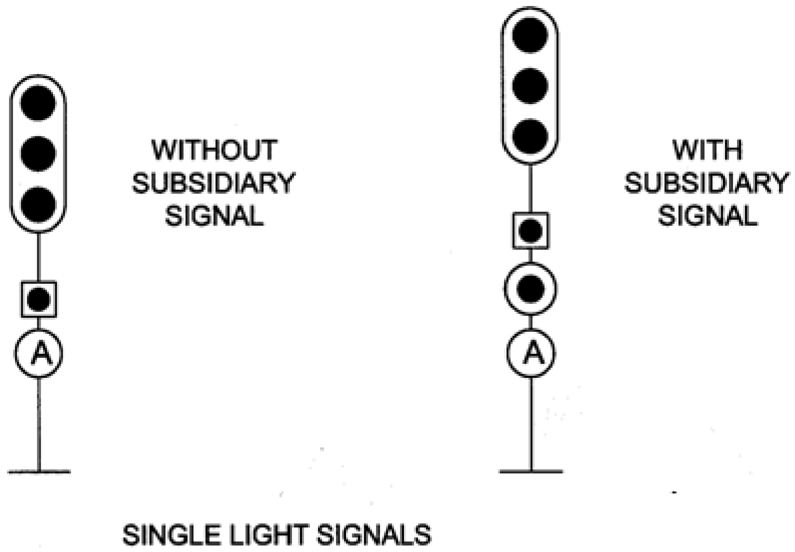


Figure 57 – Fitting of "A" Lights

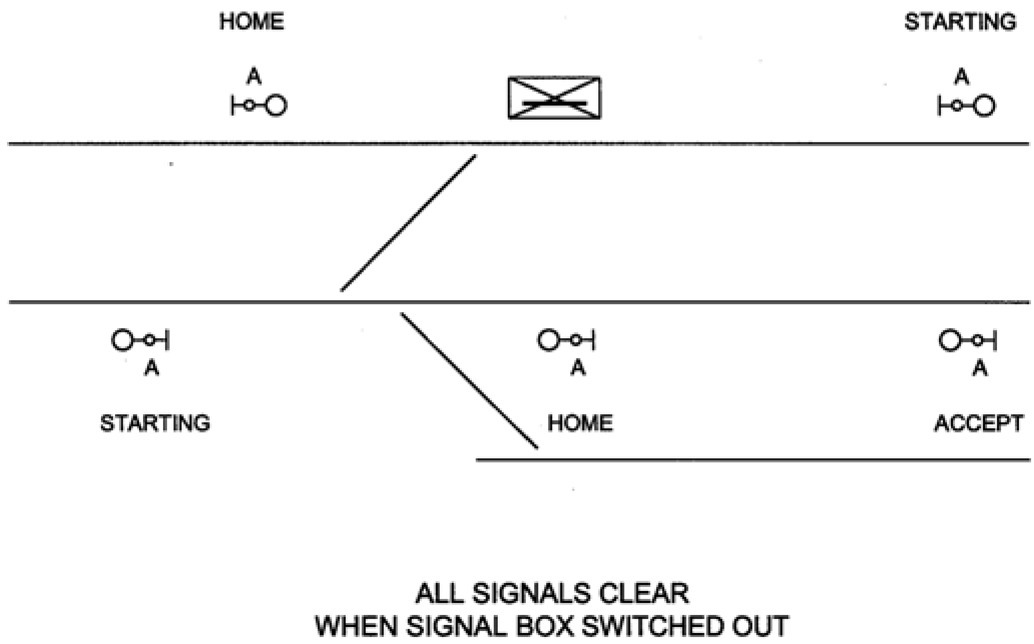


Figure 58 – 'A' Lights on Controlled Signals

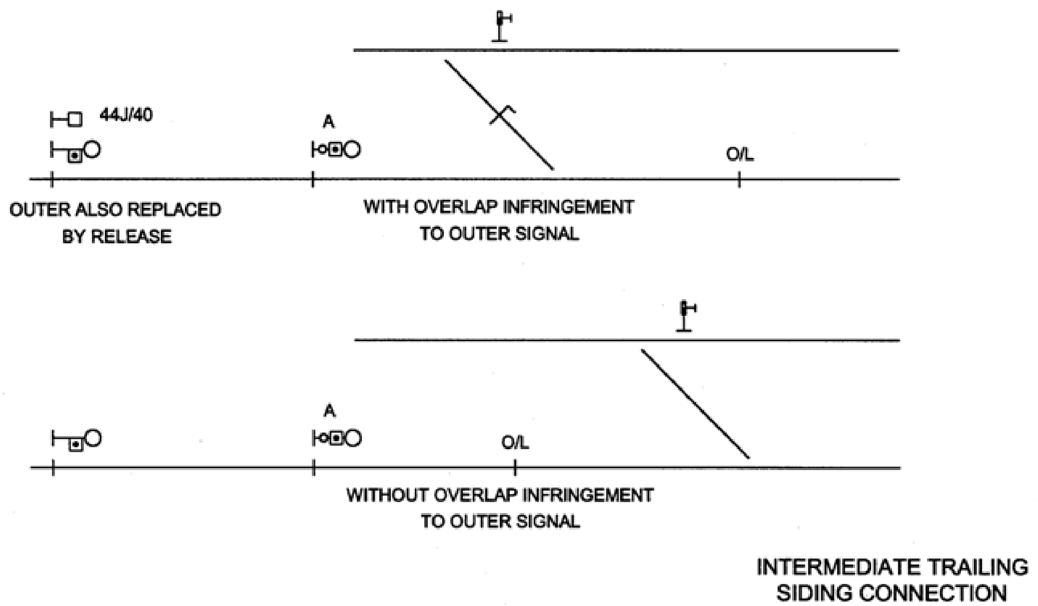


Figure 59 - 'A' Lights on Automatic Signals

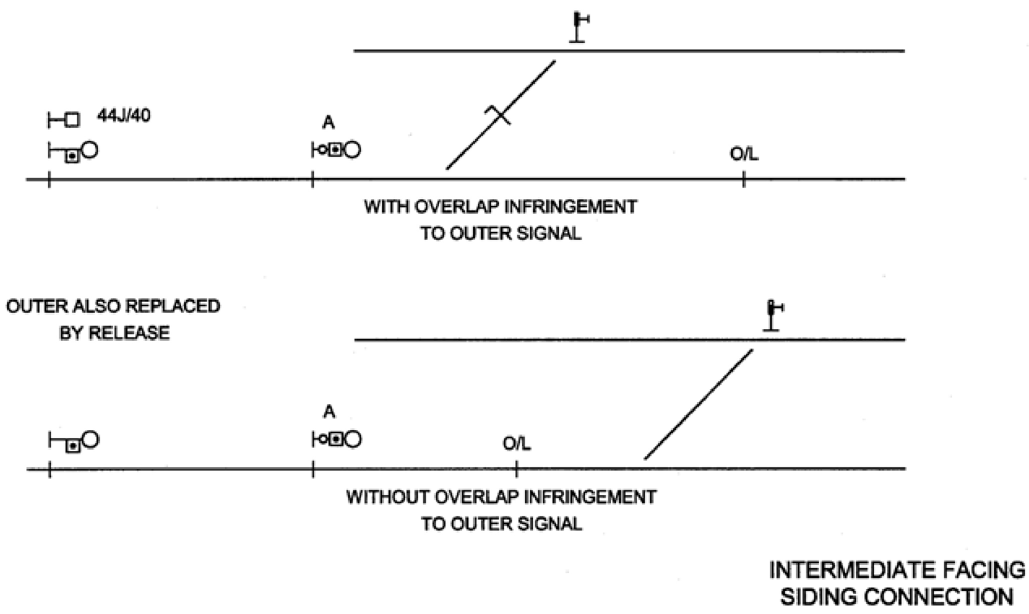


Figure 60 – 'A' Lights on Automatic Signals

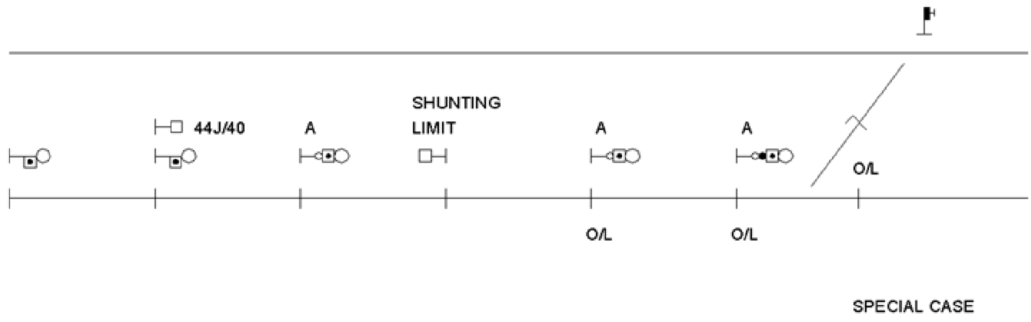


Figure 61 - 'A' Lights on Automatic Signals

1.10 Principle No. 1.10 - Section Intentionally Left Blank

1.11 Principle No. 1.11- Signal Profiles

1.11.1 Introduction

This Principle addresses the relationship between the various forms of signals and aspects and the requirements for combining these into standard profiles.

1.11.2 Running Signals

1.11.2.1 Automatic (Double Light Signals)

The top and bottom signal heads shall be vertically staggered such that the aspect displayed in the bottom head is always to the right relative to the aspect displayed in the top head. Refer to Figure 62.

If the signal heads are post mounted then the top head shall be mounted directly on top of the signal post and the bottom head shall be offset to the right.

The signal identification plate shall be mounted between the top and bottom signal heads

Refer to Principle No. 1.2.

1.11.2.2 Automatic (Single Light Signals) Including Distant Signals

The signal head and the marker light shall be vertically staggered such that the marker light is always to the right relative to the aspect displayed in the signal head

Refer to Figure 63.

If the signal head is post mounted then it shall be mounted directly on top of the signal post and the marker light shall be offset to the right.

The signal identification plate shall be mounted between the signal head and the marker light. Refer to Principle No. 1.2.

1.11.2.3 Controlled (Double Light Signals)

The top and bottom signal heads shall be vertically aligned one above the other so that the aspect displayed in the top head is directly above the aspect displayed in the lower head. Refer to Figure 64.

If the signal heads are post mounted then the top head shall be mounted directly on top of the signal post and the bottom head shall be directly underneath.

The signal identification plate shall be mounted between the top and bottom signal heads. Refer to Principle No. 1.2.

1.11.2.4 Controlled (Single Light Signals)

The running signal head and the marker light shall be vertically aligned one above the other so that the aspect displayed in the running signal head is above the marker light. Refer to Figure 65.

If the running signal head is post mounted then the marker light shall be set forward immediately in front of and on the centreline of the signal post.

If the running signal is fitted with a running turnout then the marker light shall be incorporated in the running turnout which shall be set forward immediately in front of and on the centreline of the signal post and beneath the running signal head. Refer to Figure 66.

The signal identification plate shall be mounted between the signal head and the marker light or the running turnout unit. Refer to Principle No. 1.2.

1.11.3 Subsidiary Signals

1.11.3.1 Low Speed (Double Light Signals)

The subsidiary low speed aspect shall be mounted below the lower running signal head. Refer to Figure 67.

Depending on the particular requirements it may be incorporated into the lower signal head.

1.11.3.2 Low Speed (Single Light Signals)

The subsidiary low speed signal shall be separate from the running signal head and mounted immediately below the marker light or running turnout if provided.

If the subsidiary low speed signal is associated with a route indicator then it shall be mounted immediately below the route indicator.

If the running signal is post mounted then the subsidiary low speed signal shall be on the centre line of the signal post.

1.11.3.3 Shunt (Double Light Signals)

The subsidiary shunt signal shall be separate from the running signal heads and mounted immediately below the lower head, or any low speed aspect. Refer to Figure 67.

If the subsidiary shunt signal is associated with a route indicator then it shall be mounted immediately below the route indicator.

If the running signal is post mounted then the subsidiary shunt signal shall be on the centre line of the signal post.

1.11.3.4 Shunt (Single Light Signals)

A subsidiary shunt signal shall be separate from the running signal head and mounted immediately below the marker light or running turnout or subsidiary low speed if one or more of these are provided. Refer to Figure 68.

If the subsidiary shunt signal is associated with a route indicator then it shall be mounted immediately below the route indicator.

1.11.4 Other forms of Signals

1.11.4.1 A Lights

1.11.4.1.1 On Automatic Running Signals

If an ‘A’ light is provided on an automatic running signal then it shall be mounted below the running aspects. Refer to figure Figure 69 and Figure 70.

If the running signal is post mounted then the ‘A’ light shall be set forward immediately in front of and on the centreline of the signal post.

1.11.4.1.2 On Controlled Running Signals

If an ‘A’ light is provided on a controlled running signal then it shall be mounted below the running aspects or running turnout or the lowest of any subsidiary signals which may be fitted to the running signal.

Refer to Figure 71 and Figure 72.

If the running signal is post mounted then the ‘A’ light shall be set forward immediately in front of and on the centreline of the signal post.

1.11.4.2 Turnout Repeater

On both single and double light signals the turnout repeater shall be mounted directly above and in line with the top running lampcase.

Exceptionally, where space is restricted, the turnout repeater may be mounted to one side of the top lampcase; on the left for a left hand turnout and on the right for a right hand turnout.

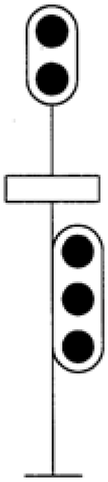


Figure 62 - Signal Profiles

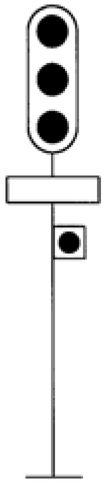


Figure 63 - Signal Profiles

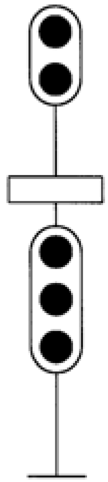


Figure 64 – Signal Profiles

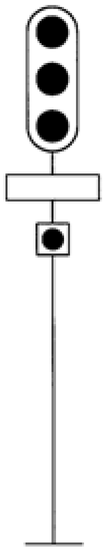


Figure 65 - Signal Profiles

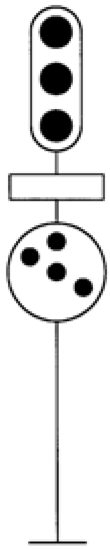


Figure 66 - Signal Profiles

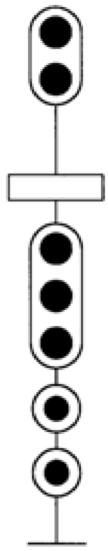


Figure 67 - Signal Profiles

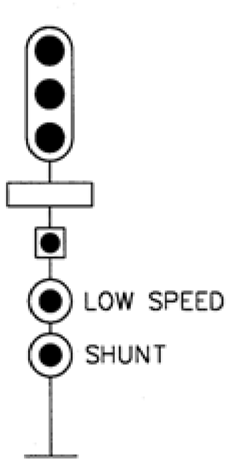


Figure 68 - Signal Profiles

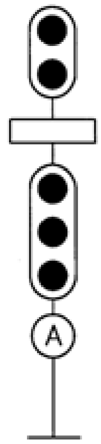


Figure 69 - Signal Profiles

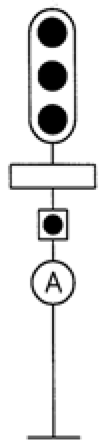


Figure 70 Signal Profiles

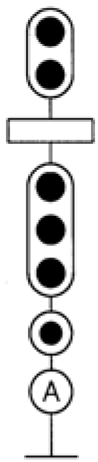


Figure 71 - Signal Profiles

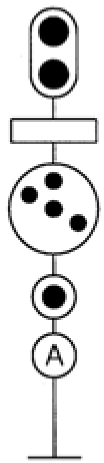


Figure 72 - Signal Profiles

1.12 Principle No. 1.12 - Positioning and Sighting of Signals

1.12.1 Introduction

This Principle addresses the requirements for positioning and sighting the various forms of signals with respect to their specific purpose as indicated on track plans, their intended physical location on site, and the necessity to provide the train driver with an unambiguous indication of the status of the track ahead.

1.12.2 Running Signals (and where fitted Subsidiary Signals)

1.12.2.1 Location of Running Signals with respect to the Track

Except where otherwise permitted, running signals shall be positioned immediately to the left of the running line to which they apply.

Guidelines for exceptions:

nn) where it is physically impossible to position the signal without incurring excessive costs in providing a special mounting arrangement or an overhead structure or undertaking substantial earthworks and the resultant relocation does not result in ambiguity or less than acceptable sighting;

oo) where trains start from sidings or other non-running line situations;

pp) where trains start from terminal platforms;

qq) where the running signal is a main or loop starting signal into a single line section;

rr) where signals apply to the wrong running direction in bi-directional signalled double line sections. These signals should be placed to the right of the line.

ss) where the signal is likely to conflict with the positions of other signals already sighted.

In cases a) b) c) and f) if the running signal is proposed to be located on the right hand side of the respective track then consideration shall be given to also providing a dwarf indicator signal in the correct position to the left of the track.

1.12.2.2 Location of Running Signals with respect to Platforms

Where running signals are situated at the departure ends of platforms, the signal shall be placed a minimum of 15 metres from the end of the platform (or the top of the platform ramp) unless track geometry or other obstruction forces the signal closer to platform.

1.12.2.3 Location of Running Signals with respect to Sighting

As a rule, each running signal should be located to provide the train driver with the best possible sighting of that signal.

The selection of location should take into account:-

tt) Fixed obstructions such as cuttings, retaining walls, foliage (make allowance for growth), structures.

uu) Other trains:- whether a train approaching on an adjacent track will obscure the signal, notably on right hand curves; whether rolling stock standing in a siding will obscure the signal, notably on left hand curves.

vv) Background lighting:- whether traffic lights, street lights, floodlights will overpower the signal aspect or tend to mislead the driver

ww) “Reading through”:- whether the driver will be misled by sighting past the signal to another brighter or more obvious signal.

xx) Where bi-directional running applies, the possibility of sighting the signal on the wrong road before the correct signal. In this instance staggering the location of the signals may be necessary.

Running signals should be located to provide:-

yy) The longest, most continuous sighting of the signal after passing the signal in the rear.

zz) Preferably a minimum of 200 metres sighting distance for speeds to 100 kph and 300m for speeds over 100 kph.

aaa) A minimum of 6 seconds sighting at line speed. Distances which equate to 6 seconds are given in Table 1.

Generally signal sighting distances should be maximised where signals are widely spaced and speeds are high.

Service Speed	Distance	Service Speed	Distance
40	73	100	183
50	93	115	200
60	110	130	239
70	129	145	266
80	147	160	294
90	165		

Note: these distances include a 10% speed tolerance but must be treated as minimum distances

Table 1 - Distances equal to six seconds sighting

It is not necessary that sighting be totally uninterrupted except for the final approach to the signal (50 metres approximately). However interruptions should be of only short duration and in total should not apply for more than 20% of the total sighting distance to the signal.

If the minimum sighting distances cannot be achieved having regard to the guidelines for exceptions listed under Section 1.12.2. then the Signal Sighting Committee shall examine and review the requirements and make the appropriate recommendations.

Sighting may be regarded as unacceptable when:-

- The signal is likely to be frequently approached at stop and it would be advantageous for train operation to advise the driver that the signal has cleared before the aspects become visible.
- The signal is a junction signal and the sighting is such that the driver would be required to slow the train more than is necessary for the diverging route.
- Local conditions are exceptional and such that it is reasonable to predict that drivers may have particular difficulty in properly observing and stopping at the signal.

In addition to providing for the driver's view of the signal, the selection of location shall also take into account:-

- Safe access for drivers to alight and use telephones. Walkways may need to be provided and handrails placed for protection on embankments or from other tracks.
- Overhead wiring air gaps. Signals shall be located such that a train can stand clear of any air gap. For this purpose, an 8 car EMU is 170m in length and an 8 car intercity is 200m in length.

Note: This requirement does not apply to bridged or switched overlaps, only to air gaps at substations and sectioning huts.

- Live overhead wiring. Avoid locating signals such that any part of the signal structure and associated access including an open signal door or the safety chain/bar or the extended arm of a maintainer servicing the signal, can be placed within 1.0 metre of any live overhead.

  Note 1: A pull off or stay wire isolated by only a single **small diameter** insulator is to be considered live. Note 2: For the purposes of this requirement, the reach of an arm may be taken as 800mm from the shoulder.

- Whether there is likely to be a possibility of phantom effects or a reduction in visibility from sunlight shining into the lens.

1.12.2.4 Provision of Appropriate Lenses

Consideration shall be given to the proposed location and purpose of a running signal to determine the optimum type of lens to be fitted to signals with incandescent lamps.

Generally running signals on sections of line which have continuous visibility of the aspect and a sighting distances in excess of 250m shall be fitted with long range lenses.

Generally running signals on sections of line which have poor or intermittent visibility and/or sighting distances of less than 250m shall be fitted with spread light lenses.

Focus or alignment of the signal is equally as important as location in providing the train driver with acceptable sighting of signal indications.

For running signals (except turnouts on single light signals) the signal should be aligned toward the defined sighting point (Principle 2.1) or the previous signal whichever is the least distance.

Turnouts on single light signals should be aligned for best sighting at 100 - 150 metres if indicating a route off the main line and at approximately 25 metres if indicating the route from a refuge or siding.

Exception:- Where the turnout is indicating a route through a medium speed turnout (turnout speed 40 kph or higher) the optimum sighting distance should be increased to 200 - 250 metres.

Subsidiary and shunt signals should generally be aligned to provide best visibility at approximately 50 metres from the signal.

With LED signals, the “standard” range LED signals with a viewing range of around 500 metres shall generally be used.

Exceptionally where the spacing between signals is 2 km or more and there is 800 metres or more of clear viewing of the signal, long range versions of LED signals may be used where the additional sighting will benefit the train driver.

Standard and long range versions shall not normally be placed adjacent to one another except that, at the end of a loop, a standard range signal may be used in the loop and a long range on the main line.

1.12.2.5 Multiple Track Sections

Running signals applying to parallel running lines in the same direction of travel should generally be of the same height and not longitudinally staggered.

This is to minimise the possibility of drivers misreading adjacent signals especially through curved sections of track.

Guidelines for exceptions:

bbb) where it is physically impossible to position the signals in line due to minor track obstructions or the permanent way layout they may be subject to a degree of stagger which should be limited to 60m.

ccc) where at platforms it is possible to position a signal to be obscured from the adjacent running lines.

ddd) where bi-directional signalling on double line sections applies and the signal for the wrong running direction on the adjacent track can be sighted well before the correct signal, the signals may be staggered to provide as close as practical to simultaneous sighting.

eee) at interlockings where signalling arrangements require signals on adjacent roads to be longitudinally staggered and the sighting of the signals in these positions is clear and unambiguous.

fff) Where the headway requirements on adjacent parallel lines are widely different, then the signalling should be arranged such that the signals on the line with the greater signal spacing align with signals on the other line with the additional signals on that other line spaced in between.

1.12.2.6 Height of Running Signals above the Track

Except where otherwise permitted, the red aspect of post mounted running signal aspects should be positioned to provide a stop aspect as close as practical to drivers eye level and in accordance with the requirements of the structure gauge, and having regard to the different types of trains likely to pass the signal.

Guidelines for exceptions:

ggg) where it is necessary to observe an aspect over the top of a train on an adjacent track.

hhh) where it is necessary to observe an aspect over a rise.

iii) where it is necessary to observe an aspect through a series of curves.

jjj) where it is necessary to observe the aspect which would otherwise be obscured by physical lineside obstructions such as the face of a rock cutting or the locality of bridge piers, etc.

Nominally this height shall be approximately 3m above rail level for single aspect signals and 2.3m for double aspect signals but shall also depend on the fitting of subsidiary signals and route indicators if required and shall be subject to sighting and operating considerations.

For a single light colour light signal the centre of the most restrictive aspect shall act as one datum for all height references and the top of the railhead of the nearest rail of the track to which the signal applies shall act as the other. Refer to Figure 73.

For a double light colour light signal the centre of the most restrictive aspect of the lower head shall act as one datum for all height references and the head of the nearest rail of the track to which the signal applies shall act as the other. Refer to Figure 74.

If a signal is to be located at a point where the track is significantly canted then the top of the rail head reference shall be obtained using a level horizontal datum off the rail concerned and without reference to the height of the opposite rail. Refer to Figure 75.

1.12.2.7 Distance of Running Signals from the Track

Post mounted running signal aspects shall be positioned close to the nearest rail of the track to which they apply and in accordance with the requirements of the structure gauge.

Nominally this distance shall be 2500 mm but this shall be subject to sighting and operating considerations and the positioning of signals in or over drains is to be avoided.

If a running signal is post mounted then the centre line of the post shall act as one datum for all distance references and the running edge of the nearest rail of the track to which the signal applies shall act as the other Refer to Figure 76.

1.12.3 Shunt Signals and Point Indicators

1.12.3.1 Location of Shunt Signals with respect to the Track

Except where otherwise permitted shunt signals shall be positioned immediately to the left of the line to which they apply and in the direction of travel for the signal and in accordance with the requirements of the structure gauge. Refer to Figure 77.

The requirements of this section also applies to Point Indicators

1.12.3.2 Location of Shunt Signals with respect to Sighting Height of Shunt Signals above the Track

Except where otherwise permitted shunt signals shall be positioned at ground level and in accordance with the requirements of the structure gauge.

Guidelines for exceptions:

kkk) where the visibility of the shunt signal is impaired or obscured by permanent obstructions on or about the track such as bridge piers and platforms; or,

lll) where the visibility of the shunt signal is impaired or obscured by irregular obstructions such as trains waiting in loops or at siding outlet signals or where rolling stock is frequently marshalled or stabled;

Then the shunt signal may be elevated to provide adequate visibility subject to sighting and operating considerations. Refer to Figure 78.

This height shall be subject to specific sighting and operating considerations.

1.12.3.3 Distance of Shunt Signals from the Track

Shunt signals shall be positioned close to the nearest rail of the track to which they apply and in accordance with the requirements of the structure gauge.

Nominally this distance shall be 2.5m but shall also be subject to sighting and operating considerations, clearance from adjacent tracks and walkways or pathways.

The centre line of the shunt signal or if elevated, the centre line of the post shall act as one datum for all distance references and the running edge of the nearest rail. See Figure 79.

1.12.4 Other forms of Signal

1.12.4.1 Co-acting and Repeater Signals

Except where permitted co-acting and repeating signals shall be positioned immediately to the left of the running line to which they apply and in accordance with the requirements of the structure gauge.

Guidelines for exceptions:

mmm) where it is physically impossible to position the signal without incurring excessive costs in providing a special mounting arrangement or an overhead structure or undertaking substantial earthworks and the resultant relocation does not result in ambiguity or less than acceptable sighting;

nnn) where it is considered by the Signal Sighting Committee that the purpose for which this form of signal is provided is better served by placing the signal to the right of the line to which it applies subject to sighting and operating considerations

1.12.4.2 Landmarks

At locations where a permanent caution requires to be displayed, a landmark or location sign may be provided in lieu of a distant signal. This takes the form of a yellow reflective triangle and has the meaning defined in the Network Rules.

1.12.5 Buffer Stop Lights

Buffer stops lights shall be positioned at the buffer stops or stop block, with the red light at a height of 1200 to 1400 mm above rail level.

Where the friction type buffer stops are in use, the light shall be mounted to the left of the track and in line with the buffer stop.

Where a fixed train stop is provided before the friction buffer stop, and no requirement for movements past the fixed train stop, the buffer stop light shall be located adjacent to the fixed train stop

Lights may be positioned in the centre of the track if approved by signal sighting.

In areas where trip fitted trains approach the buffer stop a fixed train stop shall be provided before the buffer stop & the buffer stop light shall be located adjacent to the fixed train stop.

Where the fixed train stop is more than 10m before the buffer stop, a fixed red signal shall be provided in lieu, & signage stating “Safety Overrun Area-no Rolling Stock or Equipment to be left Here” shall be provided at intervals not exceeding 40m between the signal & the buffer stop.

Buffer stop lights shall be a single red light. Where the possibility of confusing the single red with other signals or a parallel running road exists, a white light is to be provided above the red light.

At terminating locations where a fixed at stop signal is provided, buffer stop lights are not required.

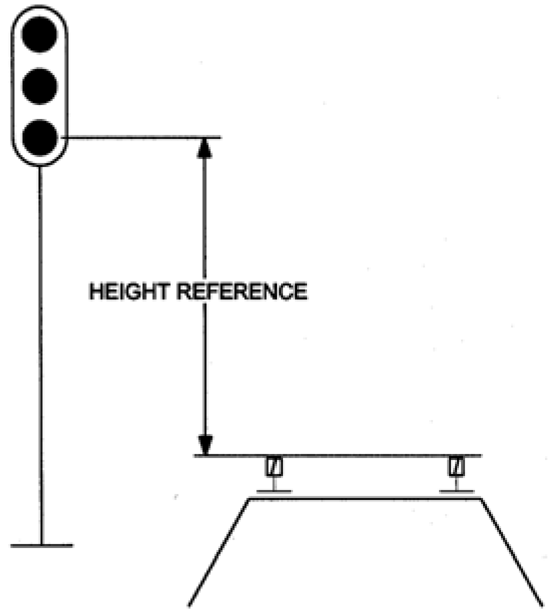


Figure 73 - Positioning and Sighting of Signals

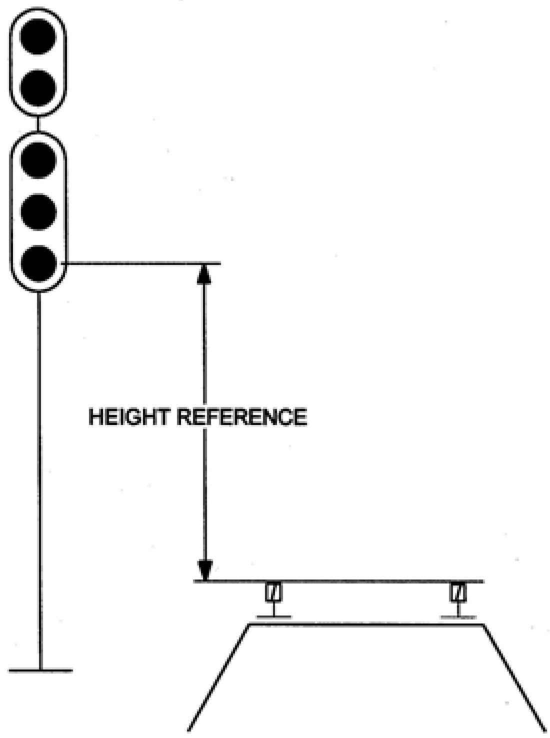


Figure 74 - Positioning and Sighting of Signals

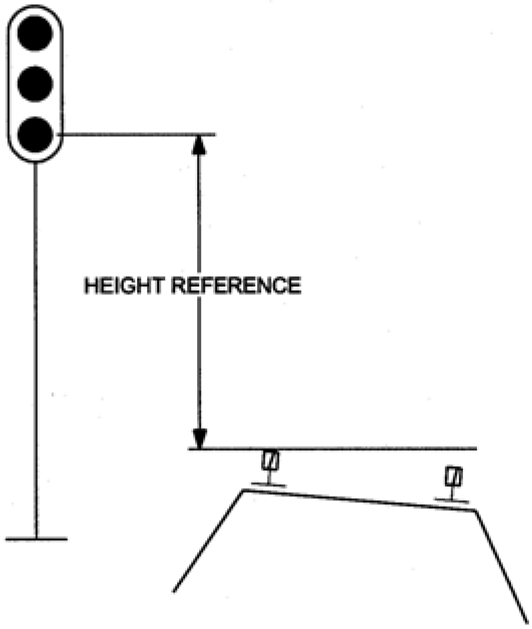


Figure 75 - Positioning and Sighting of Signals -

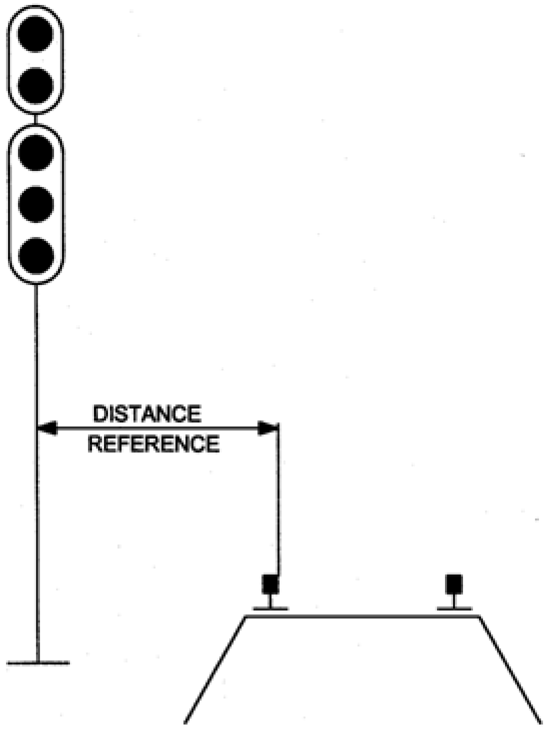


Figure 76 - Positioning and Sighting of Signals

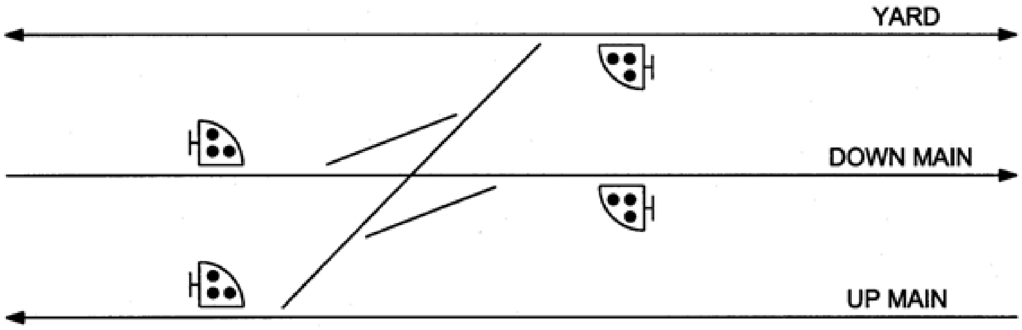


Figure 77 - Positioning and Sighting of Signals

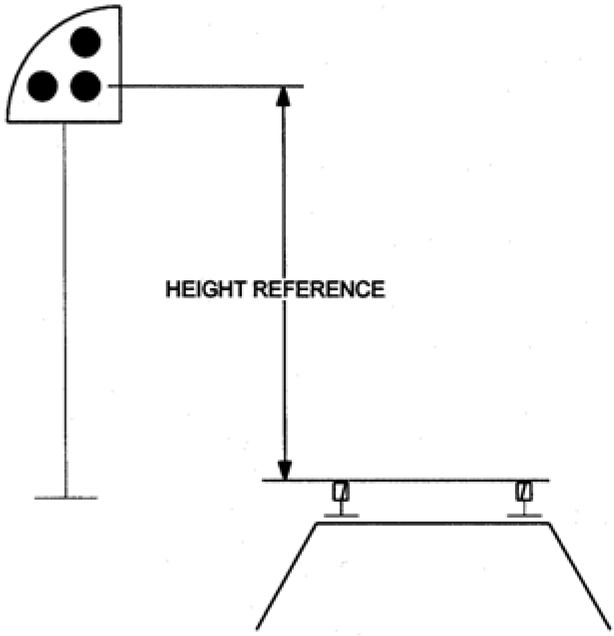


Figure 78 - Positioning and Sighting of Signals

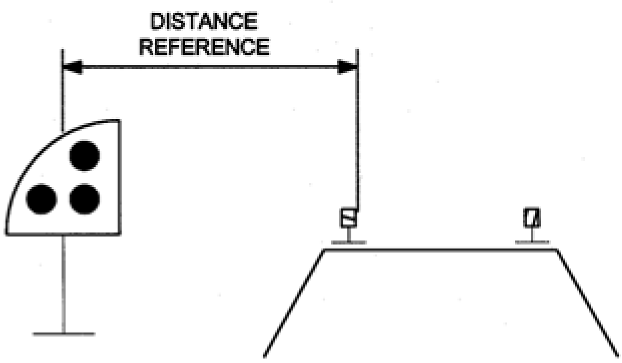


Figure 79 - Positioning and Sighting of Signals

1.13 Principle No. 1.13 - Positioning of Signals Reading Over Power Operated Points

1.13.1 Introduction

This Principle addresses the requirements for limiting the distance between a signal reading over a set of power operated points and the points.

1.13.2 Requirements

Signals are to be positioned to protect points, opposing movements and other hazards and to meet operational requirements, informing the driver of the route set and the conditions for safety proceeding including preparing to stop or be turned out through points.

Signals shall generally be positioned close to the risk they protect.

Signals shall also be positioned in relation to points with consideration of containing the delays incurred when operating under the regulations for passing failed signals at stop and also of minimising the risk with keys obtained for emergency manual operation of points after trains have passed the immediate protecting signal.

Preferably the first set of power worked points should be within 300 metres of the protecting signal and the last preferably within 750 metres.

Except where track geometry, storage capacity of loops or sidings or obstruction (such as platforms) prevents, signals should not be placed within 15 metres of the tip of the points.

1.14 Principle No. 1.14 - Reading Through

1.14.1 Introduction

This Principle addresses the concept of "Reading Through", the circumstances under which it is likely to occur and the methods of minimising its occurrence.

1.14.2 Concept

The term "Reading Through" arises from situations under which the aspect displayed by a running signal is readily visible to the driver of a train and conflicts with the aspect displayed by the signal towards which the train is approaching or at which the train is already at a stand.

Should the driver of the train inadvertently respond to a less restrictive aspect displayed by the signal in advance, then depending on circumstances, the possibility of a dangerous situation arising could occur.

1.14.3 Provision Of Controls To Minimise Reading Through

If a situation arises regularly under which a signal displays a more restrictive aspect than the aspect displayed by the running signal in advance which is also readily visible to a driver, then consideration shall be given to the provision of aspect controls to minimise the possibility of "Reading Through" occurring.

1.14.4 Typical Arrangements

The following typical arrangements should be taken as guidelines for the application of this Principle.

1.14.4.1 At Facing Points

If a train turns-out through a facing connection, then it may be desirable to maintain the signal next in advance on the straight line at stop if the facing points are reverse. Refer to Figure 80.

Where separate berth track circuits are provided this condition shall be overridden by the berth track circuit occupied.

1.14.4.2 At Trailing Points

If a train movement is through a trailing connection which is laying the other way to facilitate another train movement then it may be necessary to maintain the signal next in advance of the trailing connection at Stop unless its berth track circuit is occupied by the other train movement. Refer to Figure 81.

1.14.4.3 At Flat Crossings

If a train passes over a flat crossing, then it may be necessary to maintain the signal in advance at Stop unless its berth track circuit is occupied. Refer to Figure 82.

1.14.4.4 Between Old And New Signals

If a train is detained at an existing signal and the signal is fitted with lamps of low intensity or is of a different type, or is sighted in an unfavourable position then it may be necessary to maintain the new signal next in advance at Stop. Refer to Figure 83 and Figure 84.

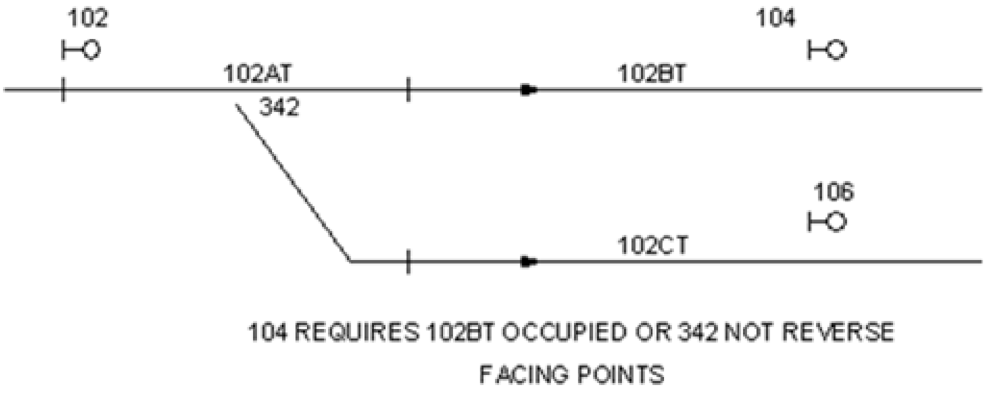
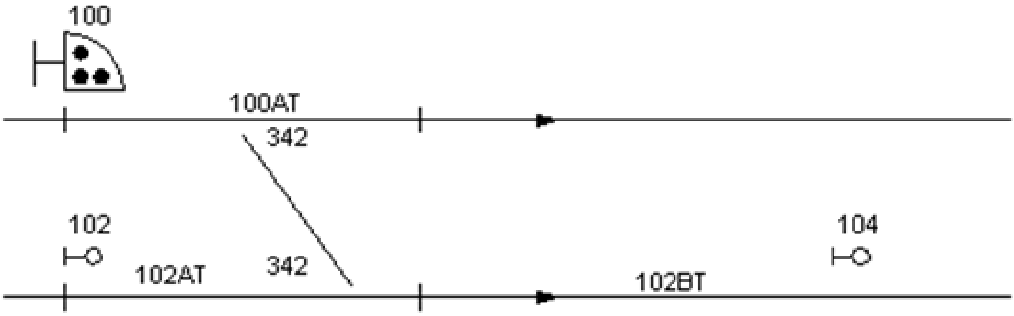


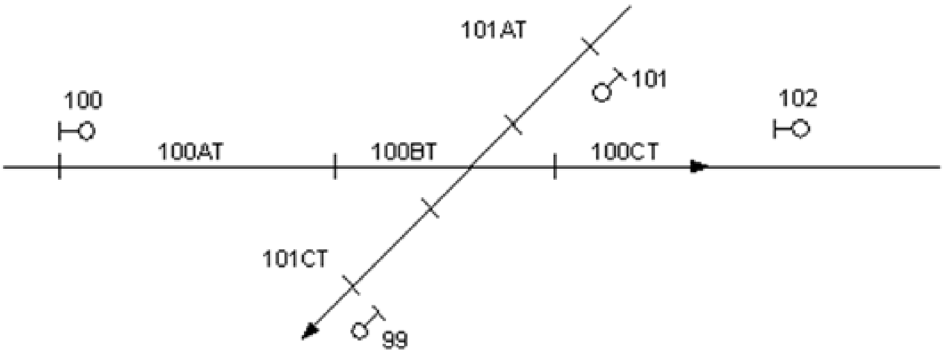
Figure 80 - Reading Through



104 REQUIRES 102BT OCCUPIED OR 342 NOT REVERSE

TRAILING POINTS

Figure 81 - Reading Through



102 REQUIRES (100CT OCCUPIED OR 101 NORMAL) 101AT CLEAR

99 REQUIRES (101CT OCCUPIED OR 100 NORMAL) 100AT CLEAR

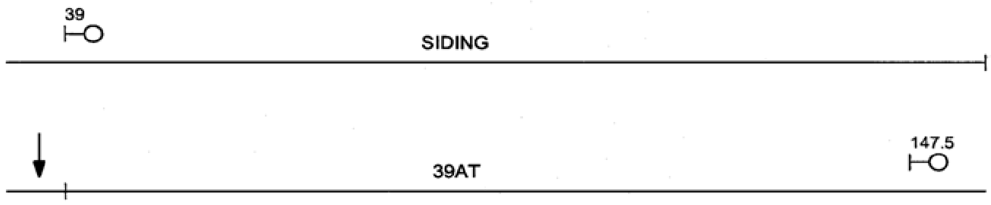
FLAT CROSSING

Figure 82 - Reading Through

147.5 REQUIRES 39AT OCCUPIED OR 39 REVERSE

MIXED TYPES OF SIGNAL

Figure 83 - Reading Through



147.5 REQUIRES 39AT OCCUPIED OR 39 CLEAR

SIGNAL IN AN UNFAVOURABLE SIGHTING POSITION

Figure 84 - Reading Through

1.15 Principle No. 1.15 - Intermediate Shunt Signals

1.15.1 Introduction

This Principle addresses the designation of and requirements for intermediate shunt signals including locking and aspects to be shown.

1.15.2 Designation of an Intermediate Shunt Signal

If a shunt signal is positioned such that a proceed aspect shown by a running signal in rear authorises a movement which passes the shunt signal then the shunt signal shall be designated an intermediate shunt signal and be shall capable of being over-set by the running signal in rear. Refer to Figure 85 and Figure 86.

1.15.3 Requirements

1.15.3.1 Aspects

If it is required to clear the running signal immediately in rear of an intermediate shunt signal then the running signal shall over-set the intermediate shunt signal and the intermediate shunt signal shall be proved clear before the running signal is permitted to clear.

If it is required to clear the running signal immediately in rear of an intermediate shunt signal, but as a condition of the aspect sequence it is not possible to display a full proceed (ie. clear) aspect in the running signal, then the intermediate shunt signal shall show a yellow aspect.

If it is required to clear a running signal immediately in rear of an intermediate shunt signal and as a condition of the aspect sequence it is possible to display a full proceed (ie. clear) aspect in the running signal then the intermediate shunt signal shall show a green aspect.

1.15.3.2 Route Indicators

If the intermediate shunt signal is fitted with a route indicator then this shall be displayed if the shunt signal has been over-set by the running signal in rear to show a yellow aspect.

The route indicator shall not be displayed if the shunt signal has been over-set by the running signal in rear to show a green aspect.

1.15.3.3 Aspect Replacement

If the intermediate shunt signal has been over-set by the running signal in rear then it shall not be replaced unless an authorised running movement passes it or it has been manually replaced by an operator even though the running signal in rear has been replaced.

1.15.3.4 Aspect Controls

The control of the green aspect on the intermediate shunt signal shall include all the track circuit sections up to the running signal next in advance and the first track circuit ("A" track) beyond.

1.15.3.5 Setting, Locking, Approach Locking and Route Holding

Full independent setting, locking and route holding shall be provided for the intermediate shunt signal which when over-set shall operate in parallel with that provided for the running signal in rear.

If the intermediate shunt signal has been over set by the running signal in rear then the approach locking of the intermediate shunt signal shall be extended by the addition of the approach locking applicable to the main running signal.

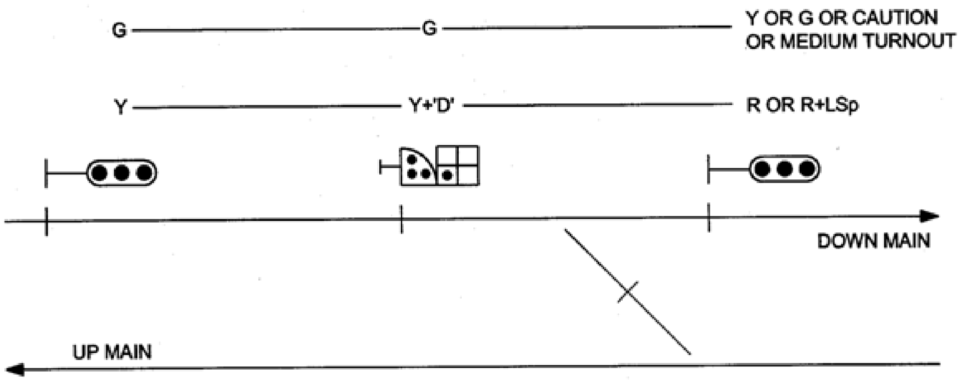


Figure 85 - Intermediate Shunt Signals

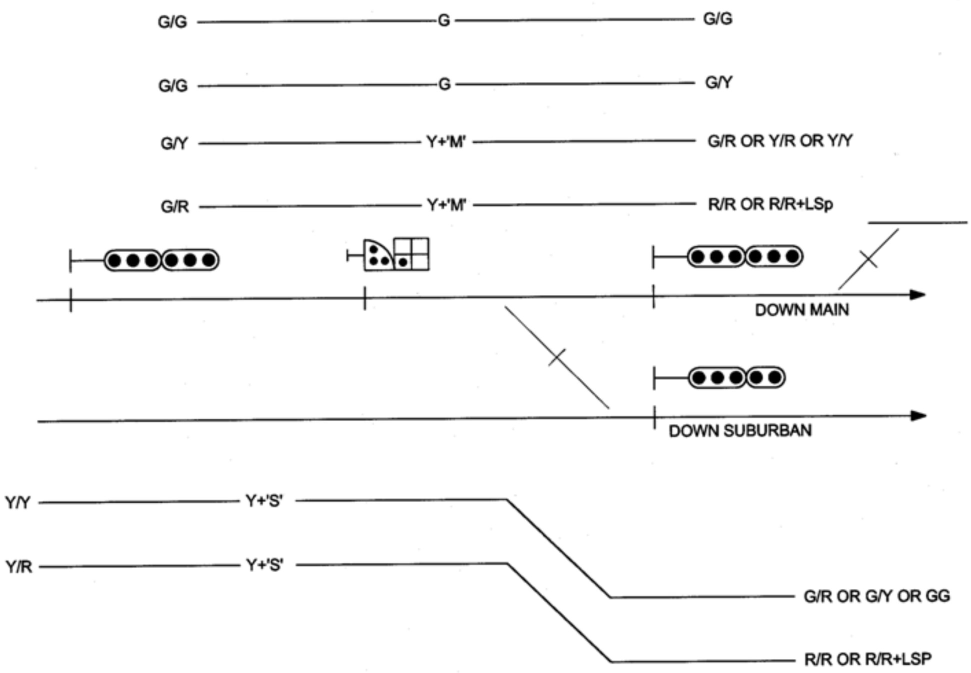


Figure 86 - Intermediate Shunt Signals

1.16 Principle No. 1.16 – Principle Withdrawn

1.17 Principle No. 1.17 - Signal Lamp Proving

1.17.1 Introduction

This Principle addresses the concepts and requirements for the provision of fail-safe signal lamp proving and controls for single light colour light and double light colour light running signals.

It also provides definitions of various types of signal lamp proving.

1.17.2 Lamp Proving - Concept

Where provided this feature enforces a fail-safe control to be exercised on the signal (or signals) in rear of the signal at which a running signal lamp has failed thus restricting the movement of a train towards the "dark" signal.

Consequently the potential for a derailment on a turnout or a rear end collision caused by an approaching train running past the "dark" signal is reduced to an extent depending on the nature of the vital controls exercised and the spacing of the signals in the system.

On double light colour light signals, a single green light may be misleading to train drivers and lamp proving is to include one or both main running lights out.

1.17.3 Lamp Proving - Definitions

A fail-safe method of monitoring the integrity of the filaments in a running signal lamp such that a total failure of the signal lamp which should be operating shall result in a change-of-state of a fail-safe lamp proving function.

Lamp proving which detects that the lamp filament is intact when the normal operating current is passing through the filament is known as hot proving.

Lamp proving which detects that the lamp filament is intact when the lamp is not operating using current sensing methods is known as cold proving.

NOTE: In the future when microprocessor based systems are installed both systems of proving will probably be available for application.

1.17.4 Signal Lamp Proving and Controls

ooo) For signals with incandescent lamps, lamp proving shall be provided on all single light colour light signals and new double light colour light signals.

For LED signals, lamp proving shall be provided on all single light signals but only on the first three double light signals at interfaces between single and double light signals. (Exception: where lamp proving is part of the type of CBI interlocking used)

ppp) If a signal lamp which should be operating is proved to be out then the aspect of the running signal in rear shall be restricted to caution or caution turnout if applicable.

qqq) On single light signals, if a signal lamp which should be operating is proved to be out then the marker light on the signal shall be illuminated.

rrr) On single light signals, if a signal lamp which should be operating is proved to be out and it is the lamp for the stop aspect of the first home signal controlling movements off a single line section in C.T.C. territory, then, to avoid a possibility that the subsidiary signal might be initially interpreted as a running signal proceed indication, any subsidiary signal fitted to the first home shall not display a proceed aspect until a train is closely approaching the signal whereby it's speed will have reduced to a speed commensurate with that required for the subsidiary signal movement. Refer to Principle 1.6.3.

sss) Deleted

1.18 Principle No. 1.18 - Signal Lamp Failure

1.18.1 Introduction

This Principle addresses the concepts and provision of first filament failure of incandescent lamps, total lamp failure and the associated warnings, alarms and indications to be provided.

1.18.2 First Filament Failure Warning

1.18.2.1 Concept

This feature enables a non vital warning to be given to an operator which indicates that the first filament of a double filament incandescent signal lamp has failed and is therefore in need of replacement.

This warning avoids the regular time-based replacement of signal lamps prior to the failure of their first filament.

1.18.2.2 Requirements

First filament failure warning shall be provided for all colour light running signals and, where economically viable, for subsidiary signals, when incandescent lamps are used.

Marker lights and 'A' lights need not be provided with first filament failure warning.

1.18.3 Lamp Failure Alarm

1.18.3.1 Concept

This feature enables a non vital alarm to be given to an operator which indicates a total failure of a signal lamp occurred, the signal is not displaying a running aspect, and that the lamp is in need of urgent replacement.

1.18.3.2 Requirement

Lamp failure alarms shall be provided for all single light colour light running signals in colour light territory.

1.18.4 Grouping of First Filament Failure Warnings and Lamp Failure Alarms

First filament failure warnings and lamp failure alarms shall be logically grouped to ensure that a common warning or alarm can service all the running signals in a particular group.

Particular groups can be formed by applying a hierarchy of geographical sorting criteria generally as follows:

- Automatic Section or Interlocking Area.
- Up line or Down line.
- Other significant lines.
- East (North) or West (South) end of Auto section or Interlocking Area, or Line.

At very large installations it may be necessary to limit the number of running signals in each group to a particular number.

1.18.5 Lamp Out Indication

1.18.5.1 Concept

This feature enables a lamp out indication to be given to an operator, which indicates a total lamp failure usually by failing the signal clear repeater.

1.18.5.2 Requirement

Light out indications shall be provided for all controlled single light colour light running signals.

1.19 Principle No. 1.19 - Track Circuit Control Of Running Signal And Subsidiary Aspects

1.19.1 Introduction

This Principle addresses the requirements for the control of caution, conditional caution, low speed and subsidiary shunt aspects on running signals by track circuits but is not applicable to the City underground or Eastern Suburbs Railway.

1.19.2 Requirements

1.19.2.1 Caution Aspect

If all the track circuits are clear from a running signal to the end of its caution overlap then subject to any other controls the running signal may display a caution aspect. Refer to Figure 87.

1.19.2.2 Conditional Caution Aspect

If the distance between running signals is less than 500 metres and if all the track circuits are clear from a running signal to a point nominally 100m and an absolute minimum of 50m past the running signal next in advance then following the expiry of a time delay on the berth track circuit and subject to any other controls the running signal may display a conditional caution aspect. Refer to Figure 87.

If the signal spacing is greater than 500 metres the conditional caution aspect must not be displayed unless the track circuits are clear from a running signal to an available overlap not less than 200 metres.

1.19.2.3 Low Speed Aspect

If the distance between running signals is less than 500 metres and if all the track circuits are clear from a running signal to an available overlap which is less than 50m then a conditional low speed aspect shall be displayed following the occupation of the berth track circuit for a sufficient period to bring the train to a stand or nearly to a stand.

Note 1: The operation of trainstops shall be in accordance with Principles Nos. 15.2, 15.3 and 15.4.

Note 2: The locking of the overlap shall be in accordance with Principle No.4.12 as applicable.

1.19.2.4 Subsidiary Shunt Aspect

If it is required to move a train beyond a running signal into an occupied section as far as the line is clear or perform a shunting movement then generally a shunt aspect shall be displayed unconditionally although it may be desirable to clear certain shunt signals conditionally.

The trainstop is not normally proved in the shunt signal.

Subsidiary shunt aspects do not usually operate the train stop. Where it is necessary to operate the train stop, such as for regular movements into terminating roads, or electric car maintenance depots, the train stop shall be conditionally cleared subject to the speed of the train being proved to be at or less than 35km/h. Lower timing speeds may be appropriate in some circumstances.

Train stops are not usually lowered when the aspect is used for closing up purposes, or in the event of track circuit failure.

Track circuit controls shall not normally be provided in the shunt aspect other than for a lever stick feature or hold clear on berth track occupancy feature depending on operational requirements. Refer to Figure 87.

1.19.2.5 Inclusion of Flank Track Circuits

At a converging junction, the protecting home signals usually share a common track circuit ‘A’ track. In the situation where one signal is set back and an additional intervening track circuit is provided, that track circuit shall be included in the controls of the main running aspect of the other signal. Refer to Figure 88.

The purpose of this is to ensure the main aspect continually proves clear any tracks are that not otherwise protected from the route, in the case where a flank protecting signal is passed in the STOP position. Where the flank route is signalled for two-way running, the points would not normally be released until the train is fully beyond the protecting signal.

The inclusion of the protecting flank track circuits is not required when the route is protected by other means such as catchpoints or turnouts. Refer to Figure 89.

Flank track circuits need not be included in overlaps or in subsidiary shunt signal control, where these are provided to assist train running during track circuit failure.

1.19.2.6 Approach Clearing of Signal Aspects

As a general principle, approach clearing of signals shall not be employed as it introduces risks of driver anticipation resulting in signals being passed at stop. Forms of approach clearing such as Conditional Clearing (defined in Section 1.19.2.2) are permissible in the context that the aspect will always step up automatically to the highest permissible aspect on track circuit clearance. Where justification for other approach clearing may exist, a determination for its application may only be made by the Chief Engineer, Signals.

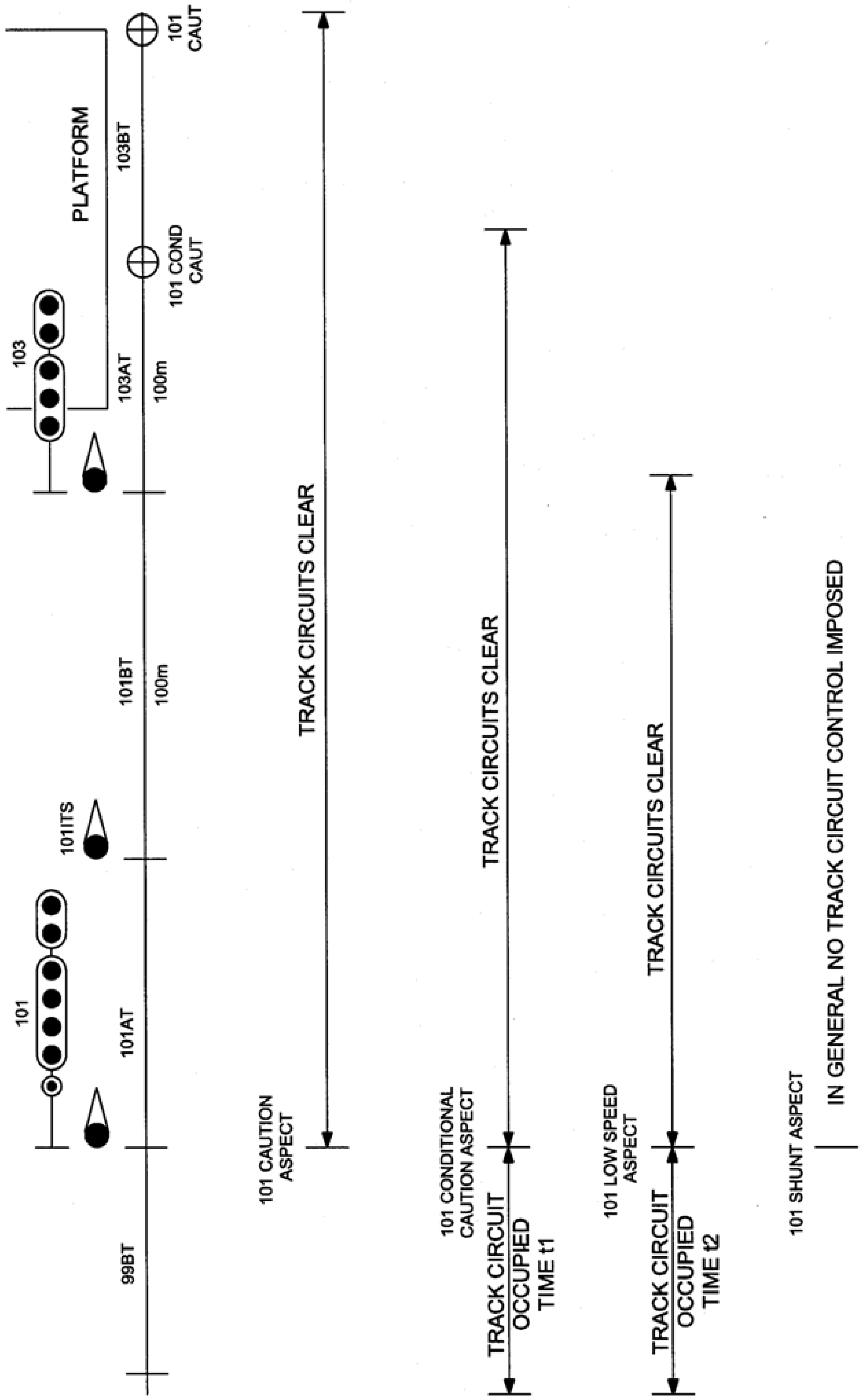


Figure 87 - Track Circuit Control of Signal Aspects

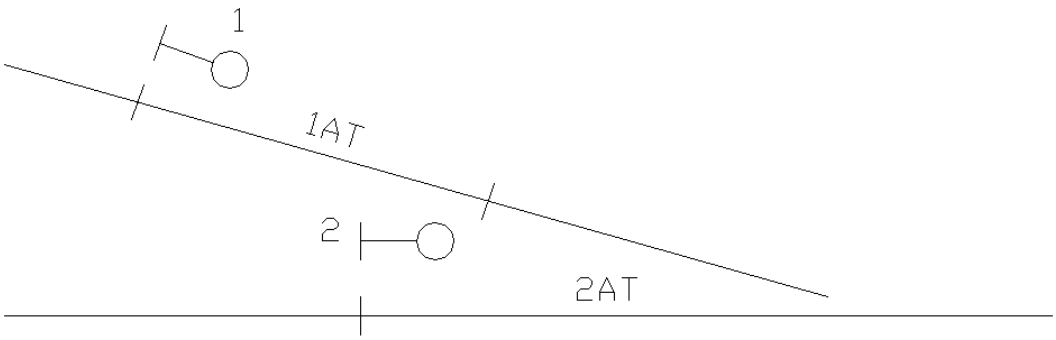


Figure 88

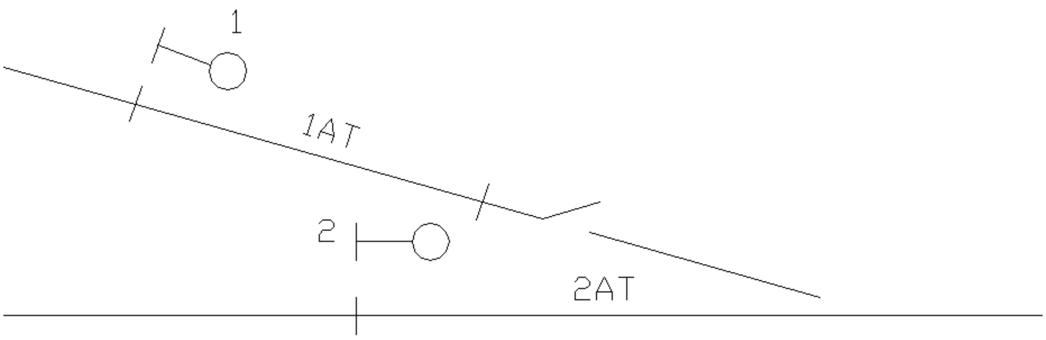


Figure 89

1.20 Principle No. 1.20 - Track Circuit Control Of Ground Shunting Signals

1.20.1 Introduction

This Principle addresses the requirements under which track circuit controls may be applied to shunting signal aspects.

1.20.2 Requirements

Generally, except where detailed hereunder, no track circuit control of ground shunt signals is required. However ground shunt signals control a variety of low speed movements and each specific or special application should be considered on its merits.

A short lever stick track circuit should be provided to ensure signal replacement, or, depending on operational requirements, approach track circuit occupancy and hold clear features may be provided in special cases to effect the signal replacement when the train has fully passed the signal.

Consideration should be given to including platform track circuits in the control of a shunt signal leading into the platform if a train conveying passengers is likely to be at a stand in the platform.

Where a train stop is provided (exceptionally) at a ground shunting signal, the operation of the train stop will be as described in 1.19.2.4, Subsidiary Shunt Aspects.

1.21 Principle No. 1.21 - Replacement Of Controlled Signals

1.21.1 Introduction

This Principle addresses the requirements for the provision of enforced replacement of controlled running signals following the passage of a train, ie. lever stick control.

1.21.2 Purpose

The purpose of lever stick control is to prevent a controlled signal from automatically reclearing once all the track circuits controlling the lowest proceed aspect are clear.

Automatic reclearing may be undesirable where it has the potential for allowing following trains to be signalled in the wrong direction, in the wrong order or into a situation where restricted locking is applied if the operator inadvertently fails to normalise the route after the first train has passed the signal.

1.21.3 Requirements

All controlled running signals shall be provided with enforced replacement (lever stick control) which requires the replacement of the route to the normal state before it is again reversed and the signal recleared for the following train.

Lever stick control shall not be effective if a controlled signal has been selected to operate in automatic reclearing mode if provided. Refer to Principle No. 1.22.

1.22 Principle No. 1.22 - Automatic Reclearing Of Signals

1.22.1 Introduction

This Principle addresses the requirements for the provision of automatic reclearing of controlled running signals.

1.22.2 Purpose

Automatic reclearing enables a controlled running signal which has already been set to operate in the same manner as automatic signals and thus avoid the need for the operator to “restroke” the signal.

1.22.3 Requirements

Automatic reclear shall be provided on all controlled running signals which require to be repeatedly cleared by an operator for the passage of non diverging following trains.

An individual automatic reclear push/pull button or an equivalent individual keyboard command shall initiate and cancel the automatic reclear feature.

The automatic reclear feature shall only be available and initiated if the route has already been set.

The cancellation of the automatic reclear feature shall be effected either by the automatic reclear feature being disabled or the signal being restored and the route normalised by the operator.

1.22.4 Control Tables

The routes of controlled running signals which are provided with an auto reclear feature shall be clearly marked in the control tables.

1.22.5 Controls

While the automatic reclear feature is in operation it shall inhibit the operation of the lever stick and automatic normalisation controls.

Signals may be provided with an individual auto reclear feature or they may be suitably grouped and provided with a common auto reclear feature.

The control may be enabled by a push button or suitable keyboard or mouse commands.

1.22.6 Indications

An indication shall be displayed for each individual or group reclear feature when it has been enabled.

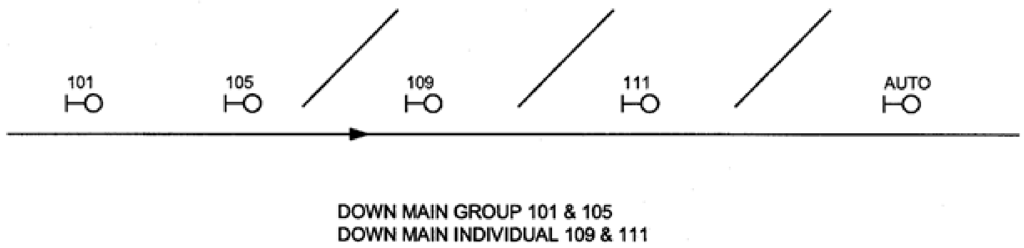


Figure 90

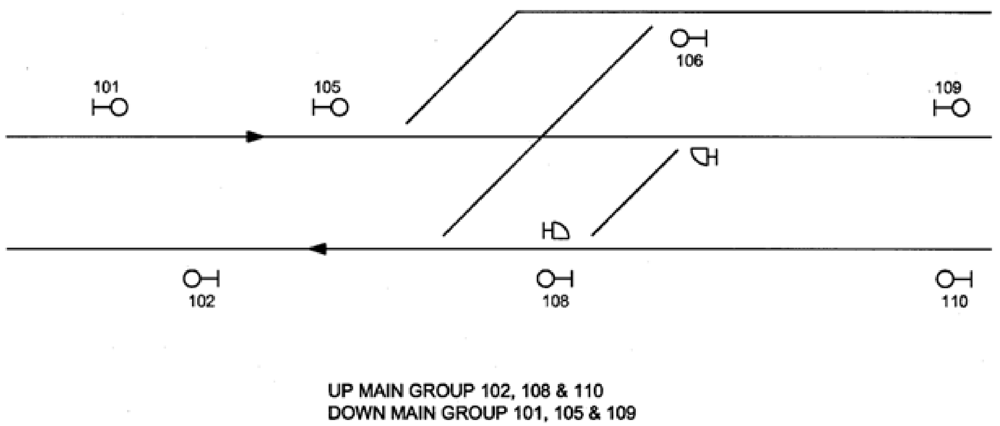


Figure 91

1.23 Principle No. 1.23 – Guards Indicators.

1.23.1 Introduction

Guards Indicators are provided to give an indication to the guard that the signal at the end of the platform is clear and the driver can be belled to depart.

Platform markers are provided which designate the location at which each type of train consist must be positioned.

The driver must stop the train at the correct marker in order to ensure that the guard is in a position to observe the correct guards indicator from the guards work station.

1.23.2 Purpose

The indicator, in conjunction with the Network Rules, prevents a guard giving the "right away" bell with the signal at stop and reduces the possibility of the driver reacting and passing the signal at stop.

1.23.3 Requirements

1.23.3.1 Provision of Guards Indicators

A guards indicator is to be provided where a signal is provided at the end of the platform, or less than a train length from the end of the platform.

1.23.3.2 Form of Guards Indicators

The guards indicator shall take the form of a lunar white (old standard) or light blue light.

A "Guards Indicator" sign is mounted below the light.

1.23.3.3 Control of Guards Indicators

The guards indicator is to illuminate when any aspect (including a shunt indication) on the signal at the end of the platform is cleared.

1.23.3.4 Location of Guards Indicators

Guards indicators are to be visible to the guard from any locations that the guard may be positioned. At some locations additional guards indicators may be required at other locations along the platform.

Guards indicators are to be oriented so that the guard is to view the indicator in the direction the train is to move.

On platforms with two way operations separate guards indicators are to be provided for each direction.

1.23.3.5 Previous Arrangements of Guards Indicators

Where arrangements of Guards indicators exist and operate together, the installation of repeat guards indicators for each direction at the same location must be assessed in view of the existing installations.

This may involve the upgrading of all guards indicators arrangements at that site, to be direction orientated.

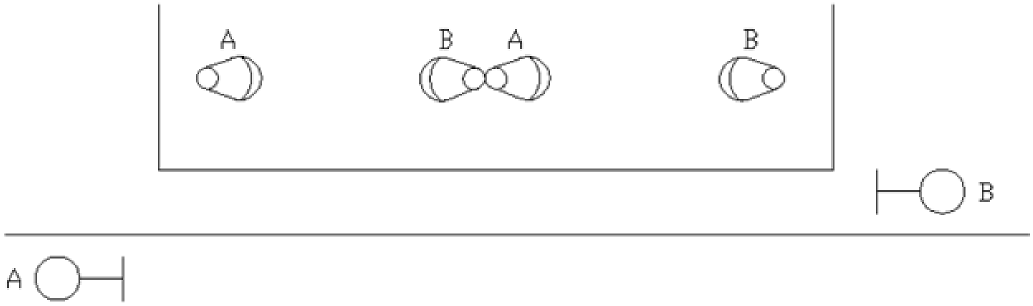


Figure 92

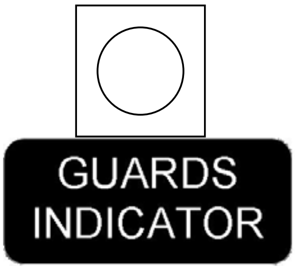


Figure 93 - Guards Indicator Typical Arrangement Diagram

1.24 Principle No. 1.24 – Dual Controlled Signals.

1.24.1 Introduction

Where there is a requirement for a signal to be dual controlled from two interlockings, this principle determines the identification plates to be provided on the signal plus the control panel inscriptions and indications.

Dual control is required where one signal has interlocking requirements from two separately controlled and located interlockings.

1.24.2 Form of Plates

The form of the plate shall be in accordance with Principle 1.2.

1.24.3 Identification to be Shown on Plates.

It is important that both signalling panels that control the signal identify the signal by the same number as shown on the signal nameplate.

The signal box identifier to be used is to be chosen after consideration of :

- The risk that exists immediately after the signal
- The controlling signal box that the signal post telephone contacts
- The interlocking that is required for that signal to clear.

Generally, a signal that protects points will be plated with the signal box that controlled the points.

Accepting and Home functions are to take priority over starting signal functions on double lines.

On single lines, home and starting functions will take priority over Accepting functions.

1.24.4 Control Panels

Dual controlled signals on control panels are to be provided with an additional inscription, such as

"Controlled by B1"

or

"Accepted by B1"

to identifying the control lever in the adjacent signal box.

Control indicator (white) lights are to be provided for signals departing the interlocking. These are a separate light to the signal repeater.

Control repeater (green) lights are to be provided for signals accepted by the interlocking. These signals may not be provided with a signal repeater, as the adjacent signal box may have prime control on this signal.

Where signal repeaters are provided in conjunction with control repeaters, the following indications shall be displayed:

Red	Signal at stop.
Flashing Green	Signal at Stop but controlling route has been set. The signal will clear when the adjacent box sets the route.
Green	Signal cleared.

A typical arrangement is shown in Figure 93.

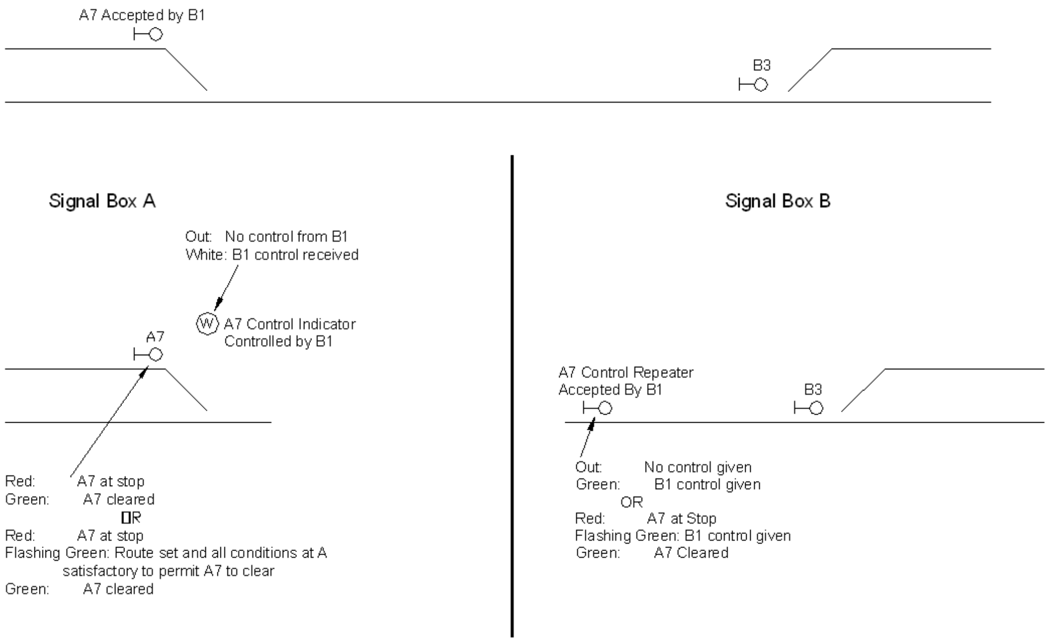


Figure 94 - Dual Control Signal A7/B1 Showing Field and Signal Box Configurations

1.24.5 Dual Controlled Signals controlled by the One signaller.

When two adjacent interlockings are controlled from the one location, the dual control indication arrangements (ie control indicators and control repeaters) are not required.

1.24.6 VDU Systems

The precise application of Control Indicators and Control Repeater Indications may vary with VDU systems, as type approved for that system.

1.25 Principle No. 1.25 - Data Arrangements for Turnout Repeaters

1.25.1 Introduction

Data complexity with turnout indications can result in increased difficulty with checking. In CBI interlockings, the functionality can be provided in a clearer form.

1.25.2 Requirements

Where turnout repeaters are provided leading to a turnout signal, then separate route dependent aspect sequence equations are required.

The arrangements are shown in Figure 95

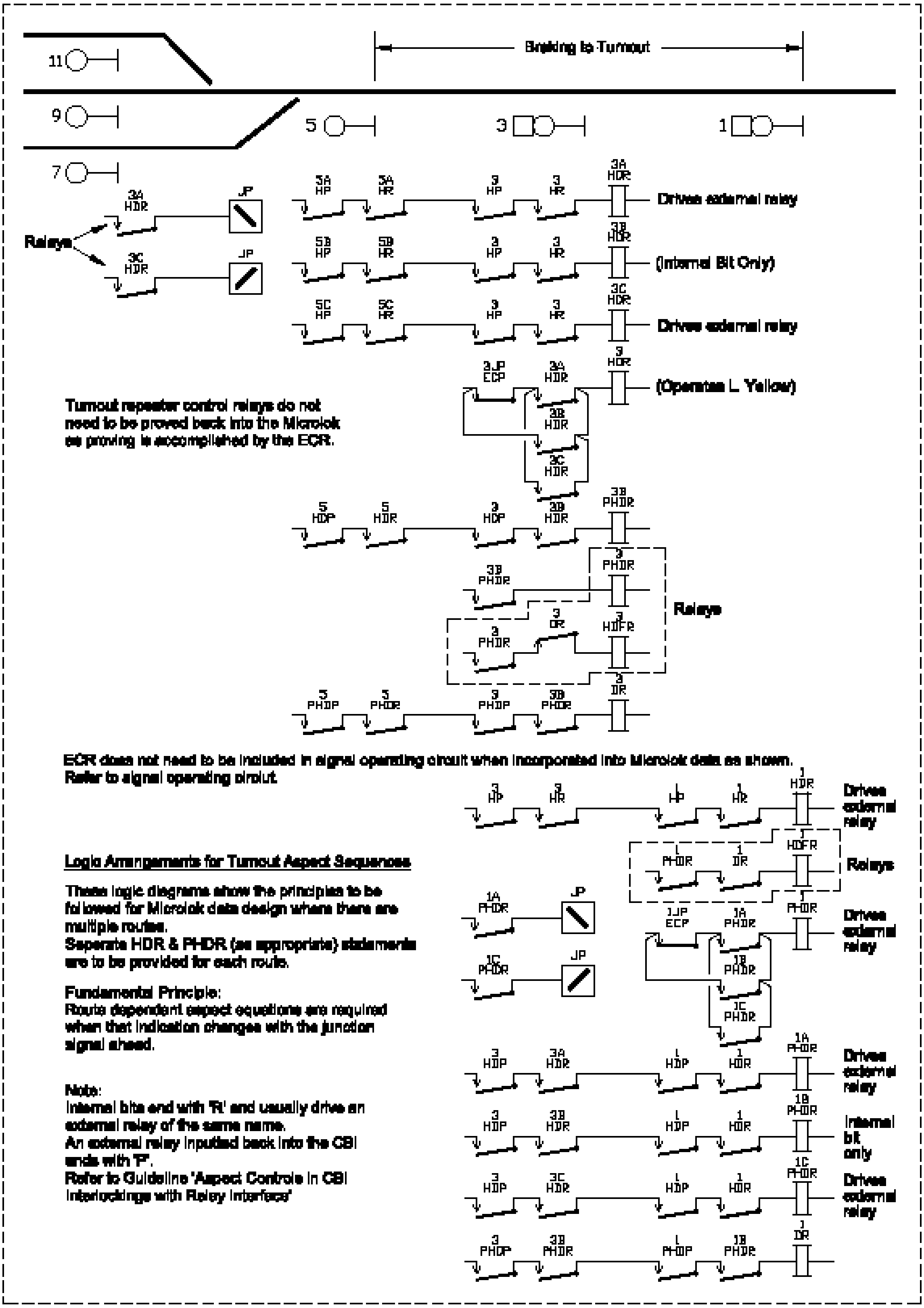

Braking to Turnout
Drives external relay
(Internal Bit Only)
Drives external relay
(Operates L Yellow)
Relays
Turnout repeater control relays do not need to be proved back into the Microlok as proving is accomplished by the ECR.
Relays
ECR does not need to be included in signal operating circuit when incorporated into Microlok data as shown.
Refer to signal operating circuit.
Drives external relay
Relays
Drives external relay
Logic Arrangements for Turnout Aspect Sequences
These logic diagrams show the principles to be followed for Microlok data design where there are multiple routes.
Seperate HDR & PHDR (as appropriate) statements are to be provided for each route.
Fundamental Principle:
Route dependent aspect equations are required when that indication changes with the junction signal ahead.
Drives external relay
Internal bit only
Drives external relay
Note:
Internal bits end with 'R' and usually drive an external relay of the same name.
An external relay inputted back into the CBI ends with 'P'.
Refer to Guideline 'Aspect Controls in CBI Interlockings with Relay Interface'

Figure 95

ESG 100.2

HEADWAY

Version 1.1

Issued May 2010

Document control

Version	Date	Summary of change
1.0	March 2006	Replaced *SC 00 13 01 02 SP Headway – v4* of 1 March 2005
1.1	May 2010	Application of *TMA 400* format

Contents

2 Headway

2.1 Principle No. 2.1 - Headway Concepts And Definitions

2.1.1 Introduction

This Principle addresses the concept of headway and provides further definitions and concepts for the various factors affecting headway.

2.1.2 Headway - Concept

The headway on any section of railway line is a measure of the capacity to pass trains through the section, with a minimum journey time.

If a complete line is to have uniform headway throughout, then all sections of the line must be considered and the factors affecting headway adjusted to ensure that uniform headway can be achieved.

Headway is often expressed as a time increment in minutes and perhaps seconds rather than the number of trains passing over a line during each hourly interval.

Headway may be stated for trains of a specific type or performance.

2.1.2.1 Headway - Definition

The headway is the time interval between successive trains running at the line speed on clear signal aspects. The train length and signal sighting distances need to be specified. Refer to the headway diagrams in Figure 1.

2.1.3 Signal Spacing - Concept

As headway considerations become critical to the performance of train services then it is necessary to provide a system of evenly time-spaced signals having regard to the effect of line speed, braking and gradient.

2.1.3.1 Signal Spacing - Definition

The distance between a series of successive signals provided to achieve a particular headway for a line.

2.1.4 Sighting Point - Concept

An adequate signal sighting point is essential if the drivers of trains are to be allowed to take the maximum advantage of the signal aspects ahead of them. Poor sighting can have a detrimental effect on headways in practice, as can excessively long sighting.

2.1.4.1 Sighting Point - Definition

The sighting point is the point in rear of a signal at which the driver of a train is first able to view the signal.

2.1.5 Sighting Distance - Concept

This is directly related to signal sighting and provides for a predetermined minimum distance at which a driver can always observe a signal before reaching it.

2.1.5.1 Sighting Distance - Definition

The sighting distance is the distance between the sighting point and the signal to which it applies.

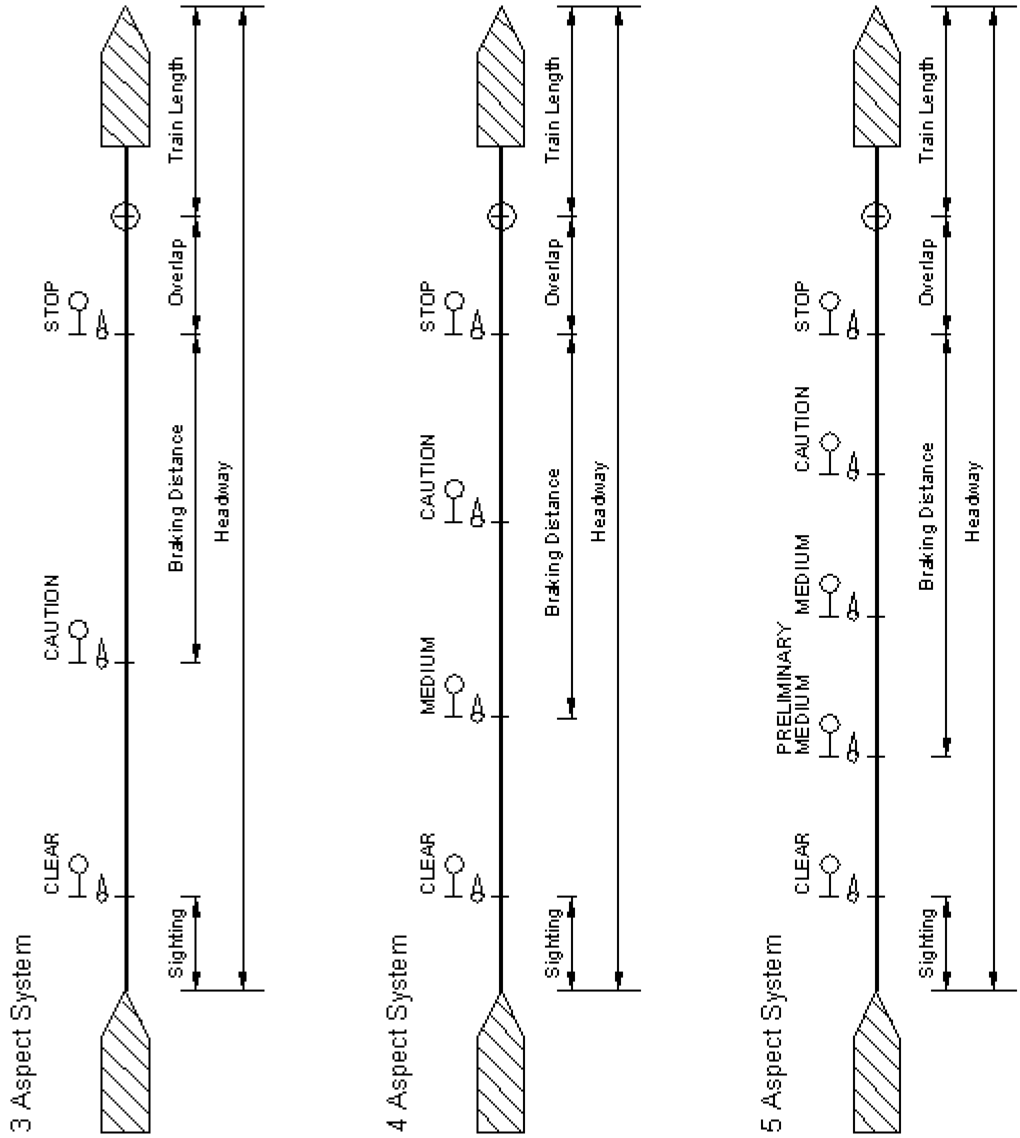


Figure 1

2.2 Principle No. 2.2 - Section Intentionally Left Blank

2.3 Principle No. 2.3 - Distance Between Running Signals

2.3.1 Introduction

This Principle addresses the requirements for determining the distance between running signals. It also addresses the spacing between a series of signals.

2.3.2 Minimum Distance Between Running Signal Aspects

The minimum distance between a signal showing a first warning aspect and the stop signal to which it applies shall not be less than the "longest braking distance".

