TS 05333.14:1.0
T HR SC 10014 ST
Standard

Signalling Design Principle

Part 14: Points

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Document history

Revision	Effective date	Summary of changes
1.0	19/05/2020	First issue as T HR SC 10014 ST *Signalling Design Principle – Points*
1.0	16/06/2023	First issue as TS 05333.14. Changes from previous version include: the structure of the document has been changed in accordance with TfNSW's current standards rules; sections have been updated, rearranged and renumbered to remove ambiguity; new section related to points identification has been added; appendices A and B have been removed.

Preface

This document a first issue as TS 05333.14 and supersedes T HR SC 10014 ST *Signalling Design Principle – Points*, version 1.0.

This standard forms a part of the TfNSW suite of railway signalling principles which detail the design requirements of the complete signalling system. To gain a complete overview of signalling design requirements, this standard should be read in conjunction with the suite of signalling design principle standards. This standard specifically covers points.

The following changes have been made to the previous version:

- the structure of the document has been changed in accordance with TfNSW's current standards rules
- sections have been updated, rearranged and renumbered to remove ambiguity
- new section related to points identification has been added
- appendices A and B have been removed

Table of contents

1 Scope

This standard sets the design principles and requirements for new and altered signalling points.

2 Application

This standard applies to heavy rail signalling points in the MRA and is intended for use by the operator and maintainer, TfNSW staff and TAOs to ensure that signalling assets are uniquely identified, consistent with existing assets naming conventions.

3 Referenced documents

The following documents are cited in the text. For dated references, only the cited edition applies. For undated references, the latest edition of the referenced document applies.

Transport for NSW standards

TS 05333.4 (T HR SC 10004 ST) *Signalling Design Principle – Overlaps*

TS 05333.12 (T HR SC 10012 ST) *Signalling Design Principle – Route Holding*

TS 05333.17 (T HR SC 10017 ST) *Signalling Design Principle – Train Detection Systems*

TS 05333.29 (T HR SC 10029 ST) *Signalling Design Principle – Naming of Locations, Tracks and Sidings*

TS 05333.31 *Signalling Design Principle – ECTS Level 1*

TS 05366 (ESG 007) *Glossary of Signalling Terms*

TS 05368 (T HR SC 02000 ST) *Mandatory Requirements for Signalling Safeworking Procedures*

Other referenced documents

BR943 *Specification of Miniature Tractive Armature AC Immune DC Biased Contactor Relay, Plug-In Type for Railway Signalling Purposes*

4 Terms, definitions, and abbreviations

For a list of signalling terms and definitions refer to TS 05366. The following terms, definitions and abbreviations also apply in this document.

Annett key key with wards which is fitted either to a staff or a large handle and which is used to operate the Annett lock on interlocking equipment or to operate a duplex lock

Annett lock lock operated by an Annett key and used to lock, release or operate signalling equipment

back drive a second drive position on the point switches used where the length of the switch is such that a single drive will leave the back part of the switch hanging off the stockrail. Location of the back drive is determined by switch length, and it may be operated by rodding from the drive or by a separate point operating mechanism.

balloon loop siding a circular portion of line that allows rail traffic to change direction of travel without change to the leading end (Source: RISSB)

CBI computer-based interlocking; a computerised software system for providing the interlocking between points and signals

CH crank handle; an appliance by which electric and electro-hydraulic point machines can be manually operated

CNP connection not permitted

EOL emergency operations lock

EOLPB emergency operations lock pushbuttons

EP electro-pneumatic

ESML emergency switch machine lock; equipment which is interlocked with protecting signals and the controlling mechanisms of power operated points so that the points can be manually operated when required in an emergency

ETCS European train control system

FPL facing point lock; a mechanical bolt lock provided in connection with the mechanism for operating facing points for the purpose of securing them firmly in position against the stock rail

HTL hand throw lever

MRA metropolitan rail area; the area bounded by Newcastle Interchange (in the north), Richmond (in the northwest), Bowenfels (in the west), Macarthur (in the southwest) and Bomaderry (in the south), and all connection lines and sidings within these areas, but excluding private sidings.

NWR normal point contactor

running rail a rolled steel section installed in the track and fastened to gauge for the purpose of carrying railway traffic

RWR reverse point contactor

SFAIRP so far as is reasonably practicable; the degree of risk in a particular situation that can be balanced against the time, trouble, cost and physical difficulty of taking measures to avoid the risk

SPAD signal passed at danger

Sperolock a fully encapsulated and long-time lubricated locking system

stockrail the rail against which the point of a point switch rests

XL lock a special safeworking padlock with a limited number of keys held by authorised operations staff

5 Catchpoints

Catchpoints prevent collisions arising from conflicting movements at converging connections where the provision of an overlap is not feasible. Catchpoints also prevent collisions arising from adjacent operational movements of different train classes or types of working, and from stabled rolling stock.

The first principle of flank protection for running lines at converging connections is the provision of a prescribed overlap, in accordance with TS 05333.4.

Where such overlaps are not feasible due to infrastructure constraints or to meet operational requirements (such as to bring trains close to the junction while the junction is not available for that train), catchpoints are used to provide the alternative protection.

Catchpoints provide protection by directing rail vehicles, that are not adequately controlled, towards a possible derailment rather than a collision with another rail vehicle.

Catchpoints take the form of single-switched points. When the catchpoint is open (usually in the normal position, but not always), the wheelset of a rail vehicle is presented with a widening gauge, and the wheels will eventually drop in between the rails. Catchpoints are typically used in conjunction with other site-specific risk controls, such as a throw-off rail and ramp block to direct the derailed vehicle well clear of the other line, or a containment rail to keep the derailed vehicle within a narrow path.

5.1 Provisioning of catchpoints

Catchpoints shall provide protection for running lines where the prescribed overlap distance of a simultaneous authorised movement, leading towards the converging connection is not in accordance with TS 05333.4.

Catchpoints shall provide protection for running lines against adjacent operational movements of different train classes or types of working that pertain. For example, catchpoints provide the protection for running line movements from adjacent movements on freight lines, sidings or refuges, or shunting operations in yards.

Catchpoints shall provide protection for running lines against the risk of runaway from stabled rolling stock (including stored track maintenance machines).

Catchpoints should also be considered as a control for risk situations such as rail vehicles rolling back from a rising grade.

The objective of catchpoints is to derail and subsequently contain a rail vehicle in a controlled manner. To achieve this objective, the use of facing catchpoints on running lines shall be commensurate with the applicable line speed. Where approach speeds are high, such that the effectiveness of the catchpoint to derail and contain a rail vehicle is compromised, facing catchpoints shall be provided with additional mitigation. Such mitigation can include intermediate trainstops or other speed-proving, or sufficient distance between the signal and the catchpoints to assist drivers in regaining control and thus prevent derailment in the event of a minor overrun. See Section 5.4 for further information.

The arrangements shown in the remainder of Section 5.1 describe circumstances where catchpoint protection shall provide the flank protection.

Figure 1 shows the provision of catchpoints at connections into sidings, yards, or non-signalled areas, or on refuge loops and relief lines where wagons can be stored, unless other points will serve the same purpose.

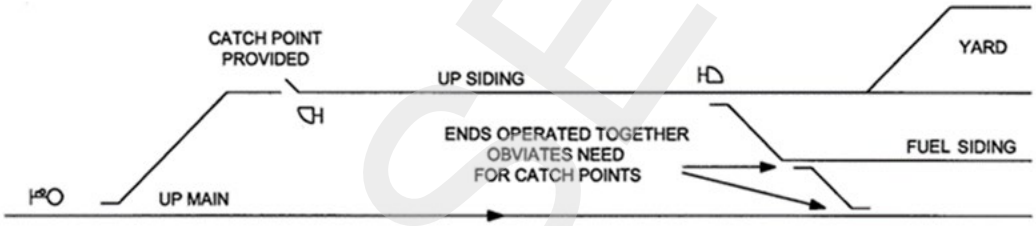


Figure 1 – Provision of catchpoints at connections

Figure 2 shows the provision of catchpoints on lines where no overlap can be provided due to infrastructure constraints or to meet the operational requirements. This provision includes signalled moves up to a home signal where simultaneous converging movements can be suitably protected from collision by a catchpoint judiciously located beyond the home signal.

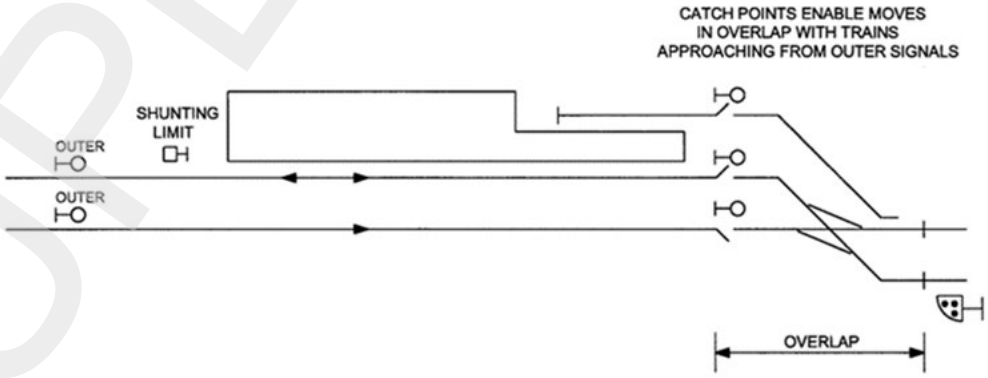


Figure 2 – Provision of catchpoints on lines where no overlaps can be provided

Figure 3 shows the provision of catchpoints on lines where shared overlap arrangements would impair the operating requirements.

