Installation of Trackside Equipment
SCP 15

Applicability

<table>
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<th>CRIA (NSW CRN)</th>
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About This Standard
This document sets out the requirements for the installation of signalling equipment which is mounted on or adjacent to the track.

The equipment covered includes, but is not limited to, signals, track circuits, train stops, points mechanisms, guards indicators and warning lights, call lights and horns, level crossing equipment.

1 General
Refer to ESC-07-01 Installation of Trackside Equipment.

2 Signals

2.1 General
Refer to ESC-07-01 Installation of Trackside Equipment.

2.2 Signal Ladders and Landings
Refer to ESC-04-02 Post Mounted Signals – Ladders.

2.3 Signal Installation
Refer to ESC-07-01 Installation of Trackside Equipment.

2.4 Relative Heights of Signals
Refer to Section 2.1 of ESC-04-01 Signal Sighting and Position.

2.5 Signal Foundations
Refer to ESC-07-01 Installation of Trackside Equipment.

2.6 Ladder Footings
Refer to ESC-04-02 Post Mounted Signals – Ladders.

2.7 Tunnel Signal Installation
Refer to ESC-07-01 Installation of Trackside Equipment.

2.8 Focusing of 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.

2.8.1 Focusing – Running Signals
Typical situations and recommended sighting arrangements are shown on drawings 004700/001, 002 and 003 in Section 13 Drawings. The alignment distances shown assume
there is no other signal or obstruction within that distance. Where there is, the alignment distance should be reduced to the distance between signals or the distance to the obstruction. The correct lens shall be selected to achieve best sighting. The spread light type of lens, which reduces the intensity of the indication, should not be used unless the approach to the signal is sharply curved and/or the maximum available sighting distance is less than 250 metres.

2.8.2 **Focusing – Turnout Signals (Band of Yellow Lights)**

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

2.8.3 **Focusing – Junction Indicators (Band of White Lights)**

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

2.8.4 **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.

2.8.5 **Method for Signal Focusing**

The methods employed for signal focusing are outlined in Appendix A.

2.9 **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 1987 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.

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.

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 ESC-11-01 Construction of Cable Route and Associated Civil Works.

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 as specified in Section 13 of SCP 21 Construction of Cable Route and Associated Civil Works.
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.

2.10 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 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 375 mm wide over stiles, the stile section not less than 50 x 10, rungs not less than 20 mm in 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 lampcase 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.

Where signal cages are cantilevered, the access to the cage from the walkway on the gantry shall be through a self closing gate which opens across the gantry walkway or through a removable (one side fixed) chain barrier. The gate or chain shall be painted gloss white.

If it is necessary for a cage to be immediately below the gantry with access through the gantry (this shall be considered a last resort solution), a suitable hinged trap door shall be provided in the gantry walkway. The trap door shall, if necessary, be counterweighted to limit the maximum force required to open it to 20 kg.

In the closed position, the trap door shall provide a similar textured surface to the walkway and shall be level with the walkway. In the open position, the trap door shall obstruct the walkway and shall open away from the normal approach direction. The underside of the trapdoor shall be painted white.

Both sides of the cage shall be covered with expanded aluminium mesh or similar as shall the back of the cage if this is not covered by sheet aluminium forming the background for the signal. The mesh size shall not exceed 100 LWM x 50 SWM.

Where sheet aluminium is used on the back of the cage to form a signal background, it shall be minimum 2 mm thick and be secured to the cage at 250 mm maximum intervals.

2.11 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. The walkway and handrail shall comply with the requirements of AS 1657.

3 Guards Indicators/Warning Lights

Refer to ESC-07-01 Installation of Trackside Equipment.

4 Flashing Lights and Horns (Calling Devices)

Refer to ESC-07-01 Installation of Trackside Equipment.