This distance shall be determined in accordance with Principle 3.2.

The minimum distance between a signal showing the first warning aspect and a points turnout to which it applies shall not be less than the "longest braking distance" to reduce to the restricted speed required for the points turnout.

The minimum distance between a signal showing the first warning aspect and a subsidiary signal showing a proceed aspect shall be the "longest braking distance" to reduce to the restricted speed required by the subsidiary signal proceed aspect where such restricted speed is applicable.

2.3.3 Maximum Distance Between Three Aspect Running Signals

The distance between three aspect running signals shall generally be limited to 4,000m and exceptionally to an absolute limit of 4,500m.

If the distance between two successive running signals is greater than 1.5 Km and more than 1.5 times the service braking distance then the sighting distance of the second signal shall be greater than the minimum sighting distance specified in Principle 1.12, and the overlap distance for the first signal beyond the second signal should be greater than the normal minimum overlap distance specified in Principle 4.2, such that the sighting distance and the overlap distance together are greater than their combined minimum distances to an extent commensurate with the greater distance between the signals.

ESG 100.3

BRAKING DISTANCE

Version 1.8

Issued 7 June 2013

Document control

Version	Date	Summary of change
		Replaced *SC 00 13 01 03 SP Braking Distance v3 1* of May 2003
1.1	21 August 2006	Amendment to end of 3.2.3 Added 3.2.4 & 3.2.5 Amendments to Braking curves in Attachment to Principle 3.2 Deletion to references to ARTC territories in Attachment to Principle 3.2
1.2	28 September 2006	XPT curves amended to GX4M
1.3	16 June 2008	3.2.2 amended; 3.2.4 & 3.2.5 new last para; new Section 3.3; note added to end of table attachment to 3.2
1.4	May 2010	Application of *TMA 400* format
1.5	24 January 2011	Appendix A – correct formatting and line mis-match and some line descriptions;
1.6	7 February 2012	Attachments to 4.2 – insert GE62, Glenfield - Leppington to South and GENG-FS-Max – Epping - Tallawong to North; New braking curve GE NG-FS-MAX;
1.7	28 August 2012	Amend sections 3.2.4, 3.2.5, 3.3, and Appendix A
1.8	7 June 2013	New section 3.4 added.

Contents

3 Braking Distance

3.1 Principle No. 3.1 - Braking Distance Concepts and Definitions

3.1.1 Introduction

This Principle addresses the concepts and definitions of braking distance and its effect on the requirements and design of a signalling system.

3.1.2 Braking Distance - Concept

Braking Distances for trains can be relatively long due to their significant mass, speed, braking characteristics, and the track gradients.

Consequently the Braking Distances become a critical consideration when determining the position of the first warning aspect with respect to the stop signal to which it applies and especially so when trains with different Braking Distances operate over the same line.

3.1.3 Braking Distance - Definition

Braking Distance is the distance travelled by a train between the point at which the driver initiates a brake application and the point at which the train eventually comes to rest.

3.1.4 Determination of Braking Distance

In designing a signalling system it is necessary to know the specific predetermined Braking Distance for each type of train running on a particular line.

This particular Braking Distance may be obtained from theoretical calculation or from dynamic tests performed on the trains themselves or result from a mixture of both sources of information.

Either way, many factors influencing this predetermined Braking Distance will have been considered, typically:

- the speed of the train when the brake application was initiated.
- the possibility of a train accelerating when it should be slowing.
- the fundamental rate of braking which can be achieved.
- the effects of the braking system reaction time.
- the number of brakes which may be cut out.
- the acceptable amount of wear and tear on braking performance.
- the effects of drivers reaction time.
- the effect of rising or falling gradients.
- % contingency.

From the above two sets of Braking Curves can be produced for each type of train, one for Service Braking and one for Emergency Braking.

3.1.5 Service Braking Distance - Definition

Service Braking Distance is the braking distance for a train when it has been subjected to a "full" service brake application.

Service Braking Distance is fundamental in determining the minimum distance between the first warning aspect given to a driver and the stop signal to which it applies.

3.1.6 Emergency Braking Distance - Definition

Emergency Braking Distance is the braking distance for a train when it has been subjected to an "emergency" brake application.

Emergency Braking Distance may be used in determining the minimum overlap distance to be provided beyond a stop signal.

Notes:

The Emergency Brake can be initiated independently of the Service Brake for example by release of the "dead mans lever" or by a train stop mechanism where provided.

Emergency Braking Distance is not necessarily less than the Service Braking Distance and is greater for some types of trains (EMU intercity sets for example).

3.1.7 Longest Braking Distance – Definition

The "longest braking distance" shall be the service braking distance of the train that takes the longest distance to stop from its maximum allowable and attainable speed at that particular brake application location.

3.2 Principle No. 3.2 - Determination of Braking Distance

3.2.1 Introduction

This Principle addresses the method employed to determine the braking distance at any point on a line.

3.2.2 Service Braking (SB) Curves

The Service Braking curves to be used in conjunction with this Principle shall be the curves nominated in the Attachment to this Principle.

When designing a signalling system the signal aspects shall be determined so as to enable the longest braking distance train, travelling at its maximum allowable and attainable speed, applying service braking at the warning signal to come to a stand at the stop signal. The sighting distance of the warning signal shall not be included in the determination of the minimum signal spacing for braking when designing the system.

3.2.3 Determination of Longest Braking Distance

The longest (service) braking distance required in any particular section of a running line shall be determined from the appropriate Service Braking Curves have regard to

- the types of trains running over the particular section of line.
- the maximum speed permitted (line speed) for each type of train. Note that it is the line speed approaching the first warning signal rather than the line speed between the warning signal and the stop signal, which is most relevant.
- the service speed of each type of train in the particular section of line. (For example, some types of freight train are limited to 80 kph maximum irrespective of line speed and an M-train simulation will show that a loaded freight cannot always attain line speed)
- the gradient on the particular section of line, in particular the gradient between the warning signal and the stop signal.
- the present speed restriction, if any, applicable to the particular section of line. This may include posted speed limits and limits imposed by the Train Operating Conditions manual.

Care must be exercised in accurately identifying the "worst" braked trains running over the particular section of line for the purpose of determining the longest (service) braking distance correctly. Within the metropolitan area, the GW16 curve is the standard to be applied despite trains with longer braking distances being permitted to operate. Trains outside the GW16 performance are managed by appropriate speed restrictions.

3.2.4 Braking Requirements for Freight Trains

The Train Operating Conditions manual will identify the train lengths that may operate on specific corridors. These train lengths have different braking curves. The normal general speed signs shall be adjusted so that the correct braking distance is provided at the posted speed, for the train lengths specified.

On EMU-only lines, occasional work trains may be operated. However, these operate under a Possession with Safe Notice restrictions and/or under TOC waivers up to 50 km/h maximum. The line speed signs do not need to provide for these situations. However, designers shall ensure safe operation is possible at 50 km/h.

3.2.5 Determination of Speed Signs

The line speed is determined by the Chief Engineer Track and published in the Train Operating Conditionals manual.

Where the signalling is optimised to suit a specific type of traffic, such as EMU services, at the line speed, a lower speed for freight will be necessary to ensure the braking distances provided are adequate. This may result in the provision of separate General, Medium and High speed signs with different speeds.

The signal design engineer shall ensure that the speed sign requirements are agreed with the Track section such that the speed signs that are agreed, integrate with the braking distances provided in the signal design.

3.3 Methodology for Determining Braking Distances and Speed Signs

Within the RailCorp area, signalling shall be designed to ensure that line speed and headway requirements for passenger services are met as a priority over freight services, except between Asquith and Teralba. Where a scheme suitable for EMU requirements is determined, the braking distances shall be checked for freight services to determine the suitable general speed sign. The freight speed shall be as high as possible and not unduly reduced. Where the general speed sign is determined to be less than 60 km/h in

an otherwise higher speed area, consideration should be given to modifying the design so as to achieve 60 km/h general speed sign.

As a guide freight braking distances should achieve GW16 at line speed as a starting point and longer or poorer braked trains controlled by lower speed general signs. Where this cannot be achieved, the arrangement shall be referred to the Chief Engineer Signals & Control Systems for determination.

3.4 Braking Distances applied to Signalling Layouts with ATP

ATP fitted trains provide a pre-indication warning to the driver that they have to commence braking. The amount of pre-indication is defined in ESG 100.31.

To avoid unnecessary warning to the driver, it is required that the minimum distance between the first warning signal and the stop signal be equivalent to the longest braking distance (defined in 3.1.7 above) plus a distance to provide for the pre-indication time at line speed.

Note: Typically the pre-indication time is 5 seconds.

Appendix A Attachment to Principle 3.2

Applicable Signalling Braking Curves For Particular Lines

Line	Braking Requirements
Inner City	
City Railway/Waverton	GE62
Erskineville – Bondi Junction	GE62
Central – Strathfield	
Main Lines	GW16, GE62, GX4M
Suburban & Local Lines	GE62, GX4M
Central – Meeks Road Junction (Tempe)	
Illawarra	GW16, GE62, GX4M
Illawarra Local	GE62, GX4M
Central – Wolli Creek (NSR)	GE62
Illawarra	
Meeks Road Junction – Helensburgh	GW30, GE62, GX4M
Sutherland-Cronulla	GE62
Helensburgh – Coniston	GW30, GE62, GX4M
Port Kembla Balloon Loop	Shunt Signals only
Coniston – Unanderra	GW30, GE62, GX4M
Unanderra – Kiama	GW16, GE62, GX4M
Kiama - Bomaderry	GW16, GX4M
North	
Strathfield – Asquith	GW40, GE62, GX4M
Epping - Tallawong	GE NG-FS-MAX
Asquith - Teralba	GW40, GX4M
Teralba – Hamilton Junction	GW40, GX4M
Hamilton Junction – Newcastle	GE62
West	
Strathfield – Lidcombe	
Main	GW16, GE62, GX4M
Suburban (699 Points)	GW62, GX4M
Lidcombe - Granville	GW40, GE62,, GX4M
Granville – Lithgow	GW30, GE62, GX4M
Clyde – Carlingford	GE62
Blacktown - Richmond	GE62
South	
Granville – Cabramatta	GW40, GE62, GX4M
Lidcombe – Cabramatta	GW40, GE62, GX4M
Tempe – Glenfield	GE62, GW40, GX4M
Glenfield - Leppington	GE-62
Cabramatta – Macarthur	GW40, GE62, GX4M
North Shore	
Waverton – Hornsby	GE62
Chatswood - Epping	GE62
Bankstown	
Sefton Park Junction - Sydenham	GE62
Metropolitan Goods Lines	
Enfield – Sefton Park Junction	GW40
Flemington – Enfield	GW40
Enfield – Meeks Road Junction	GW40
Enfield Yard Area	Shunt Signals only
Marrickville Loop – Botany	GW40

Note:

Refer to the Train Operating Conditions (TOC) Manual to determine the specific freight trains that run in any corridor and hence the train braking curve that is to be applied to determine the general speed signs.

Note:

Where multiple braking curves are specified for particular sections of lines, a check needs to be made on all curves that an adequate distance is provided. As an example, a line requiring braking to GW10, GW16, GX4M curves, is likely to be constrained by the GW10 braking curve below 80 km/hr and the GW16 braking curve around 100 – 115 km/h. Should GX4M speeds generally exceed 140km/hr then the GX4M braking curve may become the critical factor.

Braking Curves	GW6B *	Standard Goods Train Braking 115km/h max.
	GW16	Superfreighter braking (680m train) 115km/h max.
	GW36	42 NHFF loaded Coal Train braking 80km/h max.
	GW10	84 NHFF loaded Coal Train braking 80km/h max.
	GW11	84 NHFF Empty Coal Train braking
	GW40	1500m long Superfreighter braking 115 km/h max. (4 x 81 class + 3480 tonnes) (26/10/93)
	GW30	1200m long Superfreighter 115 km/h max (4x81 class +2760 tonne) (29/6/93)
	GE62	DD EMU (R/S set) full service braking (Max – 80% average deceleration) (1/12/94)
	GE52	DD EMU (R/S set) Emergency (trip) braking (crush loaded) (Max – 80% average deceleration) (1/12/94)
	GE52A	As GE52 using average distances
	GX4M	XPT, Endeavour, Explorer, Hunter full service braking 160 km/hr max.
	GX2M	XPT, Endeavour, Explorer, Hunter Emergency trip braking
	GE NG-FS-MAX	New Generation Full Service Maximum distances
Simulated Speed	SIM	That speed as determined by an M-Train simulation run.

Should trains with poorer braking, or higher attainable speeds than those listed for the braking curves, be required to operate on the line then an analysis and safety assessment of the resulting effects on infrastructure and the train operations must be conducted.

* Superseded

ESG 100.4

OVERLAPS

Version 1.7

Issued 6 March 2012

Document control

Version	Date	Summary of change
		Replaced *SC 00 13 01 04 SP Overlaps – v5* of 27 July 2004
1.1	31 July 2006	4.3.3 – Overlap speed clarified; 4.3.7 added; Attachment added ECRL
1.2	3 October 2006	4.3.7 – 'at stop' added to paragraphs about Speed Boards increase and Decrease prior to a signal. 4.3.8 added – High speed overlaps 4.13.2 clarified
1.3	26 October 2009	4.1.4 – Reference to sections in ESG 1001. added
1.4	May 2010	Application of *TMA 400* format
1.5	24 May 2011	Appendix A – correction of formatting plus change Illawarra line to show Kiama and Port Kembla
1.6	7 February 2012	Attachment to Principle 4.3 – insert Epping - Tallawong to North & Glenfield - Leppington to South
1.7	6 March 2012	Updates to the RailCorp ETCS Requirement Specifications; Figure 7 – delete reference to Principle 4.8 (now 4.9)

Contents

4 Overlaps

4.1 Principle No. 4.1 - Overlaps Concepts & Definitions

4.1.1 Introduction

This Principle addresses the concept of an overlap to provide a margin of safety between following trains and provides definition for of the terms associated with overlaps.

4.1.2 Overlap - Concept

Where provided the purpose of an overlap is to ensure a margin of safety beyond a stop signal by establishing a predetermined separation distance between two trains.

4.1.3 Overlap - Definition

An overlap is the section of track immediately in advance of a Stop signal, which must be unoccupied before the Stop signal next in rear is permitted to show a proceed indication.

4.1.4 Overlap Distance

The overlap distance is the length of the section of track which forms the overlap and is measured from the Stop signal to a predetermined clearing point in advance.

This predetermined clearing point may be prescribed under these Principles or measured dynamically resulting in sets of braking curves, or may be the result of a combination of both.

Factors which influence the predetermination of the clearing point may be

- Historical precedents and experimental data.
- Maximum Line Speed.
- Permanent Speed Restrictions.
- Service Speed.
- Service Braking Curves.
- Emergency Braking Curves.
- Impact of gradient.
- Emergency Brake Tripping System.
- Automatic Train Protection System.
- Provision of conditional caution aspect clearance of signals

Refer also to ESG 100.1, Section 1.19.2.2, for conditional caution and section 1.19.2.3, for low speed overlaps and ESG 100.31 for ATP overlaps.

4.1.5 Overlap Track Circuit(s) - Definition

One or more track circuits which constitute the predetermined overlap distance.

On plain line this will always be at least the “A” track circuit beyond a stop signal.

4.2 Principle No. 4.2 - Overlaps On Double Lines At Colour Light Running Signals Not Equipped With Train Stops.

4.2.1 Introduction

This Principle addresses the requirements for the provision of overlaps on double lines at running signals in colour light signalling territory which are not equipped with train stops.

4.2.2 Provision Of An Overlap

If a running signal on a passenger line is capable of showing an unconditional warning aspect then an overlap shall be provided immediately beyond the stop signal to which the warning aspect applies.

4.2.3 Overlap Distance

The nominal length of the overlap to be provided shall not be less than the minimum distances shown below.

Speed Range over Particular Section of Line		**Minimum Overlap Distance**
0 - 59 Kph	300m	(or longest braking distance, if less)
60 - 79 Kph	400m	(or longest braking distance, if less)
80 Kph and greater	500m	(or longest braking distance, if less)

4.2.4 Variations to Overlap Distances

If the grade on a particular section of line is greater than 1 in 100 falling then the overlap distance shall be increased for that speed range by not less than 100 metres.

If a block joint already exists or is to be provided for other purposes and could also be used as an overlap block joint without adversely affecting the line headway then the overlap distance may be increased to avoid the provision of a separate overlap track circuit.

If the line headway is adversely affected by the nominal overlap distance then a reduction in the overlap distance should be considered based on the appropriate factors presented under Principle No. 4.1.4.

Where train speeds are permanently restricted due to them departing yards or negotiating turnouts or junctions, then the overlaps beyond the signal may be reduced to 90 metres where the speed approaching the signal is restricted to 15kph and to 150 metres where the speed is restricted to 25kph, or reduced to the longest braking distance, if less.

If a running signal is more than 1.5 Km and more than 1.5 times service braking distance from the next signal then the overlap distance for that running signal beyond the next signal shall be commensurably greater than the normal minimum overlap distance.

4.3 Principle No. 4.3 - Overlaps On Lines Above Ground In Trainstop Territory

4.3.1 Introduction

This Principle addresses the requirements for the provision of overlaps on lines above ground at running signals in colour light signalling territory which are equipped with train stops.

4.3.2 Provision Of An Overlap

If a running signal on a passenger line is capable of showing an unconditional warning aspect then an overlap shall be provided immediately beyond the stop signal to which the warning aspect applies.

4.3.3 Overlap Distance

The length of the overlap shall be determined from the GE52A Trip Stop Braking Curve for R/S double deck suburban sets provided by the Principal Brake Engineer for trains operating at the permissible line speed applicable to the particular section of line concerned. Refer to the Attachment.

If the service speed is less than line speed then it may be permissible to use the service speed for the determination of the overlap length, however effective arrangements must be in place to ensure trip-fitted trains with higher service speeds and longer braking distances are not introduced to run on the line without a proper risk analysis.

Where the train speed is proven to be at a speed lower than the line speed, the overlap distance determined from the GE52A curve may be in accordance with the lower speed.

4.3.4 Provision of An Overlap Track Circuit

Separate overlap track circuits shall be provided at least equal to the overlap distance determined under 4.3.3 above.

4.3.5 Variation To Overlap Distances

If the line headway is adversely affected by the overlap distance in a particular section then a reduction of the overlap distance should be investigated based on the appropriate factors presented under Principle No. 4.1.4.

4.3.6 Overlaps in Isolated Train Stop Fitted Areas

It is permissible to install train stops in isolated areas where a safety benefit is to be realised, without necessarily adjusting existing overlaps. However, should significant work occur in these areas, overlap distances should be adjusted to conform to GE52A.

4.3.7 Applicable Line Speed

As per 4.3.3, the line speed shall be generally used for determination of overlap distances using GE52A. A risk-based approach should be used to assess the potential speed at line speed changes and when turnouts are involved. The following examples provide a guide to assist in determining the speed to be used for determining overlap length:

- **Turnout Exists Within the Overlap**

Where a low speed turnout exists in the overlap, the approach speed used to determining the overlap length need not exceed twice the turnout speed.

- **Train Approaches Through a Turnout**

  Where a train approaches a signal at stop through a turnout, the overlap may be determined based upon the turnout speed (i.e. effectively the line speed for that approach).

- **Speed Board Increase Prior to a Signal**

  Where a speed board increases the speed in the block prior to the signal at stop, the lower approach speed leading to up to this board, providing it is within the restrictive aspect sequence, may be used.

- **Speed Board Decrease Prior to Signal**

  Where a speed board decreases the speed in the block prior to the signal at stop, the higher approach speed leading up to this board shall be used, unless the track configuration physically limits the speed otherwise, or the board is further than 300m from the signal.

4.3.8 Overlaps for Trains that Operate to High speed Boards

XPT, Endeavour, Explorer, Hunter and more recent EMU trains may be permitted to run to High Speed boards. In train stop fitted areas, the overlaps would be based on GE52A. Where the length of the overlap is a constraint on line speed, the GX2M curve may be used to determine either the overlap length, where the train speed exceeds the medium speed board overlap requirement to determine the high speed board value, for an existing overlap, provided, in either case, the line speed does not exceed 115km/hr train stop capability.

Attachment to Principle 4.3

Applicable Braking Curves For Overlaps On Particular Lines

Line	Braking Requirements (Overlaps)
Inner City	
City Railway/Waverton	GE52 * To include acceleration allowance
Erskineville – Bondi Junction	GE52 * To include acceleration allowance
Central – Strathfield	GE52A
Central – Meeks Road Junction (Tempe)	GE52A
Central – Wolli Creek (NSR)	GE52
Illawarra	
Meeks Road Junction – Kiama and Port Kembla	GE52A
North	
Strathfield – Hawkesbury River	GE52A
Epping - Tallawong	GE52
Fassifern – Hamilton Junction	GE52A
Hamilton Junction – Newcastle	GE52A
West	
Strathfield – Emu Plains	GE52A
Flemington – Homebush Bay - Lidcombe	GE52A
Clyde – Carlingford	GE52A
Blacktown - Richmond	GE52A
South	
Lidcombe – Cabramatta (via Sefton)	GE52A
Granville – Cabramatta	GE52A
Tempe – Glenfield	GE52A
Cabramatta – Macarthur	GE52A
Glenfield – Leppington	GE52A
North Shore	
Waverton – Hornsby	GE52A
Chatswood - Epping	GE52
Bankstown	
Sefton Park Junction - Sydenham	GE52A

4.4 Principle No. 4.4 – Overlaps on Lines in Tunnels

4.4.1 Introduction

This principle addresses the requirements for the provision of overlaps in continuous tunnels.

4.4.2 Provision of an Overlap

If a running signal on a passenger line is capable of showing an unconditional warning aspect, then an overlap shall be provided immediately beyond the stop signal to which the warning aspect applies.

4.4.3 Overlap Distance

The length of the overlap shall be determined from the GE52 Trip Stop Braking Curve, for a train operating at the permissible line speed.

The requirements of sections 4.3.4, 4.3.5 and 4.3.7 may also apply in tunnels.

However, where a reduced speed is used, an acceleration allowance shall be included in the overlap speed determination. The acceleration allowance shall be based upon:

- The train accelerating at maximum acceleration from the location of any previous speed check (usually a train stop).
- The maximum speed obtained at the stop signal (or raised speed checking trainstop) as a result of this acceleration.
- A maximum speed of line speed being applied.

Where speed checking is employed, the overlap distance for a particular speed may apply from a speed checking trainstop, rather than a stop signal.

4.5 Principle No. 4.5 - Overlaps in CTC Territory

4.5.1 Introduction

This Principle addresses the requirements for the provision of overlaps on single lines and in crossing loops in C.T.C. colour light territory.

4.5.2 Provision Of An Overlap On A Single Line

4.5.2.1 Requirements

An overlap shall be provided at the exit from a single line block section immediately in advance of the home signal.

This overlap shall extend from the home signal as far as the opposing main and loop starting signals controlling the entrance to the single line block section and shall incorporate loop and flank protection. Refer to Principle 4.11. Refer to Figure 1.

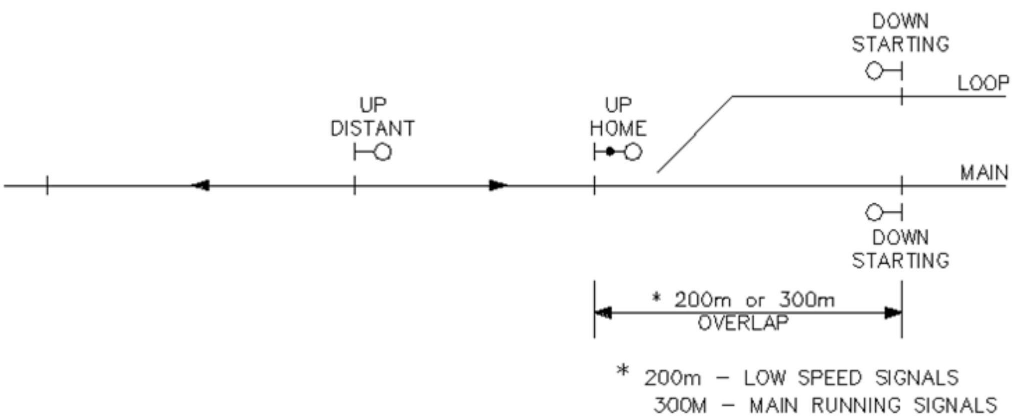


Figure 1 - Overlaps on Signal Lines in CTC Territory

If for operational reasons an outer home signal is provided at the exit from a single line block section together with an opposing starting signal on the single line then an overlap shall be provided immediately in advance of the outer home signal.

This overlap shall extend from the outer home signal towards the opposing starting signal on the single line. Refer to Figure 2.

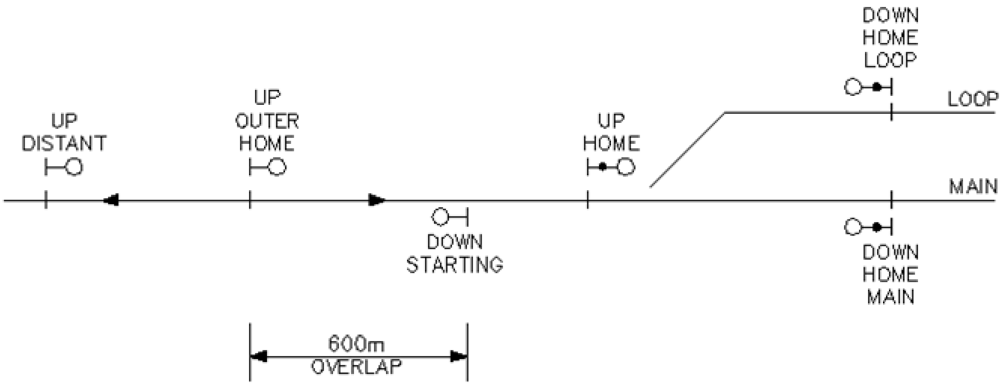


Figure 2 - Overlaps on Signal Lines in CTC Territory

4.5.2.2 Overlap Distance

If a home signal only is provided then a nominal overlap of 200m shall be provided for the single line block section extending over the loop end.

If main running signals are provided for loop entry, this distance shall be 300m. Refer to Figure 1.

If an outer home signal is provided then a nominal overlap of 500m shall be provided for the single line block section and this shall abut a 100m overlap provided immediately in advance of the opposing starting signal. Refer to Figure 2. and Section 4.5.3 of this Principle.

4.5.2.3 Variations To Overlap Distances

If a block joint which already exists or is to be provided for other purposes could also be used as an overlap block joint without adversely effecting the line headway then the overlap distance may be increased to avoid the provision of a separate overlap track circuit.

4.5.3 Provision Of Overlaps At A Crossing Loop

4.5.3.1 Requirement

The home signal shall be provided with an overlap immediately in advance of the main and loop starting signals into the single block section in advance.

The overlap shall extend from the main or loop starting signal into the single line section in advance as far as the opposing home signal. Refer to Figure 3.

Figure 3 - Overlaps in Crossing Loops in CTC Territory

If a subsidiary shunt signal is fitted to a home signal then it shall be provided with an overlap immediately in advance of the main and loop starting signals into the single line block section in advance.

This overlap shall extend from the main or loop starting signals into the single line block section in advance towards the opposing home signal.

This overlap shall be a locking overlap only and no overlap track circuit control shall apply to the subsidiary shunt aspect.

If an outer home signal is provided then an overlap shall be provided for the caution aspect.

This overlap shall extend from the home signal to the main or loop signals leading into the single line block section in advance. Refer to Figure 4.

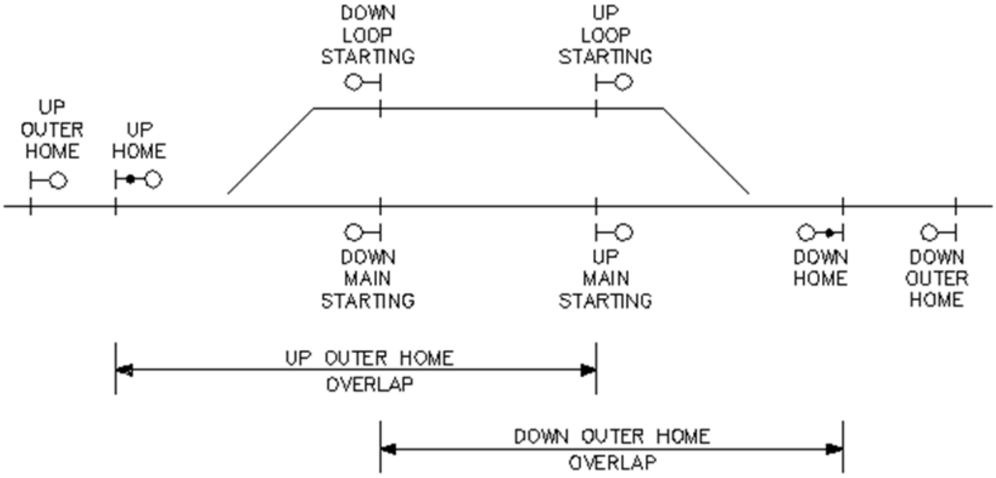


Figure 4 - Overlaps in Crossing Loops in CTC Territory

If a main or loop exit signal is fitted with a subsidiary shunt signal then the subsidiary shunt signal shall be provided with an overlap which extends towards the opposing outer home signal. Refer to Figure 2.

This overlap shall be a locking overlap only and no overlap track circuit control shall apply to the subsidiary shunt aspect.

4.5.3.2 Overlap Distances

At CTC loops using low speed for entry, the distance between the loop and main starting signals and the home signal shall be 200m. Where main running aspects are used for entry, this distance shall be 300m. The points shall be set to deflect any conflicting movement.

The nominal overlap distance for a subsidiary shunt signal shall be 100m.

The nominal overlap distance for an outer home signal shall not be less than that required under Principle No. 4.2 and not greater than the distance to the main and loop signals leading into the section in advance.

4.6 Principle No. 4.6 - Overlaps In ETS And OTS Territory Where Colour Light Running Signals Are Provided

4.6.1 Introduction

This Principle addresses the requirements for the provision of overlaps on single lines operated under electric train staff or ordinary train staff regulations and where colour light home and starting signals are provided.

4.6.2 Provision Of An Overlap

An overlap shall be provided at the exit from the single line section immediately in advance of the home signal.

This overlap shall extend from the home signal to the opposing starting signal or signals controlling the entrance to the single line section or approved clearing point as required. Refer to Figure 5.

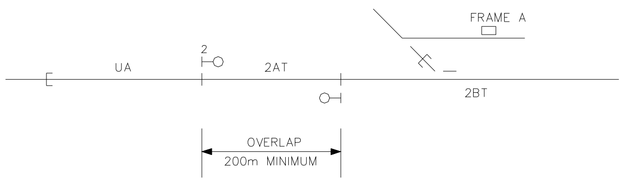


Figure 5 - Overlaps in ETS or OTS Territory

4.6.3 Overlap Distance

The length of the overlap shall be 200m minimum.

4.7 Principle No. 4.7 - Conditional Overlaps

4.7.1 Introduction

This Principle addresses the need to provide and the requirements for conditional overlaps in colour light signal territory.

4.7.2 Provision Of A Conditional Overlap

If it is necessary for specific operational purposes or for general headway reasons for trains to be brought closer together than is permitted by the requirements for a full overlap as described in Principles 4.2 and 4.3 then a conditional overlap may be provided enabling a running signal to show a conditional caution aspect.

4.7.3 Requirements For A Conditional Overlap Permitting The Display Of A Conditional Caution Aspect

If a full overlap is not available, but an overlap of reduced distance is known to be clear and the train ahead occupying part of the full overlap distance is stationary or signalled away in the correct direction of running then the running signal requiring the full overlap shall be cleared after a suitable time delay has elapsed ensuring that the speed of the following train has been reduced to be commensurate with the safety margin provided by the reduced overlap distance. Refer to Figure 6.

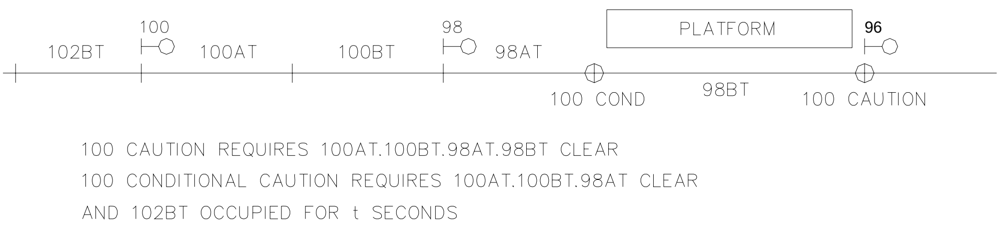


Figure 6 - Conditional Overlaps

4.8 Principle No. 4.8 – Overlaps where ATP is Provided

4.8.1 Introduction

This principle addresses the requirements for the provision of overlaps where ATP is fitted.

Where unfitted rolling stock operates over ATP fitted track, the principles on overlap distance shall be maintained.

4.8.2 ATP Supervised Location

Refer to ESG 100.31 for details of ATP supervised locations, in relation to overlaps where ATP is provided.

4.8.3 Overlap Length

Where all rolling stock operating over an ATP-equipped section of line are fitted with ATP onboard equipment, the overlap lengths may be reduced to meet the desired headway requirements. However, the overlap length shall be subject to supporting the minimum onboard calculated release speed of at least 15km/h.

For new arrangements where ATP fitted stock only operate, conditional overlaps are no longer required. ATP is not capable of distinguishing between conditional and non-conditional overlaps.

4.9 Principle No. 4.9 - Locking Opposing Routes Leading Into Or Situated Within An Overlap

4.9.1 Introduction

This Principle addresses the requirements for locking out opposing routes leading into or situated within an overlap by a particular route of the signal requiring the overlap.

4.9.2 Requirements For The Signal Requiring The Overlap

If a signal requires an overlap into which a route or overlap from an opposing signal leads or in which the route from an opposing signal is situated then the opposing route shall be normal and any associated track circuit holding released, if applicable, before the particular route of the signal requiring the overlap is permitted to set. Refer to Figure 7.

If it is required to set the particular route of the signal requiring the overlap then the opposing routes leading into the overlap or situated within the overlap shall be locked normal until the particular route of the signal requiring the overlap is normalised and any associated track circuit holding released, if applicable. Refer to Figure 7.

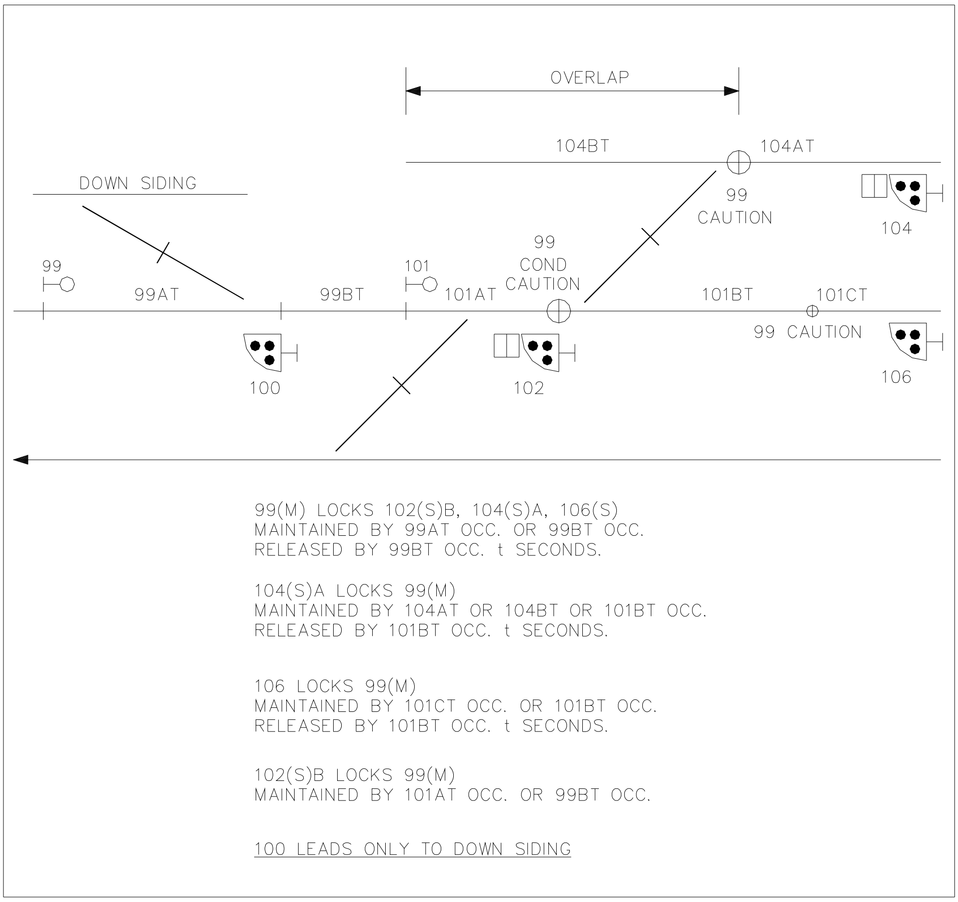


Figure 7 - Locking and releasing of opposing routes in an overlap

4.9.3 Requirements For Opposing Signals

If it is required to set a route from an opposing signal leading into or situated within an overlap then the particular route of the signal requiring the overlap shall be locked normal until the route from the opposing signal has been normalised and any associated track circuit holding released, if applicable.

4.10 Principle No. 4.10 - Setting And Locking Of Points Within An Overlap

4.10.1 Introduction

This Principle addresses the requirement for setting and locking of trailing and facing points when situated within an overlap and for trapping and flank protection to an overlap.

4.10.2 Trailing Points

If a set of trailing points situated within an overlap is available then it shall be set and locked in the appropriate position by the particular route of the signal requiring the overlap and remain locked until the particular route has been normalised or if provided an alternative overlap has been set.

If a train passes the signal requiring the overlap then the trailing points shall also become locked in position by track circuit occupancy until the train has come to a stand at the signal in advance and any time release provided has expired or the train has passed beyond the signal in advance and the trailing points have become directly locked by track circuit occupancy. Refer to Figure 8.

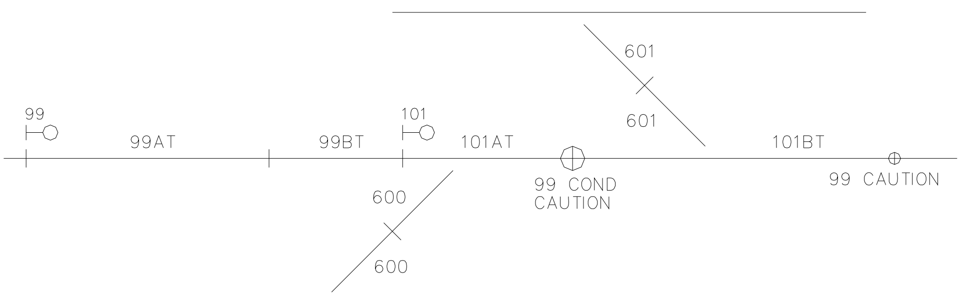


Figure 8 - Setting and locking of points in an overlap

If alternative overlaps are provided then a set of trailing points shall be set and locked as described above subject to the particular lay of the overlap. Refer to Figure 9.

If a set of trailing points situated within an overlap is not available then the particular route of the signal requiring the overlap shall be inhibited from setting.

4.10.3 Facing Points

If a set of facing points is situated within an overlap and each of the alternative overlaps is available then no setting or locking of the facing points is required. Refer to Figure 10.

If a set of facing points is situated within an overlap and one of the alternative overlaps is not permitted or is not available then the facing points shall be set and locked in the direction of the available overlap by the particular route of the signal requiring the overlap and remain locked until the particular route has been normalised or until an alternative overlap has become available. Refer to Figure 10.

If a train passes the signal requiring the overlap then the facing points shall remain locked in position, if required, by track circuit occupancy until the train has come to a stand at the signal in advance and any time release provided has expired or the train has passed beyond the signal in advance and the facing points have become directly locked by track circuit occupancy.

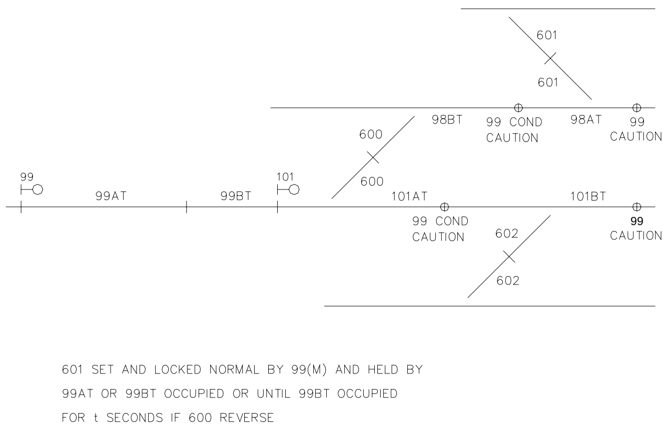
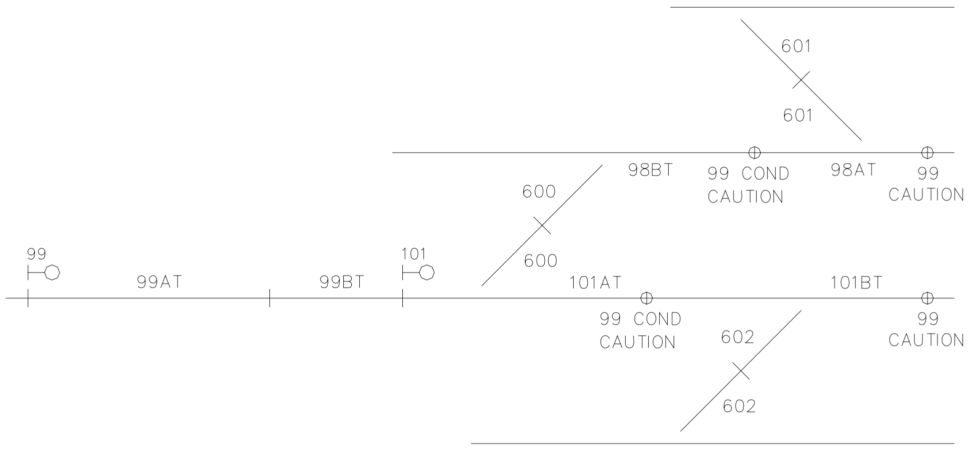


Figure 9 - Setting & Locking of Points in an Overlap

If a set of facing points situated within an overlap is not available to be set then the particular route of the signal requiring the overlap shall be inhibited from setting.

4.10.4 Facing Points Providing Flank Protection

If a set of facing points which provides flank protection to an overlap is available then it shall be set and locked in the appropriate position by the particular route of the signal requiring the overlap and remain locked until the particular route has been normalised or if provided an alternative overlap has been set.



600 SET AND LOCKED TO THE NON CONFLICTING LAY BY 99(M)
AND HELD BY 99AT OR 99BT OCCUPIED OR UNTIL 99BT OCCUPIED
FOR t SECONDS IF ONE OF THE ALTERNATIVE OVERLAPS IS OBSTRUCTED

Figure 10 - Setting & Locking of Points in an Overlap

If a train passes the signal requiring the overlap then the points shall also become locked in position by track circuit occupancy until the train has come to a stand at the signal in advance and any time release provided has expired or the train has passed beyond the signal in advance and the points have become directly locked by track circuit occupancy. Refer to Figure 8.

If alternative overlaps are provided then a set of facing points providing flank protection shall be set and locked as described above subject to the particular lay of the overlap. Refer to Figure 9.

If a set of facing points which provides flank protection to an overlap is not available then the particular route of the signal requiring the overlap shall be inhibited from setting.

4.10.5 Special Arrangements

Under certain circumstances it may be permissible to provide special arrangements for the setting of overlap conditions. For example the provision of dedicated push buttons to enable special arrangements to be invoked.

4.11 Principle No. 4.11 - Setting And Locking Of Points Within An Overlap At A Crossing Loop In CTC Territory

4.11.1 Introduction

This Principle addresses the requirements for setting and locking points situated within the various overlaps required for subsidiary low speed, shunt, and outer home signals at a crossing loop in CTC territory.

4.11.2 Requirements For Home Signals

4.11.2.1 Where an Opposing Outer Home Signal is not Provided

If the starting signal ahead is not clear and it is required to clear the low speed subsidiary signal fitted to the home signal for the main line then the particular route shall set and lock the trailing points in the overlap in the reverse position until the particular route is normalised. Refer to Figure 11.

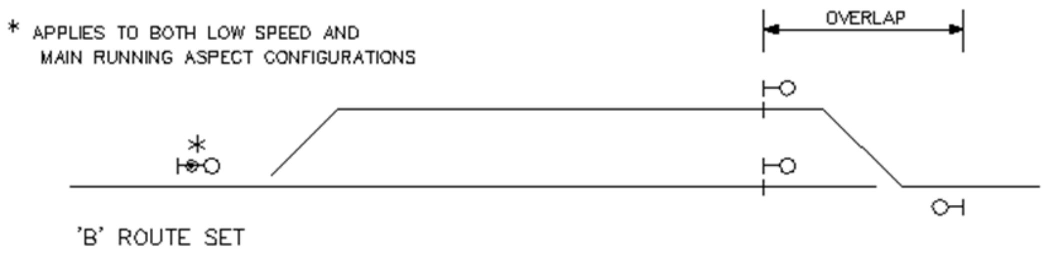


Figure 11 - Setting and Locking Points in the Overlap

This locking shall not be held by the occupation of track circuits.

The points shall be detected reverse before the signal is permitted to clear and continuously thereafter.

If it is required to clear the low speed subsidiary signal fitted to the home signal for the loop then the particular route shall set and lock the trailing points in the overlap in the normal position until the particular route is normalised. Refer to Figure 12.

This locking shall not be held by the occupation of track circuits.

The points shall be detected normal before the signal is permitted to clear and continuously thereafter.

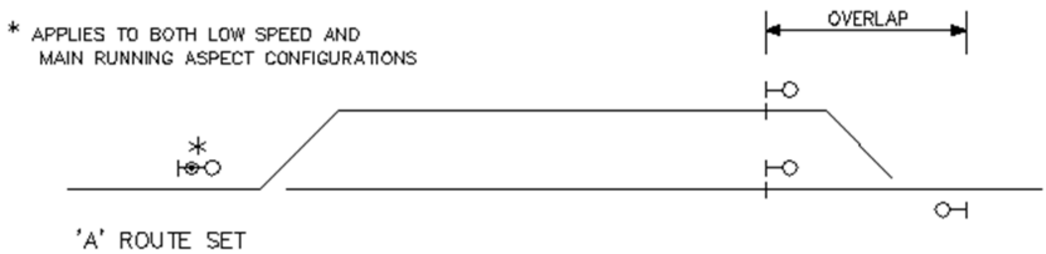


Figure 12 - Setting and Locking Points in the Overlap

4.11.2.2 Where an Opposing Outer Home Signal is Provided

If it is required to clear the low speed subsidiary signal fitted to the home signal for the main line or the loop and an opposing outer home signal is provided then the particular route required shall set and lock the trailing points in accordance with the requirements of Principle 4.10. Refer to **Error! Reference source not found.** and Figure 14.

This locking shall be held by the occupation of track circuits or released by track circuit occupation for a predetermined time.

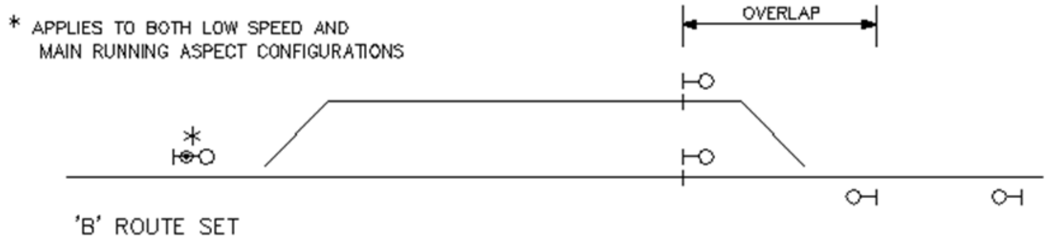


Figure 13 - Setting and Locking Points in the Overlap – with Outer Home

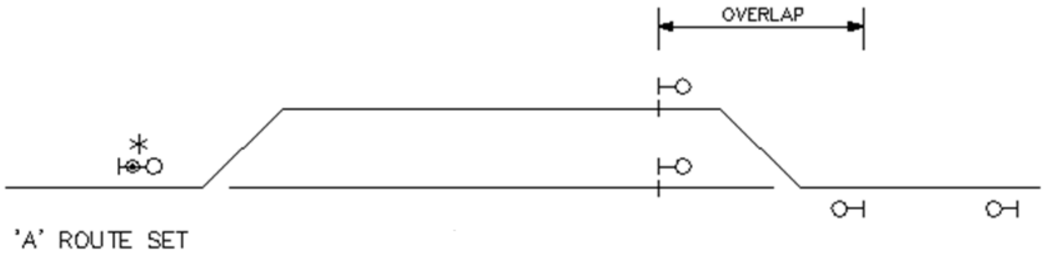


Figure 14 - Setting and Locking Points in the Overlap – with Outer Home

4.12 Principle No. 4.12 - Section Intentionally Left Blank

4.13 Principle No. 4.13 - Overlaps For Low Speed Subsidiary Signals In Colour Light Territory

4.13.1 Introduction

This Principle addresses the requirements for the provision of a locking overlap for a movement made under the control of a low speed aspect on a running signal.

4.13.2 Requirement

A locking overlap coincidental with the caution overlap of the running signal with which the low speed signal is associated shall generally be provided.

Track circuits in the overlap shall be proved clear consistent with the low speed aspect to ensure that trains proceeding at low speed are afforded adequate protection.

Depending on circumstances governing the overlap conditions, consideration should be given to the provision of an intermediate trainstop for low speed movements.

Locking overlaps used with conditional low speed indications may be considered for reduction to meet special operations requirements on obtaining special approval.

4.14 Principle No. 4.14 - Overlaps For Subsidiary Or Ground Shunting Signals

4.14.1 Introduction

This Principle addresses the requirements for the provision of a locking overlap for a movement from a shunting signal in colour light territory and applies whether the shunt signal takes the form of a subsidiary on a running signal or a ground shunt.

4.14.2 Requirement

A nominal locking overlap of 100m on a running line shall be provided for a subsidiary shunting signal or ground shunting signal.

If necessary the shunt signal requiring the overlap shall set, lock and maintain one or more sets of points in the locking overlap to eliminate the possibility of converging or opposing movements obstructing the overlap once established particularly where the opposing movement is a main route.

In yards, locking of ground frames in the overlap is not usually applied and locking in the overlap is usually via the signals, not the points, and is generally not maintained.

In yards where speeds are suitably restricted, the locking overlap distance may be reduced to 60m, or braking distance from the STOP signal if less.

In yards, for directly opposing movements between low speed shunt routes, the shared overlap may be reduced to three quarters of the combined distance of the individual overlaps, however the 60m minimum overlap (or braking distance overlap, if less) must be applied to any converging movements.

Overlap track circuits shall not be proved clear in shunting signal aspects. Refer to Principle 1.20.

4.15 Principle No. 4.15 – Preferential Setting of Conditionally Locked Points In An Overlap

4.15.1 Introduction

This Principle addresses the requirements for the provision of preferential setting of conditionally locked points in an overlap.

4.15.2 Purpose

Preferential setting of facing points in an overlap is provided to ensure that whenever possible an overlap is set in the direction of the most frequently used route ahead of an inner signal.

This reduces the probability of an overlap being set in the least used direction which may result in excessive or unnecessary overlap swinging if other routes, when setting, interact with the established overlap.

4.15.3 Requirement

If an overlap contains a set of facing points that lead over a set of trailing points which are situated beyond the facing points, and the lay of the facing points is towards the trailing

points and this is the most used direction of traffic and the trailing points are available to be set (or are already set) for the overlap then they shall be set (if necessary) and locked as applicable for the overlap. Refer to Figure 15.

This lay of overlap shall be the first preference.

If the trailing points are not available to be set for the overlap then the facing points shall be set and locked in the opposite lay towards the alternative overlap which shall be the least used direction of traffic. Refer to Figure 16.

This lay of overlap shall be the second preference.

4.15.4 Control Tables

These complimentary setting and locking conditions shall be placed in parenthesis and suffixed 1 and 2 to indicate the preference.

e.g.	101 sets & locks points normal	(401N W 400 N)^1
	101 sets & locks points reverse	(400R W 401 R)^2
	Where 2 denotes "and not free".	

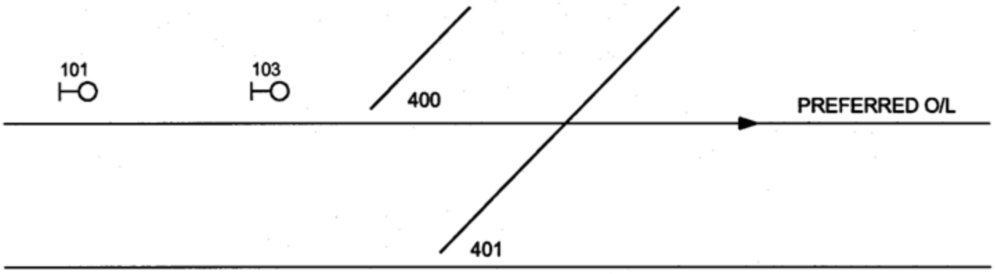


Figure 15 - Preferential Setting of Conditionally Locked Points in an Overlap

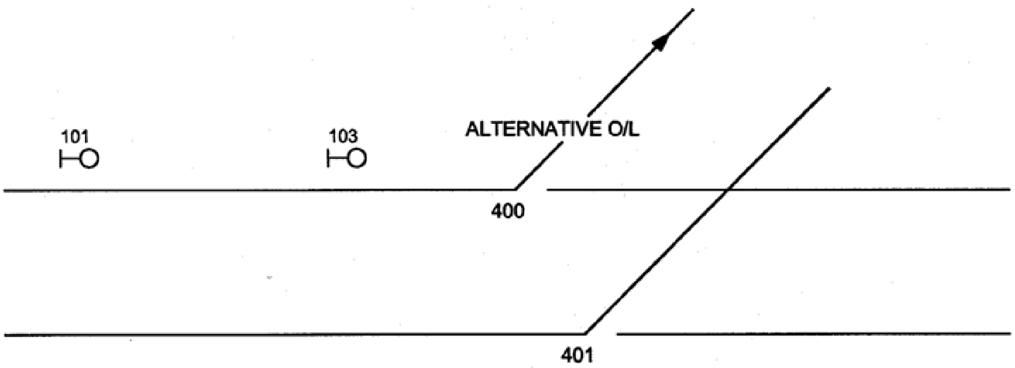


Figure 16 - Preferential Setting of Conditionally Locked Points in an Overlap

4.16 Principle No. 4.16 - Automatic Overlap Setting By Track Circuit Occupation

4.16.1 Introduction

This Principle addresses the requirements for the provision of automatic overlap setting due to the occupation of track circuits in the alternative overlap at the time a route is set.

4.16.2 Purpose

This form of automatic overlap setting is provided when an outer running signal has a choice of two or more overlaps beyond an inner signal and due to track circuit occupation one of the overlaps is not available. Under these conditions the facing points may be set towards the available overlap automatically when the route is setting.

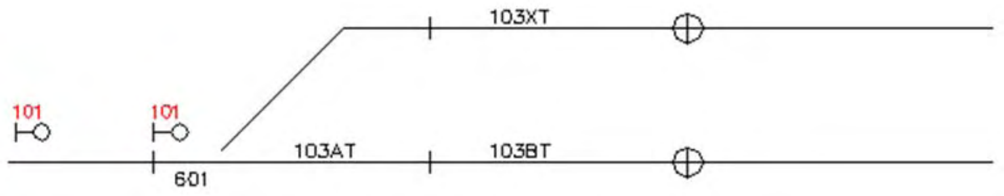
4.16.3 Requirements

If a choice of overlap exists beyond an inner signal at the time of setting an outer signal and the overlap in the direction in which the facing points are set is unavailable due to the occupation of track circuits then the outer signal may set and lock the facing points in the direction of the available overlap. Refer to Figure 17.

These arrangements may become overly complicated if two or three sets of facing points are involved and multiple overlap choices are available and care should be exercised to restrict the overlap swinging to the minimum to satisfy traffic conditions. Overlaps should not be swung across opposing roads.

4.16.4 Control Tables

Details of the overlap setting shall be shown on the Control Table points sheet concerned.



101 SETS 601 N W 103XT OCC

101 SETS 601 R W 103BT OCC

Figure 17 - Automatic Overlap Setting by Track Circuit Occupation

4.17 Principle No. 4.17 - Overlap Swinging

4.17.1 Introduction

This Principle addresses the requirements for the provision of overlap swinging facilities.

4.17.2 Purpose

Overlap swinging is provided to assist an operator to establish routes which will interact with one or more overlaps previously set for one or more routes. This avoids the operator from having to manually establish the alternative overlaps by individual point key movements before the route to be set becomes available. This may become a complex and time consuming operation where two or more junctions overlap and several routes have already been set.

4.17.3 Requirements

If one or more routes have already been set, the appropriate overlaps established and the signals are displaying proceed aspects and another route requires to be set which will alter the lay of one or more sets of points in the overlaps of the previously cleared signals then the route which is to be set shall adjust the lay of the established overlaps progressively and prove that an alternative overlap is available before the facing points leading towards the alternative overlap are reset to opposite lay.

If several sets of points are involved then this process of overlap swinging shall be enforced by the setting and locking of the overlap points in sequence.

Signals already displaying proceed aspects shall have their aspects maintained during the overlap swinging and shall prove the appropriate alternative overlap conditions when the overlap movement is complete.

4.18 Principle No. 4.18 - Overlap Maintenance

4.18.1 Introduction

This Principle addresses the requirements for the locking of facing points to ensure that a clear overlap is maintained while an alternative overlap is occupied and a route is set or a train is occupying the route leading up to the home signal at the points.

4.18.2 Purpose

This locking is provided when an outer running signal has a choice of two or more overlaps beyond an inner signal, and due to track circuit occupation, one (or more) of the overlaps is not available.

4.18.3 Requirements

If a choice of overlap exists beyond an inner signal, then the clearing of an outer signal will lock any facing points beyond the inner signal to prevent the operation of those points towards the obstructed overlap.

The points shall remain locked whenever a train is approaching the inner signal, and the alternative overlap remains obstructed.

This locking may be released when the alternative overlap becomes clear, or the route has been cancelled and the approach locking released, or the train has been time released at a stand at the inner signal.

If multiple overlaps exist, care should be exercised to ensure that overlap maintenance is properly applied through the various combination of conditions.

4.18.4 Control Tables

Details of overlap maintenance locking shall be shown on the points sheet control table.

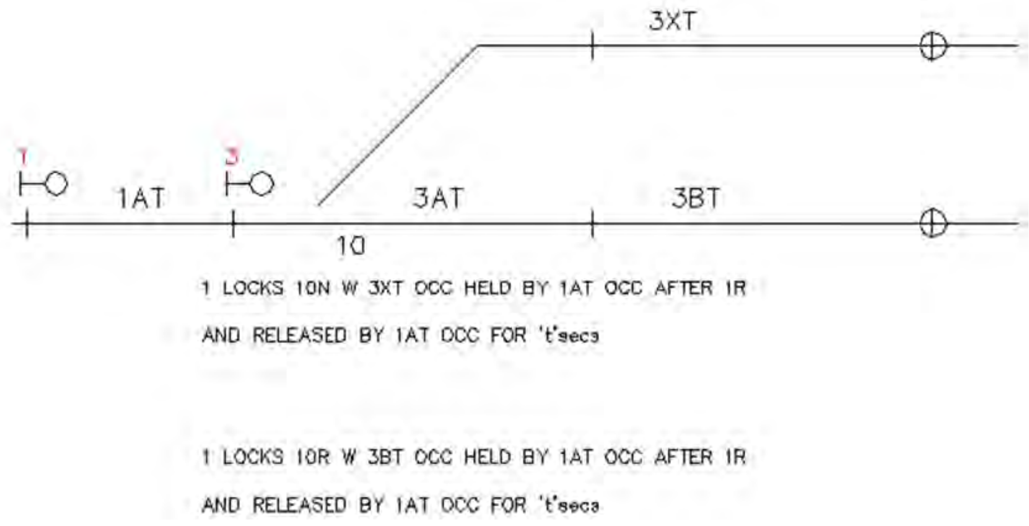


Figure 18 - Overlap Maintenance

ESG 100.5

SPEED RESTRICTIONS

Version 1.2

Issued 6 September 2011

Document control

Version	Date	Summary of change
		Replaced *SC 00 13 01 05 SP Speed Restrictions* – v3 of May 2003
1.1	May 2010	Application of *TMA 400* format
1.2	6 September 2011	Modify Advisory Speed sign section 1.5.4 Insert new section 5.1.7 – Yard Speed Signs Renamed *boards* to *signs*

Contents

5 Speed Restrictions

5.1 Principle No. 5.1 - Provision Of Advisory Speed Signs

5.1.1 Introduction

This Principle addresses the requirements for the provision of Advisory Speed signs at specific locations or at the boundaries of specific areas where it is necessary for trains with particular braking characteristics to operate at speeds commensurate with the braking distance provided by the signalling arrangements at the specific location or within the specific area.

5.1.2 Existing Signalling Arrangements

On lines carrying a range of mixed traffic which is required to operate within the limitations of the existing signalling arrangements and to avoid incurring the costs of upgrading work, Advisory Speed signs should be provided indicating to the drivers of trains that the speed must be regulated to ensure that the train does not exceed the speed indicated on the Advisory Speed sign by the time the train reaches the next signal.

If, on sighting the next signal it is displaying a full clear indication, then normal speed running may be resumed, except where the restriction applies to an area where normal speed must not be resumed until the *END* speed sign is reached.

5.1.3 Positioning of Advisory Speed Signs

The position of each Advisory Speed sign shall be determined having regard to the following factors:

a) The permitted line speed.

b) The braking characteristics of the trains operating on the line.

c) The curvature and gradient of the line and its effect on the train running for particular types of trains.

d) The braking distance provided by the existing signalling arrangements.

This shall be undertaken by calculation and/or approved simulation methods. Refer to *Figure 1.*

In close signalled multiple aspect territory, if the positioning of Advisory Speed signs occurs prior to previous signals, or be close enough to cause confusion, the signalling aspect sequence should be altered rather than install the Advisory Speed sign.

5.1.4 Style of Advisory Speed Signs

Advisory Speed signs for Freight & Passenger services (excepting XPT/Xplorer, Endeavour and Hunter) trains shall consist of a circular background 600mm in diameter covered in yellow retro-reflective material. The speed to be indicated to drivers shall be shown in numbers covered in red retro-reflective material and superimposed on the background. Refer to *Figure 2*

Where the Advisory Speed sign applies to a particular area, there will be a *BEGIN* and an *END* sign, each describing the type of train to which the speed limit applies, for example; *Freight Trains Begin (End) 80 Speed Limit*.

These signs shall consist of a circular background 600 mm in diameter covered in blue retro-reflective material with the advisory speed shown in numbers covered in yellow retro-reflective material and superimposed on the blue background.

Advisory Speed signs shall be positioned to the left of the track unless other sighting considerations apply. Refer to *Figure 3.*

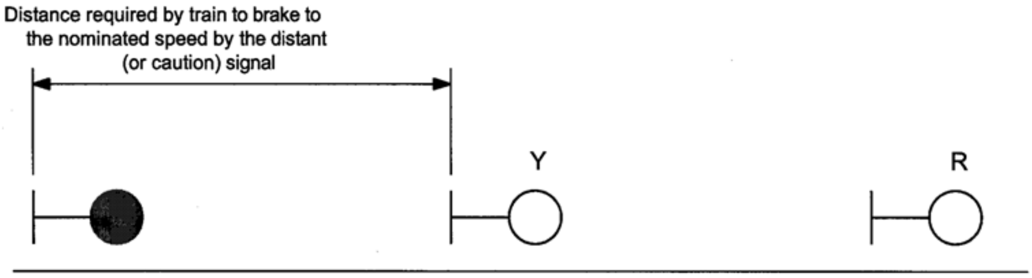


Figure 1 – Location of Advisory Speed Signs

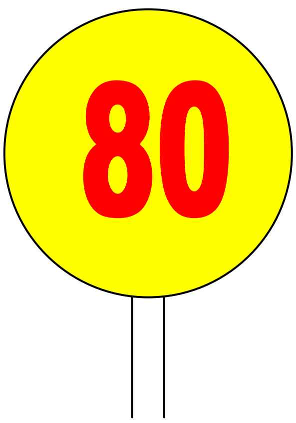


Figure 2 – Style of Advisory Speed Signs

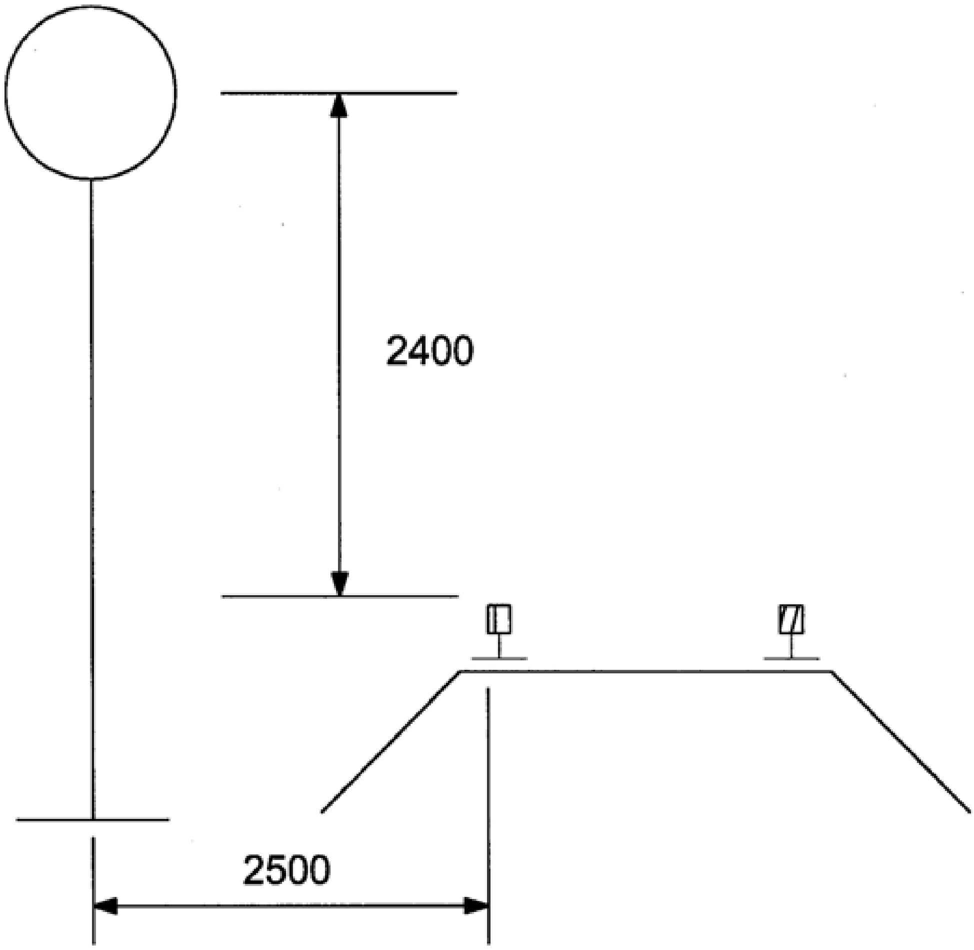


Figure 3 – Position of Advisory Speed Signs

5.1.5 New Signalling Arrangements

Wherever possible, new signalling arrangements shall take into account the requirement for mixed traffic running, to avoid the provision of Advisory Speed signs.

5.1.6 Intermediate Trainstop Advisory Speed Signs

These signs are 350mm in diameter with 150mm white numerals on a black background.

ITS advisory signs are located at the commencement of the timing point and indicate the speed a train must travel at in order to successfully negotiate the next intermediate trainstop ahead.

Figure 4 - ITS Advisory Speed Sign

5.1.7 Yard Speed Signs

Yard Speed signs are for installation at the entrance to stabling and maintenance yards. *Operator Specific Procedure OSP 16* requires trains in such yards to be limited to 13 km/h and 8 km/h in covered areas. Other yards may have their own specific limit.

The Yard Speed sign shall be located on the left hand side on each entrance track (if more than one) into the yard area, unless other sighting considerations apply. Consistent with other advisory speed signs, the yard speed limit shall be applied when the front of the train is to pass the posted Yard Speed sign.

Upon exiting the yard, normal track speed signs will apply. Train speeds on yard departure shall not be increased until the rear of the train has passed the Yard Speed sign.

The intent is for a minimum number of signs to cover the yard area, usually to be located at the first turnout in the series of turnouts forming the sidings. The speed limit is provided due to the likelihood of maintenance and cleaning staff working close to the sidings.

Where it is intended that the Yard Speed sign is to apply for multiple tracks, or tracks on the right hand side, or where there are sighting or positioning restraints, then the sign shall be of sufficient size to make its intention clear. If necessary, arrows may be provided on the sign.

The form of the sign shall be retro-reflective yellow numeral(s) in a blue circle on a rectangular white background.

Figure 5 - Examples of Yard Speed signs

ESG 100.6

NOTICE BOARDS

Version 1.6

Issued 7 February 2012

Document control

Version	Date	Summary of change
		Replaced *SC 00 13 01 06 SP Notice Boards – v3* of May 2003.
1.1	4 December 2006	Amendment of SLIP AREA to SLIP SITE in 6.3.5 and to associated Figure 2
1.2	27 November 2008	Fix typo in Figure 5B “Catch Points Ahead” notice.
1.3	2 March 2009	New section 6.5 Signal Ahead and Signal Alter Signs added
1.4	May 2010	Application of *TMA 400* format
1.5	February 2011	New section 6.5.6 Removal of Signal Alert Boards.
1.6	7 February 2012	Updated to the RailCorp ETCS Requirement Specifications, Release 4.

Contents

6 Notice Boards

6.1 Principle No. 6.1 - Types And Provision Of Notice Boards

6.1.1 Introduction

This Principle addresses the type of and provision of commonly used Notice Boards at strategic locations for safeworking and advisory purposes.

6.1.2 Types of Notice Boards

Notice Boards may be categorised into two types.

6.1.2.1 Category 1 Safeworking

Those which provide mandatory instructions to the driver of a train in lieu of fixed or hand signals to effectively limit or control the movement of a train or locomotive for safeworking purposes.

6.1.2.2 Category 2 Supplementary

Those which provide information to the driver of a train in an advisory or reminder capacity only. These may be located beneath a safeworking notice board.

6.1.3 Provision of Notice Boards

Notice Boards in Category 1 will normally be provided as shown on the signalling arrangements plan and in accordance with the rules and regulations and having regard to the traffic and operational needs at a particular location.

Notice Boards in Category 2 will normally be provided as and when needed or if special or unusual circumstances apply. They may additionally stipulate particular procedures which must be carried out.

Care shall be exercised to ensure that Notice Boards are only provided where necessary and that they conform to the laid down standards.

Any special notice board requirements shall be specially approved.

6.2 Principle No. 6.2 - Safeworking Notice Boards

6.2.1 Introduction

This Principle addresses the requirements for the provision of various types of mandatory notice boards for safeworking purposes and in accordance with NWT 318. These are grouped on the basis of their functional application.

6.2.2 Style of Safeworking Notice Boards

These shall be rectangular and show white lettering and numbering against a red background. Notice boards shall be readable at night.

6.2.3 Provision of Stop Notice Boards

6.2.3.1 Stop - Unqualified

If it is necessary to limit the distance over which a slow speed signalled movement can be made without the need to provide further fixed signals then an unqualified STOP notice board shall be provided. Refer to Figure 1.

6.2.3.2 Stop - Press Button for Level Crossing Lights

If a train movement is to take place at a level crossing on a line for which no level crossing approach initiation controls are provided then a qualified STOP notice board shall be provided specifying the method for initiating the level crossing protection. Refer to Figure 2.

6.2.4 Provision of Shunting Notice Boards

6.2.4.1 Shunting Limit - Unqualified

If wrong direction shunting movements are authorised on a line but are not limited by a fixed signal and there is no doubt as to which line a notice board would apply at the point where shunting movements must cease, then an unqualified SHUNTING LIMIT notice board shall be provided. Refer to Figure 3.

6.2.4.2 Shunting Limit - Qualified

If wrong direction shunting movements are authorised on a line but are not limited by a fixed signal and there may be doubt as to which line a notice board would apply at the point where shunting movements must cease, then a qualified SHUNTING LIMIT notice board shall be provided specifying the line to which it applies. Refer to Figure 4.

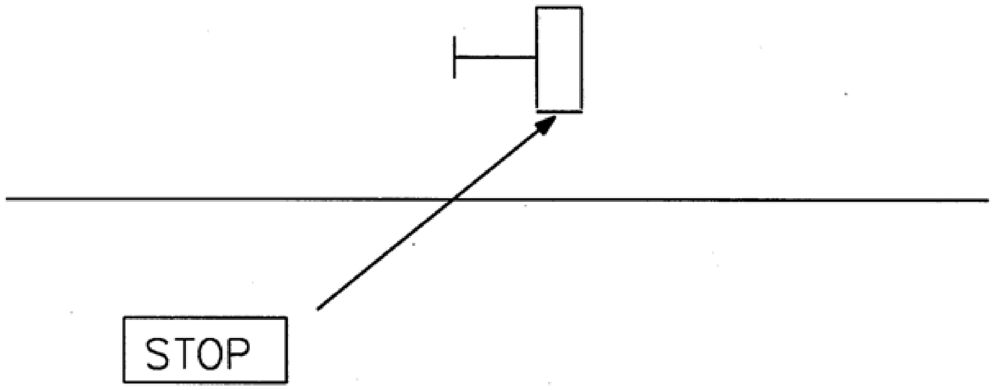


Figure 1 - Stop - Unqualified Notice Board

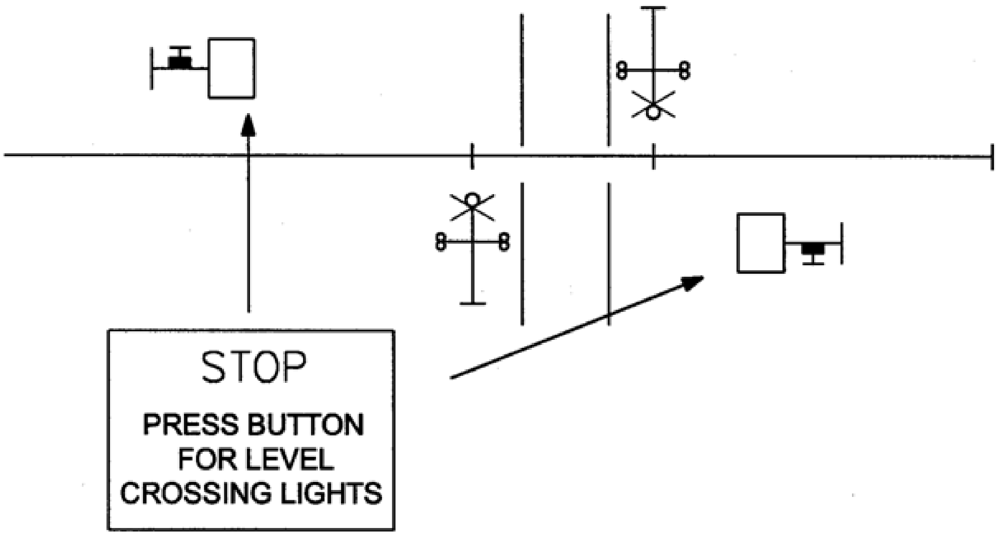


Figure 2 - Stop Notice Boards

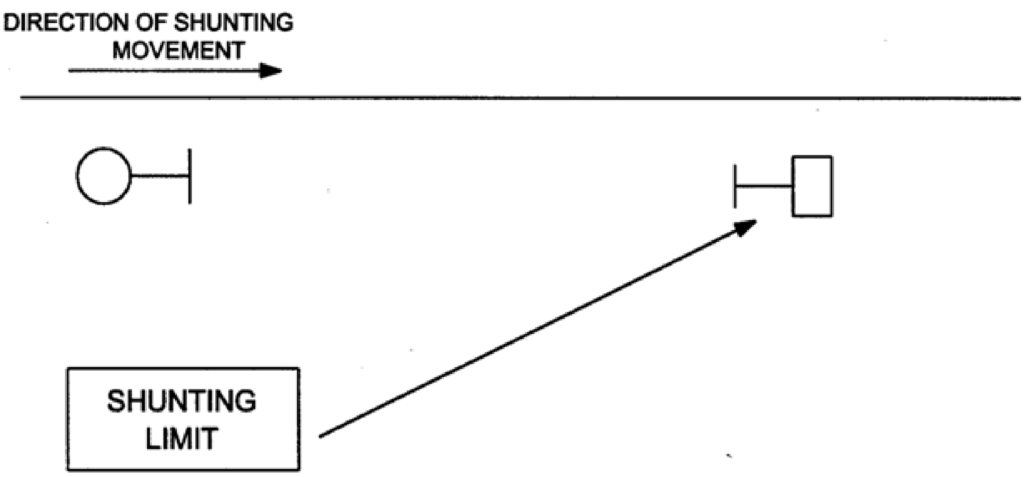


Figure 3 - Shunting Limit – Unqualified Notice Board

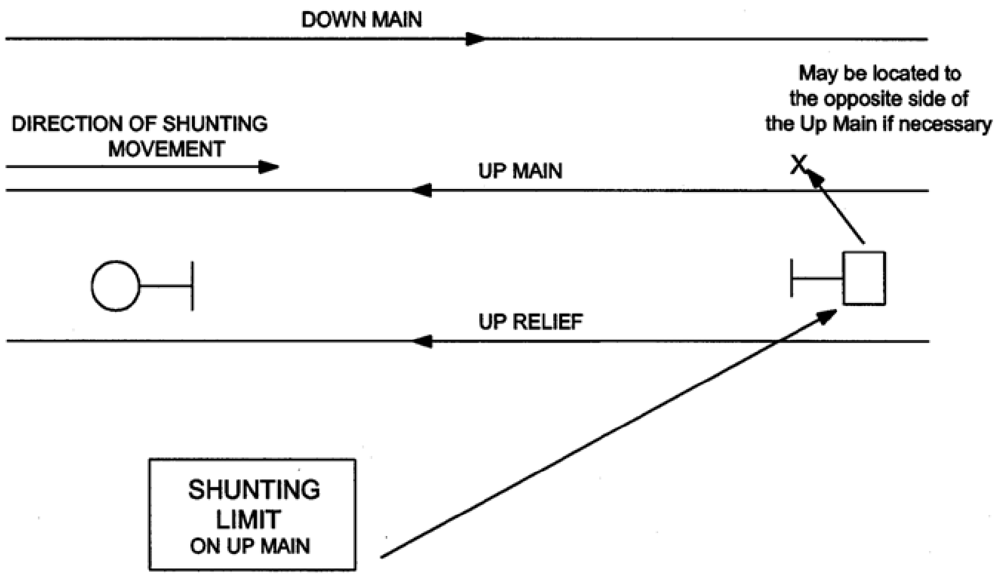


Figure 4 – Shunting Limit - Qualified Notice Board

6.2.5 Provision of Points Notice Boards

6.2.5.1 Catch Points

A **CATCH POINTS** notice board shall be provided to protect a set of catch points which is not protected by a fixed signal, where regular train movements are made towards the catch points.

The form of the notice board shall be as shown in Figure 5. The board shall be white on red background, and the board shall be located immediately in front of the catchpoints.

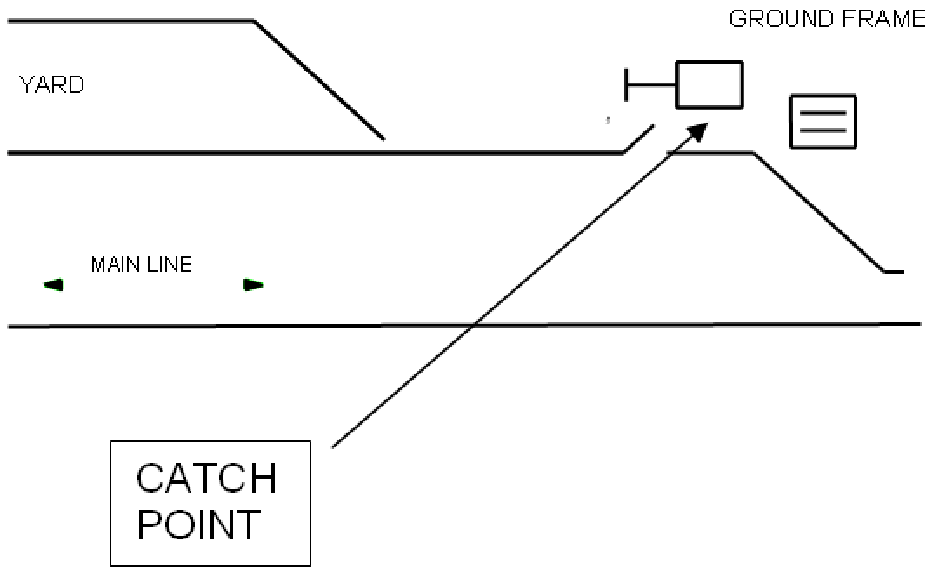


Figure 5 - Catch Points Notice Board

A **CATCH POINTS AHEAD** notice board shall be provided in the following circumstances:

- Where a signal protecting a set of catch points has been involved in multiple SPAD incidents, and where no SPAD risk mitigation measures such as timed intermediate train stops have been installed
- Where a signal protects a set of catch points which have been identified as presenting a high risk to a derailing train.

The form of the notice board shall be as shown in Figure 6 and shall be white on black background. The notice board shall be located 25 to 50 metres on the approach side of the signal protecting the catch points.

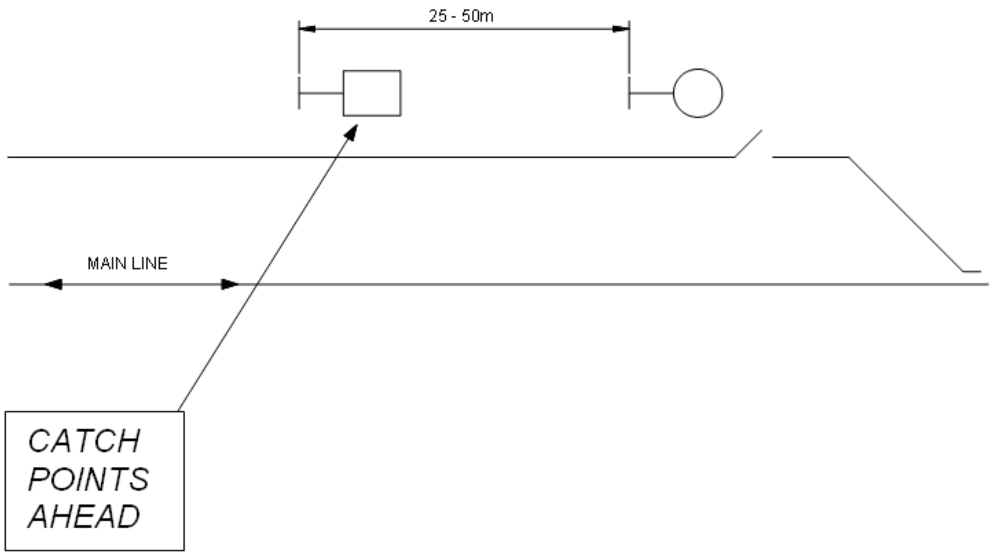


Figure 6 - Catch Points Ahead Notice Board

6.2.6 Provision of Derail Notice Boards

If a derailer is provided which is not protected by a fixed signal and regular movements are made towards the derailer, then it shall be protected with a DERAIL notice board. Refer to Figure 7.

6.2.7 Provision of End Signalled Authority Boards

Instead of a STOP board at the end of a signalled area, an "END SIGNALLED AUTHORITY" board may be installed at the end of a shunt signal route exiting an interlocked area into a non-interlocked area where it will not be necessary for the train to come to stand at the board if the driver can be otherwise authorised to proceed, it being safe to do so. The END SIGNALLED AUTHORITY board is inscribed "End Signalled Authority – do not proceed unless authorised". Refer to Figure 8.

6.2.8 Provision of Signal Notice Boards

Where accept or outer signals protect a wrong direction shunting movement or other risk, then a "THIS SIGNAL MUST NOT BE PASSED AT STOP WITHOUT THE AUTHORITY OF THE SIGNALLER" notice board shall be provided on the signal post.

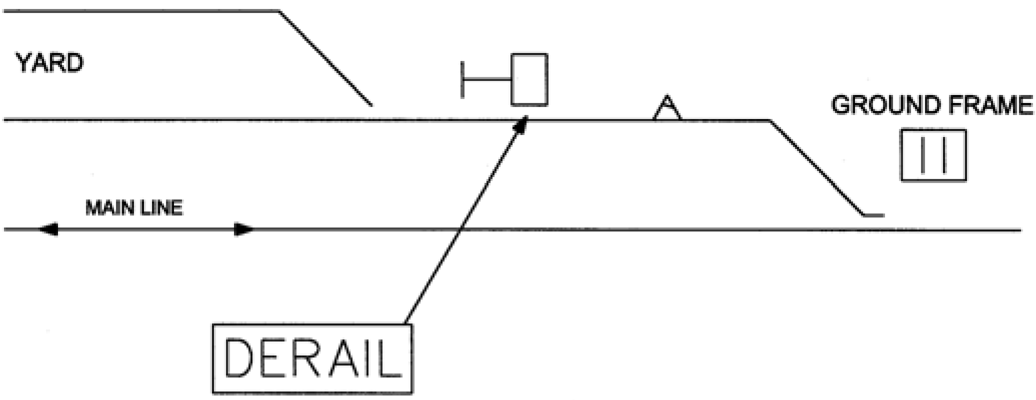


Figure 7 - Derail Notice Board

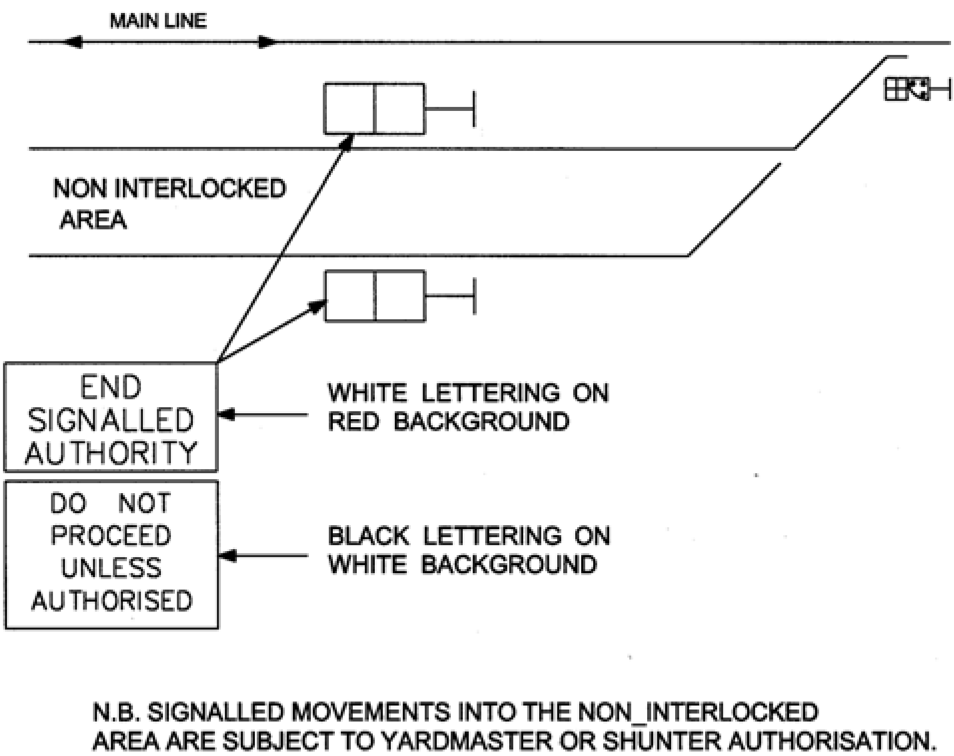


Figure 8 - Provision of End of Authority Notice Boards

6.3 Principle No. 6.3 - Supplementary Notice Boards

6.3.1 Introduction

This Principle addresses the requirements for the provision of various types of supplementary notice boards for advisory purposes. These are grouped on the basis of their functional application.