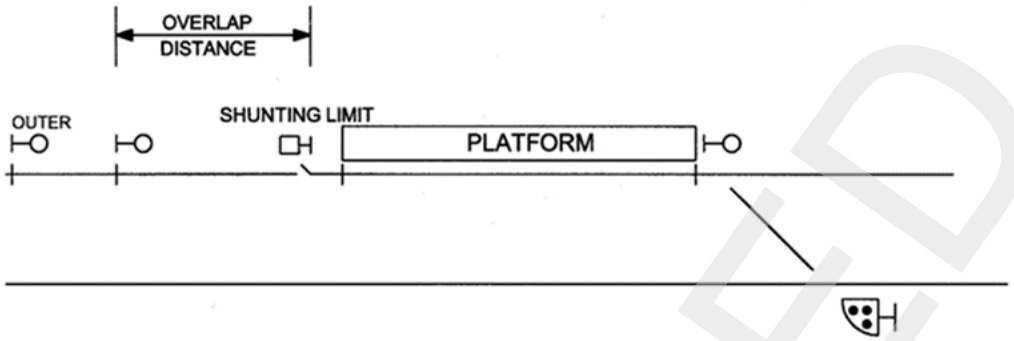


Figure 3 – Provision of catchpoints on lines where shared overlap arrangements would impair the operating requirements

Figure 4 shows the provision of catchpoints on lines where the gradient is such that a train rolling back could foul a signalled movement.

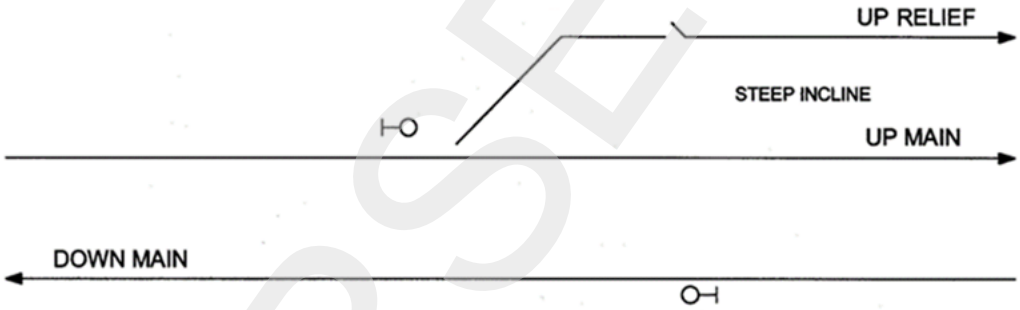


Figure 4 – Provision of catchpoints on lines where the track gradient is steep

Figure 5 shows the provision of catchpoints at crossing loops, to protect the main line from shunting movements on adjacent roads or to ease the route holding requirements.

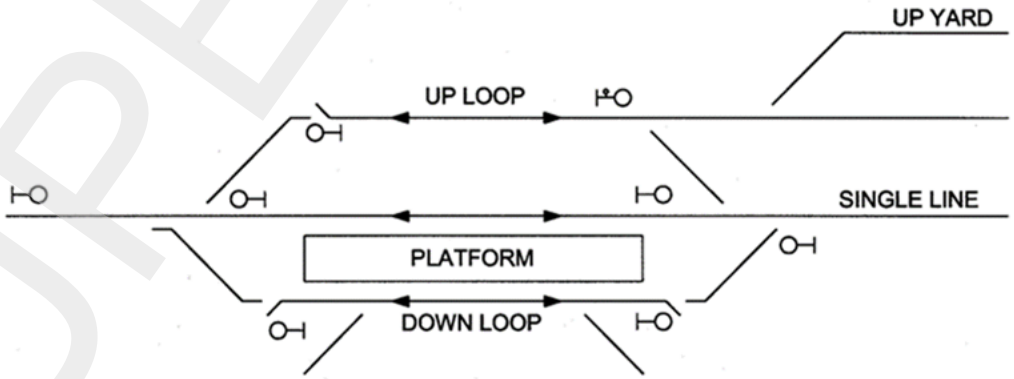


Figure 5 – Provision of catchpoints at crossing loops

Figure 6 and Figure 7 show the provision of catchpoints at main line connections leading from balloon loop sidings or other private sidings.

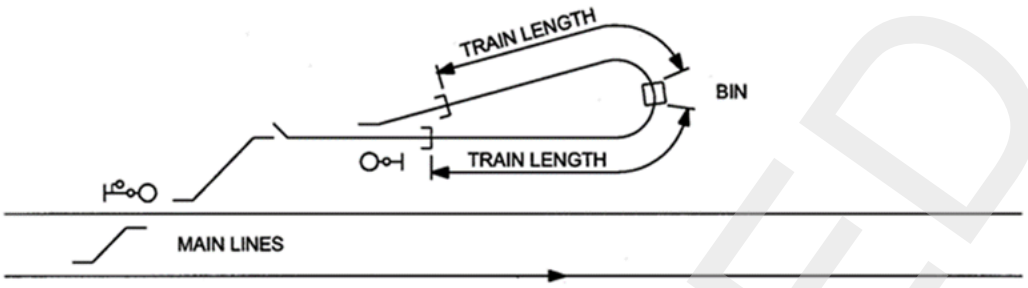


Figure 6 – Provision of catchpoints at balloon loop sidings

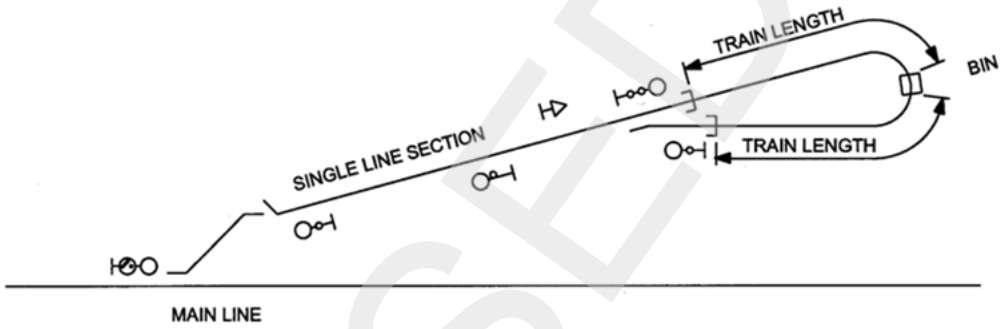


Figure 7 – Provision of catchpoints at balloon loop sidings

5.2 Consideration as to the positioning of catchpoints

The TAO shall take into account the positioning of catchpoints so as to avoid the following derailment hazards:

- adjacent running lines
- other adjacent tracks
- embankments
- bridges
- tunnel mouths
- trackside structures, such as signals, overhead masts, and the like
- platforms and station buildings
- trackside buildings such as signal boxes, relay rooms, and the like
- equipment housings, such as location cases, EOL cabinets, and the like
- at-risk adjacent structures outside the rail corridor.

5.3 Alternative configurations that may be provided

In addition to the requirements in Sections 5 to 5.2 the following additional safeguards may be provided as controls where warranted by the outcomes of an associated risk assessment:

- Full lead run-off where there is a likelihood that catchpoints could result in inadequate or unsafe deflection of the derailed vehicle (this is especially important where the run-off area is uneven and there is a risk of the rail vehicle overturning):
    - The full lead run-off shall lead into a separate length of track or into a sand drag (or similar) arrangement where approaching trains can be braking from the full-service speed to a stand immediately in rear of the run-off points.
    - Where the length of run-off is greater than 10 m from the turnout clearance points, signage stating ‘Safety overrun area - no rolling stock or equipment to be left here’ shall be provided. The signs shall be positioned within 10 m from the clearance points and subsequently at intervals not exceeding 40 m to the end of run-off (as shown by the black rectangles in Figure 8 and Figure 9).
- The use of double-switched catchpoints instead of single-switched catchpoints, where the double switch allows for additional (minor) overrun before derailing a rail vehicle.
- In some layouts, independent switches may be used to provide the equivalent protection of catchpoints. This is typical where a terminating road is between two running lines and the independent switches form part of the crossovers to both running lines.
- The use of derailers and crowders in accordance with Section 5.5.

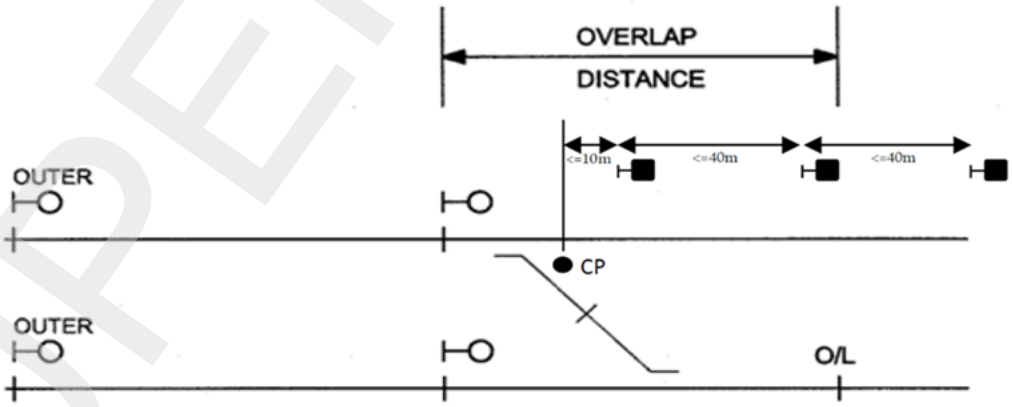


Figure 8 – Alternative configuration using a full lead run-off

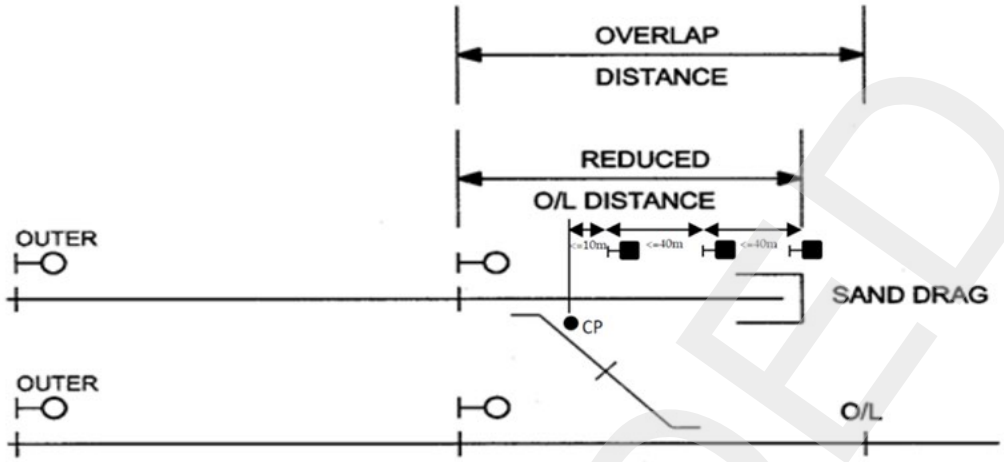


Figure 9 – Alternative configuration using a sand drag arrangement

5.4 Additional safeguards that may be provided

In addition to the requirements in Sections 5.1 to 5.3 the following safeguards shall also be taken into account where necessitated by the outcomes of risk assessment:

- Use of a containment rail instead of a throw-off rail to keep the derailed vehicle within a narrow path.
- Use of auto-normalising functionality, where catchpoints are automatically operated to the open position once the traversing rail vehicle has cleared the points.
- Use of normally closed catchpoints, for example on running lines where the catchpoints are detected Normal when in the correctly closed position.
- Use of sufficient distance between the immediate protecting signal and the catchpoints
- In trainstop territory, use of intermediate trainstops (in conjunction with low speed or conditional aspects), where the speed of a train can be satisfactorily checked on its approach to the catchpoints as shown in Figure 10.
- Where ETCS level 1 is in operation in the area and where all trains that can be routed towards the catchpoints in open position are fitted with onboard equipment to facilitate the ETCS operation, use of ETCS in accordance with TS 05333.31 to control the speed of a rail vehicle approaching an open set of catchpoints a risk assessment shall be conducted to determine if the use of ETCS for this purpose is adequate.