5 Trainstops

This section is no longer applicable to the ARTC Network and has been removed.
6 Track Circuits, Traction Bonding and Impedance Bonds

6.1 Track Circuits
Refer to ESC-07-01 Installation of Trackside Equipment.

6.2 Traction Bonding
Refer to ESD-07-02 Track Bonding and Signalling Infrastructure in Electrified Areas.

6.3 Impedance Bonds
Refer to ESD-07-02 Track Bonding and Signalling Infrastructure in Electrified Areas.

7 Points and Ground Frames

7.1 Points Indicators
This section is no longer applicable to the ARTC Network and has been removed.

7.2 Points Machines
Refer to ESC-07-01 Installation of Trackside Equipment.

7.3 Ground Frames
Refer to ESC-07-01 Installation of Trackside Equipment.

8 Location Cases and Platforms
Refer to ESC-07-01 Installation of Trackside Equipment.

9 Level Crossings

9.1 General Requirements – Road Crossings
Level crossing signal and signage installation shall comply with Australian Standard 1742 Part 7 plus any additional drawing(s) or site plan(s) that may be issued or commissioned by ARTC. The type of equipment to be used is stipulated in SCP 18 Level Crossing Equipment.

Where the relocation of any service (e.g. water, gas or electricity) is required, approval shall be obtained from the owner of the service to carry out the relocation, or arrangements shall be made with the owner to have the relocation carried out.

If for any reason relocation of the service is found to be impractical, alternative proposals to avoid the service shall be submitted.

Liaison with the appropriate road authority shall be carried out in respect to the provision of safety barriers ('Armaco' guardrail) and the provision of the required road signs outside the railway boundary. As a minimum, the curved fender complete with terminal sections shown on drawing M06-207 shall be installed where the road authority has no particular requirement. This minimum fender shall be extended as necessary to provide protection on and from any road junction adjacent to the crossing.
A typical level crossing signal and guardrail layout for a two lane road is shown on drawing 004700/008 in Section 13 Drawings.

The form of protection and the number of signals required at the crossing (i.e. Type F lights, Type F lights and half booms, additional Type F lights for side roads), shall be advised in the project specification or shown on the site plans.

### 9.2 Focusing of Level Crossing Lights

Level crossing lights shall be aligned to provide the drivers of road vehicles with the maximum possible warning of the stop indication commensurate with the road speed limit approaching and over the level crossing.

For most straight or near straight approach conditions, the left side lights facing approaching traffic shall be focused for the long range view and the backlights of the signal on the other side of the crossing shall be focused for the short range view and for a vehicle stationary at the stop line.

Typical focusing plans are shown in drawings 004700/009, 010 and 011 in Section 13 Drawings.

For multi-lane roads, both the left side lights and the lights on the median strip shall be focused for the long range view. Backlights on the signals on the other side of the crossing shall be focused for the short range view and for a vehicle stationary at the crossing.

Lights focused for the long range view shall be aligned to distances of:

- 130 metres for road speeds of 60 km/h
- 180 metres for road speeds of 80 km/h
- 260 metres for road speeds of 100 km/h
- 300 metres for road speeds of 110 km/h.

*Note: If the approach to a crossing is curved, any speed shown on an advisory speed sign is to be increased by 25 per cent, for the purposes of light focusing.*

A method for aligning level crossing signals is provided in Appendix B.

### 9.3 General Requirements – Pedestrian Crossings

The level of protection to be applied to pedestrian crossings, both independent crossings and those associated with roadways, is provided in XDS03 Pedestrian Level Crossings - Design and Installation. The equipment to be used is stipulated in SCP 18 Level Crossing Equipment.

Where the relocation of any service (e.g. water, gas or electricity) is required, approval shall be obtained from ARTC of the service to carry out the relocation, or arrangements shall be made with ARTC to have the relocation carried out.

If for any reason relocation of the service is found to be impractical, alternative proposals to avoid the service shall be submitted.