6.3.2 Style of Supplementary Notice Boards

These shall be rectangular and show white lettering and numbering against a black background except where indicated otherwise.

It shall be possible to read the notice board at night.

6.3.3 Provision of Tonnage Signal Notice Boards

At certain locations where trains over a particular weight may have difficulty in restarting if brought to a stand at a signal ahead a TONNAGE SIGNAL notice board shall be provided on a signal in rear advising the driver to wait for a full clear indication before proceeding. Refer to Figure 9.

6.3.4 Provision of Starting Signal Notice Boards

Starting signal notice boards give authority to pass a starting signal at stop on instruction from the signaller.

6.3.5 Provision of Slip Notice Boards

In areas that are prone to land slippage a SLIP SITE notice board shall be provided on the controlled running signals leading into the area. Refer to Figure 10.

6.3.6 Provision of Single Light Indication Notice Boards

If the type of signalling on a running line changes to or from single light then notice boards advising drivers of the change shall be provided at the first single light signal reading into the single light indication territory and at the last single light signal reading out of it. Refer to Figure 11.

6.3.7 Special Situations

In these circumstances the arrangement of and wording to be shown on the notice board shall be specially approved.

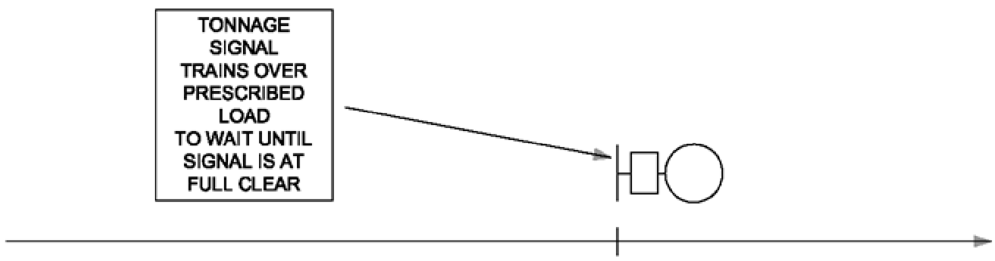


Figure 9 - Tonnage Notice Board

Figure 10 - Slip Notice Board

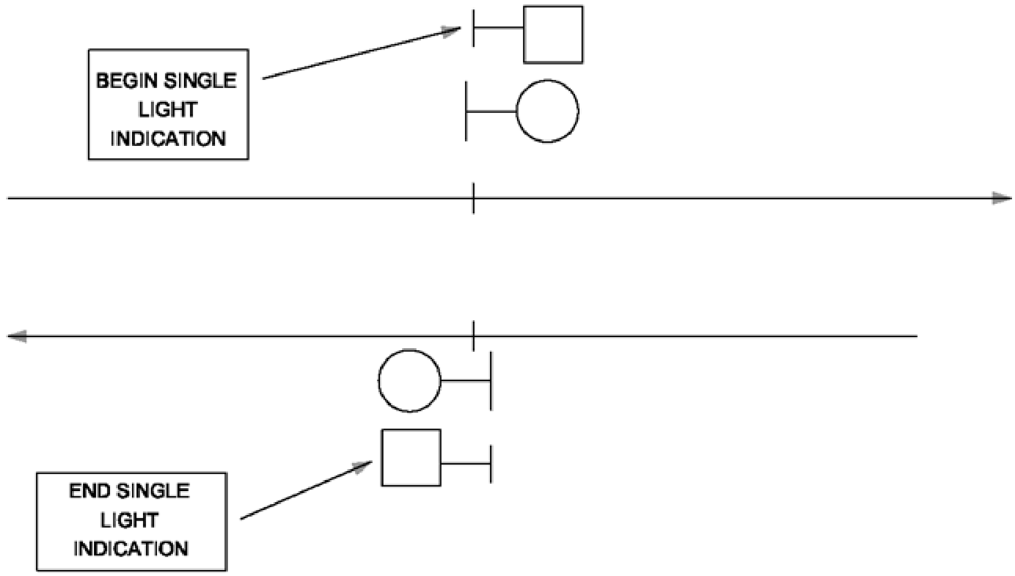


Figure 11 - Single Light Indication Notice Boards

6.3.8 Provision of ATP Border Signs

At locations where ATP coverage begins or ends, ATP border signs shall be provided.

6.3.8.1 Unidirectional Double Lines

Signs shall be provided on the left hand side of the track in the normal running direction.

The converse border sign for unsignalled movements in the reverse direction shall be mounted back to back with the sign for the normal direction. Refer to Figure 12.

6.3.8.2 Single and Bi-directional Lines

On single and bidirectional lines, the operational borders for each direction may be in separate locations. Separate signs shall be provided for each border.

On single lines, the signs shall be provided on the left hand side of the track in the applicable direction of travel. Refer to Figure 13.

On bi-directional double lines, the signs shall be provided on the left hand side of the track in the normal direction of travel. Signage for the reverse direction of travel may be on the right hand side for that direction. Refer to Figure 14.

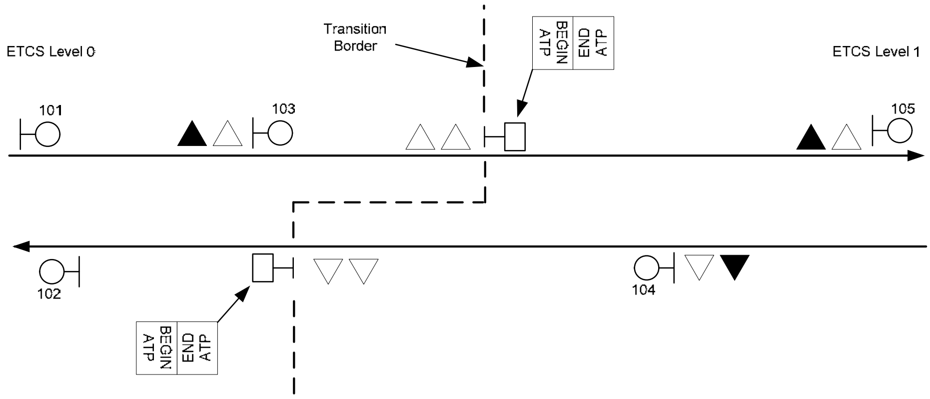


Figure 12 – ATP Border Sign – Unidirectional Double Line

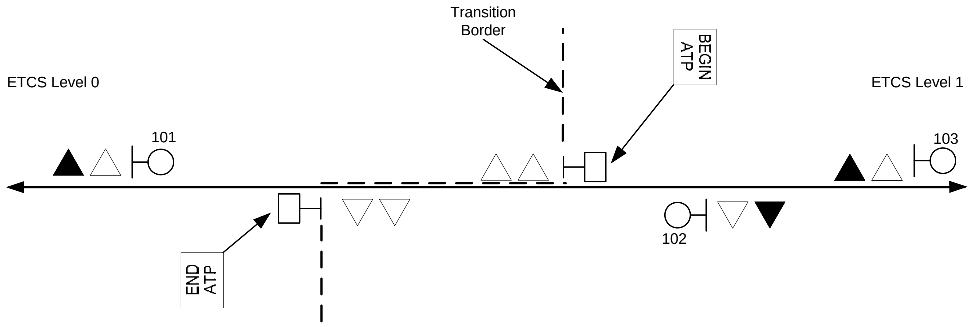


Figure 13 – ATP Border Sign – Single Line

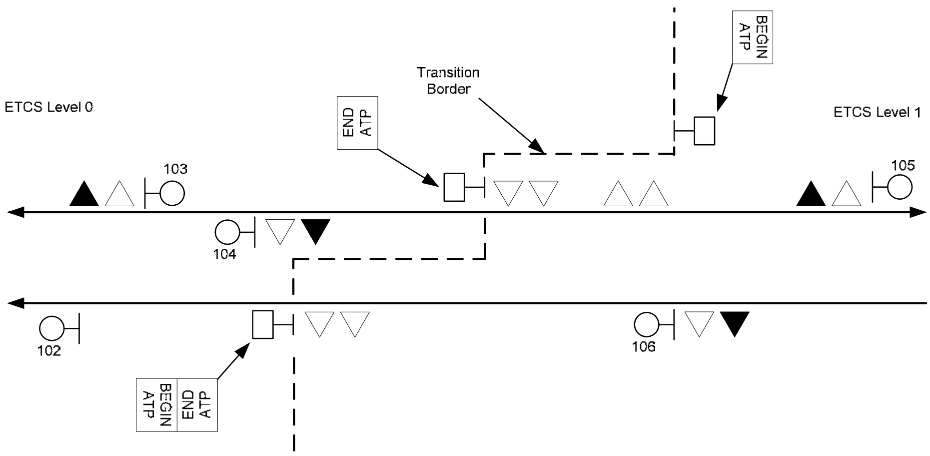


Figure 14 – ATP Border Sign – Bi-directional Double Line

6.4 Principle No. 6.4 - Type And Provision Of Clearance Posts

6.4.1 Introduction

This Principle addresses the type of and provision of clearance posts at locations where trains have to be brought to a stand clear of other movements.

6.4.2 Type of Clearance Posts

Clearance posts shall be white and stand 200mm above top of rail level. They shall be illuminated during darkness by a white light as necessary. Alternatively, in certain locations, white reflectorised vertical clearance boards 600mm high are provided.

6.4.3 Provision of Clearance Posts

Clearance posts shall be provided at crossing loops and at converging junctions in the absence of fixed signals to indicate to a driver the point at which a train may be safely brought to rest clear of any other movement at the convergence of the tracks.

6.5 Principle No. 6.5 – Signal Ahead Sign & Signal Alert Boards

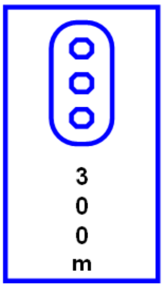
6.5.1 Introduction

This Principle addresses the type of and provision of signal ahead signs and signal alert boards provided to inform drivers they are approaching a signal.

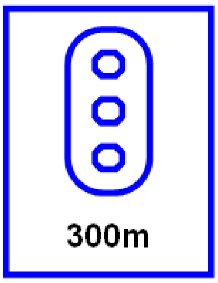
6.5.2 Type of Signal Ahead Signs

The Signal Ahead Sign come in two styles:

Vertical style (sign is Blue on Silver/White background):



Horizontal style (sign is Blue on Silver/White background)



6.5.3 Provision of Signal Ahead Signs

a) Signal Ahead signage shall only be provided in tunnels where drivers may have difficulty in placing their position due to all the surroundings being similar throughout the tunnel.

b) Signal Ahead signage shall not be provided generally but is only to be installed where the following criteria apply:

i) Where signals are spaced a further distance apart (by 300m) than the general spacing of other signals on the line, or

ii) Where the signal spacing exceeds 600m, and

iii) Signal sighting is less than 300m.

c) The sign shall be installed on a suitable post, or bracket at approximately drivers eye level (about 2.5m above rail level) on the left side of the track to approaching trains, except where the signals are located on the right hand side, in which case the sign location should be consistent with the signal locations (such as for wrong direction running on bi-directional lines).

d) A minimum of 50m sighting shall be provided for Signal Ahead signage.

e) The sign shall be located 300m before the signal.

6.5.4 Placement of Signal Ahead Signage

Where necessary, they can be located on both sides of the track if necessary to improve sighting (providing they cannot be misread from an adjacent road). Requirements for greater sighting are not recommended as the sign is likely to be installed as a control for awkward sighting situations where curvature makes sighting difficult. It would be more preferable to install an additional sign, than attempt to improve sighting.

6.5.5 Provision of Signal Alert Boards

Signal Alert Boards are provided at locations where multiple SPADS have occurred, and a request is received for a Signal Alert board.

The sign form shall be blue on silver/white background.

The distance to the signal shall be provided on the sign.

6.5.6 Removal of Signal Alert Boards

When there is a proposed configuration change of the asset (eg Incandescent to LED, resignalling etc) or an operational change of the asset (e.g. new timetable working etc) or a request to remove the Signal Alert Board, then a Signal Sighting Committee shall be formed to review the sighting of the signal and also identify any risks associated with the removal of the Signal Alert Board as follows:

a) **Review the location of the SPADed signal/ SPAD Alert Board** – is the board effectively acting as a repeater signal for the SPADed signal? If so then it is possible that by removing the board you are also removing a critical driver prompt for the approaching signal. Consideration may be given to keeping the SPAD Alert board.

b) **Review whether other mitigations have been implemented at the signal** (e.g. upgrade to LED lamps) – Have any other mitigations been implemented? If so, can these mitigations be relied on to remove the need for the Signal Alert Board.

c) **Review the date of the last SPAD** – was it between 6 – 12 months ago? If it was over 12 months ago it is probable that it is ok to remove the SPAD Alert Board.

d) **What is the risk of a SPAD at the location?** Is there a high risk immediately past the signal (e.g. catchpoints without a speed check approach), are there trains without trip gear, does the signal immediately protect a level crossing (high risk) etc.? More consideration should be given to removing SPAD Alert Boards for high risk signals.

In order to quantify the impact of its removal and allow drivers to adjust, a signal alert board shall be bagged and remain in place for a transition period of 3 months prior to its physical removal.

6.5.7 Location

Signal Alert and Signal Ahead signage location is subject to agreement through a Signal Sighting Committee.

ESG 100.7

SINGLE LINE SECTIONS

Version 1.1

Issued May 2010

Document control

Version	Date	Summary of change
1.0	March 2006	Replaced *SC 00 13 01 07 SP Single Line Sections v3* of May 2003
1.1	May 2010	Application of *TMA 400* format

Contents

7 Single Line Sections

7.1 Principle No. 7.1 - Single Line Section Control In Single Line Areas.

7.1.1 Introduction

This Principle addresses the requirements for the provision of block circuit controls on single line sections.

7.1.2 Requirements

The following requirements shall be met before a signal controlling the entrance to a single line block section is permitted to clear and continuously thereafter.

- The directly opposing signal(s) controlling the entrance to the single line block section at the opposite end, shall be proved normal.
- Intermediate directly opposing signals within the single line block section controlling movements in the opposite direction, shall be proved normal.
- The track circuits between the overlap clearance point of the signal to be cleared and the directly opposing signal(s) controlling the entrance to the single line block section at the opposite end, shall be clear unless occupied by a train being signalled through diverging points which prevent it from proceeding onto the overlap track or unless occupied by a preceding train travelling in the same direction.
- The half-pilot staffs at each end of the single line block section shall be proved normal.
- Any releasing switches situated in the single line section shall be proved normal.
- Any trapping protection on points operated from ground frames situated in the single line section shall be proved normal.
- Other points detection shall be proved normal as applicable.
- Directional controls associated with operation of level crossing equipment within the single line section shall be proved normal.
- The block control circuit closed for a period of fifteen seconds immediately before the signal controlling the entrance to the single line block section clears to show a proceed aspect.
- This is not required where the track circuit equipment provided has intrinsic delayed pick characteristics.

7.1.3 Half-Pilot Staff

On single line track control or track block sections, or on bidirectional signalling sections on double lines, pilot staff working under section signalling failure conditions may be facilitated by the installation at each end of the section of a half pilot staff held captive in a pilot staff lock erected on or near the signal(s) controlling entry to the single line section. The half pilot staffs from each end are joined together to form the one pilot staff for the section.

The following two examples show the type of details required to be inscribed on half pilot staffs in single line areas.

TARANA TA32 (to WALLERAWANG)	WALLERAWANG WG15 (to TARANA)	Interlocking and Signal where Half Pilot Staff located. Interlocking at opposite end of single line section.

KILBRIDE 05/11 (to WALLAROBBA)	WALLAROBBA 06/12 (to KILBRIDE)

The signal number is the main line Home/Starting or Starting signal for the single line section concerned and, also applies to the loop, siding, branch line, etc, Home/Starting or Starting signals(s) leading onto the single line section.

7.1.4 Pilot Staff Lock Designation Plate

Designation plates attached to Pilot Staff Locks are to be inscribed with details similar to the following two examples.

HALF PILOT STAFF WALLERAWANG WG15 to TARANA TA32	Interlocking and Home/Starting or Starting Signal(s) leading into the single line section. Interlocking at opposite end of section and opposing Home/Starting or Starting Signal(s) leading into the single line Section.

HALF PILOT STAFF KILBRIDE 05/11M.11L to WALLAROBBA 06/12M.12L

ESG 100.8

BI-DIRECTIONAL SIGNALLING

Version 1.2

Issued May 2010

Document control

Version	Date	Summary of change
		Replaced *SC 00 13 01 08 SP Bi-Directional Signalling v3* of May 2003
1.1	20 October 2009	Bi-directional Operational principles included
1.2	May 2010	Application of *TMA 400* format

Contents

8 Bi-Directional Signalling

8.1 Principle No. 8.1 - Bi Directional Signalling - General

8.1.1 Introduction

This Principle addresses the requirements for the provision and operation of bi-directional signalling over double running line sections.

8.1.2 Signalling Arrangements

Generally the number of signals provided for the reverse direction of running is less than for the normal direction of running.

Care shall be exercised in ensuring that the signals provided for the reverse direction of running are situated so as not to be confused with the signals provided for the normal direction of running, on the adjacent track. Where provided, reverse direction running signals are to be paired with the normal direction running signals on the adjacent track.

8.1.3 Signalling Controls

If a train is signalled into a bi-directional section from one end then the signal controlling the entrance into the section shall lock the signal controlling the entrance into the section at the opposite end and prove that all intermediate automatic signals controlling movements in the opposite direction to which the train is running are at stop.

In addition the signal controlling the entrance into the section for the reverse direction of running shall prove that the maintenance releases (if provided) are normal.

If a train is in the bi-directional section then its direction of travel shall be detected by the signalling system and constantly monitored at intermediate signals in order to allow a second train running in the same direction as the first train to enter the bi-directional section as soon as the first train has cleared the overlap beyond the first automatic signal in the section.

The signal at the opposite end of the bi-directional section controlling the entrance to the bi-directional section shall not be able to be cleared until all trains in the opposing direction have cleared the bi-directional section. (Opposing shunt signal moves may be permissible up to a train proved at stop at the home signal at the exit to the bidirectional section, where required).

8.1.4 Maintenance Releases

Maintenance releasing switches may be provided where necessary for maintenance staff protection and shall enable maintenance staff to block the reverse direction movements.

The routes controlling the reverse direction movements shall be proved normal and the section proved clear of all trains travelling in the reverse direction before the maintenance release can be operated and the reverse direction block enabled.

Three separate maintenance releasing switches, X, Y & Z may be provided to facilitate up to three independent maintenance crews. The removal of the key from any one of the releasing switches shall disable the reverse direction working on both lines in the double line section.

The location of the releasing switches shall be subject to their on-track accessibility with respect to the maintenance crew requirements.

8.1.5 Half – Pilot Staff Inscription

When half-pilot staffs are provided, details are required to be inscribed on half pilot staffs in bi-directional signalled areas similar to the following two examples:

CORRIMAL WG501D DOWN MAIN (to WOLLONGONG)	WOLLONGONG 466D DOWN MAIN (to CORRIMAL)	Name of the interlocking and Home/Starting or Starting Signal where half pilot staff located. Bi-directional line concerned Name of the interlocking at the opposite end of the bi-directional section

CORRIMAL WG503U UP MAIN (to WOLLONGONG)	WOLLONGONG 468U UP MAIN (to CORRIMAL)

Half pilot staffs in bi-directional signalled areas are to be further individually identified by being coloured/banded yellow for the normal down direction line and blue for the normal up direction line.

The signal number is the normal Home/Starting Signal for the line concerned and also applies to other Home/Starting or Starting Signal(s) leading onto the bi-directional line concerned.

8.1.6 Pilot Staff Lock Designation Plate

Designation plates attached to Pilot Staff Locks are to be inscribed with details similar to the following two examples:

Half Pilot Staff	
CORRIMAL WG501D/503U	Name of the interlocking and Home Starting or Starting Signal(s) leading into the bi-directional line concerned
DOWN MAIN	Bi-directional line concerned
(to WOLLONGONG WG 466D/468U)	Name of the interlocking at the opposite end of the bi-directional section and the opposing Home/Starting or Starting Signal(s) leading into the bi-directional line concerned

Half Pilot Staff
WOLLONGONG WG 466D/468U
DOWN MAIN
(to CORRIMAL WG501D/503U)

Pilot Staff Locks in bi-directional signalled areas are to be further individually identified by being coloured yellow for the normal down direction line and blue for the normal up direction line.

8.2 Operational Principles of Bi-directional Signalling

8.2.1 General Description

The design of the system is to provide a high degree of fault tolerance to failures. Features are provided to improve train operations in certain emergency situations. Failures that may occur should (or as far as is possible) only impact one track.

8.2.2 Failure Impacts

The bi - directional arrangement will permit the clearing of any of the signals not directly impacted by a track circuit failure once a direction has been established. A direction is established within the system once a route is set into the section, and the section is unoccupied. This initial direction is retained in the system and following trains can be signalled in the same direction as if it were a uni-directional automatic section. Consequently the starting signal will still be able to be cleared into a section where a failure has occurred (unless the failure directly impacts the starting signal).

This permits a normal operation of up trains on the up track and down trains on the down track to operate independently with trains only requiring to trip past those signals directly impacted by the failure.

The signaller shall not have to do anything special in setting the direction. It shall occur automatically within the system when a route is set and is used to prevent the clearance of opposing starting signals.

8.2.3 Failures Affecting the Starting Signal.

When a failure affects the starting signal the automatic signals in the same direction may still be operational. Passing the starting signal at stop on verbal authority will permit the train to proceed as far as the EYL. An intervening automatic signal displaying a proceed indication may exist.

8.2.4 Train Failures within the Section.

Should a train fail within the section but it is possible for it to return to the station behind, the opposing direction outer home may be cleared. This will result in the automatic signals between the outer home and the train changing their direction and displaying proceed aspects. By this action the clearing of the signals will result in the lowering of trainstops (including the suppression of trainstops in the trailing direction) and facilitate the movement.

Should the train be into the section past the opposing outer home signal, but not beyond an opposing direction automatic signal, then any signals between the outer home and the train may not have their train stops suppressed for the return movement.

Should a second train have progressed behind the first failed train, the setting of the outer home will permit this second train to return to the station behind. As this train departs the section, the automatic signals will clear behind it for the first train to make a similar movement, if it is able after the outer home signal route is reset.

8.2.5 Failures within the Section and a Direction Change is Required.

Should a train pass through the section and a track circuit or similar failure occur it is not possible to change the traffic direction. However trains may still be signalled through in the previous direction, as described above. Should the previous traffic movement be in the 'wrong' running direction and it is desired to establish the normal running direction and work trains through a failure as above, then an Emergency Direction Override facility shall be provided.

Before using this facility the signaller should ensure the section is clear of traffic and the previous train has exited complete and all controlled signal routes into the section are normal. The 'Direction Override' push button will place all automatic signals to stop and activate a time release. After expiration of the time delay the starting signal route may be set and the direction change will be forced resulting in the clearance of any signals in that direction that are able to do so. Trains may then proceed based on signal authority. Setting the route will automatically cancel the Direction Override.

Should it be desired to reset the original direction route, this may be reset at any time during the time out. Setting the route will automatically cancel the Direction Override.

The Emergency Direction Override is available to change the direction whatever way it was previously set.

ESG 100.9

TIME RELEASES

Version 1.2

Issued July 2010

Document control

Version	Date	Summary of change
		Replaced *SC 00 13 01 09 SP Time Releases v3* May 2003
1.1	May 2010	Application of *TMA 400* format
1.2	July 2010	Replace references to ‘kph’ with ‘km/h’.

Contents

9 Time Releases

9.1 Principle No. 9.1 - Time Releases

9.1.1 Introduction

This Principle addresses the requirements for the provision of time releases for various signalling functions and discusses the methods of determining time release expiry periods. It is intended to be read in conjunction with other Principles which specifically reference time releases.

9.1.2 Time Releasing of Approach Locking

The standard time releases for approach locking are 120 seconds for running and subsidiary signals and 60 seconds for ground shunt signals. Where the subsidiary signal has a separate approach lock to the main signal than the time release for the approach locking on the subsidiary signal may be 60 seconds.

In nominated freight yards, ground shunt signals may have time releases of 30 seconds.

Other times may apply at specific locations and consideration shall be given to the distance between signals when determining the time release period. As this distance increases it is necessary to increase the approach locking time release period to reasonably ensure the train has come to a stand.

9.1.3 Time Releasing of Route Holding

This shall be determined by calculating the time taken for a train running at a consistent speed to pass over the timing track circuit. If the timing track circuit is 200m or less then this speed shall be taken as 15 km/h. If the length of the timing track circuit is greater than 200m then this speed shall be taken as 25 km/h. The time calculated by this method shall then be rounded up to the next 15 seconds.

Where the stop signal ahead is situated some longer distance back from the potential fouling point then consideration may be given to a commensurate increase in the average speed used for calculating the time release period.

This calculated time shall be shown in the Control Tables.

9.1.4 Time Releasing of Conditional Aspects

If the overlap is limited to 100m then this shall be determined by calculating the time taken for a train running at a consistent train speed to pass over the timing track circuit.

This speed shall be taken as 35 km/h

For zero overlaps a timing speed of 15 km/h is to be applied.

For other lengths the timing speed shall be that speed for which the overlap is trip braking distance.

This calculated time shall be shown in the Control Tables.

9.1.5 Time Releasing of Intermediate Trainstops

The timing speed approaching the intermediate trainstop shall be that speed for which the overlap is trip braking distance.

For zero overlaps a timing speed of 15 km/h. is to be applied.

Where a series of intermediate trainstops are provided leading up to an obstruction such as the end of a tunnel then progressively reduced timing speeds are to be applied.

The time determined shall be shown in the Control Tables.

In tunnel areas, acceleration from the timing points to the train stop shall be considered in determining the overlap distance.

ESG 100.10

LOCKING ARRANGEMENTS

Version 1.3

Issued May 2010

Document control

Version	Date	Summary of change
		Replaced *SC 00 13 01 10 SP Locking Arrangements v3* of May 2003
1.1	1 May 2007	Amendment of 10.1.3; Addition of 10.1.4
1.2	2 July 2007	Principle 10.1.4 Fig 3C; amen 51A to 52A
1.3	May 2010	Application of *TMA 400* format

Contents

10 Locking Arrangements

10.1 Principle No. 10.1 - General Locking Arrangements Within Routes And Overlaps

10.1.1 Introduction

This Principle addresses the requirements for the provision of interlocking between signals (routes), points and ground frames.

10.1.2 Purpose

Interlocking is provided between signals (routes), points and level crossings to ensure that a signal is only cleared for a train to proceed when conflicting signals, points and level crossings are locked in position so that the passage of the train is not endangered.

The interlocking is maintained until the train has passed by the various signals, points and level crossings within the route and it is safe to release all or parts of the locking without endangering the passage of the train.

The interlocking is always extended and enforced by the addition of approach locking and where applicable route holding.

10.1.3 Requirements - General Locking within a Route and an Overlap

If a route from a signal conflicts with another route on the same signal or leads over one or more sets of points or ground frames or reads up to one or more opposing signals (routes) then it shall:

a) lock normal any conflicting routes leading away from the same signal. Refer to Figure 1.

b) lock normal any opposing signal routes which lead into the route or its overlap. Refer to Figure 1.

c) lock normal or reverse as required any sets of points in line with the direction of the route together with any points providing trap or flank protection to the route or its overlap. Refer to Figure 1.

d) lock any ground frames normal in the route or its overlap.

e) lock any trailing points in its overlap in the appropriate direction for which the overlap is set. Refer to Figure 2. Refers to Principle 4.9.

   Alternatively, there may be situations (particularly in yards) where trailing points or catch points in the overlap are not aligned with the route to reduce the impact of points failure, or provide flank protection. In this case, any and all conflicting signals will require to be locked.

f) lock normal or reverse any facing points in its overlap only if other locking conditions within or leading into the overlap make this necessary. Refer to Figure 2. Refer to Principle 4.9.

Converse locking shall always be applied except in special cases.

The overlap shall be the overlap applicable to normal speed movements, and not conditional low speed overlaps, unless there is a speed supervision system which enforces the movement to keep below the specified restricted speed. In other words the overlap distance for locking is the overlap distance applicable to the highest signal indication which can be displayed when the next signal is at stop, generally the "caution" signal indication.

10.1.4 Flank Protection

Flank protection is the setting of points (often not directly within the route) to protect the signalled movement whether or not other routes are set.

Further to 10.1.3 c), flank Protection is to be provided wherever possible, when the track layout is suitable and it does not restrict any parallel movement flexibility.

Refer to Figure 3 - Figure 6.

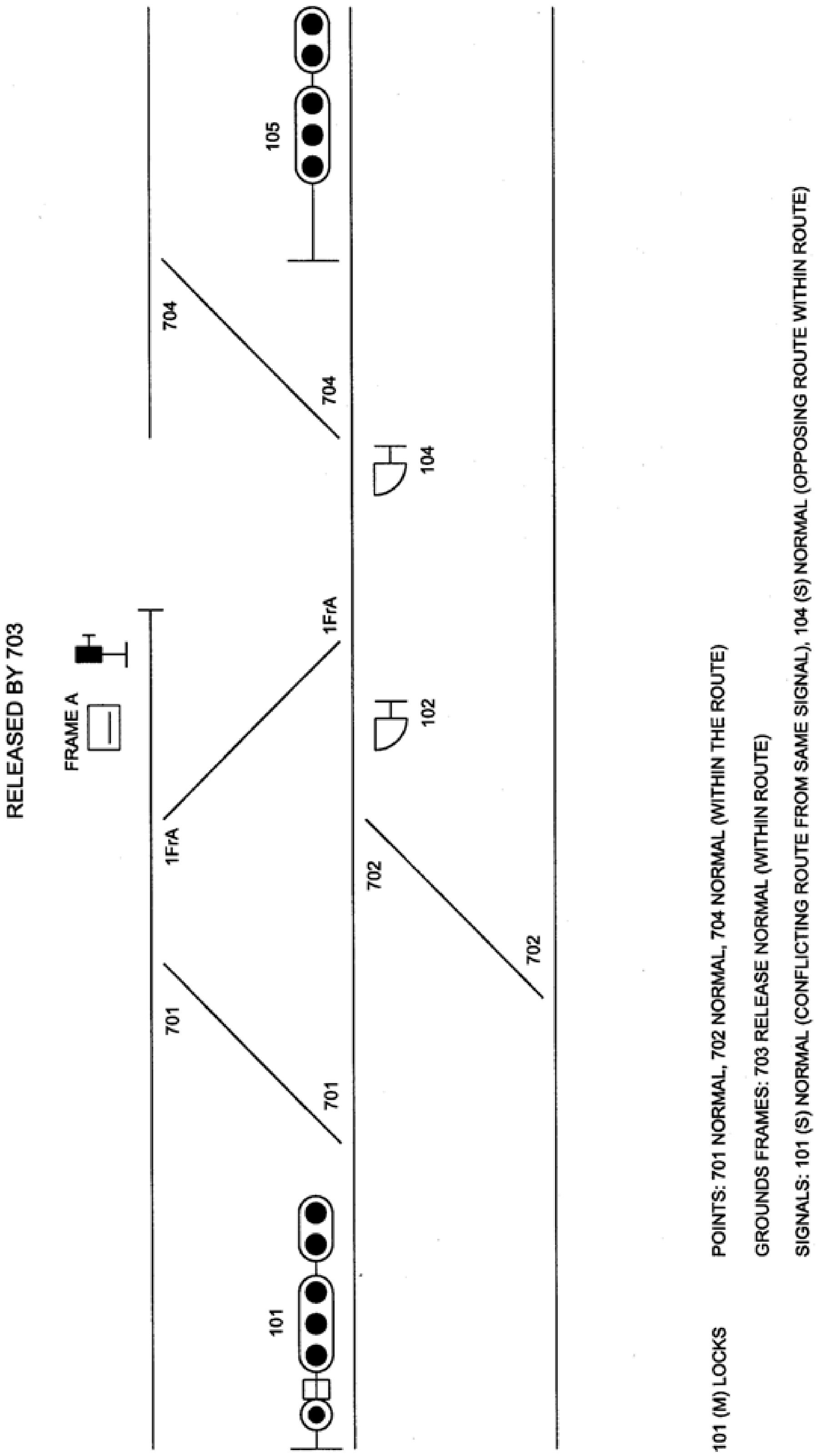


Figure 1 - General Locking Arrangements within a Route

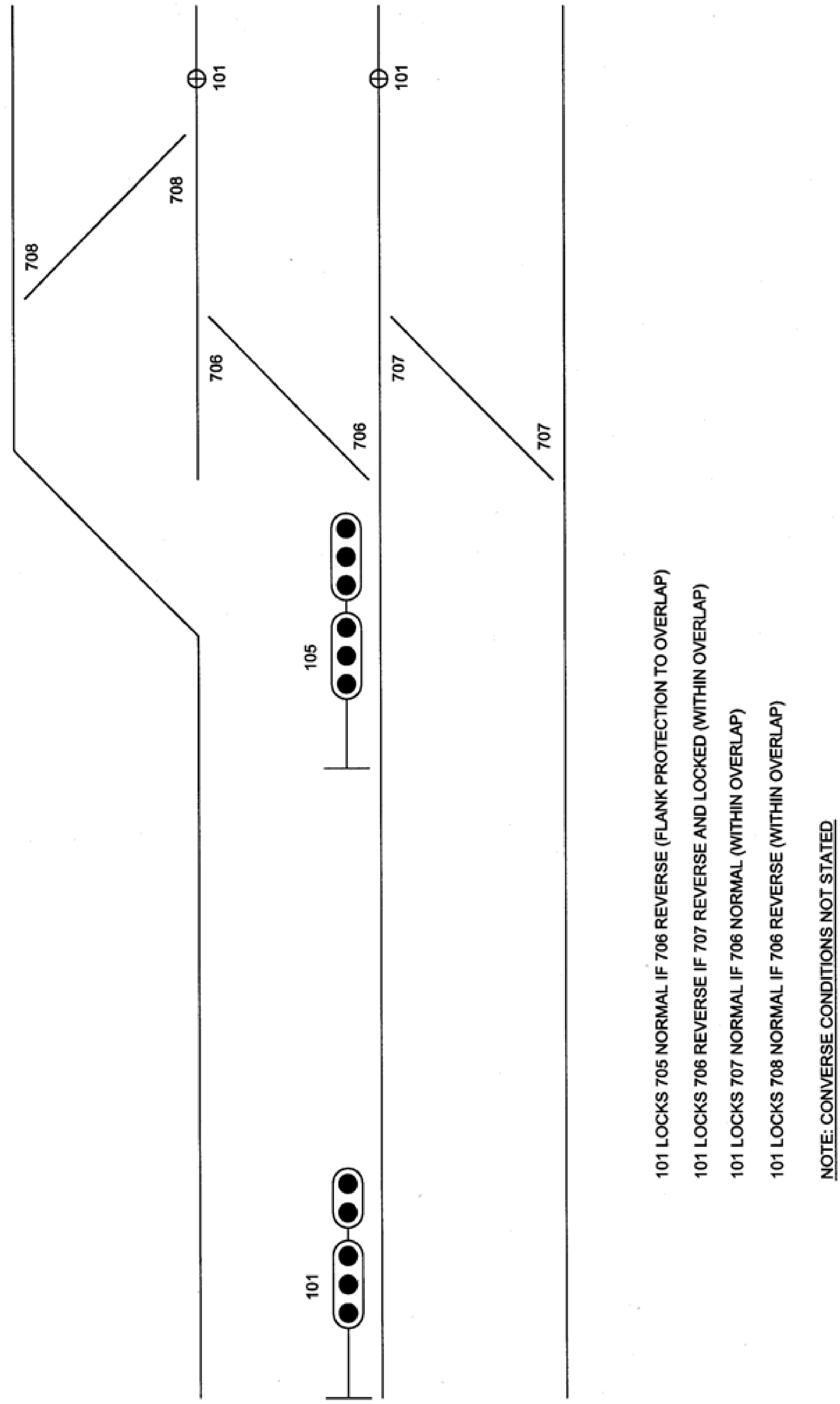
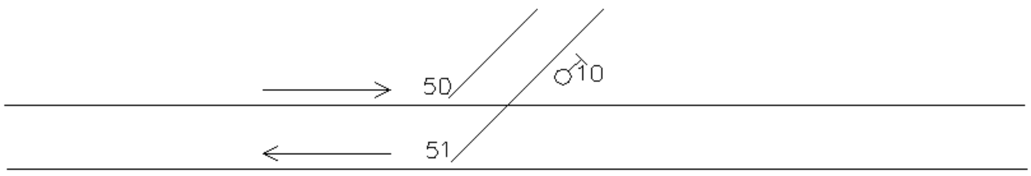
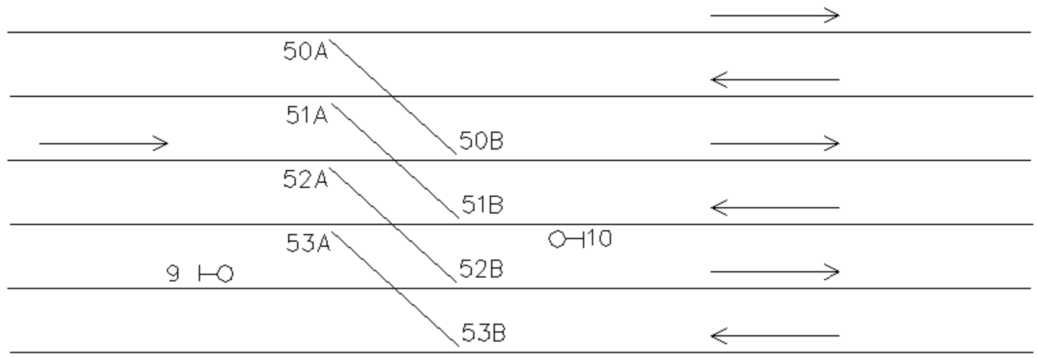


Figure 2 - General Locking Arrangements within a Route



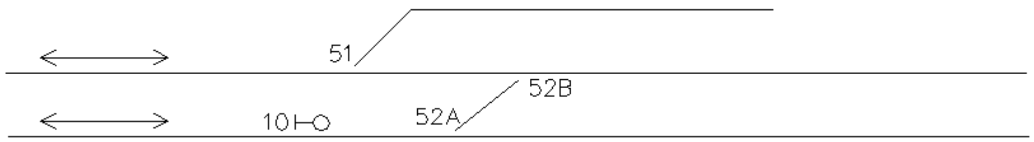
Signal 10 sets and locks 50R as flank protection

Figure 3 - Locking Arrangements



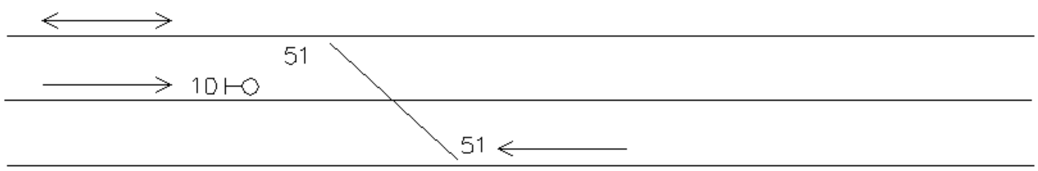
Signal 10B through 51 reverse should not set 52 reverse
as this would prevent 9 signal from clearing

Figure 4 - Locking Arrangements



Signal 10A through 52R should set and lock 51R

Figure 5 - Locking Arrangements



Signal 10 sets and locks 51N

Figure 6 - Locking Arrangements

10.2 Principle No. 10.2 - Automatic Route Normalisation

10.2.1 Introduction

This Principle addresses the requirements for the provision of automatic route normalisation in both NX and OCS systems. For Microlok systems refer to SPG 1230 for automatic normalisation in those systems.

10.2.2 Purpose

Automatic route normalisation is provided to reduce the work load on an operator by avoiding the need to manually normalise routes after the passage of a train and enable the operator to concentrate on the setting of routes ahead of trains and undertake this task more efficiently. It is also required to enable any automatic route setting functionality.

10.2.3 Requirements - Provision of Automatic Route Normalisation

All controlled signals shall be provided with automatic route normalisation.

10.2.4 NX Systems

If the signal is provided with a berth track circuit then automatic route normalisation shall be initiated provided the approach locking has been released and following the concurrent occupation of the berth track circuit and the first track circuit past the signal and the subsequent clearing of the berth track circuit.

If the signal is not provided with a berth track circuit then automatic route normalisation shall be initiated provided the approach locking has been released and following the occupation and clearance of the first track circuit past the signal.

The objective in either case shall be to ensure that the sequence of track releasing for auto normalisation is different from that for the release of approach locking such that full normalisation of the interlocking can only occur after the two different sequences have been executed. This reduces the probability of situations under which for example, insulated block joint failures could prerelease approach locking simultaneously with normalisation.

Special arrangements will be required if last wheel replacement is applicable to the signal.

10.2.5 OCS System

Automatic route normalisation shall be initiated immediately the first track circuit past the signal is occupied. In this case the first two track circuits occupied release in the approach locking shall not be permitted for main running signal aspects. Also refer to Principle 11.1.6.

Special arrangements may be required if last wheel replacement is applicable to the signal.

10.2.6 Other Methods of Automatic Route Normalisation

In some systems the automatic route normalisation may be initiated by a software algorithm and the subsequent transmission of a normalising bit to the interlocking. Special approval is required.

ESG 100.11

APPROACH LOCKING

Version 1.4

Issued March 2011

Document control

Version	Date	Summary of change
		Replaced *SC 00 13 01 11 Approach Locking v3* of May 2003
1.1	30 April 2007	11.1.6 – Amendment lock release arrangements enhanced
1.2	11 September 2008	11.1.5 – time period changed from 120 seconds to 30 seconds
1.3	May 2010	Application of *TMA 400* format
1.4	3 March 2011	Section 11.1.4 added text "Quick releasing of approach locking ……". Changed references to the word 'shall' to read 'may' in sections 11.1.4.1, 11.1.4.2, and 11.1.4.3.

Contents

11 Approach Locking

11.1 Principle No.11.1 - Approach Locking

11.1.1 Introduction

This Principle addresses the requirements for the provision of approach locking on signals and the methods and conditions under which it is applied and released.

11.1.2 Purpose

Approach locking is provided to prevent an operator or an auto-normalisation call from normalising a route ahead of an approaching train, which could allow a change of route that might endanger the passage of the train.

Approach locking is normally applied to any signal routes which are interlocked.

The approach locking becomes effective when the signal has been called to clear and all conditions for clearance are proved available.

11.1.3 Requirements - Provision and Application of Approach Locking

If a controlled signal has one or more routes which directly or indirectly interlock with other routes on the same track or on other signals or with points or ground frames or level crossings then it shall be provided with approach locking.

11.1.3.1 Running Signals

The approach locking shall become effective if a proceed aspect has been displayed in the approached locked signal and the driver of an approaching train has sighted any signal showing a proceed aspect which would be altered by replacement of the approach locked signal to stop.

The approach locking once initiated shall be maintained by the occupation of the track circuits over the appropriate approach locking distance in rear of the signal which is approach locked. If the first signal to be sighted can be seen for a reasonably long distance then the approach locking point shall commence a minimum of 600m in rear of that first signal. Refer to Figure 1 and Figure 2.

If a running signal is situated such that the number of aspects which can be displayed in rear are restricted due to physical or operational constraints of the system then the extent of the approach locking may be reduced accordingly. Refer to Figure 4.

If a running signal is situated such that no track circuit is provided in rear then it shall be approach locked immediately it displays a proceed aspect. Refer to Figure 5.

11.1.3.2 Subsidiary Shunt Aspects

The approach locking shall become effective if a proceed aspect has been displayed in the subsidiary shunt signal to be approached locked and an approaching train has passed the running signal immediately in rear and is within sighting distance of the subsidiary shunt signal and is within 600 metres of the signal. Refer to Figure 6.

The approach locking once initiated shall be maintained by the occupation of the track circuits over the appropriate approach locking distance in rear of the signal, which is approach locked. The approach locking point may commence 600m or sighting distance in rear of the approach locked signal or from the first signal in rear as the case may be. Refer to Figure 6 and Figure 7.

11.1.3.3 Ground Shunting Signals

The approach locking shall become effective if a proceed aspect has been displayed in the signal to be approach locked and an approaching train has passed the signal in rear and is within sighting distance of the signal and is within a distance of 300m of the signal to be approach locked. Refer to Figure 8 and Figure 9.

11.1.4 Requirements - Release of Approach Locking

Approach locking shall be released by:

- the signal at stop and,
- the approach clear,
- or the passage of the train past the signal which is approach locked,
- or after the expiry of a time period to allow for the train to be nearly at or have come to a stand at the approach locked signal, or the train being otherwise proved to have come to a stand.

Quick releasing of approach locking by passage of the train past the signal need only be provided where operationally required. A timed release shall always be provided.

Locations of signals where quick releasing would be required are:

- Where trains split or amalgamate, or locos are dropped off or changed.
- On the first controlled signal exiting an automatic area where there may be another (unqualified) train on the approach tracks.
- Where the signal is approach locked when cleared.

It would not be provided where shunts are primarily provided for trainstop or track circuit failure.

11.1.4.1 Running Signal

The approach locking may be released by the normal passage of the train over the track circuits before and immediately past the approach locked signal and in the direction for which the route is set or following a time release which shall commence timing immediately the approach locked signal has been replaced to stop.

If a full approach locking distance is provided in rear of the running signal then the time release period shall be a minimum of 120 seconds

Additional time may be required if the signals are widely spaced.

11.1.4.2 Subsidiary Shunt Aspects

The approach locking may be released by the normal passage of the train over the first track circuit immediately past the approach locked signal or following the expiry of a time

release which shall commence timing immediately the approach locked signal has been replaced to stop.

The subsidiary shunt aspect time release period may be equal to that of the main aspect unless a reduced time release period for the subsidiary shunt aspect is provided. In this case, the time release shall be 60 seconds.

11.1.4.3 Ground Shunting Signals

The approach locking may be released by the normal passage of the train over the first track circuit immediately in advance of the approach locked signal or following the expiry of a time release which shall commence timing immediately the approach locked signal has been replaced to stop.

The time release expiry period shall be 60 seconds except for nominated shunting yards where the period may be 30 seconds.

11.1.5 Prevention of Pre Release of Approach Locking

To prevent the possibility of approach locking being pre-released by the releasing track circuits effectively becoming occupied due to a loss of power a power-off time expiry feature shall be provided in each track circuit release path.

This shall cause a period of 30 seconds to elapse following the loss and subsequent restoration of power after which the approach locking track release shall again become effective.

11.1.6 Release of Approach Locking with Route Autonormalisation

Where automatic normalising is provided by occupancy of the A track circuit alone (eg OCS type systems) the simple track occupied release of approach locking is not to be provided for main running aspects.

Where there is a need for a track occupied release (eg on certain subsidiary signals) selection shall be incorporated to ensure that the track occupied release is not effective for main running aspects.

Alternatively, a quick release of approach locking may be provided by a suitable track circuit logic sequence that is proven to avoid a high risk failure mode that may simultaneously place the signal at stop, release the approach locking and autonormalise the route.

11.1.7 Signals Stepping from Shunt to Main Aspect

It is permissible for signals to step up directly from a shunt aspect to a main aspect without first releasing approach locking.

However, it is not permissible for a signal to step down from a main to a shunt aspect where less restrictive locking is applied without release of the approach locking.

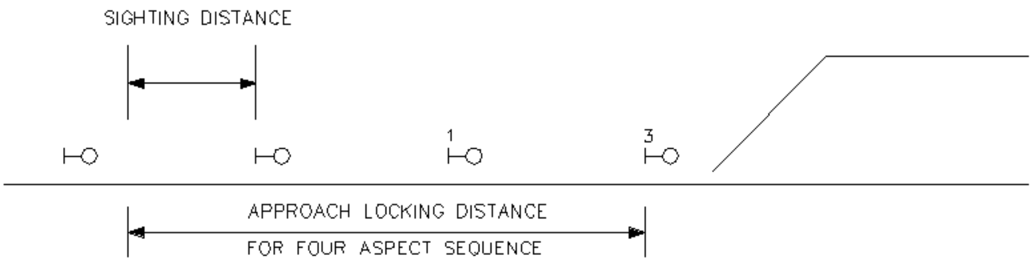


Figure 1 - Approach Locking

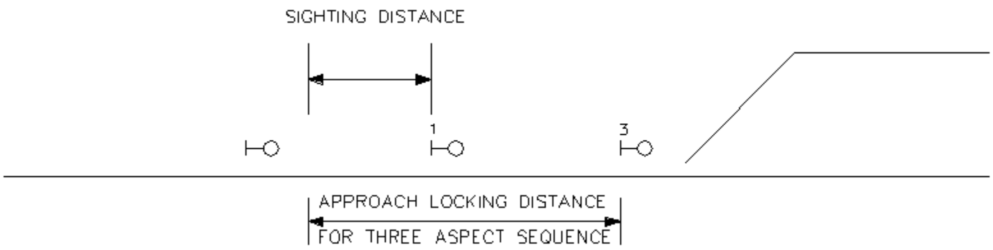


Figure 2 - Approach Locking

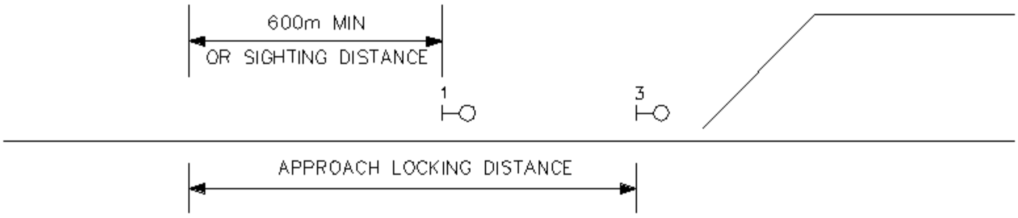


Figure 3 - Approach Locking

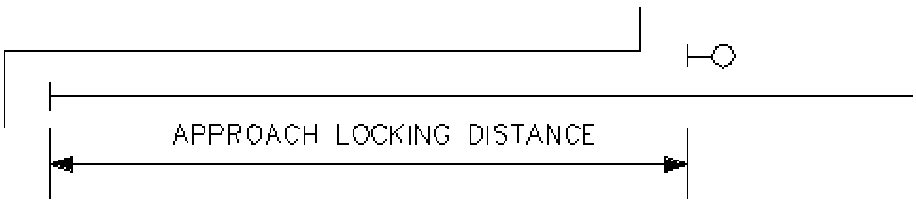


Figure 4 - Approach Locking

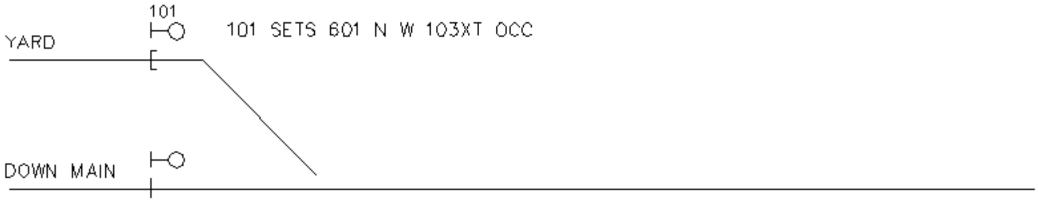


Figure 5 - Approach Locking

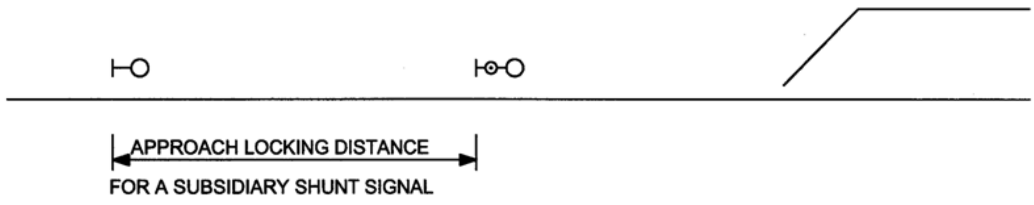


Figure 6 - Approach Locking

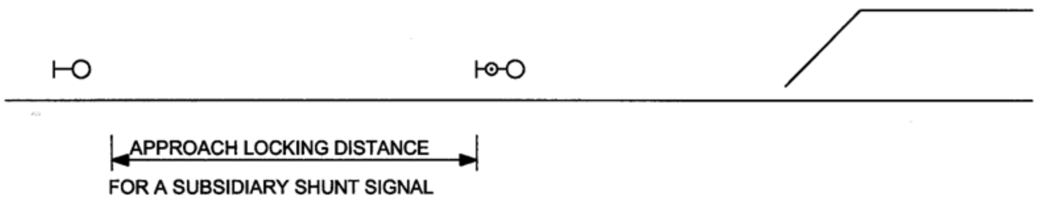


Figure 7 - Approach Locking

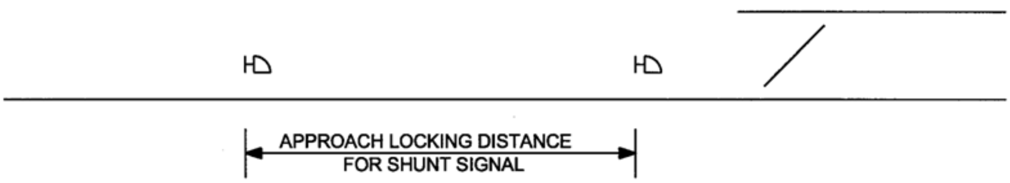


Figure 8 - Approach Locking

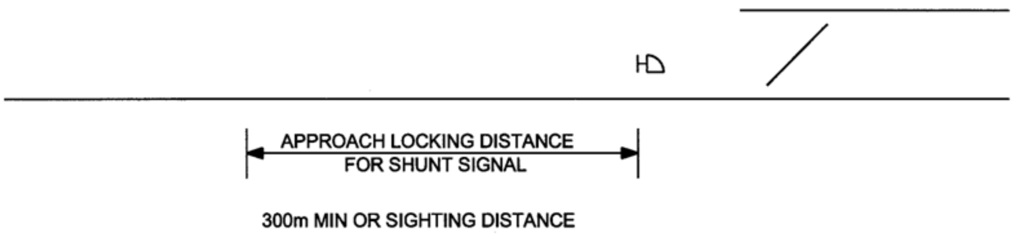


Figure 9 - Approach Locking

ESG 100.12

ROUTE HOLDING

Version 1.2

Issued 25 January 2011

Document control

Version	Date	Summary of change
1.0	March 2006	Replaced *SC 00 13 01 12 Route Holding v 3* of May 2003
1.1	May 2010	Application of *TMA 400* format
1.2	1 February 2011	Amend signal numbers on Fig 1 and Fig 3 of 12.1.5

Contents

12 Route Holding

12.1 Principle No. 12.1 - Route Holding (Route Locking)

12.1.1 Introduction

This Principle addresses the requirements for the provision of route holding as a means of maintaining locking by the occupation of track circuits once a train has entered a route and the signal has been replaced to stop and the route normalised. Route holding is also referred to as route locking.

12.1.2 Purpose

Route holding is provided to maintain the effect of route to route or route to points or similar locking by the occupation of track circuits between the functions concerned.

The route holding becomes effective once a train has entered the route and the initiating signal replaced to stop and the route normalised.

In some circumstances a time release is required to free route holding.

12.1.3 Requirements - Holding of Locking Between Opposing Routes

If opposing routes are situated such that the occupation of an intervening track circuit is in itself insufficient to maintain the aspects of opposing signals at stop, then this shall be enforced by the provision of route holding between the signals concerned.

This will be required between main and main signals and between main and shunt signals. Route holding between opposing main and shunt routes may be necessary even where there is no direct locking between the signals, (this being achieved via points – see **Error! Reference source not found.**).

Generally no route holding is applied between shunt and shunt signals, however, in special circumstances, such as where the shunt signals are widely spaced, the route holding may be applied.

12.1.4 Requirements - Holding of Route to Point Locking

If a set of points is located within the route section or overlap of a signal then the points shall be route held by the occupation of any one of the intervening track circuits within the signal route section between the signal and the set of points concerned (except for points in the overlap of home signals entering single line crossing loops without outer homes - see Principle 4.10).

Releasing of route holding of points within the route is not permitted, except for points locally operated via a releasing switch.

Generally no route holding is applied between shunt signals and points operated by ground frames however, in special circumstances, such as where the shunt signal and the ground frame points are widely spaced apart, the route holding may be applied.

12.1.5 Requirements - Releasing of Route Holding

If permitted route holding shall be released after the expiry of a time release.

Instances where a time release may be permissible are:

a) if train has come to a stand and it is required that an opposing signal be cleared

b) if a train has come to a stand at a signal and it is required that a set of points in the overlap be moved to the opposite position to facilitate the same or some other train movement.

c) if a train has come to a stand and it is required to operate a releasing switch which is in the route.

The period of time release expiry shall be determined by the length of the controlling track circuit or circuits and the average speed of the approaching train over the controlling track circuit or circuits.

Releasing arrangements are to take into account the method of operation of the interlocking and shunting arrangements. For main line movements timing shall require berth track occupancy, however, for locations where ground frames are provided, the timing track should be local to the ground frame and extend approximately 100m either side.

Long timing over a number of track circuits (e.g. in a loop) may be necessary to meet operational needs.

Direct release of route holding by track occupancy is to be avoided.

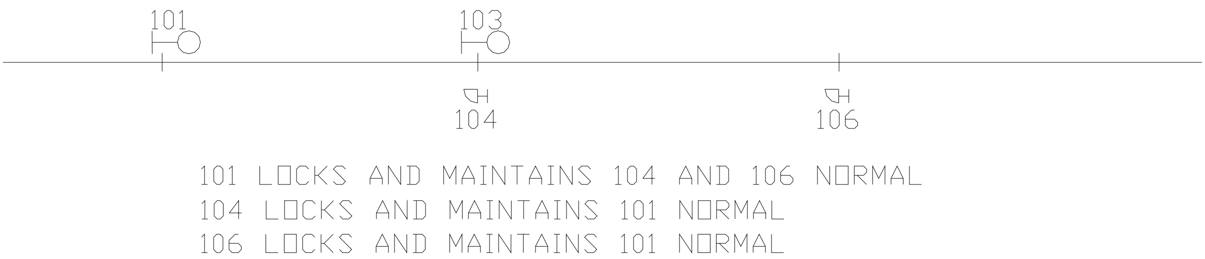


Figure 1 - Route Locking Arrangements

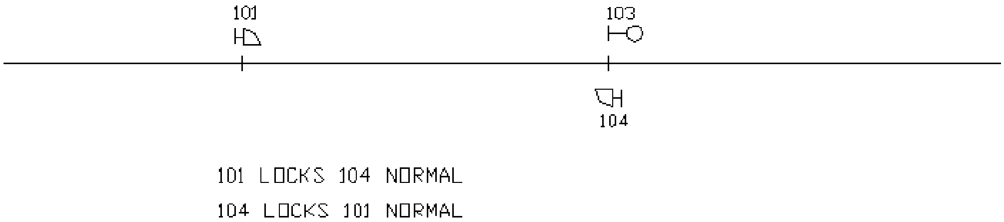


Figure 2 - Route Locking Arrangements

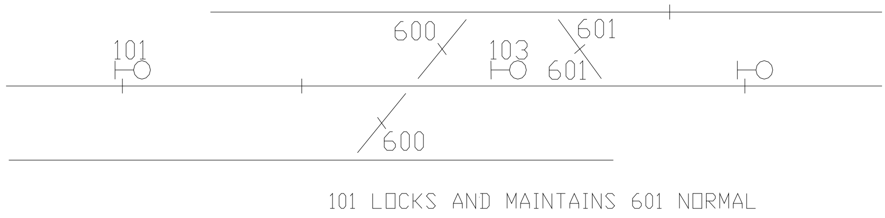


Figure 3 - Route Locking Example

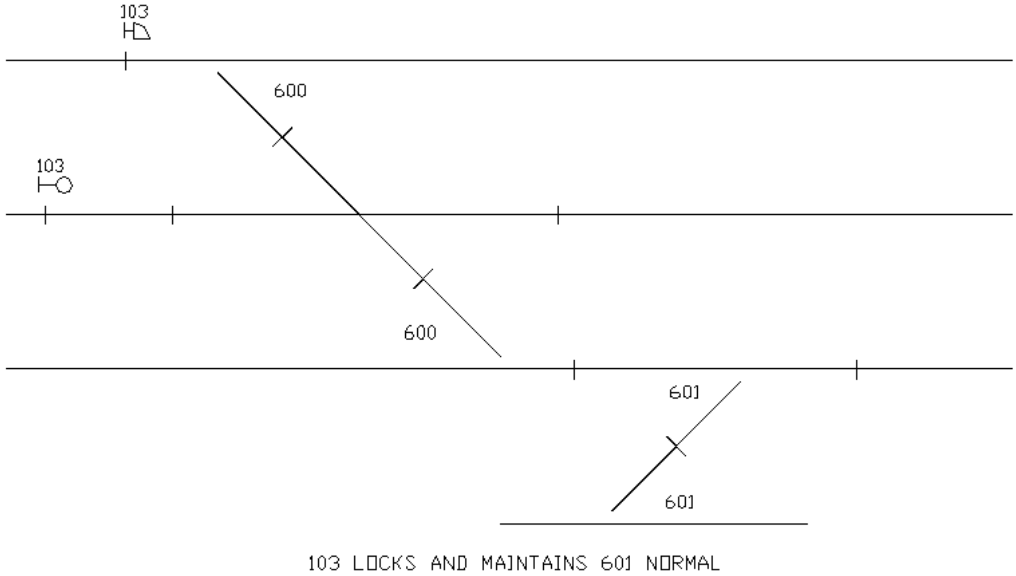


Figure 4 - Route Locking Example

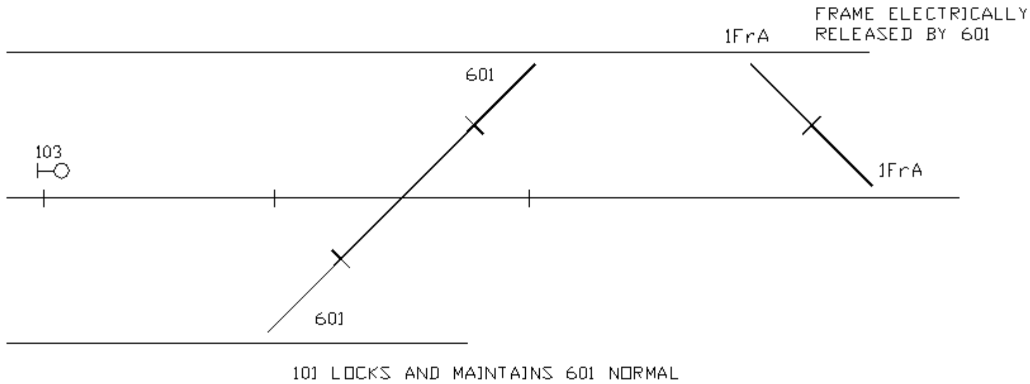
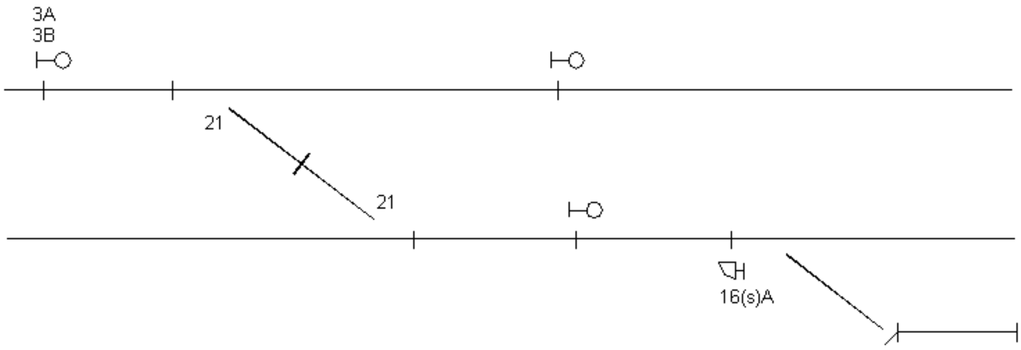


Figure 5 - Route Locking Example



16(s)A sets locks and detects 21 NORMAL
3B sets locks and detects 21 REVERSE

3B to route hold and prevent 16(s)A from clearing
as 16(s)A could set lock and detect 21 points normal
after train on 3B route has cleared 21 points

Figure 6 - Route Locking Example

ESG 100.13

LOCAL CONTROL AND OVERRIDE

Version 1.4

Issued 12 February 2013

Document control

Version	Date	Summary of change
1.0	March 2006	Replaced *SC 00 13 01 13 Local Control v3* of May 2003
1.1	May 2010	Application of *TMA 400* format
1.2	17 May 2011	Title changed to include "Override"; New section 100.13.4 – Emergency Override Facilities
1.3	22 August 2012	Amend section 13.4.3 to delete list and add text after 'mode'. Add new section 13.4.5 Override Detailed Sequence of Operation.
1.4	12 February 2013	Section 13.4.5 changed colour of light from 'steady white light' to 'steady yellow light'.

Contents

13 Local Control

13.1 Principle No. 13.1 - Local Control Of Interlockings

13.1.1 Introduction

This Principle addresses the need for the provision of and types of control panels or operator workstations to facilitate the local operation of interlockings.

13.1.2 Local Control

The term local control shall apply to an interlocking which is normally operated under remote control but due to particular operational needs is provided with facilities to enable it to be controlled locally by operations staff.

This would normally be a regular occurrence and typically where heavy local shunting operations are involved.

13.1.3 Emergency Local Control

The term emergency local control shall apply to an interlocking which is normally operated under remote control but due to the effects of a partial or total loss of the remote control system or for operation during planned maintenance works or for testing and other maintenance requirement, is provided with facilities to enable it to be controlled locally by operations staff.

13.1.4 Provision of Emergency Local Control

The provision of emergency local control should be determined having regard to the following criteria:

- The probability and consequences of remote control system failure.
- The operational needs and traffic levels involved.
- The availability of staff to operate the system locally.
- The provision of alternative arrangements such as override controls, signal post push buttons or local automatic route setting etc.
- The need to facilitate both initial and future system testing and commissioning.
- The cost effectiveness of the above considerations to revenue earning services.

13.1.5 Method of Local Control

The local control may be exercised by the provision of a local control panel (LCP).

In each instance local operation shall be enabled by the operation of a key-locked switch or other suitable security device for which the key or enabling mechanism shall be maintained in a safe place for use by authorised operations staff.

Refer to Principles 13.2 and 13.3 for full details.

13.1.6 Type of Local Control

Generally the simplest method of local control should be provided subject to interfacing considerations.

Usually if the interlocking to be locally controlled is an entrance - exit type then the local control panel shall provide entrance - exit route setting commands which directly interface with the interlocking circuits.

Usually if the interlocking to be locally controlled is a unit lever type then the local control panel shall provide unit lever commands which directly interface with the interlocking circuits.

If the control of the interlocking is of a hybrid nature then care shall be exercised to interface the local control panel to the interlocking in the most effective manner.

13.1.7 Maintenance Panels

If a local control panel is provided then wherever practical the local control panel should be positioned so that it also services the needs of maintenance staff and avoids the provision of a separate maintenance panel.

13.2 Principle No. 13.2 - Local Control Without A Closing Facility

13.2.1 Introduction

This Principle addresses the technical requirements for the local control of an interlocking without the provision of a local closing facility.

13.2.2 Requirements

13.2.2.1 General

If under normal operating conditions an interlocking is remotely controlled via a data transmission system and is also required to be operated from a local control panel (LCP) without closing facilities then the following special features shall be incorporated into the system design.

13.2.2.2 Operators Interface - Local Control Panel Switches and Indications

A two position key-locked rotary switch shall be provided to enable control of the interlocking to be transferred from remote to local and back as required. The key shall be captive in the local position. Refer to Figure 1.

The switch shall be turned to the left hand position when the interlocking is required to operate locally. Text reading LOCAL shall be provided above this switch position. Refer to Figure 1.

The switch shall be turned to the right hand position, when the interlocking is required to operate remotely. Text reading REMOTE shall be provided above this switch position. Refer to Figure 1.

A two position switch may be provided to enable all the local control panel indications to be switched on or off as required. Text reading INDICATIONS shall be provided beneath the switch. Refer to Figure 2.

An illuminated white or yellow indication shall be provided immediately above each position of the local/remote switch to indicate the current control mode to an Operator. This shall be in correspondence with the local control interlocking relay or equivalent CBI bits. These specific indications shall not be subject to control by the panel indication switch. Refer to Figure 1.

The signal post and yard working telephones shall be switched to the local or remote control centre, as applicable.

13.2.2.3 Non Vital System Switching

Transfer of a control from remote to local may be by either relays or solid state means.

The mode of operation selected shall be registered either by the relay based interlocking (RBI) or computer based interlocking (CBI) as appropriate and this shall ensure that any particular interlocking features required for the particular mode of operation are properly maintained.

The transfer of control from remote to local shall ensure that the transmission system control outputs are isolated before the local controls are enabled.

If relays are used this may be achieved by switching the appropriate system bus bars. Switching relays and repeats shall be monitored in the Local/Remote indications.

If solid state switching is used then this may be achieved by hardware or software means or any combination of the two.

Indications shall be transmitted continuously to the remote control centre irrespective of whether the interlocking is operating locally or remotely.

13.3 Principle No. 13.3 - Local Control With A Closing Facility

13.3.1 Introduction

This Principle addresses the technical requirements for the local control of an interlocking with the provision of a local closing facility.

13.3.2 Requirements

13.3.2.1 General

If under normal operating conditions an interlocking is remotely controlled via a data transmission system but is also required to be operated from a local control panel (LCP) with closing facilities then the following special features shall be incorporated into the system design.

13.3.2.2 Operators Interface - Local Control Panel Switches and Indications

A three position key-locked rotary switch shall be provided to enable control of the interlocking to be transferred from REMOTE to LOCAL to CLOSING and back as required. The key shall be captive in the local position. Refer to Figure 1.

The switch shall be turned to the centre position when the interlocking is required to operate locally. Text reading LOCAL shall be provided above this switch position. Refer to Figure 1.

The switch shall be turned to the left hand position when the interlocking is required to operate locally and unattended in automatic reclearing mode. Text reading CLOSING shall be provided above this switch position. Refer to Figure 1.

The switch shall be turned to the right hand position when the interlocking is required to operate remotely. Text reading REMOTE shall be provided above this switch position. Refer to Figure 1.

A two position switch may be provided to enable all the local control panel indications to be switched of or off as required. Text reading INDICATIONS shall be provided beneath the switch. Refer to Figure 2.

An illuminated white or yellow indication shall be provided immediately above each of the three switch positions to indicate the current control mode to an operator. This shall be in accordance with the interlocking relay conditions or equivalent CBI bits. These specific indications shall not be subject to control by the panel indication switch. Refer to Figure 1.

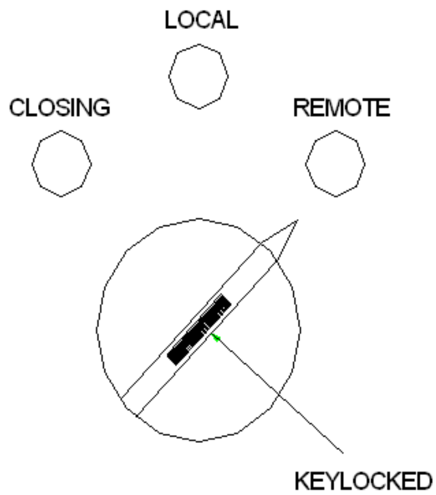


Figure 1 - Local Control with a Closing Facility

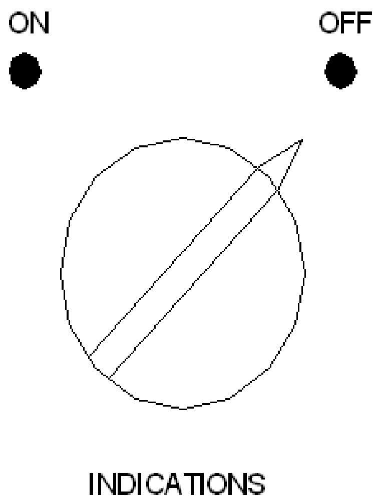


Figure 2 - Local Control with a Closing Facility

13.4 Emergency Override facilities

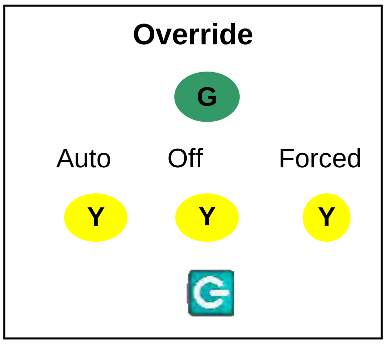
13.4.1 Introduction

Emergency override facilities are provided to permit the signalling to continue to operate under failures of the remote control arrangements and permit business continuity. Usually the override automatically sets the through routes.

13.4.2 Override Control

An override control box is provided on the outside wall of the main interlocking relay room. The box contains a three position switch. The switch positions are "Auto, Off, Forced". Each position has a yellow indicator light to confirm the setting within the interlocking. A fourth green indicator light is provided marked "Override".

The box is secured by a SL lock.



13.4.3 Method of Operation

When the control switch is in the 'Off" position no override functions are enabled.

When the control switch is in the 'Forced' position the interlocking will enter Override mode.

When the control switch is in the 'Auto' position, the interlocking will enter override mode only if both control communication links are lost.

When entering Override mode, for a straight through configuration, the sequence of operation shall be as in 13.4.5 below.:

13.4.4 Override configurations

The routes to be set during override are to be agreed with Operations and integrate into any disaster management plans that may exist. Override may also include or have elements of:

- Automatic turnback arrangement
- Automated junction operation
- First come – first served crossing loop operation

Where configurations other than a simple through setting is required, the operational arrangements shall be documented in a Signalling Functional Specification for agreement with Operations.

Override shall act at a non-vital level and shall not bypass any interlocking or safety controls.

For new works, the ‘Auto’ position is to be disconnected and booked out of use pending network rules being updated to permit its use.

13.4.5 Override Detailed Sequence of Operation

OFF:

When the control switch is placed in the ‘OFF’ position no ‘Override’ functions are enabled. A steady yellow light indicating the ‘OFF’ position is illuminated.

FORCED:

When the control switch is placed into the ‘FORCED’ position the interlocking will initiate the ‘Override’. A steady yellow light indicating the ‘FORCED’ position is illuminated.

A flashing green ‘Override’ indication will be displayed. A 10 second (adjustable) delay is provided prior to the Override activating to establish a steady state.

Through routes already set will remain set.

Non-through routes will cancel provided no train is closely approaching. Should a train be closely approaching a delay of 180 seconds (adjustable) will apply prior to the cancelling of the non-through routes. Full normalisation may be further delayed if the approach locking is required to time out.

Through routes not set, will set and all through routes will auto-reclear.

A steady green ‘Override’ indication will be displayed when all the through routes are set.

Should a through signal route not set, the ‘Override’ indication will continue to flash whilst the interlocking is in ‘Override’.

The Override ‘call’ is cancelled after a time delay. To re-stroke a signal route that has not set the Override ‘call’ will need to be re-instated by returning the control switch to the ‘OFF’ position and then back to ‘FORCED’ and repeat the above steps.

Note: The Override ‘call’ is cancelled after an adjustable, time delay. This time delay is greater than 180” + 120” approach locking.

The signal box has no control over the interlocking whilst in ‘Override’.

When the control switch is taken out of ‘FORCED’ (Override disabled) and placed in the ‘OFF” position, the control of the interlocking is transferred back to the signal box.

The ‘Override’ indication is extinguished.

During the transition from ‘FORCED’ to ‘OFF’ all routes currently set will remain set. The auto-reclearing function will be cancelled.

Note: The auto-reclearing is cancelled similar to a Closing key cancelling the auto-reclearing when it is keyed to ‘LOCAL’. The signals will remain clear and will normalise on the passage of the next train.

AUTO:

When the control switch is placed into the ‘AUTO’ position the interlocking will initiate the ‘Override’ when the communications link between the control system and the interlocking has failed. A steady yellow light indicating the ‘AUTO’ position is illuminated.

A 60 second (adjustable) delay is provided to prevent the Override activating with a momentary loss of the communications link.

The Override process will then be the same as for ‘Forced’, except as below.

The Override ‘call’ is cancelled after a time delay. To re-stroke a signal route that has not set the Override ‘call’ will need to be re-instated by returning the control switch to the ‘OFF’ position and then to either ‘AUTO’ (communications link has failed) or ‘FORCED’ as required.

When the communication links are proved healthy, the control of the interlocking is returned to the signal box. This will occur after an adjustable time delay of 60 seconds.

Note: The communication link is considered healthy when the communication status bit is true.

All through routes will remain set. The auto-reclearing will be cancelled.

The ‘Override’ indication is extinguished.

When in ‘Override’ and the control switch is taken out of ‘AUTO’ and placed in the ‘OFF” position all routes currently set will remain set. The auto-reclearing function will be cancelled. The ‘Override’ indication is extinguished.

Note: At the present time the ‘AUTO’ switch function is to be disconnected and booked out of use.

For it to be brought into use it will be necessary to enact procedures that when any worksite using controlled signal protection is established within the interlocking area, they must first turn the Override switch to ‘OFF’. On completion of work the Override control switch can then be returned to either ‘AUTO’ or ‘FORCED’ as required.

OVERRIDE - SIGNAL BOX CONTROL PANEL INDICATIONS:

The signal box control panel will display yellow indications (or equivalent) for the Override switch positions Auto-Off-Forced.

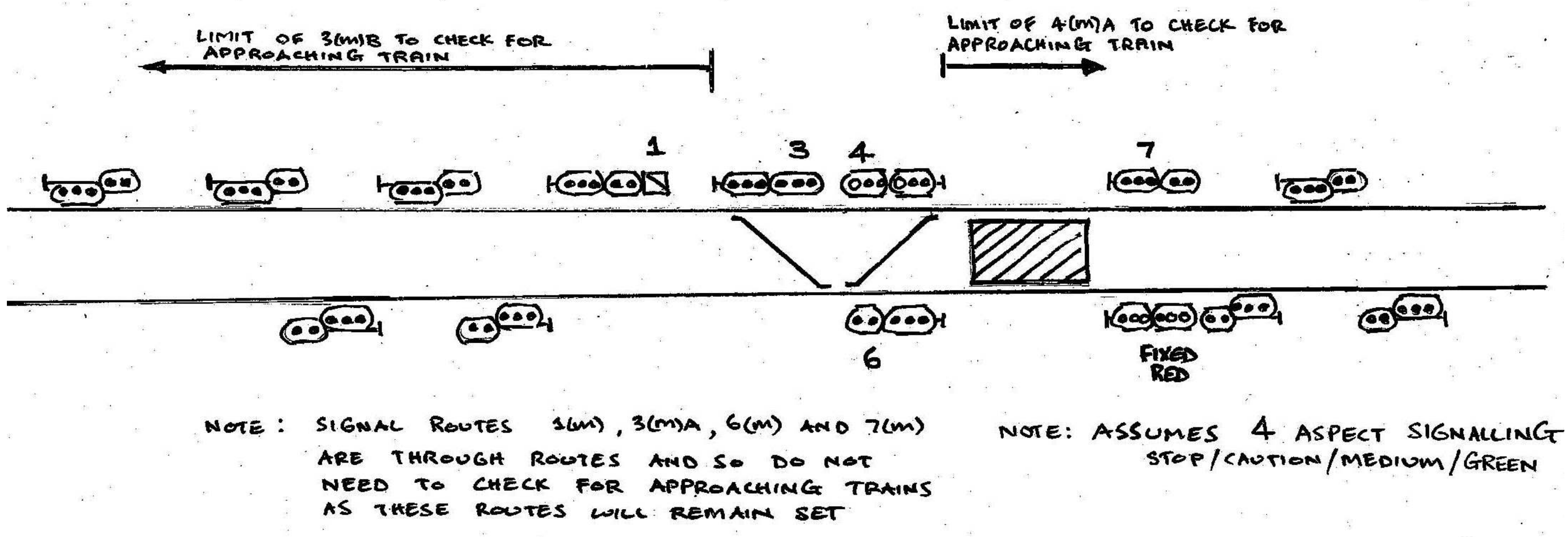

LIMIT OF 3(M)B TO CHECK FOR APPROACHING TRAIN
LIMIT OF 4(M)A TO CHECK FOR APPROACHING TRAIN
1
3
4
7
6
FIXED RED
NOTE: SIGNAL ROUTES 1(M), 3(M)A, 6(M) AND 7(M) ARE THROUGH ROUTES AND SO DO NOT NEED TO CHECK FOR APPROACHING TRAINS AS THESE ROUTES WILL REMAIN SET
NOTE: ASSUMES 4 ASPECT SIGNALLING STOP/CAUTION/MEDIUM/GREEN

Figure 3

ESG 100.14

POINTS

Version 1.16

Issued 4 December 2012

Document control

Version	Date	Summary of change
		Replaced *SC 00 13 01 14 SP Points – v 7.1* of June 2005
1.1	30 May 2006	Principle 14.14 amended to require backdrives or spring assists on 250 turnouts
1.2	22 August 2006	Amendment to wording of signs in Appendices 1 & 2 of Principle 14.4 Amendments to 14.5.1 Amendments re ‘lock’ to ‘locking in 14.5.3.1, 14.5.3.2, 14.5.3.3, 14.5.4, 14.6.4.2, 14.8.4.2 Added 14.5.5.
1.3	6 March 2007	Addition of new sections – Stagework Installation & Removal of Points – Design Principles for Mechanical Components
1.4	1 May 2007	Amendment of title to Principle 14.15 and minor amendment of first paragraph of Principle 14.15.1 Amendment of first paragraph 14.16.4
1.5	23 October 2007	Addition of 14.15.6 – Insulation of Mechanical Components plus Fig 1 & 2 of Principle 14.5
1.6	14 October 2008	Added text to section 14.12.1. Deleted reference to UIC 60B from figs. 14.12.1, 14.12.2 & 14.12.3. Sect. 14.14 added text & changed photo to show ‘T’ crank backdrive. Other additions.
1.7	23 January 2009	New section 14.17 ‘Location of Points Mechanisms’ added.
1.8	27 March 2009	Added to section 14.1.3 to include Crowder. Corrected numbering problem for section 14.15.6.1 & 14.15.6.2
1.9	26 October 2009	14.2.4 - New bullet points about facing catchpoints on high speed lines use of a guard rail
1.10	May 2010	Application of *TMA 400* format
1.11	29 June 2010	14.14 re Independent Switch Points; 14.15, figure 2 reinstated
1.12	15 March 2011	Section 14.8.4 reference to section amended from 16.8.3 to 14.8.3

1.13	17 May 2011	New section – Power Operated Ground Frames
1.14	August 2011	Principle 14.7- Changes to the Removal of Lock-Slides in Electric Machines and the Provision of Wide-cut Notch in Lock-Slides
1.15	7 February 2012	Principle 14.16 – Added provisions for Securing Swing Nose Crossings where pending commissioning or removal. Also clarified section 14.16.5 in regards to providing detection.
1.16	4 December 2012	Principle 14.14 – Amend to show spring assists not to be used on new works; amend table to delete column about Alternative Back Drive Type and delete Spring Assist Unit

Contents

14 Points

14.1 Principle No. 14.1 - Types Of Points Concepts And Definitions

14.1.1 Introduction

This Principle addresses the concepts and definitions relating to certain types of points referred to throughout these Principles and with regard to the descriptions and definitions currently accepted.

14.1.2 Catch-Points

A set of points usually comprising a single switch or run-off lead, the normal position of which provides an open trap to a movement in the facing direction resulting in an enforced derailment thus avoiding a potential collision between movements. When the catch points are closed they enable authorised facing and trailing moves to take place.

There are two fundamental reasons for providing catch points.

a) For the protection of main running line movements, especially passenger, from general freight or shunting movements or from unauthorised movements of loose wagons or stored rolling stock or track maintenance machines on other lines or sidings.

b) For the protection of simultaneously authorised movements towards signals beyond which a convergence would exist within the prescribed overlap distances applicable to the signals authorising the movements in order to facilitate operating flexibility.

14.1.3 Derail & Crowders

A Derail is a two position mechanical device attached to the rail. When seated over the rail head in the “tripping” position it will deflect a low speed movement off the rails resulting in an enforced derailment thus avoiding a potential collision between movements. When swung away from the railhead the derailer enables authorised facing and trailing movements to take place.

A derailer alone is only suitable for providing protection from very low speed general freight or shunting movements or from unauthorised movements of loose wagons or stored rolling stock or track maintenance machines in yards or sidings.

When combined with a “wheel crowder” its use may be extended to similar applications to catchpoints but only where the track speed on the track fitted with the derailer does not exceed 35 kph.

Crowders shall only be installed on straight track, & shall not be used on passenger lines, or other main lines, as the Crowder is not detected.

The provision of a catchpoint in lieu of derails & crowders is always preferred.

14.1.4 Emergency Crossover

A crossover either facing or trailing situated on a double line and where worked crossovers are long distances apart provided to facilitate single line working usually in

conjunction with an extensive programme of track engineering work and subsequently left in situ to enable single line working to be initiated should the need arise.

The crossover may be mechanically or electrically operated and when not in use facing crossovers shall be clipped and XL padlocked normal.

14.2 Principle No. 14.2 - Catch Points: Provision And Positioning

14.2.1 Introduction

This Principle addresses the requirements for providing catch points to prevent collisions arising from unauthorised conflicting movements where clearances are limited or to separate different classes of trains or types of working or to replace an overlap.

