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CRN SC 015

**Specification**

# Installation of Trackside Equipment

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# Document information

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# Document history

| Revision | Effective date | Summary of changes |
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| Version 2.0 | 30 January 2022 | TfNSW template applied. |
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# 1. General

## 1.1. Introduction

This Specification sets out requirements for the installation of trackside signalling equipment including signalling related communications equipment.

Requirements for foundations for location cases, telephones, releasing switches etc and general mounting arrangements for track circuit equipment boxes, tuning units etc are set out in Specification CRN SC 021.

This Specification shall be read in conjunction with all other relevant Signalling Specifications and the Particular Specification.

Where a method of fastening or fixing is not specified by this or any other specification the proposed method of fastening or fixing shall be submitted for approval not less than seven (7) days prior to installation.

## 1.2. Submissions for Approval

Where the Specification calls for items or activities to be approved, or where superior alternatives are proposed, the matter shall be submitted, with documented justification, to the Principal Signal & Communications & Network Control Engineer.

## 1.3. Quality of Work

### 1.3.1. Fitness for Purpose

The standard of materials and workmanship shall ensure that the installed system is fit for purpose, over the lifetime of the asset in its physical and operational environment, in terms of the standards of safety, reliability, durability, maintainability, operability and supportability as set out in this Specification and referenced documents.

All relevant Signal Sighting, Mechanical, Site Installation, Layout and/or Structural. Drawings shall be produced in accordance with CRN SC 006 and CRN SC 008 and approved by persons with delegated engineering authority. Evidence of Inspection, Testing and Certification of the works shall be provided as set out in CRN SC 007 to CRN SC 013 inclusive.

### 1.3.2. General

On site drilling, cutting or other machining or grinding of galvanized or zinc plated steel components will generally not be acceptable. However, in those circumstances where approval is granted, holes drilled as part of the installation process or any other cut, machined or ground surface shall be left clean, free of corrosion and free of burrs and shall be cold galvanised prior to the installation of the item.

Welding of previously galvanised steel components will generally not be acceptable. However, in those circumstances where approval is granted, the weld area and adjacent plating affected by the weld shall be thoroughly cleaned and cold galvanised.

Where equipment is to be attached to other equipment or structures made from dissimilar metals and there is a possibility of electrolytic action an insulating barrier shall be installed between the different metals.

Generally, equipment shall be installed so that it does not infringe within the Structure Gauge as defined in the Standard Structure Gauge 2009 contained in Specification CRN SC 021. Note that the size of the structure gauge envelope will vary according to location, track curvature and track superelevation and the nature of the type of equipment being installed.

Where physical limitations force the placement of equipment within the Structure Gauge envelope, details of the proposed location with the degree of infringement defined and details of options considered, shall be presented to the CRN Representative for approval.

Any fasteners used shall generally be hot dip galvanised or made from stainless steel. Zinc plating or similar shall be acceptable on fasteners less than 8mm diameter except where the fastener is used in a location which is likely to retain moisture.

Note that:

- Self-locking nuts (e.g., nyloc or Glenloc nuts) shall not be used with hot dip galvanised bolts unless the thread of the bolt is recut with a die nut before the self-locking nut is fitted. Where this is done, the thread shall be cold galvanised after the nut is fitted.
- An anti-seize product (e.g., Loctite Anti Seize) shall be used between stainless steel bolts and stainless steel nuts or inserts.

Bolts used to attach equipment to timber sleepers (or any timber at or close to ground level) shall be installed such that nuts are located on the top of the sleeper or timber. A special lock washer shall be installed under the head of the bolt to prevent rotation of the bolt. The nut shall be secured with “Loctite 242 or equivalent”.

# 2. Signals

## 2.1. General

### 2.1.1. Signal Location

The longitudinal location of signals shall be generally as defined by the Signalling Plan and the signal sighting forms.

The longitudinal location of signals shown on signalling plans may be adjusted, with written approval:

- To meet the sighting requirements of this Specification.

- To avoid obstructions or placement on a bridge or viaduct.
- To avoid the provision of a signal gantry.
- To avoid switched airgaps in the 1500 Volt Traction system on the approach side of a signal.
- To avoid placement adjacent to live overhead wiring and components.
- Provided that this does not:
    - Compromise braking distances or overlap requirements.
    - Unduly compromise headway requirements.

And the amended Signalling Plan is approved by the Principal Signal & Communications & Network Control Engineer or their delegate.

Such adjustments shall be agreed prior to the approval of the Detailed Site Surveys and the surveying or marking of the signal foundation location or the surveying or marking of the location of any associated track circuit, train stop, location case or walk-in enclosure and prior to any construction of cable route in the vicinity.

### 2.1.2. Signal “Out of Use” Marking

Immediately following the installation of any signal or MLI, a large white retro-reflective cross, each arm 100 mm x 1000 mm, shall be attached either in front of or immediately below the top mainline lamp case and shall remain in this position until the signal is brought into use. The cross shall be securely attached to the signal.

Alternatively, the signal head may be covered with a purpose made laminated woven or extruded, heavy duty minimum 0.2 mm thick, weatherproof, UV resistant plastic bag incorporating a large white retro-reflective cross. The bag may be black or white in colour. The most prominent bag on any signal displaying a cross shall be positioned to ensure that the cross is displayed in the direction of oncoming traffic.

The cross should consist of two pieces of tape, either self-adhesive or sewn on, each 50 mm in width and 450 mm to 600 mm in length.

The retro-reflective cross material shall be Class 1 white material.

Similarly, any signal which is taken out of use, but not removed, shall be fitted with a diagonal retro-reflective white cross.

For MPIs and PSIs, these shall be covered with a black UV stabilised material and securely attached to the MLI and/or PSI. A white cross as detailed above shall be securely fitted facing oncoming rail traffic.

### 2.1.3. Security

Lamp case doors shall be fitted with appropriate signalling safeworking padlocks and locked immediately the signal is erected.

### 2.1.4. Ladders and Landings

Signal ladders and landings shall be provided to give maintenance staff safe access and egress to/from all lamp cases, indicators etc fitted to the signal and shall be manufactured to the requirements of Specification CRN SE 036 and AS 1657.

Where it is not possible to install the ladder immediately behind the signal post, alternative proposals shall be submitted for approval.

### 2.1.5. Alignment of Colour Light Running Signals

Refer Appendix A for focusing of colour light signals.

