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Installation of Trackside Equipment

ESC-07-01

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1.3	13 Aug 10	All	Issued as final.
1.4	14 Feb 22		Updated to include relevant information from SCP15. Provided reference to CoP Section 7 Clearances. Other minor changes throughout the document. SCP15 withdrawn.

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1 General

1.1 Purpose

This purpose of this document is to provide the guideline and minimum requirements for the installation of trackside signalling equipment.

1.2 Scope

Except as otherwise noted in this document, all items of equipment and all materials required for installation shall be supplied and installed by the Contractor as part of any contract.

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

1.3 Document Owner

The General Manager Technical Standard is the Document Owner. For any query, initial contact to be made at standards@artc.com.au

1.4 Responsibilities

Project Manager, Signal Construction Contractor and Signal Maintenance staff are responsible for the implementation of this standard across the ARTC network.

1.5 Safety

Contractors at all times during the period of the contract and to the satisfaction of ARTC, shall arrange for the work to be carried out in a manner which will ensure the safety of employees, not cause danger, delay, obstruction or stoppage to railway traffic and not interfere with the business of ARTC or its Operators.

Contractors shall ensure that all personnel working on the contract including sub-contractors staff are appropriately accredited for work on or about Rail corridors in accordance with ARTC network safeworking requirements.

The Contractors shall prepare a “dial before you dig” plan of all services within the vicinity of the works before commencing any earth works.

Safe and convenient access of signalling equipment by other railway staff must be considered and arrangements put in place.

1.6 Definitions

In this document, the following definitions of terms shall apply:

Term or acronym	Description
ARTC	Australian Rail Track Corporation
Contractor	A person, company or authority nominated by ARTC to manage a specific contract.
Subcontractor	A person, company or authority hired by ARTC's Primary Contractor to perform a specific task as part of the overall project.
ARTC's Representative	A person, company or authority nominated by ARTC to make engineering determinations on ARTC's behalf.
Points	To maintain consistency with the National Code of Practice (NCoP) the term Switch has been altered to Points, i.e. switch machine is now point machine and Emergency Switch Machine Lock (ESML) is now Emergency Point Machine Lock (EPML).
LED	Light Emitting Diode

1.7 Quality of Work

The standard of materials and workmanship shall ensure that an asset will remain in service for a minimum of 25 years, during which it must remain fit for purpose in its physical and operational environment, in terms of safety, reliability, maintainability, durability, operability and supportability as set out in this document and referenced documents.

The quality of materials and workmanship shall also ensure that the necessity for regular preventative maintenance tasks to retain the safety, reliability and usability of the asset over its lifetime is minimised.

General materials such as conduits, grommet's, flanges, nuts, bolts, support brackets and other fastenings shall perform as detailed above. For example, external fastenings and steelwork shall be stainless steel or have corrosion protection such as galvanising, internal fastenings shall be zinc or cadmium plated and external conduits shall be UV resistant.

1.8 Submissions for Approval

All installed equipment must be approved for use on the ARTC Network.

Where alternatives or new equipment types are proposed, the matter shall be submitted by the Contractor with documented justification in writing, in accordance with EGP-21-01 - "New Equipment and Systems" approval.

1.9 Referenced Documents

The following standards and documents are referenced in this document:

1.9.1 Australian Standards

AS 1657 Fixed Platforms, walkways, stairways and ladders

1.9.2 ARTC Specifications

ESC-07-04	Installation of Equipment Racks & Termination of Cables & Wiring
ESC-03-01	Level Crossing Equipment
ESC-04-01	Signal Sighting and Position
ESC-04-02	Post Mounted Signals - Ladders
ESC-07-03	Small Buildings, Location Cases, Terminal Cases & General Purpose Cases
ESC-07-04	Installation of Equipment Racks and Termination of Cables and Wiring
ESC-09-02	Lightning and Surge Protection Requirements
ESC-11-01	Construction of Cable Route & Associated Civil Works
CoP Section 7	Clearances

2 Signals

2.1 General

2.1.1 Signal Location

The longitudinal location of signals shall be defined by the Signalling Plan and confirmed by the Signal Sighting Group on the relevant signal sighting forms to be found in Engineering (Signalling) Standard ESC-04-01 Signal Sighting & Position.

Any adjustments shall be agreed prior to the site surveying and position marking of signal foundation locations, the location of any associated track circuits, location cases or walk-in enclosures and prior to any construction of cable route in the vicinity.

2.1.2 Signals Not Commissioned into Use

Immediately following the installation of any signal, a large retro-reflective white cross shall be installed in front of mainline signal and shall remain in this position until the signal is brought into use. The white cross shall be securely attached to the signal.

The white cross should consist of two pieces, each arm 1000mm x 1000mm with width of 100mm and 4mm thick aluminium plate.