14.2.2 Circumstances Under Which Catch Point Protection Shall Be Provided

Catch points shall be provided as follows:

- At converging and diverging connections into sidings or other non signalled areas unless other independent switches will serve the same purpose. Refer to Figure 1.
- On lines where no overlap can be provided due to constraints governing the positioning of signals or track work and catch points can replace an overlap. This includes lines where operating headways require signalled moves up to a home signal protecting a converging movement in the overlap, provided the simultaneous movements can be suitably protected from collision by a catch point judiciously located beyond the home signal. Refer to Figure 2.
- On lines where shared overlap arrangements would impair the operating requirements. Refer to Figure 3 and Figure 4.
- On lines where the gradient is such that a train rolling back could foul a signalled movement. Refer to Figure 5.
- At crossing loops to enable through running on the main line if the Up and/or Down loop is being shunted. Refer to Figure 6.
- At crossing loops to ease the route holding requirements.
- To prevent shunting movements from occupying certain sections of track without authority.
- On refuge loops and relief lines where wagons may be stored.

14.2.3 Consideration As To Where Catch Points Shall be Positioned

In addition to the requirements for the minimum clearance between adjacent tracks catch points shall be positioned with consideration being given to avoiding the following derailment hazards whenever possible.

- Adjacent running lines.
- Other adjacent tracks.
- Embankments.
- Bridges.
- Tunnel mouths.
- Trackside structures such as signals & overhead masts, etc.
- Platforms and station buildings.
- Buildings such as signal boxes and relay rooms, etc.
- Equipment housings such as location cases.

14.2.4 Additional Safeguards Which May Be Provided

Over and above the previous requirements, additional safeguards shall be provided as follows:-

- Double blade catch points or full lead run-offs where there is a likelihood that a single bladed catch will result in inadequate or unsafe deflection of the derailed vehicle.
  Note: This is especially important where the run off area is uneven and there is a risk of overturning a vehicle.
- Full run-off points onto a separate length of track or into a sand drag arrangement where approaching trains may be braking from the full service speed to a stand immediately in rear of the catch points. Refer to Figure 7 and Figure 8.
- Use of a guard rail in lieu of a throw-off rail to direct a derailed vehicle when required.
- If warranted in trainstop territory intermediate trainstop(s) where the speed of an approaching train can be usefully checked prior to it stopping immediately in rear of the catch points. Refer to Figure 9.
- Where approach speeds may be high, facing catch points are best avoided. Where this is not possible, additional mitigation against derailment should be considered. These include intermediate train stops or other speed proving, good signal sighting, and space to assist drivers to regain control and so prevent derailment in the event of a minor overun.

14.2.5 Balloon Loop Loading/Unloading Sidings

Catchpoints are not required at the exit end of Balloon Loops where:

- the system of Yard Working is in use around the Balloon Loop and train speeds are low, and
- train movements up to the exit signal at the end of the Balloon Loop are under control of the loading/unloading bin operator, and
- passenger trains are not involved, and
- the connection to the main line is protected by catchpoints

Refer to Figure 10 and Figure 11.

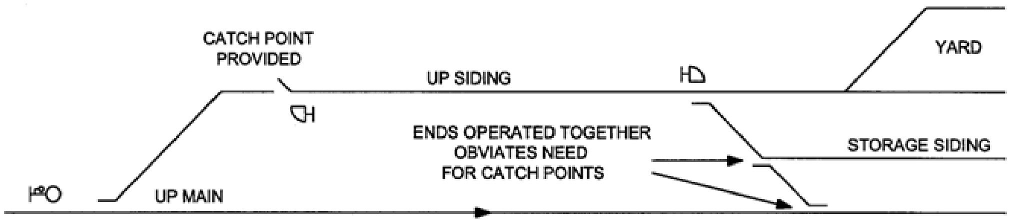


Figure 1 - Provision of Catch Points

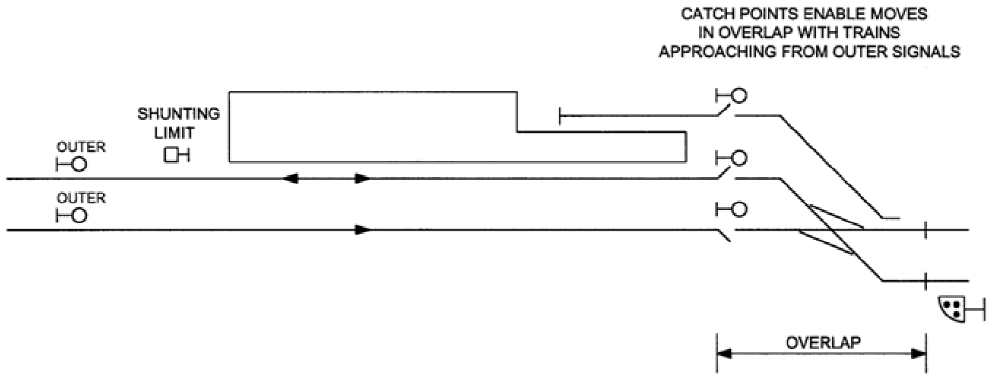


Figure 2 - Provision of Catch Points

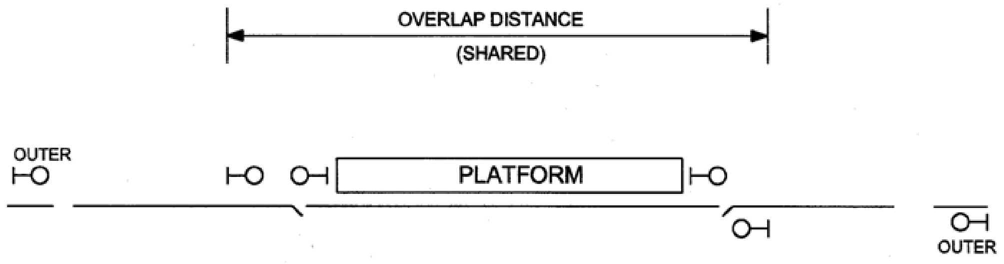


Figure 3 - Provision of Catch Points

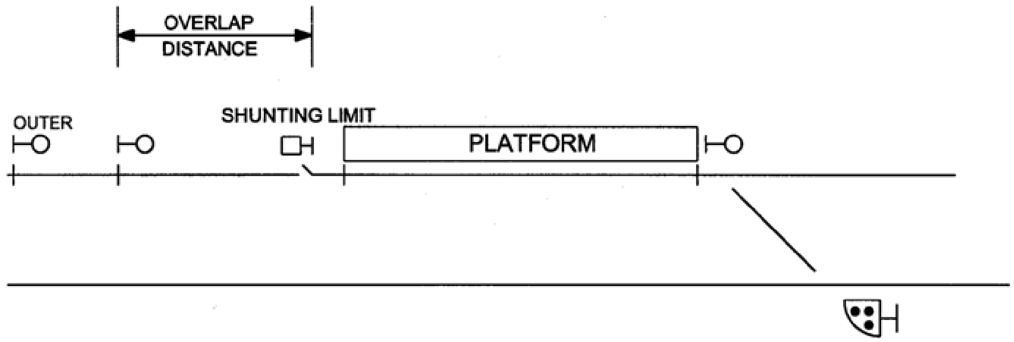


Figure 4 - Provision of Catch Points

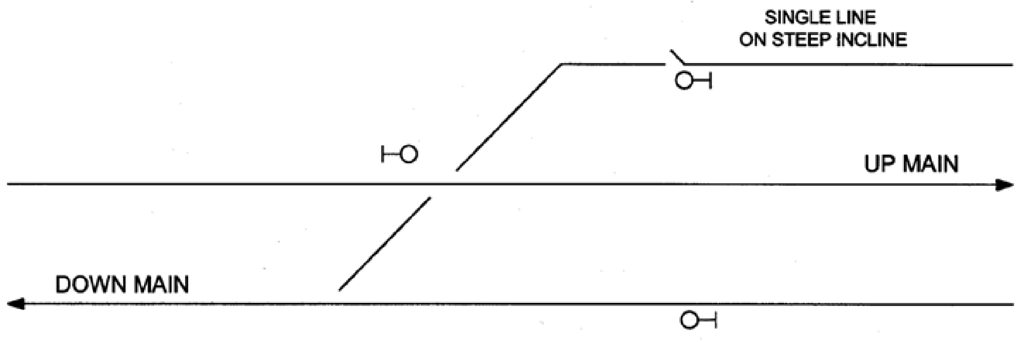


Figure 5 - Provision of Catch Points

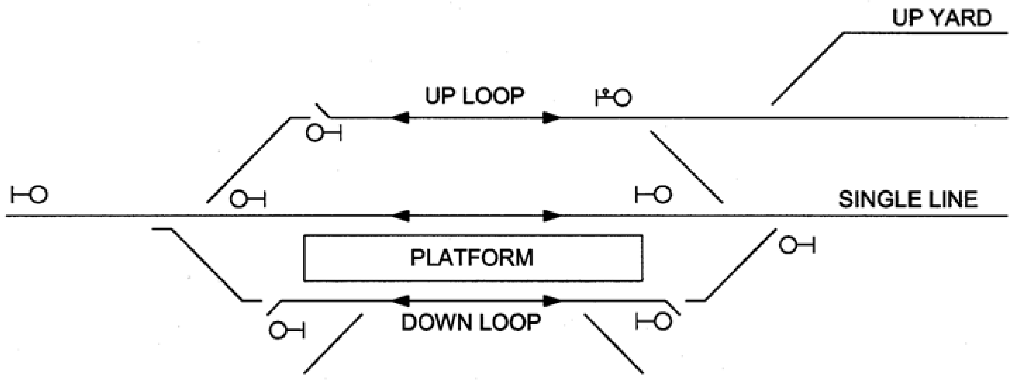


Figure 6 - Provision of Catch Points

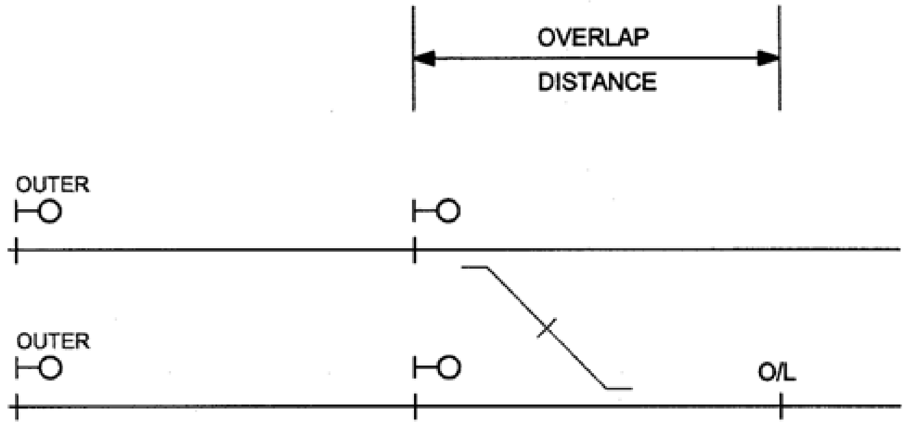


Figure 7 - Additional Safeguards

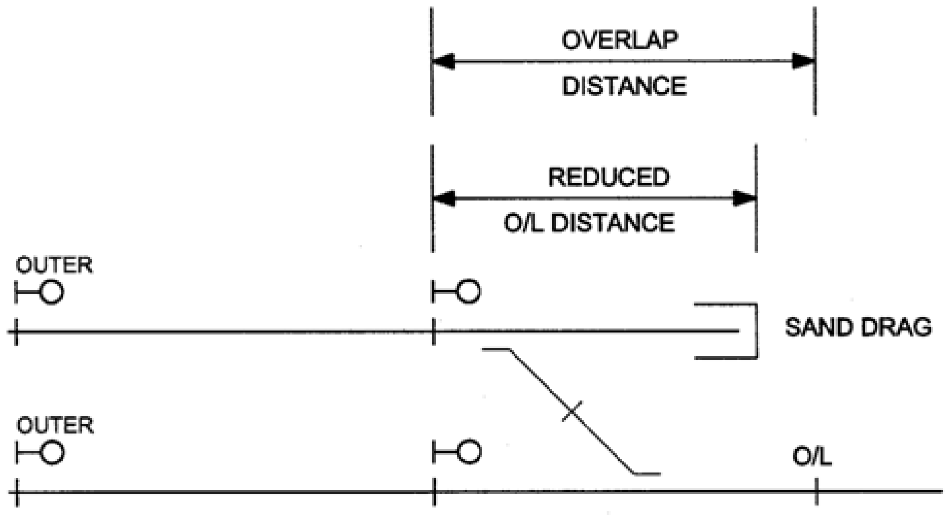


Figure 8 - Additional Safeguards

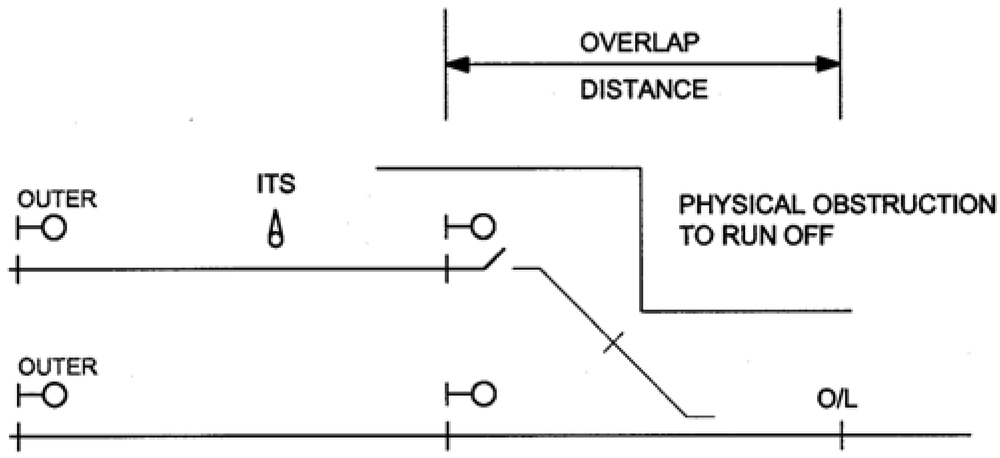


Figure 9 - Additional Safeguards

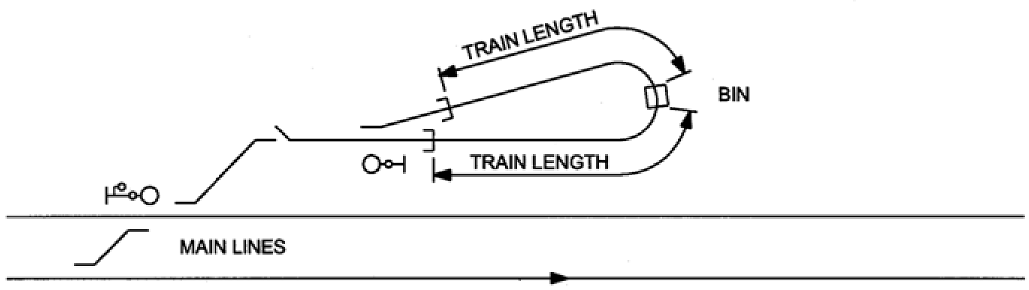


Figure 10 - Provision of Catch Points

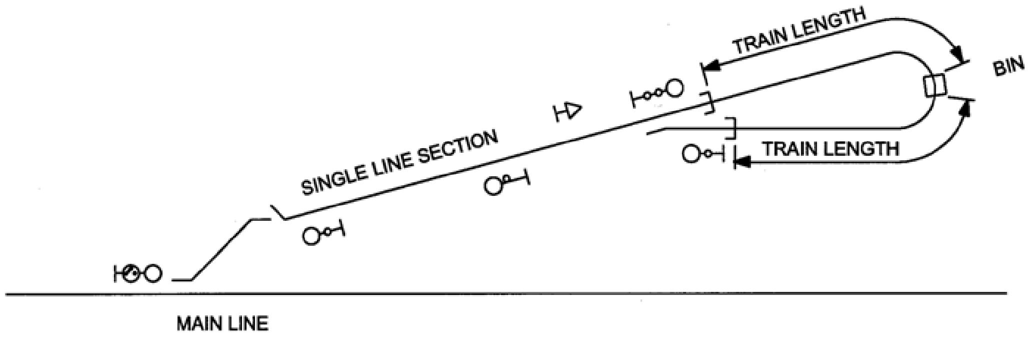


Figure 11 - Provision of Catch Points

14.3 Principle No. 14.3 - Emergency Crossovers Operated From Mechanical Ground Frames

14.3.1 Introduction

This Principle addresses the requirements for operating emergency crossovers located in sections of double line track to facilitate single line operations during programmed engineering works or emergency circumstances and operated from a mechanical ground frame.

14.3.2 Requirement For Facing Emergency Crossovers Operated From Mechanical Ground Frames

Generally the ground frame shall operate the facing point locks (FPL's) and points switches from three or more levers as required.

The ground frame release lever shall be the first lever and shall be fitted with an Annett type lock.

The FPL lever shall be the second lever and lock the points both ways.

The crossover lever shall be the third lever (or third and fourth levers if required for 60kg crossovers).

An XL locked traffic hut shall be provided near the ground frame. A Train Working phone is also provided.

An Annett type lock with contact box and key secured by flap and XL lock shall be provided in the traffic hut.

When the emergency facing crossover is not in use the ground frame shall be locked normal by the Annett type lock and the normally closed switches shall be clipped and secured with an XL padlock.

The Annett key shall be proved normal in the contact box. This shall enable any automatic running signals reading over the emergency crossover to clear.

14.3.3 Ground Frame Operation

If the emergency crossover is to be reversed then the Annett type key shall be removed from the contact box and the XL padlocks and clips removed from the points. Any

automatic running signals reading over the emergency crossover shall be replaced to stop.

The Annett type key shall be inserted in the Annett type lock fitted to the ground frame releasing lever and the lever reversed. This shall enable the FPL to be withdrawn, the crossover to be reversed, and the FPL replunged.

14.4 Principle No.14.4 - Emergency Crossovers Operated From Electric Ground Frames

14.4.1 Introduction

This Principle addresses the requirements for protecting and operating emergency facing crossovers located in sections of double line track to facilitate single line operations during programmed engineering works or emergency circumstances and operated from electric ground frames.

The same principle may be applied to trailing crossovers.

14.4.2 Requirements For Facing Emergency Crossovers Operated By Electric Switch Machines and Controlled From Electric Ground Frames

14.4.2.1 Operators Panel

A simple operators panel shall be provided to form the basis of the Electric Ground Frame and shall accommodate the following:

Controls

A push button to establish an electric release to free the crossover.

A two position switch to operate the crossover between the Normal and Reverse positions.

Indications

A white light to indicate if the electric release is free thus enabling the release to be taken.

A white light to indicate if the crossover is detected normal.

A white light to indicate if the crossover is detected reverse.

A green light to indicate if the crossover is free from local track locking and may thus be operated.

Red lights to indicate the occupancy of the approach track circuits sections on the Up and Down lines.

14.4.2.2 Signals

The automatic running signals leading over the facing crossover shall be fitted with ‘A’ lights.

The automatic running signals leading over the facing crossover shall be provided with a notice board worded as shown in Appendix A to this Principle. Refer to Figure 12.

The automatic running signal in rear of the signals leading over the facing crossover shall be provided with a notice board worded as shown in Appendix A to this Principle. Refer to Figure 12.

14.4.2.3 Panel Operation

If the emergency crossover is not in use then it shall be continuously locked normal and the automatic running signals leading over the crossover shall be enabled to show proceed aspects and the ‘A’ lights shall be illuminated and the switches shall be clipped and XL padlocked.

If the emergency crossover is to be reversed then following the removal of the clips and XL padlocks the push button shall be operated causing the automatic signals interlocking with the crossover to be replaced and ‘A’ lights to be extinguished.

If the approach track circuits are clear on both lines and all replaced signals are proved at red then the electric release will be free to be taken as indicated by the illumination of the white free light. Following this the crossover may be operated to the reverse position from the two-position switch.

If an approach track circuit is occupied when the signals are replaced then the electric release will remain locked until an approaching train has been proved to be at or nearly at a stand by the expiry of a track time release. Provided that the replaced signals are proved at red the electric release will become free as indicated by the illumination of the white free light. Following this the crossover may be operated to the reverse position from the two-position switch.

Local track locking shall be applied to the emergency crossover for both the normal and reverse lays to prevent a movement of the crossover while a train is passing over it. If the crossover is track locked then the green indication light shall be extinguished.

If the release is restored to the normal position then its next movement to the reverse position shall be subject to the operation described above.

Appendix A To Principle 14.4

DRIVERS WHEN PASSING THIS SIGNAL AT STOP IN ACCORDANCE WITH THE RULES MUST PROCEED AT RESTRICTED SPEED TO THE NEXT SIGNAL BEING PREPARED TO STOP SHORT OF ANY OBSTRUCTION.

Appendix B To Principle 14.4

DRIVERS WHEN DIRECTED TO PASS THIS SIGNAL AT STOP MUST PROCEED AT RESTRICTED SPEED AND BRING THEIR TRAIN TO A STAND WELL CLEAR OF THE CROSSOVER AND MUST NOT RESTART UNTIL SATISFIED THAT IT IS SAFE TO DO SO (or THAT SHUNTING IS NOT TAKING PLACE, as applicable).

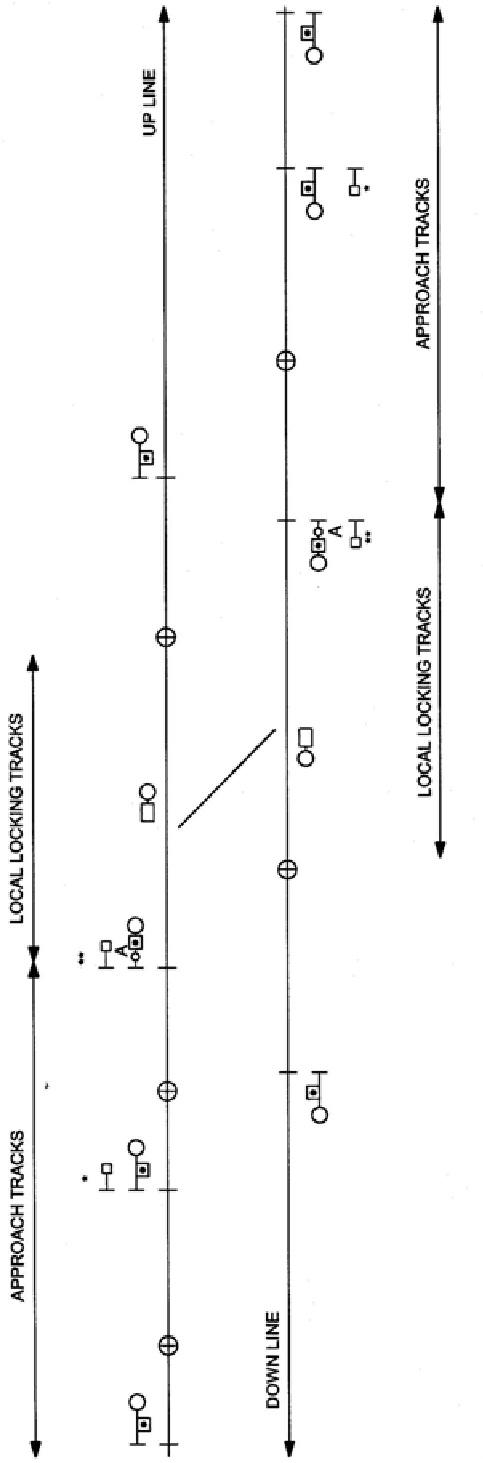


Figure 12 - Emergency Crossover Operated by an Electronic Groundframe

14.5 Principle No. 14.5 - Detection Of Points

14.5.1 Introduction

This Principle addresses the requirements for the electrical detection of mechanically, power or ground frame operated points in colour light signal aspects.

Facing point locks or equivalent security shall be provided on facing points on running lines for all signalled facing movements for trains conveying passengers. Moreover, facing point locking are to be provided for all authorised running movements over interlocked emergency crossovers.

14.5.2 Detection of Mechanically Operated Points

14.5.2.1 Detection Of Mechanical Points In The Route Section

If a set of mechanically operated facing points is situated within the route of a signal, then the correct position of the open switch, closed switch and facing point lock shall be detected before the signal is permitted to clear and continuously thereafter to maintain a clear aspect. Refer to Figure 13.

If a set of mechanically operated trailing points is situated within a route, then the correct position of the open switch and closed switch will not generally be required to be detected in the signal aspect. Refer to Figure 14.

If the end of a set of mechanically operated points is situated such that it provides trapping/flank protection to the route then it may be desirable for the correct position of the closed switch and the open switch, or the open switch in the case of single switch catch points, to be detected before the signal is permitted to clear and continuously thereafter to maintain a clear aspect. Refer to Figure 15.

14.5.2.2 Detection Of Mechanical Points in The Route Overlap

If a set of mechanically operated facing points is situated beyond the exit for the route for a signal, but within the overlap distance applicable to the signal, and is protecting an alternative overlap which is unavailable, or not permitted, then it is desirable that the correct position of the open switch and closed switch be detected before the signal is permitted to clear and continuously thereafter to maintain a clear aspect or, if it is not practical to include the points switch detection then at least the points lever shall be proved to be in the correct position and electrically lever locked, where applicable.

If a set of mechanically operated facing or trailing points is situated outside the route of a signal but offers trapping/flank protection to the route then it may be desirable to detect the appropriate position of the points subject to operating considerations. Refer to Figure 14.

14.5.3 Detection of Power Operated Points

14.5.3.1 Detection Of Power Operated Points In The Route Section

If a set of power operated facing points is situated within the route of a signal then the correct position of the open switch, closed switch and facing point locking (and plunger lock where used on EP points) shall be detected before the signal is permitted to clear and continuously thereafter to maintain a clear aspect. Refer to Figure 16.

If a set of power operated trailing points is situated within the route of a signal then the correct position of the open switch, closed switch and facing point locking, if provided, shall be detected before the signal is permitted to clear and continuously thereafter to maintain a clear aspect. Refer to Figure 17.

If the end of a set of power operated points is situated such that it provides trapping/flank protection to the route then the correct position of the open switch, closed switch and facing point locking, if provided, or the open switch in the case of a single switched catch point, shall be detected before the signal is permitted to clear and continuously thereafter to maintain a clear aspect. Refer to Figure 17.

14.5.3.2 Detection Of Power Operated Points In The Route Overlap

If a set of power operated facing points is situated beyond the exit of a route for a signal but within the overlap distance applicable to the signal and is protecting an alternative overlap which is unavailable, or not permitted, then the correct position of the open switch, closed switch and facing point lock shall be detected before the signal is permitted to clear and continuously thereafter to maintain a clear aspect. Refer to Figure 18 and Figure 19.

If a set of power operated trailing points is situated beyond the exit of a route for a signal but within the overlap distance applicable to the signal, the actual field position of the points switches in the line of the overlap will not require to be detected in the signal. However if the points can be manually operated in emergencies then operation of the emergency facility provided (eg ESML, EOL) shall reliably and fail-safety replace and retain at stop all signals which interlock with the trailing points.

If an end of a set of power operated points is situated such that it provides trapping/flank protection to an overlap then the correct position of the open switch, closed switch and facing point locking, if provided, or open switch in the case of a single switch catch point, shall be detected before the signal is permitted to clear over that line of overlap and shall remain detected continuously thereafter to maintain a clear aspect. Refer to Figure 17 and Figure 19.

14.5.3.3 Multiple Ended Points

If a set of points comprises two or more point ends, then the correct positions of the open switch, closed switch and facing point locking, if provided, at each end shall be detected as prescribed before a signal is permitted to clear and continuously thereafter to maintain a clear aspect.

14.5.4 Detection of Ground Frame Operated Points

In relation to ground frame operated facing points in the route section and point ends providing trapping/flank protection to the route section or route overlap, the correct position of the open switch, closed switch and facing point locking, if provided, or the open switch in the case of a single switched catchpoint, shall be detected before the signal is permitted to clear and continuously thereafter to maintain a clear aspect.

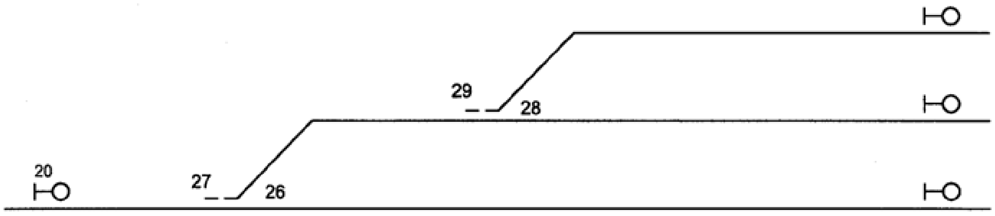
14.5.5 Facing Point Locking

Facing point locking is the securing of the points switches such that they cannot move once locked. This security is to be proven effective before signals over the points can be cleared.

Facing point locking is applied differently with different point operating technologies.

Examples of facing point locking include:

- A plunger that engages a locking mechanism to secure the switches.
- An operating bar that engages claw lock mechanisms.
- Alternative operating mechanisms that incorporate internal locking arrangements.
- Where a position of a bar needs to be maintained to ensure the lock remains effective then, additionally, the application of positive air, cylinder latches or motor brake and the detection that the measure employed is effective.

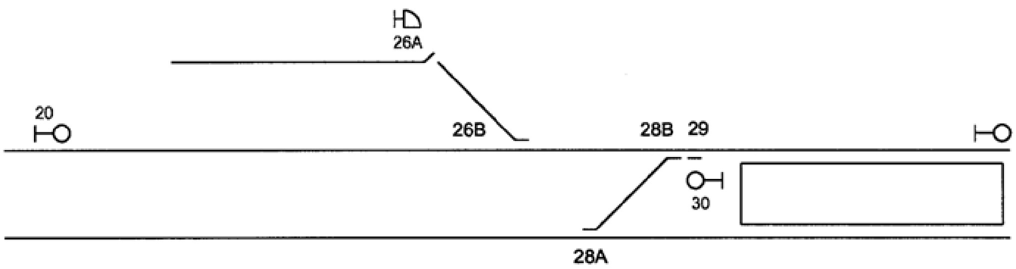


SIGNAL	DETECTS	
	POINTS	FPL'S
20	26N 26R 28N 26R 28R	27R 27R 29R 27R 29R

FPL OUT BOTH WAYS

DETECTION OF FACING POINTS AND FPL'S IN ROUTES

Figure 13 - Detection of Mechanically Operated Points

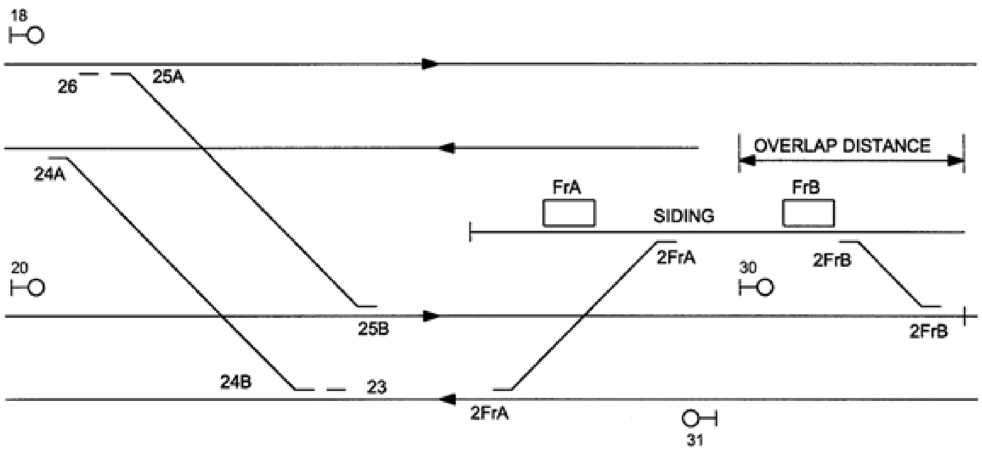


SIGNAL	DETECTS	
	POINTS	FPL'S
20	26AN	NIL
30	28BR 26AN	29R

DETECTION OF TRAILING POINTS IN ROUTES

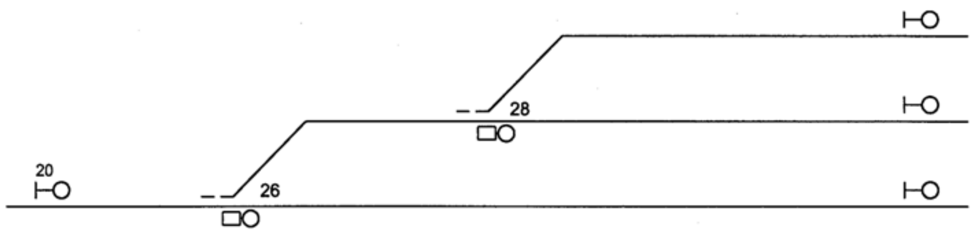
AND AS TRAPPING PROTECTION

Figure 14 - Detection of Mechanically Operated Points



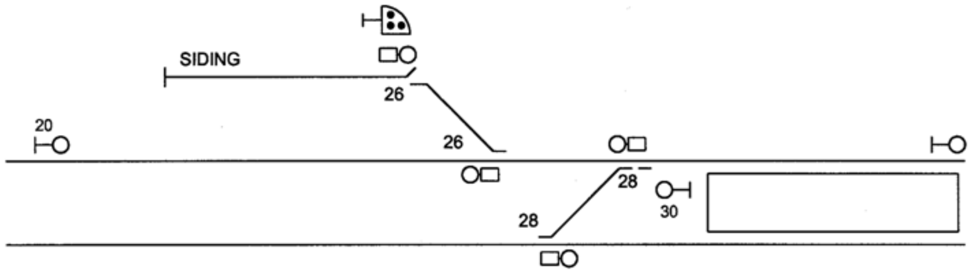
SIGNAL	DETECTS		
	IN ROUTE OR OVERLAP		AS TRAPPING PROTECTION TO ROUTE OR O/L
	POINTS	FPL'S	POINTS
18	25AN	26R	
	25AR	26R	2FrAN (SIDING END), 2FrBN (SIDING END)
20			24BN, 2FrAN (SIDING END), 2FrBN (SIDING END)
30			2FrBN (SIDING END)
31	24BR	23R	2FrAN (SIDING END)
	24BN	23R	2FrAN (SIDING END)

Figure 15 - Detection of Multiple Ended Points in Routes and as Trapping Protection



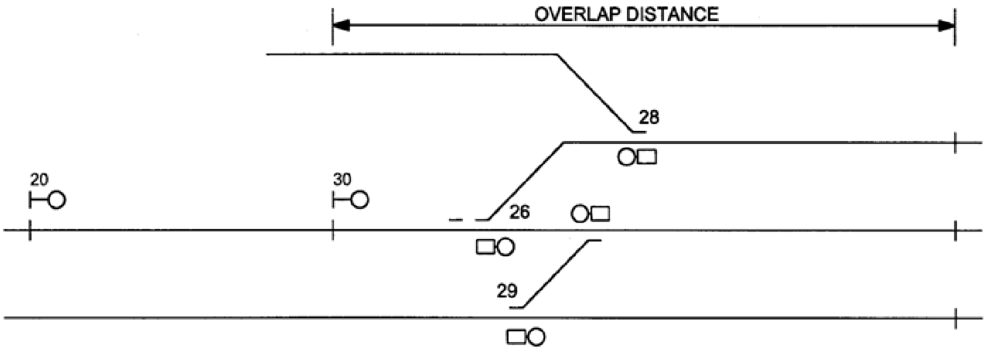
SIGNAL	DETECTS POINTS
20	26N 26R 28N 26R 28R

Figure 16 - Detection of Facing Points in Routes



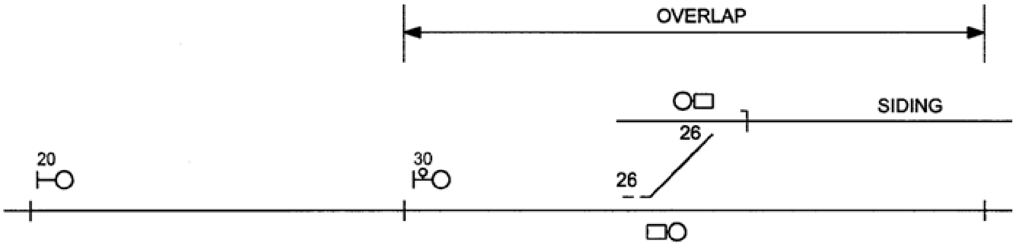
SIGNAL	DETECTS POINTS
20	26N 28N
30	26N 28R

Figure 17 - Detection of Trailing Points in Routes and as Trapping Protection



SIGNAL	DETECTS POINTS
20	29N W 26N 28N W 26R 26N W 28R 26R W 29R

Figure 18 - Detection of Points in an Overlap



SIGNAL	DETECTS POINTS
20	26N

Figure 19 - Detection of Facing Points in a Fixed Overlap
(Note: No overlap is permitted into the siding)

14.6 Principle No. 14.6 - Electric Switch Machines

Requirements for the provision of crank handles, emergency switch machine locks, hand throw levers, emergency operations locks and isolating relays.

14.6.1 Introduction

This Principle addresses the concepts and requirements for the provision of equipment, which can electrically isolate an electric switch machine under various operating conditions.

14.6.2 Crank Handle (CH) or Hand Throw Lever (HTL)

14.6.2.1 Concept

A crank handle or hand throw lever is a mechanism which allows an electric switch machine to be manually operated under hand signalling arrangements or during failure conditions or for testing or maintenance purposes.

Crank handles and EOL (Emergency Operations Lock) keys (to release hand throw levers) are often configured to fit specific machines and are mechanically indexed for this purpose.

Generally a crank handle or hand throw lever requires the switch machine motor to be open circuited before the gearbox is engaged.

This is to avoid any possibility of a conflicting control being applied to the machine when it is under manual control.

The crank handle incorporates an ESML (Emergency Switch Machine Lock) key.

14.6.2.2 Requirements

Crank handles and EOL keys shall be mechanically indexed such that they can only be inserted into the gearbox or hand throw lever lock of an identically indexed switch machine.

If a set of points has more than one end and these additional ends are operated by separate switch machines then all the machines associated with the set of points shall be identically indexed.

Only one crank handle shall be provided for each set of points irrespective of the number of point ends. Separate EOL keys are provided for each point end.

Crank handle and EOL key indexes shall not be repeated within a specific group of points.

These groups are usually determined by the arrangement of sets of points in the track layout.

If a crank handle is inserted into a switch machine then it shall not be possible to commence manual operation unless the motor circuit has been broken by a crank handle contact (CHC) mechanism within the machine.

If an EOL key is inserted into a hand throw lever lock then it shall not be possible to commence manual operation unless the motor circuit has been broken by moving the selector lever from the 'motor' to the 'hand' position.

Crank handles and the tag attached to the EOL key are to be inscribed with the interlocking name, type of emergency box and the points number(s) to which they apply in accordance with the following examples.

Crank Handle	a)	**Single ended set of points.** "Glenfield ESML & 43A PTS MTR"
	b)	**Multiple ended set of points** "Glenfield ESML & 42A&B PTS MTRS"
EOL Key Tag		One different tag required for each end ie, "Strathfield EOL & 43A PTS. MTR" "Strathfield EOL & 43B PTS MTR"

14.6.3 Emergency Switch Machine Lock (ESML)/Emergency Operations Lock (EOL)

14.6.3.1 Concept

For safety reasons it is normal practice to keep the crank handle or EOL key(s) in a locked box and this way it is only available to authorised operators.

Further safeguards can be provided however by detecting the presence of the crank handle or EOL key(s) in the locked box and then ensuring that signals reading over the points are unable to clear whenever the crank handle or EOL key(s) are removed from the locked box.

The device in which the crank handle and EOL key(s) are normally held and detected is the Emergency Switch Machine Lock or an Emergency Operations Lock.

14.6.3.2 Requirements

If a crank handle or EOL key(s) are provided for the manual operation of an electric switch machine(s) then it shall be held in an Emergency Switch Machine Lock or an Emergency Operations Lock except when its removal has been authorised.

If a crank handle or EOL key is removed from an Emergency Switch Machine Lock or an Emergency Operations Lock then the aspects of all the signals interlocked with the points concerned shall be replaced to and maintained at stop.

The Emergency Switch Machine Lock and Emergency Operations Lock shall be mechanically indexed such that it only accepts the crank handle or EOL key(s) for a specific and identically indexed set of points.

An Emergency Switch Machine Lock or an Emergency Operations Lock shall be given the same number as the set of points to which it applies and the number shall be prominently displayed on the front of the Emergency Switch Machine Lock box or Emergency Operations Lock box.

14.6.3.3 Location

It is generally required that Emergency Switch Machine Locks and Emergency Operations Locks are mounted on the wall of a hut or the side of an equipment case containing the point control and indication circuits, and in particular the Isolating Relays and feed to the main detection relays to ensure effective single cutting of these circuit functions by the ESML or EOL contacts; alternatively the ESML or EOL should have sufficient contacts to double switch these circuits.

However further consideration shall be given to the distance between the location of the ESML or EOL and the set of points to which it applies.

This is to ensure that if an employee authorised to use a crank handle or EOL key(s) removes it from the ESML or EOL then there is sufficient time for a train which has passed the replaced signal protecting the points to arrive at the points before the employee authorised to use the crank handle arrives at the points, thus minimising the possibility of the train running through open or wrongly positioned points.

These considerations shall take into account:

- The distance between the signal or signals protecting the points and the points.
- The type or types of signal protecting the points.
- The speed of the trains approaching the signal or signals protecting the points.
- The time taken for the employee authorised to operate the points to walk between the ESML or EOL and the points.

However, bearing in mind the levels of protection required for employees crossing tracks under current safeworking rules,

- Other than where the points are in the centre tracks or crossovers span more than two tracks, the ESML or EOL should be located so that it is not necessary for employees to cross several tracks between the ESML or EOL and the points to which they apply.
- Where it is necessary to locate an ESML or EOL away from the hut or equipment case, then the circuit functions of the ESML or EOL contacts shall be double cut.

14.6.4 Isolating Relays

14.6.4.1 Concept

An isolating relay is used to electrically isolate the motor circuit of an electric switch machine once any signal leading over the points in the facing direction has been cleared and this condition is maintained until the signal has been restored, is free from approach locking and the track circuit(s) immediately approaching and over the points is clear.

Consequently any spurious control conditions such as a false feed which could potentially cause a wrong side failure involving the movement of a set of points under a train will be rejected.

14.6.4.2 Requirements

An isolating relay shall be provided for each electric switch machine.

If a route is set in the facing direction over a set of points operated by an electric switch machine or the track circuit immediately over the points is occupied or the crank handle or EOL key is withdrawn from an Emergency Switch Machine Lock or Emergency Operations Lock then the isolating relay shall be de-energised.

The isolating relay shall be proved to be de-energised before the aspect of a signal leading over the points in the facing direction is permitted to clear.

If the same signal is restored and is free from approach locking then the isolating relay shall be enabled to energise.

The isolating relay shall be to BR Spec 943.

Front contacts of the isolating relay shall double cut the motor operating circuit directly.

Back contacts of the isolating relay shall double cut the detection circuit directly.

Note : Isolating relays are not required at SSI installations.

On EP points, the isolating relay functionality is incorporated into the plunger lock, if provided, or the particular control arrangements for new technology.

14.6.4.3 Location

An Isolating Relay shall be located in the hut or equipment case closest to the point machine it isolates.

14.7 Principle No. 14.7 - Removal Of Lock-Slides and Provision for a Wide-Cut Notch

14.7.1 Introduction

This Principle addresses the circumstances under which it is acceptable to operate a point mechanism without lock-slides fitted, or with provision for a wide-cut notch in the lock-slide.

This principle of lock-slide removal only applies to Trailing ONLY points operated by Combined Electric Switch Machines.

This principle of a lock-slide with provision for a wide-cut notch only applies to points operated by Combined Electric Switch Machines or EP Signal Branch assemblies.

This permits coarser adjustment of the trailing detection as referenced in TMG J030 *Facing Point Lock and Detection Testing on Power Operated Points.*

14.7.2 Concept of Lock-Slide Removal

Where a set of electrically operated points is:

- signalled exclusively for trailing movements (in both directions), and
- there are no set back movements whereby part of a long train would pass over the points in a facing direction, and
- having regard to the possibility of hand signalled facing movements taking place over the points, and
- the probable frequency of single line working over the points in a facing direction

then to reduce the likelihood of detection failures arising as a result of a tight facing point lock, consideration may be given to the removal of the lock-slides from the Combined Electric Switch Machine.

14.7.3 Concept of Provision for a Wide-Cut Notch in the Lock-Slide

14.7.3.1 For Catchpoints

The Open-switch facing point lock in Combined Electric Switch Machines or Signal Branch EP assemblies which operate a single switch catchpoint may be difficult to keep in reliable adjustment in some poor condition track areas. Where this is a persistent problem, it may be permissible to provide a wide-cut notch in the Open-switch lock-slide.

14.7.3.2 For Points with a Trailing Only Position

Where the nominated position (Normal or Reverse) of a set of Signal Branch EP operated points is:

- signalled exclusively for a trailing movement, and
- there are no set back movements whereby part of a long train would pass over the points in a facing direction, and
- having regard to the possibility of hand signalled facing movements taking place over the points, and
- the probable frequency of single line working over the points in a facing direction

then to reduce the likelihood of detection failures arising as a result of a tight facing point lock, consideration may be given to the provision of a wide-cut notch in the Trailing Position lock-slide of the Signal Branch EP assembly.

14.7.4 Requirements for the Removal of Lock-Slides or Provision of a Wide-Cut Notch in Lock-Slides

Prior to any lock-slide being removed or a wide-cut lock-slide being provided, specific approval must be obtained and approved designs must be issued. Working sketches, signalling plans and track plans shall explicitly indicate which point ends are subject to this procedure.

The allowable cut-out for the wide-cut notch shall not exceed 13mm wider than the respective locking dog.

The Signal Box register listing trailing points that require clipping for the purposes of Yard Working, shall be amended in regards to this provision.

14.8 Principle No. 14.8 - Track Circuit Locking of Points

14.8.1 Introduction

This Principle addresses the requirements for the provision of track circuit locking over power operated points and extended conditional track locking as applicable.

14.8.2 Purpose

Track locking is provided over points to ensure they are held in position for the passage of a train once the direct route to point locking has been normalised and the train is between the points and the signal leading over them.

14.8.3 Requirements - Track Circuit Locking of Points Controls

All sets of power operated points shall be locked in both the normal and reverse positions by the occupation of the track circuit or circuits immediately over the points. Refer to Figure 20.

The limits of this track circuit or track circuits over the points shall extend at least as far as the clearance point in accordance with Principles No. 19.1 and 19.2.

If the track layout and train movements permit, the track locking shall be extended as far as each signal which reads over the point either in the normal or reverse position. Refer to Figure 21.

If the track layout and train movement do not permit the track locking to be extended then route holding as described in Principle No. 12.1 shall be provided.

14.8.4 Requirement - Direct Track Circuit Control of Power Operated Point Mechanisms

In addition to the track circuit locking of the point controls described in 14.8.3 above, direct track circuit control of all power operated facing point mechanisms shall be provided.

14.8.4.1 Electrically Operated Points

The motor circuit of electrically operated facing points shall be directly controlled by a contact of the track circuit immediately over the points and any track circuits between the running signal or signals reading over the points via an isolating relay except in the case of points controlled from a SSI installation or where trailable point machines are installed in yards. Approach sticks relays of facing signals are also included in the isolating relays.

Track locking in the isolating relay circuit should operate through contacts of the parent track relays or through repeat relays, which are close to the parent track relay.

A feature shall be included such that the occupation of the track circuits concerned does not preclude the completion of a point movement once it has commenced.

14.8.4.2 Pneumatically Operated Points (except claw locks)

The facing point lock of pneumatically operated facing points shall be held in position by a plunger lock device controlled by a contact of the track circuit immediately over the points and any other track circuits between the signal or signals reading over the points and the points concerned.

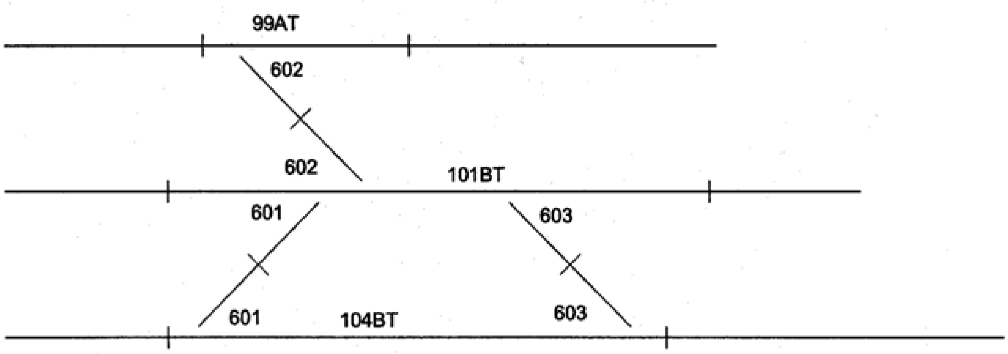
Track locking in the plunger lock circuit should operate through contacts of the parent track relays or through repeat relays, which are close to the parent track relay.

Pneumatically Operated Claw Locks

Where the points are to be controlled to an opposite position, the operation shall be controlled by a contact of the track circuit immediately over the points and if facing points any other track circuits between the points concerned and the signal or signals reading over the points.

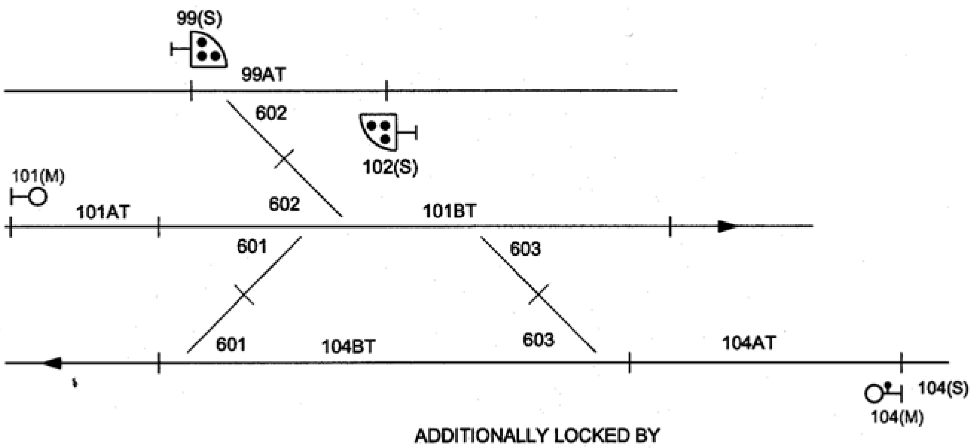
14.8.5 Control Tables

The requirements for the direct track locking of point operating mechanisms shall be in accordance with the Control Tables concerned.



POINTS N°	LOCKED NORMAL & REVERSE BY TRACK CIRCUITS OCCUPIED
601	101BT 104BT
602	99AT 101BT
603	101BT 104BT

Figure 20 - Track Circuit Locking of Points



POINTS N°	ADDITIONALLY LOCKED BY TRACK CIRCUITS OCCUPIED	
	NORMAL	REVERSE
601	101AT 104AT	
602	101AT	(104AT, 104BT, W 603R)
603	101AT 104AT (99AT W 602R)	104AT

Figure 21 - Track Circuit Locking of Points

14.9 Principle No. 14.9 - Mechanical Trailable Facing Point Mechanisms

14.9.1 Introduction

This Principle addresses the requirements for the provision of mechanical trailable facing point mechanisms, point indicators and signage.

14.9.2 Purpose

Mechanical trailable facing points are used where it is desired that trains proceed over the points in a facing direction without stopping with the driver viewing an indicator which gives an assurance that the points are locked in the correct position, but where it also allows the points to be trailed through in the reverse direction without the attendance of a shunter.

14.9.3 Mechanical Trailable Facing Point Mechanisms

Mechanisms used for this purpose must be able to provide a mechanical indication of the closed switch being within the normal detection limits of the stockrail, and the open switch being suitably clear of the other stockrail. The switches are to be snubbed for the trailing movements to prevent continual movement of the switches between wheel sets passing over them in the trailing direction.

Mechanisms are to be able to be operated reverse by a suitable trackside lever which may be secured against misuse by a lock operated by a Operators Key, SL key or similar as appropriate to the situation.

14.9.4 Mechanical Point Indicators

The mechanical point indicators are a retro-reflective white bar against a black background post mounted next to the point mechanism. The indicator is double sided.

When the points are set and locked for the normal direction movement the bar is inclined to 45°. The bar is horizontal when the points are unlocked.

Indication	Aspect Name	Meaning
Horizontal Bar	Stop	Stop-points are unlocked or out of position
Inclined Bar	Points normal and locked	Points are set and locked in the normal position.

A diagram of the indicator is shown in Principle 19.1.4 Figure 3.

14.9.5 Signage

A notice board with black lettering on a white retro-reflective background "Trailable Points" is to be provided on the trailable road leading through the points. The points are generally only trailable while in the normal position.

14.9.6 Speed Restrictions

Any manufacturers' recommendation regarding speed through the points in the facing and trailing directions is to be considered. Speed while trailing is not to exceed 25km/h.

14.9.7 Operational Instructions

Movements over the trailable points may be made without inspection of the points providing it is a normal direction movement and the point indicator bar is inclined at 45°.

Movements through the points reverse in the facing direction may only be made after the points have been operated to the reverse position and the switches inspected to ensure they are firmly against the stockrail before hand signalling the movement to proceed. After the movement is completed the points are to be restored to the normal position and the lever secured, if fitted with a lock. While the points are reverse, the point indicator will display a horizontal bar and movements must not be made over the points without inspection and hand signalling.

Trailing movements through the points in the reverse position may only be made at a speed not exceeding 25km/h past a board inscribed "Trailable Points." Should the train come to a stand on the points, the train must not set back until the points lever has been reversed and a hand signaller has inspected the points before hand signalling the train back.

After a train has completely trailed a set of trailable points, the points will automatic reset for the normal position and providing the switch is detected close against the stock rail and locked, the indicator will return to the 45° position.

The mechanical point indicator is not in itself authority for the train movement. Drivers must ensure that the movement is authorised, and in yard areas, keep a look out for any obstruction.

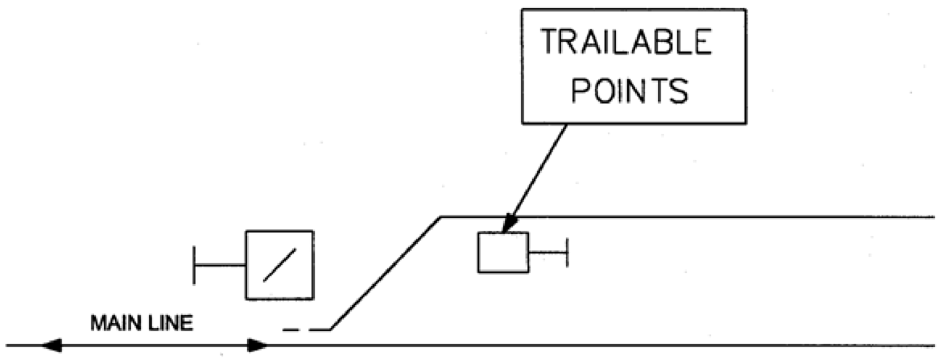


Figure 22 - Trailable Facing Points Layout

14.10 Principle No. 14.10 – Ground Frame Releases

14.10.1 Introduction

This Principle addresses the requirements for the provision of ground frame releases and the methods by which releases are generally given.

14.10.2 Provision of Ground Frames

Ground frames are provided to operate points for infrequent movements such as for shunting, emergencies and possessions.

A ground frame may consist of levers controlling the points switches, facing point locks and signals reading over the points in the normal or reverse position. Where running signalled movements are made in the facing direction through points operated by a ground frame, a facing point lock (FPL) is provided.

Mechanical ground frames are normally held locked by a mechanical lock on one of the levers in the ground frame which acts as a releasing lever for the ground frame interlocking. In some cases, the mechanical lock is located on the facing point lock lever.

The mechanical lock on the ground frame lever is operated by a key, which is only available, if conflicting movements are locked out. Wards on the key (eg Annett key) are matched to the wards on the corresponding mechanical lock (eg Annett lock).

14.10.3 Ground Frames inside Interlocking Areas

14.10.3.1 Key from lever in the main frame

The common method of releasing ground frames within mechanical interlockings and in some electro-mechanical interlockings is by key removed from a lock on a releasing lever in the main frame in the signal box. The main frame releasing lever is locked in the releasing position when the key is removed.

Locking is provided in the main frame between the releasing lever and all points and signal levers, which conflict with operation of the ground frame.

The key, obtained from the main frame releasing lever, is then taken to and inserted in the lock on the respective ground frame lever to release the ground frame.

Electric Releasing Switch

Where electro-mechanical, relay type or computer based interlockings are provided an electric releasing switch is generally installed near the ground frame.

The key to release the mechanical lock on the ground frame releasing lever is held locked in the electric releasing switch until the electric releasing switch lever (handle) is turned from the normal to the reverse position. The releasing switch lever (handle) is locked in the normal position until the releasing lever in the main frame at the signal box is reversed which causes the indicator in the electric releasing switch to change from a “locked” to a “free” indication. Reversing the releasing switch lever and removing the key locks the electric releasing switch reverse which, in turn, locks the signal box main frame releasing lever in the reverse position via an electric lever lock.

A reverse electric lever lock is provided on the main frame releasing lever, which also has an indicator, inscribed “locked” and “free”. The indicator displays a “locked” indication when the corresponding electric releasing switch is operated to the reverse position. The indicator displays a “free” indication when the ground frame and electric releasing switch are normal.

The Signaller reverses the main frame releasing lever at the request of the shunter or the traffic officer.

14.10.4 Ground Frames outside Interlocking Areas in Double Line Sections

In double line track sections outside interlocking areas, ground frames may be provided to operate emergency crossovers and connections to sidings.

14.10.4.1 Emergency Crossovers

Emergency crossovers may be released by a key from an Annett or Duplex Lock, Emergency Releasing Lock, Pilotmans Lock, or a key from an Electric Releasing Switch.

14.10.4.2 Sidings adjacent to Main Line

Where local regulations stipulate that portion of the train must always remain standing on the Main Line during the time a siding is being shunted, a Guard’s Key may be used to release the ground frame.

The portion of the train standing on the Main Line maintains the signal or signals in the rear in the stop position and as a further protection, the track circuit at the points is cut through a points normal electrical detector connected to the catch points end leading out from siding.

At sidings where the whole train may be refuged, the Ground Frames are provided with an Electric Releasing Switch.

14.10.5 Ground Frames outside Interlocking Areas in Single Line Sections

When a siding is located in a single line staff section, a key on the Electric Staff or Ordinary Train Staff, or a Receptacle Key in conjunction with a ticket on an Ordinary Train Staff section, or a key from a Staff Drawer Lock, is utilised to unlock the ground frame, and the key is held captive in the ground frame mechanical lock until the point connections and the levers have been returned to normal.

On single line track block and single line track control sections, an Electric Releasing Switch is provided to release the ground frame, and once the release is taken the section control circuit is open circuited.

14.10.6 Ground Frames and Mechanical Point Indicators

When a ground frame is located in the following areas: ordinary train staff, electric train staff, Train Order working area, yard areas where signals cannot be cleared for the train movement or where the release is by a releasing lock or loose key not directly interlocked with the signals then a mechanical point indicator is to be provided. Details of mechanical point indicators are given in Principle 19.2.4. Points fitted with mechanical point indicators must always have a catchpoint or derail to prevent points being trailed through, unless a trailable mechanism is provided.

In staff sections, landmarks may also need to be provided.

14.11 Principle No. 14.11 – Electro – Pneumatic (EP) Points

Requirements for the provision of emergency operations locks, (EOL) and emergency operations lock pushbuttons (EOLPB).

14.11.1 Introduction

This Principle addresses the concepts and requirements for the provision of equipment, which can manually operate a set of EP points under various operating conditions.

14.11.2 Emergency Operations Lock (EOL) (Keyless Type)

14.11.2.1 Concept

An EOL switch is a rotary switch located in the EOLPB unit on the master control valve for the points.

When the switch is turned to the emergency (or manual) position, a time delay function of a minimum of 60 seconds commences. At the end of the time delay period an indicator in the EOLPB unit illuminates, advising that the normal and reverse pushbuttons are available and that points may be operated normal or reverse as required.

The cover of the EOLPB unit is arranged so that it cannot be closed with the switch in the emergency position.

The minimum time delay period is 60 seconds. However the time delay applied to any particular location must take into account:

- The distance from the points or crossover of the first warning signal protecting the points or crossover
- The speed and braking capabilities of trains using the line or lines.

When the EOL switch is rotated either

- Any approaching train must be further away than the first warning signal approaching the points and be able to stop before the points

OR

- There must be sufficient time for a train, which is inside the first warning signal to reach the points before the normal and reverse pushbuttons are enabled.

Optionally:

If all tracks in the approach locking to the points or crossover are proven unoccupied, the timing function may be qualified out.

Requirement

Only one EOL switch and one set of normal and reverse pushbuttons shall be provided for each set of EP points irrespective of the number of point ends.

The master control valve fitted with the EOLPB unit shall so far as is possible be located at the facing end of any facing and trailing crossover or at the main line end of any points leading to a refuge or siding.

Indications may be provided above the pushbuttons to indicate the position to which the points have been called.

In all cases, the points must be examined, clipped and locked, before trains are permitted to pass over them.

14.11.3 Emergency Operations Lock (Keyed Type)

In the Sydney, Sydenham and North Sydney areas, the EOL unit is provided with a key and lock. Removal of this key will prevent the signals from clearing. This key is then inserted and turned in the lock in the EOLPB unit, where it performs the same function as the rotary switch in 14.11.2. Indicator lights are not provided in this unit. This method is no longer preferred.

14.12 Principle No 14.12 – Maximum Distances Between Mechanical Interlocking Machines and Turnouts (for information only)

14.12.1 Introduction

This principle addresses the maximum operating distances between mechanical interlocking machines and turnouts to ensure provision of safe and reliable operation of the turnout.

Note that the conventional style turnouts listed are not to be used for new works.

Tangential turnouts are not permitted to be operated mechanically from mechanical signal boxes or mechanical ground frames. They must be power operated unless a special arrangement is permitted by the Chief Engineer Signals.

14.12.2 Operating Distances

The distance from an interlocking machine to a turnout is defined as:

For a single turnout:- from the interlocking machine to the tip of the switches, Table 1.

For a turnout plus catch point:- from the interlocking machine to the tip of the switches of the turnout or catchpoint whichever is furthest from the machine, Table 2

For a crossover:- from the interlocking machine to the tip of the switches of the end of the crossover furthest from the machine, Table 3.

For a turnout plus derail:- from the interlocking machine to the tip of the switches of the turnout or the derail whichever is furthest from the machine, Table 2 plus 10 m.

In the tables means **Connection Not Permitted**

		Mechanical Interlocking Machine Type		
Switch	Turnout	Elevated or Platform Level Machine	Ground Frame Type E or G	Single Lever Type F
60 kg	1 in 15 9150 (one backdrive)	170 m	105 m	
60 kg	1 in 12 9150 (one backdrive)	170 m	105 m	
60 kg	1 in 10.5 9150 (one backdrive)	170 m	105 m	
60 kg	1 in 10.5 6100	180 m	115 m	
60 kg	1 in 9 6100	180 m	115 m	
60 kg	1 in 8.25 6100	180 m	115 m	
53 kg	13650 switch (one backdrive)	180 m	115 m	
53 kg	All others	240 m	150 m	
47 kg	All	280 m	180 m	25 m Loops, refuges, sidings, branch lines only

Table 1 - Single Turnout

		Mechanical Interlocking Machine Type		
Switch	Turnout	Elevated or Platform Level Machine	Ground Frame Type E or G	Single Lever Type F
60 kg	1 in 15 9150 (one backdrive)	145 m	95 m	
60 kg	1 in 12 9150 (one backdrive)	145 m	95 m	
60 kg	1 in 10.5 9150 (one backdrive)	145 m	95 m	
60 kg	1 in 10.5 6100	160 m	100 m	
60 kg	1 in 9 6100	160 m	100 m	
60 kg	1 in 8.25 6100	160 m	100 m	
53 kg	13650 switch (one backdrive)	160 m	100 m	
53 kg	All others	215 m	130 m	
47 kg	All	255 m	150 m	

Table 2 - Turnout plus Catchpoint

For a turnout plus derail, add 10 m to the above distances. A type F single lever may be used for a 47kg turnout plus derail to a maximum distance of 70 m.

		Mechanical Interlocking Machine Type		
Switch	Turnout	Elevated or Platform Level Machine	Ground Frame Type E or G	Single Lever Type F
60 kg	1 in 15 9150 (one backdrive)	125 m	80 m	
60 kg	1 in 12 9150 (one backdrive)	125 m	80 m	
60 kg	1 in 10.5 9150 (one backdrive)	125 m	80 m	
60 kg	1 in 10.5 6100	140 m	85 m	
60 kg	1 in 9 6100	140 m	85 m	
60 kg	1 in 8.25 6100	140 m	90 m	
53 kg	13650 switch (one backdrive)	140 m	90 m	
53 kg	All others	190 m	110 m	
47 kg	All	240 m	125 m	

Table 3 - Crossover

14.13 Points Requiring Clipping for Unsignalled Movements

14.13.1 Introduction

In accordance with the rules, signallers may authorise unsignalled facing movements over points.

In order to discriminate those locations, which require additional security for these movements, a sign is to be provided adjacent to the points end, for the direction that the points would become facing.

14.13.2 List of Points Required to be Clipped

A list of points that require to be clipped for unsignalled facing movement is displayed in the controlling Signal Box.

This list is to be maintained with any infrastructure change.

The provision of signs at these points as per this principle will apply for new works only or upon request.

14.13.3 Form of Sign

The sign is white lettering on a red background and states:

STOP

THESE POINTS MUST BE CLIPPED
AND LOCKED FOR ANY FACING
MOVEMENT

14.13.4 Identification of Points Requiring this Sign

The following criteria will identify points where this sign may be provided:

- Electric points (combined machines) signalled for trailing only moves where the lock slides have been removed, or provided with a coarse detection setting.
- Mechanically operated points without an FPL worked from the signal box, or ground frames controlling points where the rodding is greater than 100m and where no signal is provided.
- Signal Branch EP points where either position is trailing only.

Points operated from ground frames, where the channel rodding run is short and direct (less than 100m) will not require the sign.

However any set of points where a situation exists that the points can not be guaranteed for a movement, such as due to switch or stock rail condition, may be fitted with the sign.

Documentation

The installation of signage is to be documented on the signalling plan. Refer to Figure 23.

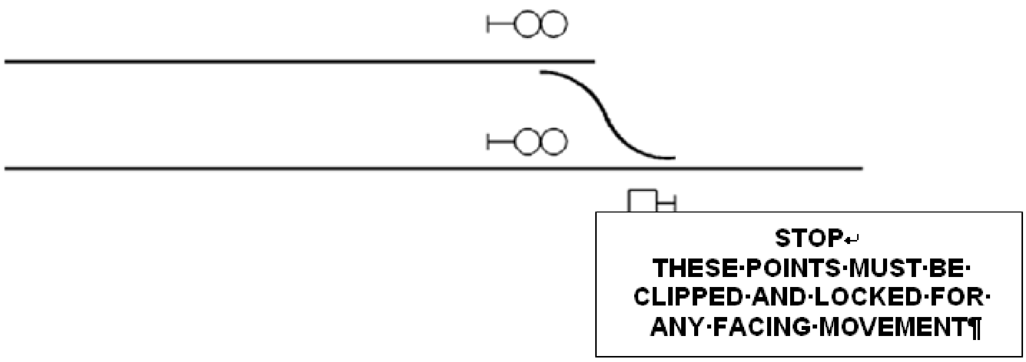


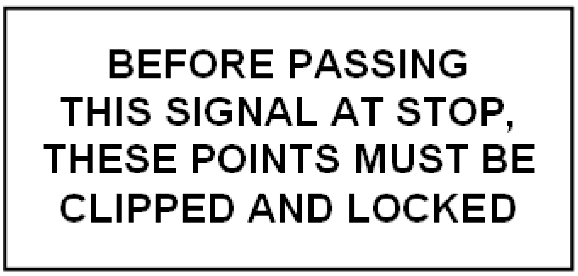
Figure 23 -

14.13.5 Points requiring Clipping when Passing Signal at Stop

The following criteria will identify points, which need to be clipped when passing a signal at stop.

Motor worked points not controlled from a Signal Box. (for example, 'Ulan' style automatic crossing loops).

The following sign is to be displayed on or adjacent to the Signal in these situations.



This sign should be retroflective white on a black background.

14.13.6 Motor Points not requiring special signage

Points controlled from the Signal Box where the Signaller can operate the points from one position to the other and back to confirm the correct functioning of the detector and the indicator diagram and be in a position to be able to provide advice to the driver that the points are either operating correctly, or need to be clipped.

14.14 Principle No 14.14 – Application of Back-drives to Tangential Turnouts

The length and hence flexibility of the switch determines the number of thrust points or drives that are needed to ensure that: -

- The switch closes up to the stockrail along its machined section and up to the chocks behind this.
- The switch opens sufficiently to provide a clear flange-way between it and the stockrail. This flange-way must be between 60mm +/-5mm measured at the end of the head machining on the switch.

The turnout manufacturer will determine the location and number of back-drives required and the turnout will be supplied with switch and (sometimes) stockrail drilled to accept the back drive components.

As a general statement 250m and larger turnouts require back-drives. 190m turnouts do not require back-drives.

The following table lists the various sizes of tangential turnout and shows the number of drives generally required for each type.

Back-drives can be provided by: -

- A mechanical linkage from the main drive at the tip of the switch
- A spring assist unit
- A second (or second and third) power unit directly operating the back drives.

Spring assists should not be used on new works and have only been provided on switches which move independently (ie claw locks, EP or 84M drives). They are not to be used on turnouts with superelevation.

Whenever possible backdrive arrangements shall provide for detection of obstruction in the switches such that the closed switch is not closed throughout its length, or the flangeway gap is not adequate. This detection may be achieved mechanically or electrically. Accordingly spring assist devices are to be phased out in favour of ‘T’ crank style backdrives.

Independent Switch Points shall not exceed 250m radius as backdrives are impractical and difficulty will result in achieving the required flangeway clearance.

Figure 24 - Mechanical 'T' crank back drive

The spring assist unit consists of two cranks coupled by a spring link. Each crank is connected to one switch. As the operating mechanism at the tip begins to move the switches, the spring link is compressed until about mid travel. At this stage the spring link moves past centre and expands applying force to close one switch and open the other. No other linkage is required.

Figure 25 - Spring Assist Unit

Figure 26 - Separate Mechanisms for front and back drives (not currently in use in NSW)

Turnout Type	Operating Mechanism	Back-drive required?	Back-drive Type
190m – 1 in 7.5	Spherolok or Claw lock – 84M or EP	No	
	Conventional drive switch machine #	No	
250m – 1 in 8.25	Spherolok or Claw lock – 84M or EP	Yes one	Mechanical Linkage
	Conventional drive switch machine #	Yes one	Mechanical Linkage
250m – 1 in 10.5	Spherolok or Claw lock – 84M or EP	Yes one	Mechanical Linkage
	Conventional drive switch machine #	Yes one	Mechanical Linkage
300m – 1 in 9	Spherolok or Claw lock – 84M or EP	Yes one	Mechanical Linkage
	Conventional drive switch machine #	Yes one	Mechanical Linkage
300m – 1 in 12	Spherolok or Claw lock – 84M or EP	Yes one	Mechanical Linkage
	Conventional drive switch machine #	Yes one	Mechanical Linkage
500m – 1 in 12	Spherolok or Claw lock – 84M or EP	Yes one	Mechanical Linkage
	Conventional drive switch machine #	Yes one	Mechanical Linkage
500m -	Spherolok or Claw	Yes one	Mechanical

Turnout Type	Operating Mechanism	Back-drive required?	Back-drive Type
1 in 15	lock – 84M or EP		Linkage
	Conventional drive switch machine #	Yes one	Mechanical Linkage
800m – 1 in 15	Spherolok or Claw lock – 84M or EP	Yes two	Mechanical Linkage
	Conventional drive switch machine # (Note 2)	Yes two	Mechanical Linkage
800m – 1 in 18.5	Spherolok or Claw lock - EP	Yes two	Mechanical Linkage
	Conventional drive switch machine # (Note 2)	Yes two	Mechanical Linkage
1200m – 1 in 18.5	Spherolok or Claw lock - EP	Yes two	Mechanical Linkage (Note 3)
1200m – 1 in 24	Spherolok or Claw lock - EP	Yes two	Mechanical Linkage (Note 3)

Notes:

Some existing turnouts may have spring assists. Spring assists are to be phased out in favour of mechanical linkages.

Conventional drive switch machines are to be phased out in favour of EP and 84M operating Spherolock or claw locks.

Notes

1. Deleted

2. While conventional switch machines will readily operate 800m turnouts under power, emergency hand operation is likely to be heavy.

3. For electric machines, two machines may be used, one for the main drive at the tip and one to operate both back drives. Electric operation is not preferred. For EP, a larger cylinder should be used. Note that back drive detection (on at least one drive) will be necessary if a separate drive is provided. 1200m turnouts shall not be installed without special approval from the Chief Engineer Signals.

14.15 Principle No 14.15 – Design Principles for Mechanical Components of Points

14.15.1 Introduction

The principle establishes the basic design principles to be applied to mechanical components of points and associated systems.

14.15.2 Strength of components

All mechanical components shall be capable of meeting the forces that are applied in the normal operation of the equipment. Normal operation includes failure conditions, but does not include interference or damage from external sources, such as derailment damage.

14.15.3 Component Failure

The failure of any one item shall not result in an unsafe situation.

The failure modes shall be managed by ensuring, whenever possible, that mechanical components are diverse or duplicated.

If the component cannot be duplicated, it must be of sufficient strength that it is unlikely to break, including fracture, in service.

Pins, which are critical to the safety of the installation, shall be double secured to ensure against their accidental or unintended removal.

14.15.4 Detection of Component Failure

Wherever possible, all failures shall be detectable. It is preferred that partial failure be detected automatically and reported, but otherwise a regular maintenance visit shall ensure the full redundancy of the installation remains effective.

14.15.5 Assurance of Locking Mechanisms

The locking of point mechanisms, where a switch is locked against a stock rail, shall be provided with a means to ensure the locking remains applied at all times except when the points are operated. This includes the continuous application of air or other means to hold claw lock operating bars in position or a mechanical brake or similar to prevent mechanism drift.

14.15.6 Insulation of Mechanical Components

14.15.6.1 Insulation Scope

Mechanical components connected to running rails require insulation to:

- Prevent the track circuit from being short circuited
- Assist in preventing dangerous voltages being presented to employees from traction faults
- Prevent wiring faults in equipment from connecting to running rails or earth and consequently being affected by influences from track circuits and traction currents.

14.15.6.2 Insulation Requirements

Stretcher bars and equipment between switches shall, where possible, be insulated at each connection, effectively providing double insulation between the switches. Where the type of mechanism prevents this, single insulation is permissible.

All backdrives shall be insulated between the crank and the drives where the equipment between the switches is only single insulated.

All points mechanisms shall be insulated from the drive and lock rods, where the equipment between the switches was only single insulated.

Point detector rodding shall be insulated from the switches.

Steel bearers provide a significant earth connection. Steel bearers are to be insulated from running rails.

Additionally, any electrical mechanisms, such as point machines and detectors, shall be insulated from the steel bearers so that an electrical fault to the equipment case is isolated from earth, as far as possible.

Equipment operating rods shall not contact steel bearers. Where guides or supports are provided, insulation is to be provided unless the rod is already insulated from the electrical equipment.

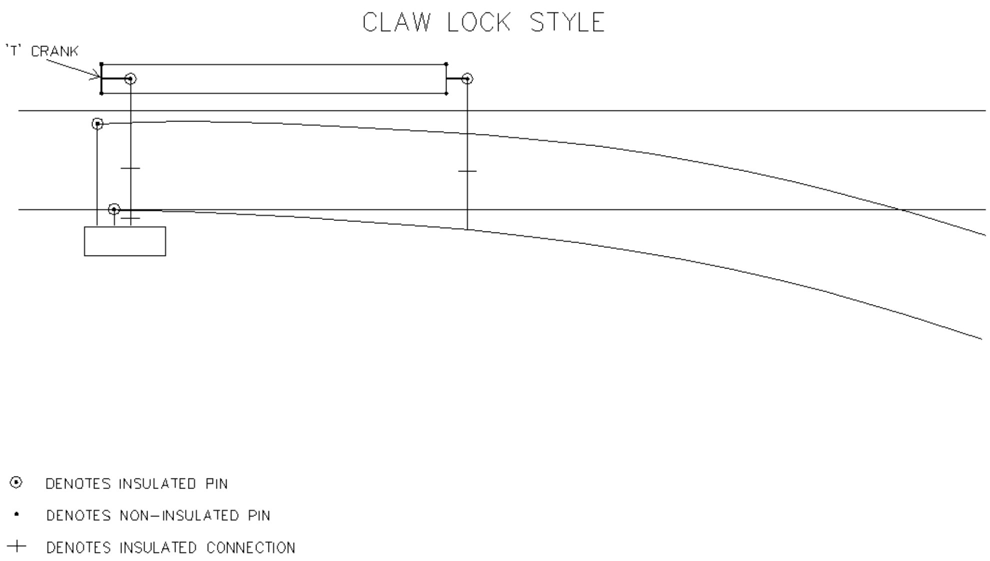
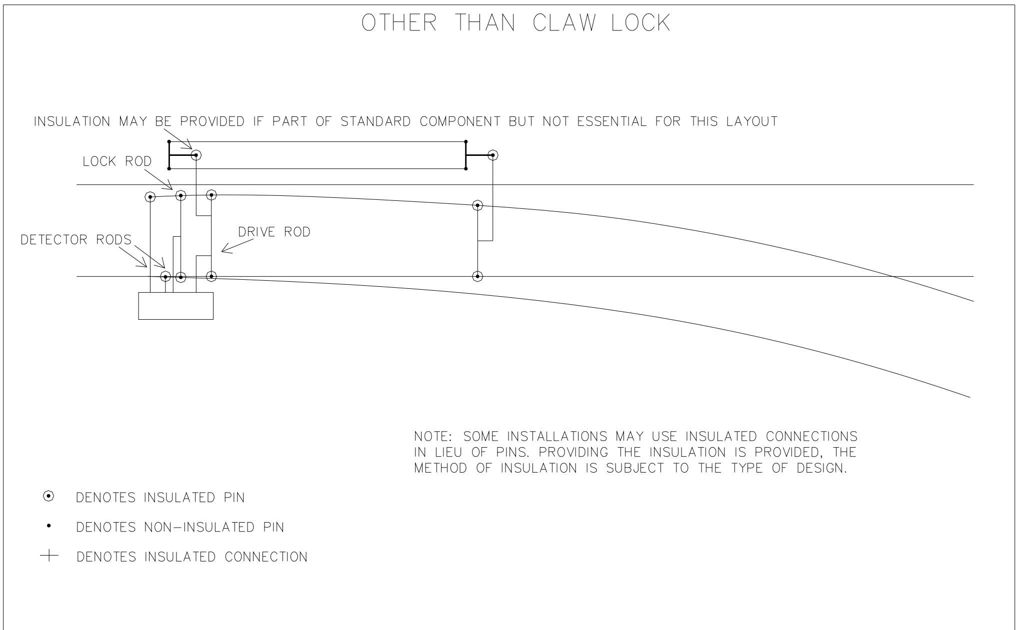


Figure 27 - Points Rods Insulation



POINTS RODS INSULATION
PRINCIPAL 14.15 – FIGURE 2

14.16 Principle No 14.16 – Stagework Installation & Removal of Points

14.16.1 Introduction

Where a set of points is to be installed as a precursor to being connected to the signal interlocking or where the signal interlocking equipment is removed from a set of points pending removal, the points need to be adequately secured according to this principle.

14.16.2 Securing of Points

Points not in service and not connected to the signal interlocking shall be physically secured by two separate mechanical methods. The securing is to ensure that both the open and closed switches are dual secured.

One of the methods shall be the fitting of a point clip and XL lock on the closed switch.

The additional method shall be:

- Spiking the points closed; or
- Providing a steel bracket secured to the bearers and wedged against the switch.

The use of spiking or brackets secured to the bearers shall be methods approved by the Chief Engineer Track.

The open switch may be secured by the fitting of two fixed stretcher bars or, alternatively, the final points rodding and mechanisms may be fitted. In the case of Claw Lock and Spherolock layouts, where the point motor is not provided, the operating bar shall be physically secured to secure the open switch.

However, if the complete points mechanism, including motor, is provided, then this can be the additional method and this also adequately secures the open switch.

14.16.3 Securing of Catchpoints

Catchpoints that are required to be in the closed position shall be secured as 14.16.2 except that no open switch exists to be secured.

Where a catchpoint is to be secured in the open position, it shall be secured using a point clip and block that positively holds the open switch in position. The clip shall be XL locked.

Independent switches shall be treated as two separate catchpoints unless they can be treated as a normal set of points.

14.16.4 Securing of Swing Nose Crossings

Swing nose crossings shall be treated similar to facing points and secured as 14.16.2 except that the points operating bar shall fitted in lieu of the spiking and be physically secured to secure the swing nose (in addition to the point clip).

14.16.5 Detection of Points Not in Use

New facing points installed as stagework shall be detected. In an emergency, a period of 16 weeks without detection is permitted. In such cases, Track Standards may require some additional risk mitigation to be provided, such as the removal of switches and the straight railing of some components. The loss of detection shall place to stop the immediate signals reading over the points.

When a set of trailing only points is provided, electrical detection need not be provided.

When a catchpoint is provided to protect the main line, electrical detection is required to prove the catchpoint open.

Electrical detection is not required where points are in yards where the speed limit is 13 km/h or less.

14.16.6 Bonding

Any points installed shall include bonding to ensure track circuit operation and traction return both exist for the route in operation.

14.16.7 Protection of Running Movements

Where train operations will occur over one leg of the points, the other leg is to be provided with a stop block at clearance point to prevent construction vehicles and any unauthorised movements from fouling the line.

14.17 Principle No 14.17 – Location of Points Mechanisms

14.17.1 Introduction

This principle addresses the requirements for location of points mechanisms.

14.17.2 Concept

Point machines shall be shown on signalling plans on the side of the track on which they are located. The location is required to fulfil several requirements which may be conflicting. The requirements are to ensure the arrangements are safe for maintenance access & that the mechanical arrangements are reliable & maintainable.

14.17.3 Requirements

Point machine location shall be in accordance with the following:

- Located on the side closest to a safe place. On double lines they shall be located on the outside of the track. On multiple lines they shall be located to minimise the distance to a safe place.
- Emergency equipment & access shall be in a safe place.
- Machine mounted operation handles shall be orientated such that the operator stands, off track, unless a physical obstruction exists.
- Where ever possible, points are not to be located in tunnels, steep cuttings or on or under bridges unless a safe place is available next to the points.
- Points rodding is to be direct & close to the points, to prevent or limit excessive deflections & vibration in rods & to minimise the number & length of structural elements between the machine & the switches & stockrails. Points bearers shall be designed to accommodate the close fitting of mechanisms. Catchpoint motors shall be adjacent to the switch they operate. Scarfed bearers assist in keeping rods as direct as possible.
- Sets in rodding shall be minimised.
- Wherever possible, on track equipment shall be minimised.

14.18 Principle No. 14.18 – Power Operated Ground Frames

14.18.1 Introduction

This principle addresses requirements for power operated points when used as a ground frame application.

14.18.2 Provision

Modern concrete sleeper turnouts are not usually compatible with hand operation and compliance with occupational standards for manual safe work.

Motor operation is needed, but this introduces the risk of the points operating under a train due to the ease of manipulation of the controls and the potential for the vehicles not being capable of effectively shunting the track circuit. Special arrangements are required for such installations.

This principle provides the requirements for these arrangements.

14.18.3 Situations Used

Power operation of points in the following situations are covered by this principle:

- Emergency crossovers used for planned and emergency work, usually within automatically signalled areas. (See Figure 1)
- Sidings for Per Way Vehicles within automatically signalled areas. (See Figure 2)(Note the axle counter shown could be a track circuit)
- Sidings for Per Way Vehicles within interlocking areas.(See Figure 3)

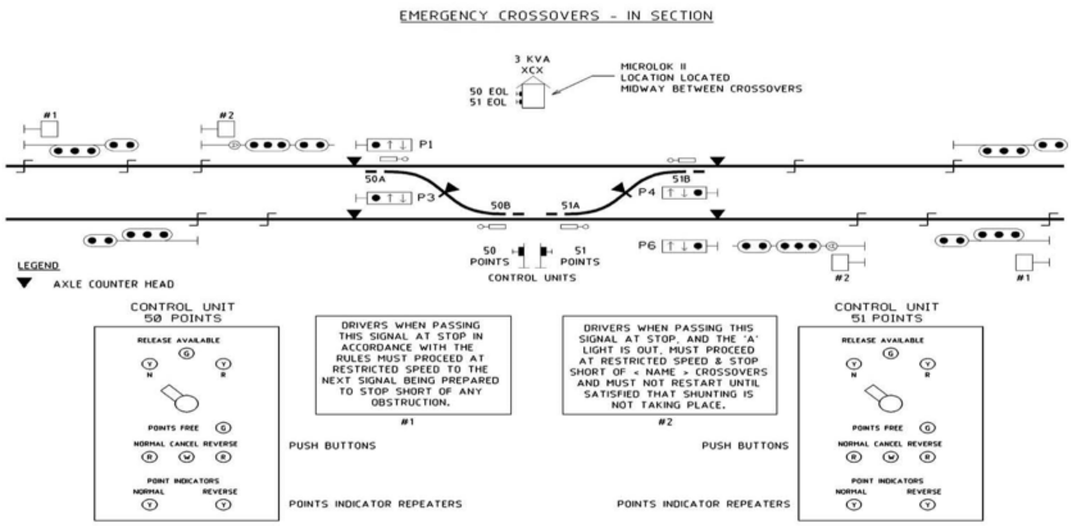


Figure 1 - EMERGENCY CROSSOVERS

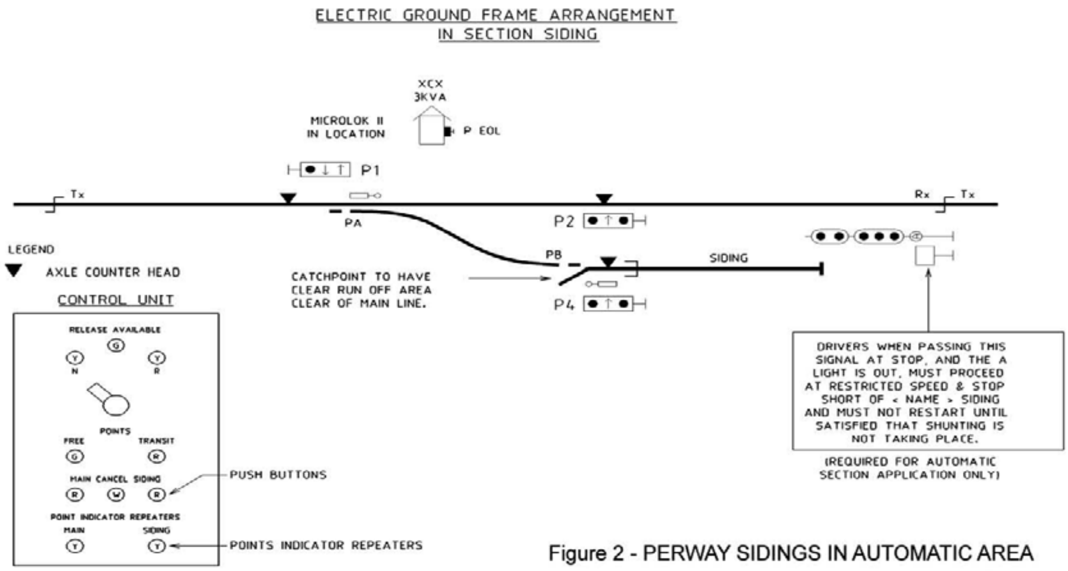


Figure 2 - PERWAY SIDINGS IN AUTOMATIC AREA

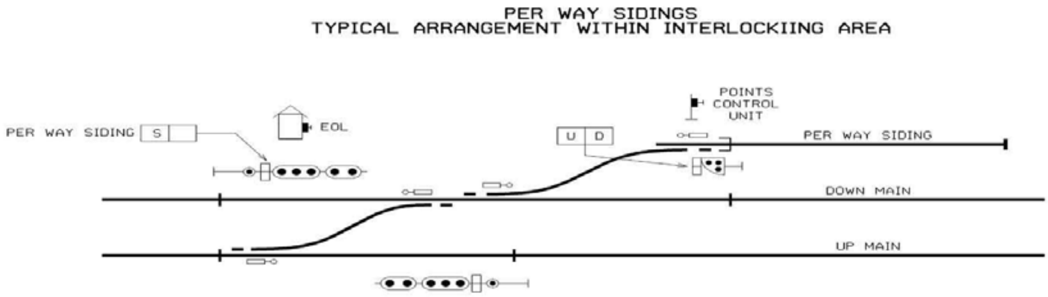


Figure 3 - PERWAY SIDINGS IN INTERLOCKING

14.18.4 Infrastructure Requirements

The basic infrastructure consists of:

- Power operated (electric or EP) points mechanisms.
- Electric point indicators or signals to prove point position.
- A control box including release lever, point operation button and indication lights.
- A small computer based interlocking to provide the control logic processing and interfacing with the signalling system.