## 2.2. Signal Installation

### 2.2.1. Structure Gauge

No signal shall be installed within the area defined by the CRN Standard Structure Gauge 2009 without prior written waiver approval from CRN or CRN's nominated Representative.

### 2.2.2. Location of Signals

#### 2.2.2.1 Location

Signals shall be located in accordance with the information contained in signalling plans and the approved signal sighting forms provided that the requirements of Clause 2.2.1 and the guidelines included in this clause are met.

The centre of the signal post shall be located between 2.2 and 2.5 metres from the running face of the nearest rail. Exceptions may be approved provided that the requirements of Clause 2.2.1 are met, and sighting is not compromised.

Running signals shall be placed to the left of the track in the direction of travel.

Exceptions:

- At the ends of crossing loops in single line sections.
- Where the signal is for the “wrong” running direction in bi-directionally signalled double line track areas only, and all signals are similarly located.

If it is considered necessary to place a signal to the right of the track for any other reason, the proposal along with a copy of the signal sighting forms shall be submitted to the Principal Signal

& Communications & Network Control Engineer for approval, with full reasons, including as assessment of risks associated with the location. Co-acting signals on the correct side may be required.

The selection of location shall take into account:

- Fixed obstructions interfering with sighting e.g., cuttings, retaining walls, foliage, and structures.
- Other trains - whether acceptable sighting is available with another train approaching on an adjacent track, notably on right hand curves, whether acceptable sighting is available with rolling stock standing on sidings, notably on left hand curves.
- Background lighting - whether road traffic lights, street lights, floodlights will overpower the signal aspect or tend to mislead the train driver.
- "Reading through" - whether the driver will be misled by sighting past the signal to another more obvious signal.
- That signals on parallel running lines, or at the ends of loops, should generally be placed opposite one another and stagger along the track should be minimised. Exceptions may be made where the approach is such that both signals are visible and there is no possibility of confusion, and as noted below.
- Where bi-directional running applies, the possibility of sighting the signal on the "wrong" road before sighting the correct signal.
- Overhead wiring switched airgaps, and components of the overhead wiring including pull-off arms where these would be within 1 m of a person’s outstretched arm. Signals shall not be located in such locations.

#### 2.2.2.2 Acceptable Sighting

Running signals shall be located to provide:

- As far as practical, the longest, most continuous sighting of the signal after passing the signal in the rear.
- Preferably, a minimum of 200 metres sighting distance for speeds to 100 km/h and 300 metres for speeds over 100 km/h wherever the environment permits.
- A minimum of 6 seconds sighting at line speed. Distances which equate to 6 seconds at various speeds are given in Table 1 (Note: These distances include a 10% speed tolerance, but must be treated as minimum distances)

- Signal sighting distances shall be maximised where signals are widely spaced, and speeds are high. Where related[1] signals are spaced more than 2.5 kilometres apart, the minimum sighting distances shall not be less than 200 m for speeds to 100 km/h and 300 m for speeds over 100 km/h.

**Table 1 – Absolute minimum Sighting Distances (Equal to six (6) seconds sighting)**

| Service Speed (km/h) | Distance (metres) |
|---|---|
| 40 | 73 |
| 50 | 93 |
| 60 | 110 |
| 70 | 129 |
| 80 | 147 |
| 90 | 165 |
| 100 | 183 |
| 115 | 200 |
| 130 | 239 |
| 145 | 266 |
| 160 | 294 |

### 2.2.2.3 Sighting Limitations

Sighting of running signals generally cannot be guaranteed for all types of rolling stock and locomotives when the drivers' position is within 5 metres of the signal. Deflecting prisms in lenses, where available, will improve very short range 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.

A gantry mounted signal will not normally be visible, in daylight, within about 10-15 metres of the gantry. If a train is required to pull right up to a gantry mounted signal (e.g., at a platform), a co-acting indicator signal will usually be necessary.

[1] Related means that the indication on one signal will affect the indication on the signal in the rear e.g., home and distant signals, automatic signals in section.

#### 2.2.2.4 Unacceptable and Undesirable Sighting

Signal sighting shall be regarded as unacceptable when:

- Local conditions are exceptional and such that it is reasonable to predict that drivers may have particular difficulty in properly observing and being able to stop at the signal when required to do so.
- The signal will not be visible to the driver when the train is stationary at a platform or when the train is stationary within 15 metres of the signal.

Signal sighting may be regarded as undesirable when:

- Trains frequently approach a signal with restricted sighting, having received a caution indication at the previous signal. In order to prevent unnecessary slowing of the train it would be advantageous to advise the driver before the signal becomes visible, that the signal has cleared.
- 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.

#### 2.2.2.5 Solutions to Unacceptable and Undesirable Sighting

In most circumstances careful selection of location, varying the height of a signal and/or providing screening against background lighting, correct lens selection and careful focusing of the signal will provide the train driver with acceptable sighting.

Co-acting and repeating signals shall be provided only in those cases where there is no alternative method of providing acceptable viewing to the train driver.

#### 2.2.2.6 Other Considerations

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

- The location of any live overhead pull-off, stay or isolating insulator. Avoid locating signals such that any part of the signal or the maintainer servicing the signal is within 1.0 metre of any live overhead. If this is impossible, protective cages or screening shall be provided to prevent inadvertent contact with live wiring. Note that a pull off or stay wire isolated by only a single small diameter insulator is to be considered live (wherever possible CRN will, in this case, replace the single small insulator).

## 2.3. Relative Heights of Signals

Adjacent signals on running lines of equal importance shall be of equal height.

At crossing loops, the loop starting signal shall be 400 to 500 mm lower than the main line starting signal and substantially in line with it unless otherwise approved.

For single aspect signals the main red shall be the reference point for height measurements.

## 2.4. Signal Post Foundations

Signal foundations shall be installed in accordance with the requirements of Specification CRN SC 021.

Foundation bolts shall be not less than 30mm diameter galvanised steel for 140 mm OD signal posts, not less than 24mm diameter galvanised steel for 114 mm OD signal posts and not less than 16mm galvanised steel for dwarf signals.

The top of the foundation shall generally be positioned at rail level. However, where the cess depth or ballast shoulder exceeds 750 mm the top of the foundation may be positioned not less than 300 mm above ground level and the signal post lengthened accordingly. In some circumstances the top of foundation may be positioned above rail level where agreed on the Signal Sighting form.