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.

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

2.1.3 Security

All equipment shall be fitted and secured with construction padlocks immediately after the equipment is installed.

The warding and keying of the padlocks is to be the same as that currently in use on the rail corridor.

2.2 Signal Ladders and Landings

Refer to ESC-04-02 post mounted Signals – Ladders for additional information relating to ladders and ladder footings.

2.3 Signal Installation

2.3.1 Structure Gauge

No signal shall be installed within the area defined by the relevant Standard Structure Gauge without written approval from ARTC or ARTC's nominated Representative.

Signals must be positioned to afford structural clearance between all parts of the signal and adjacent lines. Refer to CoP Section 7 Clearances.

2.3.2 Signal Sighting and Positioning

Signals shall be located in accordance with the information contained in Signalling plans and the endorsed Signal Sighting forms provided that the requirements of Clause 2.3.1 and the guidelines and documents defined in Engineering (Signals) Standard ESC-04-01 Signal Sighting & Position.

The centre of the signal mast shall be located no closer than 3.0 metres from the running face of the nearest rail. Refer to CoP Section 7 Clearances for more details. Exceptions may be approved provided that the requirements of Clause 2.3.1 are met, the sighting of the signal is not compromised and agreement reached with the Signal Sighting Group.

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

If it is considered necessary to place a signal to the right of the track for any other reason, the proposal shall be submitted to ARTC's Representative for determination in consultation with the Signal Sighting Group.

2.3.3 Signal Focussing

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.

For new works, signals should be LED type.

The methods employed for signal focusing are detailed in Appendix B.

2.3.3.1 Running Signals

Typical situations and recommended sighting arrangements are shown in the diagrams in Appendix B. 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.

For incandescent signals, 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.

For LED signals, the alignment should be adjusted such that maximum available sighting distance should not be less than 300 metres.

2.3.3.2 Turnout Signals (Band of 3 Yellow or White 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.

2.3.3.3 Junction Indicators (Band of 5 White Lights)

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

2.3.3.4 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.

2.3.4 Relative height of Signals

Refer to Section 2.1 of ESC-04-01 Signal Sighting and Position for further information.

2.4 Tunnel Signal Installation

Tunnel Signals shall be fixed to the tunnel wall through the bracket provided on the signal using an anchor type and size that is approved by competent engineer that is appropriate type for the conditions.

2.5 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 Section 7 – Clearances 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.

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.

2.5.1 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 signal head 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.

2.5.2 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.

2.6 Signal and Gantry Foundations

2.6.1 Location of Signal and Gantry Foundations

The foundations for signals and signal gantries shall be installed at the position indicated on the corresponding Signal Sighting Form.

Signal foundations shall be located at the distance from rail and height relative to rail shown on the signal sighting form consistent with the constraints imposed by the Standard Structure Gauge.

Gantry foundations shall be located at the location shown on signal sighting form and at the distance from nearest rail and height relative to rail level shown on the engineering plans for the gantry.

2.6.2 Embankments and retaining walls shall not be disturbed without written approval form the respective Infrastructure Manager. Backfilling and Levelling Site

When the signal and gantry foundations are installed, the Contractor shall backfill the foundations, level the site and remove any surplus spoil. The spoil shall not be allowed to contaminate the ballast or be placed foul of the track gauge and access ways.

Handrails shall also be provided, where necessary, to protect train crews from drains or embankments, etc.

2.6.3 Foundations Affecting Track Drainage

If a signal or gantry foundation is to be located such that it would obstruct existing or proposed track drainage arrangements the Contractor shall liaise with the appropriate Track and Civil representative such that alternative drainage arrangements can be agreed.

2.6.4 Access to Signals and Gantries from Public Roads

Where railway lines run alongside public roads, access to Signalling equipment shall be provided. This shall include the provision of walkways/steps/handrails as necessary for safe and convenient access in addition to the provision of a lockable single width gate in the boundary fence in accordance with the requirements of Engineering (Signals) Standard ESC-07-03 Small Buildings, Location Cases, Terminal Cases and General Purpose Cases and ESC-11-01 Construction of Cable Route & Associated Civil Works.

3 Other Indicators

3.1 Guard Indicators

Guard indicators and warning lights shall be located as shown on the Signalling plan or as directed to enable it to best fulfil its intended purpose.

Guard indicators and Warning Lights may be mounted on station buildings or awnings. Where it is intended to mount onto a building, the building owner’s permission shall be obtained. The guard indicator should be attached to the building in a manner that is agreed by the building’s owner.

Warning lights shall not block or detract from the driver's observation of any signal.

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

4 Track Circuit Insulation & Bonding

4.1 General

Track circuit bonding and insulation is provided to ensure reliable train detection.