14.18.5 Associated Risks

In a signalling system, motorised point operation is subject to train detection proving the track is clear.

Approach locking is applied through signals to prevent points operation after a movement authority has been given.

With the types of uses proposed it is likely that:

a) Vehicles may not be of a type that effectively shunts track circuits.

b) Rails may not be clean enough to support track circuit operation due to infrequent use.

c) Wheels may not be suitable for the operation of axle counters.

Accordingly the power operated ground frame system is designed to address these risks, as described in 14.18.6 (below).

14.18.6 Operational Requirements

Where a power operated ground frame is used for Per Way vehicles it is likely that the vehicles may not effectively shunt track circuits, (or only some may operate track circuits) or where due to low speeds, vehicles operating in a convoy may allow the track circuit to pick up in the space between the vehicles.

Where a power operated ground frame is used as an emergency crossover for emergency and planned working, trains are potentially passenger or freight trains of significant length and weight. Train speeds through these points in the normal direction may be up to line-speed, but will be lower for the turnout direction, or generally slower on either direction when used under track working conditions (i.e. stopping for handsignallers).

The local qualified person will take the release and operate the points push buttons to operate the facility.

Mitigation against moving points under trains is provided by:

- Maintaining points indicators clear for the movement with approach locking.
- Providing a time release once point indicators are returned to stop.
- Placing the Control Box for the poswer operated points within sighting distance of the points and the clearance points.
- Providing local instructions at the control box.
- An option for an axle counter to provide local interlocking (note that some Per Way vehicles may not have wheels suitable for axle counters), over the turnouts only.

Failure of the power worked ground frame (or parts thereof) when in the normal (i.e. not released) state shall, as far as practical (where it is safe to do so) not impact signal clearance for the usual running movements.

EOL arrangements shall be provided for manual operation of the points.

Instructions shall be provided within the control box.

14.18.7 Interlocking Arrangements

Release
The control box will contain a two position releasing lever (Normal and Reverse) and three indication lights are provided – Release Normal (white), Release Reverse (white) and Release Available (green).

The release available light shall display when the release is available to be taken, i.e. when no trains are closely approaching, or when a train has come to a stand at the siding or emergency crossover.

Route Cancel
A 'route cancel' push button is provided. When operated, it places all point indicators to stop. A time release shall elapse before the points become free. During this period the points free light shall flash green.

Points Free
When the points are free, a green 'Points Free' light is displayed.

Points Control and Indication
A points Normal ("Main") push button or a points Reverse ("Siding") push button is pushed to change the point position. For sidings these shall be labelled 'Main' or 'Siding'.

When the points reach their required position they will automatically lock and the point indicators shall automatically clear.

Clearance of the point indicators is displayed by one of the two indicator repeater lights -

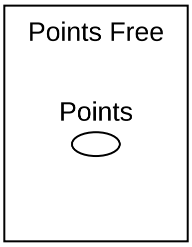
Point Indicators – Main; Point Indicators – Siding/Reverse

These repeaters extinguish when the points indicators display red.

Per Way Sidings in Interlockings
When the siding is within an interlocking and the entry and exit signals are provided over the points, the setting of a route into or out of the siding by the signaller will be permitted. When these routes are set the route lights will display but the points will not operate until a qualified person at the points depresses a 'points' push button. This is to guarantee the points are clear of rail vehicles.

A "points free" indicator light is displayed above the points push button when the route is set and the operation of the points is waiting for the button operation.

Following the movement, the signaller needs to set a main route or normalise the points by key, again in conjunction with the qualified person.



14.18.8 Vehicle Movements

Movements through the points are authorised when the points indicator displays a clear indication, providing assurance that the points are in the correct position and locked.

14.18.9 Mainline Signals

Mainline signals that approach or lead over these installations shall be treated as for mechanical ground frames ESG100.14.9

14.18.10 Control Box Instructions

The following are example instructions for the in-section arrangements.

a) Contact signaller

b) When permission given to take release, (release available light should be displayed), operate switch to reverse position.

c) Release reverse indicator light shows release taken.

d) Operate push button to operate points.

e) Point indicator repeaters will show when point indicators have cleared.

f) To change points, press cancel button.

g) After time release, points free light will illuminate.

h) Points can then be operated.

i) When finished, leave points set for main line and normalise release lever.

ESG 100.15

TRAINSTOPS

Version 1.7

Issued 8 March 2013

Document control

Version	Date	Summary of change
		Replaced *SC 00 13 01 15 SP Trainstops v4* of 29 July 2004.
1.1	May 2006	Use of trainstops with shunt signals included 15.1.2, 15.2.3, 15.2.4, 15.3.2 & 15.4.2
1.2	May 2010	Application of *TMA 400* format
1.3	1 June 2010	New Section 15.5 – Provision of Intermediate Trainstop Advisory Speed Signs
1.4	3 August 2010	New section – Train Stop Proving
1.5	7 June 2011	15.4.3 – para 4 – GE63 to read GE62
1.6	6 March 2012	Updated to RailCorp ETCS Requirement Specifications, release 4.
1.7	8 March 2013	Section 15.3.3 added text to end of paragraph.

Contents

15 Trainstops

15.1 Principle No. 15.1 - Provision And Identification Of Trainstops

15.1.1 Introduction

This Principle addresses the requirements for the provision of trainstops at signals, fixed trainstops at specific locations, intermediate trainstops and their identification on lines which have not yet transitioned to all ATP operation.

15.1.2 Requirements - Provision of Trainstops

If a running signal is located on a designated suburban passenger carrying line in DC electrified territory and controls the passage of electric multiple unit passenger trains then it shall be provided with a trainstop.

The designated passenger lines are those within the CityRail area bounded by Fassifern and Newcastle on the main North and the area around Sydney bounded by Hawkesbury River on the main North, Emu Plains and Richmond on the main West, Macarthur on the main South, the Carlingford line and Helensburgh on the Illawarra.

Running signals located outside the above areas but within the area bounded by Fassifern on the Main North, Lithgow on the Main West, and Kiama on the Illawarra may also be fitted with trainstops where it is considered that a train over-running a signal would be at serious risk of a collision with another train. E.g. at the approach to crossovers leading to or from areas of bi-directional running. Signals within this area are risk assessed on an individual basis to determine whether trainstops are to be installed.

If a running signal is located on a designated freight line then it need not be provided with a trainstop.

Shunt signals may be provided with trainstops where a risk assessment identifies a hazard that may be controlled through installation of a trainstop.

15.1.3 Requirements - Provision of Intermediate Trainstops

Where it is necessary to provide low speed and conditional caution aspects with reduced overlaps then one or more intermediate trainstops may be provided to check the speed of a train as it approaches the reduced overlap.

Intermediate trainstops may also be provided to check the speed of trains approaching a stop signal immediately in the rear of open catchpoints where there is little or no overlap between the signal and catchpoints. The requirement for intermediate trainstops in these circumstances shall be assessed for each location.

15.1.4 Requirements - Identification of Trainstops

Trainstops provided at running signals shall be given an identification number which is exactly the same as the identification number of the signals to which they apply.

Fixed trainstops shall be identified on track plans only by the word “FIXED” against the trainstop symbol. Refer to Figure 1. Intermediate trainstops provided in advance of running signals shall be given an identification number which is exactly the same as the identification number of the signal to which it applies. In addition it shall be suffixed by the acronym ITS (Intermediate Trainstop).If more than one ITS is provided past a running

signal the ITS immediately in advance of the signal shall additionally be suffixed by the number 1 and the next in advance by the number 2, e.g. ITS 1 and ITS 2 respectively. Refer to Figure 2.

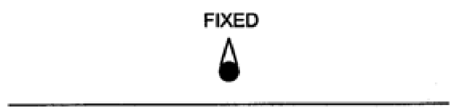


Figure 1 - Identification of Trainstops

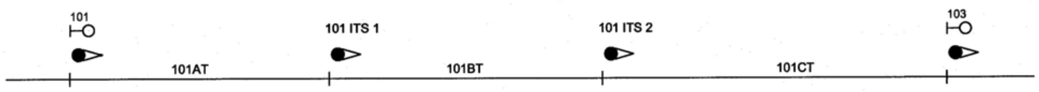


Figure 2 - Identification of Trainstops

15.2 Principle No.15.2 - Control And Operation Of Trainstops

15.2.1 Introduction

This Principle addresses the requirements for controlling the operation of trainstops and proving the trainstop position correct for the safe and proper operation of the signalling system.

15.2.2 Requirements - Control of Trainstops

If a running signal is displaying a stop aspect then the trip arm on the trainstop at the signal shall be in the raised position.

If a running signal is displaying a proceed aspect then the trip arm on the trainstop shall be in the lowered position.

The raising of the trip arm shall occur as a result of the occupation of the first track circuit past the running signal.

Where a shunt signal lowers the trainstop, it shall be after proving the speed of the approaching train suitably reduced. As a general rule, trainstops are not to be lowered into occupied section. However they may lower into storage sidings, or where an operational need exists.

15.2.3 Requirements - Proving of Trainstops

If a running signal is to display a proceed aspect requiring a trainstop reverse but the trip arm on a trainstop associated with the signal fails to lower (reverse) as required then the signal shall display an enforced stop aspect.

If a particular running signal is to display a stop aspect but the trip arm on the trainstop associated with the signal fails to rise (normal) following the passage of a train then any running signals immediately in rear shall be maintained at stop until enabled to reclear by the particular running signal reclearing.

If the running signal associated with the trainstop is a controlled signal then the failure of the trip arm to rise shall inhibit the normalisation of the locking.

The normal and reverse positions of the trainstop shall be proved in the signal normal indicating relay and signal reverse repeaters respectively.

Higher aspects of signals are to prove that the trainstop at the signal in advance is reverse.

Shunt signals are not to prove the trainstop lowered (reverse). The reverse signal repeater shall prove the signal reverse only; however the normal repeater and signal normal indicating relay shall prove the trainstop normal.

15.2.4 Exceptions in Designated Areas

In the City Underground and the Eastern Suburbs railway the lowering of the trip arm of the trainstop shall be on the timed approach of the train after the clearing of the signal to Low Speed or Caution.

Trainstops shall be proved reverse before the associated signal displays a proceed aspect that requires the trainstop reverse.

15.3 Principle No.15.3 - Suppression Of Trainstops

15.3.1 Introduction

This Principle addresses the requirements for providing suppression on trainstops to facilitate the movement of trains in the wrong direction or over bi-directional lines without initiating an unnecessary brake application or damaging the trainstop equipment.

15.3.2 Requirements - Suppression of Trainstops

If a trainstop associated with a running signal is located in a situation where train movements from other running signals or subsidiary signals or shunt signals pass over it in the opposite direction of running, then the trainstop shall be suppressed (lowered) for the opposite direction movement. Refer to Figure 3.

If an opposing direction signal displays a proceed aspect then the trip arm of the trainstop to be suppressed shall be lowered and maintained lowered by the occupation of any of the track circuits between the initiating opposing direction signal and the suppressed trainstop.

The trip arm of the suppressed trainstop shall rise when the opposing direction train movement has cleared all these controlling track circuits.

If the trip arm of the suppressed trainstop fails to rise after the opposite direction movement is clear then the running signal with which it is associated shall be maintained at stop.

Where trainstops are provided at shunt signals in yards, and there is a risk that a driver may observe a suppressed trainstop and mistake it for authority to proceed, trainstop suppression shall not be provided.

15.3.3 Proving of Suppressed Trainstops

The trainstops shall be proved normal when required in signalled movements leading up to them in the applicable direction.

Suppressed trainstops shall not be proved reverse when cleared for train movements in the other direction, however shall be proved in higher aspects.

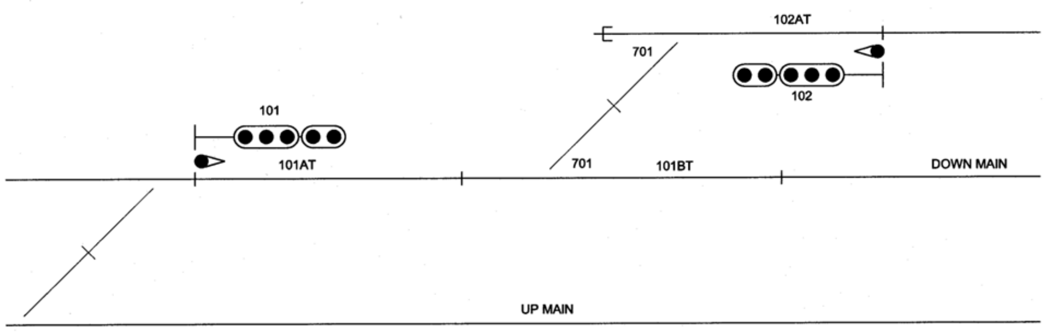


Figure 3 - Identification of Trainstops

15.4 Principle No.15.4 - Control Of Intermediate Trainstops

15.4.1 Introduction

This Principle addresses the method of control of intermediate trainstops provided where no overlap or reduced overlap conditions apply. It should be noted that this Principle does not apply to the City underground.

15.4.2 Requirement - Control of Intermediate Trainstops where Minimal Overlap is Available

If it is necessary to close trains up under minimal overlap conditions then an intermediate trainstop will be required in accordance with Principle No. 15.1.

If a running signal route is set with minimal overlap available then the running signal shall display a conditional low speed aspect and the trainstop associated with the running signal and the intermediate trainstop shall remain raised.

As the train approaches the intermediate trainstop its speed shall be determined during a time expiry period.

If the average speed of the approaching train is in excess of low speed then it will engage the raised trip arm of the intermediate trainstop and be subject to a brake application.

If the speed of the approaching train is satisfactory then the trip arm of the intermediate trainstop shall be lowered allowing the train to continue up to the running signal in advance at low speed.

If it is necessary to close up trains and the overlap conditions improve then the trip arm of the intermediate trainstop provided to facilitate minimal overlap conditions shall be lowered when the improved overlap is available.

The intermediate trainstop shall be proved to return normal, before a signal leading to it that requires it normal, is cleared.

Intermediate trainstops shall be proved reverse before the associated signal displays a proceed aspect that requires the intermediate trainstop reverse.

Where an intermediate trainstop is used for line speed control, and a full overlap is available from the intermediate trainstop for the speed the train is approaching at, the signal preceding the intermediate trainstop may clear unconditionally (trainstop down) to low speed, and the speed proving performed by the intermediate trainstop. The term 'line speed control' is for a situation where the train speed may be constant, but constrained by a low speed indication, or speed sign.

15.4.3 Requirement – Control of Intermediate Trainstops in the Rear of Catchpoints

Where there is minimal or no overlap between a set of catchpoints and the signal protecting the catchpoints then one or more intermediate trainstops shall be provided to ensure that the speed of an approaching train is such that it will stop at the signal (or, at worst, be travelling at very low speed) when the catchpoints are open.

As the train approaches each intermediate trainstop its speed shall be determined during a time expiry period.

The location of the intermediate trainstops shall be determined from consideration of:

- Previously checked speed
- GE52A trip braking curve

The timing of the intermediate trainstops may be determined using the GE62 braking curve rather than assuming a constant speed over the timing track, where the timing distance is long enough that a constant speed is not operationally practical.

Where appropriate, intermediate trainstop advisory speed signs may be installed to assist train drivers.

15.5 Provision of Intermediate Trainstop Advisory Speed Signs

15.5.1 Introduction

This principle addresses the requirement for the provision of intermediate trainstop advisory speed signs.

15.5.2 Requirements

Where intermediate trainstops are provided, and their timing is less than the 25km/hr defined by the low speed signal, advisory speed signs are to be provided to assist drivers in controlling their speed.

The intermediate trainstop advisory speed sign shall be white numerals on a round black background.

The sign shall be located adjacent to the commencement of the timing position, either a DPU or insulated joint or the centre of a tuned loop.

The speed displayed on the sign should preferably be 5km/hr below the speed for which the timing is set. This is to permit the system to operate in time for the driver to see the arm drop as the train approaches.

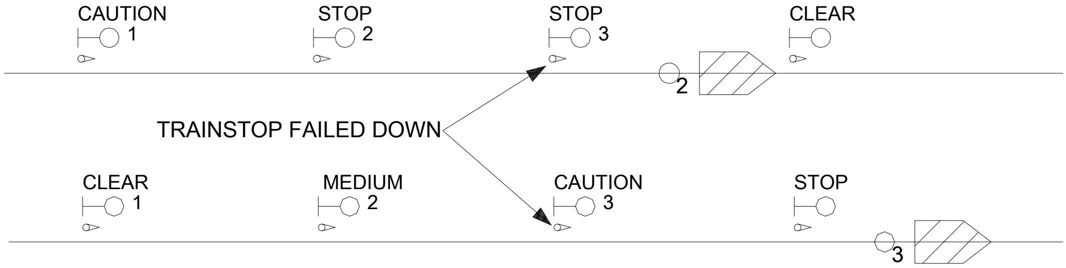
Where the timing is set for speeds 25km/hr or above, no advisory speed boards are required.

15.6 Trainstop Proving

Following the passage of a train, trainstops shall be proved to be raised before a signal is permitted to be cleared towards it.

Trainstops shall be proved to be in the raised position in all signal normal indications. When required to be suppressed for opposite direction movements to avoid back tripping, this proving may be temporarily qualified. The qualification shall be removed and the trainstop raised as soon as practicable.

Should a trainstop fail to raise, it will be permissible for the signal leading toward it to clear, providing the next section ahead (including the overlap) is proved clear such that the signal with the failed down train stop will clear, as long as the signal ahead at stop has successfully proved its trainstop raised.



ESG 100.16

CONTROLS AND INDICATIONS

Version 1.4

Issued 7 June 2013

Document control

Version	Date	Summary of change
1.0	March 2006	Replaced *SC 00 13 01 16 SP Controls and Indications – v4.2* of 14 March 2005
1.1	3 March 2009	Add to table in Section 16.4.1 and remove unwanted text “IV .” in Section 16.4.2
1.2	May 2010	Application of *TMA 400* format
1.3	5 July 2011	New table “Other Indications” at end of 16.4.1
1.4	7 June 2013	16.2.3 text deleted & TCS expanded to Train Control System. 16.2.4 added text "see 16.2.5", also added more text "Use of a centre position……". Added new section 16.2.5 Alternative method for vital blocking. Added new section 16.2.6 Vital blocking in computer based interlocking.

Contents

16 Controls and Indications

16.1 Principle No.16.1 - Controls And Indications

16.1.1 Introduction

This Principle addresses the various types of operators' controls and indications used for controlling vital signalling systems and providing the essential signalling system status and ancillary system information to ensure the efficient and safe running of trains.

16.1.2 Controls

The type of controls described in Section 16 will generally be of the non-vital type. However in some cases the method of control will be considered to be a mixture of both non-vital and vital and in some cases the controls may be considered exclusively as vital.

These distinctions are of paramount importance when considering the nature of the control to be provided and the means by which it is to be implemented.

16.1.3 Indications

The type of indications described in Section 16 will generally be of the non-vital type. However care should be exercised when providing non-vital indications such that they complement the integrity of the fail safe design of the vital system so that the indications will fail to a predictable and non-contradictory state.

16.1.4 Control Panels

The term control panels (CP) will be used in Section 16 and shall be taken to mean any electro-mechanical man-machine interface using switches, push-pull buttons, and some form of illuminated track display either as a single integrated system or with separated control console and indicator diagram provided for the purpose of train control.

16.1.5 Operator Interface

The term operator interface (OI) will be used in Section 16 and shall be taken to mean any microprocessor based man-machine interface, typically any graphic user interface (GUI) using a keyboard, mouse or other device and any array of visual display units (VDUs) to form a workstation for the purpose of train control.

16.1.6 Train Control System

The term train control system (TCS) will be used in Section 16 and shall be taken to mean one or more microprocessor based operator interface stations with the processing capacity to handle route setting, automatic route setting, train tracking, train describing, train reporting, event logging and all similar functionality.

16.2 Principle No.16.2 - Vital Blocking Requirements And Application

16.2.1 Introduction

This Principle addresses the requirements for and the forms of and method by which vital blocking will be applied to signalling systems. It also discusses the types of controls and indications to be provided.

16.2.2 Vital Blocking - Definition

Vital blocking is the blocking of a specific section of track to signalled train movements by the initiation of a vitally secure operators control which prevents the setting of any controlled signal routes and hence the display of a proceed signal aspect into the blocked section.

16.2.3 Requirements For The Provision of Vital Blocking

Vital blocking shall be provided for all single line sections and on the main and loop lines at crossing loops and where the operation of the train control system is such that only a single control command will initiate a route call.

16.2.4 Method of Implementing Vital Blocking

Vital blocking shall be controlled using two entirely separate controls or commands.

Vital blocking shall be applied or cleared using two independent controls over a three position key locked switch as described herein or via an approved equivalent method. (See 16.2.5). Refer to figure 1. Under normal circumstances this switch shall be maintained in the centre position to ensure that the blocking lock relay (BLR), which shall be a magnetically latched vital relay, is stable and electrically isolated and not subject to any type of electromagnetic interference (EMI) which could detach it.

If the key locked switch is unlocked and turned to the left then the BLR shall be de-energised provided all the routes leading into the section of track to be blocked are already normal.

The de-energising of the BLR either by legitimate controls or due to any failure condition, shall prevent any of the routes leading into the section of track to be blocked from being set.

The key locked switch should then be replaced to the centre position and the key removed and held by an authorised employee until the vital block is to be removed.

If the key locked switch is unlocked and turned to the right, then the BLR shall be operated instantly and the vital block shall be cleared.

The switch is to be spring loaded, returning to the centre position to prevent storage of a release or block command.

Two indications shall be displayed on the Control Panel.

If the BLR is in the operated position then no vital blocking shall be effective and a white “CLEAR” indication shall be given. Refer to figure 2.

If the BLR Is in the released position, then vital blocking shall be effective and a red “BLOCKED” indication shall be given. Refer to figure 2.

Vital blocking is to be only incorporated in signal controls within the interlocking (this could include an adjacent interlocking starting signal, if it were on the diagram and controlled, such as in Track Block working). Vital blocking is not to be included in single line or bidirectional section control circuits such as to affect in-section automatic signals. (Once a train has entered the section, a vital block then applied should protect the train in that section, but not restrict its progress or exit from the section).

In remotely controlled areas the vital section block should simultaneously operate both the blocks at the adjacent interlockings on the one section blocking command. Indications are to reflect the correct operation of equipment at both interlockings.

Use of a centre position switch permits the local and remote operation of the blocking without the switch being out of correspondence with the locking.

Operations procedures are to reflect the method of operation of vital blocks to permit block working of trains.

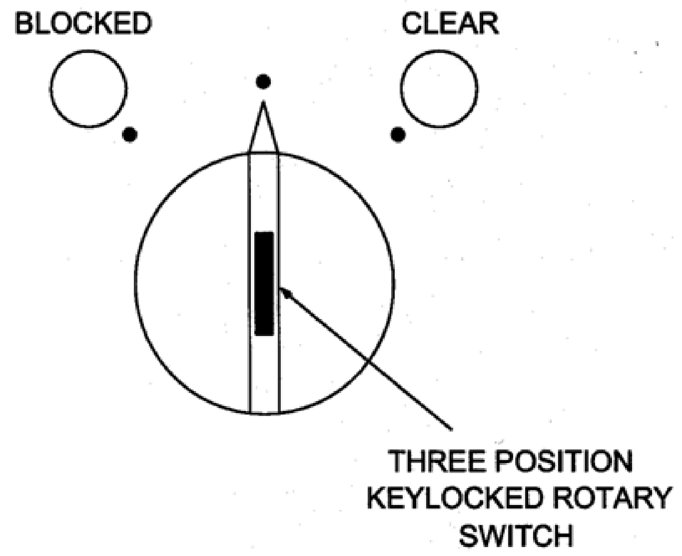


Figure 1 - Vital Blocking

16.2.5 Alternative Method for Vital Blocking

Where vital blocking is to be implemented on a local panel only (and not within a remote controlled interlocking), the blocking may be implemented using a two position key locked switch.

Operation of the blocking switch to the 'Blocked' position shall not replace any signals previously set to stop. However, once the train passes the signal, the block shall apply.

16.2.6 Vital Blocking in Computer Based Interlocking

When the vital blocking is performed within a computer based interlocking, a failure and restart of the interlocking will result in all blocks being applied. These will then have to be manually removed by the signaller. Alternatively, a duplicated system or the train control system, may re-establish the block correspondence to the current status automatically.

Where a two position switch is used as a hardwired input into a CBI the blocking status may be directly corresponded to the switch position.

16.3 Principle No.16.3 - Non Vital Blocking

16.3.1 Introduction

This Principle addresses the requirements for and the types of non-vital (software) blocking which may be implemented on a train control system.

16.3.2 Non Vital Blocking - Definition

Non-vital (or software) blocking is the blocking of specific processing functionality within an OI or TCS to provide the equivalent of lever sleeves on conventional control panels. The result is to inhibit specific controls to call routes and points from being sent out to an interlocking or to impose restrictions within train control system processing to inhibit higher levels of processing, typically automatic route setting and train describer functions.

16.3.3 Requirements For Non Vital Blocking

Non-vital blocking shall be available on all TCS's and shall include some or all of the following functionality:

a) signalling restrictions which can be placed on signalling functions such as signals, points, releasing switches and track circuits.

b) track restrictions which can be placed on specific sections of line between two identifiable points.

c) reminder notice restrictions placed on signals, points and releasing switches.

16.4 Indications to be Provided for Entrance – Exit Type Signalling Panels and Workstations

16.4.1 Panel and Workstation Signalling Indications

Signalling panels and workstations are to be provided with the following indications as a basic operational requirement. Additional indications may be provided to meet specific needs for increased functionality or safety.

Signalling Equipment Indications

Status	Name	Usual Form of Indication
Main Signal cleared and trainstop down	RGK	Green
Signal at stop and trainstop up	NGK	Red
Signal approach locked and signal at stop and trainstop up	~ALSK* NGK	Flashing Red
Track Circuit Clear	TK	Nil or Neutral
Track Circuit Occupied	~TK	Red
Points normal detection	NWK	White and 'N'
Points reverse detection	RWK	White and 'R'
Points Free Points Locked	WZK ~WZK	Green Red Note: Either points free or points locked indication required
Releasing Switch Normal	NR	White and 'N'
Releasing Switch Control Reverse and Key	RR*	White and 'R'

Status	Name	Usual Form of Indication
Out	~NK	
Releasing Switch Control Reverse and Key In	RR* NK	Flashing White & 'N', White and 'R'
Route Set	~NL	Route light or button light
Time Release	TJ	Red
Shunt signal cleared	RGK	Green (or yellow)
If a shunt signal is provided with a trainstop, the green repeater is displayed whenever the signal displays a proceed indication, irrespective of whether the trainstop is driven or not.		
Main Signal cleared and trainstop up	RGK	Green
Used where a low speed or caution indication is displayed in conjunction with a conditionally timed trainstop		

Status	**Name**	**Usual Form of Indication**
Main signal at stop and route set and clear to the extent permitted by that interlocking	LP	Flashing Green (See Note 1)
A separate control condition from another signaller or berth track occupancy is required to clear the signal, or the route setting has permitted a less restrictive indication to be displayed to the driver.		
Signal in Auto Reclearing	(A)R	White and/or 'A'
External Control received (control indicator) NB: A normal indication is not provided	RK	White (with control name)
Control Repeater NB: A normal indication is not provided	RK	Green - If flashing green indication not provided in conjunction with a full repeater.
Signal – (dual controlled) at stop and control indicator, route not set	NG	Red
Signal (dual controlled) at stop. Control indicator not received but route set	LP	Flashing Green
Signal (dual controlled) at clear. Control indicator clear	RGK RK	Green White

Note 1:

Flashing green indications are used by exception only to avoid signaller being potentially misled as to the state of a signal. Their prime use is when the signaller does not completely control the signal, but it is subject to an external control not immediately apparent. Such external controls are the dual control by another signal box, or the permanent application of approach clearing. The display of a flashing green is an indication to the signaller, that to the extent permitted by the interlocking under their control, the main control conditions for the signal have been met and the non-clearance is not a failure.

Cases which are specifically not to be provided with flashing greens are:

- When a signal is waiting point operations
- When a signal is waiting for level crossing booms to be horizontal, or the level crossing to have operated for a time, or a warning light to have operated for a time
- Signals fitted with conditional clearing for reduced overlaps

Other Indications

Status	Name	Usual Form of Indication
Local Control	LCR	Yellow
Remote Control	RCR	Yellow
Supervisory Fail	~LinkOK	Red
Override Enabled	ORR	Yellow

16.4.2 Alarm Indications

Alarm indications may be directed to maintenance where more discreet alarms to suit the installation may be provided. However, critical areas are always to be provided to the signaller. Signallers' alarms may be grouped. Wherever possible, and particularly on centralised systems, alarms and indications are to be arranged such that any one alarm does not cause other unrelated alarms to occur.

Alarm	Name	Indications
Power Supply Normal	PSN	Green
Partial (Single channel) Power supply failure	PSK & ~PSN	Yellow
Total Power Failure	~PSK	Red
Lamp Failure	ECK	Red (if provided)
Filament Failure	FCK	Yellow (if provided)

NB: ~ = Logical not

ESG 100.17

TRACK CIRCUITS

Version 2.2

Issued 7 June 2013

Document control

Version	Date	Summary of change
1.0	20 March 2006	Replaced *SC 00 13 01 17 SP Track Circuits – v4* of 7 November 2005.
1.1	3 October 2006	Amendments to Principle 17.7 & addition of 17.9.6
1.2	18 June 2007	17.7.4 changed from blank to “Jointless Track Circuits”; New Figures 9 & 10
1.3	5 May 2009	17.7.7 added “However, frequency alternation must be observed for adjacent audio frequency tracks, whether jointless or jointed.”
1.4	19 January 2010	Amendment to 17.9.5 (Overhead Wiring Switches) and insert new 17.9.7 (Temporary Rail Connections) concerning connections to rails
1.5	3 May 2010	17.3.3, 17.3.4, Figs 1, 2 & 5 concerning location of insulated joints and trainstops.
1.6	18 May 2010	Application of *TMA 400* format
1.7	16 May 2011	17.8.7 Amend figures to show Electrical Discipline responsibilities. 17.8.8 Location of Cables – New section,
1.8	7 February 2012	17.7.5 Blank section -> New section “Impedance Bonds”
1.9	22 August 2012	Added Principle 17.4 – Location of Insulated Joints near Bridges.
2.0	19 November 2012	Added new section 17.10 Traction Return.
2.1	5 February 2013	Add new section 17.11 Traction Bonding past the end of OHW.
2.2	7 June 2013	Section 17.8.2 added new text regarding not tying audio track circuits of the same frequency together.

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.

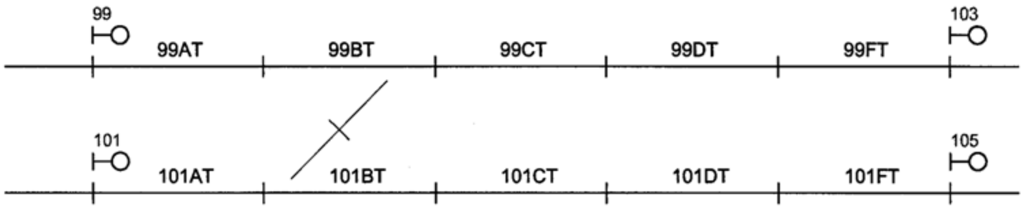


Figure 1 - Identification of Track Circuits

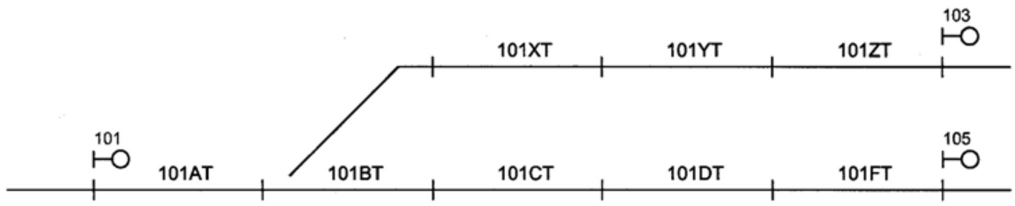


Figure 2 – Principle 17.1 – Identification of Track Circuits

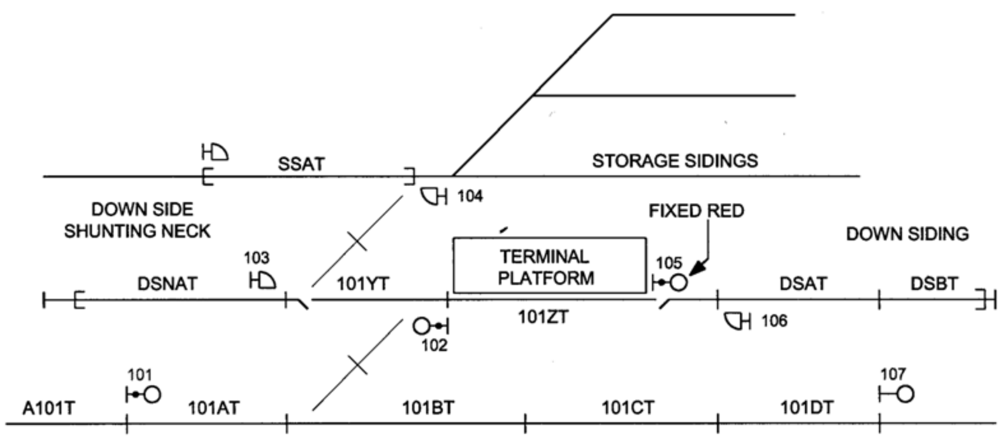


Figure 3 – Identification of Track Circuits

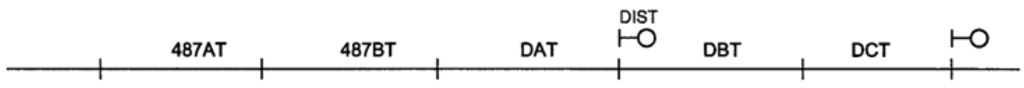


Figure 4 – Identification of Track Circuits

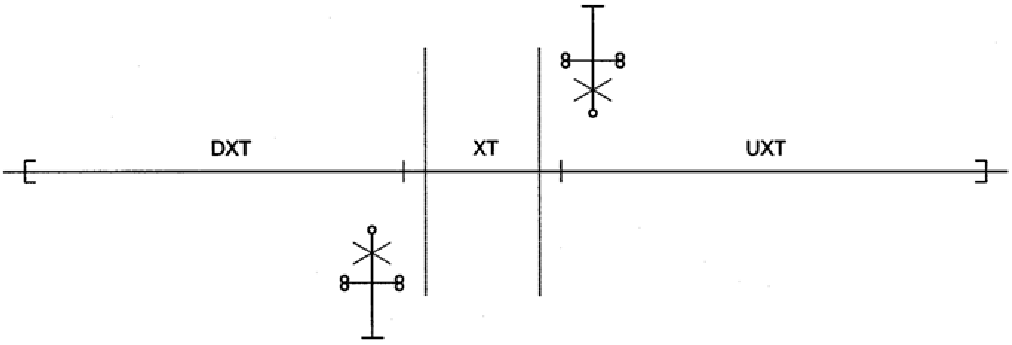


Figure 5 – Identification of Track Circuits

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 metres 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 6.

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 7.

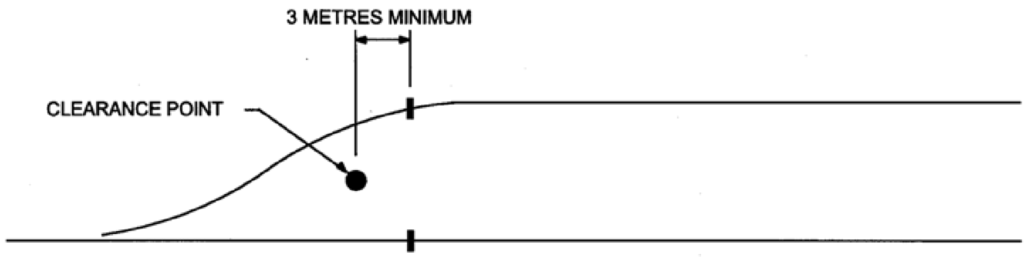


Figure 6 - Location of Insulated Block Joints

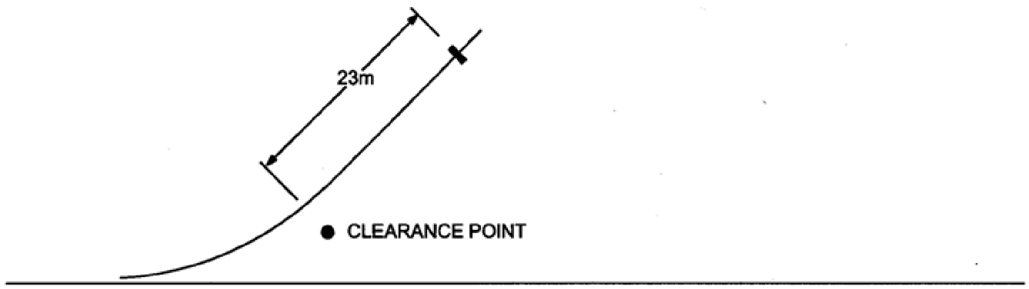


Figure 7 - Location of Insulated Block Joints

17.3 Principle No.17.3 - Location Of Insulated Joints

17.3.1 Introduction

This Principle addresses the requirements 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 8.

17.3.3 Location of Insulated Joints at Signals with Trainstops

The trainstop shall be located adjacent to the signal.

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 9.

Exceptionally insulated joints may be placed more than 4m past the signal but only where the permanent way layout prevents closer location. 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 10. 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 and consistant with traction return continuity requirements in 17.3.6. Care must be taken that any length of rail that will not shunt is minimised.

Alternatively, where the turnout route takes the heavy traffic, 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 11. In points and other locations where single rail track circuits adjoin and particularly where the traction rail changes side, care is to be taken that a small overlap is provided, between traction rails as otherwise this could result in arcing. Refer to Figure 12.

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.

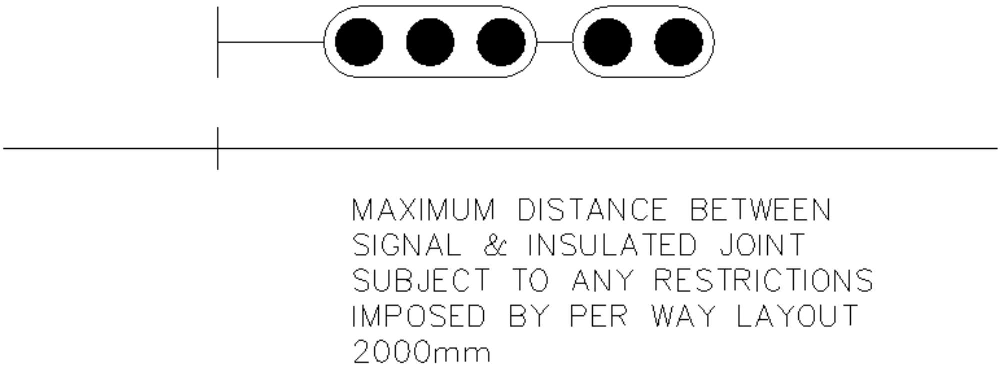


Figure 8 - Location of Insulated Block Joints

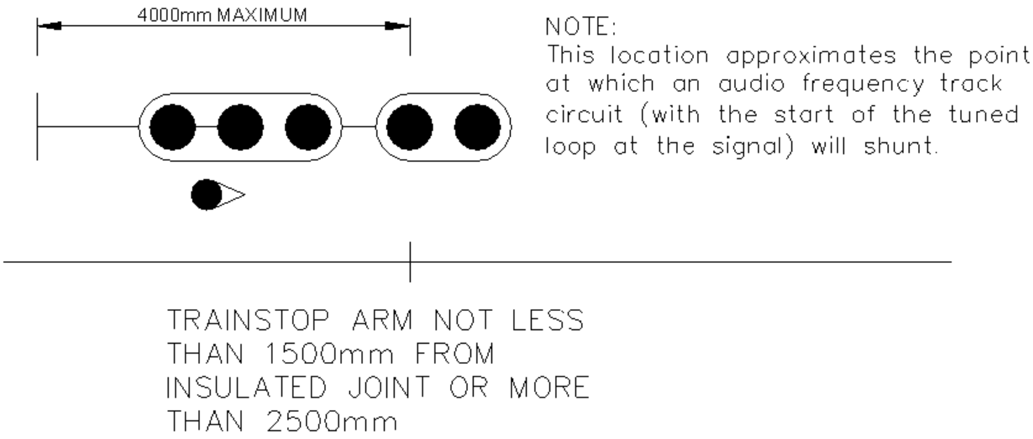


Figure 9 - Location of Insulated Block Joints

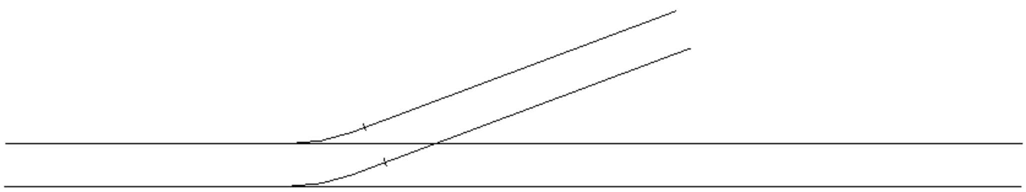


Figure 10 - Location of Insulated Block Joints

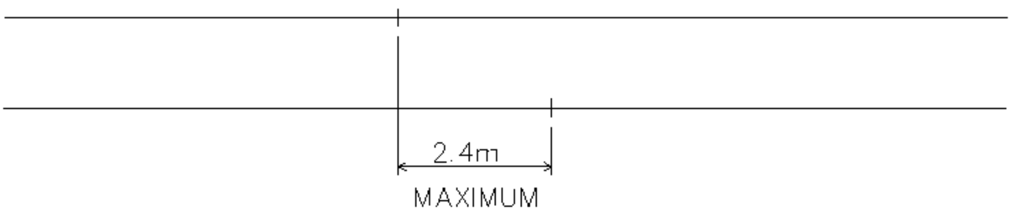


Figure 11 - Location of Insulated Block Joints

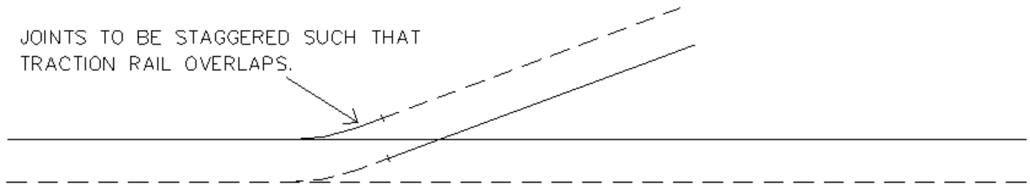


Figure 12 - Stagger of Joints in Single Rail Traction Return Areas

17.4 Principle No. 17.4 –Location of Joints near Bridges

Insulated joints should not be installed within 10m of bridge ends and preferably not within 30m.

Where the location of insulated joints is proposed to be within 10m of the bridge end, agreement is to be obtained from the Chief Engineer Track.

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 13, 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 14 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 15.

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 16.

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

a) a track feed on either side, or

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

c) 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.

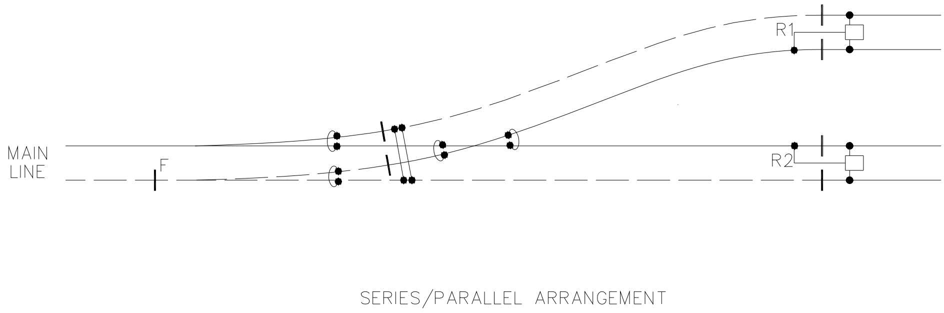


Figure 13 - Non Electrified – Two Relays

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.

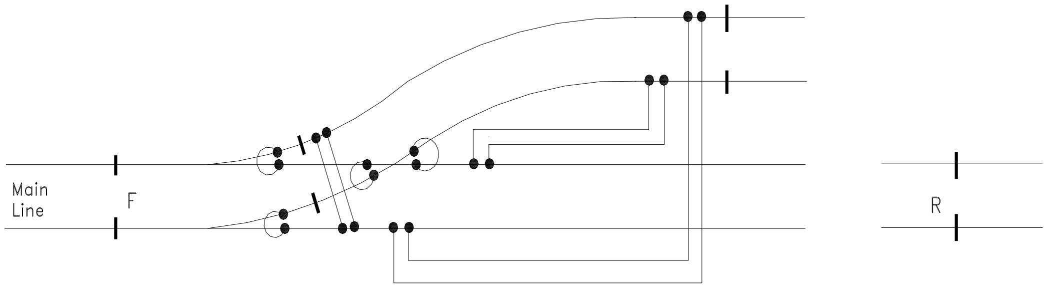


Figure 14 - Parallel bonds connected back along the main line

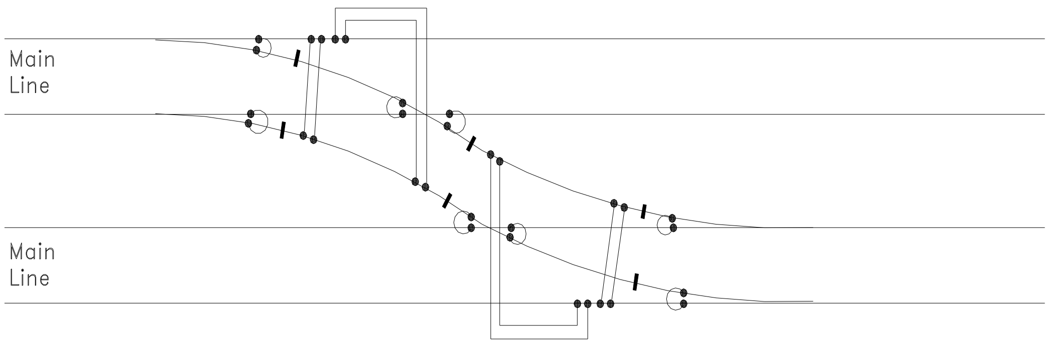


Figure 15 - Track Circuit Bonding in Non-Electrified Territory

Non electrified crossover
Parallel bonds connected back along the main line

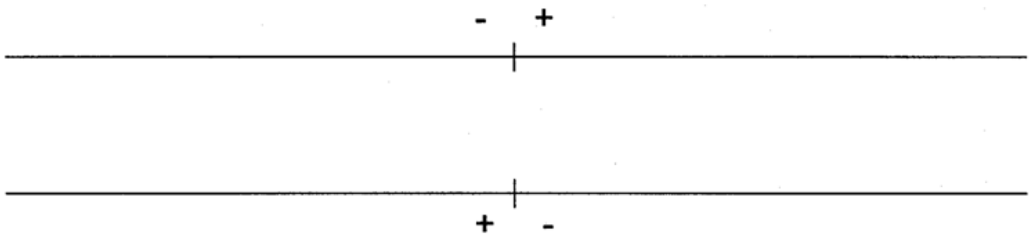


Figure 16 - Polarity of Adjacent Track Circuits

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

17.7.2.1 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 17. 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 are 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.

The use of series parallel bonding on single track circuits may be used in lieu of the twin relay configuration when:

- Track speed is low, such as in stabling yards
- Where the rail that is parallel bonded does not provide any significant reduction in broken rail protection (eg ends of crossing loops)

Such arrangements shall always have the feed or relay on the bonded in leg, such that removal of a bond will fail the track circuit. This arrangement is shown in Figure 24.

17.7.2.2 Crossovers - Single Rail Track Circuits

The full parallel bonding arrangement shown in Figure 23 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.

17.7.3 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 18, 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 19. 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 20. 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 21, with two receivers is preferred for Jeumont track circuits as it provides for broken rail protection.

17.7.3.4 Crossovers - Double Rail Track Circuits

The full parallel bonding arrangement shown in Figure 22 shall be adopted for double rail tracks on crossovers in electrified areas.

17.7.4 Jointless Track Circuits

Where jointless track circuits are used over turnouts and the tied-in leg is less than 36 metres long, parallel bonds at 12m intervals are to be provided as per Figure 25. Where the tied-in leg is greater than 36 metres in length, a receiver is to be provided on each leg, as in Figure 26.

17.7.5 Impedance Bonds

No more than three impedance bonds shall be installed on any one track circuit. Impedance bonds shall not be installed closer than 50 metres to a tuned loop.

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:

a) a track feed on either side, or

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

c) 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.

However, frequency alternation must be observed for adjacent audio frequency tracks, whether jointless or jointed, even if there are intervening non 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.

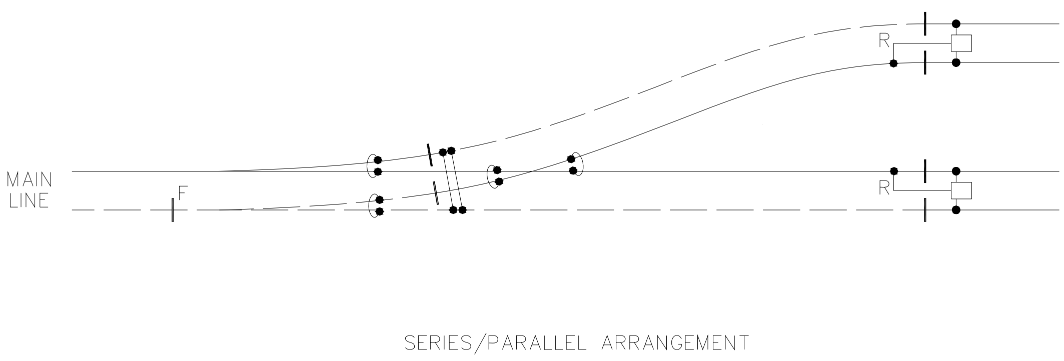


Figure 17 – Single Rail Electrified – Two Relays

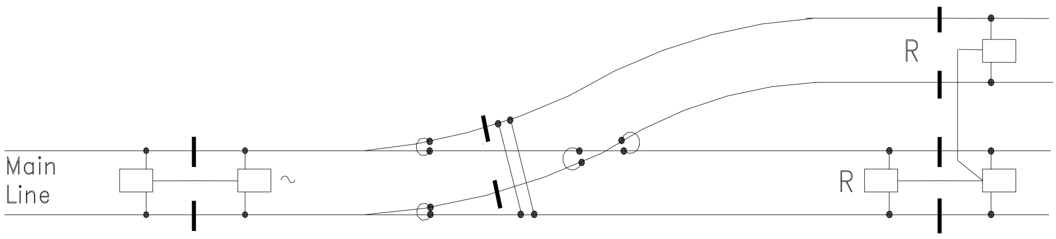


Figure 18 – Double Rail Electrified - AC Track Circuit

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)

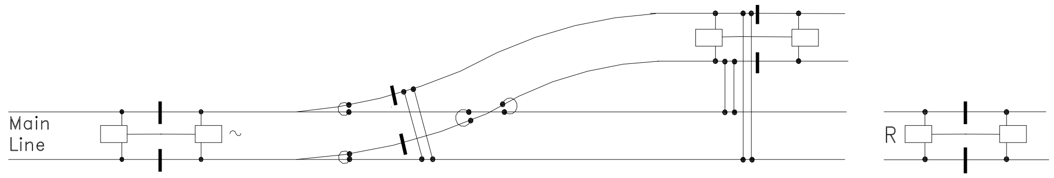


Figure 19 - Track Circuit Bonding in DC Electrified Territory

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

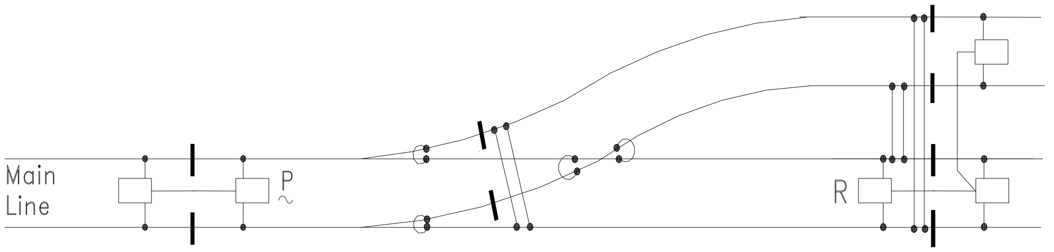


Figure 20 - Double Rail Electrified: Jeumont with 4 wire Receiver

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

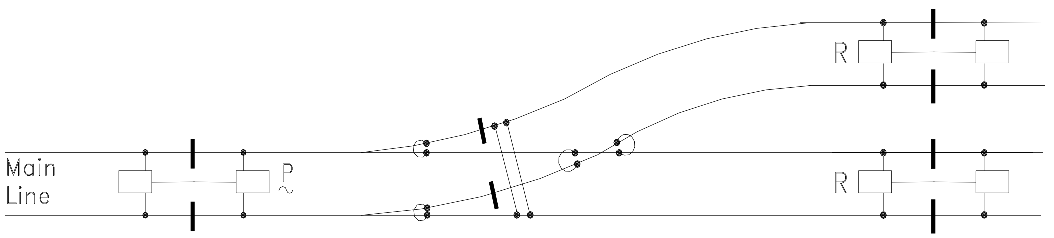


Figure 21 – Double Rail Electrified: Jeumont with 2 wire Receiver – Two Relays

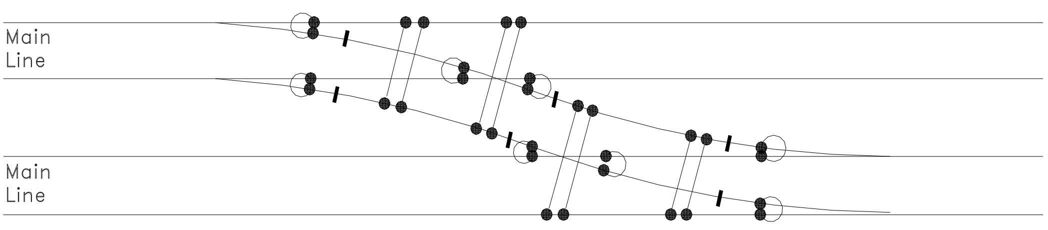


Figure 22 - Track Circuit Bonding in DC Electrified Territory – Double Rail Electrified Crossover - Parallel Bonds

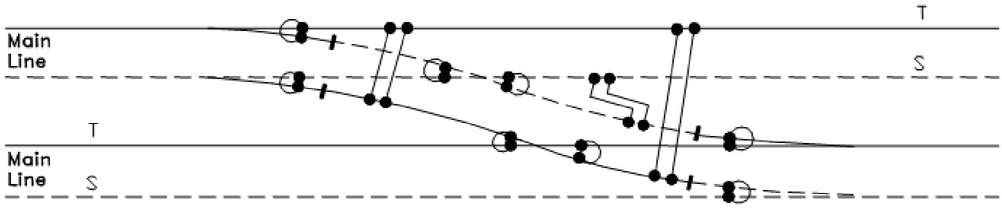


Figure 23 - Track Circuit Bonding in DC Electrified Territory – Single Rail Electrified Crossover – Parallel Bonds

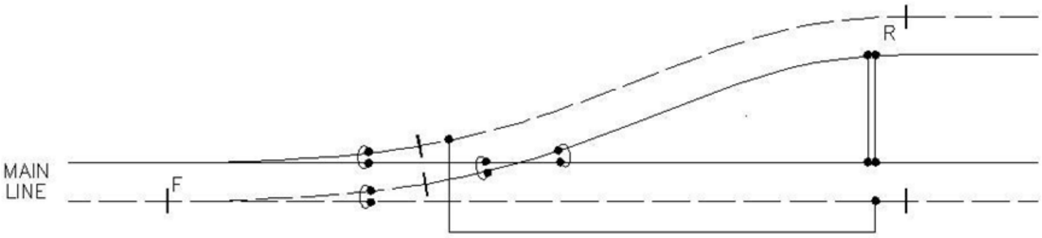


Figure 24 - Series/Parallel Arrangement

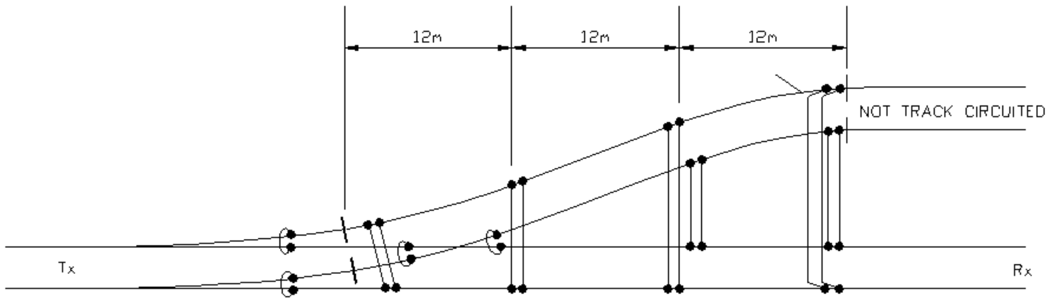


Figure 25 - Jointless Track Circuits – Tied–In Leg Less than 36m

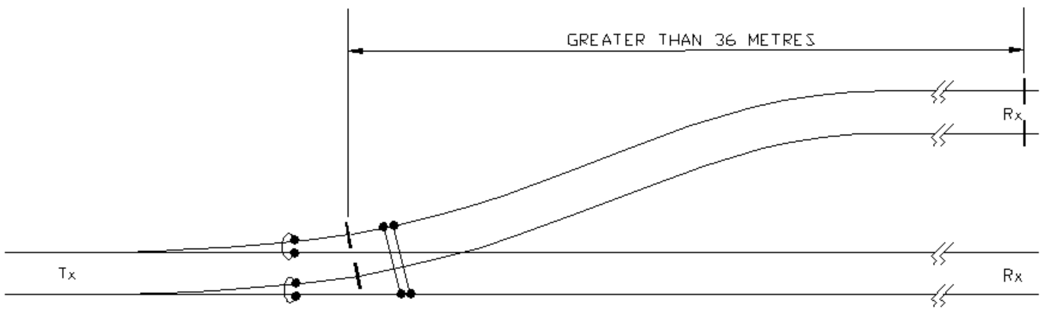


Figure 26 - Jointless Track Circuits – Receiver on each Leg

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. On multiple track lines audio track circuits of the same frequency shall not be tied together.

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 27.

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 Figure 28 and Figure 29.

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.

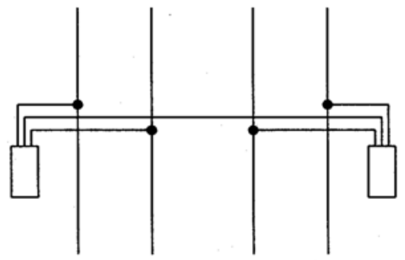


Figure 27 - Tie-In Traction Bonding in DC Electrified Territory

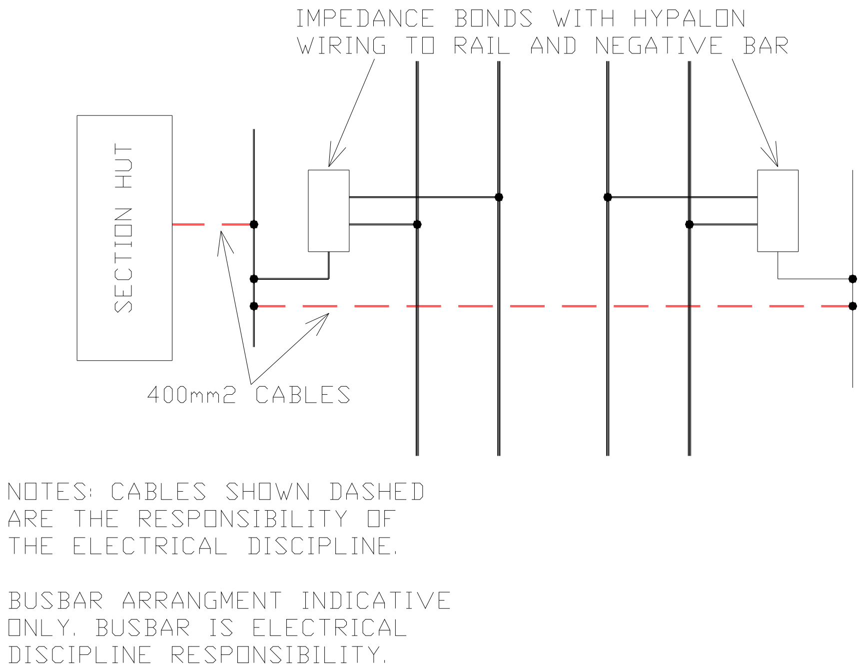


Figure 28 - Sectioning Hut Connection

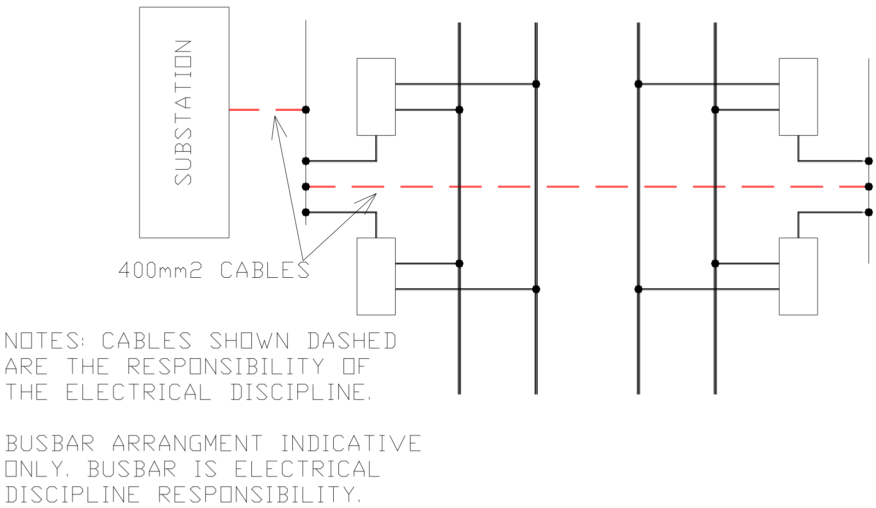


Figure 29 - Substation Connection

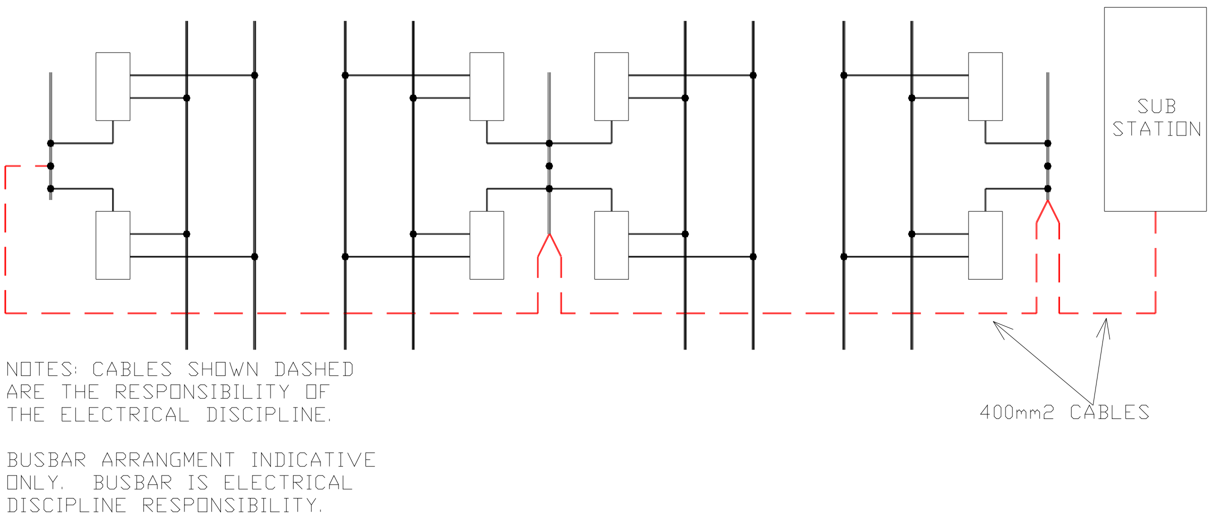


Figure 30 – Substation Connection in 4 Track Territory – Option 1

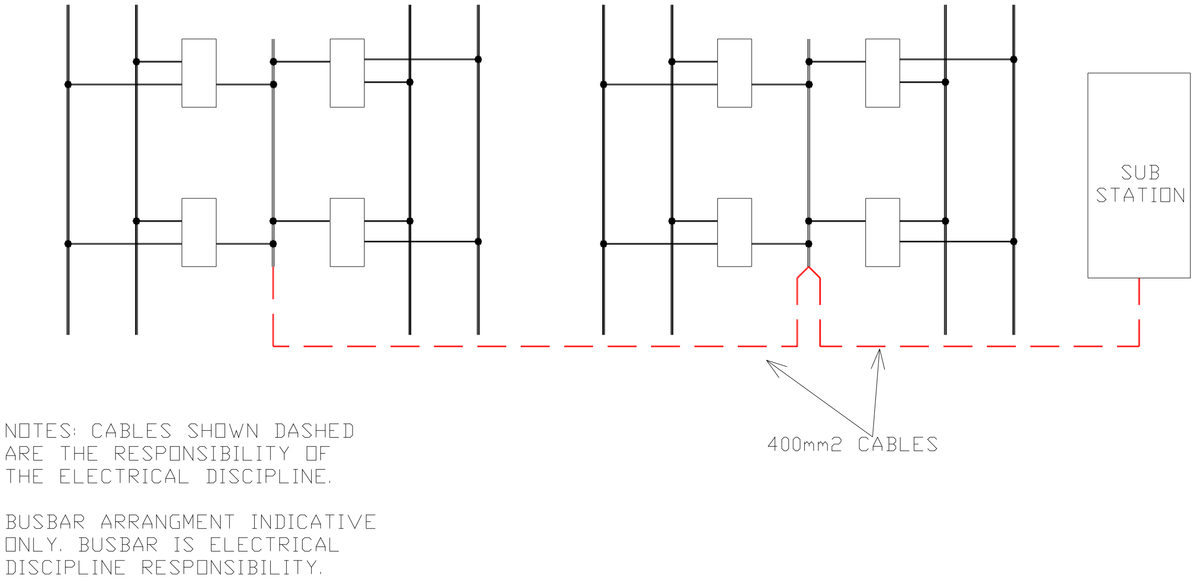


Figure 31 - Tie-In Traction Bonding in 4 Track Territory – Option Location of Cables

17.8.8 Location of Cables

Traction return cables shall not be located on the surface across multiple lines. It is important that track maintenance on one track, which requires disconnection of cables shall not also require disconnection on an adjacent track, as this track is required to minimise the impact on the traction return currents and to ensure rail-connected overhead wiring remains safe.

Where traction return cables are provided between busbars, and to the substation or section hut, these buried cables are the responsibility of the electrical discipline.

17.9 Principle 17.9 - Other Bonding to Traction Systems

17.9.1 Introduction

This section prescribes the requirements for connection of equipment, not associated with the signalling, to the traction return system.

17.9.2 Guard Rails

Guard rails, when provided, provide the potential for track circuit currents to bypass the running rails.

To protect against this, guard rails shall be electrically broken into lengths of a train length, or less. A distance of 150m-200m sections is suitable. The electrical break may be by insulated joint, or by the guard rail itself finishing and recommencing as a separate rail.

Both guard rails shall have their isolation points located adjacent, and preferably at the centre of the track circuit.

17.9.3 Spark Gaps

Overhead wiring structures and other metal structures may require to have a rail connection installed via a spark gap. Advice on the structures to be connected will be provided by the Electrical Design Section.

When provided, the rail connection shall be either:

- To the traction rail (for single rail track circuit)
- To the neutral point of an impedance bond.
- In the case of double rail type traction return systems, to the nearest rail, except that when audio frequency track circuits are in use it, connections of subsequent structures must remain on the same rail, and change to the opposite rail at the middle of the track circuit.

A potential exists for spark gap connections to provide a bypass path for track circuit current and care is to be taken that spark gap and other bonding arrangements are designed to minimise this risk.

Spark gap connections are not to be made within the tuned loop.

17.9.4 Electrolysis Bonds

Electrolysis bond connections are to be made to either:

- Traction rails of single rail track circuit
- Neutral points of impedance bonds
- A 'Store 54' electrolysis bond choke installed across the rails, as if it were an impedance bond.

The connections are of two cable – one for current and one for voltage measuring.

17.9.5 Overhead Wiring Switches

Rail connections for overhead wiring switch connections must only be made to rails connected for traction return.

These are:

- Traction rails of single rail track circuits
- Neutral points of impedance bonds

Overhead wiring switch rail connections shall be made to the nearest traction return point. The location of the switches and suitable traction return points are to be considered in the design to minimise the length of cables from the switch to the traction return point. Switches for several tracks may have a common traction return point.

17.9.6 Friction Buffer Stops

Friction buffer stops rely on being clamped to the rails to achieve their frictional sliding characteristics. Where friction buffer stops are provided on track circuited lines, insulated joints are to be provided before the buffer stops to ensure the correct operation of the track circuit. Bonding shall be provided to ensure the rails that the buffer stops are mounted on are connected to the traction return system. The arrangements are shown in Figure 32.

17.9.7 Temporary Rail connections

Termporary rail connections for overhead wiring shall only be made to rails connected for traction return. These are:

- Traction rails of single rail track circuits.
- Neutral points of impedance bonds

Connections to the closest rail of a double rail track circuits are only permitted if the track circuit is not required to be functional.

17.10 Traction Return

A minimum of 3 out of 4 rails & preferably 4 out of 4 rails shall be used for traction return on multiple main lines and 2 out of 2 rails on single lines. Single rail traction return may be used in sidings only where multiple parallel roads exist, providing the single rail commences after the division of the entrance neck. Each siding traction rails shall be bonded in at each extremity to the general traction return network. Bonding cables shall not be relied upon to provide an alternate traction path where rails have been specified above.

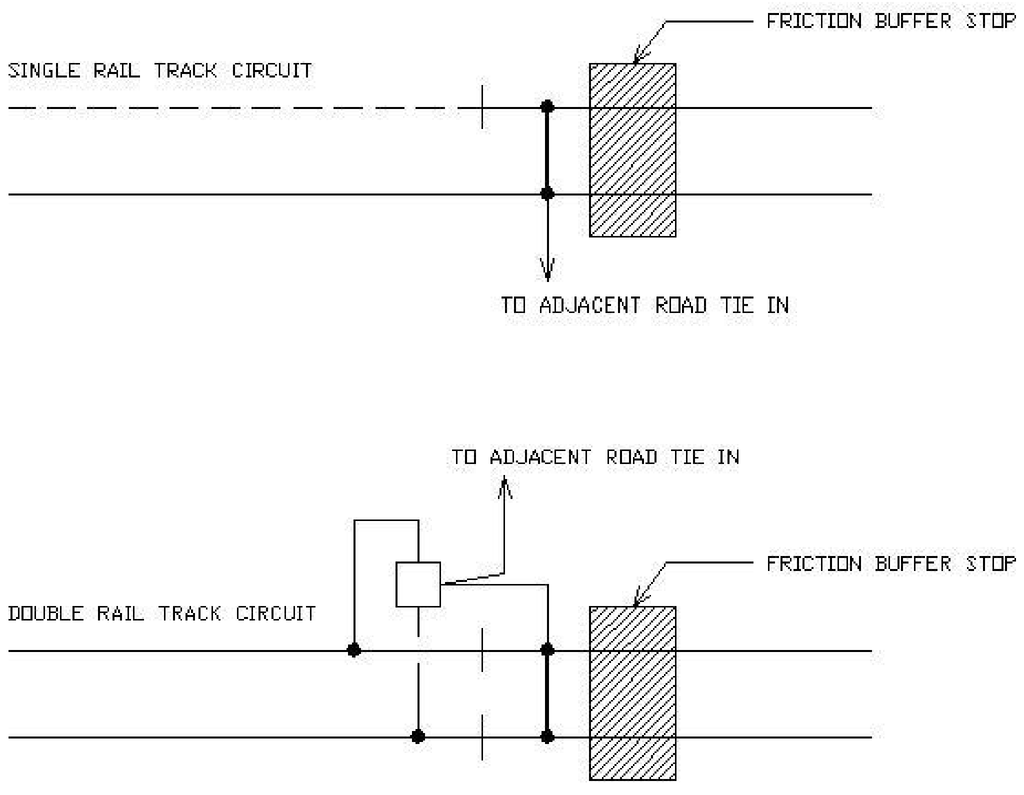


Figure 32 - Friction Buffer Stop

17.11 Traction Bonding past the end of OHW

In places where the overhead wiring ends but the track continues, or a set of points exist where one track is wired for traction but the other track is not, it is necessary to provide

traction return bonding to ensure that an overrun of an electric train into the unwired track does not result in dangerously high voltages on the rails.

As the pantographs on a train are located some distance behind the front of the train, the traction bonding shall extend beyond the end of the overhead wiring, by at least this distance.

As some 4-car trains and 4-car blocks of 8 car trains can feed 1500v from the rear pantograph to the front of the 4 car consist, this minimum distance shall be 100m.

Beyond the area which needs to be bonded for traction return, insulated joints shall be provided to prevent traction currents flowing in areas where it is not designed for.

ESG 100.18

LEVEL CROSSINGS

Version 2.1

Issued 6 March 2013

Document control

Version	Date	Summary of change
1.0		Replaced *SC 00 13 01 18 SP Level Crossings – v5.4* of 26 July 2005.
1.1	07/05/07	Note added to end of 18.7.4; 'operate' replaced 'rise' in last para 18.7.6; 18.10 – Note added re non-RVD areas; 18.13.4 & 18.13.5 – Sentences added at end; 18.3.8 list added; 18.13.12 added; Principle 18.14 added.
1.2	28/05/07	18.14.14 deleted pending Risk Assessment
1.3	03/09/2007	Rail and road signal synchronisation - Amendments to 18.11 – 18.11.1, , 18.11.3, 18.11.4; 18.11.2 amended and split; added 18.11.2.2 & 18.11.2.3 + 18.11.5; Amendments to 18.11.2.3, 18.11.3 & 18.11.6; addition of 18.11.4 – Manual operation and Test Switch Operation
1.4	21/01/2008	18.14.4 added
1.5	06/05/2009	Sections with text added are: 18.13.8.1 re Master Emergency switches, 18.13.9 Local Test Switch and Manual Operation Switch, and 18.13.11 Audible Warning – Road Level Crossings text added re standards for consideration. 18.14.2 first paragraph amended to agree with 18.13.8 regarding signals over crossing able to be cleared.
1.6	3/11/2009	18.13.11 - Para 2 – add note to include booms on single lines; Amend detail standards to be considered
1.7	2/02/2010	18.13.12 – add note about irregular operation of direction stick relays
1.8	May 2010	Application of *TMA 400* format.
1.9	5/10/2010	18.13.7 – multiple lx and overlapping control areas
2.0	22/08/2012	Add new section 18.13.13 Level Crossing Identification Signage
2.1	6/03/2013	Section 18.12.2 reference to specification SC07600000SP changed to SPG 0723. Sections 18.13.8 & 18.13.9 & 18.13.10 text added.

Contents

18 Level Crossings

18.1 Principle No 18.1 - Level Crossings: Definitions, Types and Classifications

18.1.1 Introduction

All road/rail intersections (grade or level crossings) are provided with either passive or active protection. Passive protection is by signage only, which provides an unchanging warning to the road user whether or not a train is approaching the crossing.

Active protection varies the warning provided to the road user and, in some cases, blocks access to the crossing when a train is within a pre-determined distance of the crossing.

This Principle addresses the terms and definitions relating to those locations where active level crossing warning or protection devices have been provided for the safety of both road users, including pedestrians, and rail traffic.

These terms and definitions are used throughout these Principles and have regard to the wording used in the current Australian Standards and other RailCorp documents.

18.1.2 Protected Level Crossing (Public or Private Road) - Definition

A Protected Level Crossing is defined to be a road-rail intersection at which a risk assessment has determined that the hazard is such that provision of active warning and/or protection devices is required in the interests of the safety of the road users, including pedestrians, but in particular road traffic, and rail traffic.

The active warning devices provide the total protection for the crossing and there are no passive devices such as “GIVE WAY” or “STOP” signs

18.1.2.1 Types of Active Level Crossing Protection

These are defined in accordance with Australian Standard 1742.7 as:

- Level Crossing controlled by Flashing Lights.
- Level Crossing controlled by Flashing Lights and Half-Boom Gates.
- Level Crossing controlled by Flashing Lights and Four Quadrant Boom Gates.

In these Principles the term Half-Boom Gate shall be synonymous with the term Half Boom Barrier and the term Gates shall be synonymous with the term Full Boom Barriers. Four quadrant barriers shall refer to half boom barriers arranged to provide full protection, similar to Full Boom Barriers.

18.1.3 Protected Pedestrian Level Crossing - Definition

A Protected Pedestrian Crossing is defined to be a pedestrian-rail intersection at which a risk assessment has determined that the hazard is such that provision of active warning and/or protection devices is required in the interests of the safety of pedestrians.

Types of Pedestrian Level Crossing Protection

These are defined as

- Pedestrian level crossing controlled by lights.

- Pedestrian level crossing controlled by lights and boom barriers or swing gates.

18.1.4 Level Crossing Signs - Definition

A level crossing sign is a warning device provided to advise road users of the potential hazards associated with road-rail intersections.

18.1.5 Types of Level Crossing Signs

All level crossing signs, both at and approaching the level crossing, shall be in accordance with Australian Standard 1742.7 except that in specific situations, supplementary signage may be added to define a particular function or requirement.

18.1.6 Warning Lights

The assembly for a protected public level crossing shall be the RX-5 flashing light assembly defined in AS 1742.7.

Where the usage and type of road traffic justifies private level crossings may also be fitted with the RX5 assembly,

In these Principles the term RX-5 shall be synonymous with the term Type F Highway signal.

18.1.7 Advance Warning Lights - Definition

Two side by side yellow flashing lights mounted on the same post as the W7-4B (or C) road sign, generally within a sign reading “Prepare to Stop”. Used where the road layout or obstructions limit the motorists view of the Type F signals at the level crossing. Advance warning lights can be provided for level crossings fitted with Type F lights only and on level crossings fitted with Type F lights and Booms.

18.1.8 Supplementary Warning Lights - Definition

Steady red lights fitted as a supplement to the passive “STOP” or “GIVE WAY” signage protection, generally at private level crossings, where limited sighting of approaching trains significantly increases the risk to road users and trains.

Supplementary warning lights may also have application to minor secondary unsealed public roads subject to negotiation between the rail and local road authorities.

18.1.9 Level Crossing Controls - Definition

Crossing Controls are defined to be the electrical (or electronic) controls necessary to initiate, maintain and end the operation of the warning and protection devices at a level crossing.

The Crossing Controls may be initiated automatically or manually or by a combination of both.

The Crossing Controls may have to be interlocked with railway signalling equipment controlling the passage of trains over the level crossing and depending on the complexity of the arrangements a number of “special controls” may be required.

At some locations it may be necessary to integrate the crossing controls with other systems, for example those controlling highway traffic lights.

18.1.10 Level Crossing Operation - Definition

Operation is defined to be the sequence and mode in which the Crossing Controls operate including the manner in which the level crossing warning and protection devices operate.

The mode of operation for all types of level crossing arrangements shall generally be in accordance with the recommended practices of the American Railway Engineering and Maintenance of Way Association (AREMA) for Railroad - Highway Grade Crossing Practices.

18.1.11 Level Crossing Warning Time - Definition

The absolute minimum warning times applicable to road level crossings shall be in accordance with the AREMA Manual Part 3.3.10 which is 20 seconds.

Design warning times for new road and pedestrian crossings shall be:-

- 25 seconds for Type F light installations.
- 30 seconds for Type F light and boom installations with a gate delay of 10-12 seconds.
- 19 seconds for pedestrian crossings with lights.
- 25 seconds for pedestrian crossings with lights and booms or swing gates.

Note: where the pedestrian crossing is associated with a road crossing, the times for the road crossing will apply. Additionally, where the design includes disabled access, these timings may need to be adjusted to suit the specific design.

Care shall be exercised in relation to ascertaining the minimum warning time of the fastest trains for various level crossing applications having regard to the avoidance of excessive warning times as a result of slow or stopping train patterns.

Use of a constant warning time device is preferred where the technology and application is suitable.

While the minimum warning times specified herein must be met for Supplementary Warning Lights, significantly longer warning times are acceptable if advantage can be taken of existing track circuits in the area.

18.1.12 Tail Flashing Definition

This is when the level crossing continues to operate after the train has passed and no other train is approaching.

MAXIMUM PERMISSIBLE SPEED FOR FASTEST TRAIN APPROACHING THE LEVEL CROSSING (km/hr)	LENGTH OF CONTROLLING SECTION OF TRACK FOR 25 SECOND WARNING (metres)	LENGTH OF CONTROLLING SECTION OF TRACK FOR 30 SECOND WARNING (metres)
40	280	340
45	320	375
50	360	420
55	390	460
60	420	505
65	460	545
70	490	585
75	520	630

MAXIMUM PERMISSIBLE SPEED FOR FASTEST TRAIN APPROACHING THE LEVEL CROSSING (km/hr)	LENGTH OF CONTROLLING SECTION OF TRACK FOR 25 SECOND WARNING (metres)	LENGTH OF CONTROLLING SECTION OF TRACK FOR 30 SECOND WARNING (metres)
80	560	680
85	600	710
90	640	750
95	660	800
100	700	840
105	740	880
110	780	920
115	800	960
120	840	1010
125	880	1045
130	920	1190
135	950	1130
140	980	1170
150	1040	1260
160	1120	1360

Table 1 - Principle 18.1

18.2 Principle No.18.2 - Level Crossing Controlled By Flashing Lights Only

18.2.1 Introduction

This Principle addresses the requirements for a level crossing controlled by flashing lights only including its mode of operation and the determination of the appropriate crossing controls and indications.

18.2.2 Provision Of The Arrangement

This particular arrangement shall only be provided where a public road intersects a single line public railway. Refer to Figure 1.

An audible warning device is provided on the country side.

Other arrangements may apply to private roads and railways.

18.2.3 Local & Environmental Requirements

Local and environmental requirements shall determine the need to:

- provide additional Type F highway signals.
- position the warning bell on the Sydney side Type F highway signal post.
- provide an additional warning bell.
- A controlled volume warning siren may be substituted for the bell at night, where required, and exceptionally at other times where specially approved.

18.2.4 Sequence Of Operation

If no train is approaching the level crossing then the Type F highway signals shall be extinguished and the warning bell shall be silent.

If a train is approaching the level crossing then the Type F highway signals, together with advance warning lights (where fitted), shall commence and continue to flash alternately and the warning bell shall commence and continue to sound.

When the rear of the train passes clear of the level crossing then the Type F highway signals and advance warning lights shall become extinguished and the warning bell shall be silenced.

18.2.5 Warning Time

The warning time interval between the Type F highway signals commencing to flash and a train travelling at the maximum permissible speed applicable to a particular level crossing arriving at the level crossing shall be designed to provide 25 seconds warning.

Exception:- In those locations in the Southwest, West and Northwest of the state where road trains and B-triples are permitted to operate the warning time is to be increased to 30 seconds.

Where the intersection between the road and the railway deviates from 90^{o} consideration shall be given to increasing the warning time to enable long vehicles to clear the crossing. Refer to Table 1. Excessive warning times and continued unnecessary operation after the passage of a train should be avoided.

18.2.6 Crossing Controls

The operation of the level crossing shall be initiated and maintained automatically by the occupation of a controlling section of track on the approach side to the level crossing.

The length of this controlling section of track shall be determined to ensure that the prescribed warning time can be met.

Generally this section of track shall comprise a dedicated track circuit. It shall be designated UXT for trains approaching the level crossing and travelling towards Sydney and DXT for trains approaching the level crossing and travelling away from Sydney unless other Track Circuit naming requirements take precedence. Refer to Figure 1.

The operation of the level crossing shall also be maintained by the occupation of a short section of track over the level crossing.

The length of this section of track shall be kept as short as practicable having regard to minimum permissible length to ensure the level crossing operation ceases promptly when the rear of a departing train has passed clear of the level crossing.

This section of track shall always comprise a dedicated track circuit designated XT unless other Track Circuit naming requirements take precedence. Refer to Figure 1.

Controls shall also be provided to prevent the continued operation of the level crossing when a departing train occupies the section of track circuit controlling the operation of the level crossing for trains approaching from the opposite direction.

These controls shall be proved to have operated correctly in signal circuits, staff lines or by other approved techniques.