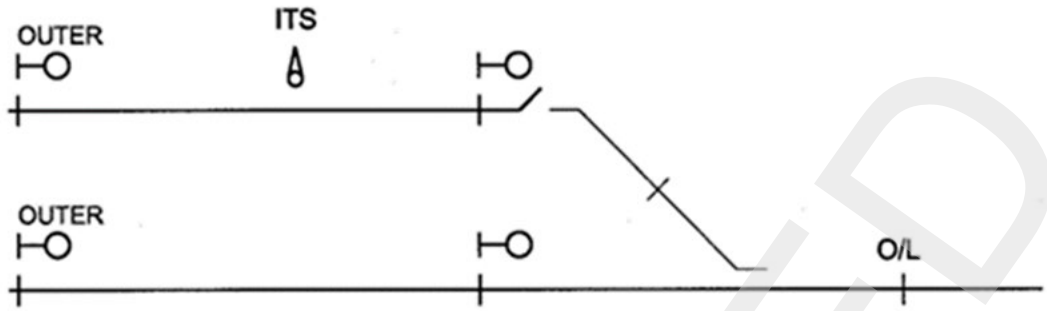


Figure 10 – Additional safeguard in trainstop territory

5.5 Derailer and crowder

A derailer is a device designed to limit the unauthorised movement of rail vehicles. When the derailer position is over the rail, the derailer lifts and transversely deflects the wheel flange over the rail head resulting in a derailment. For increased effectiveness, crowders may be installed opposite the derailer. The crowder operates in unison with the derailer to push the adjacent wheel off the rail. When derailers and crowders are positioned away from the railhead, rail movements are uninhibited.

The use of a derailer alone is only suitable to protect against unauthorised movements of rail vehicles in yards or sidings where speeds do not exceed 15 km/h, and such rail vehicles are not subject to a falling grade.

When a derailer is also provided with a crowder and speeds do not exceed 35 km/h they may be used instead of a catchpoint, subject to the following conditions:

- only installed on straight track
- not to be used on passenger lines, with the exception of train movements that commence from terminal platform roads, following consultation with, and approved by, the Asset Management Branch.

The provision of catchpoints over derailers and crowders shall always be the prime consideration for protection, as they provide better functional and containment capability.

6 Emergency crossover

An emergency crossover can be either facing or trailing and situated on a double line where the worked crossovers are long distances apart. Crossovers are provided to facilitate single line working usually in conjunction with an extensive programme of track engineering work and subsequently are left in place to enable single line working to be initiated should the need arise.

The emergency crossover can be mechanically or electrically operated. When not in use, such facing crossovers shall be clipped an XL lock locked in the normal position.

6.1 Emergency crossovers operated from mechanical ground frames

Sections 6.1.1 and 6.1.2 address 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.

6.1.1 Requirement for facing emergency crossovers operated from mechanical ground frames

Generally, the ground frame shall operate the FPLs and points switches from three or more levers as required.

The ground frame release lever shall be the first lever and be fitted with an Annett 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 60 kg crossovers).

A traffic hut locked with an XL lock shall be provided near the ground frame. A train working phone shall also be provided.

An Annett 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 in the normal position by the Annett lock and the normally closed switches shall be clipped and secured with an XL lock.

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.

6.1.2 Ground frame operation

If the emergency crossover is to be reversed, the Annett key shall be removed from the contact box and the XL locks and clips removed from the points. Any automatic running signals reading over the emergency crossover shall be replaced to stop.

The Annett key shall be inserted in the Annett 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.

6.2 Emergency crossovers operated from electric ground frames

Section 6.2.1 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.

Section 6.2.1 may be applied to trailing crossovers.

6.2.1 Requirements for facing emergency crossovers operated by electric switch machines and controlled from electric ground frames

6.2.1.1 Operators panel

A simple operators panel shall be provided to form the basis of the electric ground frame and shall accommodate the following controls and indications.

- controls as follows:
  - 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 as follows:
  - 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.

6.2.1.2 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 with wording as shown in Figure 11.

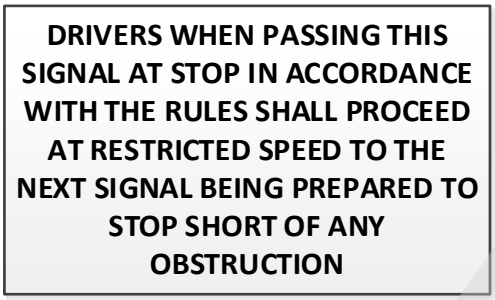


Figure 11 – Notice board signage – automatic running signals

Drivers when directed to pass this signal at stop shall proceed at restricted speed and bring their train to a stand well clear of the crossover and shall not restart until satisfied that it is safe to do so (or that shunting is not taking place, as applicable). Figure 12 shows for an example of this signalling layout arrangement.

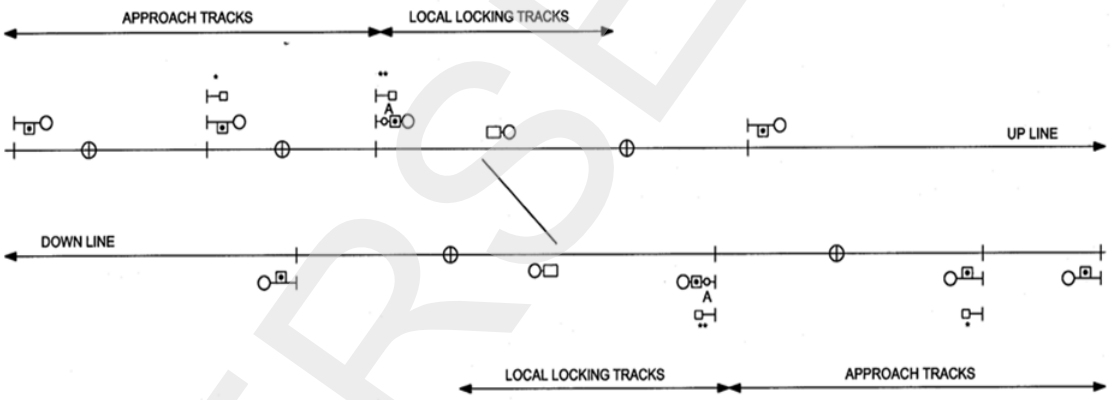


Figure 12 – Emergency crossover operated by an electronic ground frame

6.2.1.3 Panel operation

If the emergency crossover is not in use, 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 an XL lock attached.

If the emergency crossover is to be reversed, then following the removal of the clips and XL locks 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, 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, the electric release will remain locked until an approaching train has been proved to be at or nearly at a standby 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 preceding described operation.

7 Points identification

All points shall have a distinctive number, not exceeding four digits. For power operated points, a prefix and suffix shall be provided.

A prefix shall be provided to indicate the local interlocking controlling the points end or set of points, in accordance with TS 05333.29.

A suffix shall be provided to denote the following:

- A – the end nearest to Sydney
- B, C, D and so on' – sequentially allocated (as required) at points ends further away from Sydney.

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

8 Detection of points

Sections 8.1 to 8.2 contain the requirements for the electrical detection of mechanically, power or ground frame operated points in colour light signal aspects.

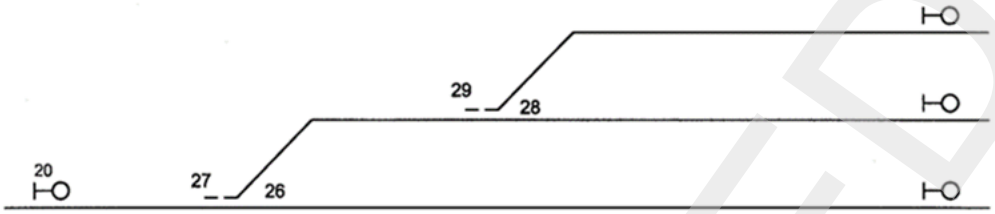
FPLs or equivalent security shall be provided on facing points on running lines for all signalled facing movements for trains conveying passengers. Moreover, facing points locking shall be provided for all authorised running movements over interlocked emergency crossovers.

8.1 Detection of mechanically operated points

8.1.1 Detection of mechanical points in the route section

Where a set of mechanically operated facing points is situated within the route of a signal, the correct position of the open switch, closed switch and FPL shall be detected before the signal is

permitted to clear and continuously thereafter to maintain a clear aspect as shown in the example in Figure 13.