## 2.5. Ladder Footings

A concrete landing/footing pad for ladders used on signal posts shall be 600 x 900 x 150 mm minimum size, with F72 mesh and projecting 600 mm behind the ladder, except where the provision of the pad would interfere with drainage or other equipment. In this case an alternative proposal shall be submitted for approval.

Where more than one ladder is fitted to a signal post, a single concrete pad should be formed and poured linking all ladders.

Signal gantry access ladder concrete landing/footing pad shall comply with Civil manufacturing drawing E1-451.

## 2.6. Cabling Distribution Pit

Main running signal installations (and behind nominated shunt signals) shall include a cable distribution pit between the signal base and the ladder unless agreed otherwise. The pit shall be incorporated into the ladder footing. The pit shall be 600 mm deep and be of sufficient size to accommodate all incoming and outgoing conduits without being wider than the adjacent signal base or affecting the stability of the signal. Conduits include local cabling from the adjacent signal location for the signal and track circuit Site Installation Drawings (CRN SC 008) shall be produced and approved for each typical installation drawing at each signal.

## 2.7. Tunnel Signal Installation

Tunnel Signals shall be fixed to the tunnel wall through the bracket provided on the signal using Stainless Steel masonry anchors, either “Chemset” or “Dynabolt” or similar anchors, the depth of fixing to be determined by the condition of the tunnel wall. Standard fixing depths as specified

by the masonry anchor manufacturer shall be used in concrete or brickwork in good condition. For old, weathered or sandstock brickwork the anchor depth shall be at least 1½ bricks.

The signal lamp cases shall be clear of the tunnel wall by 20–30 mm at the closest point and shall be mounted so that the top red aspect is between 2250 and 2550 mm above rail level. The signal shall be vertical in both planes.

Where the top lamp case of the signal is more than 2 metres above the floor level of either the tunnel or refuge (if the signal is mounted at the edge of the refuge), a step, platform or ladder shall be installed to provide maintenance access to the signal.

The lamp case door shall be able to fully open without obstruction.

# 3. Alignment (focusing) of LED Colour Light Running Signals

## 3.1. Main Signals

The signal shall be focused (aligned) to provide the train driver with optimum sighting of signal indications.

The final check of signal focus shall be carried out from a train approaching the signal. This check shall be carried out in daylight, where possible with the sun in front of the signal. A signed record of this check shall be submitted as part of the contract quality documentation.

The alignment shall be carried out in daylight. (If circumstances force initial alignment to be carried out at night, a follow up check in daylight must be made).

The signal shall be viewed from a distance of approximately 300 metres, or at the maximum sighting distance, or from the signal in the rear, whichever distance is the lesser. The signal shall be viewed from a position immediately above the left hand rail.

The person aligning the signal should first approximately align the lamp case to point towards the viewer and vertically align the lamp case so that the light beam is approximately horizontal.

Where possible, sighting should be carried out using the green indication as this is usually the least visible of the indications in daylight due to the colour green being the closest of the colours to daylight in the colour spectrum.

The lamp case is then to be rotated side to side and the viewer is to indicate the position of maximum visibility. Lock at the position of maximum visibility. If a focusing ring is fitted adjust the ring and insert the locking pin.

Finally, the lamp case is to be rotated up and down until the viewer indicates the position of maximum visibility. Again, lock at the position of maximum visibility.

Where the approach to the signal is curved, the viewer is then to walk along the track towards the signal checking the visibility. Some reduction in the intensity of the indication can be

expected on a curved approach as can some obstruction from overhead wiring structures. Provided the signal is visible for 80% or more of the approach distance, this is acceptable. There must be unobstructed and clear visibility of the signal indication between 15 and 50 metres from the signal.

Where maximum sighting distances are 150 metres or greater, it is not necessary for the viewer's eye level to be elevated to driver's eye level. The vertical spread of the LED signal will take care of the difference.

Special attention shall be paid to gantry mounted signals. Because they are mounted so far above the track and need to be angled downwards.

Further requirements associated with conversion of incandescent signals to LED are set out in CRN SC 013 Interface Requirements and Procedures for Alterations.

## 3.2. Turnout Signals (band of yellow lights)

Turnout signals shall be aligned for best sighting at 150-200 metres if indicating a route off the main line and at approximately 30 metres if indicating a route from a refuge or siding.

## 3.3. Turnout Indicators (band of white lights)

Junction indicators shall be aligned to provide best sighting at 200-300 metres or to the maximum available sighting distance if less than 200 metres.

## 3.4. Subsidiary Signals, Horizontal and Vertical Shunt Signals

Subsidiary signals and horizontal and vertical shunt signals (dwarf position and colour light signals) shall be aligned to provide best visibility at the point from which the driver is most likely to be viewing the signal.

In yards where trains may stand very close to shunt signals, mounting on a post may improve visibility.

# 4. Signal Gantries

Signal gantries shall be provided where indicated by the signalling plans and signal sighting forms. The gantry shall span the minimum number of tracks consistent with obtaining clearances between mast and track required by the Standard Structure Gauge 2099 and the necessity to clear any pathway or roadway adjacent to the track.

Gantries shall be designed to accommodate dead load from the structure, cages, signals, walkway and handrails; live loading from maintenance personnel and wind loading assuming a maximum wind speed of 160 km/h and the appropriate terrain category for the location, plus any

construction and temperature loadings. The design (where design details are not provided) and a Structural Engineer's certificate specifying that the gantry is suitable for its intended use, shall be submitted for approval.

Welding to or drilling of the gantry structure after fabrication and erection to attach signals, signal cages, walkways, handrails, ladders, notice plates, telephones, cable trays or cables is not permitted.

Either holes and/or brackets for attachment are to be included in the gantry structure during manufacture or the various items are to be clamped to the gantry.

Signals gantries and all ferrous attachments thereto shall be hot dip galvanised after fabrication.

Gantry foundations shall be constructed in accordance with the requirements of Specification CRN SC 021.

Gantry masts shall be vertical in both planes. The gantry beam shall be horizontal and be either straight or have small positive camber. Masts shall be wedged, shimmed or packed on foundations to achieve levelling then grouted between foundation and mast foot.

The gantries shall be positioned on the footings to allow a minimum of 25 mm of low shrinkage concrete grout to be installed between the concrete footing and the column base plate after levelling has been completed. All temporary packing (if used) shall be removed.