Care shall be taken to ensure that the audible warning devices at pedestrian crossings, which have a directional sound output, are adjusted to face towards approaching pedestrians and, as far as possible, away from any residence in the vicinity. The volume of these devices is internally adjustable and shall be adjusted so that the warning becomes audible at 10 to 15 metres from the crossing under average ambient noise conditions. There is no benefit to the pedestrian if the device is audible at greater distances.

### 9.4 Test and Emergency Boxes

Every crossing shall be equipped with test and emergency boxes. For associated road and pedestrian crossings, common test and emergency boxes shall operate both.

The test and emergency boxes shall be assembled and wired as detailed on drawings M06-300 and 301 and shall operate in accordance with the requirements of SCP 01 Signalling Control Systems.
9.5 Level Crossing Location

Equipment for the control and operation of the level crossing shall be housed in a pre-cast concrete walk-in location\(^1\) adjacent to the level crossing, which complies with Part B of SCP 22 Small Buildings, Location Cases, Terminal Cases and General Purpose Cases.

This building shall be located not less than 15 metres from the edge of the roadway and as close to the railway boundary as practical to reduce exposure in the event of an accident and to reduce obstruction to the line of sight of an approaching train.

The test and emergency boxes together with a weatherproof, vandal resistant telephone shall be mounted on the outside of this location usually on the side facing the railway line, or mounted within the emergency operation traffic hut located adjacent to the level crossing, where such a hut is provided.

10 Handrails Generally

The minimum size of handrail posts and rails shall comply with the requirements of AS 1657 - Fixed Ladders and Walkways.

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.

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.

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\(^1\) In some limited circumstances, the particular specification may permit the use of location cases or prefabricated sandwich panel buildings to house the level crossing power supply and control equipment. Where location cases are permitted, power supply shall be in one location case, control equipment in the other.
11 Appendix A: Alignment (Focusing) of Signals

Generally three persons (including a lookout) are required to align a signal; one to adjust the signal and one (with the lookout person) to view the signal indication. (When there are no trains running, the lookout person may not be required.)

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 completed.

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 lampcase to point towards the viewer and vertically align the lampcase so that the indication 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 lampcase 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 lampcase 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 per cent 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 signal lens system will take care of the difference.

For sighting distances less than 150 metres, the viewer’s eye level needs to be elevated to close to driver’s eye level (between 2.4 and 3.3 metres above rail level).

Special attention shall be paid to gantry mounted signals. Because they are mounted so far above the track and need to be angled downwards, the vertical spread of the indication beam is less able to compensate for variations in eye level and it will be necessary for the viewer’s eye level to be approximately that of the train driver when aligning these signals.

A gantry mounted signal will not normally be visible in daylight within approximately 10 to 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.
12 Appendix B: Alignment (Focusing) of Level Crossing Signals

Three persons (including one to act as the viewer’s lookout for road traffic) are required to align level crossing signals.

The alignment must be carried out in daylight.

For the front lights, the person who is to view the signal shall do so from the distance nominated in Section 9.2 Focusing of Level Crossing Lights for the road speed limit applying to the approaches to the level crossing or at the maximum available sighting distance, whichever is less. The viewer should be positioned 1 to 1.2 metres to the left of the road centre line, for two lane roads and approximately one metre to the right of the lane dividing line for four lane roads. (For four lane roads both the left-hand side front lights and the median strip front lights should be aligned to the same point.)

For the backlights, the viewing position should be as shown on the typical situation diagrams in drawings 004700/009, 010 and 011 in Section 13 Drawings. (For four lane roads, the median strip back lights (if fitted) should be aligned to the left lane and the opposite side backlights aligned for the right lane.)

For straight road approaches, the level crossing signal lampcase door, on the front lights only, should be opened and the signal aligned directly from the lamp and reflector.

For curved approaches, particularly those sharp enough to require a 70 degree spread lens in the front lights, and for the back lights, the level crossing signals should be aligned with the lampcase door closed.

The person aligning the signal should first approximately align each lampcase to point towards the viewer with the indication beam approximately horizontal.

The lampcases should then be rotated side to side and up and down until the viewer indicates the position of maximum visibility.