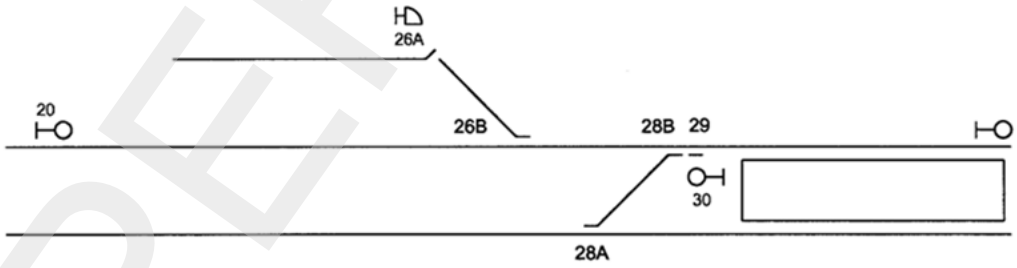
SIGNAL	DETECTS	
	POINTS	FPL'S
20	26N 26R 28N 26R 28R	27R 27R 29R 27R 29R

FPL OUT BOTH WAYS

DETECTION OF FACING POINTS AND FPL'S IN ROUTES

Figure 13 – Detection of mechanical operated facing points

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 as shown in Figure 14.



SIGNAL	DETECTS	
	POINTS	FPL'S
20	26AN	NIL
30	28BR 26AN	29R

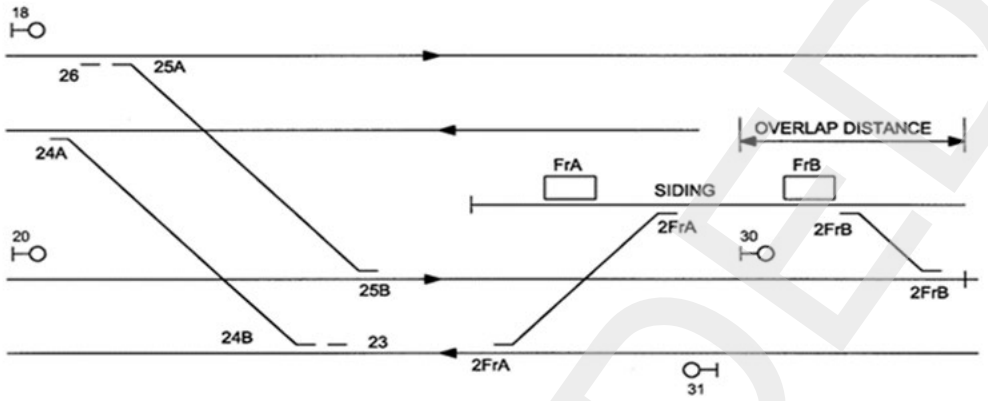
DETECTION OF TRAILING POINTS IN ROUTES

AND AS TRAPPING PROTECTION

Figure 14 – Detection of mechanical operated trailing points

Where the end of a set of mechanically operated points provides trapping and flank protection to the route, the correct position of the closed switch and the open switch (or the open switch in

the case of single switch catchpoints) should be detected before the signal is permitted to clear and continuously thereafter to maintain a clear aspect as shown in the example in Figure 15.



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

8.1.2 Detection of mechanical points in the route overlap

If a set of mechanically operated facing points is situated beyond the exit of 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 the correct position of the open switch and closed switch should be detected before the signal is permitted to clear, and continuously thereafter to maintain a clear aspect. 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.

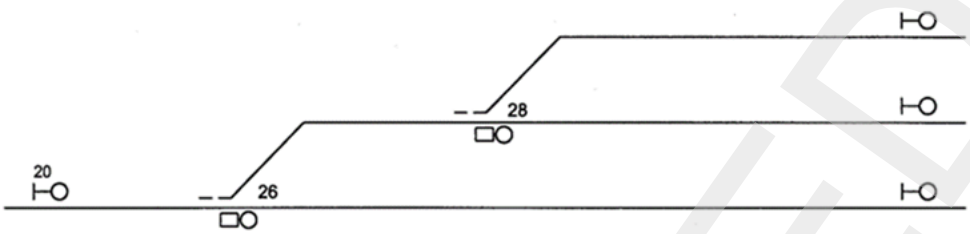
Where a set of mechanically operated facing or trailing points is situated outside the route of a signal but offers trapping and flank protection to the route, the appropriate position of the points should be detected and take into account operating considerations as shown in Figure 14.

8.2 Detection of power operated points

8.2.1 Detection of power operated points in the route section

Where a set of power operated facing points is situated within the route of a signal the correct position of the open switch, closed switch and facing points locking (and plunger lock where

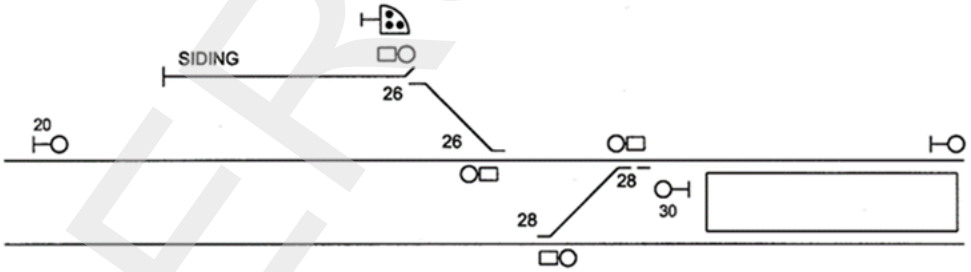
used on EP points) shall be detected before the signal is permitted to clear and continuously thereafter to maintain a clear aspect as shown in Figure 16.



SIGNAL	DETECTS POINTS
20	26N 26R 28N 26R 28R

Figure 16 – Detection of facing points in routes

If a set of power operated trailing points is situated within the route of a signal, the correct position of the open switch, closed switch and facing points locking, if provided, shall be detected before the signal is permitted to clear and continuously thereafter to maintain a clear aspect as shown in Figure 17.



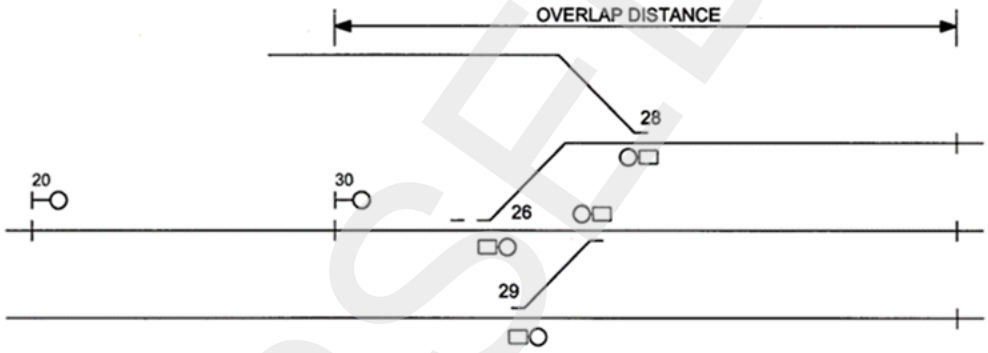
SIGNAL	DETECTS POINTS
20	26N 28N
30	26N 28R

Figure 17 – Detection of trailing points in routes and as trapping protection

If the end of a set of power operated points is situated such that it provides trapping and flank protection to the route then the correct position of the open switch, closed switch and facing points 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 as shown in Figure 17.

8.2.2 Detection of power operated points in the route overlap

If a set of power operated facing points is situated beyond the exit signal and within the overlap distance of the signal route which has alternative overlaps available, the points are not required to be detected in the route as the likelihood of a SPAD is minimal based on route and aspect controls and the points are likely to be in a safe position. This allows for the overlap to be swung and provides flexibility to the operator in establishing routes. For situations where the alternate overlap is unavailable or not permitted, then the correct position of the open switch, closed switch and FPL shall be detected before the signal is permitted to clear and continuously thereafter to maintain a clear aspect. Figure 18 and Figure 19 show detection of points in overlap situations.



SIGNAL	DETECTS POINTS
20	29N W 26N 28N W 26R 26N W 28R 26R W 29R

Figure 18 – Detection of points in an overlap

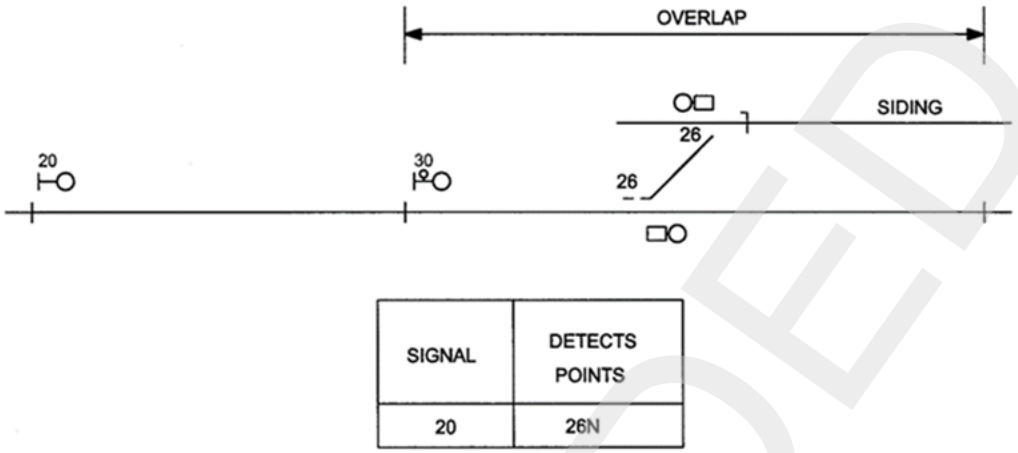


Figure 19 – Detection of facing points in a fixed overlap

Note for Figure 19: Overlap shall not be permitted into the siding

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 shall be detected in the signal. However, if the points can be manually operated in emergencies, the operation of the emergency facility provided (for example, ESML, EOL) shall be reliable, fail-safe and replaced and retained at stop for 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 and flank protection to an overlap then the correct position of the open switch, closed switch and facing points locking, if provided, or open switch in the case of a single switch catchpoint, 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. Figure 17 shows an example of detection of trailing points in routes and as trapping protection and Figure 19 shows detection of facing points in a fixed overlap.

8.2.3 Multiple ended points

If a set of points comprises two or more points ends, then the correct positions of the open switch, closed switch and facing points 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.

8.2.4 Detection of ground frame operated points

In relation to ground frame operated facing points in the route section and points ends providing trapping and flank protection to the route section or route overlap, the correct position of the open switch, closed switch and facing points 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.