## 4.1. Gantry Access Ladders

Gantries spanning three or less tracks shall include one access ladder to the gantry walkway. The walkway shall extend sufficiently from the ladder to access all cages on the gantry. All other gantries shall have ladders at each end of the gantry and continuous walkway between the ladders unless approval is granted for a single ladder and reduced walkway. A safety chain or bar shall be provided across the ladder opening in the balustrade.

Gantry access ladders shall not exceed 6m in height without an intermediate landing, in compliance with AS 1657 Fixed Platforms, walkways, stairways and ladders.

Gantry access ladders shall be fitted with safety cages.

Cages shall extend down no lower than 2 m above the ground level landing and be fitted with a lockable door panel to restrict unauthorised access. A split door panel is preferred in lieu of a single door construction, in order to reduce the overall weight and potential for the door to fall on the user.

## 4.2. Signal Gantry Cages

Signal gantry cages shall be securely fastened to the gantry with galvanised steel bolts (or U-bolts if clamped), flat washers, spring washers and nuts.

Cages shall be installed such that they are vertical in both planes, except that where the gantry beam is cambered, no compensation is necessary for the angle caused by the camber unless this exceeds 0.2°.

The cage shall be provided with an access ladder not less than 380 mm wide between stiles, stile section not less than 50 x 12, rungs not less than 20 mm diameter and rung spacing not greater than 300 mm.

Where cages are cantilevered from the gantry, the ladder stiles shall extend to the topmost rail on the gantry handrail. There shall not be less than 175 mm clearance behind any rung on the ladder to any part of the cage or gantry.

The cage shall be either pre-drilled for lamp case brackets or shall have the brackets welded in as part of the cage. Similarly, the cage shall be pre-drilled for attachment to the gantry.

## 4.3. Gantry Walkways and Handrails

Gantry walkways and handrails shall be attached to the structure in accordance with the fastening method defined on the relevant design drawing and the walkway and handrail shall comply with the requirements of AS 1657.

# 5. Guards Indicators/Warning Lights

Guards indicators and warning lights shall be in accordance with Specification CRN SE 036, and each shall be located as shown on the signalling plan or as directed to enable it to best fulfil its intended purpose.

Guards indicators may be mounted on station buildings or awnings (Drawing 015/008) or may be mounted on free standing posts away from the building. Where it is intended to mount onto a building, the building owner’s permission shall be obtained. The guards indicator should be clamped to the building; drilling or welding for fixture is to be avoided.

Approval shall be obtained where it is required to mount indicators on heritage listed infrastructure.

Warning lights may be attached to any convenient structure provided it is not on a heritage listing and provided that the warning light will not block or detract from the driver's observation of any signal. A warning light shall not be mounted within 3 metres (20 m in the approach direction) of a signal if it faces the same direction as the signal and is likely to be illuminated when a train approaches the signal.

Guards Indicators and warning lights shall be covered or wrapped in black opaque woven or re-enforced material until brought into use.

# 6. Buffer Stop Lights

Buffer stop lights are normally mounted immediately behind the buffer stop in the centre of the "four foot" or immediately to the left of, and in line with, the face of the buffer stop.

Where metal buffer stops are provided, any metal work for the buffer stop light shall be insulated from the buffer stop frame itself or separately mounted and insulated, to avoid any touch potentials from the buffer stop.

Refer to CRN SC 021 for positioning details and CRN SD 001 for configuration details.

# 7. Track Circuits, Traction Bonding and Impedance Bonds

## 7.1. Track Circuits

Track Circuit types, characteristics and applications are given in Specification CRN SE 039.

Insulated joints in turnouts shall be placed in accordance with the track insulation plans and will normally be in the least used and/or slowest speed route (usually the turnout route) whenever possible.

Junctions between rails of different section shall not be used for insulated joints.

Track circuit trackside equipment shall be mounted and fixed in accordance with the requirements of Specification CRN SC 021. Wiring to connect track circuits to both control equipment and to rail shall be as stipulated in Specification CRN SC 020.

Maintenance access shall be made available to tuning units, matching units etc of audio track circuits and terminal cases of impulse track circuits. Where these are mounted on the edges of drains or cesses which are likely to be water filled or in which staff cannot stand, a suitable standing area formed by either filling or by installing a fabricated platform, shall be installed.

### 7.1.1. Bootleg Risers

The bootleg riser is used as an interface between the surface mounted rail connecting cables and the track circuit cables running to the equipment location case or to the relay room as applicable or between the surface mounted rail connecting cables and the bonding cables in the cable route.

Their most common application is DC track circuits.

The bootleg riser is suitable for only for terminating cables of sizes up to 7/1.7 mm. For larger size bonding cables specific proposals shall be submitted for approval.

Except where site conditions preclude, the bootleg risers shall be installed 2500 mm (minimum) from the nearest rail face and the top of the terminal box shall be 300–400 mm above ground

level. Where track centres do not permit this position, the riser shall be placed centrally between tracks and the top of the box shall be at least 50 mm below rail level.

### 7.1.2. High Voltage Impulse and Audio Frequency Track Circuits

Where the high voltage impulse and audio frequency track circuit trackside equipment can be installed within three (3) metres of the rail, surface mounted track connecting cables may be run directly to the trackside equipment.

The posts and trackside equipment shall be installed opposite the applicable IRJ or track connection position to avoid excessive length on the track connecting cables.

Incoming cable from location case to box shall be protected by either passing through the post or by a rigid conduit securely fixed to the post. Cables to the track shall be supported by clamping to the post to minimise loading on the cable terminations.

Cable entries into tuning units shall be sealed to prevent entry of moisture.

## 7.2. Traction Bonding

Traction bonding shall be installed in accordance with bonding plans and the requirements of Specifications CRN SC 020 and CRN SC 002.

Where traction bonds are attached to rails with either stainless steel tapered bolts or stainless steel Cadweld studs, an antisieze compound (such as ‘Loctite’ 771) shall be used between the stainless steel nuts and stainless steel bolts/studs. Care shall be taken to ensure that the anti-seize is not permitted to contaminate the mating surfaces between cable lug and bush or boss on the rail.

The mating surfaces of cable lugs and of the copper bush in the rail or the Cadweld boss welded to the rail shall be cleaned (with solvents or abrasive products if needed) prior to assembly.