With curved road approaches, the viewer should then walk back towards the level crossing checking the visibility of the signals throughout the curve.

If there is significant loss of sight of the signals, then the lampcases will need to be re-aligned to compensate even if this slightly reduces the intensity at the original viewing point.

If the loss of intensity is such that the signals cannot be aligned to provide full coverage from the required sighting distance over the approach to the crossing, then either additional signals at the level crossing are required or pre-warning signals are required.

It is not necessary to make any special provision for the height of the viewer. A standing person’s eye level is a reasonable compromise between the eye levels of car and heavy commercial vehicle drivers.

13 Drawings

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<tr>
<td>004700/002</td>
<td>Signal Alignment - Gently Curved Approach</td>
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<td>004700/003</td>
<td>Signal Alignment - Sharply Curved Approach</td>
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<tr>
<td>004700/008</td>
<td>Typical Level Crossing Installation</td>
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<td>004700/009</td>
<td>Level Crossing Signal Alignment - Straight Road Approach Level</td>
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<td>004700/010</td>
<td>Crossing Signal Alignment - Left Hand Curved Approach Level</td>
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<td>004700/011</td>
<td>Crossing Signal Alignment - Right Hand Curved Approach Level</td>
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Drawing 004700/001 - 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 200 metres
   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 004700/002 - Signal Alignment - Gently Curved Approach
The 30 degree spread lens should be 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. Vertical "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 004700/003 - Signal Alignment - Sharply Curved Approach
Guardrail (optional) supplied and installed by Road Authority

3 metres

1.2 metres

If boom gates are fitted nominal boom length = 1/2 bitumen seal width plus 1.2m - 0.1m Boom tip must not overhang centreline

Guardrail (typical) supplied and installed by Road Authority

Guardrail (typical) supplied and installed by Road Authority

Drawing 004700/008 - Typical Level Crossing Signal Installation
Aim the "hot spot" of the front light beam to:
- 130m from the stop line for 60k zone
- 200m for 80k zone
- 250m for 90k zone
- 300m for 100k zone
- 300m for 110k zone
or to the maximum available sighting distance whichever is the lesser.

NOTE:- DO NOT use advisory speed signs to estimate road vehicle speed.

Aim the centre of the backlight beam 3 - 4 metres ahead of the stop line and 1 -1 1/2 metres from the road centre line.

Front lights 30 degree spread
Back lights 70 degree spread

Drawing 004700/009 - Level Crossing Signal Alignment - Straight Road Approach
The centre of the front light beam should be aimed as far around the curve as practical consistent with the road speed limit for the approach to the crossing. However do not aim so far round the curve that there is a "black spot" between the front light beam and the back light beam.

Aim the centre of the backlight beam 3-4 metres ahead of the stop line and 1 -11/2 metres from the road centre line.

Back lights 70 degree spread
Front lights 30 degree spread

Note 1
The selection of roundel, 30 degree or 70 degree, will depend on the curvature of the road approaching the level crossing. For a curve with an advisory speed sign of greater than 70kph, the 30 degree roundel will generally offer sufficient spread. Sharper curves will require 70 degree roundels.

Drawing 004700/010 - Level Crossing Signal Alignment - Left Hand Curved Approach
The centre of the front light beam should be aimed as far around the curve as practical consistent with the road speed limit for the approach to the crossing. However do not aim so far round the curve that there is a "black spot" between the front light beam and the back light beam.

Aim the centre of the backlight beam 3-4 metres ahead of the stop line and 1 -11/2 metres from the road centre line.

Note 1
The selection of roundel, 30 degree or 70 degree, will depend on the curvature of the road approaching the level crossing. For a curve with an advisory speed sign of greater than 70kph, the 30 degree roundel will generally offer sufficient spread. Sharper curves will require 70 degree roundels.

Back lights 70 degree spread
Front lights 30 degree spread

Drawing 004700/011- Level Crossing Signal Alignment - Right Hand Curved Approach