8.2.5 Facing points locking

Facing points locking is the securing of the points switches such that they cannot move once locked. The securing of the points and switches shall be proven effective before signals over the points are cleared.

Facing points locking is applied differently with different points operating technologies.

Examples of facing points locking include the following:

- 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.

9 Electric switch machines

Sections 9.1 to 9.3 contain the concepts and requirements for the provision of equipment, which can electrically isolate an electric switch machine under various operating conditions.

9.1 Crank handle or hand throw lever

A CH or HTL are mechanisms which allows an electric switch machine to be manually operated under hand signalling arrangements or during failure conditions or for testing or maintenance purposes.

CHs and EOL keys (to release hand throw levers) are often configured to fit specific machines and are mechanically indexed for this purpose.

Generally, a CH or HTL 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 CH incorporates an ESML key.

CHs 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.

Where 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 CH shall be provided for each set of points irrespective of the number of points ends. Separate EOL keys are provided for each points end.

CH 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.

Where a CH 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 CH contact (CHC) mechanism within the machine.

If an EOL key is inserted into a HTL 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.

CHs and the tag attached to the EOL key shall be inscribed with the interlocking name, type of emergency box and the points number or numbers to which they apply in as shown in the following examples.

- crank handle
  - single ended set of points

    ’Glenfield ESML & GD43A PTS MTR’
  - multiple ended set of points

    ‘Glenfield ESML & GD42A&B PTS MTRS’
- EOL key tag
  - one different tag required for each end such as the following,

    ‘Strathfield EOL & ST43A PTS. MTR’

    ‘Strathfield EOL & ST43B PTS MTR’.

9.2 Emergency switch machine lock and emergency operations lock

For safety reasons the CH or EOL key or keys shall be kept in a locked box and this way it is only available to authorised operators.

Further safeguards may be provided by detecting the presence of the crank handle or EOL key or keys in the locked box and then ensuring that signals reading over the points are unable to clear whenever the crank handle or EOL key or keys are removed from the locked box.

The device in which the CH and EOL key or keys shall be held and detected is the ESML or an EOL.

Where a CH or EOL key or keys are provided for the manual operation of an electric switch machine or machines they shall be held in an ESML or an EOL except when its removal has been authorised by the signaller.

Where a CH or EOL key is removed from an ESML or an EOL the aspects of all the signals interlocked with the points concerned shall be replaced to and maintained at stop.

The ESML and EOL shall be mechanically indexed so that it only accepts the CH or EOL key or keys for a specific and identically indexed set of points.

An ESML or an EOL shall be given the same number as the set of points to which it applies. The number shall be prominently displayed on the front of the ESML box or EOL box.

9.2.1 Location of emergency switch machine lock and emergency operations lock boxes

ESML and EOL boxes shall be mounted on the wall of a hut or the side of an equipment case containing the points 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.

Where an employee authorised to use a CH or EOL key or keys removes them from the ESML or EOL, it is important 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 CH arrives at the points, to minimise the possibility of the train running through open or wrongly positioned points.

The distance between the location of the ESML or EOL and the set of points to which it applies shall take into account the following:

- the distance between the signal or signals protecting the points and the points
- the type or types of signals 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.

Safeworking rules require specified levels of protection for employees crossing tracks, so the following also apply:

- Other than where the points are in the centre tracks or crossovers span more than two tracks, the ESML or EOL shall 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, the circuit functions of the ESML or EOL contacts shall be double cut.

9.3 Isolating relays

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 or track circuits 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 shall be rejected.

An isolating relay shall be provided for each electric switch machine. An exemption exists where points are controlled from specific CBIs and in accordance with the requirements in Section 9.3.2.

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 CH or EOL key is withdrawn from an ESML or EOL 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 the isolating relay shall be enabled to energise.

The isolating relay shall be in accordance with to BR943.

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.

On EP points, the isolating relay functionality shall be incorporated into the plunger lock, if provided, or the particular control arrangements for new technology.

9.3.1 Housing

An isolating relay shall be housed in the location or equipment case closest to the points machine it isolates.

9.3.2 Omitting points isolating relays

Where points are controlled from CBI systems designed to eliminate fleeting outputs that cause spurious output controls, the requirement for an isolating relay shall be exempt.

The exemption to omit isolating relays shall be based on the following conditions:

- the CBI adequately minimises the likelihood of an equipment fault causing even momentary energisation of an output
- the functions of the isolating relay are incorporated into the points contactors (NWR and RWR) functions
- the outputs shall be double cut internal to the CBI equipment, or provide equivalent protection against false energisation by external wiring fault, such as fully isolated output
- the points detection inputs (normal and reverse) operate from separate isolated supplies
- each leg of the points operating circuit is double cut by the respective contacts of the Normal points contactor (NWR) and Reverse (RWR) points contactor
- the circuit design shall be such that the A end points contactors are operated directly from the CBI output, and any points contactors of subsequent ends are operated from contacts of the A end contactors

Where the requirements in the preceding bullet list are met, isolating relays shall be omitted for all cases. However, where such requirements are not met, the isolating relays shall be retained.

10 Removal of lock-slides and provision for a wide-cut notch

Sections 10.1 to 10.3 addresses the circumstances under which it is acceptable to operate a points mechanism without lock-slides fitted, or with provision for a wide-cut notch in the lock-slide.

Section 10.1 only applies to trailing only points operated by combined electric switch machines.

Section 10.2 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 TS 05368.

10.1 Concept of lock-slide removal

Where a set of electrically operated points is all of the following:

- signalled exclusively for trailing movements (in both directions)
- there are no set back movements whereby part of a long train would pass over the points in a facing direction
- having regard to the possibility of hand signalled facing movements taking place over the points
- the probable frequency of single line working over the points in a facing direction

To reduce the likelihood of detection failures arising as a result of a tight FPL, consideration may be given to the removal of the lock-slides from the combined electric switch machine.

10.2 Concept of provision for a wide-cut notch in the lock-slide

10.2.1 For catchpoints

The open switch FPL in combined electric switch machines or signal branch EP assemblies which operate a single switch catchpoints 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.

10.2.2 For points with a trailing only position

Where the nominated position (normal or reverse) of a set of signal branch EP operated points is all of the following:

- signalled exclusively for a trailing movement
- there are no set back movements whereby part of a long train would pass over the points in a facing direction
- having regard to the possibility of hand signalled facing movements taking place over the points
- the probable frequency of single line working over the points in a facing direction

To reduce the likelihood of detection failures arising as a result of a tight FPL, consideration may be given to the provision of a wide-cut notch in the trailing position lock-slide of the signal branch EP assembly.

10.3 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 shall be obtained, and approved designs issued. Working sketches, signalling plans and track plans shall explicitly indicate which points ends are subject to this procedure.

The allowable cut-out for the wide-cut notch shall not exceed 13 mm 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 regard to this provision.

11 Track circuit locking of points

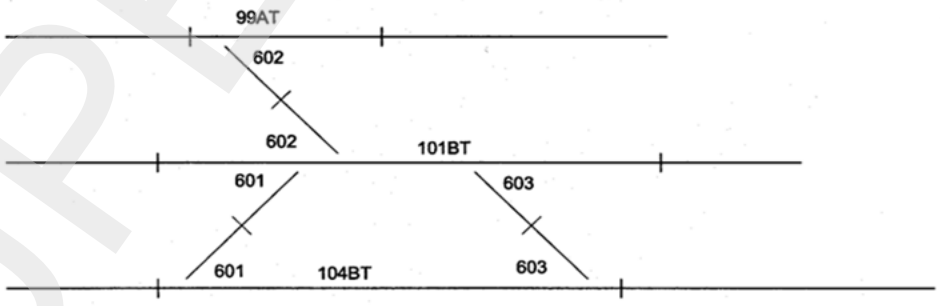
Sections 11.1 to 11.4 addresses the requirements for the provision of track circuit locking overpower operated points and extended conditional track locking as applicable.

11.1 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 points locking has been normalised and the train is between the points and the signal leading over them.

11.2 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.



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

The limits of this track circuit or track circuits over the points shall extend at least as far as the clearance points in accordance with TS 05333.17.

If the track layout and train movements permit, the track locking shall be extended as far as each signal which reads over the points either in the normal or reverse position. Refer to Figure 21.

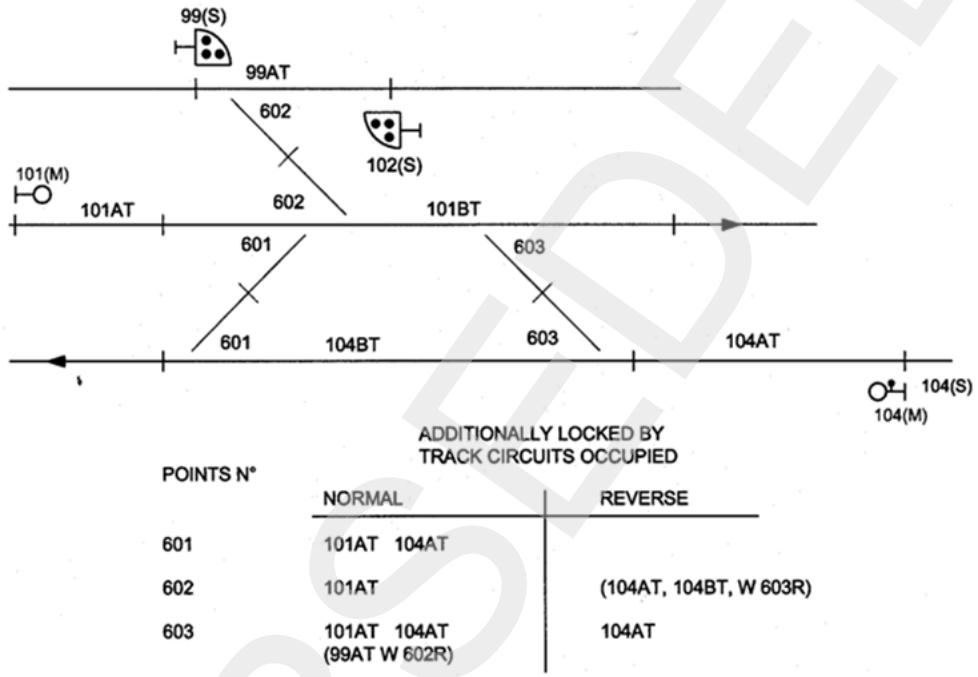


Figure 21 – Track circuit locking of points

If the track layout and train movement do not permit the track locking to be extended, then route holding as described in TS 05333.12 shall be provided.