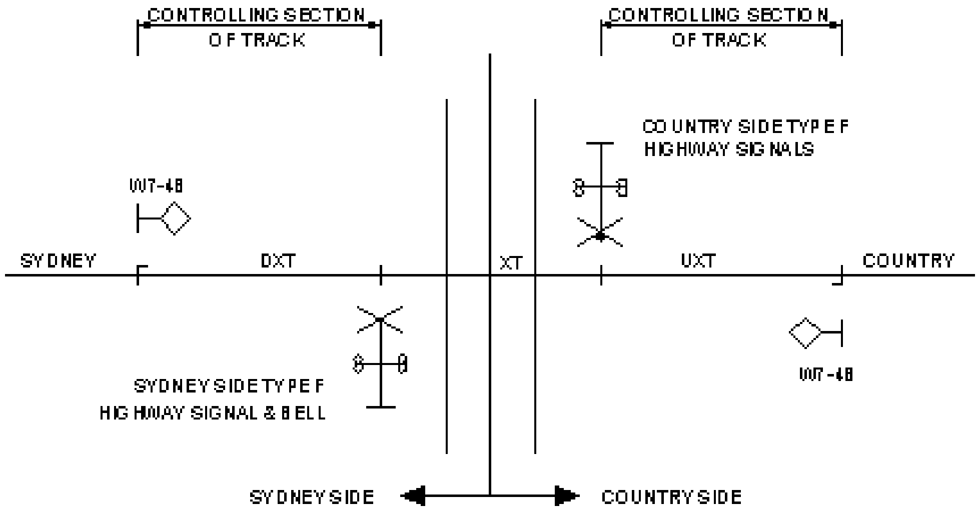


Figure 1 - Arrangement of Level Crossing

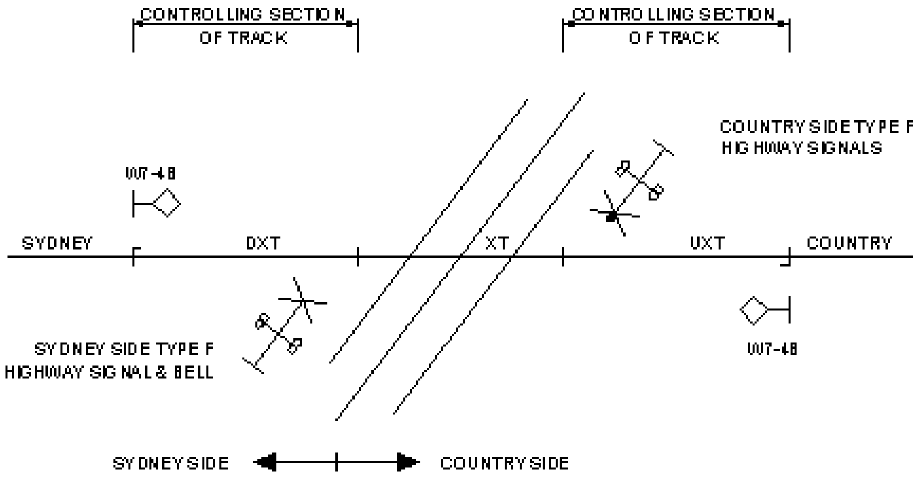


Figure 2 - Arrangement of Level Crossing

18.3 No.18.3 - Level Crossing Controlled By Flashing Lights And Half-Boom Barriers

18.3.1 Introduction

This Principle addresses the requirements for a level crossing controlled by flashing lights and half-boom barriers including its mode of operation and the determination of appropriate crossing controls and indications.

18.3.2 Provision Of The Arrangement

This particular arrangement shall be provided where a public road intersects two or more running lines of a public railway and is the preferred arrangement for double lines. Refer to Figure 3 of Principle 18.3.

Warning bells are provided on both sides of the crossing.

On single lines, booms may also be installed following a risk assessment.

Other arrangements may apply to private roads or railways.

18.3.3 Local & Environmental Requirements

Local and environmental requirements shall determine the need to:

- provide additional Type F highway signals.
- mute or conditionally suppress warning bells at night.
- substitute controlled volume warning sirens in lieu of the bells at night and, if specially approved, during the day.

18.3.4 Sequence Of Operation

If no train is approaching the level crossing then the Type F highway signals shall be extinguished, the half-boom barriers shall be in the fully raised position and the warning bells shall be silent.

If a train is approaching the level crossing then the Type F highway signals shall commence and continue to flash alternately and the warning bells shall commence and continue to sound.

After a predetermined time interval the half-boom barriers shall commence to lower.

After a predetermined time interval the half-boom barriers shall reach the fully lowered position and one of the warning bells shall be silenced.

After a predetermined time interval the front of the approaching train shall reach the level crossing.

If the rear of the approaching train passes clear of the level crossing then both the half-boom barriers shall commence to rise and the other warning bell shall be silenced.

When both half-boom barriers reach the fully raised position the Type F highway signals shall become extinguished.

If a second train is approaching the level crossing as the rear of the first train passes clear of the level crossing and there is insufficient time for the half-boom barriers to rise and remain in the fully raised position for a predetermined time interval before commencing to lower for the second train then they shall remain lowered until the rear of the second train has also passed clear of the level crossing.

18.3.5 Warning and Operating Times

The warning time interval between the Type F highway signals commencing to flash and the front of a train travelling at the maximum permissible speed applicable to a particular level crossing arriving at the level crossing shall be designed to provide 30 seconds warning.

During the warning time interval the half-boom barrier equipment shall operate as follows.

- Generally, 10-12 seconds after the highway signals have commenced to flash the half-boom barriers shall commence to lower. This also covers long road vehicles (eg. 25m B doubles, road trains or B-triples) which may be permitted to operate on the road over the level crossing.
- 10 to 12 seconds after the half-boom barriers have commenced to lower they shall reach the fully lowered position.

Excessive warning time and continued unnecessary operation after the passage of a train should be avoided.

Where the intersection between the road and the railway deviates from 90° consideration shall be given to increasing the warning time to enable long vehicles to clear the crossing. Refer to Figure 4 of Principle 18.3.

18.3.6 Crossing Controls

The operation of the level crossing shall be initiated and maintained automatically by the occupation of a controlling section of track on the approach to and immediately over the level crossing.

The length of this controlling section of track shall be determined to ensure that the prescribed warning time can be met.

The operation of the level crossing shall also be maintained by the occupation of a holding section of track on the approach side of the controlling section of track.

The length of this holding section of track shall be determined to ensure that a minimum holding time of 15 seconds is provided for the second train.

If bi-directional movements take place over the level crossing then a separate local track circuit shall be provided.

The length of this section of track shall be kept short as practicable having regard to minimum permissible length to ensure the level crossing operation ceases promptly when the rear of a departing train has passed clear of the level crossing.

If bi-directional movements take place then controls shall also be provided to prevent the continued operation of the level crossing when a departing train occupies the section of track circuit controlling the operation of the level crossing for trains approaching in the other direction.

If the level crossing is situated on a single line than these controls shall be proved to have operated correctly in signal circuits, staff lines or by other approved techniques.

Because of the gate delays, the potential exists in a boom crossing for the booms to rise and continue to rise, if the approach track circuits momentarily indicate clear and the crossing control energises. As this resets the gate delay, booms may rise and even if the crossing control subsequently drops, the booms will not recommence to fall until the gate delay expires. To protect against this eventuality, a timing circuit shall be provided to ensure that once the crossing control is activated, it cannot be cancelled unless a time limit expires or the train has proved to have arrived at the crossing. In the case where every track circuit in the approach has a minimum three second slow-to-operate time or the technology used itself incorporates protection (eg grade prediction), this will be adequate to protect against this eventuality and a separate timer will not be required.

At some installations shunters push buttons may be provided to operate the level crossing when shunting movements are taking place over the crossing on normally non track circuited sidings.

An additional track circuit may be provided in the siding to hold the crossing down and provide an auto reclear feature when the shunting movement has passed clear.

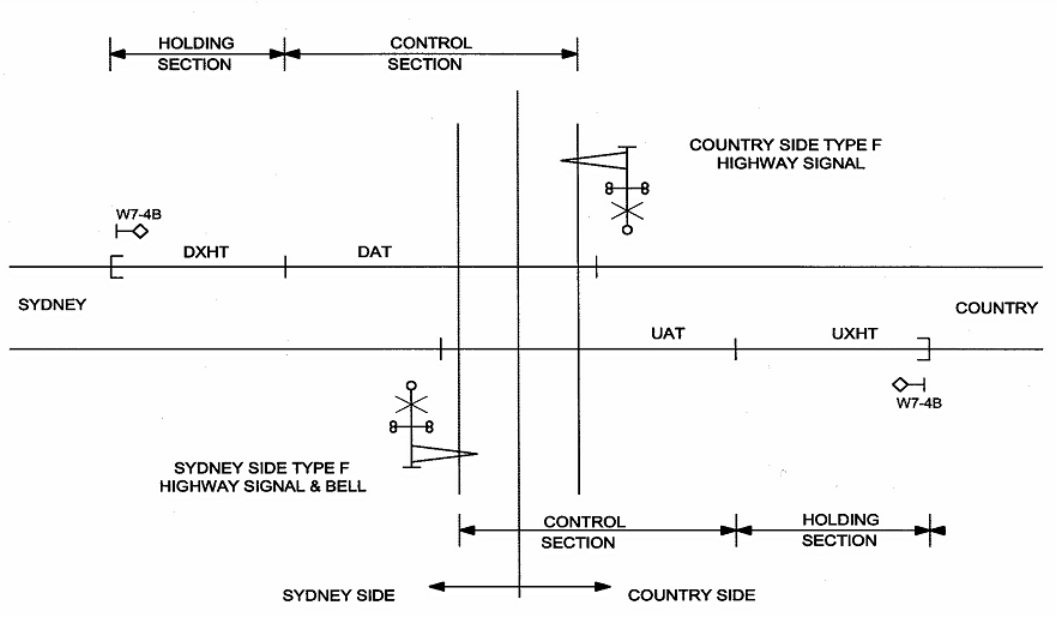


Figure 3 - Arrangement of Level Crossing

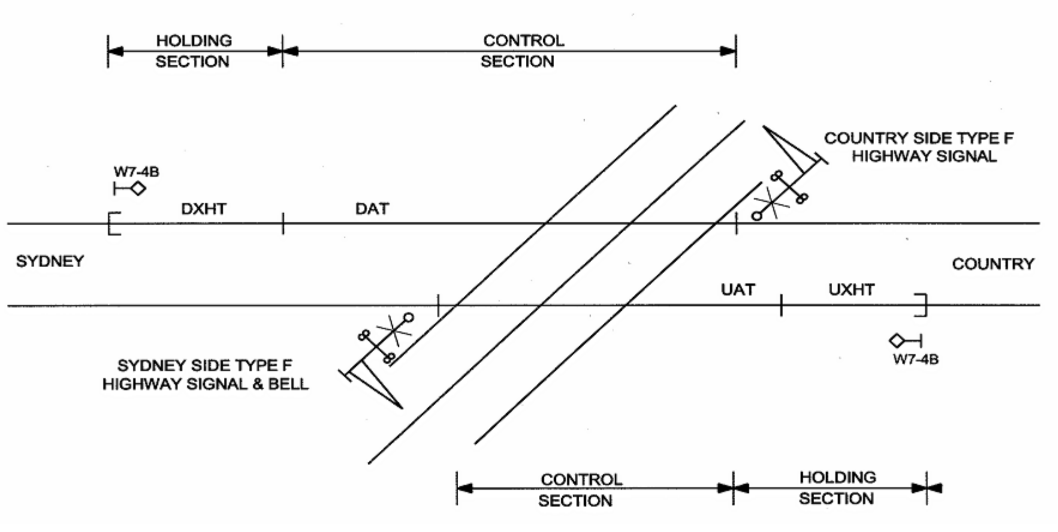


Figure 4 - Arrangement of Level Crossing

18.4 Principle 18.4 – Operation of Four Quadrant Boom Gates

18.4.1 Introduction

On some crossings, four quadrant boom gates may be used to effectively seal off the railway corridor. This principle identifies the operation of these installations.

18.4.2 Automatic Operation of Four Quadrant Boom Gates

18.4.2.1 Operating time

The minimum operating time for an automatic level crossing with four quadrant boom gates is 30 seconds.

18.4.2.2 Operation of Crossing

When a train is to pass through and operates the approach track circuits with signals clear, all level crossing lights will operate.

The Type F lights will flash and the Red Man pedestrian lights (if a pedestrian crossing is provided) will also flash. The Red Man lights will go steady after 12 seconds. 18 seconds after the commencement of the lights, the pedestrian gates will close.

Should any pedestrian remain on the crossing after the gates have closed, they will be able to exit via the emergency exit gates.

The delay time is 10-12 seconds for the leading booms and 18 seconds for the trailing booms.

When the train has passed over the crossing, all booms will raise and the swing gates will open automatically. The pedestrian lights will extinguish when the swing gates commence to open. The Type F lights shall extinguish when all the booms have raised.

18.4.2.3 Boom Operation

18.4.2.3.1 Lowering of Trailing Booms

When the booms are lowered, the trailing booms will lower a minimum of 6 seconds after the leading booms. This is to allow any vehicles that pass the lead boom to clear the trailing boom before it commences to fall.

18.4.2.3.2 Raising the Booms

Once all booms are down, the raising of the booms will be staggered. The trailing booms will be proved to be raising before the leading booms commence to rise.

This is to prevent a vehicle progressing onto the crossing unless it is reasonably guaranteed that it can pass completely across.

Proving of the trailing boom raising will be by a 15°- 90° contact made in the mechanism. The leading boom will commence to rise when the trailing boom reaches the 15° position.

18.4.2.3.3 Pedestrian Swing Gates

All pedestrian swing gates will close and open together.

Each gate will be independently monitored normal and reverse. These gates will be included in the XNR for clearance of signals (if signals are interconnected), however once the signal clears this function will be qualified to avoid manipulation of the gates affecting signal aspects.

18.4.3 Signaller Operation of Four Quadrant Boom Gates

18.4.3.1 Signaller's Facilities

The crossing is to be interlocked with the signals and is controlled from the Signal Box.

Switches will be provided to independently lower each gate.

Video surveillance of the crossing will be provided with colour monitors, and adjusted to ensure the full crossing, including any pedestrian crossings, can be viewed by the signaller. Lighting to suit the camera equipment will also be provided.

The method of operation described below is for the signaller to operate the level crossing up to the time of train passage, and then to restore the crossing for road traffic.

Because the level crossing is to be down before the signals can be cleared, it is likely that the crossing will be operating for longer periods than a fully automatic level crossing. This presents an increased risk of persons attempting to circumvent the protection.

18.4.3.2 Operation of Crossing

When a train is to pass through, the signaller will operate one of the boom levers to the 'lights' position. This will cause all level crossing lights to operate.

The Type F lights will flash and the Red Man pedestrian lights (if a pedestrian crossing is provided) will also flash. The Red Man lights will go steady after 12 seconds. 18 seconds after the commencement of the lights, the pedestrian gates will close.

The signaller has no direct control over the pedestrian swing gates. Should any pedestrian remain on the crossing after the gates have closed, they will be able to exit via the emergency exit gates.

The signaller will view the monitors and, if the crossing is clear, the booms switches are moved to the BOOMS DOWN position. If the gate delay times have passed the booms will descend immediately on operation of the switch. If the delay time has not elapsed, the booms will descend only after the delay time has elapsed.

The delay time is 10-12 seconds for the leading booms and 18 seconds for the trailing booms.

The signaller will be able to raise any boom by operating the lever back to the Booms Raise position. By viewing the monitors, the signaller can lower the booms to avoid vehicles.

When all booms are lowered, the signaller should ensure the crossing is clear of pedestrians and vehicles, before clearing the protecting signal. When the signal is clear, the booms cannot be raised until the train has passed or the signal has been replaced and the approach locking has been released by time out (2 minutes).

When the train has passed over the crossing, all booms will raise and the swing gates will open automatically if the Auto Raise function is engaged (switch is in the Auto position). The signaller can then restore all switches to the boom up position.

If the Auto Raise is in the Manual position, the booms will remain down until each individual lever is restored to the Booms raise position. The pedestrian gates will not open until all levers are in the raise position.

It will not be possible to clear the signal(s) until all booms have been proved in the down position, and the pedestrian gates proved closed.

To lower the booms the emergency switch will need to be switched off. The signaller may then lower the booms using the lever.

18.4.3.3 Boom Operation

18.4.3.3.1 Lowering the Booms

When the booms are lowered, the trailing booms will lower a minimum of 6 seconds after the leading booms. This is to allow any vehicles that pass the lead boom to clear the trailing boom before it commences to fall.

The controls will not permit the signaller to lower the trailing booms unless the leading booms have been operated first.

If the trailing boom switch is in the lower position, and the leading boom switch in the raise position, both booms will remain up.

If the leading boom switch is then operated to the lower position and:

1.	Gate Delay has not expired:	The leading boom will remain up until the 10-12s gate delay has expired, and then it will commence to fall. Approximately 6s later the trailing boom will then fall.
2.	First Gate Delay (10-12s) has expired (10-12s to 18s) but Second Gate Delay (18s) has not:	The leading boom will drop immediately and the trailing boom will delay until the 18s delay has dropped (which will occur in less then 6 seconds from the first boom operation).
3.	Both Gate Delays have expired:	Both booms will lower immediately

18.4.3.3.2 Raising the Booms

Once all booms are down, the raising of the booms will be staggered. The trailing booms will be proved to be raising before the leading booms commence to raise.

This is to prevent a vehicle progressing onto the crossing unless it is reasonably guaranteed that it can pass completely across.

Consequently the leading booms will not raise unless the trailing boom switch has first been selected to raise, when the Auto Raise switch is in the Manual position.

Proving of the trailing boom raising will be by a 15°-90° contact made in the mechanism. The leading boom will commence to raise when the trailing boom reaches the 15° position.

18.4.3.3.3 Pedestrian Swing Gates

All pedestrian swing gates will close and open together.

Each gate will be independently monitored normal and reverse. These gates will be included in the XNR for clearance of signals (if signals are interconnected), however once the signal clears this function will be qualified to avoid manipulation of the gates affecting signal aspects.

For controlled crossings, Open and Closed indicator lights shall be provided on the panel.

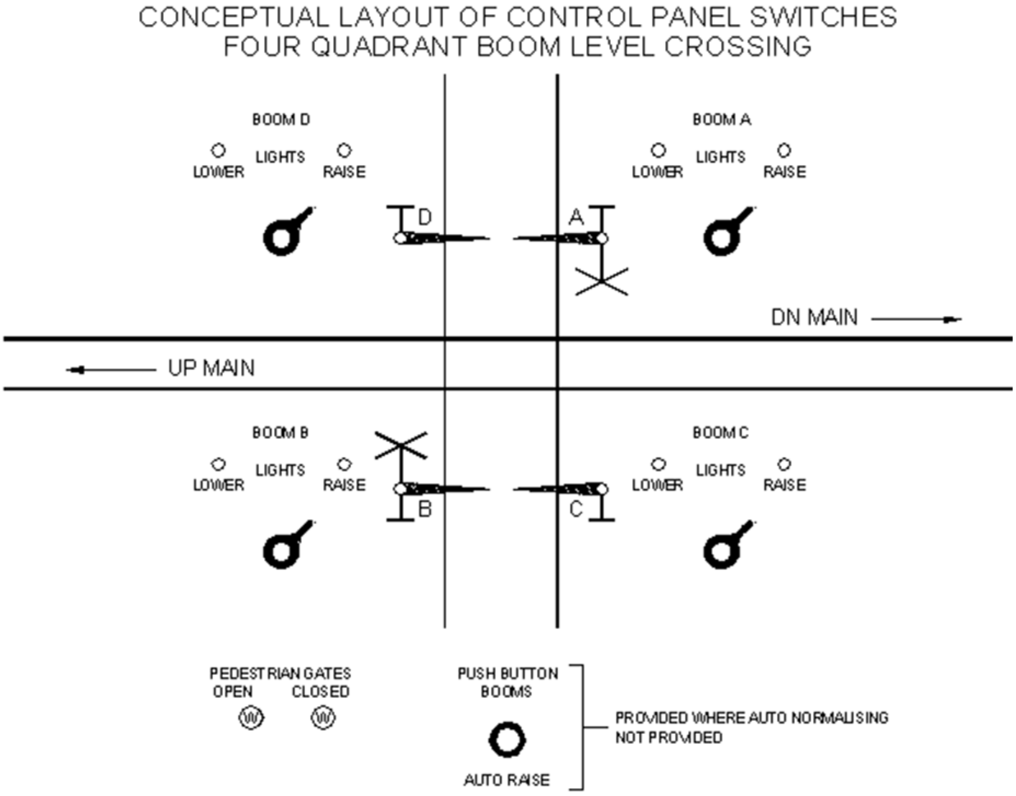


Figure 5 - Signaller Operation of Four Quadrant Boom Gates

18.5 Principle No.18.5 - Pedestrian Level Crossing Controlled By Lights Only

18.5.1 Introduction

This Principle addresses the requirements for pedestrian level crossings controlled by red lights and supplemented by controlled volume audible warning sirens. It includes the mode of operation of the level crossing and the method of determination of appropriate crossing controls.

18.5.2 Provision Of The Particular Arrangement

This particular arrangement shall only be provided where a public pedestrian way intersects a single line public railway and there is no more than a moderate volume of pedestrian and rail traffic. Refer to Figure 6 of Principle 18.5.

18.5.3 Local & Environmental Requirements

Local and environmental requirements shall determine the need to:

- provide additional warning lights.

18.5.4 Sequence Of Operation

If no train is approaching the pedestrian level crossing then the warning lights shall be extinguished and the audible warning devices shall be silent.

If a train is approaching the pedestrian level crossing then the warning lights shall display and maintain steady red lights and the audible warning devices shall commence and continue to sound.

If the rear of the train passes clear of the pedestrian level crossing then the warning lights shall become extinguished and the audible warning devices shall be silenced.

18.5.5 Warning Time

The warning time interval between the red warning lights being displayed and a train travelling at the maximum permissible speed applicable to the pedestrian level crossing arriving at the level crossing shall be designed to provide a minimum of 19 seconds warning.

18.5.6 Crossing Controls

The operation of the pedestrian level crossing shall be initiated and maintained automatically by the occupation of a controlling section of track on the approach side to the level crossing.

The length of the controlling section of track shall be determined to ensure that the prescribed warning time can be met.

If bi-directional movements take place over the level crossing then a separate track circuit shall be provided.

The length of this section of track shall be kept short as practicable having regard to minimum permissible length to ensure the level crossing operation ceases promptly when the rear of a departing train has passed clear of the level crossing.

If bidirectional movements take place then controls shall also be provided to prevent the continued operation of the level crossing when a departing train occupies the section of track circuit controlling the operation of the level crossing for trains approaching in the normal direction.

If the level crossing is situated on a single line than these controls shall be proved to have operated correctly in signal circuits, staff lines or by other approved techniques.

It is permissible to locate the crossing in the centre of the tuned loop of a jointless track circuit.

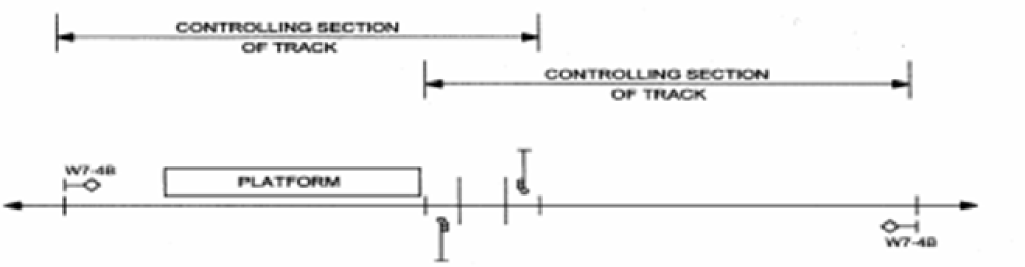


Figure 6 - Arrangement of Pedestrian Level Crossing on a Single Line - Pedestrian Level Crossing Control by Lights Only

18.6 Principle No.18.6 - Pedestrian Level Crossing Controlled By Lights And Barriers or Swing Gates

18.6.1 Introduction

This principle is for existing crossings. New crossings shall be to Principle 18.7.

This Principle addresses the requirements for pedestrian level crossings controlled by red lights and barriers or swing gates and supplemented by controlled volume audible warning devices. It includes the mode of operation of the level crossing and the method of determination of appropriate crossing controls. Barriers should preferably be type approved swing gates.

18.6.2 Provision Of The Particular Arrangement

This particular arrangement shall be provided where a pedestrian way intersects two or more lines of a public railway and there is a moderate volume of pedestrian and rail traffic, or where a pedestrian way intersects a single line public railway and there is a high volume of pedestrian and rail traffic. Refer to Figure 7 of Principle 18.6.

Note: A pedestrian crossing should only be used over more than two lines where rail traffic volumes and speeds are low.

18.6.3 Local & Environmental Requirements

Local and environmental requirements shall determine the need to:

provide additional warning lights.

18.6.4 Sequence Of Operation

If no train is approaching the pedestrian level crossing then the warning lights shall be extinguished, the barriers shall be in the fully open position and the audible warning devices shall be silent.

If a train is approaching the pedestrian level crossing then the warning lights shall display and maintain steady red lights and the audible warning devices shall commence and continue to sound.

After a predetermined time interval the barriers or gates shall commence to close.

After a predetermined time interval the barriers or gates shall reach the fully closed position.

After a predetermined time interval the front of the approaching train shall reach the level crossing.

If the rear of the approaching train passes clear of the level crossing then both the barriers or gates shall commence to open and the audible warning devices shall be silenced, the warning lights shall become extinguished.

After a predetermined time interval both barriers or gates shall reach the fully open position.

18.6.5 Warning and Operating Times

The warning time interval between the warning lights commencing to display a steady red light and the front of a train travelling at the maximum permissible speed applicable to a particular pedestrian level crossing arriving at the pedestrian level crossing shall be designed to provide 25 seconds warning.

If the pedestrian level crossing spans a single track, as in an Island Platform arrangement, during the warning time interval the barrier equipment shall operate as follows.

- 5 to 7 seconds after the warning lights have been displayed the barriers or gates shall commence to close.
- Within 10 seconds after the barriers or gates have commenced to close they shall reach the fully closed position.

If the pedestrian level crossing spans two or more tracks then during the warning time interval the barrier equipment shall operate as follows.

- 10 to 12 seconds after the warning lights have been displayed the barriers or gates shall commence to close.
- Within 10 seconds after the barriers or gates have commenced to lower they shall reach the fully closed position.

18.6.6 Crossing Controls

The operation of the pedestrian level crossing shall be initiated and maintained automatically by the occupation of a controlling section of track on the approach to and immediately over the level crossing.

The length of this controlling section of track shall be determined to ensure that the prescribed warning time can be met.

If bi-directional movements take place over the level crossing then a separate track circuit shall be provided.

The length of this section of track shall be kept short as practicable having regard to minimum permissible length to ensure the level crossing operation ceases promptly when the rear of a departing train has passed clear of the level crossing.

If bi-directional movements take place then controls shall also be provided to prevent the continued operation of the level crossing when a departing train occupies the section of track circuit controlling the operation of the level crossing for trains approaching in the other direction.

These controls shall be proved to have operated correctly in signal circuits, staff lines or by other approved techniques.

It is permissible to locate the crossing at the centre of the tuned loop of a jointless track circuit.

18.6.7 Crossing Controls If The Pedestrian Level Crossing Is Located Adjacent To A Public Road Level Crossing

If the pedestrian level crossing is located adjacent to a public road level crossing controlled by flashing highway signals only, it shall have a common sequence of operations, warning times and controls as for the highway crossing. Where flashing highway signals and half boom barriers are installed, a separate pedestrian gate delay of

10-12 seconds is required if B doubles and road trains are not permitted to operate, and where B doubles and road trains are permitted to operate, a common sequence of operations, warning times and controls as for the highway crossing is required.

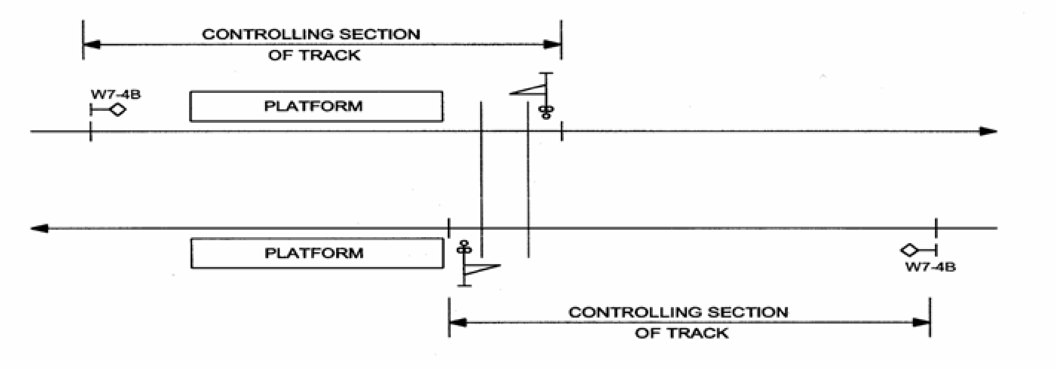


Figure 7 – Arrangement of Pedestrian Level Crossing on a Double Line - Pedestrian Level Crossings Controlled by Lights and Barriers

18.7 Principle No.18.7 - Pedestrian Level Crossing Controlled By Lights and Barriers or Swing Gates – Designed for Disabled Access

18.7.1 Introduction

This Principle addresses the requirements for pedestrian level crossings controlled by red lights or swing gates and supplemented by controlled volume audible warning devices. It includes the mode of operation of the level crossing and the method of determination of appropriate crossing controls. Emergency exit gates and races are included.

18.7.2 Provision Of The Particular Arrangement

This particular arrangement shall be provided where a pedestrian way intersects two or more lines of a public railway and there is a moderate volume of pedestrian and rail traffic, or where a pedestrian way intersects a single line public railway and there is a high volume of pedestrian and rail traffic.

On single lines barriers or swing gates may also be installed following a risk assessment.

Note: A pedestrian crossing should only be used over more than two lines where rail traffic volumes and speeds are low or other additional protection is provided such as local signaller monitoring or CCTV.

18.7.3 Local & Environmental Requirements

Local and environmental requirements shall determine the need to:

provide additional warning lights.

18.7.4 Sequence Of Operation

If no train is approaching the pedestrian level crossing then the warning lights shall be extinguished, the barriers shall be in the fully open position and the audible warning devices shall be silent.

If a train is approaching the pedestrian level crossing then the warning lights shall display a flashing red light and the audible warning devices shall commence and continue to sound.

After a predetermined time, the lights shall become steady red.

After a predetermined time interval the barriers or gates shall commence to close.

After a predetermined time interval the barriers or gates shall reach the fully closed position.

After a predetermined time interval the front of the approaching train shall reach the level crossing.

If the rear of the approaching train passes clear of the level crossing then both the barriers or gates shall commence to open and the audible warning devices shall be silenced, the warning lights shall become extinguished.

After a predetermined time interval both barriers or gates shall reach the fully open position.

Note: Pedestrian warning lights operate by the crossing control and do not prove the gates reverse to cease operation.

18.7.5 Warning and Operating Times

The warning time interval between the warning lights commencing to display a warning light and the front of a train travelling at the maximum permissible speed applicable to a particular pedestrian level crossing arriving at the pedestrian level crossing shall be designed to provide a minimum of 25 seconds warning for a single track and 30 seconds for double track.

When the crossing is activated, the siren is to sound and the Red Man stop lights shall flash. Twelve seconds later, the stop lights will display steady red.

Timing for these pedestrian crossing gates is to be based on the distance between the gate on one side of the line, and being within the gate in a safe place, on the other side of the line. The time taken for a person to cross the line at a speed of 0.8 m/s shall be calculated given this distance.

For example, a typical double track pedestrian crossing is 14.5m across. At 0.8 m/s, it takes 18 seconds for a person to cross. This time becomes the minimum gate delay time. For this typical example, the timing will be:

- When the train activates the warning equipment, the Red Man stop lights shall flash red
- Twelve seconds after activation they will display steady red.
- Eighteen seconds after activation the gates will begin to close.
- Within ten seconds of the gates commencing to close, the gates will be fully closed.
- At least two seconds after the gates are closed, the train may arrive (30 seconds total).

Should the crossing be wider and the time taken to cross be longer than the typical, the total crossing time is to be extended commensurate with longer gate delay time. Similarly, for a narrow crossing (eg single lines) however the total operating time shall not be less than 25 seconds.

Where emergency exit gates are provided and the time period between the main gate commencing to close and the train arriving shall not be less than the time taken to traverse the crossing between safe places in the emergency exit at a speed of 1.2 m/s.

18.7.6 Crossing Controls

The operation of the pedestrian level crossing shall be initiated and maintained automatically by the occupation of a controlling section of track on the approach to and immediately over the level crossing.

The length of this controlling section of track shall be determined to ensure that the prescribed warning time can be met.

If bi-directional movements take place over the level crossing then a separate track circuit shall be provided.

The length of this section of track shall be kept short as practicable having regard to minimum permissible length to ensure the level crossing operation ceases promptly when the rear of a departing train has passed clear of the level crossing.

If bi-directional movements take place then controls shall also be provided to prevent the continued operation of the level crossing when a departing train occupies the section of track circuit controlling the operation of the level crossing for trains approaching in the other direction.

These controls shall be proved to have operated correctly in signal circuits, staff lines or by other approved techniques.

It is permissible to locate the crossing within the tuned loop of a jointless track circuit, if it is a separate pedestrian crossing.

If a second train is approaching the pedestrian level crossing as the rear of the first train passes clear of the level crossing and there is insufficient time for the gates or barriers to operate and rise such that they can remain in the fully open position for a predetermined time interval before commencing to close for the second train then they shall remain closed until the rear of the second train has also passed clear of the pedestrian level crossing.

18.7.7 Crossing Controls If The Pedestrian Level Crossing Is Located Adjacent To A Public Road Level Crossing

If the pedestrian level crossing with disabled access is located adjacent to a public road level crossing controlled by flashing highway signals only, it shall have a common sequence of operations, warning times and controls as for the highway crossing. Where flashing highway signals and half boom barriers are installed on double lines, a separate pedestrian gate delay of 18 seconds is required and the minimum warning time shall be 30 seconds.

18.7.8 Emergency Exit Gates

Emergency Exit Gates shall hinge outwards away from the track and be self closing. These gates shall be fitted with a latch or lock that can be operated by disabled persons using the exit. The purpose of the latch or lock is to prevent unauthorised access toward the track when the crossing gates are closed. The failure mode of an electric latch or lock shall be to unlock the Emergency Exit Gate.

18.7.9 Tactile Marking

Tactile markings for disabled users shall be provided in accordance with RailCorp Drawing M06-244 and AS1742.7

18.8 Principle No.18.8 – Principle Withdrawn

18.9 Principle No.18.9 – Shunters Operated Level Crossings

18.9.1 Application

Where a Type F level crossing (with or without booms) is provided in a shunting area, the crossing may be protected by 'STOP' signs in either direction facing rail traffic.

The two types of crossings to be considered in this principle are:

a) Level crossings without track circuits (18.9 Figure 8)

b) Level crossings with a local cancelling track circuit. (18.9 Figure 9)

18.9.2 Level Crossings Without Track Circuits

Where a Type F level crossing is provided and track circuiting is not feasible or required, the shunter's control is to be by Shunter's Switches arranged in a two way switching arrangement. The shunter's switches are provided in an SL locked box adjacent to the 'STOP' boards. No functions exist that require a battery supply.

As train movements over the crossing are made by authority of the shunter, the shunter is required to activate the crossing and if the crossing fails to operate, an unsafe situation does not result. Accordingly, a single power supply is permissible. However, if the supply is unreliable, a battery-backed or alternate supply may be provided.

18.9.3 Level Crossings with a Local Cancelling Track Circuit

Where a Type F Level Crossing is provided and track circuiting is provided to automatically cancel the crossing after the passage of the train, shunter's pushbuttons labelled "Start" and "Cancel" are to be provided on either side of the crossing adjacent to the Stop Board.

Operation of the 'Start' pushbutton shall cause the crossing to operate by deactivating the crossing control. Operating the 'Cancel' button, or a train occupying the track circuit re-picks the crossing control. To avoid the unnecessary operation of the crossing with power supply interruptions, a battery backup supply is required.

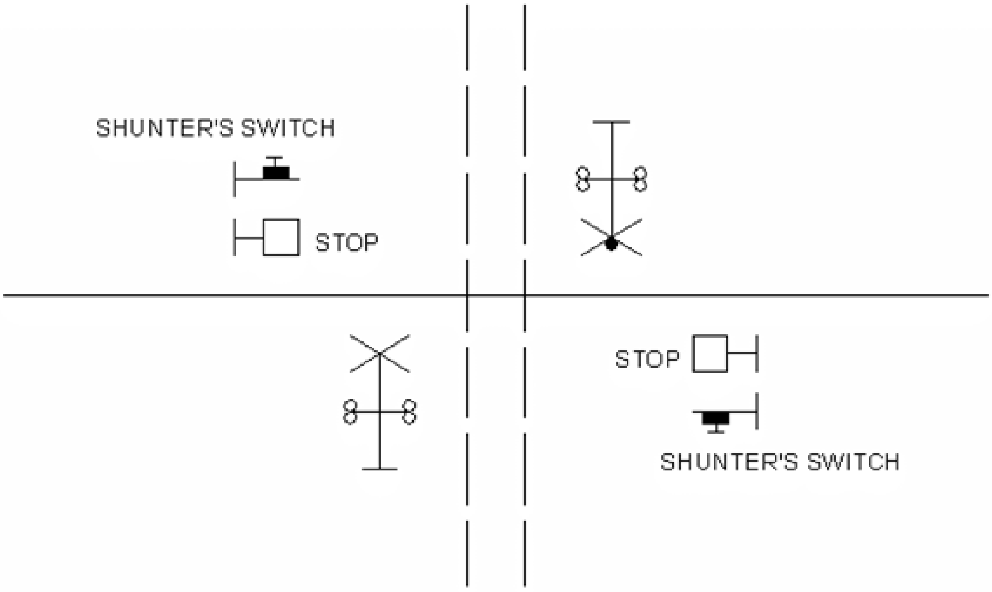


Figure 8 - Shunters Switch Level Crossing

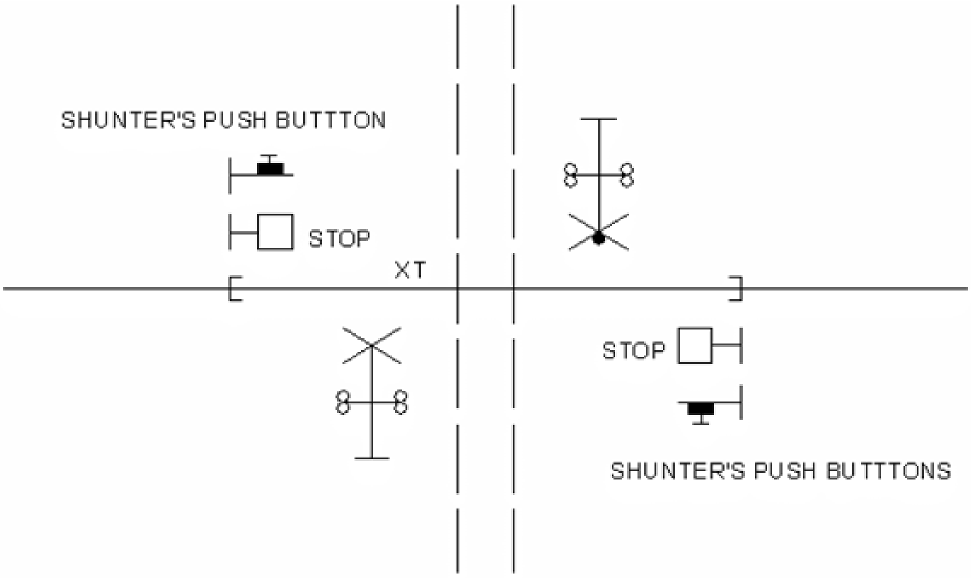


Figure 9 - Shunters Push Button Level Crossing

18.10 Principle No.18.10 - Level Crossings Near Interlockings & Sidings

[Note: This principle is predominantly for non-RVD areas]

18.10.1 Introduction

At locations where protected level crossings exist at interlockings, arrangements need to be made to prevent unnecessary operation of the level crossing warning equipment while trains are shunting at the interlocking, or standing at platforms, or waiting (for some other reason) on the level crossing warning approach track circuiting.

Refer also to Principle 19.7 (Train Orders).

18.10.2 Requirement

Where trains regularly approach level crossings, but where the movement over the crossing is not made for some time, the level crossing warning should not operate until the train is ready to proceed.

If this is an infrequent occurrence, arrangements may be made to cancel the level crossing warning operation after the train has come to a stand.

However, where trains regularly approach the crossing but do not proceed over the crossing, the crossing warning should not operate on the train's initial approach.

18.10.3 Crossing Warning Cancelled after Train Comes to a Stand

In the situation where a siding exists within the approach track circuit of a level crossing, or where trains would come to a stand on the approach track for an extended period, and where this occurs less than 3 times per week, it is necessary to provide arrangements to permit the level crossing warning to be cancelled.

18.10.3.1 ETS/OTS Staff Token Sections (For Per Way and other little used sidings)

Arrangements would consist of a mechanical duplex lock whereby the top lock is unlocked by the key on staff or receptacle key for the section releasing a key from the bottom lock to operate the ground frame. Removal of the key from the bottom lock makes an electrical contact on the duplex lock to cancel the level crossing warning operation. After restoring the key from the bottom lock to the ground frame, the level crossing begins to operate with the train on the approach tracks and the staff or receptacle key can be removed from the top lock. Refer to Figure 10 of Principle 18.10.

18.10.3.2 Train Order Working Areas (For Per Way and other little used sidings)

Arrangements would consist of a mechanical duplex lock located on a Mechanical Point Indicator, whereby the top lock is unlocked by an operator's key releasing a key from the bottom lock to operate the ground frame. Removal of the key from the bottom lock puts the Mechanical Point Indicator to stop and makes an electrical contact on the duplex lock to cancel the level crossing warning operation. After restoring the key from the bottom lock to the ground frame, the Mechanical Point Indicator clears and the level crossing warning begins to operate with the train on the approach tracks and the operator's key can be removed from the top lock. Refer to Figure 11 of Principle 18.10.

18.10.3.3 General

If, after cancellation, shunting is to occur across the level crossing, then push buttons must be provided to initiate and cancel level crossing warning operation.

Where this operation is to be used, the level crossing shall be in close proximity to the duplex lock, so that the train crew are aware of their interaction with the level crossing, or if distant from the level crossing a sign should be installed. Refer to Figure 11 of Principle 18.10.

Special care needs to be taken with these arrangements to ensure reliable proving of direction stick functions, and to prevent the proving circuitry from timing out and unnecessarily operating the crossing during shunting. Additional track circuits may be required to initiate the proving system, and it should be established that these are not adversely affected by train length.

Where these arrangements are difficult to apply, a signal (or Main Line Indicator) should be installed as in 18.10.4.

18.10.4 Level Crossings Protected by Signals

Where trains regularly approach level crossings 3 or more times per week but the movement over the crossing is not proceeded with, then a signal (or a Main Line Indicator) should be provided to protect the level crossing. Refer to Figure 12 of Principle 18.10.

This signal or Main Line Indicator may be operated by one of the following methods:

- Operators Key and/or duplex lock
- Staff Contact box
- Staff Lock
- Driver's push buttons
- Remotely controlled via the level crossing monitor or other remote control system
- Whistle activation or other method suitable for the situation

Wherever arrangements exist for the signal or Main Line Indicator to be cleared without the train being present, then the track circuited approach must be arranged for the fastest non-stopping train, and time releasing of approach locking is to be provided. This must be particularly addressed when lines operated by token systems are converted to train order working.

18.10.5 Power Arrangements and Circuit Configuration

Where normal and back up AC power supplies are not available it will be permissible for the system to be configured such that a failure of the signal lights (or the Main Line Indicator lights) does not cause a failure of the level crossing, although the level crossing warning may consequently operate for longer periods or when the warning would normally not occur.

Signal or Main Line Indicator lighting is not normally supplied from the level crossing battery due to the necessity to ensure the battery is not exhausted prematurely, under AC power failures, by the lighting drain. Consequently the signal or Main Line Indicator may be supplied from a separate battery-backed supply. Where infrequent loss of the 120volt AC supply occurs and is within acceptable availability criteria, the signal or Main Line Indicator may be supplied at 120volt AC, that is directly from the available supply; in this situation it is essential for all functions that would normally qualify level crossing controls to drop away during failure of the lighting supply.

Additionally, signal normal or approach locking times must prove the red light lit on the signal or Main Line Indicator. Basic level crossing functions are to be retained on the level crossing battery supply.

As a guide, the following circuit supply arrangements would be typical:-

Level Crossing Battery Supply:	XR, XPR, direction sticks, DSJR
Other Battery Supply:	Solar fed track circuits; store 70 fed track circuits
Non Backed Up Supply:	NJR, XNR, XRJR, push button relays, signal control relays, signal lights.

Level crossing monitors should be provided to give remote alarms of any power failure.

18.10.6 Special Arrangements

Where a level crossing is remote, and signals or main line indicators are provided to protect the crossing, a failure of an approach track circuit, may after the elapse of a suitable time period, replace the signal or main line indicator to stop. Following the release of any approach locking it is permissible to qualify the level crossing operation and thus prevent unnecessary level crossing operation. This will minimise unnecessary obstruction of the road traffic while waiting for maintenance staff to attend and repair the failed track circuit.

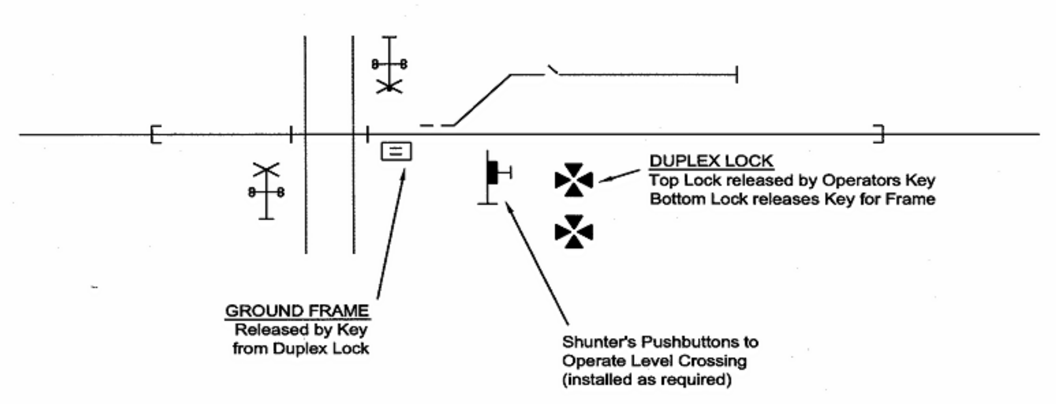


Figure 10 - ETS/OTS Section

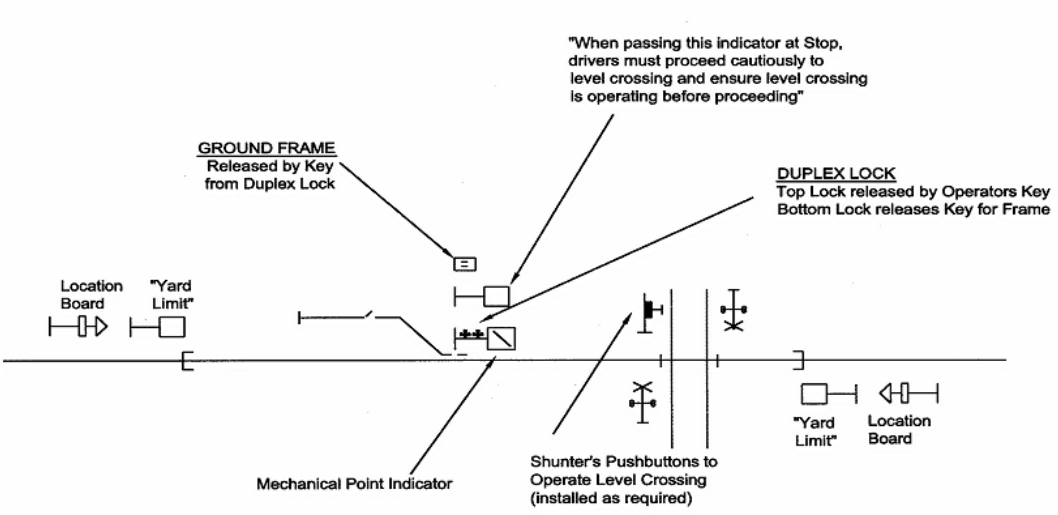


Figure 11 - Train Order Working Area

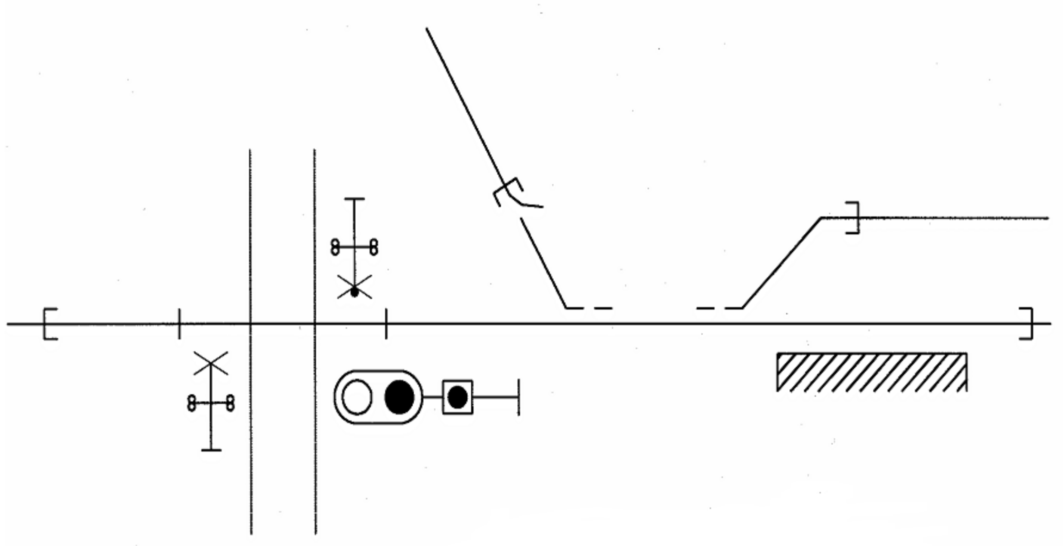


Figure 12 - Level Crossing Protected by Signal

Signal or Main Line Indicator Qualifies Track Circuit Control in Level Crossing. For Control of Signal see 18.7.4.

18.11 Principle 18.11 – Level Crossing Interfaces to Road Traffic Lights

18.11.1 Introduction

Where a level crossing exists adjacent to a set of traffic lights, the potential exists for motor vehicles to stop at the traffic lights and queue back across the railway or for a queue at a level crossing to obstruct the intersection behind. Where this occurs, interconnection between level crossing controls and the traffic lights may be provided to assist in minimising this problem.

18.11.2 Rail Signal and Road Signal Synchronisation

18.11.2.1 Requirement

The requirement is to coordinate railway level crossing operation with the operation of nearby traffic signals to ensure that the operation of one facility doesn't adversely impact on the safe operation of the other. In addition, the facilities and the interface between them need to be designed to minimise delays to both railway and road vehicles.

In order that the traffic lights can synchronise with the level crossing, an advanced indication of train approach needs to be provided to the road authority. This is called the **Train Demand** (**TD**).

The road authority will specify the **Train Demand Response Time**.

In response to the **Train Demand**, the traffic signals are to

a) Prevent road traffic being directed onto the level crossing and

b) Clear road traffic queued across the level crossing (**Clearance Phase**).

The worst case time for the traffic signals to reach **Clearance Phase** and the minimum duration of the **Clearance Phase** is determined by the road authority for each intersection and, together with the minimum gate delay, is used to calculate the **Train Demand Response Time**.

The **Clearance Phase** is to extend beyond the start of flashing of the warning signals of the level crossing and concludes when it can be assured that the queue can not reform.

When traffic lights are provided on both sides of the railway, the road authority will arrange the traffic light phasing so as to prevent a queue from forming, as far as practical. This may reduce the criticality of the clearance time.

Where a traffic light is located prior to the level crossing or at the level crossing, it must display 'stop' whenever the Type F lights are operating.

18.11.2.2 Automatic Signals

In this situation, a single **Train Demand** input will be provided to the road authority.

The **Train Demand** will be provided to the traffic lights when the train approaches. The traffic lights will cycle through to **Clearance Phase** before or on activation of the level crossing. Activation will occur on expiry of the **Train Demand Response Time**.

18.11.2.3 Controlled or Interfaced[1] Signals Within The Train Approach Zone.

In this situation, the road authority will provide a **Traffic Light Response** (TLR) function to the level crossing.

When a rail movement is to be made, the **Train Demand** indication is provided to the traffic lights when the train approaches (with the signal clear) or the signal route is set (if a train is closely approaching). If the traffic lights can cycle to the clearance phase earlier, then an indication (Traffic Light Response) is provided to the Rail Signals.

The TLR enables the Rail Signal to clear earlier without waiting for the expiration of the Train Demand Response Time. Whether the level crossing activates on receipt of the TLR is dependent upon the location of the Rail Signal within the level crossing approach and on the location of the train approaching. However, the level crossing will commence to operate on expiration of the Train Demand Response time.

The TLR will always be sent at a given time after the start of the clearance phase (the time delay is queue clearance time minus the gate delay).

Should the **Traffic Light Response** not be received, the activation of the level crossing may be initiated at the expiry of the **Train Demand Response Time**.

18.11.3 Interface Controls

Interface controls should be arranged to fail safe principles and an absence of circuit continuity is indicating train approach.

The interface between the rail and road signals shall constitute all three functions. All functions are a voltage-free contact for electrical isolation.

[1] An **Interfaced** signal refers to an automatic signal requiring additional traffic light interfaces.

Rail indications to Road:

- Train Demand (normally closed)
- Train Demand (normally open)
- Crossing Lights Control (normally closed)
- Crossing Lights Control (normally open)
- Traffic Light Response (normally open) [Acknowledge TLR received]

Road indications to Rail

- Traffic Light Response (normally open)

The **Train Demand** (TD) is to be given at the nominated train demand time prior to the crossing control point and is to remain until the train has cleared the crossing (ie booms are rising, lights may still be flashing).

The **Crossing Lights Control** (XE) is to be given when the crossing lights are activated and is to remain until the lights cease operating (ie booms fully up).

The **Traffic Light Response** (TLR) is provided by the road authority when the traffic light phasing is suitable for the crossing to commence operatingThe **Traffic Light Response** will lapse once the Train Demand has been removed from the traffic light controller.

NOTE: The level crossing may not commence to operate on receipt of the TLR as this is dependent on the location of the Rail Signals and the approaching train.

18.11.4 Manual Operation and Test Switch Operation

When the level crossing is being operated by the Manual Operation or Test Switch the level crossing will activate immediately.

The **Train Demand** (TD) and **Crossing Light Control** (XE) will be applied at the same time. The responsibility for ensuring the level crossing is clear of road traffic prior to the train proceeding lies with the Railway Safeworking Officer operating the switches.

Note: "Normally open" or "normally closed" refers to the contact state when no train is present and the crossing is not operating.

18.11.5 Crossing Activation and Clearance Phase

The level crossing is activated when the Train Demand Response Time period expires.

The level crossing may also be activated by receipt of the Traffic Light Response from the road traffic signals, if the train is within the crossing (X_c) area.

The **Clearance Phase** commences at or before the time of level crossing operation and should not end until after the crossing operates. This is to prevent the queue from extending by more cars entering the crossing area. The actual end point may be extended by the road authority if a queue is detected. However, it will not be prior to the commencement of boom operation, where booms are provided. Cessation of the Clearance Phase is based upon the **Crossing Lights Control** (XE).

The **Train Demand Response Time** will be advised by the road authority.

The **Train Demand Response Time** will include any allowance to ensure the clearance time is correct for that situation.

The level crossing holding point is to be extended to align with the **Train Demand** initiation point.

18.11.6 Requirements for Boom Gates

When an interface with traffic lights is to be provided on a Type F crossing without boom gates, it will be necessary to install boom gates where the boom operation is an essential part of preventing a queue reforming over the crossing when the clearance phase on the traffic lights ahead is terminating. When separate traffic light installations exist on either side of a Type F crossing without booms, it may not be necessary to provide the booms where the traffic light interfacing ensures that vehicles will not require to come to a stand at the Type F lights themselves. Where this occurs, individual sites should be risk assessed to ensure a suitable level of protection is provided.

18.12 Principle 18.12 - Operation of Advanced Warning Lights for Level Crossings

18.12.1 Introduction

This principle addresses the requirements for Advanced Warning Lights for road traffic when integrated as part of the level crossing installation.

18.12.2 Local and Environmental Requirements

Advance warning lights may be provided on one or both road approaches to the level crossing where the motorists view of the type F signals is compromised by the road layout or by other uncorrectable obstructions or where a risk assessment deems them appropriate. (For advance warning light positioning and cable sizes required for various applications refer to specification SPG 0723)

18.12.3 Sequence of Operation

The Advanced Warning Lights will usually operate simultaneously with operation of the Type F lights.

In some cases, it may be preferable to initiate operation of the AWL at a predetermined time before the Type F lights are activated. This is to permit vehicles travelling at the road speed limit after passing the AWL extinguished will be able to pass through the crossing without the crossing commencing to operate before they arrive at it.

Figure 13 - Advanced Warning Signs

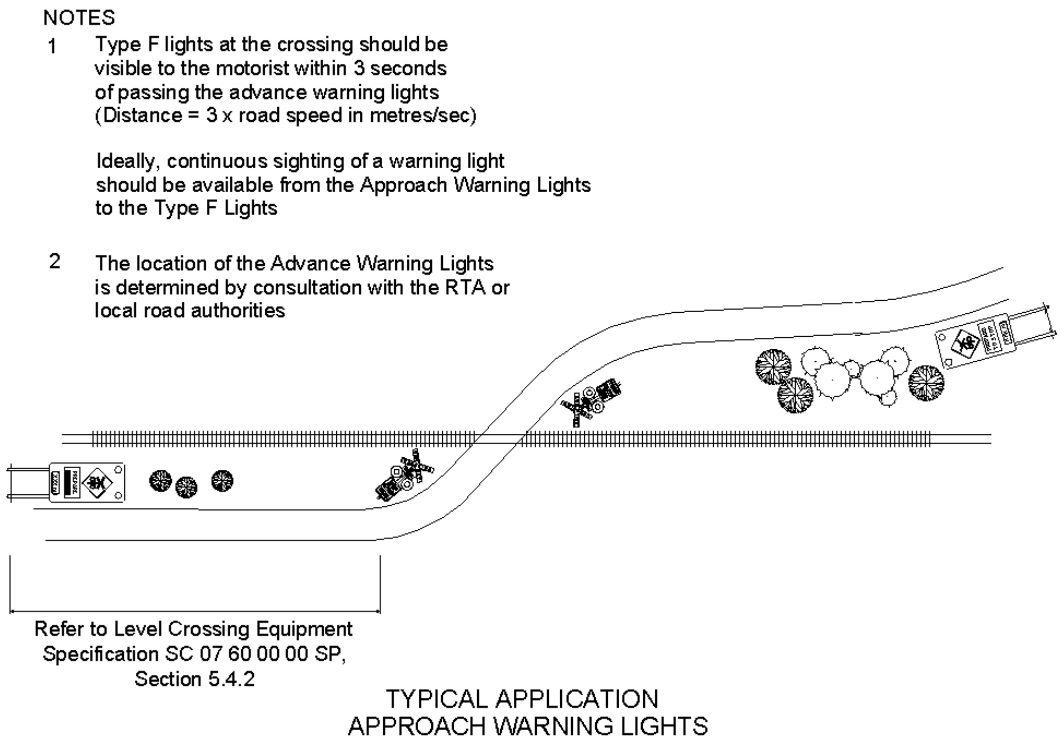


Figure 14 - Typical Application Approach Warning Lights

18.13 Common Level Crossing Requirements

18.13.1 Introduction

This section includes definitions and comments that are common to all types of level crossing.

18.13.2 Statutory Requirements

These shall be in accordance with AS1742.7 for a level crossing controlled by Type F highway signals only.

When a pedestrian crossing is attached to a road crossing, then the requirements of the pedestrian crossing shall also apply.

18.13.3 Lighting

The pedestrian crossings will be illuminated to 45 lux unless the environment and risk assessment confirms another figure.

18.13.4 Power Supply

A secure signalling supply shall preferably be provided.

A standby battery and battery charger shall be permanently connected to the supply.

The standby battery shall be of sufficient capacity to ensure the proper operation of the crossing equipment for at least 32 hours under normal operating conditions.

Where power interruptions may impact the level crossing, the battery backed up supply shall be utilised such that the gate delay time between a warning being given and the road booms commencing to drop is not reduced.

18.13.5 Power Supplies for Pedestrian Crossings

The pedestrian level crossing shall be provided with standby power supply arrangements. Normally, this is provided by batteries. If batteries are not used for standby power supply then a total failure of the power supply shall also fail the signals over the crossing.

If supplied from a secure signalling supply arrangement (ie a normal and an independent emergency AC supply), a pedestrian level crossing with barriers which close on loss of supply need not be provided with battery backed power supply arrangements.

Battery supplied warning light circuits shall be provided in new works.

18.13.6 Circuit Integrity

Duplicated flasher units (or single units with internally duplicated flashers) and wiring shall be provided and the flasher units shall be "ring" wired out to each Type F highway signal such that the failure of one flasher or the open circuit failure of one wire or connection point shall not result in the total loss of all the highway signals on one side of the crossing.

Advance warning lights shall be wired so that each light on any one approach is connected to a separate flasher.

18.13.7 Approach Warning Signs (Rail)

W7-4B warning signs to AS 1742.7 and AS 1743 shall be erected immediately to the left of the running line and adjacent to the approach track circuit block joints advising drivers that they are approaching an actively protected level crossing and to avoid bringing their trains to a stand on level crossing approach track circuits.

Where a grade crossing predictor is used, the predictor warning signs shall be edged in blue. The sign shown in Figure 16 advises drivers not to increase speed on the approach to the crossing

In situations where multiple level crossings exist and the approach control areas overlap, the Approach Warning sign shall have an additional sign with the name of the level crossing to which it applies.

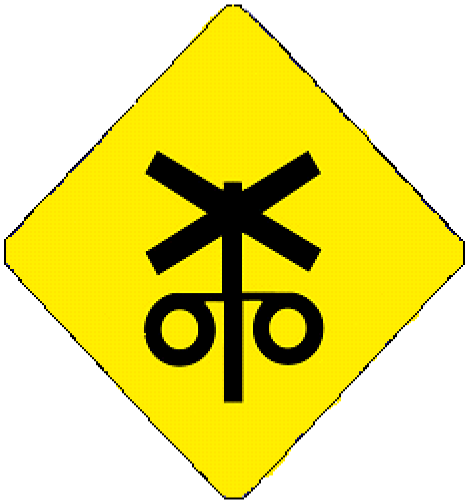


Figure 15 - Sign used for normal level crossings

Figure 16 - Blue-banded sign used for level crossings fitted with grade crossing predictors

18.13.8 Crossing Monitoring and Testing

Level crossing functions shall be monitored locally with a level crossing monitor/event logger.

Crossing functions to be monitored include:

- Road Gates normal and reverse
- Pedestrian Gates normal and reverse (preferably individually)
- Crossing control
- Gate Delay

- Light controls
- Emergency gate operations and lock proving
- Local track circuits
- All Test, Manual Control and Emergency switches
- Lamp integrity
- Other functions available within the level crossing location may be monitored, if required

Remote monitoring and testing of the level crossing functions, including a battery check, should also be provided whenever suitable communications facilities are available.

18.13.8.1 Emergency Switches

A single Master Emergency switch will be provided, labelled the "Master Emergency" to turn off the crossing. This will cause all booms to raise, pedestrian gates to open, lights to extinguish and the silencing of the warning bell. When the Master Emergency switch is operated, signals over the crossing cannot be cleared unless the level crossing is proved operating. The Master Emergency switch has two positions – 'Normal' and 'Emergency'.

Each road boom & set of pedestrian gates will be provided with its own emergency boom switch. This will permit a damaged boom to be tied up and the mechanism disconnected so that it is not damaged while the rest of the crossing operates. While the boom is tied up it will not be possible to clear signals over the crossing.

Where four quadrant booms are provided, the booms on the same side of the road shall be switched through the same emergency switch. Each pair of pedestrian gates shall also have an emergency switch.

Emergency switches shall be key locked such that it is not possible to remove the keys unless the switches are in the correct position for normal operation.

Emergency switches shall be unlocked by emergency keys. The key shall be captive in the switch, when it has been switched off. It shall not be possible to close & lock the lid of the emergency switch box whilst an emergency switch is operated.

Local emergency switches are not required for Private Level Crossings.

18.13.9 Local Test Switch and Manual Operation Switch

A test switch may be provided to enable the highway signals, the half-boom barriers, the warning bells and warning lights (each where fitted) to operate directly from the standby power supply, with the main supply switched off. The test switch positions are 'Normal' and 'Test'.

The test switch box shall be unlocked by a special key & it shall not be possible to close the lid and lock the box unless the test switch is in the 'off' position.

Test switch boxes are not required if the crossing is fitted with a manual operation switch and is remotely monitored, with the monitor performing battery and level crossing functioning checks. Test switch boxes shall be provided where local testing is required.

A manual operation switch shall be provided in a SL locked box. This switch shall not switch off the mains power supply to the level crossing equipment, but shall permit activation of the level crossing, even if the emergency switch has been operated. The switch positions are 'Auto' and 'Manual'.

18.13.10 Test Switch Indications

Where a test switch box is provided a power supply indication shall be provided to enable the charge status of the standby battery to be determined when the test switch is activated.

This shall be an indication lamp operating from a voltage-sensing device.

The lamp shall be illuminated when the test switch box is opened and the voltage of the standby battery is equal to or above a predetermined level.

The lamp shall remain extinguished when the test switch box is opened if the voltage of the standby battery is less than a predetermined level.

18.13.11 Audible Warning – Road Level Crossings

On single line level crossings, a warning bell, or other approved audible warning device, shall be provided at the level crossing and shall surmount the Country side Type F highway signal post. The audible warning may be suppressed when the front of the train passes over the level crossing.

On multiple line level crossings or where booms are provided on single lines, two warning bells, or other approved audible warning devices, shall be provided at the level crossing such that one shall surmount the Sydney side Type F highway signal post, and one shall surmount the Country side Type F highway signal post.

The audible warning on one side of the level crossing may be silenced when both the half-boom barriers are fully lowered. Alternate arrangements for silencing of audible warnings may be applied if site conditions warrant and special approval is provided.

In those locations where pedestrian barriers and lights are fitted, both the level crossing audible warning bells can be suppressed if required when the booms are fully lowered provided that the pedestrian crossing is fitted with controlled volume warning sirens.

The road audible warning may be silenced at night between 2200 and 0600 Eastern Standard Time providing the crossing is provided with booms and environmental conditions require it. Alternatively, where pedestrian traffic is likely, but a separate crossing is not provided, the road bells may be switched to tone generators.

Pedestrian tone generators are not to be silenced. Level crossings without booms are not to have audible warnings silenced.

The suppression of any warning equipment is subject to a prior assessment that minimum audible warning standards are maintained. Standards that need to be considered are:

- RailCorp Signalling & Construction Standards,
- AS 1428.2 Design for Access and Mobility
- AREMA Communications & Signals Manual Section 3 – Highway-Rail Grade Crossing Warning Systems
- AS 1742.7 Manual of Uniform Traffic Control Devices – Railway Crossings
- Disability Standards for Accessible Public Transport 2002

18.13.12 Level Crossing Failure Modes

Level crossing warnings are intrinsically non-failsafe, since the absence of a warning implies that it is safe to cross. Level crossings shall be designed so as to minimise the

impact of failures on the operation of the crossing. The following are acceptable minimum failure modes and goals.

- No single failure of the level crossing equipment shall result in the level crossing failing to give a warning indication when required. Modes that are to be protected against are:
- Protection against inhibition of warning for next train in opposite direction on lines with traffic in both directions (see note below);
- Protection against extended continuous operation without train present.;
- Protection against loss of lights caused by a single high resistance relay contact or broken wire or terminal.
- A failure of the external power supply shall not affect the integrity of the level crossing protection as permitted by the battery capacity (refer to Section 18.13.4).
- Lamp and flasher circuits shall be configured so that in the event of a single failure, a reduced, but effective warning is provided for vehicles approaching from both directions.
- Additional lights, when provided, shall be wired to enhance the operation in failure conditions.
- Boom mechanisms shall descend on failure, except for trailing booms on four quadrant boom installations, where the failure mode shall be determined by risk assessment.
- Pedestrian Emergency gates shall unlock on failure.
- Pedestrian swing gates shall close on failure.
- Road Warning lights shall continue to be displayed until booms are fully raised.

Note: Specifically irregular operation of direction stick relays shall be anticipated and designed out. At least three independent track circuits need to be included in the logic and any qualifying relay (or direction stick) shall not energise until the train is on the level crossing.

18.13.13 Level Crossing Identification Signage

Level crossings shall be provided with identification signage in accordance with SPC 521.

18.14 Principle 18.14 – Signals and Level Crossings

18.14.1 Introduction

Where signals are located close to level crossings, the level crossings may not operate when a train approaches the signal at stop. This principle prescribes the controls that may apply for automatic crossings. Section 18.14.11 applies for Manually Controlled Crossings.

18.14.2 Requirement – Automatic Signals

Where automatic signals are provided within the track controlled approach of a level crossing and EMR arrangements are provided the automatic signal in the approach to the crossing shall be held at stop when the master emergency switch is operated and will not clear unless the level crossing is proved operating. In existing level crossings where the EMR is not provided the automatic signal controls are not interfaced to the level crossing and operate independently of the crossing.

Where trains may regularly stop at automatic signals within the level crossing track controlled approach, the level crossing operation may be qualified by the signal at stop, if road movements are adversely affected. In this situation, the method of operation shall be as if the signal was a controlled signal.

Automatic signals that qualify level crossing operation shall be a distance from the level crossing, such that should the signal be passed in the stop position, in accordance with the rules, adequate warning time is provided by the level crossing to road vehicles.

This time may be the minimum safe time and may consider such aspects as the time taken for the train having to trip, recharge the brakes and restart.

Consideration shall also be given to maintenance of level crossing holding requirements.

18.14.3 Requirement – Controlled Signals

Where a controlled signal exists within the track-controlled area of a level crossing, the signal shall be interfaced to the level crossing to ensure that:

- The minimum warning time occurs
- Level Crossing holding requirements (for multiple line crossings) are maintained,
- Level crossings, once the warning ceases and booms rise, remain open for road traffic for a minimum time before being initiated for another train movement.

18.14.4 Signal Overlaps At Level Crossings

Where a signal qualifies a level crossing operation, for new works, the signal shall be a minimum of 40m from the level crossing.

18.14.5 Minimum Booms Open time

When a crossing requires to be operated for a second time soon after a previous operation, the crossing must not activate until the booms have been fully up for a minimum of 15 seconds, giving sufficient time for vehicles that start to cross to complete their crossing. This is the same result as provided by holding controls on fully automatic crossings.

18.14.6 Signals Within The Crossing Control Track Circuits

When a signal is located close to a crossing and the signal is to be cleared, the signal must not clear until the booms are horizontal, if a train is closely approaching.

Where a signal is located in the outer approach control of a crossing, the signal may clear without the booms being down providing there is sufficient time to provide the normal warning time before the train reaches the crossing at the reduced speed at which the train is likely to be travelling.

18.14.7 Signals Within The Crossing Holding Track Circuits

Signals within the holding track circuit area do not require to be delay cleared, provided the conditions for the minimum boom open time have been met.

18.14.8 Avoidance Of Excessive Operating Time

Care should be taken that level crossing operating times are not unduly lengthened when signals are located in the approach and train speeds are lower than line speed.

Train simulation software can assist in determining the train speed profiles that can be applied.

18.14.9 Avoidance Of Excessive Signal Clearance Times

Signals shall not take an excessive time to clear. Where Type F level crossings are not fitted with booms, the crossing shall be considered ‘normal’ after 15 seconds of operation.

18.14.10 Application Of Approach Locking

Once a signal is cleared over a level crossing, the route cannot be normalised unless the usual approach locking conditions are met. Care is to be taken that approach locking is applied at the time of signal clearing and not at the time of level crossing initiation.

18.14.11 Manually Controlled Crossings

Manually controlled crossings are usually provided where road traffic levels are high and signallers need to visually observe the crossing clear of vehicles before lowering booms or signalling a train to cross. In some cases, VDU style monitors may be provided in conjunction with cameras at the level crossing to provide the visibility required. Such monitors shall ensure that the full area of the crossing between boom gates and pedestrian swing gates is visible.

Manually controlled crossings shall not be permitted to operate reverse until all routes over the crossing are normal and any route holding between the signal and crossing is normalised.

Conversely, signals over the crossing are to require the crossing proved normal.

Booms may have individual operating switches for each boom or, alternatively, and subject to risk assessment, a single switch for all booms.

Switches are not provided for pedestrian crossings.

The switches are “Raise-Lights-Lower” 3 position switches.

When any switch is operated to the ‘lights’ position, all warning lights shall operate and pedestrian crossings shall continue to complete their operation.

The operation of the boom is then subject to operation of the switch to the ‘lower’ position. The signaller may toggle the boom up and down if necessary.

Where appropriate, automatic normalisation of signal routes and automatic raise of the boom gates may be provided. This will require an ‘Auto Raise’ pushbutton to be able to select ‘Manual’ or ‘Auto-Raise’ options.

The manual position is required for vehicles that may not reliably operate the track circuits.

Indication lights of ‘Booms Down’, ‘Booms Up’ and ‘Auto-Raise’-On’ shall be provided for each switch provided.

ESG 100.19

TRAIN ORDERS

Version 1.1

Issued May 2010

Document control

Version	Date	Summary of change
1.0	March 2006	Replaced *SC 00 13 01 19 SP Train Orders v7* of 1 July 2004
1.1	May 2010	Principle withdrawn

ESG 100.20

WARNING LIGHTS

Version 1.4

Issued February 2011

Document control

Version	Date	Summary of change
		Replaced *SC 00 13 01 20 SP Warning Lights v3* of May 2003
1.1	May 2006	Amendment to 20.2.1 20.3 – Safety Officer added to make up of Sighting Committee and 'risk' assessment added to requirements of the committee
1.2	4 August 2008	Amendment to 20.2.1 Fourth dot point – replace the wording "warning lights" with the word "signals"
1.3	May 2010	Application of *TMA 400* format.
1.4	9 February 2011	Section 20.1.3 - 4th list item changed word 'normal' to "Signalled".

Contents

20 Warning Lights

20.1 Principle No 20.1 - Train activated warning lights

20.1.1 Introduction

This principle addresses the minimum requirements of all fixed train activated warning light systems provided for the purpose of warning persons on, or near the track.

20.1.2 Requirements-Provision of warning lights

Fixed warning lights are provided adjacent to running lines in order to provide adequate warning of the approach of rail traffic to all authorised persons required to walk or carry out work on or near parts of the track where only a limited safe place is available. These areas include entrances to tunnels, tunnels, walkways along or across railway lines and other areas where there is only limited visibility.

20.1.3 Form of Warning Lights

- In the City Underground area, or where specifically approved due to possible conflict with other adjacent white lights, the warning light shall be rectangular "**yellow**" light.
- In all other areas warning light shall be round "**white**" light.
- Notice plate inscribed "**Warning light**" **with the name of the applicable line**, shall be displayed with warning lights.
- Warnings shall be provided for the approach of any train from any signalled running direction, on the applicable line.
- Employee Crossings:

  - A sign " Light Out indicates train approaching" shall be displayed.
  - Where used across double tracks, a separate warning light for each track shall be provided clearly marked with the track to which it applies. An additional sign "**Do not cross unless both lights are showing**" shall be provided.
  - Warning lights are **not** to be provided for installation at more than 2 tracks in the one crossing. For such installation, normal pedestrian crossing arrangements shall be considered.

20.1.4 Positioning

- Warning lights shall be positioned immediately adjacent to the track to which they apply and on the left hand side in the normal running direction.
- Spacing shall be such that at least one light is clearly visible from any point adjacent to the track.
- Warning lights shall not be placed on signals.
- Warning lights shall not be positioned close to signals in such a way that a driver may misread a warning light for a signal or the warning light reduces the visibility of the signal.

20.1.5 Warning time

The initiation of the warning shall allow an absolute minimum of 20 seconds or sufficient time for any user to reach a safe place before the arrival of a train. Designs shall be based on 30s warning unless additional time is required to reach a safe place.

20.2 Warning Light Controls

Warning lights shall be designed to operate in a failsafe mode so that an absence of indication is considered as a warning. Separate warning lights shall be used for separate tracks unless specifically approved otherwise.

The warning given by the system shall be initiated by the detected approach of any rail traffic movements routed towards the protected area, and shall be maintained until such time as all those movements are detected as being clear of the protected area. Operation of the warning lights shall be automatic and not require any action by the signaller.

Fail safe means of train detection shall be used. Failure of train detection equipment shall ensure that the system is maintained in a "warning" state.

20.2.1 Signal Operated Controls

When the track controlled approach area of the warning light extends past a controlled signal, the signal may qualify the warning light control as follows:

- If the signal is close to the protected area, the warning light shall extinguish on train approach to the signal, and after a route time release and the signal remaining at stop, the warning light may be then illuminated.
- If the signal is a distance from the protected area the warning may be suppressed if a train approaches and the signal is at stop.
- If a signal is to be cleared with a train on the approach, design shall ensure sufficient warning is given.
- Excessive time delay clearing of signals is to be avoided. A maximum delay of ten seconds shall apply. A period of ten seconds shall apply for driver response to a signal clearing. Where point operation is included in the signal controls, any delay to signal clearing may operate concurrently with point operation.
- Wherever possible, warning lights that remain out for extended periods should be avoided. In such cases, it is preferable to ensure the warning light provides an indication of altered circumstances (ie train movement) even if minimum operation times may not always be achievable. Such situations may occur in sidings or terminating roads where signal clearance may precede train movement by a significant period of time.

20.3 Sighting Committee

When a request for installation of warning lights is received by the Signal Engineer, a sighting committee shall be convened and sign off on the placement of warning lights. The committee shall consist of:

- Signal Engineer
- Designer
- Representatives from on-track staff who may use the warning light
- Any other parties who may use the warning light
- Safety Officer

The Committee shall consider the outcomes of the risk assessment including:

- Availability of safe place
- the time taken for staff to move to the safe place
- the area the warning light is to protect

- the directions from which trains may approach
- sighting of the warning light
- possible misreading of the warning light
- possible conflicts with background lighting

ESG 100.21

PLACING SIGNALS TO STOP TO PROTECT A WORKSITE

Version 1.4

Issued May 2013

Document control

Version	Date	Summary of change
1.0	May 2006	Replaced *SC 00 13 01 21 SP v 1.1* of 29 July 2004
1.1	May 2010	Principle withdrawn
1.2	8 Oct 2010	Principle reinstated
1.3	2 Nov 2010	21.4 - delete extent to be 5 km; 21.5 – discussion of extent exceeding 2.5 km
1.4	May 2013	Minor terminology update pertaining to Worksite Protection Key

21 Placing Signals at Stop to Protect a Worksite

21.1 Introduction

This principle addresses the requirements for provision of a key lock arrangement to place the signal at stop in order to protect a worksite.

21.2 Concept

Utilisation of signals to protect worksites is advantageous as train drivers are aware of the location of signals and the same level of protection offered by the signalling system can be extended to protect worksites. Workers holding possession of the worksite protection key are provided with additional assurance of the protecting arrangements.

21.3 Requirements – Worksite Protection Key Lock Arrangement

A worksite protection key and a key-locked switch fitted in an SL locked box shall be provided at selected locations.

The worksite protection key applicable to each signal shall be mechanically indexed and labelled showing the extent of the protected area (possession area) i.e. from and to in kilometres, the line to which it applies and the signal number.

Example:

SY136 Up Main 7.8km to 6.5km

A maximum of 18 wardings are available as follows

WSA	WSB	WSC	WSD	WSF
WSG	WSH	WSJ	WSK	WSL
WSM	WSN	WSO	WSP	WSR
WSS	WST	WSU		

Wardings shall be allocated so that the maximum distance is provided between reuse of the same warding.

When the key lock box is unlocked with the SL key, a flap shall be opened displaying the signage, “WORKSITE – DO NOT PASS AT STOP WITHOUT AUTHORITY” IN WHITE WRITING ON RED BACKGROUND. The sign shall not be restored unless the key is inserted and turned to restore the signal.

The SL locked box shall be labelled: Worksite **Protection Key “XXX”** (Signal number).

21.4 Control Requirements

When the worksite protection key is removed from the key lock box, the signal and trainstop (if fitted) shall return to the stop position.

The worksite shall be nominated to commence clear of the overlap of the previous signal. Conditional overlaps may also be utilised for this purpose. Where full block overlaps are

utilised well in excess of braking requirements, an overlap point may be derived to be that point which the *Signal Design Principles* would ordinarily nominate as the required overlap.

Where conditional overlaps are in use, the removal of the worksite protection key must also disable the full overlap of the signal in the rear.

21.5 Extent of Worksite

The limits of each worksite area shall be identified by signs at the respective locations. The sign shall give the notations 'Worksite' and kilometrage, with black writing on a white background.

Each start may or may not be the finish location of the previous one.

The furthest extent of any area shall not exceed 5km from the signal, unless specially approved due to the particular conditions. A risk assessment of any altered arrangements must be performed to determine the alternative arrangement and ensure all other configuration aspects (such as Safeworking Rules) are addressed.

Where the extent exceeds 2.5km, a consideration of the risks shall include the potential for driver distraction due to station of signal stops, level crossings or other line-side feature or activity.

ESG 100.22

MEASUREMENT OF DISTANCES ON SIGNALLING PLANS

Version 1.1

Issued May 2010

Document control

Version	Date	Summary of change
1.0	March 2006	Replaced *SC 00 13 01 22 SP v1.1* of 30 July 2004
1.1	May 2010	Application of *TMA 400* format.

Contents

22 Measurement of Distances on Signalling Plans

22.1 Introduction

This Principle addresses the requirements for labelling distances on signalling plans and specifically in train order areas.

22.2 Purpose

Traditionally, kilometerage posts marked on signalling plans are utilised to locate the position of signalling equipment.

With the implementation of the GPS system and its reliance in Train Order territory to locate trains, short or long kilometres have been identified at some locations.

The Train Order computer used in Train Order working requires consistent kilometerage measurements as reference points for determining authorities.

These guidelines set out the requirements for measuring distances on signalling plans.

22.3 Requirements – General

All signalling equipment, but in particular, yard limit boards and shunting limit boards in Train Order areas shall be measured from the nearest Sydney end kilometres or half kilometres posts.

22.4 Requirements – Loop Length

Loop lengths shall be an absolute length and shall not be measured using kilometerage posts.

When measuring loop lengths, the published standing room shall be the distance between starting, home starting signals or clearance posts at either end of the loop, less 5 metres for sighting.

22.5 Drivers Diagrams

Kilometerage on driver's diagrams for Train Order areas shall be field checked with the COC of the signalling plans and updated before being published in the weekly notice.

Other areas should update kilometerages in the normal certification and updating process.

22.6 Field Engineers

It is the responsibility of the field engineers to inform Chief Engineer Signals when distances between kilometerage posts on signalling plans are found to be substantially (>10%) different to the measured distances.

On signalling plans where it is known that the kilometerage posts are inconsistent with the actual measurements, it shall be highlighted.

22.7 Measurements

All Measurements must be taken along the Down Rail of the Main Line and distances read across to the item to be measured.

ESG 100.23

PLACEMENT OF YARD LIMIT SIGNS

Version 1.3

Issued May 2010

Document control

Version	Date	Summary of change
1.0		Replaced *SC 00 13 01 23 SP v1.1* of 30 July 2004
1.1	16 May 2008	23.3.3 Reworded for clarity
1.2	2 July 2009	'Yard Limit Boards' changed to 'Yard Limit Signs'
1.3	May 2010	Application of *TMA 400* format.

Contents

23 Placement of Yard Limit Signs

23.1 Scope

There are two types of Yard Limit Signs.

The first type displays the words 'Yard Limit'. It may be qualified by the addition of 'P' or 'A'.

The second type displays the letters 'YL' on an oval background. An 'EYL' plate is also provided for and has a rectangular background. Horizontal and vertical formats are provided.

All Yard Limit lettering is black on a white background.

23.2 Application of 'Yard Limit' Signs

23.2.1 'Yard Limit' Signs

These Signs are used to define the boundary between a section and an interlocking area or between adjacent yards.

In Train Order Working areas, these Signs denote the end of the train order section and the start of the train order location.

They may also be used to define the boundary of two adjacent train order locations.

The criteria for the placement of these Signs in Train Order areas are detailed in the Principle on Train Order Working (ESG 100-19).

These Signs may also be used in token areas to define the boundary between the section and the interlocking or yard.

They may be used in lieu of a home signal where the signal may be permanently fixed at stop.

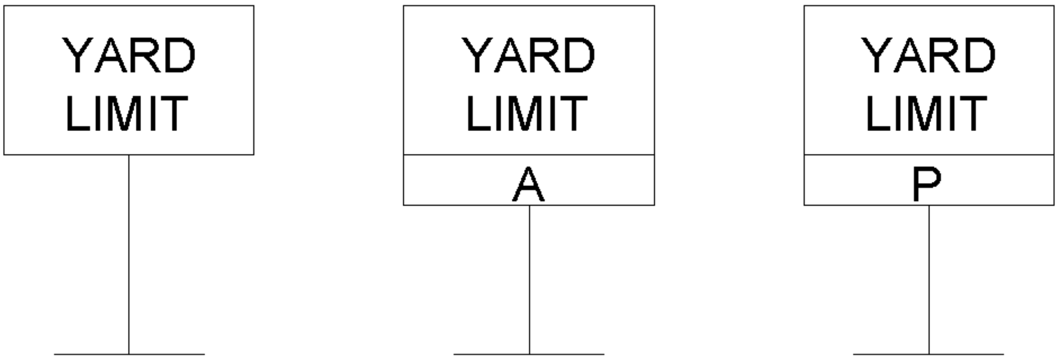
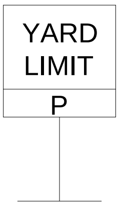


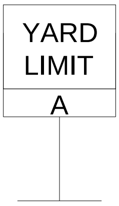
Figure 1 - Typical Yard Limit Signs

23.2.2 Qualification Plates

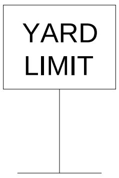
Yard Limit Signs may be fitted with one of the following qualification plates:



A 'P' plate makes the Yard Limit Sign permissive.
Drivers may pass this board if it is safe to do so.



An 'A' plate makes the Yard Limit Sign absolute.
A verbal authority is required to pass this board.