## 7.3. Impedance Bonds

Impedance bonds shall be mounted in accordance with the requirements of Specification CRN SC 021.

Size, type, quantity and connection requirements for side lead and neutral conductors to rails and impedance bonds shall be as specified in Specifications CRN SC 020 and CRN SC 002.

Side lead and neutral conductor cable terminations shall be accessible for examination and disconnection with the bond lid or cover in place but shall not be unduly exposed to damage. Cables shall be mechanically supported to reduce the load on the termination point and cable lugs.

The side leads to one rail shall be equal in length and configuration to the side leads to the other rail.

All cable connections to bonds shall be made using stainless steel fastenings. An anti-seize compound (Loctite 771 or equivalent) shall be applied to the fastenings during installation. Care shall be taken to ensure that the compound is not permitted to come between cable lug and bond termination plate.

The mating surfaces of cable lugs and of the impedance bond terminals shall be cleaned (with solvents or abrasive products if needed) prior to assembly.

# 8. Points and Ground Frames

## 8.1. Points

All bolted connections that are not adjustable shall use nyloc nuts.

All critical elements shall be evidenced as unlikely to fail or shall be provided with redundancy e.g., double secured pins.

Any work involving drilling switches and stockrails shall be carried out in accordance with the requirements of appendix ‘D’ Drilling of Switches and Stockrails.

All point machines shall be installed to the standard designs. Where individual set screws or plain nuts are used, “Loctite 242” or equivalent shall be used. Self-locking nuts are to be used wherever possible.

If stainless steel bolts are used with stainless steel inserts in the sleeper an anti-seize compound (Loctite 771 or equivalent) shall be applied to the bolts.

Where a standard layout drawing is not available a design for a suitable layout shall be prepared and presented for approval.

Connections between the machine and switches shall be to details referenced on the standard points layout drawing. Where the referenced details are unsuitable, detailed designs for the connections are to be prepared and submitted for approval. Every effort shall be made to use or adapt items referenced on the standard layouts.

Protection ramps shall be installed ahead of the electrical detector and rodding as shown in the standard layout drawings.

## 8.2. Point Indicators

Mechanical point indicators may be attached to extended timbers with coach screws or fixed to a separate steel or concrete base with suitable bolts or anchors.

Electrical point indicators shall be in accordance with the requirements of Section 2 of this Specification and the requirements of Specification CRN SC 021 for horizontal or vertical shunt signals.

## 8.3. Point Machines

### 8.3.1. Electric

All power operated point driving and locking mechanisms used shall be in accordance with the requirements of Specification CRN SE 037**.**

The switch machine shall be installed so that no part infringes structure gauge except that the hand throw levers on a dual control machine may infringe when being thrown between the normal and reverse positions and the crank handle may infringe when inserted in the switch machine for emergency operation.

Where there is insufficient space to locate the switch machine without some infringement of structure gauge, the extent of the required infringement shall be submitted for determination as to whether the proposed infringement can be permitted.

Backdrives shall be provided as shown on the standard layout drawing or where not available, a design shall be prepared and submitted to CRN for approval.

The switch machine cable entry shall be sealed with a neutral cure silicon sealant after cable termination to prevent moisture entry.

## 8.4. Ground Frames

The general layout of ground frames and rodding shall be as shown on Drawing M10-301.

The layout of ground frame and channel rodding runs, including compensation, if it differs in any way from the layout shown on Drawing M10-301, shall be drawn up and submitted for approval.

Tangential type turnouts and large conventional turnouts shall not be fitted with hand operated ground frames.

## 8.5. Identification of Points and Catchpoints

100 mm cast aluminium or enamelled steel numerals coloured white shall be fixed to the sleeper either in the “four foot” or adjacent to the switch machine giving the point (turnout) number and, if there are multiple ends with the same number, the end identification, “A”, “B” etc. e.g., 441A, 441B

‘N’ and ‘R’ letters shall also be provided to indicate the normal and reverse positions.

When concrete bearers are in use, the identification shall be glued to the bearer.

When in-bearers are in use or it is otherwise not possible to fit to the A beam, the identification shall be provided on the A1 sleeper (the beam preceding the tip of the blades).

# 9. Location Cases and Platforms

Location cases and platforms for location cases shall be installed in accordance with the requirements of Specifications CRN SC 022 and CRN SC 021.

Direct access for maintenance staff shall be provided from the equipment which is serviced by the location case (e.g., track circuit units, points machines etc) to the location case.

In this context “direct” shall be taken to mean that:

- the case and equipment are not separated by a cess or drain which is too deep to walk through.
- the case is not at the foot of a steep embankment.
- the case is not at the top of a steep cutting.

Where necessary, walkways, steps, ladders or bridging over drainage ditches or cesses shall be provided.

Walkways, steps and landings shall comply with the requirements of AS 1657 - Fixed Ladders and Walkways.

Handrail posts shall be bolted to masonry surfaces with stainless steel "Dynabolt" or equivalent expanding anchors or stainless steel chemical anchors. The minimum anchorage depth shall be such that the strength of the anchorage is equal to or exceeding that of the post.

Handrail posts (where not welded to the structure) shall be bolted to steel structures with galvanised bolts with spring washers and nuts. The strength of the fastenings shall be equal to or exceeding that of the post.

# 10. Notice Boards and Signage

Notice boards and other signage shall be installed on 50 mm nominal bore galvanised steel pipe posts at a distance of 2500 mm from the running face of the adjacent rail.

The height of the sign shall be not more than 1600 mm above the level of the formation. This height is to ensure that the sign does not become a hazard by being at head height. Where the formation falls away and the sign would be too low for reasonable driver visibility, the post height may be increased, but in such cases the lower edge of the sign must be installed well above head height, which for these purposes shall be taken as 2200 mm. In any case the lower edge of the sign shall not be more than 2000 mm above rail height. When these longer posts are required the post size shall be 65 mm nominal bore and shall extend 600 mm into the ground.

Where these requirements cannot be met due to site constraints and local requirements, the matter shall be referred to the Principal Signal & Communications & Network Control Engineer for determination.

Signage that requires being mounted low to clear structure gauge, such as between tracks, such as Yard Limit, EYL, Shunting Limit boards etc, may be located low down on similar posts. It may be appropriate to lay back the post so that the sign is more easily readable. Such posts should not protrude above the sign by more than 50 mm.