11.3 Requirement - direct track circuit control of power operated points mechanisms

In addition to the track circuit locking of the points controls described in Section 11.2, direct track circuit control of all power operated facing points mechanisms shall be provided.

11.3.1 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 an SSI installation or where trailable points machines are installed in yards. Approach sticks relays of facing signals shall also be included in the isolating relays.

Track locking in the isolating relay circuit shall 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 so that the occupation of the track circuits concerned does not preclude the completion of a points movement once it has commenced.

11.3.2 Pneumatically operated points (except claw locks)

The FPL 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.

11.3.3 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.

11.4 Control tables

The requirements for the direct track locking of points operating mechanisms shall be in accordance with the control tables concerned. Refer to Figure 20 and Figure 21 for an example of track locking shown on a control table.

Note: Interlocking prefixes omitted from Figure 20 and Figure 21 for clarity.

12 Ground frame releases

Sections 12.1 to 12.4 addresses the requirements for the provision of ground frame releases and the methods by which releases are generally given.

12.1 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, FPLs 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, an 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 FPL 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 (for example, Annett key) are matched to the wards on the corresponding mechanical lock (for example, Annett lock).

12.2 Ground frames inside interlocking areas

12.2.1 Key from lever in the main frame

Section 12.2 is not to be used for new works and is included for reference when working on existing installations.

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 and inserted in the lock on the respective ground frame lever to release the ground frame.

12.2.2 Electric releasing switch

Where electro-mechanical, relay type or CBIs 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.

12.3 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.

12.3.1 Emergency crossovers

Emergency crossovers may be released by a key from an Annett lock, emergency releasing lock, pilotmans lock, or a key from an electric releasing switch.

12.3.2 Sidings adjacent to main line

Where local regulations stipulate that a portion of the train needs to 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 catchpoints end leading out from siding.

At sidings where the whole train may refuge, the ground frames shall be provided with an electric releasing switch.

12.4 Ground frames and mechanical points 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 points indicator is to be provided. Points fitted with mechanical points indicators shall 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.

13 Electro-pneumatic-points

Sections 13.1 to 13.2 address the concepts and requirements for the provision of equipment, which can manually operate a set of EP points under various operating conditions.

13.1 Emergency operations lock (keyless type)

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 shall be arranged so that it cannot be closed with the switch in the emergency position.

After the EOL switch is rotated, the minimum time delay period before the indicator in the EOLPB unit illuminates shall be 60 seconds. However, the time delay applied to any particular location shall take into account the following:

- 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
- Any approaching train shall be further away than the first warning signal approaching the points and be able to stop before the points or there shall 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. However, If all tracks in the approach locking to the points or crossover are proven unoccupied, the timing function may be qualified out.

13.1.1 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 points 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 shall be provided above the pushbuttons to indicate the position to which the points have been called.

In all cases, the points shall be examined, clipped, and locked, before trains are permitted to pass over them.

13.2 Emergency operations lock (keyed type)

In the Sydney, Sydenham and North Sydney signalling 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 referred to in Section 13.1. Indicator lights are not provided in this unit. However, the keyed type is being phased out as this method is no longer preferred.

14 Maximum distances between mechanical interlocking machines and turnouts

The information of this section is not to be used for new works, and is included for reference when working on existing installations.

Section 14.1 addresses the maximum operating distances between mechanical interlocking machines and turnouts to ensure provision of safe and reliable operation of the turnout.

Note: The conventional style turnouts listed are not to be used for new works.

Tangential turnouts shall not be operated mechanically from mechanical signal boxes or mechanical ground frames and shall be power operated.

14.1 Operating distances

The distance from an interlocking machine to a turnout is defined as the following:

- for a single turnout – from the interlocking machine to the tip of the switches as shown in Table 1
- for a turnout plus catch points – from the interlocking machine to the tip of the switches of the turnout or catchpoint whichever is furthest from the machine as shown in 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 as shown in 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 as shown in Table 2 plus 10 m
- for a type F – single lever may be used for a 47 kg turnout plus derail to a maximum distance of 70 m.

Table 1 – Single turnout

Switch	Turnout	Mechanical interlocking machine type – elevated or platform level machine	Mechanical interlocking machine type – ground frame type E or G	Mechanical interlocking machine type – single lever type F
60 kg	1 in 15 9150 (one back drive)	170 m	105 m	CNP
60 kg	1 in 12 9150 (one back drive)	170 m	105 m	CNP
60 kg	1 in 10.5 9150 (one back drive)	170 m	105 m	CNP
60 kg	1 in 10.5 6100	180 m	115 m	CNP

Switch	Turnout	Mechanical interlocking machine type – elevated or platform level machine	Mechanical interlocking machine type – ground frame type E or G	Mechanical interlocking machine type – single lever type F
60 kg	1 in 9 6100	180 m	115 m	CNP
60 kg	1 in 8.25 6100	180 m	115 m	CNP
53 kg	13650 switch (one back drive)	180 m	115 m	CNP
53 kg	All others	240 m	150 m	CNP
47 kg	All	280 m	180 m	25 m loops, refuges, sidings, branch lines only

Table 2 – Turnout plus catchpoint

Switch	Turnout	Mechanical interlocking machine type – Elevated or platform level machine	Mechanical interlocking machine type – Ground frame type E or G	Mechanical interlocking machine type – single lever type F
60 kg	1 in 15 9150 (one back drive)	145 m	95 m	CNP
60 kg	1 in 12 9150 (one back drive)	145 m	95 m	CNP
60 kg	1 in 10.5 9150 (one back drive)	145 m	95 m	CNP
60 kg	1 in 10.5 6100	160 m	100 m	CNP
60 kg	1 in 9 6100	160 m	100 m	CNP
60 kg	1 in 8.25 6100	160 m	100 m	CNP
53 kg	13650 switch (one back drive)	160 m	100 m	CNP
53 kg	All others	215 m	130 m	CNP
47 kg	All	255 m	150 m	CNP

Table 3 – Crossover

Switch	Turnout	Mechanical interlocking machine type – Elevated or platform level machine	Mechanical interlocking machine type – Ground frame type E or G	Mechanical interlocking machine type – single lever type F
60 kg	1 in 15 9150 (one back drive)	125 m	80 m	CNP
60 kg	1 in 12 9150 (one back drive)	125 m	80 m	CNP
60 kg	1 in 10.5 9150 (one back drive)	125 m	80 m	CNP
60 kg	1 in 10.5 6100	140 m	85 m	CNP
60 kg	1 in 9 6100	140 m	85 m	CNP
60 kg	1 in 8.25 6100	140 m	90 m	CNP
53 kg	13650 switch (one back drive)	140 m	90 m	CNP
53 kg	All others	190 m	110 m	CNP
47 kg	All	240 m	125 m	CNP

15 Points requiring clipping for unsignalled movements

In accordance with the rules, signallers may authorise unsignalled facing movements over points.

In order to differentiate 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.

15.1 List of points required to be clipped

A list of points to be clipped for unsignalled facing movement shall be displayed in the controlling signal box.

This list shall be maintained with any infrastructure change.

The provision of signs at these points as per this principle shall apply for new works only or upon request.

15.2 Form of sign

The sign for installation at the location of the points outlined in Section 15.1 shall have white text as shown in Figure 22 on a red background.

Figure 22 – Signage to remind points clipping before making unsignalled movements

15.3 Identification of points requiring reminder sign

The following criteria will identify points where reminder sign shall 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 100 m 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 100 m) shall not require the sign.

However, any set of points where a situation exists that the points cannot be guaranteed for a movement, such as due to switch or stock rail condition, shall be fitted with the sign.

15.4 Documentation

The installation of signage shall be documented on the signalling plan such as in the example in Figure 23.

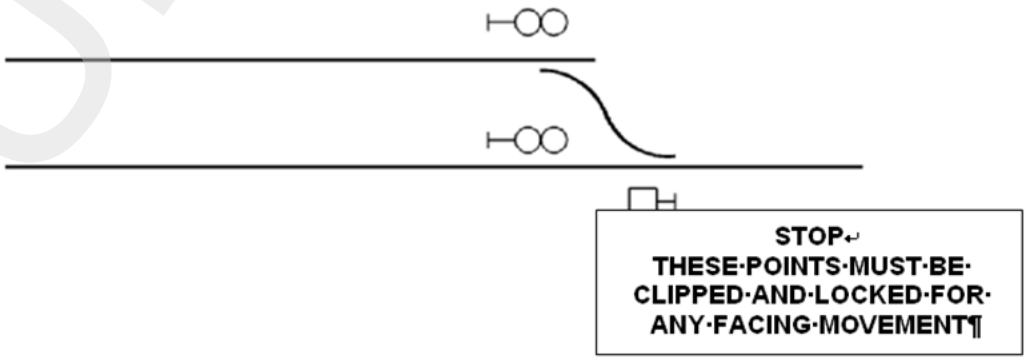


Figure 23 – Installation of signage

15.5 Points requiring clipping when passing signal at stop

Motorised points that are not controlled from a signal box (for example, Ulan style automatic crossing loops) shall be clipped and locked before a rail vehicle is permitted to pass the signal at stop.

A sign with retroreflective white text as shown in Figure 24 on a black background shall be displayed on or adjacent to the signal in these situations.

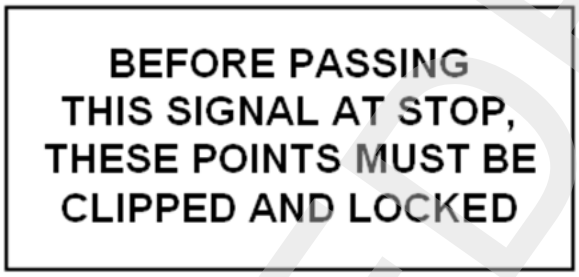


Figure 24 – Sign

15.6 Motor points not requiring special signage

In relation to points that are controlled from the signal box, the signaller can verify the functionality of the points and be in a position to advise the driver if the points are either operating correctly or need to be clipped and locked.