A Yard Limit Sign without qualification (as used on Train Orders) is a restrictive board and can only be passed on written authority (i.e. Train Order or Special Proceed Authority)

Figure 2 - Yard Limit Signs with Qualification Plates

23.3 Application of ‘YL’ & ‘EYL’ Signs

23.3.1 ‘YL’ and ‘EYL’ Signs

YL signs are used in signalled areas to define the start of Yard Limits for the purposes of yard working as defined in the Network Rules and in assisting Track Occupancy Authority (TOA) working.

EYL signs define the end of the yard.

The signs are provided for each track and both running directions on that track, whether signalled or not.

The signs are located to define an area of control

Figure 3 - YL and EYL Signs

23.3.2 Unidirectional Double Lines

On unidirectional double lines, the YL sign is usually mounted back to back with the EYL sign.

The signs are usually located as follows:

Normal Direction of Travel	
YL Sign	On the first controlled signal (usually the accept).
EYL Sign	On the first automatic signal after the last controlled signal.

Reverse Direction of Travel	
YL Sign	On the rear of the signal fitted with the normal direction EYL Sign.
EYL Sign	On the rear of the controlled signal fitted with the normal direction YL Sign.
Note: Placement of the plates for the reverse direction of travel may be on the right hand (or 'wrong') side	

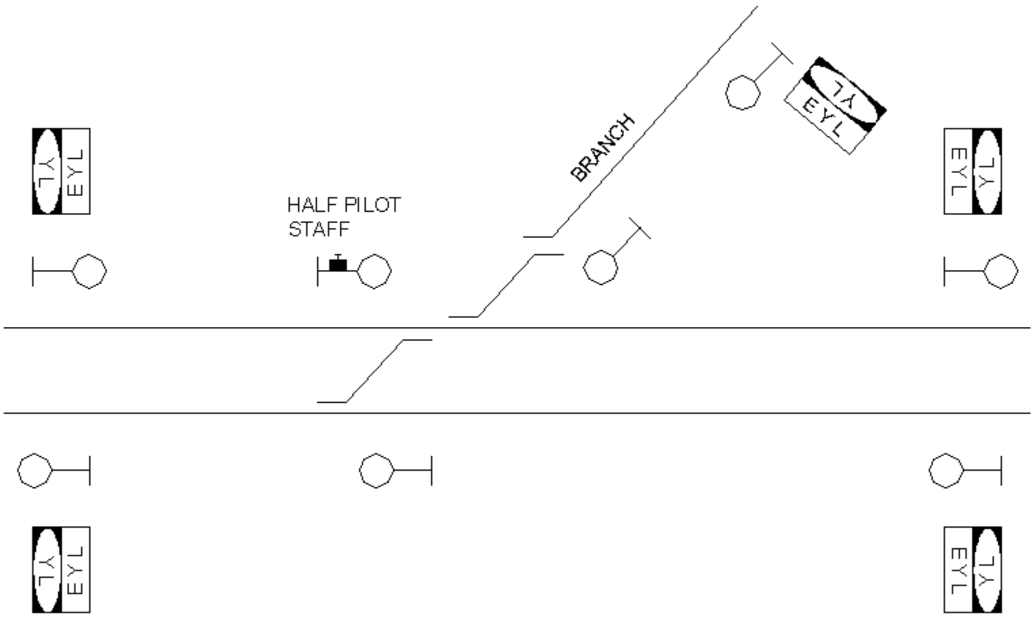


Figure 4 - Placement of YL and EYL Signs at Single Line Junction

23.3.3 Unidirectional Multiple Lines

On multiple lines, the placement of the YL and EYL will be the same criteria as for double lines. However, plates are to be located on the left side in the direction of travel and are to be of the vertical format when located in the '6ft'.

This is to avoid misreading due to plates being located on the 'wrong' side.

23.3.4 Single Line

On single lines, YL and EYL plates are not normally provided, as the yard limits are clearly defined by the location of the signals.

However, at certain locations where the provision of YL and EYL signs is requested, the signs are to be placed as follows:

YL Sign	On the first controlled home signal.
EYL Sign	On the reverse of the first controlled home signal.

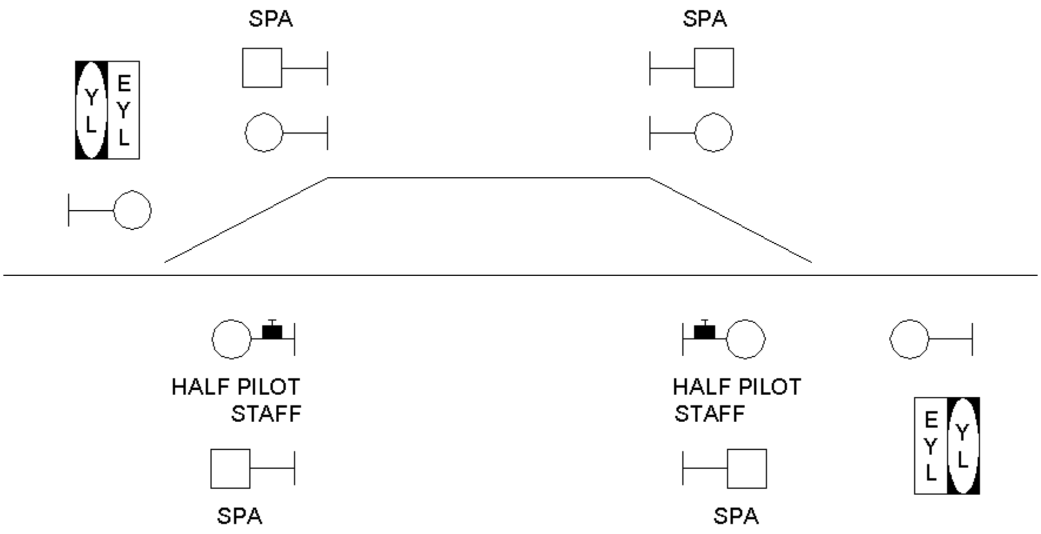


Figure 5 - Single Line Crossing Loop

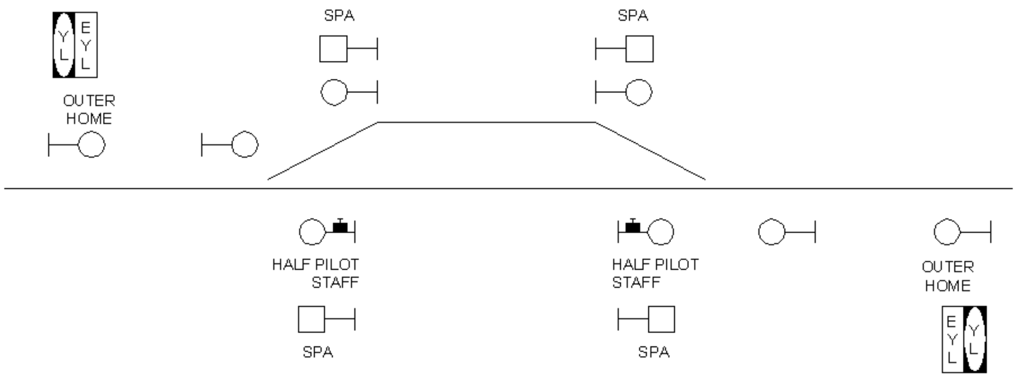


Figure 6 - Single Line Crossing Loop with Outer Home

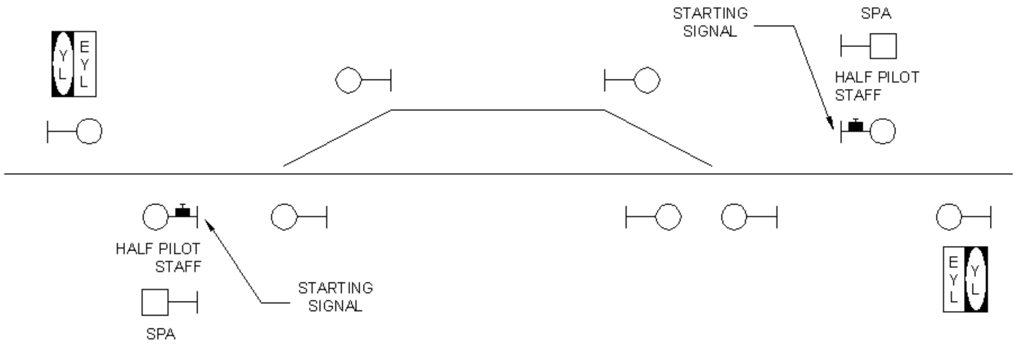


Figure 7 - Single Line Crossing Loop with Starting Signal

A Special Proceed Authority (SPA) sign may be provided on these signals. The SPA signs may be mounted either on the signal post or separately adjacent to the signal. The inscription on the SPA sign shall read:

> WHEN AUTHORISED TO PASS THIS SIGNAL AT STOP DRIVERS MUST NOT PROCEED BEYOND YARD LIMITS EXCEPT ON AUTHORITY OF A SPECIAL PROCEED AUTHORITY OR DURING PILOT STAFF WORKING

23.3.5 Bidirectional Lines

At simple bi-directional crossover locations, the YL and EYL signs are located on the first protecting outer home signal or home.

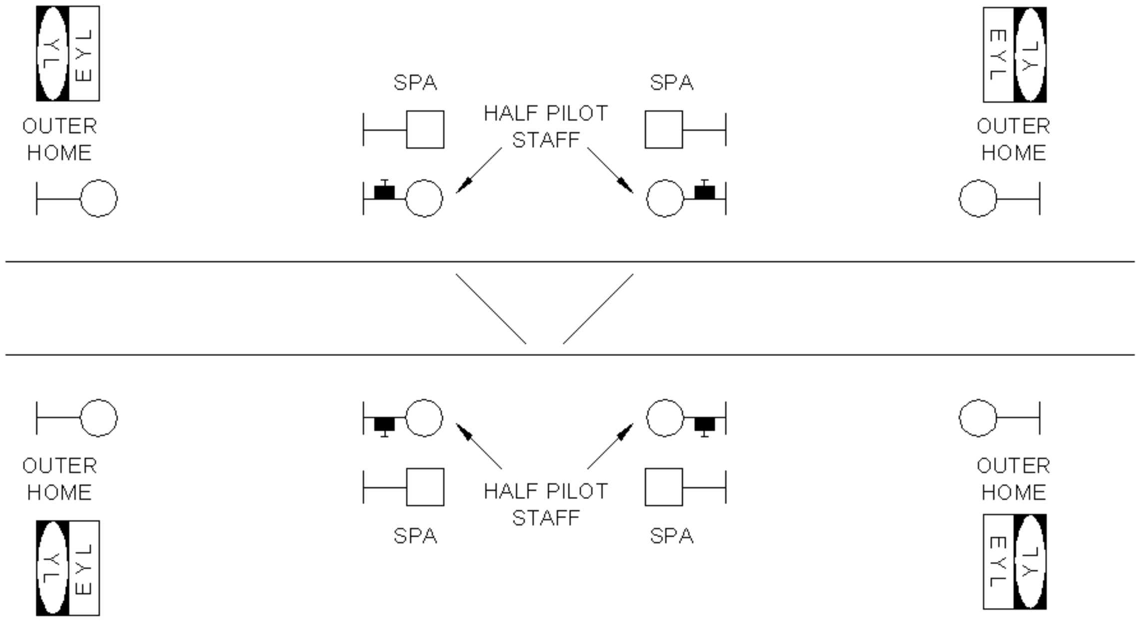


Figure 8 - Bi-directional Lines - Crossover

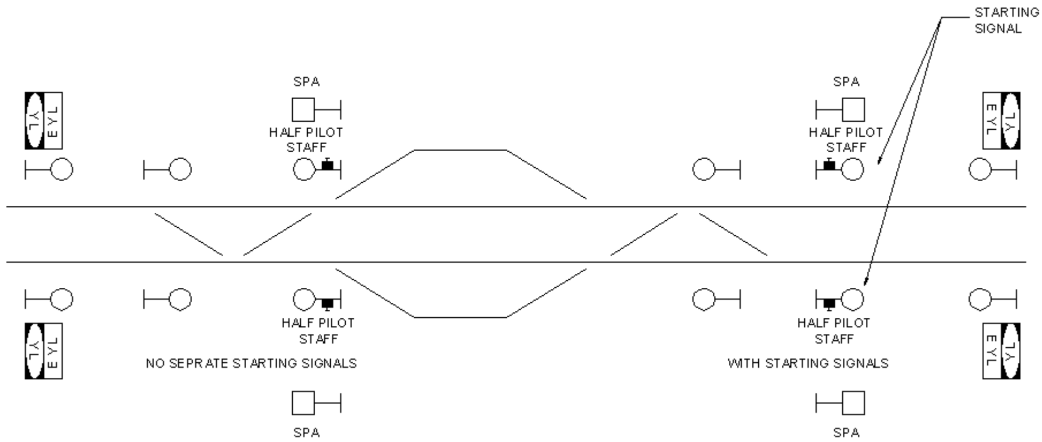


Figure 9

The criteria shall be the same as for single lines in 23.3.4.

A Special Proceed Authority (SPA) sign may be provided on these signals. The SPA signs may be mounted either on the signal post or separately adjacent to the signal. The inscription on the SPA sign shall read:

> WHEN AUTHORISED TO PASS THIS SIGNAL AT STOP DRIVERS MUST NOT PROCEED BEYOND YARD LIMITS EXCEPT ON AUTHORITY OF A SPECIAL PROCEED AUTHORITY OR DURING PILOT STAFF WORKING

23.3.6 Adjoining Locations

There may be cases where two locations are adjacent such that the signals are dual controlled, or the signal past the starting signal is the Accept Signal of the next location.

In this context, the EYL of the previous location and the YL of the next are located on the same signal. When this occurs, the location name is added to the YL and EYL signs to distinguish the to which the location each sign applies.

On horizontal format signs, the name is located immediately above the sign. On vertical format signs, the name is placed vertically down the left side of the sign.

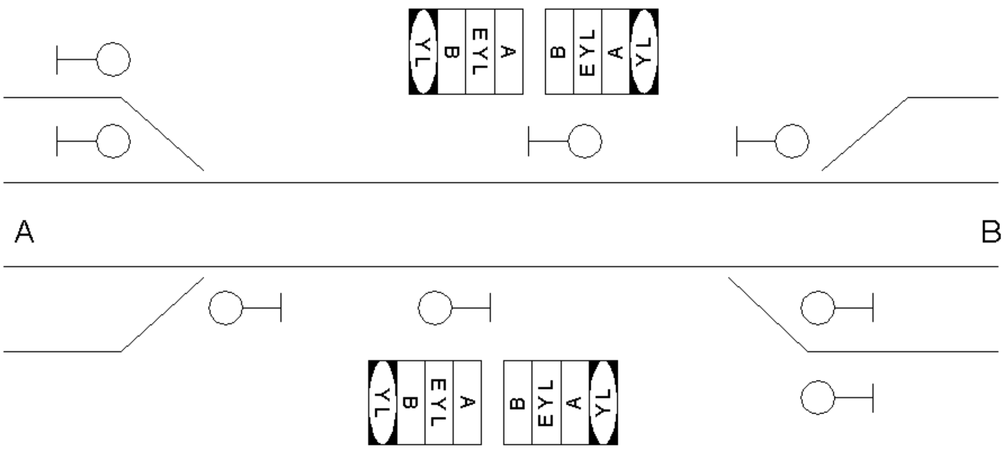


Figure 10 - Adjoining Locations - Double Track

In an extreme case where shunting occurs within the dual control area and separate risks protected by each signal box individually exist, the signs may be located at the Shunting Limit Sign.

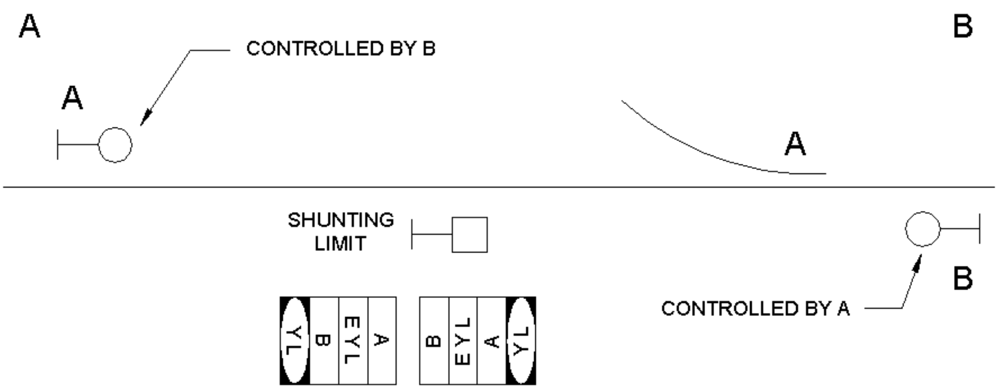


Figure 11 - Adjoining Locations - Single Track

Where dual signs are fitted, the EYL is placed above the YL sign, purely for consistency.

23.4 Determination of the Yard Area Extent

23.4.1 Small Interlocking

The Yard Area is usually the local interlocking area controlled by a signaller.

23.4.2 Consolidated Interlocking

In larger consolidated signal boxes, the larger area may be considered the yard providing:

There are no long sections of automatic signals in the area, unless special circumstances exist where yard working may reduce hazards in the event of an emergency (e.g. City Underground).

The entire area has track circuit occupancy indications displayed in the signal box. Carefully consider if areas with cut tracks provide discrimination of the critical points.

The adjacent signallers controlling the consolidated area can communicate freely and easily between each other. This means they must be in the same place, unless special procedures exist.

There are no separate local control panels that may be separately operated, unless instructions are issued that all the unsignalled operations of that panel are directed from the larger consolidated control location.

23.4.3 Exceptions

The location of YL and EYL signs may be located on signals different to that indicated above if a specific request is made by Operations and the arrangement is safe.

However, the area contained in the Yard must always be able to be protected by the controlled signals at that interlocking or control area. In no case should the protecting signal be an unusually long distance away and for the purpose of this, a distance of three kilometres should not be exceeded without special approval from the Chief Engineer Signals. Difficulties may exist in areas signalled with 2 aspect (automatic and distant)

signals. In this case, the YL/EYL should be at the starting signal or home signal, rather than the Accept or the first automatic past the starting signal.

Starting signals on bi-directional single and double lines should be provided with a plate advising that

> WHEN AUTHORISED TO PASS THIS SIGNAL AT STOP DRIVERS MUST NOT PROCEED BEYOND YARD LIMITS EXCEPT ON AUTHORITY OF A SPECIAL PROCEED AUTHORITY OR DURING PILOT STAFF WORKING

23.4.4 Network Rules Interface

The Network Rules provide for a checklist to be completed by the Signaller before Yard Working is carried out, to minimise the risks associated with the movement.

Regular use of Yard Working at any particular location is monitored by network controllers and considered for the provision of a signalled move.

ESG 100.24

ARRANGEMENTS OF INFRASTRUCTURE TO TRAIN ORDER AND TOKEN AREA BOUNDARIES

Version 1.1

Issued May 2010

Document control

Version	Date	Summary of change
1.0	May 2006	Replaced *SC 00 13 01 24 SP v1.1* of 29 July 2004
1.1	May 2010	Principle withdrawn

ESG 100.25

COMPRESSED AIR SYSTEMS

Version 2.7

Issued 7 March 2012

Document control

Version	Date	Summary of change
1.0	08/01/2008	New document
2.0	15/05/2008	Minor updates from recent works
2.1	02/06/2008	Minor changes by Signals Standards Committee
2.2	30/03/2009	Minor change requested by CES to section 2.1 Design Principles
2.3	26/10/2009	2.1(a) – add flow rate based upon operational requirements.
2.4	May 2010	Application of TMA 400 format.
2.5	June 2010	Application notes to the Design Principles added at the end of section 25.3.1. Page 4 spelling mistake values corrected to valves.
2.6	6 December 2011	25.3.3 Note about instrumentation to detect faults in pipes
2.7	7 March 2012	25.3.1(i), add (v)-(y), 25.3.1.1 – para 2

Contents

25 Scope

25.1 General

This standard details the design principles of compressed air systems for railway signalling use, incorporating air compressors, dryers, receivers, pipework and associated components. The compressed air systems will be used to operate track turnouts (points) and train stops, both of which are actuated by pneumatic cylinders.

This standard is to be read in conjunction with other relevant RailCorp standards and specifications, which will define the scope and methodology for the total system design.

25.2 Definitions

The following definitions apply to this document:

Air system System consisting of compressors, dryers, receivers, pipework, and air users.

Air users Consumers of compressed air, typically train stops and points.

Compressor Room Compressed air supply centre, typically consisting of compressors, dryers, and power supply components housed within a building, and air receivers outside the building.

Duty/duty Refers to two identical items of equipment (eg compressors), which are normally operating concurrently.

High Signifies the highest point of the design operating range.

High high Signifies the point, which is a set (small) margin above the highest point of the design operating range.

High high high Signifies the point, which is a set (large) margin above the highest point of the design operating range.

Lead/lag Refers to two identical items of equipment (eg compressors), which can be both operating at any instant, but which has a 'lead' unit that turns on first, followed by the 'lag' unit (if required).

Low Signifies the lowest point of the design operating range, usually 470 kPa.

Low low Signifies the point, which is a set (small) margin below the lowest point of the design operating range, usually 460 kPa.

Low low low Signifies the point, which is a set (large) margin below the lowest point of the design operating range, usually 400 kPa.

25.3 Design

25.3.1 Design Principles

The following principles shall be adhered to in the design:

a) The total system design flow is to be based upon the operational requirements and is to be calculated assuming 5% concurrent use of train stops and points, plus 30% allowances for leakage;

b) System design pressure is to be 800 - 1000 kPa, regulated to 510 kPa downstream of the receivers;

c) Where two separate systems are interconnected, non relieving regulators shall be provided to permit each system to operate independently under normal conditions but allow air to inter feed between the two systems in the event that one system has a pressure reduction to 450 kPa.

   Air systems on main corridors shall be sized such that one may also feed an adjacent system. Additional capacity need not be provided for this providing it is within the 200% rating of the system design flow as in (f). Where a smaller branch system adjoins the main corridor system, the Branch system shall be designed to be self-contained, and need not have to feed the main system. A single non-relieving regulator shall be provided for the main system to feed the branch system as a second supply point.

d) Current signalling equipment operating pressure is in the range 400-500 kPa;

e) Each Compressor Room feeding the air system to have lead/lag compressors and duty/duty dryers;

f) The total capacity rating of each Compressor Room shall be at least 200% of system design flow;

g) The total capacity of all Compressor Rooms feeding the system shall be at least 400% of the system design fl ow & shall be capable of maintaining system pressure above 450 kPa with the total failure of one flexible hose;

h) Each Compressor Room shall be fed with dual independent power supplies available to both compressors. The failure mode of the system shall be both compressors operating. Loss of a phase shall cause a changeover. The control system shall automatically restart following loss of power;

i) Total receiver and pipework capacity shall be sufficient to maintain system pressure above 400 kPa for 1 hour after compressor equipment failure;

j) An emergency air inlet point (for connection of a temporary compressor) shall be provided in the vicinity of each Compressor Room;

k) System air quality shall meet ISO 8573 class 4, with a maximum dewpoint of +3°C;

l) The system shall be designed such that individual air users can be fed from two independent sources. Thus the system shall be a 'ladder' type design, consisting of an air main on each side of the rail corridor, connected by cross ties at 300 m intervals. The spacing of the cross ties may be increased, with approval, if there are no intervening manifolds. Alternatively a 'ring' type system, or a 'single side' system may be used for smaller systems where approved. For

the ring and single side systems, there shall be a Compressor Room at either end of the system;

m) Maximum design pressure drop under maximum flow conditions, in any pipe, shall be 0.5 kPa/100 m;

n) Minimum pipe and hose size under any flow conditions shall be DN 20;

o) Maximum design pressure drop under maximum flow conditions, between any two points in the system, shall be 50 kPa;

p) System design shall be sufficient to allow for thermal expansion;

q) Orifice plates shall be included in every manifold branch to limit system pressure loss in the event of a downstream failure; and

The failure of any single hose shall not result in the line pressure falling below 450 kPa at any point. Orifices shall be as small as possible consistent with the operating of the equipment in the required operating time at 460 kPa.

These times are:

EP Points – maximum 4 seconds.

EP Trainstops – maximum 1 second.

r) The components of a cross tie and a manifold shall not be combined, where the two are adjoining.

s) Low parts of the system shall have a facility for draining condensate.

t) Lubrication is not to be provided where the field equipment is designed to operate without external lubrication.

Lubrication must not be removed unless all equipment (including piping and control valves) is of the type not requiring external lubrication.

Care is to be taken when lubricators are removed that equipment that has been previously lubricated is refurbished before use in a system without external lubrication.

u) The designer shall calculate a duty cycle for the compressor based on these parameters.

v) Each take-off point to equipment shall be provided with a Pressure Containment (non return) valve to prevent local pressure loss in the event of an air mains failure.

w) Local reservoirs may be provided to maximise local equipment operating time in the event of air mains failure or to even out the air supply under peak operations.

As a guide, at least 50% of the stored air capacity required in item (i) should exist within the system pipework and local reservoirs, and the rest in the main reservoirs.

x) Compressors shall feed the mains and bring them to operating pressure before filling main reservoirs.

y) Main reservoirs and all piping between the compressors and main manifolds shall be duplicated with interconnecting isolation to permit each side to be shut down for maintenance.

25.3.1.1 Application Notes to the Design Principles

Where a provision has been made for an emergency or backup situation, then that allowance does not need to propagate into an overall system requirement. The configuration is to allow for a single fault, and suitable backup for that single fault situation, and not for multiple faults.

Hence the stored air in the system (allocated to that compressor house) is to last for 1 hour upon temporary loss of the 2 compressors in a single compressor house. The stored air can consider the pipe capacity and local reservoirs. Upon a cold start, the pump up time to reach operating pressure is to be less than 30 minutes for the system area allocated to that compressor house. Preference shall be given to charging the line rather than the reservoir, as a priority. Both compressors may be operating to meet this time requirement.

Upon loss of a compressor house, the adjacent system should be able to supply the normal operational air requirements of its own plus the adjacent system. Both compressors may be running for this purpose. Upon loss of a single compressor, the second compressor should be able to meet the normal operational air demand for that part of the system allocated to that compressor house.

Under a pipe rupture situation we can assume that the open ends would be fed by both compressors operating in both houses at either end. The intent is to maintain a reasonable pressure profile in the pipes to minimise any equipment failure. This is the basis of the 400% flow requirement.

In the case where there is a reduction in operational capacity in an adjacent system, providing each large system has an equivalent sized system adjacent, any other adjacent system may be smaller and does not need to be considered to be sized in respect of the adjacent larger system. In this case the larger system may still back up the smaller system.

The size of any system is defined by the location of the non relieving regulators located in the air line between adjacent compressor locations (or the expected location of these, should they not exist in a pre-existing system).

25.3.2 Design Outputs

Design outputs shall include:

- Calculations covering “peak hour” and “off peak” load cases, and emergency conditions such as equipment failure in the Compressor Room;

25.3.3 Operating and Control Philosophy

The typical Compressor Room shall consist of two compressors operating on a lead/lag basis. They will operate in conjunction with two duty dryers, delivering dry air to receivers, which may be located outside the Compressor Room. Air from the receivers is piped to the compressed air system mains.

Instrumentation in the Compressor Room shall consist of flow transmitters (total compressed air flow to receivers), and pressure transmitters (at each compressor, at the receiver, and downstream of any pressure control valves), and at the end of the line.

Further instrumentation shall be provided along the main piping run to detect faults, such as leaking or ruptured PVC hoses. Detection of tail hoses protected by orifice plates is not required. Typically, transducers either side of a PVC hose in a steel main is required.

All compressors and dryers will be monitored and controlled by a local PLC based controller. The controller shall monitor run status (off/running/faulted), lead/lag allocation, and hours run. The controller shall automatically reallocate the lead compressor unit based on hours run and a preset changeover value. The controller shall also transmit control and data signals to a PLC based control system located in the maintenance office, to allow remote monitoring and operation of the compressors and dryers. Where required, signals from this control system shall be transmitted to the signalling panel for monitoring by the signallers.

In the event of an instrumentation or control system failure, the compressors will remain switched on. In the event of a power failure, the compressors and dryers will automatically restart.

Starting and stopping of the compressors is based upon the following:

- Starting of the lead compressor is based upon a low pressure setpoint at the receiver pressure transmitter;
- Stopping of the lead compressor is based upon a high high pressure setpoint at the receiver pressure transmitter;
- Starting of the lag compressor is based upon a low low pressure setpoint at the receiver pressure transmitter; and
- Stopping of the lag compressor is based upon a high pressure setpoint at the receiver pressure transmitter;

25.3.3.1 Signallers Alarm Indications

The signaller shall be provided with air system warning and fail alarms. These may be integrated with other warning and fail alarms for the signaller.

Warning – A warning (yellow light) shall be displayed if a partial failure of the system has occurred. This will include:

- Starting of the lag compressor
- Compressor failure
- Dryer failure (if provided separate from compressor)
- Activation of any low low pressure
- Activation of any high high high pressure
- Loss of either power supply either partially (e.g. loss of phase) or completely

Fail – A fail (red light) shall be displayed:

- Activation of low low low pressure
- Failure of both compressors
- Loss of both power supplies

25.3.3.2 Compressor Room Alarm Indications

All alarms shall be individually displayed at the compressor room, including the individual display of each pressure transducer.

25.3.3.3 Remote Maintenance System Indications

All alarms shall be individually displayed at the remote maintenance system, including individual display of each pressure transducer.

25.3.3.4 Small-Scale Air Systems

For smaller air systems, the above philosophy will be modified accordingly, whilst maintaining the overall control philosophy. The modifications will be subjected to a risk analysis to confirm suitability.

25.4 Equipment

In general, all equipment shall be housed inside a Compressor Room, except for the air receivers, which may be separate and installed outside the building. Receivers integral to the compressor should be considered for smaller systems.

25.5 Standard System Settings

25.5.1 High Pressure Settings

	Reservoir (kPa)	Line after Regulator (kPa)	End of Line (kPa)
Normal Op Range	800 - 1000	480 - 510	460 - 510
High	1000 ①	510 ④	510
High High	1000 ②	550	550
High High High (Warning Alarm)	1100 ③	600 ③	600

① Stops the lag compressor.
② Stops the lead compressor.
③ Relief valve setting.
③ Regulator setting.

25.5.2 Low Pressure Settings

	Reservoir (kPa)	Line after Regulator (kPa)	End of Line (kPa)
Normal Op Range	800 - 1000	480 - 510	460 - 510
Low	800 ①	480	455
Low Low (Warning)	750 ③	470 ②	450
Low Low Low (Fail)	700 **Note**: The reservoir pressure controls the compressor cut in / cut out.	400	400

① Starts the lead compressor.
② Set to be marginally above the inter feed pressure of 450 kPa.
③ Starts the lag compressor.

ESG 100.26

STABLING YARD SIGNALLING AND PLACEMENT OF BERTH SIGNS

Version 1.2

Issued February 2011

Document control

Version	Date	Summary of change
1.0	9 March 2010	New principle
1.1	May 2010	Application of TMA 400 format.
1.2	14 February 2011	Title changed from 'Berth Signs' to 'Stabling Yard Signalling & Placement of Berth Signs' including section 26. Section 26.1 heading changed from 'General' to 'General Signalling Arrangements'.

Contents

26 Stabling Yard Signalling & Placement of Berth Signs

26.1 General Signalling Arrangements

Where Signalling is provided for in stabling yards, the yard will generally be track circuited into 8 car train length sections, each section being separately indicated on the indication panel.

Signals shall be post mounted shunting signals.

Signals shall be located adjacent to their insulated joints.

A minimum of 5m signal sighting shall be provided between the end of any train and the signal. Additional distance may be required, e.g. sighting distance for ground signals, or overlap distances for train stops.

Speed in the yard shall match the overrun mitigation provided by friction buffer stops.

A fixed train stop shall be provided 2.5m before each buffer stop (unless it is required to be further forward to mitigate higher yard speeds).

The buffer stop light shall be mounted adjacent to the fixed train stop.

Interlocking between signals and points; and signal to signal shall be provided but no route holding shall be provided for movements wholly within stabling sidings where speed is 15km/h or less. A locking overlap of 30m shall apply.

26.2 Placement of Berth Signs

Berth signs may be used in stabling yards to sub-divide roads where trains are to be stabled.

A berth shall be defined as the length of track between berth signs.

Each berth may be individually track circuited.

Berth signs shall be located adjacent to the block joints.

A berth sign represents a boundary, not a stopping point.

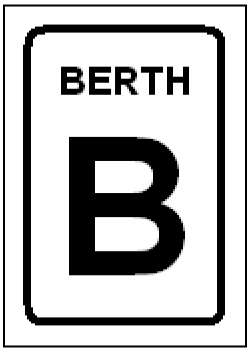


Figure 1 - Berth Sign Concept

Berth signs shall have silver retro reflective border and lettering on a blue background.

Berths shall be named with letters and should be in a logical sequence e.g. A, B, C or X, Y, Z. Letters shall not be repeated in the same locality and the letters I, O and Q shall not be used.

Berths shall be named from the siding entry end. If there are two entries, then the berths shall be named from the Sydney end.

Berth signs shall be used in conjunction with track circuits to enable the signaller to determine what berths are occupied.

Berth signs may be used in conjunction with a Train Describer System to enable the signaller to determine which train is in which berth.

Berth signs may be used in conjunction with signals. When used with signals the berth sign should be mounted on the signal post where practical. Generally signals will be spaced to suit 8 car sets.

When a berth ends at a buffer stop the berth sign should be mounted on the buffer stop light post where practical.

Trains may occupy more than one berth. For example, one 8 car train may occupy 2 berths spaced for 4 car sets.

Consideration should be given to future requirements, e.g. spacing for signals, or different train types or lengths likely to run in the area.

Each train length of 8 cars shall include an additional 4m to allow for the train to divide.

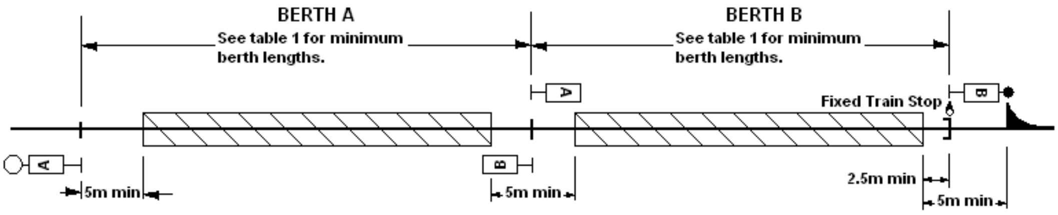


Figure 2 - Berth arrangements and minimum distances

Set/No. Cars	C	K	L	M	H	R	S	T, G	V	A	Endeavour	Hunter Railcars
2	-	45.8	-	-	-	-	-	-	53	-	55.5	55.5
3	-	-	66.2	-	-	-	-	-	-	-	-	-
4	87	87	-	87	87	-	87	87	101	-	106*	106*
6	-	-	127.3	-	-	126.5	-	-	149	-	-	-
8	172*	172*	-	172*	172*	-	172*	172*	201*	172#	-	-
9	-	-	192.4*	-	-	-	-	-	-	-	-	-

* Includes 4m to divide train.

Cars to be delivered & length to be confirmed. No allowance to divide required.

Note: Consists taken from Standard Working Timetable 2009.

Table 1 - Minimum berth lengths in metres

ESG 100.29

NAMING OF LOCATIONS, TRACK & SIDINGS

Version 1.4

Issued 22 August 2012

Document control

Version	Date	Summary of change
1.0	3 August 2010	First issue
1.1	7 June 2011	Section 29.3 updated listing of Interlocking Identifiers. Flinders = FS, Schofields = SS, St Marys = SA.
1.2	5 December 2011	29.2.14 – "designed" -> "defined"
1.3	3 April 2012	Updated to the RailCorp ETCS Requirement Specifications, Release 2. 29.3 NWRL Interlockings included. Various minor editorial corrections.
1.4	22 August 2012	Amend section 29.3 Interlocking Identifier to show (name) Hamilton Jn = HN (proposed) and Springwood = SW (proposed)

Contents

29 Naming of Locations, Track & Sidings

29.1 Introduction

The naming and renaming of locations, tracks or sidings has significant safety implications. Once selected, names will appear in all documentation associated with the line including public documentation, and technical designs, and it is thus desirable that agreement is reached from all stakeholders for high level names well before they are required to be used in design documentation.

Some locations or sidings may have local names. Names for localities are generally historical and are either part of the legal determination by the Geographical Names Board or where the former site of a station, platform, signal box or siding existed. The retention of these old names is important in that they form part of the driver's route knowledge, are identified on older configuration documents and may represent timetable timing points.

In the case of tracks or sidings, naming should reflect traditional naming practices and purpose of the line or siding. Up and Down directions following existing conventions with Up being the normal direction of traffic flow towards Sydney.

Local names of localities or sidings will only be accepted for historical reasons and are not to be invented for future use.

The network rules contain restrictions on the use of various tracks. It is important that the function of the track is clear, and the infrastructure provided matches the name given. For example vehicles may be left on certain tracks, such as sidings and refuges, but may not be left on main lines or loops.

29.2 General Rules for Naming

29.2.1 Localities

Existing names are not to be changed. When infrastructure is installed at a former location of rail infrastructure, it would be preferred that the original name of that locality be utilised.

Where no rail infrastructure has ever existed at the locality, then the Geographical Names Board listing is preferred or a local feature can be recommended for adoption. No location should be named after a person, living or dead unless the area is known by such a name already, e.g. Oatley, Lawson or St James.

29.2.2 Corridor Naming (Corridor Identifier)

The corridor name is held within the Base Code database held in the Geographic Information System. The original corridor names describe the general direction of the corridor viz Main North – Strathfield to Wallangarra, Main West – Granville to Bourke, Main South – Granville to Albury, South Coast (usually called Illawarra) – Illawarra Jct to Bomaderry (Nowra). These names are not to be changed.

All other lines usually parallel, branch from or link to these original Main Lines.

Parallel Corridors usually are given a name which may have a geographical reference but will often include reference to some feature e.g. North Shore, Airport Line, East Hills Line.

Branches are usually generally known by the station or locality at the furthest extent the line reached, e.g. Richmond. However care is to be used if the line is to be extended in the future and a different name may be appropriate to avoid having to change a name in the future.

Connecting lines are identified by the names of the station at either end, Chatswood-Epping, or by a special name (e.g. Airport Line).

The Sydney end location is placed before the country end in any naming. The track base code defines exactly where the corridor will commence and terminate.

29.2.3 Double and Multiple Tracks

All tracks are designated Up and Down according to the principal direction of traffic flow. Exceptions are lines that travel in a circular fashion such as City Circle and Balloon Loops.

The principal pair of tracks will be designated the Main Lines. In the past where only two tracks exist and are not the primary corridor (e.g. Main North), the tracks sometimes use the name of the corridor e.g. Up and Down (North) Shore, Up and Down East Hills. This arrangement is not to be perpetuated as it does not permit consistent naming to be provided when additional tracks are provided, or the line is extended.

Where more than two running lines are provided, the principal pair will be called the Main Lines (usually those with the highest permitted speeds) and the next pair will be called the Suburban or Local. Where two lines from two corridors diverge from a junction, newer lines can have the corridor name appended for a short distance (e.g. Up West Main). Where the tracks exist in a corridor then they may be termed Up and Down Main and Up and Down Suburban or, for example, Up and Down West Main and Up and Down West Suburban.

Where six parallel lines are provided then as above the pairs will be designated Main, Suburban and Local.

Where a parallel running line or lines are provided alongside the Main Lines, and are of short length, they should be names the Up or Down Refuge. They are normally used to hold freight trains or used for overtaking.

Longer parallel lines can be provided to allow slow trains to be overtaken by faster trains whilst both are moving. These lines may be several kilometres long. They are termed Relief Lines.

In certain cases an additional line may be for a specific purpose. In this case a name related the purpose may be used such as 'Goods line, or 'Freight' line, or 'Transit Road' or 'Through Road'.

Refuges, Relief Lines, Transit Road, Terminating Road, etc usually have catchpoints to permit these tracks to provide the functionality of a siding. Crossing loops may not have catchpoints, but loop sidings are fitted.

29.2.4 Sidings

All lines off the running lines are usually described as sidings and the name of the siding describes its position and or its role, e.g. No. 1 Down Siding or Kellogg's Siding. Sidings that form a general role are simply given a number and identified by the side of the line on which they are located, Down or Up and are numbered away from the running line in the direction of travel, that is No. 1 Siding is closest to the running line, No. 2 next siding away and so on. Nests of sidings are similarly numbered.

Those sidings which are connected to another, or to the running line at one end only are termed sidings. Sidings connected at both ends are termed loop sidings. Crossing Loops usually do not have catch points (or derails) to protect the main line whereas sidings do have catchpoints.

Where sidings are located as a large nest such as a stabling yard, sidings can be numbered from 1, starting on the left facing Sydney.

Special purpose sidings may have a name that described the purpose, such as 'Terminating Platform' or 'Turnback Road.

29.2.5 Single Lines

The Main Line is the running line and is used to describe the track on which through trains run. The only significant exception is at junctions when the secondary line (at the time the junction was opened) was designated the Branch Line. Away from the junction, this branch line is referred to as the Main Line to distinguish from the sidings and to make various rules simpler.

Use of the corridor name to name tracks is not to be perpetuated (e.g. Richmond Line).

Where trains pass, cross or overtake on single line the parallel running line of short length is known as the (crossing) Loop. It is not the passing siding or passing loop. Where each track is unidirectional, they are described as Up Main or Down Main or Up and Down Loop, if of shorter length.

At locations where the platform is on the Loop, this Loop may be called the Platform Road. The straight road is designated the Through Road or Main.

Loops without catchpoints cannot be used for stabling vehicles. If this functionality is required, catchpoints can be provided whereupon it should be called a loop siding.

Rules for sidings off the main line or loop apply here as well as double line.

29.2.6 Interlockings

Interlockings are to be named after the localities and not the controlling signal box (unless they are the same). Usually the first and last letter of the name is used. Alternatively it may be the first letter of each if it is a two word name. Where an identifier is already in use, the second letter is then altered to be unique.

The interlocking area retains that interlocking name to the extent of its control even if it encompasses other localities.

Preferably interlockings are physically separated by automatic sections. Where this is not the case, and different interlockings adjoin each other, even if the identification changes, reuse of signal and point numbers should be avoided. However, this need not apply where they are separately located, as otherwise the numbering becomes unmanageable. Established interlocking identifiers are attached in Section 29.3.

29.2.7 Signal Boxes

The term 'Signal Box' is to be used for all places where signalling is controlled from, and not being an emergency facility. Where a panel is provided for emergency operation, it will be located in a Traffic Hut, unless the building or room already has a specific function, such as the station master's office.

The terms control centre, equipment centre, control building, CTC or similar are not to be used.

Signal Boxes are named after the localities, e.g. Sydney Signal Box.

29.2.8 Signals

29.2.8.1 Signals at Interlockings

Signals within interlockings are given a two letter prefix of the interlocking name as per ESG 100.1.1.2. Numbering is also as required by ESG 100.1.1.2.

Current and potential interlocking identities are shown in Section 29.3 - 'Interlocking Identification'.

29.2.8.2 Automatic Signals

Signals not located within interlockings are given a corridor/line identifier as a prefix, as per 29.4. A suffix may also be added to indicate the line direction where required, which can identify the direction the signal is facing (by virtue of the odd-down and even-up last digit of the number) and the line section direction suffix e.g. S18.4D – an up direction signal located on the down suburban at approximately 18.4km.

Details are contained in ESG 100.1.1.2.

29.2.9 Equipment Cupboards and Locations

Equipment cupboards and locations are named after the item of equipment which is closest in the following priority order:

- Adjacent signal
- Signal on non-adjacent track
- Points adjacent
- Relay end of adjacent track circuit
- Relay end of non-adjacent track circuit
- Feed end of adjacent track circuit

Main locations which contain the interlocking shall be named after the interlocking name. Names based on a number sequence along the track (i.e. CN1, CN2, CN3, etc) shall not be used.

29.2.10 Junctions

Where a number of distinct junctions of main lines occur (such as with a triangle) each junction shall be named. Suitable names usually relate to the geographical location of the junction such as 'East Junction' etc. A sign is usually erected at the junction with the junction name.

29.2.11 Route Indicators

When entering platforms (i.e. on the approach of stations) route indicators are to display the platform number unless a clearly identified line name exists, such as Up Main (UM) or Down Main (DM). When departing platforms route indicators are to display the destination (usually) as a one figure indication (e.g. E for Epping, C for Chatswood, P for Parramatta) or the line the route is set for (e.g. DM, UM).

29.2.12 Direction

The use of U and D will be a suffix to clarify the track (particularly for the bi-directional line) if required, and as first or second character for use with route indicators.

29.2.13 Signal Numbering

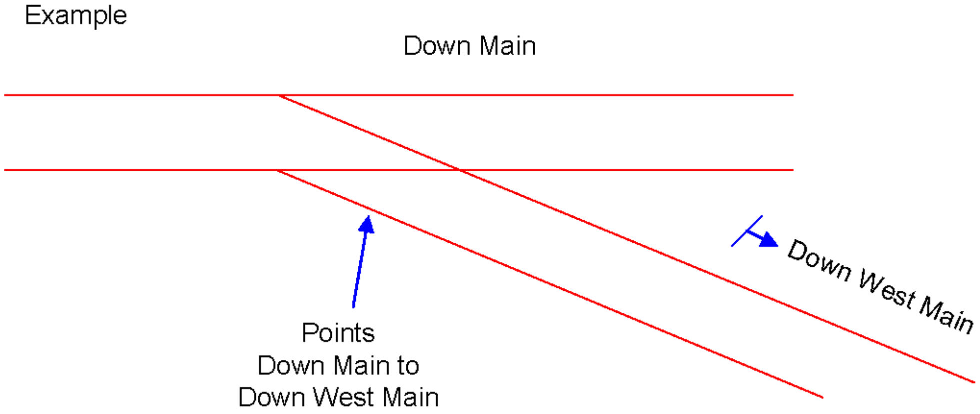
Controlled numbers as allocated by the Signal Designer with the appropriate prefix as 26.2.8.1, automatic signals to have a kilometre based number. Last digit to be odd for a down direction signal and even for an up direction signal. In the case of an up signal on the down track and vice versa, a Direction identifier to be added following the number as 26.2.12.

29.2.14 Change of Track Names

Where a name changes (e.g. Up Branch to Platform Road) it shall occur at a well defined point (e.g. a signal, a clearance point, a prominent structure) and be clearly identified on the driver's diagram.

Where the change occurs at a junction, the new track name shall commence at the catchpoints/points or clearance point clear of the points on the end of the new track.

Example



29.3 Interlocking Identifier

Interlocking Identification

NAME	Existing	Proposed	NAME	Existing	Proposed
Albion Park	42	AP	Lawson	LN	
Ashfield		AD	Leightonfield		LF
Auburn		AN	Leppington		LE
Awaba	A	AW	Lidcombe		LM
Bankstown		BK	Lindfield	LD	
Berowra	B	BA	Lithgow		LW
Berry		BE	Liverpool	LL	
Bella Vista		BV	Macquarie Park	MP	
Blacktown	BN		Martin Place		MA
Bombo	44	BO	Meeks Road		MR
Bomaderry (Nowra)		BY	Minto	MO	
Bondi Junction		BJ	Morisset		MT
Broadmeadow	B	BW	Mortdale		MD
Cabramatta		CM	Mt Victoria		MV
Campbelltown		CT	Mulgrave	ME	
Castle Hill		CH	Newcastle		NE
Chatswood	CD		Newnes Jn		NJ
Clarendon	CN		North Strathfield		NT
Clyde		CL	North Sydney	NS	
Cowan	C	CO	Parramatta Rd	PR	
Cronulla	CA		Penrith		PH
Cudegong Rd		CR	Revesby	RY	
Dapto	41	DO	Rhodes	RS	
Dunmore	43	DE	Richmond	RD	
East Hills	EH		Riverstone	RE	
Eastwood	EW		Rooty Hill		RH
Edgecliff		EF	Rouse Hill		RL
Edgecombe		EE	Schofields	SS	
Emu Plains		EP	Sefton Park	SP	
Epping	EG		Springwood	SD	SW
Eraring	E	ER	St Marys	SM	SA
Enfield	ED		Strathfield	ST	
Fairfield		FD	Sulphide Jn	S	SJ
Fassifern		FN	Sutherland	SD	
Flemington		FL	Sydenham	SM	
Flinders		FS	Sydney	SY	
Glenfield	GD		Thornleigh	TH	
Gordon	GN		Turrella		TA
Gosford		GF	Vales Point	V	VP
Granville	GE		Warnervale		WV
Hamilton Jn		HN	Waterfall	W	WL
Hawkesbury River	HR		West Ryde	WR	
Homebush		HH	Wickham		WM
Homebush Bay		HB	Wolli Creek		WC
Hornsby	HY		Wollongong	WG	
Hurstville		HE	Woodville Jn		WJ
Ingleburn	IN		Wyee		WE
Katoomba		KT	Wyong	WG	WY
Kiama	45	KA	Wynyard		WD
Kingsgrove		KE	Yennora	YA	
Lady Game Drive	LG		Zig Zag		ZZ

29.4 Corridor/Line Identifier

CORRIDOR IDENTIFICATION			
NAME	LINE	EXISTING	ATP & PROPOSED
Central - Granville	Main	M	
	Suburban	S	MS
	Local	L	ML
West (Granville - Lithgow)	Main West	M	W
	West Suburban	S	WS
Richmond		R	
FGJ - Homebush Bay	Olympic Park		FH
Y-Link (Merrylands - Harris Park)	South-West Inner	WI	
	South- West Outer	WO	
South (Granville - Macarthur)	Main South	S	
Lidcombe - Cabramatta (old)		LC, SP	LC
North (Strathfield - Woodville Jn)	Main North	N	
	North Suburban	NS	
Hamilton Jn - Newcastle	Newcastle	NH	
North Shore		SH	
Chatswood - Epping		CE	
Illawarra (Illawarra Jn - Bomaderry)	Illawarra Main	I	
	Illawarra Local	IL	
	Illawarra Relief	IR	
Eastern Suburbs (Central - Bondi Jn)	Eastern Suburbs	ES	
Sutherland - Cronulla	Cronulla	SC	
City Railway	City Inner	CI	
	City Outer	CO	
Bankstown (Sydenham - Sefton Park Jn)		SM	B
New Southern (Airport)	Airport	SR	
East Hills (Turrella - Glenfield Jn)	East Hills Main	M, EH	E
	East Hills Local	L	EL
Glenfield - Leppington		GL	
Epping - Tallawarra Rd			ET

ESG 100.30

AUTOMATIC TRACK WARNING SYSTEM

Version 1.0

Issued 6 September 2011

Document control

Version	Date	Summary of change
1.0	6 September 2011	New document

Contents

30 Automatic Track Warning System

30.1 Introduction

The Automatic Track Warning System (ATWS) is a system provided to detect the approach of rail traffic towards a worksite and to then warn the workers of the approaching rail vehicles.

The system comprises of track-mounted detection units that are linked by cabling through a control unit to a number of horns and warning lights, which are positioned throughout the work area.

The ATWS system is used in conjunction with existing *work on track* methods and authorities and does not replace or exempt any worksite protection requirement that are mandated by the Network Rules or Network Procedures.

It is only to be used for work that is performed outside the Danger Zone.

30.2 ATWS Planning Principles

This document shall be read in conjunction with the *ATWS System Requirement* and *ATWS Standard Operating Instruction*.

This document aims to provide the necessary background and principles to ensure the safe planning of the ATWS system before being implemented on a worksite.

Verification of these principles shall ensure the ATWS Strike-in and Strike-out treadles are located to:

- Activate the warning system for all signalled approaches toward the designated worksite.
- Minimise the need for operator (manual) intervention of the Zollner control equipment.

Additionally, ATWS Planners shall ensure the following:

- Correct start and finish limits of the worksite are defined.
- Potential of any non-signalling approaches resultant of Yard Working are considered.
- Minimum warning time requirements are achieved.

30.3 ATWS Treadle Description

The following arrangement is used to describe the configuration of ATWS treadles at a worksite.

a) Strike-in treadles are denoted by two inverted triangles with an arrow on top showing the direction of rail traffic. The symbol is annotated with the channel connection reference on the control unit e.g. E1, E2, E3, E4. All Strike-in treadles are annotated with reference ‘E#’.

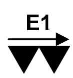


Figure 1 Strike-in treadle

b) The Strike-out treadle is denoted by one inverted triangle with an arrow on top showing the direction of rail traffic. The symbol is annotated with the channel connection reference on the control unit e.g. A1, A2, A3, A4. All Strike-out treadles are annotated with reference 'A#'.

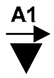


Figure 2 Strike-out treadle

30.4 ATWS Treadle Configuration

Each strike-in point MUST consist of two Strike-in treadles that are connected to each other using a 'Strike-in Box'. There must always be TWO Strike-in treadles at each entry point. The duplication provides a contingency should one treadle fail to detect the approach of any rail traffic.

Strike-in treadles MUST conform to the direction of train movements and can be placed in either one of the two following configurations:

a) Left rail leg in the direction of the traffic - maximum one sleeper distance apart.

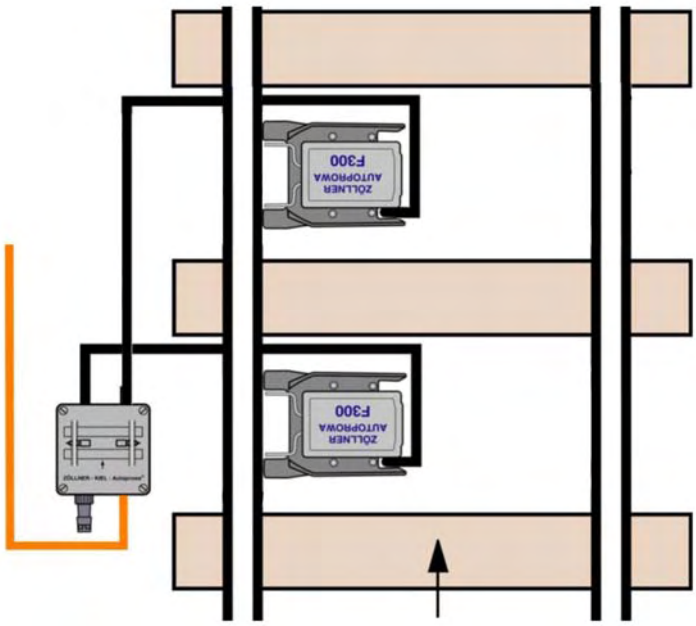


Figure 3 Two Strike-in treadles on left rail leg (maximum 1 sleeper apart) connected to the Strike-in Box

Note: Each F300 box represents ONE Strike-in treadle which includes TWO treadle arms.

b) Opposite one another on both rails in a straight line in the same bay.

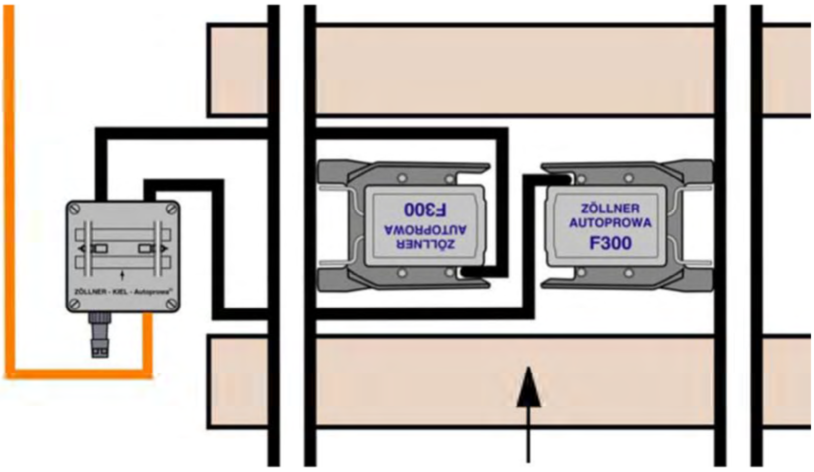


Figure 4 Two Strike-in treadles in the same bay connected to Strike-in Box

Note: Each F300 box represents ONE Strike-In treadle which includes TWO treadle arms.

30.5 ATWS Treadle Placement Rules

30.5.1 Strike-in treadles must be placed:

a) At a distance from a worksite where the Minimum Warning Time (MWT) of 15 seconds can be achieved in accordance with NWT310.

Figure 5 Strike-in treadles at the beginning of the sighting distance (MWT)

Note: A worksite commences at the point beyond the Strike-in treadle where the MWT is achieved and ends where the Strike-out treadle is located.

b) A minimum of 3 metres or more on the departure side of a signal and away from any track-mounted rail infrastructure.

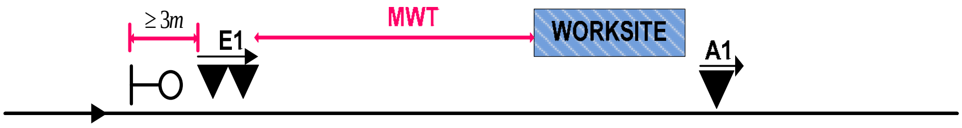


Figure 6 Strike-in treadles at the beginning of the sighting distance and 3m on the departure side of the signal

Note: The reasoning for the three metre requirement is to avoid any interference or damage to rail equipment e.g. rail joints, insulated block joints, switch joints, axle counters, automatic train protection equipment, level crossing treadles, train radio systems or rail signalling infrastructure that may be installed within the 4foot as well as trainstops and track circuit connections etc.

c) At locations so as to activate the warning equipment from all signalled routes that rail vehicles could possibly take to approach a worksite.
Note: ATWS Planners shall also consider other possible approaches resultant of Yard Working.

30.5.2 Treadles are not to be placed:

a) Within 200 metres to the approach of a location where rail traffic could reasonably be expected to stop, for example, this could include fixed signals that display stop.

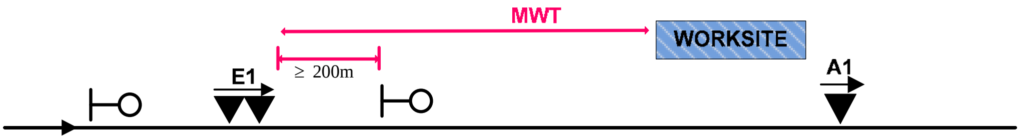


Figure 7 Treadle location showing the 200m region where a train may stop

Note: This requirement is only applicable to EMU traffic. The 200 metre requirement could be exceeded where trains in operation in the area are expected to be more than 200 metres in length, for example, where freight trains operate. On lines where freight traffic operates, consideration should be given to extending the 200 metre requirement.

The reasoning for 200 metre distance requirement is such that the 200metres is provided to mitigate the possibility of a train standing over the Strike-in treadles and thus causing the treadles to detect a second train movement when the stationery train moves again.

b) Within platform limits.

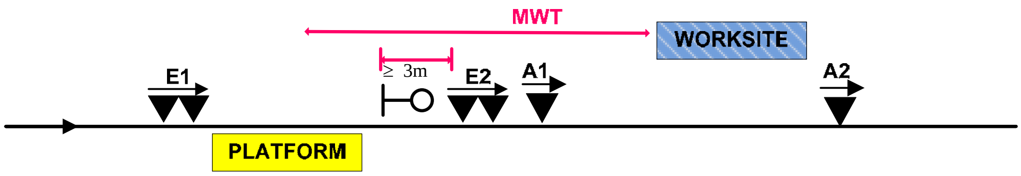


Figure 8 Treadle location within station limits

c) At locations where a wrong direction movement could be expected, for example, wrong direction movements authorised by a signal within yard limits.

d) On the approach, or next to a car marker.

e) At locations where trains are likely to stop, or split in normal operating conditions.

30.5.3 Strike-out treadle precautions

Strike-out treadles must be placed on the departure side of a worksite, but they cannot be placed in a position where they can be activated from an alternate route. Their direction of operation must conform to that of the Strike-in treadles.

30.5.4 Multiple entry points

For locations where there are multiple entry and exit points, both Strike-in and Strike-out treadles can be placed either in an independent arrangement, or cascaded arrangement.

Figure 9 and Figure 10 below show independent and cascaded arrangements respectively.

a) Independent arrangement means that the treadles are connected to 2 different (independent) inputs on the control unit.

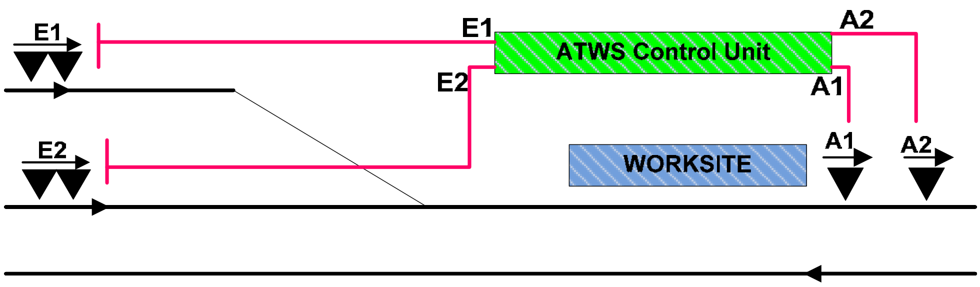


Figure 9 Independent Arrangement

Note: Strike-in treadles E1 and E2 are connected to two different inputs (E1 and E2 of the control unit). Similarly, A1 will cancel the warning from E1, and A2 will cancel the warning from E2.

b) Cascaded arrangement means that treadles are connected to the same input on the control unit. In *Figure 10* below, Strike-in treadles E1a and E1b are shown in a cascaded arrangement where they are connected to the same input E1 of the ATWS control unit. Strike-out treadle A1 will cancel the warning from either E1a or E1b. Therefore only one Strike-out treadle is required.

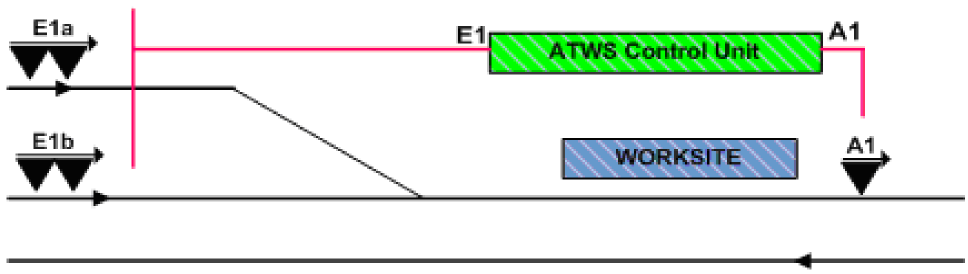


Figure 10 Cascaded Arrangement

Note: E1a and E1b indicate that both treadles are connected to the same input E1 of the control unit. A1 will cancel the warning from either E1a or E1b.

30.5.5 Inadvertent activation

Placement of treadles should give consideration to all signalled routes that may cause the inadvertent activation of Strike-in or Strike-out treadles.

The use of ATWS should be avoided where it can be reasonably expected that the warning equipment will be falsely activated by rail traffic movements that will not enter the worksite limits.

30.6 ATWS Typical Scenarios

30.6.1 Single Entry: Unidirectional – One train between Strike-in and Strike out-treadles

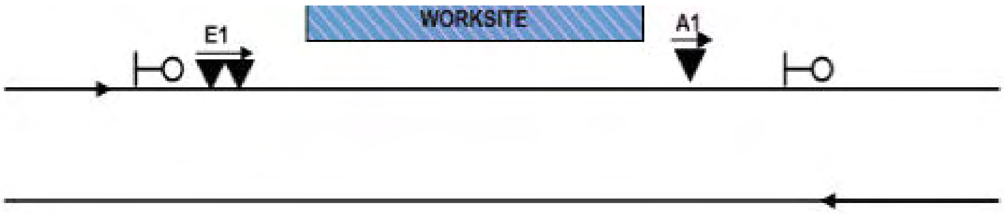


Figure 11 ATWS arrangement for single entry unidirectional track

30.6.2 Single Entry: Unidirectional – Two trains between Strike-in and Strike-out treadles

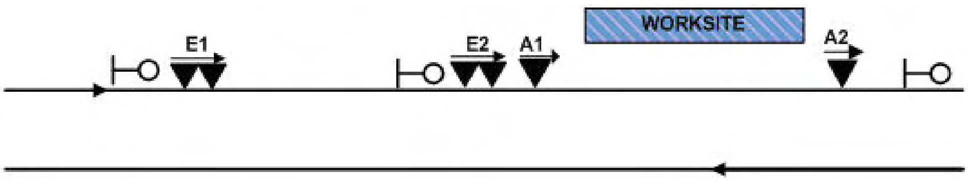


Figure 12 ATWS arrangement to cater for two trains between Strike-in and Strike-out treadles

Figure 12

30.6.3 Single Entry: Bidirectional

Figure 13 ATWS arrangement for worksite near a bi-directional line

30.6.4 Multiple Entry: One train between Strike-in and Strike-out treadles

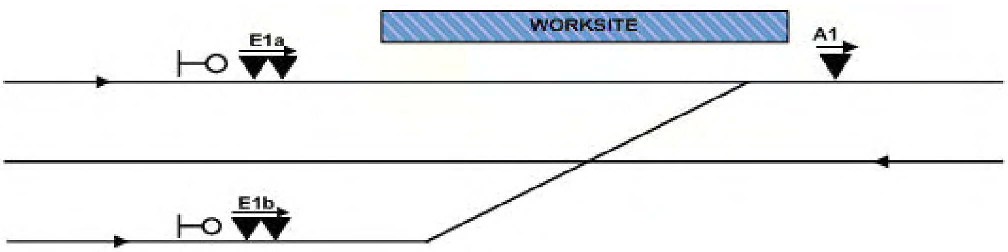


Figure 14 ATWS arrangement for all possible entry points

Note: E1a and E1b are in a cascaded arrangement

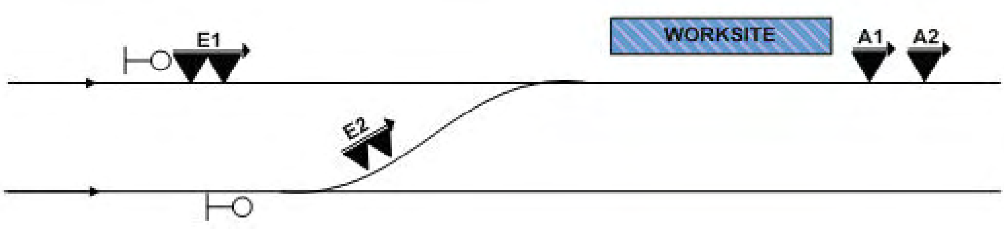


Figure 15 ATWS arrangement for multiple entry

Note: E1 and E2 are on separate channels

Figure 16 ATWS arrangement for multiple entry using two separate channels

Note: E1a and E1b are on one channel and E2 is connected to another channel.

30.6.5 Multiple Entry: Two trains between Strike-in and Strike-out treadles

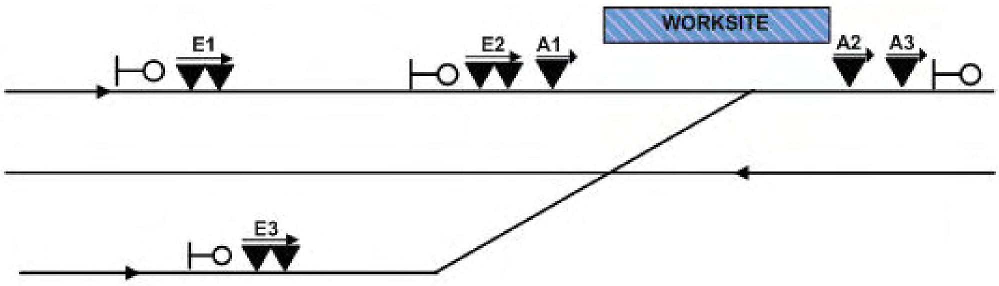


Figure 17 ATWS arrangement for multiple entry and more than one train between Strike-in and Strike-out treadles

30.6.6 Multiple Entry: Platform situation

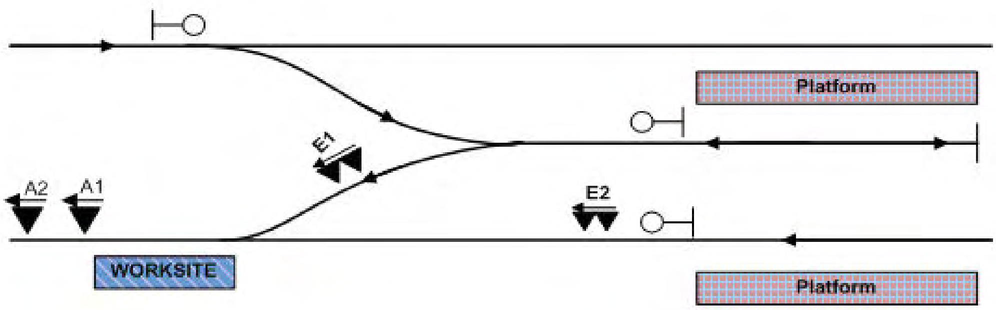


Figure 18 ATWS arrangement for multiple entry near a platform using two separate channels

Note: E1 and E2 are on separate channels

ESG 100.31

AUTOMATIC TRAIN PROTECTION

Version 1.4

Issued – 7 June 2013

Document control

Version	Date	Summary of change
1.0	December 2011	First Issue
1.1	7 February 2012	Updates to Traceability Analysis of the ETCS RailCorp Requirement Specifications (Release 4)
1.2	3 April 2012	31.17 – amend “normal” direction to read “down” and “up” to clarify the direction.
1.3	14 September 2012	Updates to align with Design Guideline for Supervised Locations (v1.0); Update to 31.7.6.2.1 Overset Control and 31.10.4.1 Un-signalled Direction
1.4	7 June 2013	Updates to an Independent Traceability Analysis against the RailCorp ETCS Requirement Specifications.

Contents

Note

The following principle is to be used for ATP design work to ensure that a consistent methodology is applied.

It has been produced during the development of the RailCorp ETCS Requirement Specifications and subsequent further development of the principle may be required as the specifications evolve.

Comments are invited and should be sent to the Chief Engineer, Signals and Control Systems.

31.1 Introduction

RailCorps's Automatic Train Protection (ATP) is based on the European Train Control System (ETCS).

Information from the trackside, relating to signals, speed limits, and track gradient, is transmitted to the ATP equipment on the train. The onboard computer uses that information and braking parameters for the train to calculate brake interventions to keep the train within safe speed and distance limits.

31.2 Purpose

The purpose of this document is to define the principles associated with the application of the trackside signalling requirements for an ETCS level 1 system on the existing RailCorp network.

31.3 References

European Rail Agency (ERA) Unisig Specifications:

Subset 026 – System Requirement Specifications

Subset 036 – (Form Fit Function Interface Specification (FFFIS)

RailCorp ETCS Requirements:

ETCS System Requirements

ETCS Signalling and Operating Requirements

ETCS Trackside Design Requirements

31.4 Principle – ATP Fitment

ATP should be provided on all signals on lines and in yards where ATP fitted trains operate.

31.5 Principle – Balises

31.5.1 Purpose

This principle defines the position for installation of balises relative to signals and other infrastructure.

31.5.2 Concept

Balises are used to transmit information from trackside to train.

Balises may be either fixed or controlled, a fixed balise can transmit one telegram and a controlled balise is connected by a cable to a Lineside Electronic Unit (LEU). The LEU receives inputs from the trackside signalling controls, which are used to select which telegram the controlled balise will transmit.

Information transmitted by a balise includes the direction of train travel for which the information is valid. Different data within a balise telegram can be valid for different directions.

31.5.3 Balise Groups

Balises are organised into balise groups. A group can consist of one to eight balises.

A balise group is generally required to consist of at least two balises for directionality and failure detection purposes, unless balise linking can be used.

The following configurations are examples of balise groups:

- Signal balise groups (including colour light repeater signals, distant signals that display stop and shunt signals), shall normally consist of one controlled balise and one fixed balise.
- Balise groups at fixed red signals, stop signs, shunting limit signs and locations protecting wrong direction moves, shall normally consist of two fixed balises.
- Buffer stops and the end of the line where 'Overrun' and 'Setting Back' is not possible, a single fixed balise shall be provided.
- Terminating platforms where a train may potentially overrun and shall be required to set back shall be provided with two fixed balises.
- Balise groups used for announcing an ETCS Temporary Speed Restriction shall consist of two fixed balises.
- Balise groups at intermediate shunt signals shall normally consist of two controlled balises, but may consist of one controlled and one fixed balise (dependent on the ETCS data functionality).
- Balise groups at level transition borders and level transition pre-announcement (if not associated with a signal balise group), shall consist of two fixed balises.
- Balise groups used for repositioning shall consist of two fixed balises.
- Balise groups for infill (which includes distant signals and white position light repeater signals) shall normally consist of a single controlled balise
- A calibration balise group shall consist of a single fixed balise.
- Balise group used for Big Metal Mass Announcement (excluding signal balise groups), shall consist of two fixed balises.
- Balise groups for sending National Values shall consist of two fixed balises.

31.5.4 Balise Placement

Balises are generally not required in level '0' territory but may be required for the following circumstances:

- Announcement of Big Metal Masses and transition borders
- ETCS Temporary Speed Restrictions
- Announcement of national values

Balise positions are measured from the signal and 'A' track shunting point. The kilometerage for the first balise in the balise group shall be used as the reference point for the balise group.

The balise locations are dependent on the onboard antenna relationship to the leading axle being a maximum distance of 3.7m with a read allowance of 1.3m.

Consideration shall also be given to site conditions where the installation of a balise is not desirable, such as tunnels, bridges, areas with restricted access etc.

Refer to the figure below for the typical balise placement configurations:

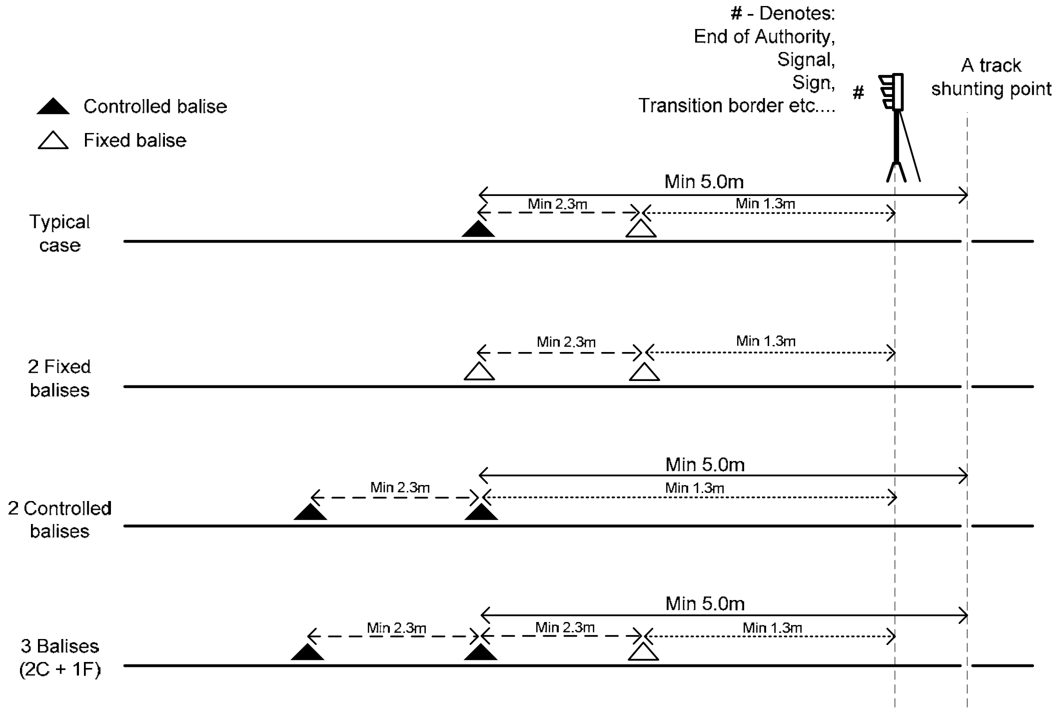


Figure 1 – Typical Balise Placement Configurations

31.5.4.1 Signal Balise Group

31.5.4.1.1 Controlled Balise

The controlled balise at a signal must be read by the train before the signal is replaced by shunting the 'A' track. Accordingly, the controlled balise shall be located not less than 5.0m from the replacement point of the 'A' track, but as close as practically possible to the signal.

Track Circuit Replacement Point

The replacement point of the 'A' track is considered to be:

- The insulated joint location for jointed track circuits.
- A point 3.5m past the first tuning unit for jointless track circuits with tuned loops 19m or longer.
- The tuned bond connection for jointless tracks with tuned loops shorter than 19m.
- The axle counter head.
- Centre of DPU

31.5.4.1.2 Fixed Balise

The fixed balise shall be located after the controlled balise, but not closer than 1.3m to the signal.

31.5.4.1.3 Locations where there is no Space

At locations where the 5.0m distance from the replacement point to the controlled balise cannot be achieved without trains stopping past the balise, the following special arrangements are to apply.

a) The controlled balise shall be located closer to the replacement point, consistent with the balise not being able to be read by the train when standing at the required stopping point train marker. The proposal is to be approved by the Chief Engineer, Signals and Control Systems.

b) The 'A' track shall be qualified out of the movement authority replacement controls. Special circuit arrangements are required to qualify the 'A' track (only) out of the movement authority replacement controls. Replacement by other controls (such as signaller, points detection, and other track circuits), is to be unaffected. The qualification is only to be effective if the berth track is occupied before the 'A' track. This provides for a last wheel replacement if the 'A' track is longer than the train length, or immediately the 'B' track is occupied

31.5.4.1.4 Train Stopping Locations

The designed stopping location for a train at a signal may vary depending on local site constraints, platforms and signal sighting but shall generally be as close as practically possible to the signal. At locations other than platforms, the designed operational stopping location for passenger rolling stock shall be 5m from the coupler to the signal.

At platforms, the operational stopping location shall generally be the drivers shoulder in line with the car marker.

In addition to the minimum positioning arrangements for balises at signals, balises for departure signals at platforms shall be positioned after the last platform car stopping marker.

It is preferable that the current train stopping locations at platforms shall not require alteration due to balise positioning. Relocation of signals may assist in correct balise positioning. Where signals are to be repositioned, or the balise encroach on the 'A' track circuit, the proposal is to be approved by the Chief Engineer, Signals and Control Systems.

31.5.4.2 Fixed Red Signals, Shunting Limit Boards & Stop Signs

The two fixed balises shall be positioned relative to the signal, board or sign; as per Figure 1.

31.5.4.3 Repositioning Balise Group

Repositioning is the provision of specific route information at a later balise group, when the specific information is not given with the original movement authority.

Repositioning shall not be used for main routes. It may be used for subsidiary main or shunt routes where the signal control outputs do not provide the specific route information, or where the LEU inputs are limited.

Repositioning information may be given by balise group(s) provided for opposing signals, but where no signal balise group exist in the necessary location, a repositioning balise group shall be used.

Where repositioning is used, the repositioning balise groups shall be the same orientation.

Where a balise group is provided for repositioning, the fixed balise group shall be positioned with the first balise in the group (N_PIG=0) located at the designed repositioning location.

The balise group shall be provided as close as practically possible to the junction, but beyond the clearance point of the points, and no greater than the shortest movement authority from the signal issuing the movement authority.

31.5.4.4 Calibration

Calibration balise groups are required for the purpose of resetting the confidence interval onboard and maintaining the odometer accuracy, due to inaccuracies between the estimated and actual train location.

Where balises fall within close vicinity of existing balises, the quantity of balises may be rationalised.

31.5.4.4.1 Calibration balise placement where release speed is calculated onboard

The following figure shows the various configurations for the calibration balises with an end of authority release speed calculated onboard:

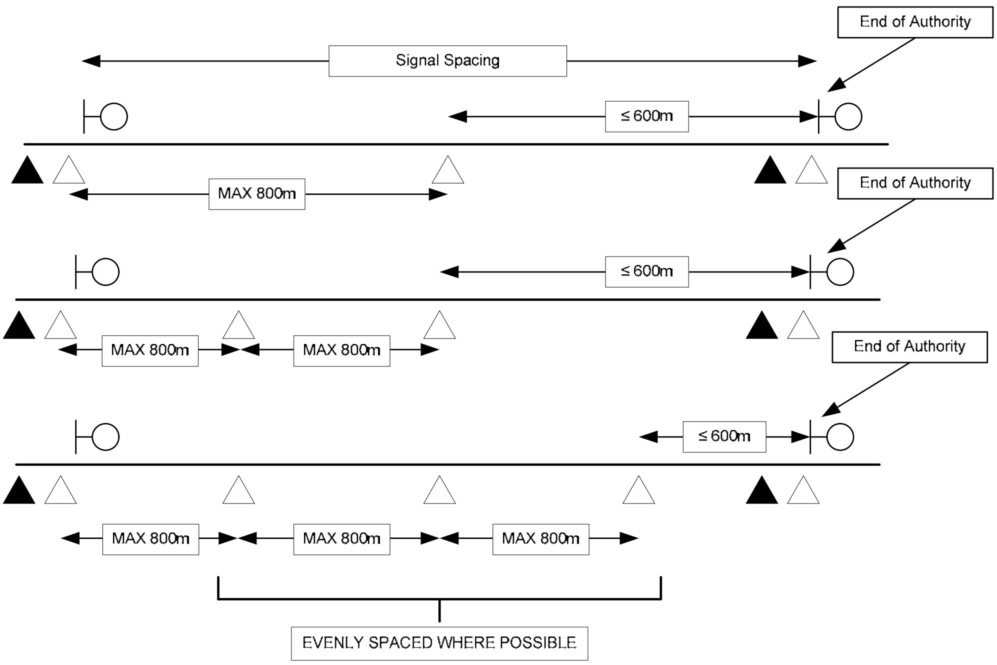


Figure 2 - Placement Configurations (RS calculated onboard)

Calibration balises shall be provided approximately equal between signals, with the last calibration balise no more than 600m from a signal. Additional balises used for calibration shall have intervals of no more than 800m.

Where balises already exist between signals (including balises used for the opposite direction), the following conditions can apply:

- If an existing balise is located within 301 to 599m of the end of authority, the previous calibration balise may be positioned up to 800m from the existing balise.
- If an existing balise is located within 300m of the end of authority, an additional calibration balise is still required no more than 600m before the end of authority.

A tolerance of ±20m shall generally be allowed when designing the balise locations.

31.5.4.4.2 Calibration balise placement for a fixed release speed

On running lines, where a fixed release speed is to be applied or approaching a buffer stop, a calibration balise is required within 40m from the end of authority. This balise ensures a trip occurs just beyond the signal location, if the signal balise group is not read.

Note – Rationalisation may be considered when the signal is usually clear and there is a reduced benefit in providing a calibration balise 40m from an end of authority.

An additional calibration balise is required between 150m and 240m before the end of authority. Any balise group within 150m may additionally be used for calibration, but by itself may result in calibration too late in the braking curve to be useful.

The ±20m design tolerance shall not apply to these balises.

Calibration balises earlier in the approach are to be provided at maximum spacing's of 800m (which are not directly associated with a signal balise group), equally spaced between the signal and the balises positioned at 240/150m.

The following figure shows the various configurations for the calibration balises with a fixed release speed:

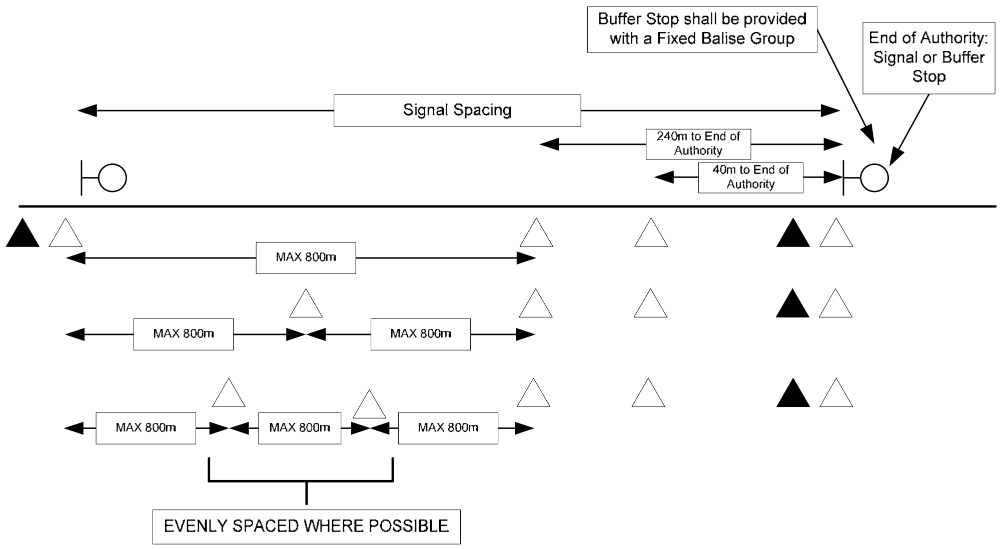


Figure 3 - Placement Configurations (Fixed Release Speed)

31.5.4.4.3 Balises Groups Ignored for Calibration

Where two controlled balises are used at an intermediate shunt signal, or two fixed balises at a shunting limit sign, these cannot provide calibration for running movements in the direction to which the signal or sign applies.

31.5.4.5 National Value Balise Group

A balise group shall be provided for the purpose of sending national values to the onboard, for when ATP fitted stock exits unfitted areas such as maintenance centres and depots.
Where no suitable balise group exists, a balise group for sending national values shall be positioned with the first balise in the group (N_PIG=0) located at the defined ATP commencement location.

31.5.4.6 Balise Spacing

31.5.4.6.1 Lateral Separation

Where balises are located on converging/diverging tracks, they shall not be located in areas where the track centres are less than 1.5m apart.

31.5.4.6.2 Longitudinal Separation

Balises shall be between 2.3m and 12m apart. To achieve best operational outcomes, balises within the same balise group shall be installed at the minimum separation permissible for a given site.

31.5.4.7 Track Curvature

Balises shall not be placed on curves of radius tighter than 160m, without prior approval from the Chief Engineer Signals and Control Systems.

31.5.4.8 Equipment to be Kept Clear of Balises

The sleeper bay either side of the balise shall be kept clear of other equipment including:

- Cables (including cables located in cable routes and cables from other balises)
- DPUs
- Metallic equipment such as point rodding etc…

Metronet transponders shall not be positioned within 10m of a balise.

31.5.5 Balise Data Capacity

Where the variable data to be transmitted by a balise group exceeds the capacity limits of a typical balise group (two balises), it is permissible to add additional balises (controlled) to the balise group. This is only likely to apply at some junctions, particularly where the different routes have considerably differing gradients. In this situation, the fixed balise shall be omitted. However, if the two controlled balises are still insufficient for the total amount of data to be transmitted, then an additional fixed balise will also be required.

Note – balise data capacity constraints may apply to Infill balise groups and the necessary provision of an additional balise to the group may be required.

Due to the 5.0m general constraints on placement of balises relative to the track circuit replacement point and the end of authority, the additional controlled balise will usually need to be placed before the typical controlled balise position.

Where two controlled balises are used, care must be taken to ensure that the onboard antenna will not be within reading range of, or past the first balise with the train stopped at the applicable stopping location.