# 11. Level Crossings

Requirements for Level Crossings is located in Specification CRN SE 038 and CRN SC 018. Refer to Specification CRN SC 021 for foundation details.

# 12. Alignment (focusing) of Level Crossing Signals

Focusing of Level Crossing Signals is located Specification CRN SC 018.

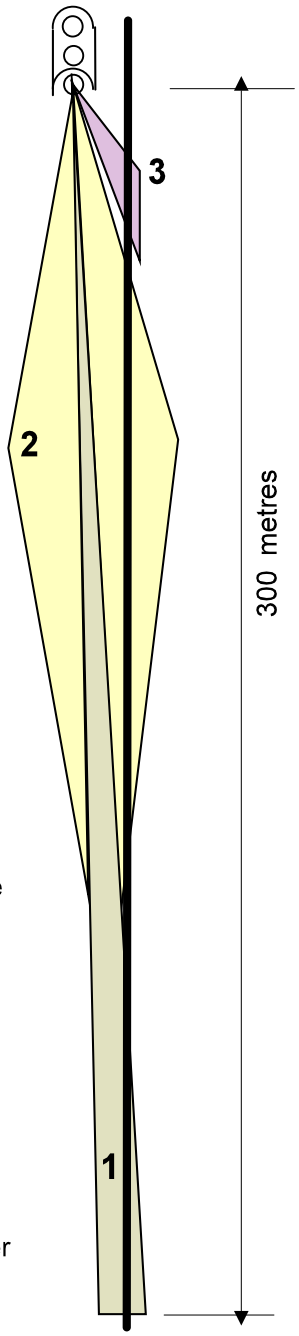
# A.1. Appendix A - Drawings

| | | |
|---|---|---|
| 015/001 | - | Incandescent Signal Alignment - Straight Track |
| 015/002 | - | Incandescent Signal Alignment - Gently Curved Approach |
| 015/003 | - | Incandescent Signal Alignment - Sharply Curved Approach |
| 015/006 | - | Relationship of Signal, Trainstop and Insulated Joint |
| 015/007 | - | Relationship of Signal, Trainstop and Audio Track Circuit Tuned Loop |
| 015/008 | - | Guards Indicator suspended from buildings |

① The main part of the beam has a spread of approximately 1 degree. This will provide a beam width of:
0.85 metres at 50 metres
1.7 metres at 100 metres
3.4 metres at 200metres
and 5.1 metres at 300 metres.

② There will be additional spread of lower intensity of 2 - 3 degrees which will provide for shorter distance viewing. Width of this part of the beam will be 3.5 - 5 metres at 100m.

③ The close up view provided by the deflecting sector in the lens will only be visible from approximately 25 metres ahead of the signal.




When focusing the signal, the viewer should be at a point approximately 300 metres from the signal.

Only the standard non-spread lens should be used in this situation.

A full lens indication will only be visible from within the main part of the beam. A partial indication only will be visible from within the wider spread part of the beam.

At a distance approximatel 300 metres, the signal can be focused by standing at track level. There is sufficient beam spread to compensate for the difference between viewer eye level and train drivers eye level.

**Drawing 015/001 – Incandescent Signal Alignment - Straight Track**

① The main part of the beam has a spread of approximately 1 degree. This will provide a beam width of:
0.85 metres at 50 metres
1.7 metres at 100 metres
3.4 metres at 200metres
and 5.1 metres at 300 metres.

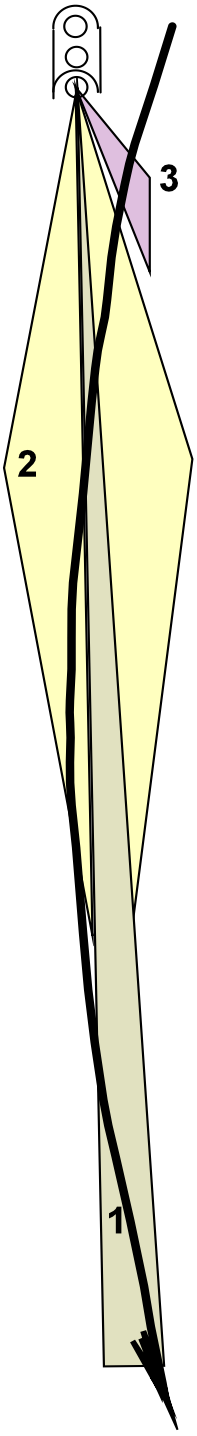
② There will be additional spread of lower intensity of 2 - 3 degrees which will provide for shorter distance viewing. Width of this part of the beam will be 3.5 - 5 metres at 100m.

③ The close up view provided by the deflecting sector in the lens will only be visible from approximately 25 metres ahead of the signal.

When focussing the signal, the viewer should be at a point approximately 260 metres from the signal.

A full lens indication will only be visible from within the main part of the beam. A partial indication only will be visible from within the wider spread part of the beam.

At a distance of approximately 260 metres, the signal can be focused by standing at track level. There is sufficient beam spread to compensate for the difference between observers eye level and train drivers eye level.



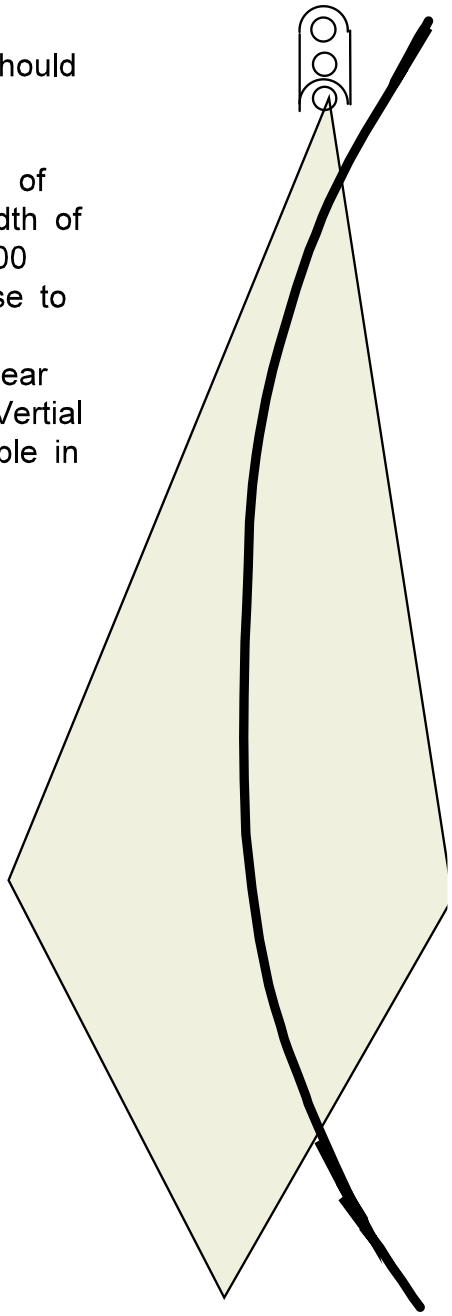

**Drawing 015/002 – Incandescent Signal Alignment – Gently Curved Approach**

The 30 degree spread lens should used in this situation.