16 Application of back drives to tangential turnouts

The length flexibility of the switch determines the number of thrust points or drives that are needed to ensure the following:

- The switch closes up to the stockrail along its machined section and up to the chocks behind the switch.
- The switch opens sufficiently to provide a clear flange-way between it and the stockrail. This flange-way shall be between 60 mm +/-5 mm measured at the end of the head machining on the switch.

The TAO shall determine the location, the number of back drives required, and supply the turnout with switch and stockrail drilled to accept the back drive components.

Generally, 250 m and larger turnouts require back drives while 190 m turnouts do not.

Table 4 lists the various sizes of tangential turnouts and shows the number of drives generally required for each type.

Table 4 – Tangential turnout size and number of drives generally required for each type

Turnout type	Operating mechanism	Back drive required?	Back drive type
190 m – 1 in 7.5	Spherolock or claw lock – 84M or EP	No	–
190 m – 1 in 7.5	Conventional drive switch machine #	No	–
250 m – 1 in 8.25	Spherolock or claw lock – 84M or EP	Yes one	Mechanical linkage
250 m – 1 in 8.25	Conventional drive switch machine #	Yes one	Mechanical linkage
250 m – 1 in 10.5	Spherolock or claw lock – 84M or EP	Yes one	Mechanical linkage
250 m – 1 in 10.5	Conventional drive switch machine #	Yes one	Mechanical linkage
300 m – 1 in 9	Spherolock or claw lock – 84M or EP	Yes one	Mechanical linkage
300 m – 1 in 9	Conventional drive switch machine #	Yes one	Mechanical linkage
300 m – 1 in 12	Spherolock or claw lock – 84M or EP	Yes one	Mechanical linkage
300 m – 1 in 12	Conventional drive switch machine #	Yes one	Mechanical linkage
500 m – 1 in 12	Spherolock or claw lock – 84M or EP	Yes one	Mechanical linkage
500 m – 1 in 12	Conventional drive switch machine #	Yes one	Mechanical linkage
500 m – 1 in 15	Spherolock or claw lock – 84M or EP	Yes one	Mechanical linkage
500 m – 1 in 15	Conventional drive switch machine #	Yes one	Mechanical linkage
800 m – 1 in 15	Spherolock or claw lock – 84M or EP	Yes two	Mechanical linkage
800 m – 1 in 15	Conventional drive switch machine # (Note 1)	Yes two	Mechanical linkage
800 m – 1 in 18.5	Spherolock or claw lock – EP	Yes two	Mechanical linkage
800 m – 1 in 18.5	Conventional drive switch machine # (Note 1)	Yes two	Mechanical linkage

Turnout type	Operating mechanism	Back drive required?	Back drive type
1200 m – 1 in 18.5	Spherolock or claw lock – EP	Yes two	Mechanical linkage (Note 2)
1200 m – 1 in 24	Spherolock or claw lock – EP	Yes two	Mechanical linkage (Note 2)

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.

1 – While conventional switch machines will readily operate 800 m turnouts under power, emergency hand operation is likely to be heavy.

2 – 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 shall be used. Back drive detection (on at least one drive) will be necessary if a separate drive is provided. 1200 m turnouts shall not be installed.

Back drive can be provided by the following:

- 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 (such as claw locks, EP or 84M drives) and shall not be used on turnouts with superelevation.

Whenever possible back drive arrangements shall provide for detection of obstruction in the switches so that the closed switch is not closed throughout its length, or the flangeway gap is not adequate. The detection of obstruction may be achieved mechanically or electrically. Accordingly, spring assist devices are to be phased out in favour of T crank style back drives as shown in Figure 25.

Figure 25 – Mechanical T crank back drive

Independent switch points shall not exceed 250 m radius as back drives are impractical and difficulty will result in achieving the required flangeway clearance.

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. A spring assist unit is shown in Figure 26.

Figure 26 – Spring assist unit

Separate mechanisms for front and back drives, as shown in are not currently in use in NSW.

Figure 27 – Separate mechanisms for front and back drives

17 Design principles for mechanical components of points

Sections 17.1 to 17.5 specify the basic design principles to be applied to mechanical components of points and associated systems.

17.1 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.

17.2 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 shall 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.

17.3 Detection of component failure

All failures shall be detectable. Partial failure should be detected automatically and reported, but otherwise a regular maintenance visit shall ensure the full redundancy of the installation remains effective.

17.4 Assurance of locking mechanisms

The locking of points 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.

17.5 Insulation of mechanical components

17.5.1 Insulation scope

Mechanical components connected to running rails shall be insulated to achieve the following:

- prevention of the track circuit from being short circuited
- prevention of dangerous voltages being presented to employees from traction faults
- prevention of wiring faults in equipment from connecting to running rails or earth and consequently being affected by influences from track circuits and traction currents.

17.5.2 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 back drives 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 is only single insulated.

Points detector rodding shall be insulated from the switches.

Steel bearers provide a significant earth connection. Steel bearers shall be insulated from running rails.

Additionally, any electrical mechanisms, such as points machines and detectors, shall be insulated from the steel bearers so that an electrical fault to the equipment case is isolated from earth, SFAIRP.

Equipment operating rods shall not contact steel bearers. Where guides or supports are provided, insulation shall be provided unless the rod is already insulated from the electrical equipment. Figure 28 and Figure 29 show points rods insulations.

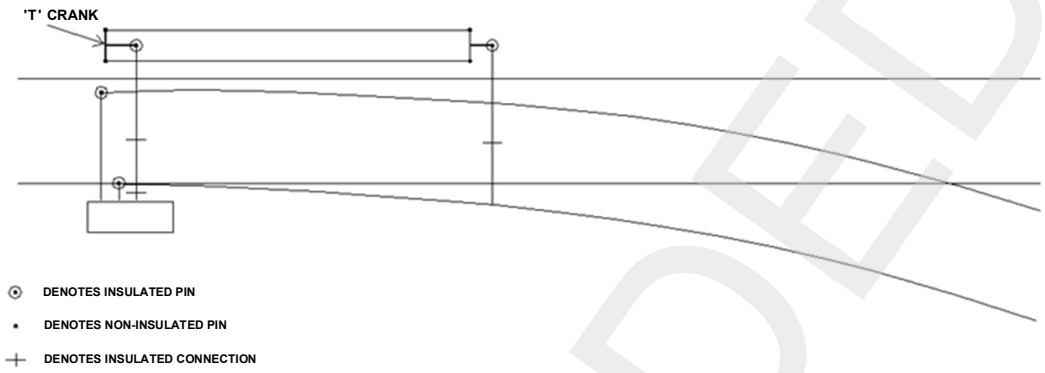


Figure 28 – Points rods insulation – claw lock style

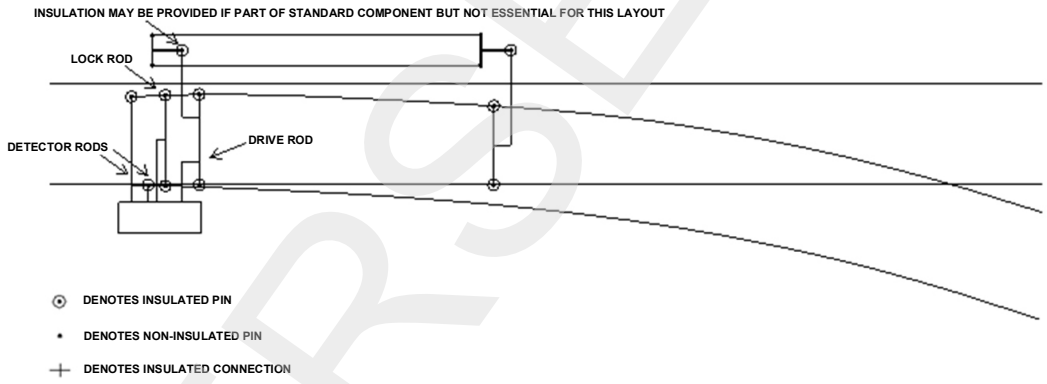


Figure 29 – Points rods insulation – other than claw lock

18 Stagework installation and removal of points

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 shall be adequately secured in accordance with Sections 18.1 to 18.6.

18.1 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 points clip and an XL lock on the closed switch.

The additional method shall be one of the following:

- spiking the points closed
- 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 AMB.

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 points 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.

18.2 Securing of catchpoints

Catchpoints that are required to be in the closed position shall be secured in accordance with Section 18.1 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 points clip and block that positively holds the open switch in position. The clip shall be locked with an XL lock.

Independent switches shall be treated as two separate catchpoints unless they can be treated as a normal set of points.

18.3 Securing of swing nose crossings

Swing nose crossings shall be treated similar to facing points and secured in accordance with Section 18.1 except that the points operating bar shall be fitted instead of the spiking and be physically secured to secure the swing nose (in addition to the points clip).

18.4 Detection and representation of points pending commissioning or removal

Where facing points are pending commissioning (not yet connected to the interlocking) or removal (disconnected from the interlocking) and they are installed on running lines, then electrical detection shall be provided or maintained. The detection shall prove the points switches are in the correct position for the running direction. The loss of detection shall place at stop the signal that immediately leads over the facing-end of points.

Where points (including catchpoints) are pending commissioning or removal and they are installed on non-running lines which lead to running lines electrical detection shall be provided or maintained. The detection shall prove the points switches are in the correct position so to divert railed vehicles away from the running lines. The loss of detection shall place at stop the

signal on the running line that immediately leads toward the connection (or proposed connection if not complete) from the non-running line, including any intermediate crossing associated with such connection.

Detection is not required where a set of installed trailing-only points is pending commissioning. However, electrical detection for trailing-only points pending removal should be retained until such points are removed.

Detection is not required for points pending commissioning or removal where they are installed wholly in yards, having no safety impact on running lines, and the speed limit is 13 km/h or less.

The presence of all installed points whether pending commissioning or removal shall be graphically represented to the signaller. The representation shall make it clear and obvious to the signaller of the presence of such points, so to enable them to make appropriate safeworking decisions when authorising movements affected by the points. Additionally, consideration should be given to providing the points detection status (indication) at the signaller's panel for those points requiring detection.