31.6 Principle - Balise Identification

31.6.1 ETCS Balise Name

The following ETCS components are required for the balise name:

- NID_C
- NID_BG
- N_PIG

The NID_C & NID_BG components shall not be identified on signalling documentation, and are not considered part of the balise name. During the data design phase, the two values shall be allocated during the data preparation process.

For the purpose of differentiation within a balise group, the N_PIG value shall be provided in the balise name.

31.6.1.1 NID_C

Regional identity number **(NID_C)** (allocated by European Rail Agency).

The following values have been allocated as follows:

540	North
541	Inner Sydney Metropolitan Area
542	West
543	South
544	Illawarra
545	Spare

Refer to Appendix A (Diagram A)

31.6.1.2 NID_BG

The NID_BG value is the unique ETCS data balise group number, within the region identifier (NID_C). The NID_BG value shall be allocated for each balise group during the data preparation process.

31.6.1.3 N_PIG

Position in the balise group.

0 – 7 (0, being the first balise in the nominal direction of travel). The N_PIG value shall be included in the balise name, identified for each balise on the signalling plan.

31.6.2 Balise Naming

31.6.2.1 Purpose

All balises shall be identified with its own specific name.

The balise name shall be identified on the signalling plan for each balise. The name shall be identical to the balise ID plate and balise location ID plate on site.

31.6.2.2 Requirements

The balise name is broken up into various components:

- Geographic name (See 31.6.2.3)
- Balise group function (See 31.6.2.4)
- Position in the balise group (N_PIG, See 31.6.1.3)
- Balise type (See 31.6.2.6)

31.6.2.3 Geographic Name

The Geographic name shall be determined as follows:

- For a signal balise group, the name shall be the same as the signal identification (signal identification plate), but where the signal identification does not presently include the existing/proposed interlocking identifier (for controlled signals) or existing/proposed corridor/line identifier (for automatic signals); it shall be included in the name.
- For other balise groups, the name shall generally be the same as the signal identifier of the next signal ahead (in the relevant direction). The interlocking identifier or corridor/line identifier shall be prefixed if not already.
- For balise groups where it is not practical to be referenced against a signal number, the kilometerage shall be used together with the applicable corridor identifier.
- A direction identifier shall be provided, only where required.

Where practical, the naming convention shall adhere to the signal design principles ESG 100.29 & ESG 100.1.

In any name, a decimal point shall be replaced with an underscore.

31.6.2.4 Balise Group Function

The following abbreviations denote the primary function of the balise, as per the normal direction of travel:

- SG – Signal balise group
- CA – Calibration balise group(CA1, CA2 etc working backwards from the signal)
- RE – Repositioning balise group
- IN – Infill balise group(IN1, IN2 etc working backwards from the signal)
- LB – Level Transition Border balise group (LB1, LB2 etc working backwards from the signal)

  - Note – Level Transition Border balise groups may include balise groups used for pre-announcement for wrong direction running, but shall adopt the same naming convention as per a level transition border.

- MM – Big metal mass announcement balise group
- HZ - Hazard balise group
- NV – National Value balise group (NV1, NV2 etc…)
  Note - Several balise groups may be provided dependent on the infrastructure layout, i.e. number of entrances and exits to a yard etc…).

31.6.2.5 Direction Assignment

Balise groups consisting of only one balise do not have an inherent direction; direction must be assigned by providing linking information (from an additional balise group).

For infill, direction shall be assigned as per the direction approaching the signal for which the infill is provided.

For calibration balises on unidirectional and bidirectional lines, the direction shall be as per the normal direction of travel for the particular line. For single lines, the ‘Up’ direction of travel shall be assigned as the direction.

The allocation of the N_PIG (direction) is required where an additional balise is added to a balise group consisting of a single balise.

31.6.2.6 Balise Type

Controlled –'C', or Fixed – 'F'.

31.6.2.7 Balise Name Example

Controlled signal SM1160UI (as shown on the signalling plan)

SM1160UI_SG_0_C

Requirement	Value	Denotes	ETCS Data
Geographic Name	SM1160UI	Signal Name (or kilometerage)	
Balise Group Function	SG	Signal Balise Group	
Position in Balise Group	0	First balise in the group, as per the direction of travel	Yes
Balise Type	C	Controlled	

The calibration balise before the last calibration balise before an automatic signal (North Corridor, Down Direction, Signal 61.23, as shown on a signalling plan)

N61_23_CA2_0_F

Requirement	Value	Denotes	ETCS Data
Geographic Name	N61_23	Signal Name (or kilometerage)	
Balise Group Function	CA2	Calibration balise group	
Position in Balise Group	0	First balise in the group, as per the direction of travel	Yes
Balise Type	F	Fixed	

31.7 Principle - Movement Authorities

31.7.1 Purpose

Movement authorities are received by trains when passing over balises.

A movement authority permits the train to travel a specified distance according to the trackside signalling route information.

A movement authority is derived from the signal controls. It is possible to provide a movement authority from the controls even if a failure prevents the signal showing a proceed indication (e.g. lamp failure or trainstop failure), providing it is safe to do so.

No movement authority shall be issued for landmarks or location signs.

31.7.2 ETCS Data

The Movement authority must also be accompanied by gradient and speed limit data to permit calculation of the braking for speed reductions and the end of authority.

The following data is required:

- Speed Limits including any turnout speeds applicable to the route
- Gradients
- Balise group linking (if any)

- The most restrictive overlap lengths (e.g. usually the conditional length, not the full overlap).

31.7.2.1 Gradients

A conservative gradient shall be used in determining gradients (i.e. favour a more level gradient when calculating rising grades, and a greater falling grade for falling grades, when grades are changing).

The gradient details covering the full distance of the movement authority to the furthest supervised location shall be used. For the ATP overlap, the most restrictive overlap gradient shall be used.

Where routes ahead of a turnout have significantly different gradients, the gradient information shall be specific to the route selected through the junction. This may require the use of two controlled balises at the junction signal balise group plus signal balise groups leading up to the junction signal. To avoid the need to provide route specific gradient information and the requirement for two controlled balises, the most restrictive gradient shall be selected from the overlaps only where a legitimate movement authority can be given and if there is no operational disadvantage.

Balise groups that are used to send an ETCS Temporary Speed Restriction to protect a hazard in the unsignalled direction or the end of the line (level 0), shall have a default gradient value. The default gradient shall be the most restrictive gradient at twice the braking distance (minimum 500m) before the start location of the ETCS Temporary Speed Restriction.

31.7.3 End of Authority

The end of authority shall be assumed to be the first stopping point or indication consistent with the signalling aspect sequence, or a sign denoting the limit of signalled authority, i.e. entrance to an un-signalled yard or depot, for any signalled movement.

Where the operating stopping location and buffer stop are the same location, the end of authority shall be the buffer stop or buffer stop light. At buffer stops where the operating stopping location and buffer stop are staggered, the end of authority is defined at a point 5m past the operating stopping location.

Repeater Signals shall not be considered as an end of authority.

The speed at an end of authority is zero.

Where the release speed is fixed at 15km/h (unique supervised location – no overlap), the actual end of authority is defined at a point 1 metre past the signal, for all other scenarios the end of authority is 3m past the signal.

Should the balise group be positioned closer to the signal (non-standard arrangement), the end of authority shall be relocated the same distance further past the signal.

31.7.4 Repeater Signals

Where a colour light type repeater signal is fitted with a signal balise group, a valid movement authority will be sent from the repeater signal balise group for a proceed aspect. Where the repeater signal shows a stop aspect, the repeater signal will be treated as a main signal ‘Stop’ aspect.

31.7.5 Intermediate Shunt Signals

Movement Authorities are typically derived from the local signal controls or operating circuits. At an intermediate shunt signal, there is typically not enough information contained in the controls to match the possible movement authorities that can be given from a main signal which oversets the intermediate shunt signal. Special care is required to ensure that a train holding a FS MA does not then receive more restrictive information from the intermediate shunt signal. At the same time, it is important that if the intermediate shunt signal is returned to Stop in an emergency, that information can be accepted by the train.

Where the data preparation tools support, the preference is to provide two controlled balises at the intermediate shunt signal. When the intermediate shunt signal is cleared, the balise group at the shunt signal shall have its 'linked' attribute set. When the intermediate shunt signal is at stop, the 'linked' attribute shall not be set. The balise group shall always provide the MA and associated information that corresponds to the controls/indication on the intermediate shunt signal.

With the signal clear, the linking information given at the previous signal can effectively instruct the onboard whether to accept the proceed information given at the intermediate shunt signal or ignore it (allowing the train to continue operating on the basis of the FS MA already received). With the signal at stop and the 'linked' attribute not set, onboard equipment must obey the trip order information regardless of the linking information received at the previous signal.

Where the data preparation tools do not support changing the 'linked' attribute, the solution is to provide an additional relay (or equivalent) to indicate when the intermediate shunt signal has been 'overset' by a main route. The relay is used as an input to the LEU of the intermediate shunt signal. When the LEU 'overset' input is not set, the MA and associated information corresponding to the signal controls / indication shall be given. When the LEU 'overset' input is set, the LEU shall give no MA or associated information.

The balise group for the shunt signal (two controlled, or one controlled/fixed), shall be positioned relative to the shunt signal, refer to Figure 1.

31.7.6 Trip Orders

All signals at stop, limits of signalled authority or where a balise group is provided to specifically protect a wrong direction movement, shall issue a trip order and 'Stop if in Staff Responsible' information provided. If within an interlocking's area, 'Danger if in Shunting' information shall additionally be provided.

At signals, an ETCS Temporary Speed Restriction of 25km/h shall accompany the trip order where the speed in Staff Responsible Mode, exceeds the recommended value of 25km/h.

When approaching a buffer stop, a second ETCS Temporary Speed Restriction shall be applied 10m before the buffer stop (10km/h). The second temporary speed restriction shall be sent at the same time as the initial speed restriction.

Trip orders shall only apply in the same direction as the signal, unless specifically required to protect wrong direction movements.

31.7.6.1 Passing a Signal at Stop - Override

At this stage the use of Override is not authorised, however the following technical rules shall be applied to mitigate unauthorised use:

Activation of the override function shall be possible only when a train has slowed down to standstill (National Value Reference: V_NVALLOWOVTRP).

The maximum permitted speed for the override function is 25km/h (National Value Reference: V_NVSUPOVTRP)

When override is triggered, the train trip function shall be suppressed as per the following:

- 100m passed the signal (National Value Reference: D_NVOVTRP) or,
- 80s (National Value Reference: T_NVOVTRP)

If override is not used (either prohibited or driver error), the train will be tripped by the ATP. In either case, further train movement shall be in Staff Responsible Mode (at staff responsible speed) until a new movement authority is received.

31.7.7 Approaching a Buffer Stop or End of the Line

To trip the train approaching a buffer stop, a balise group/s shall be provided.

Where overrun and setting back is not possible, the single fixed balise shall be positioned 5.3m from the Buffer Stop light (where the light is on or immediately before the buffer stop).

Where overrun and setting back is possible, a fixed balise group shall be positioned relative to the end of authority as per a signal, refer to Figure 1 (This will allow setting back without tripping).

Refer to the following figures for balise placement at Buffer Stops and the end of the line:

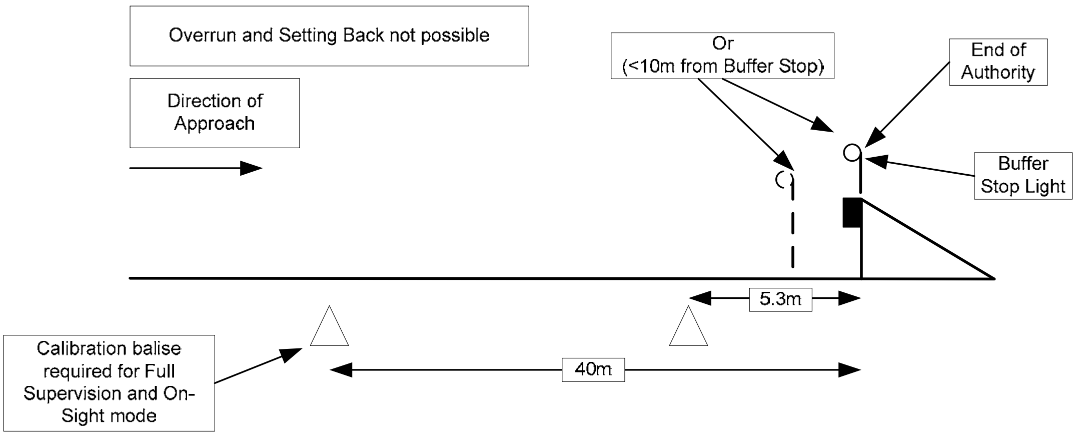


Figure 4 – Buffer Stop Light and Buffer Stop – Same Location

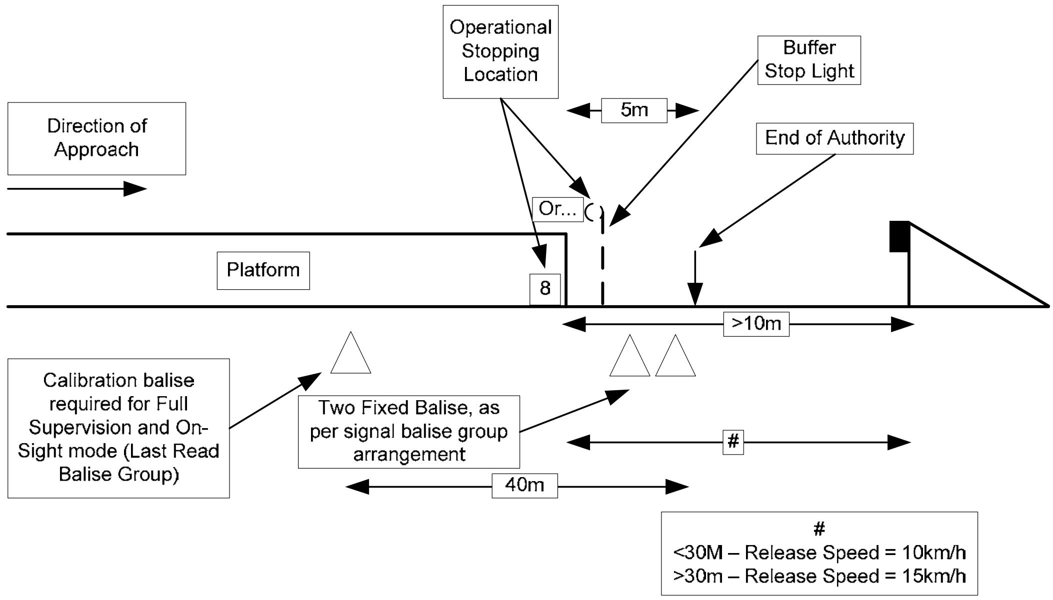


Figure 5 – Separated End of the Line and Operating Stopping Location

Where the operating stopping location and the end of the line are separated by more than 10m, then the following shall apply:

- The end of authority shall be 5m past the stopping location.
- A balise group consisting of two fixed balises shall be provided to trip any train passing the end of authority, but will permit an overrun train to reverse without a further trip.
- The fixed balise group shall be positioned relative to the end of authority, refer to Figure 1.

If no suitable balise group exists, a fixed balise group shall be provided to send the speed restriction, the first balise in the group (N_PIG = 0) shall be positioned at the location of the temporary speed restriction announcement; refer to Figure 1.

In level 0 territory, where a significant operational risk is identified, balise groups consisting of two fixed balises may be provided to restrict the speed (sent as a temporary speed restriction) when entering terminal platforms.

31.7.8 Balise Linking

Balise linking is used to transmit information about successive balise groups that the train is expected to pass over. The information consists of the distance to the next linked balise group, identity, direction in which the balise group should be passed over and the linking reaction.

Generally, balise linking information is only provided by signal balise groups.

Linking information shall generally include all permanent balise groups up to the next signal balise group, and up to the farthest end of authority of all movement authorities possible, as can be accommodated by the data capacity. Where balise data capacity may be exceeded, additional linking information may be provided by calibration balise groups.

On the approach to level transition borders (in level 1), the level transition border balise group and the preannouncement balise group shall have linking information provided to the previous signal balise group.

The ETCS system provides that linking information is only applicable in Full Supervision or On-Sight mode.

31.7.8.1 Linking Reaction

Linking reaction specifies the action of the onboard when the train fails to read a linked balise within the expectation window. For each balise group, the linking reaction will be specified as either:

- No reaction
- Service Brake

The final calibration balise before an end of authority where a fixed release speed is used shall apply a service brake linking reaction. For all other cases the linking reaction shall be no reaction.

The ETCS system provides that where two consecutive linked balise groups fail to be read, a service brake reaction will occur.

31.7.8.2 Intermediate Shunt Signals & Shunting Limit Signs

31.7.8.2.1 Intermediate Shunt Signal – 2 Controlled Balises

Where two controlled balises are used at the intermediate shunt signal and the 'linked' attribute is changed depending on the signal aspect, the following linking rules apply:

- When a main signal is cleared past an Intermediate Shunt Signal, the linking information shall exclude the balise group at the intermediate shunt signal.
- When a shunting signal, including the subsidiary aspect of a main signal, is cleared up to the intermediate shunt signal, linking information must ensure that the balise group at the intermediate shunt signal will not be ignored. Depending on the data preparation tools, this may be achieved by preferably giving linking information that includes the balise group at the intermediate shunt signal (including possibly giving linking information past the signal), or by giving linking information which ends before the intermediate shunt signal (including possibly giving no linking information).

Where the 'overset' input method is used, linking information shall always include the balise group of the intermediate shunt signal.

31.7.8.2.2 Intermediate Shunt Signal With Overset Control

Where it would be not suitable to provide two controlled balises, a signal balise group arrangement shall be used together with the provision of an ‘Over-Set’ stick relay at the intermediate shunt signal location. A stick circuit is required to qualify the shunt route input in the LEU. An input of the overset relay in series with the aspect relay will result in no movement authority information being provided.

For direct drive CBI signals, an additional output function shall be provided from the interlocking to perform this function.

For this arrangement, linking information shall include the balise group at the intermediate shunt.

31.7.8.2.3 Shunting Limit Signs

If a main signal is cleared past a Shunting Limit sign, the linking information shall exclude the balise group at the sign.

When a shunting signal, including the subsidiary aspect of a main signal, is cleared up to the Shunting Limit sign, linking information must ensure that the balise group at the sign will not be ignored. Depending on the data preparation tools, this may be achieved by preferably giving linking information that includes the balise group at the shunting limit sign (including possibly giving linking information past the sign), or by giving linking information which ends before the shunting limit sign (including possibly giving no linking information).

31.7.9 Section Timers

A movement authority may extend across multiple block sections and shall be split into sections with a section release timer provided for each controlled signal.

Section timers shall only be provided for movement authorities that extend beyond controlled signals.

The train will be considered to have occupied a section, and the timer for that section therefore no longer applicable, 15m into that section.

Refer to the following figure:

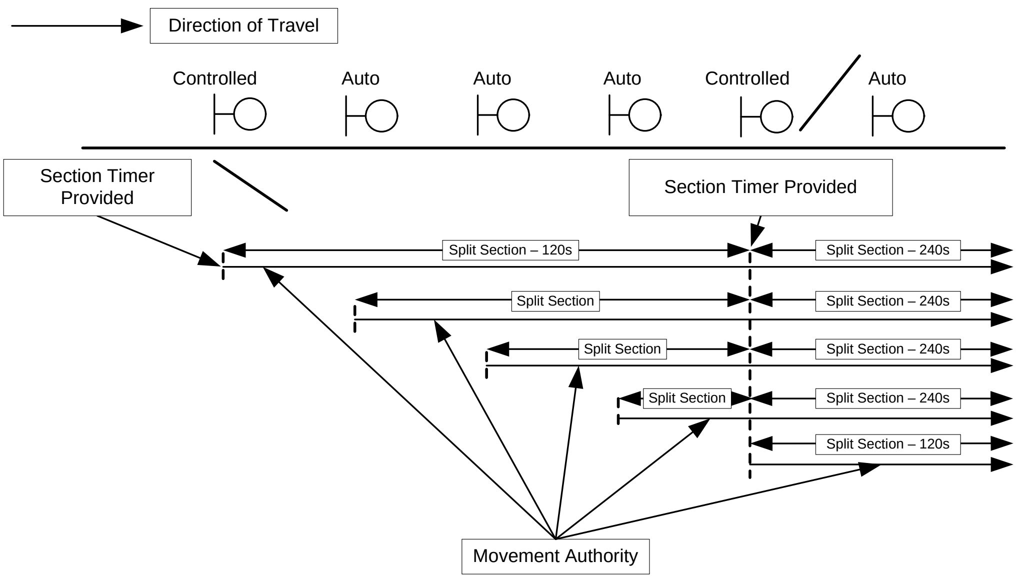


Figure 6 – Movement Authority - Section Timers

The default value for a section timer shall be 4 minutes, but may be extended where required. An extension is only required where a train may regularly take longer than 4 minutes to pass through the section at a cleared signal, e.g. long wait in a platform.

For the first section of a movement authority, the section timer value shall be specified with the same value as the approach locking timer of the signal giving permission to enter the first section. For a shunt signal giving an On Sight movement authority, the section timer value shall be set to the same duration as the approach locking timer for the shunt signal.

31.7.10 Un-Signalled Moves

31.7.10.1 Route Protection Provided

Where no lineside signal is provided, but an equivalent level of route locking is achieved e.g. by a ground frame release, a movement authority in on-sight mode may be provided.

31.7.10.2 Wrong Direction, Un-Signalled Movements

Where an operational risk is identified of a train performing a wrong direction movement, stop information for the incorrect movement may be included in the balise group of the closest signal for the normal direction. Where no suitable balise is available, a balise group ('HZ' – Hazard Balise Group) may be provided independent of a stop sign or fixed red signal (at a suitable location depicted by the operational requirements).

31.7.10.2.1 Level Crossings, Emergency Crossovers & Intermediate Sidings

Where hazards exist that would be protected in a normal direction movement, e.g. level crossings, emergency crossovers and intermediate sidings, the following shall be applied for wrong direction moves.

- A text message (sent from a balise group) identifying the hazard (refer to 31.7.13).
- An ETCS Temporary speed restriction enforcing a speed limit of 15km/h (1m in length), 50m before the hazard (this provides 12 seconds visual warning at 15km/h, approaching the hazard).

The temporary speed restriction shall be sent from two separate balise groups

The two separate balise groups announcing the temporary speed restriction shall meet the following conditions:

- The first temporary speed restriction (in the applicable direction) shall be sent from a balise group no more than 500m before the second announcement.
- The second temporary speed restriction shall be sent at a suitable balise group located at twice the braking distance but no less than 500m from the start of the temporary speed restriction location.

The text message shall be given with the second ETCS TSR and shall be displayed 300m before the start of the hazard.

If possible and to achieve the necessary protection, the closest balise group for the normal direction located on the wrong direction approach to the hazard, shall have an additional balise to provide for directional capability (if only one balise is provided, i.e. calibration).

Refer to the diagram below for protecting hazards and temporary speed restriction arrangements:

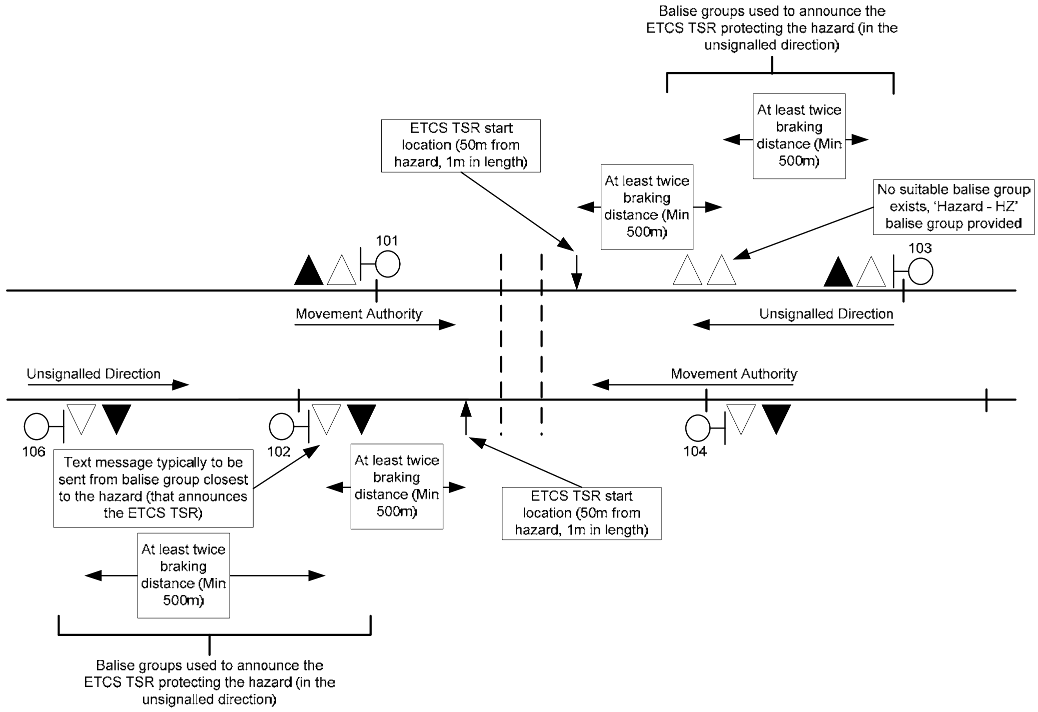


Figure 7 – ETCS Temporary Speed Restriction (Protecting a Level Crossing)

31.7.10.2.2 Wrong Direction, Un-signalled Moves in Station Areas

Where a risk is identified of drivers incorrectly departing a station in the unsignalled direction, the following may be provided:

- A balise group to prevent the wrong direction movement,
- A trip order sent,
- 'Danger if in SH mode' and 'Stop if in SR mode' and
- Text message warning of the hazard.

An existing balise group for the signalled direction may be used if located within 50m of the platform and outside the area of where the train must stop.

31.7.11 No Movement Authority

If a movement is to be made in an ATP fitted area, for which no movement authority is available (e.g. starting up, after changing ends, passing a signal at stop etc…), the train speed shall be limited to 25 km/h, unless approved otherwise by the Chief Engineer, Signals & Control Systems.

31.7.12 Track without Overhead Wiring

Unwired track may be excluded from the ATP-fitment if no ATP fitted non-electric stock operate over it.

If a signal route is cleared into non-ATP fitted unwired track, the last signal (or electric trainstop sign) before the unwired section shall be treated as an ATP end of authority.

Signals reading up to signals protecting unwired track, shall have route indication information (from the protecting signal) included in the movement authority. The

indication for the route not leading into the unwired section shall be sent back to the previous signal. Routes to the unwired track only shall be treated as a trip order movement authority.

31.7.13 Text Messages

The following fixed plain text messages shall be provided on the Drivers Machine Interface:

Text Message	Begin ATP ahead
Display Conditions	Start – Immediately upon passing the level transition announcement balise group. Finish – When train exits Level 0
Description	Message informs the Driver with a minimum of text that the train is approaching a level transition and that it is from Level 0 to Level 1. The text message shall be consistent with the terminology used for the level transition border trackside signage.
Driver Acknowledgement Required, Y/N?	N

Text Message	Begin ATP
Display Conditions	Start – Immediately upon entering Level 1. Finish – 10 seconds after entering Level 1.
Description	Message informs the Driver with a minimum of text that the train has crossed a level transition border and has entered a Level 1 area. The text message shall be consistent with the terminology used for the level transition border trackside signage.
Driver Acknowledgement Required, Y/N?	N

Text Message	Begin ATP XXXm ahead: stop & override
Display Conditions	Start – Immediately upon passing the level transition announcement balise group Finish – When train exits Level 0.
Description	Message informs the Driver with a minimum of text that the train is approaching a level transition, that it is from Level 0 to Level 1, and provides specific information to remind the Driver of the correct procedure for this particular situation. The text message shall be consistent with the terminology used for the level transition border trackside signage. The specific distance (listed above as "XXXm") may vary depending on the location of the level transition announcement balise group relative to the level transition border.
Driver Acknowledgement Required, Y/N?	N

Text Message	End ATP ahead
Display Conditions	Start – Issued at the pre-announcement balise group. Finish – When the train exits level1.
Description	Message informs the Driver with a minimum of text that the train is approaching a level transition border and that it is from Level 1 to Level 0.
Driver Acknowledgement Required, Y/N?	N

Text Message	End ATP
Display Conditions	Start – Immediately upon entering Level 0. Finish – 10 seconds after entering Level 0.
Description	Message informs the Driver with a minimum of text that the train has crossed a level transition border and has entered a Level 0 area.
Driver Acknowledgement Required, Y/N?	N

Text Message	Warning: level crossing
Display Conditions	Start – Message displayed 300m before the start of the ETCS Temporary Speed Restriction approaching the level crossing in the un-signalled direction. Finish – 49m before the hazard.
Description	ETCS temporary speed restrictions (ETCS TSR) will be used to enforce speed limits for particular hazards encountered during wrong running-direction movements. The text message identifies the specific type of hazard and serves to inform the driver of the reason for the upcoming TSR.
Driver Acknowledgement Required, Y/N?	N

Text Message	Warning: emergency crossover
Display Conditions	Start – Message displayed 300m before the start of the ETCS Temporary Speed Restriction approaching the emergency crossover in the un-signalled direction. Finish – When train min safe rear end has passed the location of the emergency crossover.
Description	ETCS temporary speed restrictions (ETCS TSR) will be used to enforce speed limits for particular hazards encountered during wrong running-direction movements. The text message identifies the specific type of hazard and serves to inform the driver of the reason for the upcoming TSR.
Driver Acknowledgement Required, Y/N?	N

Text Message	Warning: intermediate siding
Display Conditions	Start – Message displayed 300m before the start of the ETCS Temporary Speed Restriction approaching the intermediate siding in the un-signalled direction. Finish – When train min safe rear end has passed the location of the intermediate siding.
Description	ETCS temporary speed restrictions (ETCS TSR) will be used to enforce speed limits for particular hazards encountered during wrong running-direction movements. The text message identifies the specific type of hazard and serves to inform the driver of the reason for the upcoming TSR.
Driver Acknowledgement Required, Y/N?	N

Where brakes are to be applied if a text message is not acknowledged, a 5s response time (Driver Acknowledgement Time) will be applied consistently with Fixed Value Reference: Tack).

31.8 Principle – Speed Supervision

31.8.1 Speed Profiles

The ATP speed profiles shall match the RailCorp posted speed profiles: ‘General’, ‘Medium’ and ‘High’.

The RailCorp ‘General’ speed profile shall be implemented as the ATP basic speed (default) profile.

The ETCS default static speed profile shall be the lowest posted speed profile of ‘General, Medium and High’

Where the RailCorp ‘3 Speed’ sign system is not provided (i.e. General, Medium and High), the ATP speed profiles shall be translated from the existing normal/XPT speed signs as per the following table:

Existing Speed Sign System **(Normal/XPT)**	**New 3 Speed Sign System** **(General/Medium/High)**	
Single yellow sign (Normal)	Applies to all three speed profiles	Normal → General Normal → Medium Normal → High
Yellow sign (Normal) above white ‘MU’ sign (MU)	Normal sign applies to the General sign. ‘MU’ sign equates to Medium and High signs.	Normal → General ‘MU’ → Medium ‘MU’ → High
Yellow sign (Normal) above white sign (XPT)	Normal sign equates to General and Medium signs. XPT sign equates to High sign.	Normal → General Normal → Medium XPT → High

In Full Supervision mode, when approaching a facing junction the trackside shall provide the speed profile information for the most restrictive route, unless the specific route can be ascertained from the signal indications, in which the case the applicable speed profile shall be used.

The speed profile for turnouts shall be supervised as follows:

Turnout - From the toe of the points to the first insulated joint past the clearance point on departure (or vice versa).

Crossover - From the toe of the points on approach to the toe of the points on departure.

In both cases the speed shall be supervised until the rear of the train has passed clear of the departure point.

The speed profile information shall cover the entire length of the movement authority and to the furthest supervised location.

For an increase in linespeed, ATP shall prevent the train increasing speed until the rear of the train has passed the speed sign. Where no speed sign is provided to indicate the speed can increase such as turnout speed signs, ATP shall prevent the train increasing speed until the rear of the train has passed the point at which the restriction no longer applies. At level transition borders (approaching level 1), the pre-announcement balise group shall include the speed profile for the complete distance between the pre-announcement and level transition balise groups.

Where a level crossing speed sign is provided, the prevailing linespeed may be resumed when the front of the train has passed over the crossing, as per Network Rules – NGE 216 ‘Level Crossings’.

If not otherwise identified, the line speed of a refuge loop shall be defined as the highest speed of either the entry or exit turnouts.

Where speed information is not posted, track design shall be consulted.

31.8.1.1 Margins Between Speed Boards and ATP Ceiling Speed Monitoring

ATP warning, 5km/h above the posted speed signs.

Service brake intervention, 7.5km/h above the posted speed signs.

Emergency brake intervention, 10km/h above the posted speed signs.

31.8.2 ATP Braking

31.8.2.1 Pre-Indication Location and Indication Curve

The ATP onboard equipment calculates a braking curve for each speed profile/reduction and provides the driver with a notification before its start.

The notification consists of the following:

- 4s: Driver reaction time, between permitted speed supervision limit and the first limit of intervention.
- 5s: Indication time between permitted speed supervision and the indication curve.
- Time between the pre-indication location and the indication curve. The pre-indication location is determined by the set pre-indication time at line speed. Note – Set to zero for the RailCorp network. This places the pre-indication location at the beginning of the line speed braking point.

As the ATP will only command full service or full emergency brake, the indication location warning is effectively a last chance for the driver to commence braking. A driver would normally only make partial brake applications, if they wait until the indication location they will have to make a full brake application in order to avoid ATP intervention.

31.8.2.2 Relationship Between Pre-indication Location and First Signal Warning Indication

Design of signalling aspect sequences and their input into ATP shall ensure that end of authorities do not shorten once they are transmitted to the train, except for when the signal is returned to stop in the face of the train.

Designs should ensure that the pre-indication location does not occur before the first warning signal. If this occurs, either the track speed needs to be lowered, or the aspect sequence extended (refer to 31.14.4), or infill provided (see 31.12.2.1).

Should the pre-indication location fall before the first warning indication, the aspect sequence will require the addition of a virtual indication when the next signal is clear.

Should the preindication location point fall between the clear and the first warning signal and is likely to affect headway, in lieu of the virtual aspect it may be necessary to provide an infill balise group.

Provision of these arrangements may be termed ‘Look Ahead’.

Alternatively lowering of the track speed may be considered to bring the indication point back to the location of the first warning signal. Lowering of the track speed should only be done if trains do not achieve the posted speeds.

31.8.2.3 Trackside Calculations

31.8.2.3.1 Odometry Allowance

Odometer error, 5% of the distance travelled (+/-5m) shall be allowed for safety related calculations.

31.8.2.3.2 Service Braking

Area	Curve
Inside Metropolitan Area	GE76
Outside Metropolitan Area	GE NG-FS-MAX

31.8.2.3.3 Emergency Braking

Area	Curve
All Areas	GE52

Note – Parameters used from the braking curves stated above are incorporated into the ERA tool used to carry out the trackside calculations. For specific information relating to the parameters, refer to ESG 100.3 ‘Braking Distance’.

31.9 Principle - Release Speed

31.9.1 Purpose

Release Speed is a speed at which a train is allowed to move right up to an end of authority, for the purpose of passing over the balise group to obtain a new movement authority. Therefore this is a speed that a SPAD could occur. It is allowed on the basis that there is an overlap available past the signal.

Each movement authority (Full Supervision or On-Sight), the release speed shall be specified as a fixed value, or calculated onboard (based on the supervised location). The onboard calculated releases speed for an On-Sight movement authority should never exceed 25km/h.

Where the overlap is reduced to the danger point after the overlap timer expires, the release speed shall be the nominal release speed (if the onboard calculated release speed is less than the nominal).

31.9.2 Application of the Release Speed

The nominal release speed for the RailCorp network shall be 15km/h. Generally an onboard calculated release speed shall be used.

The designer shall check that the release speed calculated onboard at the final balise group capable of giving calibration before the end of authority, would be above the nominal fixed release speed (15km/h).

Where an onboard calculated or the nominal release speed would result in an unduly low release speed for the overlap available (due to odometry and other issues), a fixed release speed may be used. Where catchpoints are provided, any uncertainty margins in train speed or position may be mitigated by the catch point.

The fixed release speed is assessed, based on the following factors:

- Distance to the Supervised Location
- Most restrictive gradient of the overlap
- GE52 Braking
- The risk beyond the danger point (a trailing set of points may have a greater risk than a mitigating set of catchpoints)
- The consequences of the signal balise not being read

When a signal cleared into unwired track is treated as an end of authority, the nominal release speed shall be applied.

A fixed release speed of 10km/h shall be applied for Buffer Stops and the end of the line. Where the operating stopping location and the end of the line are separated by a distance greater than 30m, a fixed 15km/h release speed shall be specified.

The release speed for an On-Site movement authority shall be 25km/h, unless the line speed or yard speed is lower.

31.10 Principle - Application Levels and Level Transition Borders

31.10.1 Purpose

ETCS can be implemented in different application levels. The transmission systems, data transmitted and functionality available differ with each level.

The limits of an area operating in a particular level are defined as Level Transition Borders.

31.10.2 Application Levels

- Level ‘0’

- Level ‘1’

31.10.2.1 Level ‘0’

Unfitted lines are defined as level ‘0’, where the track to train transmissions are minimal. The transmissions used are for the following:

- Pre-announcement of level transition borders.
- Pre-announcement of Big Metal Masses
- ETCS Temporary Speed Restrictions located at specific risk locations, e.g. terminal platforms.

31.10.2.2 Level ‘1’

In level ‘1’ areas, movement authorities are transmitted to the train via balises.

31.10.3 Transition Border Locations

The level transition border is defined as the point where the level transition occurs. Typically the transition is pre-announced to the train, and then enforced at the transition border.

Generally transition borders are to be placed:

- In automatic sections.
- In areas where the driver is less likely to be concentrating on other critical tasks.

The transition border shall not under any circumstances be located in the following areas:

- In the vicinity of tunnels or bridges greater than 80m in length.

When selecting the transition border location, where possible, the border should occur within a trainstop fitted area and outside of an interlockings yard limits.

For uni-directional lines, level transition borders shall apply for the normal direction of travel and the complementary transition for the reverse direction. For Bi-directional lines, the transition borders may be positioned at separate locations dependent on infrastructure constraints.

The border shall generally be placed 250m past a signal in the direction of travel (to allow for 12 car fitted rolling stock) but as close as practically possible to the signal, up to 350m (arbitrary tolerance to allow for site constraints). The last signal prior to a transition border shall be used to pre-announce the transition border to the train (pre-announcement signal balise group), for both level ‘1’ & ‘0’.

The level transition balise group shall be positioned relative to the level transition border location; refer to Figure 1.

Where no suitable signal balise group exists for pre-announcement, a balise group shall be provided. The fixed balise group shall be positioned with the first balise in the group (N_PIG=0) located at the defined pre-announcement location.

The following figures detail level transition examples:

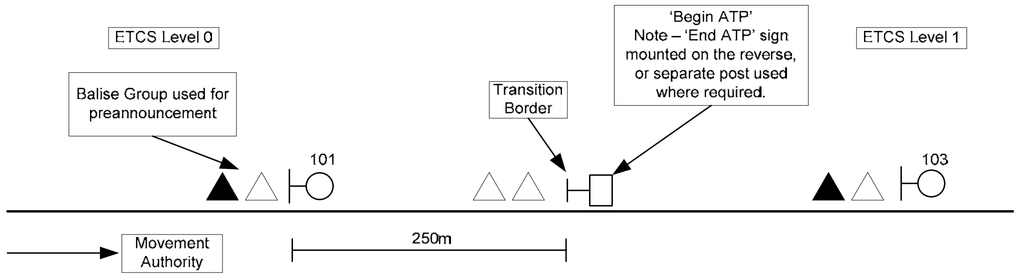


Figure 8 – Level Transition Border – Level 0 – 1

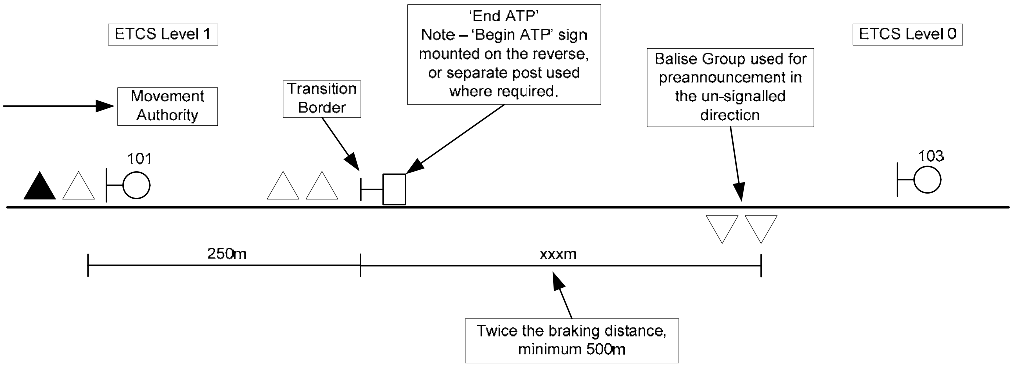


Figure 9 – Level Transition Border – Level 1 – 0

31.10.3.1 Single or Bi-Directional Lines

Where a separate border location applies in each direction, separate balise groups shall be provided for each direction.

Where the borders for both directions are at about the same location, a balise group shall be provided, placed for the direction transition entering level 1.

31.10.4 Level 0 – Level 1

A Movement Authority shall be transferred to the train along with a text message provided (refer to 31.7.13), from the pre-announcement balise group prior to the transition border. The movement authority will contain all the necessary information associated with the signalled route, corresponding to the last signal before the transition border. If there is no valid movement authority from the pre-announcement balise group, i.e. the signal is at stop, the balise group shall command the immediate transition, in order to avoid a second stop at the transition border.

A text message shall be provided at the transition border balise group (refer to 31.7.13).

The national values for the RailCorp network shall be transmitted to the train at the transition border balise groups.

31.10.4.1 Un-Signalled Direction

A transition from Level 0 to level 1 during an unsignalled direction move will result in a trip. To allow the driver to stop before the border and draw forward slowly, the transition

border shall be positioned past the pre-announcement balise group at approximately twice the braking distance but no less than 500m, based on the following:

- The most restrictive gradient
- The highest permitted wrong direction speed
- The worst braked ATP fitted train operating on the particular section of line.

A text message and a 15km/h ETCS Temporary Speed Restriction shall be sent at the pre-announcement balise group.

The fixed balise group shall be positioned with the first balise in the group (N_PIG = 0), located at the pre-announcement location.

The temporary speed restriction shall be 1m in length and start at the transition border location and be released from the front of the train.

The direction and highest permitted speed (for the normal direction) shall be identified on the signalling plan for the un-signalled direction move.

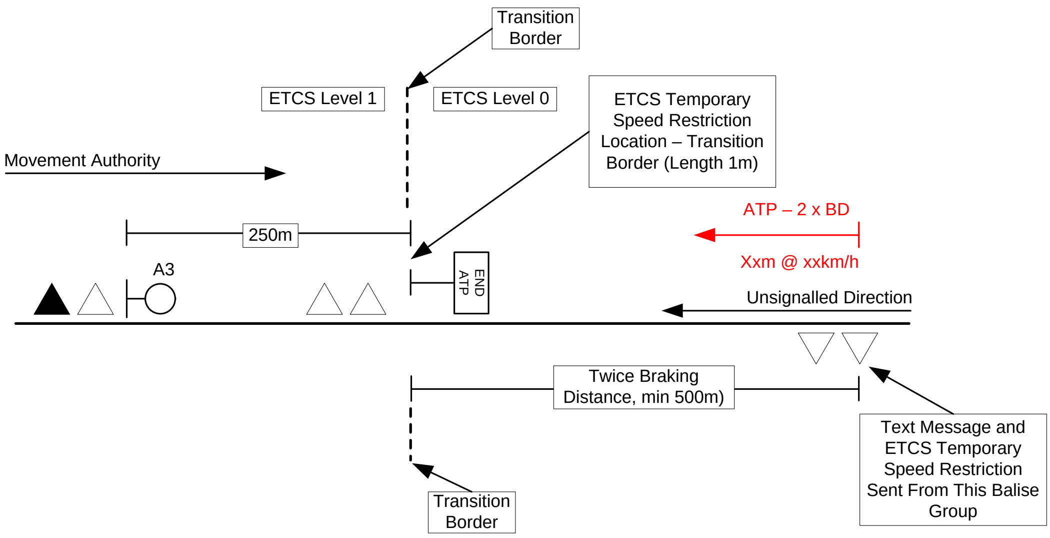


Figure 10 : Level Transition Border - Un-Signalled Move

31.10.5 Level 1 to Level 0

A train transitioning from level 1 to level 0 involves a reduction in the safe supervision of the train speed. As such the driver is required to acknowledge the level transition order within 5s of passing the border (driver acknowledgment time - National Value Reference: T_{ack}). A text message shall be provided at both the pre-announcement balise group and the transition border balise group (refer to 31.7.13).

The balise groups before the level 0 border shall provide information for the complete distance of the movement authority, including the overlap into the level 0 territory, based on the appropriate signal indications.

31.11 Principle – Metal Masses

31.11.1 Purpose

Metal masses on or beneath the track structure may interfere with the ability of the onboard equipment to reliably read balises and steel guard rails can cause cross talk.

Subset-036 of the ERA/Unisig specifications defines several categories of metal mass and the metal mass exclusion zone.

When producing signalling plans, consideration shall be given to potential Big Metal Masses on site that may cause alarms, for example:

- Level Crossings
- Bridges
- Derailment Plinths
- Concrete Slab Track

The above infrastructure examples shall be identified as requiring assessment as to whether they fall in the category of a Big Metal Mass, and may require pre-announcement.

31.11.2 Big Metal Mass Announcement

Where a new fixed balise group is required for announcing a Big Metal Mass, the balise group shall be positioned with the first balise in the group (N_PIG = 0) located at the designed Big Metal Mass pre-announcement location, as per Figure 11.

31.11.2.1 Level 0 Track

When operating in level 0, a big metal mass announcement shall be given by a balise group prior to the big metal mass but located at least 70m from the start location, before any object longer than 300m which exceeds the allowable metal mass limits (Distance for metal immunity – National Value Reference: D_Metal).

31.11.2.2 Level 1 Track

A big metal mass announcement shall be given by a balise group prior to the big metal mass but located at least 70m from the start location, before any object longer than 10m which exceeds the allowable metal mass limits.

The start and finish location of a big metal mass shall be identified on a signalling plan, as per the figure below:

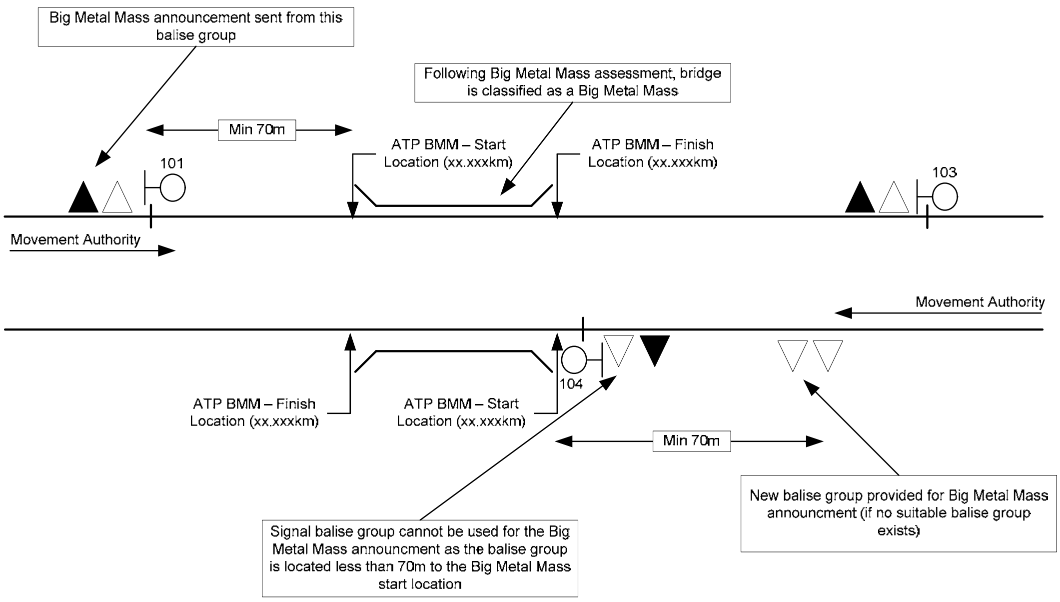


Figure 11 - Big Metal Mass Announcement Arrangements

31.11.2.3 Junctions

All possible approaches to a big metal mass, in particular at converging junctions, shall have big metal mass announcement.

At diverging junctions, big metal mass announcement shall only be given when the signal is clear for the route containing the big metal mass.

31.11.2.4 Existing Balises

Existing balises may be used for warning of big metal masses where appropriate.

31.11.3 Balises Near Big Metal Masses

Balises shall not be located within 10m of a big metal mass.

31.11.4 Metal Mass Exclusion Zone

Balises should preferably not be positioned within metal structures or objects, these include:

- Bridges,
- Viaducts,
- Structures with steel reinforcing (concrete slab track, derailment plinths etc...)
- Guard Rails.

31.11.4.1 Guard Rails

Guard rails are considered in a different category and are not Big Metal Masses. Guard rails should not cause onboard alarms, but cross talk may occur between balises installed in the track, where guard rails are present.

Balises shall not be placed alongside guard rails unless infrastructure constraints make it unavoidable.

31.12 Principle – Infill

This principle for identifying the selection for infill is dependant on the general provision of high release speeds due to long overlaps. If overlaps are shortened, infill may be needed to compensate for low release speeds.

31.12.1 Background

Where trains regularly approach a signal at stop, and that signal clears on approach, it may be necessary for infill to be provided to permit that train to accelerate in response to the signal indication. This principle details the process for determining when infill is to be provided. Infill is provided by a balise installed at the infill point and generally cabled from the LEU at the signal ahead.

Infill is only processed by the onboard equipment for trains operating in Full Supervision mode. Infill is not processed in the following normal or exceptional circumstances:

- On-Sight or Shunting mode after passing a shunt proceed aspect.

- Staff Responsible after changing ends, restarting ATP, or passing a signal at stop.

31.12.2 Infill Assessment Criteria

Generally, where a high release speed is available due to a reasonable length overlap, the release speed reduces the operational restrictions for the driver and thus no additional infill is required.

31.12.2.1 Provision of Infill

Where the release speed is low (due to short overlap, or a low speed junction just beyond the signal) infill may be required.

Infill is generally not required:

- For automatic signals.
- At locations where the signal ahead cannot be sighted.
- Where the release speed is 40km/h or higher.
- Where the signal spacing is 300m or less.
- At signals which are rarely at stop.

Calculation for infill at station areas shall be based on a level gradient and an acceleration rate of 1.0m/s.

Additional balises may be required dependent on the balise data capacity constraints and trackside infill assessment.

31.12.2.1.1 Infill Balise Placement

Infill may also be required to maintain headway where the pre-indication location occurs before the first warning signal. In these situations, the infill balise shall be located just prior to the pre-indication location. The infill balise should be provided if the timetabled headway is close to the design headway such that drivers would receive undue warnings when the signal ahead steps up to clear. This may mitigate the need for an additional aspect or networked LEU.

Where a signal is regularly at stop and the conditions are such that infill would benefit train running (low release speed), then infill may be provided. The infill balise shall be installed not further than half the linespeed service braking distance (for EMU trains) before the signal, based on a GE76 braking curve.

Where Infill is required at platform areas, the infill balise location shall be just after the train stopping location. The balise location may be moved closer to the signal to avoid excessive cabling, as long as the trains speed would not exceed 80% of the release speed before reaching the infill location.

Where there is a risk associated with trains restarting after having stopped at a station and the release speed being exceeded at the next signal, infill can be provided. For this situation to occur, trains must stop at least 40m from the signal (i.e. greater than two car lengths) and regularly enter the platform with the next signal at stop. Multiple infill may be required at platforms dependent on the outcome of the Infill assessment.

Where a distant signal or repeater is provided, infill shall be provided at the distant signal or repeater signal location, unless the distant or repeater signal shows a stop aspect, where upon it shall be treated as a normal signal in order to provide a movement authority when cleared. The infill balise group shall be positioned relative to the signals, as per the controlled balise of a signal balise group, refer to Figure 1.

31.13 Principle – Supervised Locations

The supervised location is a defined point beyond the end of authority which a train must not pass, similar to a signalling overlap. It is protected by the emergency brake intervention curve, and considers the maximum safe front end (i.e. the worst case train positioning given odometer inaccuracies).

31.13.1 Introduction

The supervised location can be any of the following:

- ATP Overlap
- Danger Point

Where only one supervised location is used, it will be coded as a danger point due to specific functionality specified for the overlap.

The signalling overlap shall be treated as the danger point in the ETCS data, unless the interlocking can release the overlap. After the release of the overlap, the supervised location is the danger point.

The supervised location shall be defined for all end of authorities in level 1 territory, and all signals included in the last aspect sequence (level 0) from the last signal in level 1 territory.

31.13.2 ATP Overlaps

The ATP overlap will be the existing conventional signalling overlap for each signalled main route.

Where multiple overlaps exist for a signalled route (e.g. low speed, conditional and full overlaps, or alternative overlaps through points), the ATP overlap shall be the shortest overlap.

Where the exit signal at the End of Authority is a controlled signal and the shortest existing signalling overlap is greater than 500m, the ATP overlap shall be specified at a maximum of 500m past the signal.

Where the exit signal or end of authority is an automatic signal, the ATP overlap shall be the same as the shortest signalling overlap.

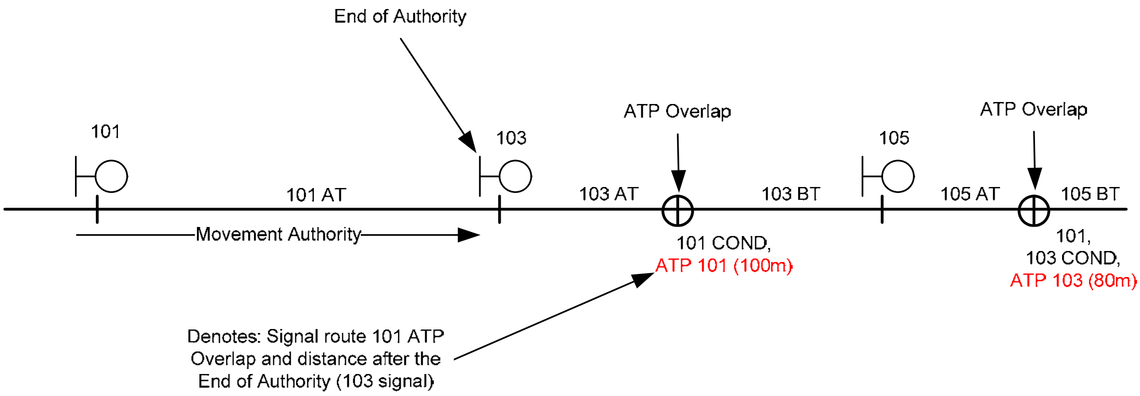


Figure 12 - ATP Overlap

The figure above identifies the ATP overlap as the shortest overlap available for the signalled route.

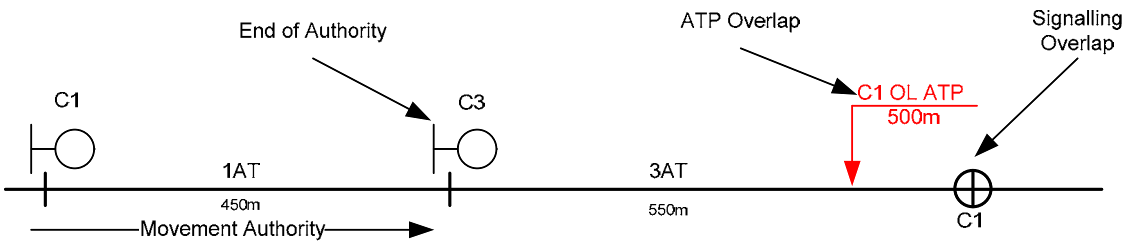


Figure 13 – ATP Overlap (From a Controlled Signal with O/L >500m)

The ATP overlap is specific to the signal route overlap past the applicable end of authority. Data design shall consider the ATP overlap as the danger point (no danger point defined) for the applicable end of authority when no route release timer is provided.

Any subsequent future reduction in overlap lengths (fully ATP fitted areas only), shall as a minimum accommodate a release speed higher than the nominal 15km/h.

When overlaps are considered for reduction, consideration shall be given to any local risks that may impact wheel to rail adhesion. Where adhesion risks exist, an assessment shall be made on the overlap length providing suitable protection for the ATP system.

The ATP overlap shall be recorded on the signalling plan and identified by the name of the movement authority, together with the distance past the end of authority.

31.13.2.1 Catch Points

Where a catch point exists in the signal overlap, the ATP overlap will be specified as the danger point location of the next converging point (where a conflict may exist) past the catch points, and classified as the 'Unique Supervised Location'.

Where the danger point of the next convergence and 'Throw off Rail' are at different locations, the closer of the two locations to the end of authority shall be specified as the danger point.

31.13.3 Danger Points

The danger point is used to protect the closest conflict past an end of authority, according to the track layout.

The distance from the signal to the danger point shall be recorded on the signalling plan. The danger point shall be referenced from the immediate signal at stop, not the signal issuing the movement authority, as the danger point is generally only applicable after route locking has released.

31.13.3.1 Defining the Danger Point

31.13.3.1.1 Trailing Points

The Danger Point for trailing points (converging) in the overlap shall be the surveyed clearance point (identified on site), of the closest convergence past the end of authority.

If the clearance point is not identified on site, the danger point shall be defined as a point 3m in rear of where the distance between the converging rails is equal to 2170mm.

Note – This section defines the danger point only, not the clearance point.

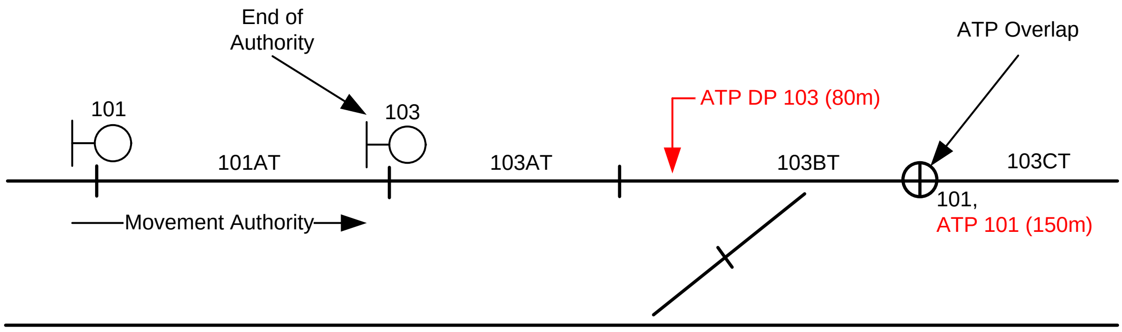


Figure 14 - Danger Point where trailing points exist within the signal overlap

31.13.3.1.2 Facing Points

Where a facing point exists within the overlap, the danger point will be the departure end of the points locking track circuits for the facing points.

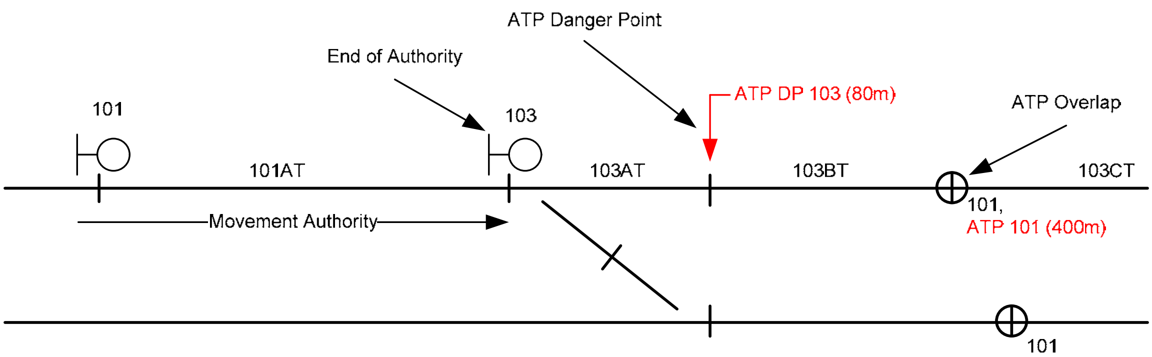


Figure 15 - Danger Point where facing points exist in the overlap

31.13.3.1.3 Multiple Point Ends

Where multiple crossovers or point ends exist past the end of a movement authority, all conflicting movements within the overlap are to be considered when determining the closest conflicting point past the end of that authority as the danger point.

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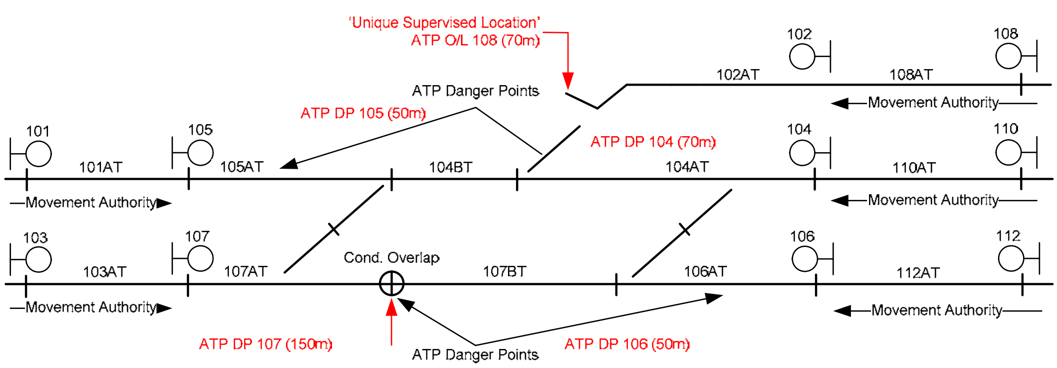


Figure 16 - Danger Point where Multiple Point Ends exist in the overlap

31.13.3.1.4 Ground Frame Operated Points

Points operated from a ground frame shall not be considered when defining danger points.

31.13.3.2 Overlap Time Out

If a signalled overlap can be released on the expiration of a Route Holding Release Timer, then where that overlap is used in ATP, it must be released by the ATP overlap time out (Overlap Timer). The duration of the ATP Overlap Timer shall be the same as the route holding release timer.

The location to start the overlap timing and the start and finish location of an overlap track shall be defined as the beginning of the track circuit used for the commencement of the route holding release timer in the interlocking.

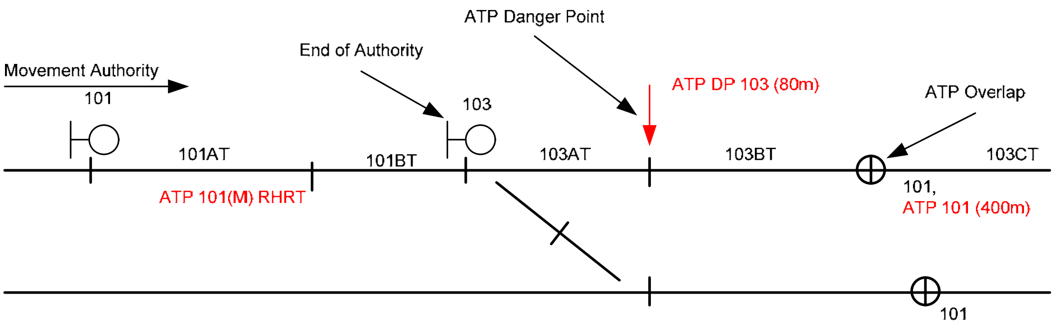


Figure 17 – Start location of a Route Holding Release Timer (RHRT)

Where the signal ahead is likely to conditionally clear, or has a low speed route, the timer may need to be extended in order to prevent the release speed being reduced due to the time out occurring early due to a low speed approach.

For the purpose of defining the start and finish locations of a route holding release timer track and overlap track, the following is considered as the start/finish point:

- The centre of a tuned loop,
- DPU,
- Insulated joint

31.13.3.3 Un-Signalled Areas

Movement Authorities into un-signalled areas (yards, maintenance centres etc…), the danger point shall be defined as the end of authority.

31.13.4 Unique Supervised Location

31.13.4.1 Level Crossings

Where a level crossing is located in the signalling overlap, the nearest edge of the crossing shall be defined as the ATP overlap if the protecting signal qualifies the crossing.

Where a signal before a level crossing does not qualify the crossing operation, the normal signal overlap is to be used to determine the ATP overlap.

31.13.4.2 Buffer Stops and the End of the Line

The supervised location shall be located a minimum 40m beyond the End of Authority.

Where the distance between the End of Authority and Buffer Stop is greater than 40m, the supervised location may be defined as the Buffer Stop.

31.13.4.3 Un-Wired Sections

The ‘Shunting Limit’ or ‘Electric Trains Stop’ sign shall be treated as the unique supervised location for both the protecting and preceding signals before the un-wired section. No previous ATP overlaps shall be beyond the unique supervised location.

31.13.5 Routes To Shunt Signals

The supervised location for a shunt signal shall be defined as the end of authority.

31.14 Principle - LEUs and LEU Inputs

31.14.1 Background

Signalling information is passed into the ATP system through inputs in a Lineside Electronics Unit (LEU). Two forms of inputs are possible; contact sensing (from relays) and current sensing (of lamp currents). Contact sensing may be achieved by using current sense inputs and a load resistor.

31.14.2 Arrangements

31.14.2.1 Provision of LEUs

Each signal including distant signals which can show stop and colour light repeater signals, shall have their full range of aspects provided as an input to the signal’s LEU. White light style repeater signals and distant signals which cannot show stop shall be treated as infill.

LEUs shall not be used to control balises on different running lines but may be used to control consecutive signals in the same direction.

On bi-directional lines, up and down signals shall be connected to different LEUs, unless specifically approved by the Chief Engineer, Signals and Control Systems.

Adjacent shunt signals on converging lines may use a single LEU.

31.14.2.2 Location of LEUs

LEUs shall be installed in lineside bungalows, relay rooms or cupboards.

The LEUs shall be mounted at the signal control output location wherever practical.

Where new enclosures are required, consideration shall be given to minimise double cutting arrangements where contact sensing is used.

31.14.2.3 Risk Mitigation

Where current sensing is used, additional inputs or other arrangements shall be provided to mitigate against a false movement authority being generated under a single failure mode.

31.14.2.3.1 Red Retaining

Where red retaining features are provided on the lamp drivers in a current sensing arrangement, all red retained lamps shall be located on the one LEU plug. Shunt and low speed aspects shall input on a separate plug. Red retained wires shall be provided with additional sleeving when bundled with wires of other indications.

Where an ATP location is separate to the signal control output location and the adjoining cable route is external or underground, all red retaining wiring is to be segregated in a separate cable to all other signal operating wiring.

Generally the inputs shall be provided sequentially where possible, after the red retaining arrangements have been facilitated.

31.14.2.4 Configuration of Multiple LEU Modules

Where there are insufficient inputs on a single LEU module, additional modules may be provided. The number of modules used shall be kept to the minimum as required, i.e. 'spare' inputs should be used before adding another module.

Note that where Alstom Microcoders are used, the balise message selection table can consider a maximum of 16 inputs, whether from locally grouped LEU modules or from remote networking.

The controlled balise(s) shall be connected to the output of the first LEU module. Outputs on the second module shall only be used where required for additional controlled balises.

31.14.2.5 LEU Power Supply

The power supply for the LEU shall be derived from the same power source as the signalling system supply. Where the LEU cannot operate directly from the signalling supply, an intermediate power supply may be provided.

For each LEU installation, the LEU shall be supplied from a separate 120Vac power supply isolation device in the form of a fuse. The fuse and fuse holder shall be separate to other signalling equipment.

For external voltage source contact sensing inputs, a separate fuse/fuse holder shall be provided for the contact wetting voltage source supply for each LEU. The fuse shall be located in the same location enclosure as the LEU.

If no inbuilt surge protection is provided on the 120Vac supply for the LEU, surge protection shall be provided at the 120Vac bus supplying the LEU equipment.

31.14.2.6 LEU Failure Reporting

There is no requirement to provide remote failure reporting other than indications to the driver though the DMI, but where the LEU provides fault monitoring facilities, these may be used where it can be accommodated within existing telemetry or communications system.

31.14.2.7 Signalling – LEU Interface

There are two configurations to providing the Signalling to LEU interface.

- Contact Sensing
- Current Sensing

Wherever possible contact sensing inputs shall be used.

Where shelf relays are used, current sensing may be considered.

The inputs for the LEU shall be typically derived from the direct controls of the signal aspects: Aspect control relays, CBI signal modules.

For infill, the controls shall be taken from the signal ahead.

For a distant signal or a white light repeater, the controls of the distant signal/repeater can be used as the input for the infill.

31.14.2.7.1 Turnout Repeaters

Turnout repeater controls shall be included for routes through the junction. Should a repeater not be provided on the outer signal but the junction signal is visible to the driver, the diverging route controls shall be included in the outer signal's LEU interface.

31.14.2.7.2 Contact Sensing

For all contact sensing each route HR, and each higher aspect including turnout repeater control relay shall be an input. There is no requirement to prove the turnout repeater lit to the LEU input.

Where the signal displays only turnout routes, the inputs are to be allocated as if the turnout route is the main route. Where the information for the turnout route cannot be determined from the aspect control relays, the detection of points shall be used as an input.

Where the LEU is located externally to the control relays, arrangements are to be made for double cutting of the LEU inputs.

All control relays for higher aspects shall be inputted with their respective lower aspect (in series), including the 'A' track, as per 31.14.2.9.

For signals controlled from mechanical interlockings, provision shall be made for a vital relay/LEU interface.

Where provided, the VRR & ECR shall also be inputted when required for inhibition of infill.

31.14.2.7.3 Current Sensing

Current sensing is to be adopted where control relays do not exist or do not meet the requirements of contact sensing.

All aspect lamp circuits will be used as an input to the LEU, including subsidiary aspects and route indications to determine routes taken at a diverging junction. Where a co-acting signal is provided, only the lamps of the main signal are to be sensed.

31.14.2.8 Non-Standard Stopping Locations

For situations where the balise group is positioned at a non-standard stopping location closer or past the signal, new signal controls are to be provided which will not include the replacement track circuit or 'A' track, but otherwise all other controls are included.

Special circuit arrangements are required to qualify the 'A' track (only) out of the movement authority replacement controls. Replacement by other controls (such as signaller, points detection, and other track circuits), is to be unaffected. The qualification is only to be effective if the berth track is occupied before the 'A' track. This provides for a last wheel replacement if the 'A' track is longer than the train length.

31.14.2.9 Track Stick Protection

For contact sensing, the LEU inputs shall include the 'A' track as a track stick protection in series with all the track controlled inputs.

31.14.2.10 Trainstop Removal

Wherever practical the arrangements shall facilitate the future removal of trainstops and also potentially signals, with the minimum of alterations.

31.14.2.11 Allocation of Inputs

LEU inputs shall not be provided for signalled movements not used by ATP fitted rolling stock.

LEU inputs shall use the arrangements in the standard circuits. Where additional inputs are required (due to the signal having more routes or lights than shown on the standard circuit) any spare inputs (such as unused VRR/ECR for infill) shall be used before an additional LEU is provided. Inputs should be used sequentially whenever possible.

Generally where more than one LEU is utilised, the preference is for all main route inputs and shunt route inputs to be separated on individual LEUs.

However, the preference for the allocation of the LEU inputs is a follows (in preferential order):

a) All main routes and associated aspects (Inc Low Speed) for the straight ahead route.

b) All main routes and associated aspects (Inc Low Speed) for the diverging route, starting with the furthermost route to the left and sequentially all remaining routes from left to right.

c) Shunt route and associated aspect for the straight ahead destination. Irrespective of whether a main class route is available for the same destination.

d) All shunt routes and associated aspects for the diverging routes, starting with the furthermost route to the left and sequentially all remaining routes from left to right, irrespective of whether a main class route is available for the same route.

Note – Low speed and caution relay contact proving inputs shall use the same input.

'T' (Tonnage) indicators (where provided), do not need to be inputs to the LEU.

31.14.3 Repositioning

Repositioning shall only be used for subsidiary main and shunt routes, and only where doing so will prevent the need for an additional LEU module.

31.14.4 Additional Aspect Information

Should information not be available for a movement authority through a diverging junction or the calculated pre-indication location falls before the first warning aspect, advance information of the movement authority is required. The aspect sequence may be extended via additional discrete circuits or CBI outputs feeding local LEU inputs, or by networking the LEUs. These additional aspects do not need to be displayed on the signal, i.e. they may be ATP virtual aspects, e.g. a medium indication may be enhanced with the straight route ahead being set to avoid speeds being restricted for a potential turnout. It is preferred that existing aspect circuits are used for this purpose to avoid additional LEU inputs to replicate all the controls from the aspect circuit being provided. The use of LEU

networking will result in networks carrying vital data critical to train running. As the network may not be duplicated or redundant, or alarmed for failure, this shall be approved by the Chief Engineer, Signals and Control Systems.

31.15 Principle - LEU Identification

LEUs shall be named after their related signal. The first LEU module will be identified as 'A'. Subsequent LEUs shall be denoted 'B', 'C' etc...

31.16 Principle - ETCS Operational Modes

31.16.1 Purpose

The following outlines the ETCS operational modes used for signalled and un-signalled movements.

Transition to a mode providing higher supervision, shall occur at the earliest practical opportunity.

The operational modes are as follows:

- Full Supervision (FS)
- On Sight (OS)
- Shunting (SH)
- Staff Responsible (SR)
- Unfitted (UN)

Note – Only shunting mode (SH) shall be identified on signalling plans against the relevant route information (route box), where applicable.

31.16.1.1 Full Supervision

All main and subsidiary running signals shall generate a FS movement authority.

31.16.1.2 On-Sight

All shunt routes fitted with ATP shall generate an OS movement authority, unless SH mode is to be applied for a specific purpose. OS mode shall not be announced by infill

A 25km/h on sight permitted speed limit shall be applied (National Value Reference: V_NVONSIGHT).

31.16.1.3 Shunting

SH mode is required for propelling, amalgamation/division of trains and for moves within yards where not all signals are fitted with ATP. It will normally be selected by the driver as required, but can be commanded from the trackside for specific situations and locations.

A 15km/h shunting mode permitted speed limit shall be applied (National Value Reference: V_NVSHUNT).

31.16.1.4 Staff Responsible

SR mode allows the driver to operate the train under his/her own responsibility, without the onboard providing any movement authority information. Staff responsible does not correspond to any signalled route information

In staff responsible mode, the speed is not supervised by the speed of the lineside speed boards but has a maximum national value set at 25km/h (National Value Reference: V_NVSTFF).

31.16.1.5 Un-Fitted

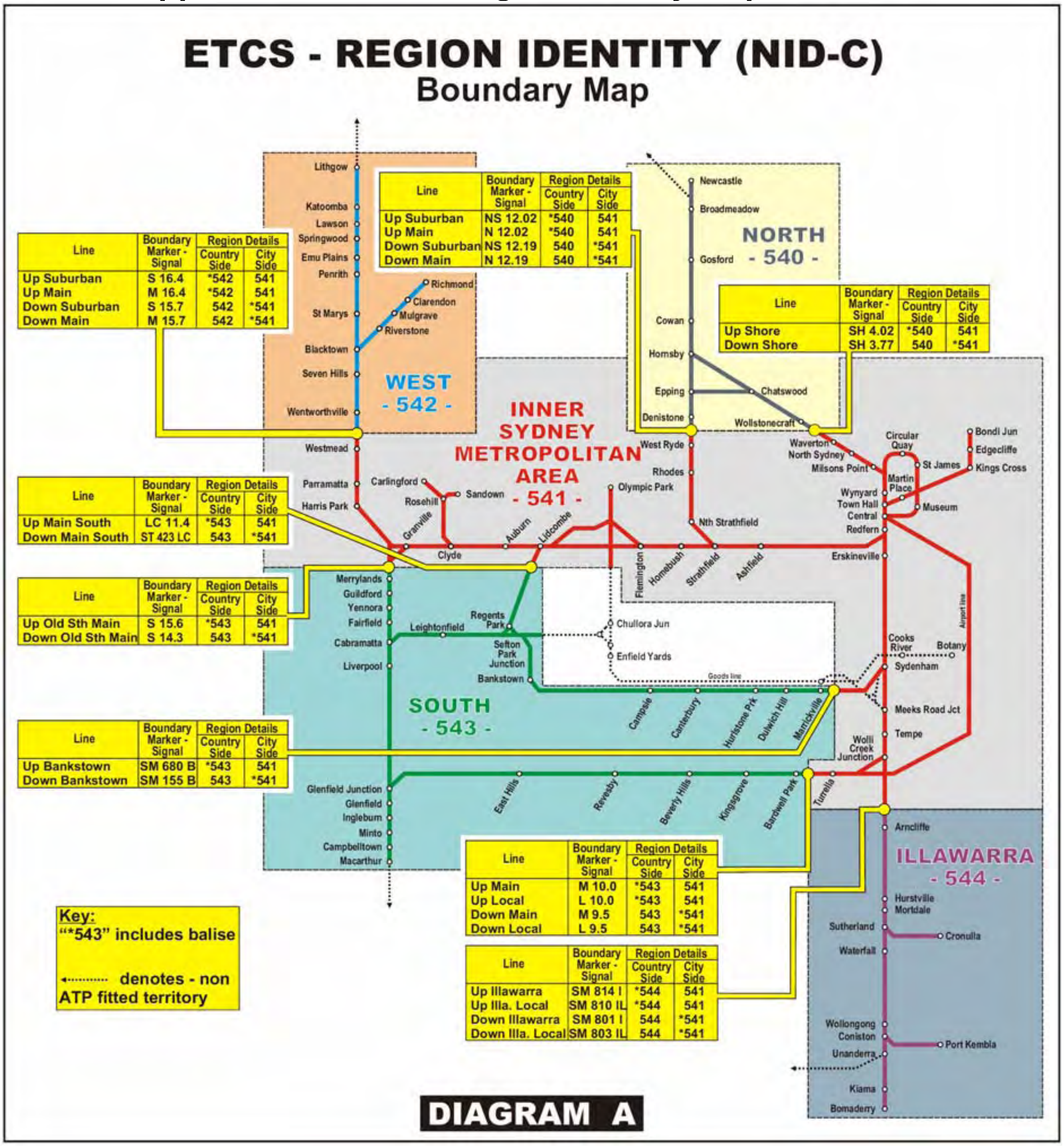
UN mode is applicable to trains operating in level 0 territory. The maximum speed for un-fitted mode allowed for the network is 160km/h (National Value Reference: V_NVUNFIT).

31.16.1.6 Yards

For trains entering a yard, OS or SH mode shall be applied at the signal protecting the yard depending on the movements to be made, e.g a straightforward entry into a yard (including up to Buffer Stops) should be OS mode for the longest possible movement. Where the movement is required to propel, the use of SH mode may be more appropriate. For movements within the yard, SH mode is required where propelling is involved or OS mode where the movement is a straightforward exit.

For trains exiting a yard, On-Sight mode shall be applied at the signal protecting the running line (or Full Supervision if a running signal) and 'Danger for Shunting Information' provided at the balise group.

Appendix A – ETCS Region Identity Map



ESG 100.32

CIRCUIT NOMENCLATURE

Version 1.0

6 November 2012

Document control

Version	Date	Summary of change
1.0	6 November 2012	First Issue

Contents

31.1 Introduction

Nomenclature is a system of words used in particular disciplines. It is used in respect of giving names systematically, following a convention that is used on signalling circuit designs to ensure that the correct information is always conveyed without ambiguity.

31.2 Purpose

The purpose of this document is to define the principles associated with the application of circuit nomenclature for the signalling circuit design requirements on the existing RailCorp network.

31.3 References

British Standard 376: Part 2:1954

RailTrack Standard GK/RT0205 1995

State Rail Authority of NSW:

Route Control System of Interlocking 1982

ST102 Signalling Principles 2 Training Manual

ST401 Route Locking Training Manual

RailCorp Engineering Specifications

SDG 001 Circuit Design Standards

31.4 Principle – Circuit Nomenclature

In order to provide a concise, suggestive, graphic code for marking the units on plans, the following system has been evolved which makes use of designation made up of two parts, namely:-

1. Numerical/Alphabetical Prefix

   The number of the individual lever, signal, point, track circuit, etc. and their associated equipment, entering into the control of, or controlled by, the unit.

   Where a letter or letters are used to identify equipment (e.g. – track circuits) these letters shall be placed immediately before the Numerical Prefix.

   Where confusion could arise the control number may be prefixed by the letters indicating the control point or locality; - SP31, where SP = Sefton Park.

2. Alphabetical Term

   Consisting of one or more letters. Where the letter is used singly or finally it is used as a noun and designates the general kind of unit. Preceding letters, which are used as adjectives, denotes the purpose of the unit.

   Where reference is to be made to the position of levers, switches, push buttons or any other device operated by the signaller, as in the case of a lever lock or a relay representing a lever position, the letters shall be used in brackets immediately before the final letter.

31.5 Combination of Numerical and Alphabetical Prefix and Terms

As far as practicable in the list of nomenclatures, assigned letters are suggested, either because they are the first letter in the words they represent (e.g. – A in Approach) or because of usage. However many letters stand for names which cannot be associated, and are arbitrary symbols only (e.g. – G for Signal). Some of the letters represent several different meanings of words, depending on their position with respect to numerals and other letters. The scheme nomenclature shall be used consistently so that there is no mistake in the meaning.

Where reference is to be made to the position of levers, switches, push buttons or any other device, the combination of letters shall be used as an adjective, e.g. – RWK as in 203RWKR.

To provide for exceptional cases where the nomenclature does not cover the whole of the conditions, a description may be placed in brackets after the Prefix. E.g.:

38(S)A HR

Refers to the 38 Shunt A route Caution Relay.

The complete designation of a unit is written as follows:-

31DR (without dots or dashes)

(Numerical prefix)	(Prefix letter)	(Final letter)
31	D	R

In the example, “31” is the number of the signal, but when used to refer to the signal will be “31G”. When the figure is used alone, it will be understood to refer to the lever, switch, push button or other equipment actuated by the signaller for the control of the signal, thus “31(N)R” indicates a relay repeating the normal position of the lever, push button etc.

“31R” indicates a relay associated with Signal 31 and “31DR” indicates a relay controlling the clear (green) aspect of Signal SP31. In other words, the letter “R” means relay in general; the letter “D” indicates the function of this relay is to control the clear (green) aspect; and the number “31” definitely indicates the signal which this “clear” relay controls.

31.6 Rules for Standard Naming of Repeat & Indicating Relays

When naming track repeat relays, indicating relays and repeat relays of proved functions the following rules are to apply:

1. Add a ‘P’ when indicating to a remote site.

2. Add a number when repeating at the same site

For further explanation and examples refer to RailCorp Engineering Specification

SDG 001 Circuit Design Standards Sheets Z001- Z003

31.7 Nomenclature Meaning of Letters

Description Term (Prefix Letter)	**Apparatus (Last Letter)**
A. Approach; Automatic; Available	A.
B. Block; Bolt; positive of power source	B.
C. Checking or proving; Centre; Control; Country; Council	C. Contact
Ce. Commence	
D. Clear (Distant/green); Data; Direction; Down	D.
E. Lamp; Light; Earth; Electronic: Emergency;	E. Electric apparatus
F. Flashing	f. Fuse
Fn. Finish	
G. Signal	G. Signal apparatus, including signals
H. Caution (Home/yellow)	H. Capacitor
HD. Medium (Home/Distant)	
I. Intermediate; Isolating	I. Inductor
J. Time Delay; Time Limit; Timer; Timing	J. Rectifier
JP. Turnout (Junction) Repeater	
K. Indicating or Detecting; Indicator	K. Indicator (visual)
L. Left; Lever; Lineside; Local; Lock; Locked; Locking; Low; Lower	L. Lock
M. Machine; Marker; Motor	M. Motor; Module
Mu. Machine in Use	
N. Normal; Normalising; negative of power source	N. Release; hand operated switch, push-button or key
O. Off; Operation	O. Resistor
OL. Overlap	
P. Repeat; Repeating; Pick Up; Plunger; Power; Preliminary; Proving	P. Lever, latch or trigger contact
Q. Treadle or bar	Q. Local coil of double element relay
R. Red(danger); Remote; Reverse; Right;	R. Relay or Contactor (line or track element of double element relay); Receiver
S. Section; Shunt; Side; Stick; Supply; Switch; Sydney	S.
Sn. Suppression	
Sp. Speed	t. Terminal
T. Track Circuit; Transit	T. Transformer; Transmitter
U. Route; Up; Upper	U. Train description apparatus (for route indicating); Unit
V. Trainstop	V. Trainstop apparatus
W. Points	W. Point operating apparatus
X. Crossing; AC power supply	X. Audible Indicator (such as bell, buzzer, horn)
Y. Disengaging	Y. Disengaging apparatus
Z. Special, Free	Z. Special unit

31.8 Examples of Combinations

31(R)R	No.31 button reverse relay
31(R)PR	No.31 button reverse repeat relay
31(N)R	No.31 button normal relay
31YR	No.31 button disengaging relay
31CeR	No.31 commence relay
31FnR	No.31 finish relay
FnPR	Finish repeat relay
FnJR	Finish timing relay
MuR	Machine in use relay
31SR	No.31 lever stick relay
31LSpR	No. 31 low speed relay
31HR	No.31 caution (home) relay
31HDR	No.31 medium (home/distant) relay
31DR	No.31 clear (distant) relay
31USR	No.31 route stick relay
31ALSR	No.31 approach lock stick relay
31V	No.31 trainstop
31VNR	No.31 trainstop normal r relay
31VRR	No.31 trainstop reverse relay
31VSnR	No.31 trainstop suppression relay
31ECR	No.31 lamp checking (proving) relay
31DE	No.31 green light
31HE	No.31 yellow light
31RE	No.31 red light
31ME	No.31 marker light
31NKE	No.31 normal indicating (repeater) lamp
31RKE	No.31 reverse indicating (repeater) lamp
203(N)R	203 lever normal relay
203(R)R	203 lever reverse relay
203(C)R	203 lever centre relay
203NLR	203 normal lock relay
203RLR	203 reverse lock relay
203NWKR	203 normal point detector relay
203RWKR	203 reverse point detector relay
203NWKPR	203 normal point detector repeat relay
203NLKPR	203 normal lock detector repeat relay
203RLKPR	203 reverse lock detector repeat relay
203WZR	203 point free relay
203NWAR	203 normal point available relay
203RWAR	203 reverse point available relay
203NWR	203 normal point contactor
203RWR	203 reverse point contactor
203NOLR	203 normal overlap relay
203ROLR	203 reverse overlap relay
203WTJR	203 point transit timer relay
POJR	Power off timer relay
XNR	Crossing control relay
7CTJR	No. 7 “C” track timing relay

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