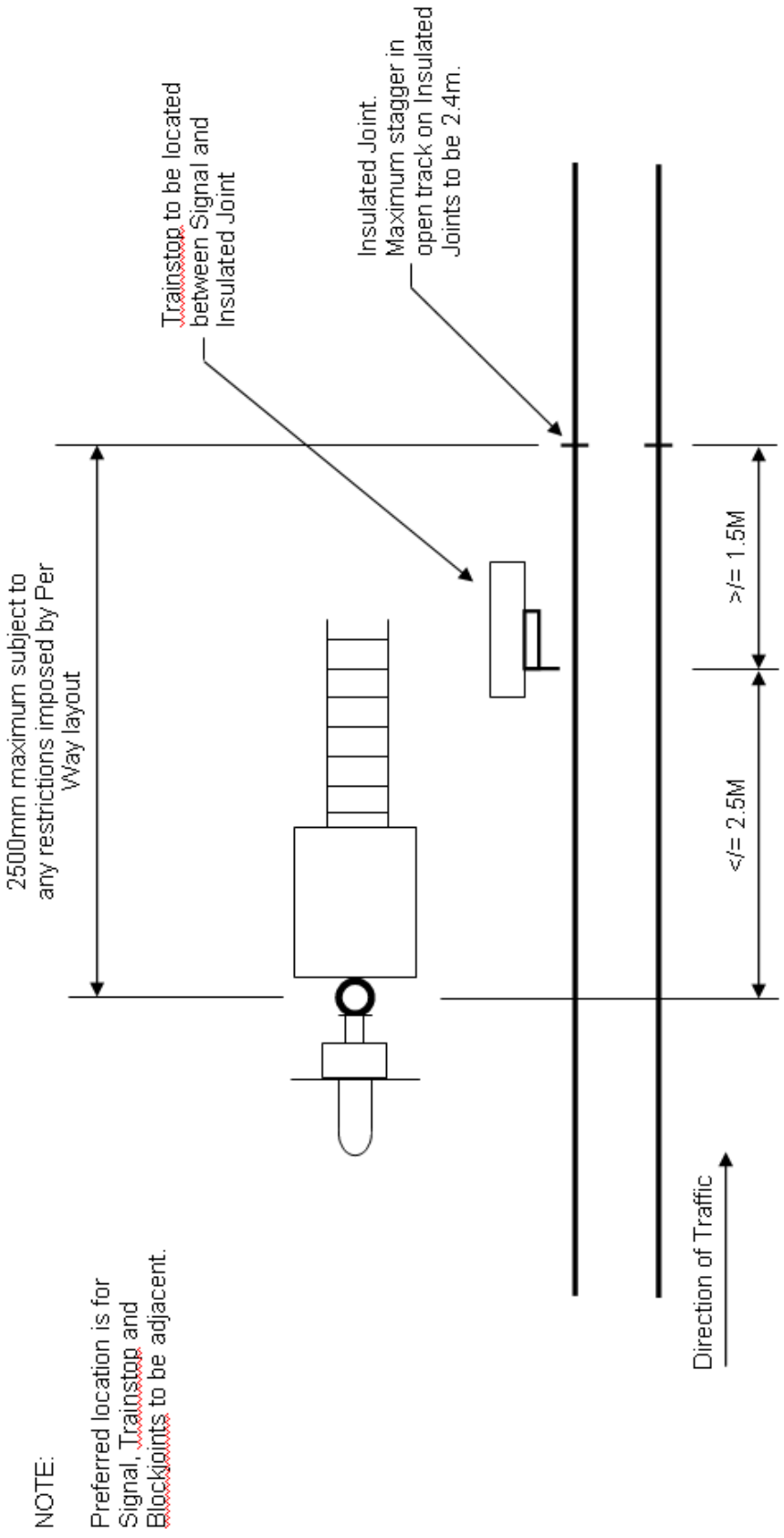
The main beam has a spread of 30 degrees giving a beam width of approximately 25 metres at 100 metres. However intensity close to the edge of the beam will be reduced and the lens will appear to be only partly illuminated. Vertial "black" lines may also be visible in the indication.

The viewer should be located 150 - 200 metres from the signal (or at the maximum sighting distance whichever is the lesser).
The viewer's eye level should also be elevated to drivers eye level