18.5 Bonding

Any points installed shall include bonding to ensure track circuit operation and traction return both exist for the route in operation.

18.6 Protection of running movements

Where train operations will occur over one leg of the points, the other leg shall be provided with a stop block at clearance points to prevent construction vehicles and any unauthorised movements from fouling the line.

19 Location of points mechanisms

Points 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 and that the mechanical arrangements are reliable and maintainable.

The following requirements apply to points machine locations:

- 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 and access shall be in a safe place.
- Machine mounted operation handles shall be orientated so that the operator stands, off track, unless a physical obstruction exists.

- Wherever 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 shall be direct and close to the points, to prevent or limit excessive deflections and vibration in rods and to minimise the number and length of structural elements between the machine and the switches and 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.

20 Power operated ground frames

Sections 20.1 to 20.9 addresses requirements for power operated points when used as a ground frame application.

20.1 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, however 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, Sections 20.2 to 20.9 specify the requirements.

20.2 Situations used

Power operation of points in the following situations are as follows:

- emergency crossovers used for planned and emergency work, usually within automatically signalled areas as shown in see Figure 30
- sidings for vehicles within automatically signalled areas as shown in Figure 31
- sidings for vehicles within interlocking areas as shown in see Figure 32.

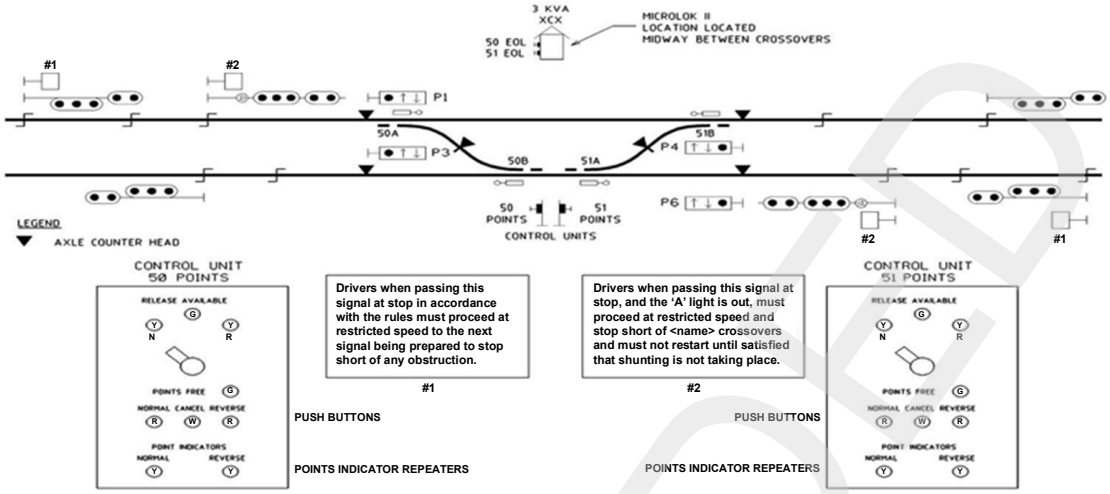


Figure 30 – Emergency crossovers – in section

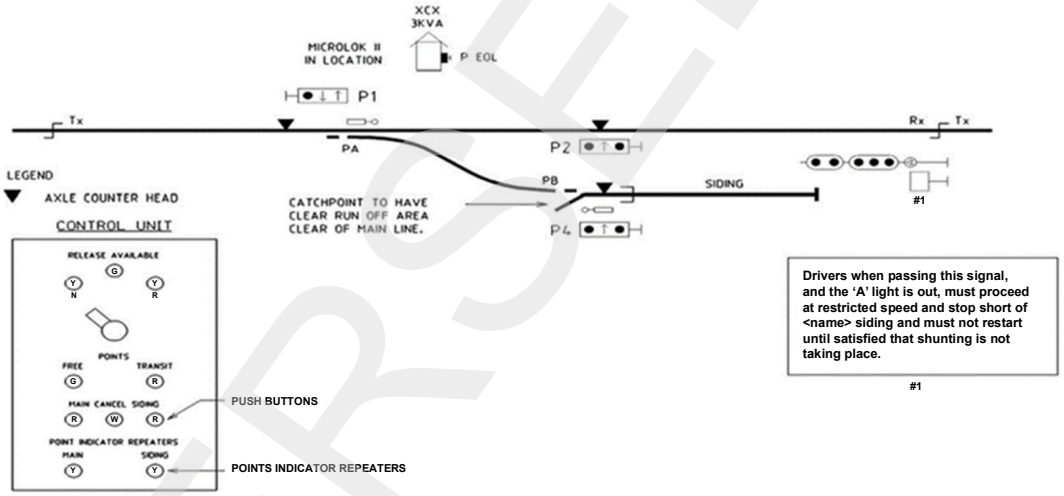


Figure 31 – Sidings in automatic area – electric ground frame arrangement

Note: The axle counter shown could be a track circuit.

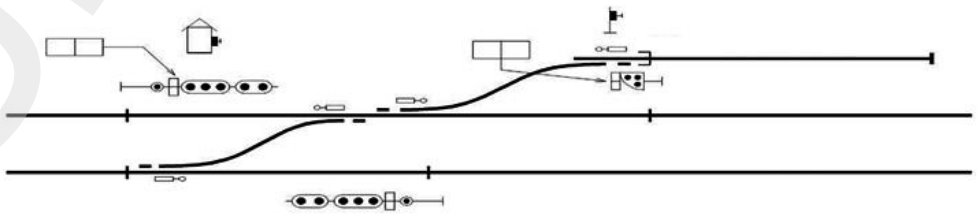


Figure 32 – Sidings in interlocking – typical arrangement

20.3 Infrastructure requirements

The basic infrastructure shall consist of the following:

- power operated (electric or EP) points mechanisms
- electric points indicators or signals to prove points position
- a control box including release lever, points operation button and indication lights
- a small CBI to provide the control logic processing and interfacing with the signalling system.

20.4 Associated risks

In a signalling system, motorised points operation is subject to train detection proving the track is clear.

Approach locking shall be applied through signals to prevent points operation after a movement authority has been given.

With the types of use outlined in Section 20.2 it is likely that at least one of the following applies:

- vehicles may not be of a type that effectively shunts track circuits
- rails may not be clean enough to support track circuit operation due to infrequent use
- wheels may not be suitable for the operation of axle counters.

Accordingly, the power operated ground frame system shall be designed to address these risks, in accordance with Section 20.5.

20.5 Operational requirements

Where a power operated ground frame is used for 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 (such as stopping for hand signallers).

The local qualified person shall take the release and operate the points push buttons to operate the facility.

Mitigation against moving points under trains is provided by the following:

- maintaining points indicators clear for the movement with approach locking
- providing a time release once points indicators are returned to stop
- placing the control box for the power 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 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 (that is, 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.

20.6 Interlocking arrangements

20.6.1 Release

The control box shall contain a two-position releasing lever (normal and reverse) and the following indication lights:

- release normal – white
- release reverse –white
- release available – green.

The release available light shall display when the release is available to be taken, that is, when no trains are closely approaching, or when a train has come to a stand at the siding or emergency crossover.

20.6.2 Route cancel

A route cancel push button shall be provided. When operated, the route cancel button places all points indicators to stop. A time (release) shall elapse before the points become free. During this period the points free light shall flash green.

20.6.3 Points free

When the points are free, a green points free light shall be displayed.

20.6.4 Points control and indication

A points normal (main) push button or a points reverse (siding) push button shall be pushed to change the points position. For sidings the push button shall be labelled main or siding.

When the points reach their required position, they shall automatically lock and the points indicators automatically clear.

Clearance of the points indicators is displayed by one of the two indicator repeater lights as follows:

- points indicators – main
- points indicators – siding or reverse

The two indicator repeaters extinguish when the points indicators display red.

20.6.5 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 shall be permitted. When these routes are set the route lights will display but the points shall 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 shall be displayed above the points push button when the route is set and the operation of the points is waiting for the button operation as shown in Figure 33

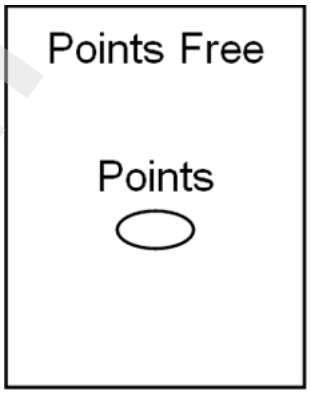


Figure 33 – A ‘points free’ indicator light displayed above the points push button

Following the movement, the signaller shall set a main route or normalise the points by key again in conjunction with the qualified person.

20.7 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.

20.8 Mainline signals

Mainline signals that approach or lead over these installations shall be treated as for mechanical ground frames Section 12.

20.9 Control box instructions

The following are example instructions for the in-section arrangements:

- contact signaller
- when permission given to take release (release available light should be displayed), operate switch to reverse position
- release reverse indicator light shows release taken
- operate push button to operate points
- points indicator repeaters will show when points indicators have cleared
- to change points, press cancel button
- after time release, points free light will illuminate
- points can then be operated
- when finished, leave points set for main line and normalise release lever.

21 Points maintenance isolating switches

21.1 Application

Where a privately maintained siding or balloon loop siding 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 balloon loop siding while maintenance is being performed within the private facility.

21.2 Form of switch box

The key switch shall be 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 as shown in Figure 34.

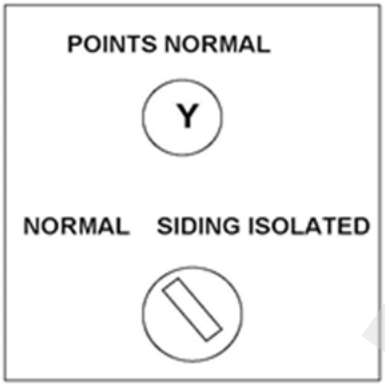


Figure 34 – LED and key operated switch

21.3 Switch box functions

The yellow LED shall be illuminated when the points are detected normal (the position where the trains cannot enter the siding or 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 shall be 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.

21.4 Circuit arrangements

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

In new 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.

21.5 Method of operation

To lock out the private siding or balloon loop siding, the maintainer shall 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.