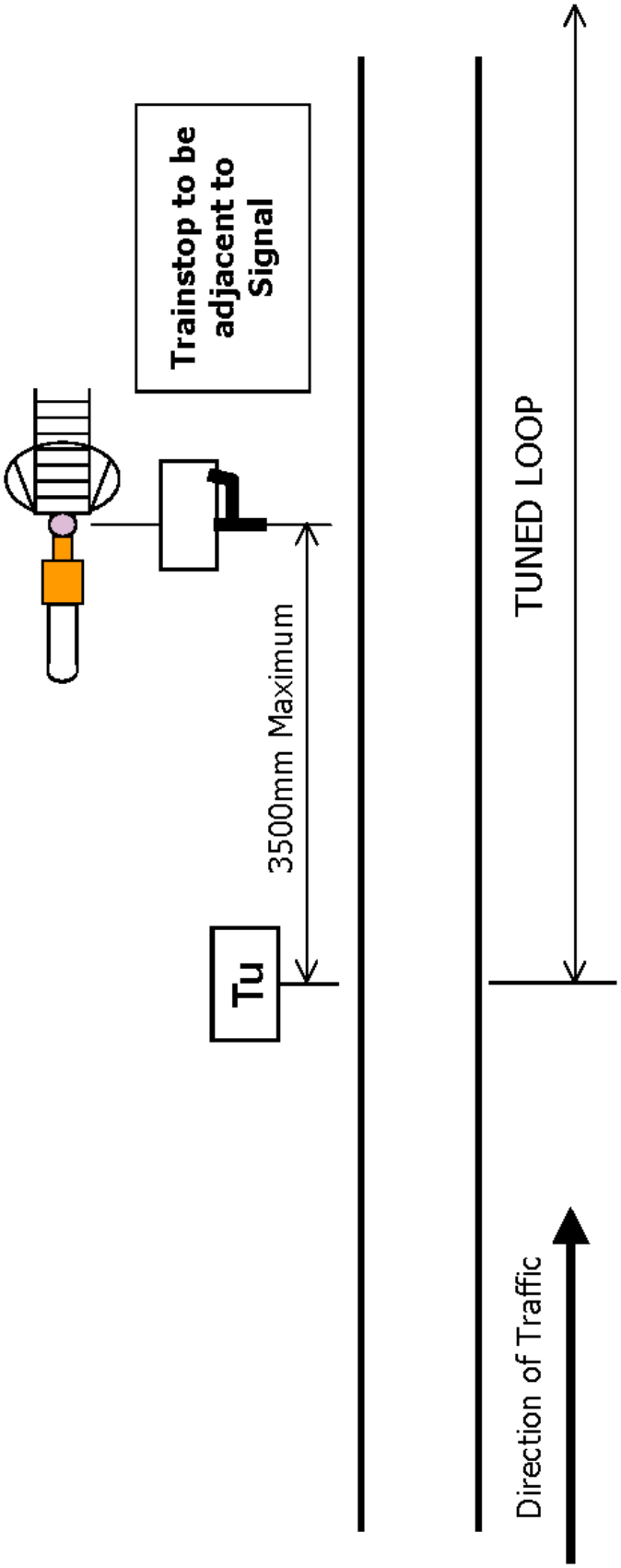
There is no deflecting sector in this lens.



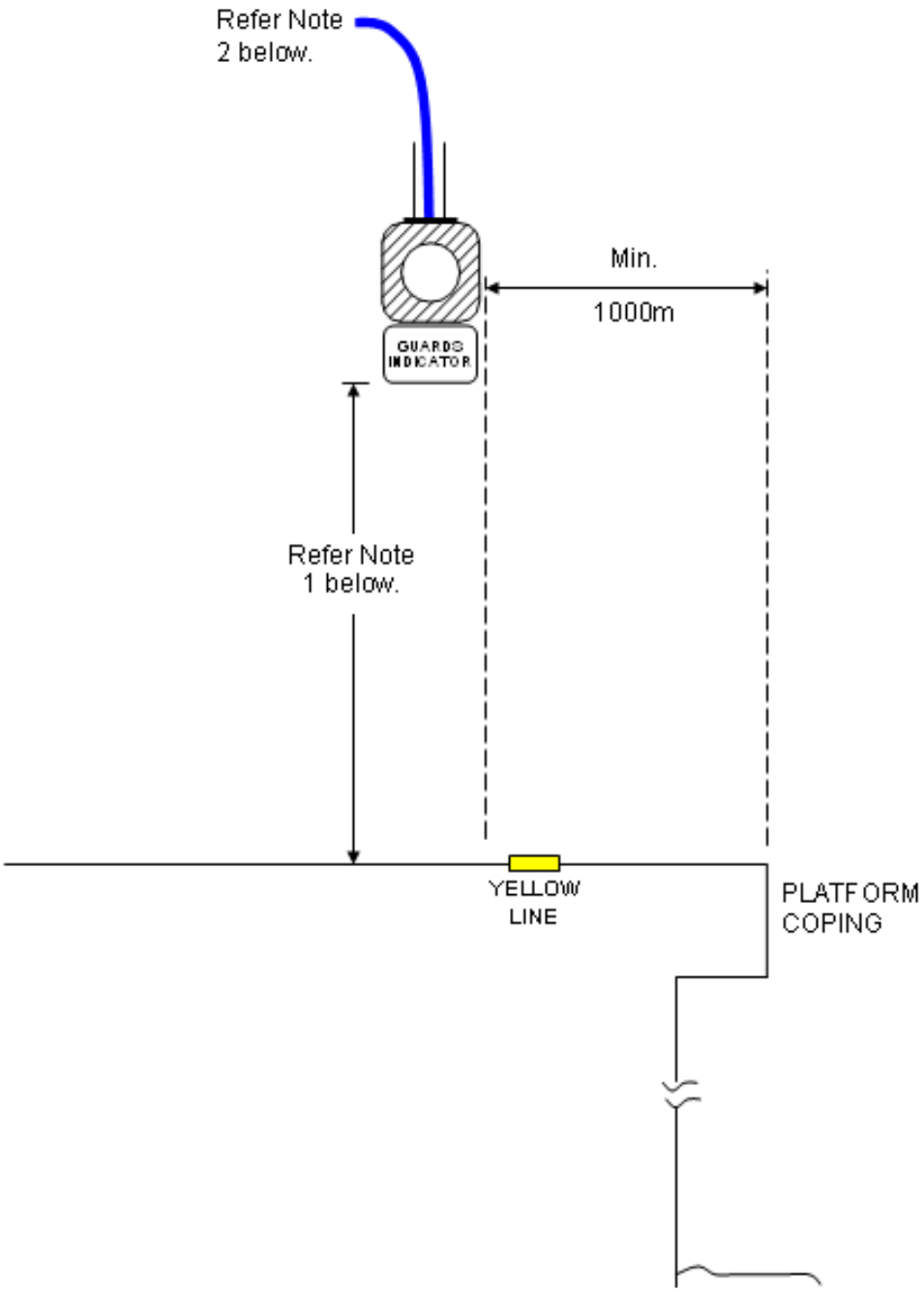
**Drawing 015/003 – Incandescent Signal Alignment – Sharply Curved Approach**




**Drawing 015/006 – Relationship of Signal, Trainstop and Insulated Joint**




**Drawing 015/007 – Relationship of Signal, Trainstop and Audio Track Circuit Tuned Loop**




**Drawing 015/008 – Guards Indicators suspended from buildings**

Notes:

- Minimum underside clearance shall be 2400 mm. Maximum underside clearance should not exceed 3000 mm.
- Cable should be top entry and preferably incorporated within the support bracket to provide mechanical protection.