Track circuit trackside equipment shall be installed on mounting posts in accordance with the requirements of Section 4.4.

The cables from the track side connection boxes or bootleg risers (BLRs) to rail shall be duplicated. Wiring to connect track circuits to both control equipment and to rail shall be in accordance with Engineering (Signalling) Standard ESC-07-04 Installation of Equipment Racks and Termination of Cables and Wiring.

All series and parallel bonding inclusive of rail bonds shall be duplicated to ensure a robust interface connection between rail and track circuit control equipment.

Positioning of the equipment and the track circuit limits shall take into account maintenance access requirements. Adequate arrangements shall be put in place to ensure compliance with the WHS.

4.2 Location of Insulated Joints

4.2.1 Location of Insulated Joints at Signals

Ideally the insulated joints shall be located directly in line with the signal to which they apply and no more than 2m past the signal.

The centre of the insulated joint shall be positioned such that it is centred between sleepers.

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

The installation of insulated joints on a curve should be avoided. However, if required an assessment shall be carried out to determine the wear impacts on the rail.

4.2.2 Location of Insulated Joints at Turnouts

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.

The insulated joint stagger in crossovers shall be the minimum permitted by the type and angle of the V crossing and the track centres at the particular location.

The centre of the insulated joint shall be positioned such that it is centred between sleepers.

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

4.2.3 Location of Insulated Joints at Level Crossings

Wherever possible, the insulated joints at which level crossing warning controls cease to operate shall not be located more than 3m from the edge of the roadway in order to minimize delays to road users.

4.2.4 Location of Other Insulated Joints

These shall be located in accordance with the position shown on the clearly dimensioned Bonding plan and be located adjacent to each other.

In dual gauge track applications the insulated joint stagger shall be no more than 600mm or one (1) sleeper bay.

4.3 Track Circuit Bonding

"Long bonds" in excess of 8.0 metres shall be as a minimum 7/1.70 twin Red and Black PVC cable and be direct buried between bootleg risers (BLRs).

The connection from the BLRs to the track shall be either Stainless Steel or Copper Hypalon, whichever is applicable to the track circuit in use in accordance with ESC-07-04 Installation of Equipment Racks and Termination of Cables and Wiring Appendix A – Procedure 1 and 2.

4.3.1 Connection of Bonds to Rails

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

4.4 Installation of Track Circuit Equipment

4.4.1 General

This section of the document provides for the installation of track circuit equipment and cables in accordance with this Specification and that of Engineering (Signals) Standard ESC-11-01 Construction of Cable Routes & Associated Civil Works and ESC-07-04 Installation of Equipment Racks and Termination of Cables and Wiring

4.4.2 Bootleg Risers

For the purposes of this specification, 'Bootleg Riser' (BLR) is defined as a small termination box mounted on a 50NB hollow galvanized steel post or pipe with a steel or concrete base. The incoming cable from the relay room or location case to the bootleg riser shall pass through the base and inside the pipe into the termination box. RSA or similar terminals with links shall be provided within the box.

The BLR is used as an interface between the surface run rail connecting cables (Hypalon) and the track circuit cables running to the equipment location case or to the relay room as applicable or between the surface run rail connecting cables and the bonding cables in the cable route.

The BLR shall be of dimensions such that it is suitable for terminating cables of sizes up to 7/1.7 mm.

Except where site conditions preclude, the bootleg risers shall be installed 2500 mm (minimum) to 3000mm maximum 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.

4.4.3 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.

Posts used for mounting high voltage impulse (Jeumont Schneider) and audio frequency track circuit (CSEE, ML and Westinghouse) trackside equipment and boxes shall be 50mm x 25mm x 5mm galvanized channel iron.

The posts shall be concreted and secured into the ground so that there will be no movement of the base of the post.

Incoming cable from the location case to box shall be protected by either passing through the post or by a rigid conduit securely fixed in the web of the post. Cables to the track shall be secured to the post with UV stabilized cable ties to minimise loading on the cable terminations.

Cable entries into the trackside equipment units shall be sealed with neutral cure silicon sealant to prevent entry of moisture and insects.

4.4.4 Microtrak

Microtrak installations shall be configured to minimise cross talk between wires. “Dirty” wiring shall be separated as much as possible from wires carrying electronic data signals. The location case wiring layout shall also be arranged to minimise noise.

Were possible track leads, switch machine power wiring and any other “noisy” wiring shall be separated from the Microtrak wiring, both in the location case and in outside cable runs.

Cables and wires are to be kept as short as possible to minimise induced line noise.

Tail cables from the location case to the trackside box must not exceed 150 meters in length.

5 Points and Ground Frames

5.1 Electric Point Machine

Point machines fitted to tie plates and timber sleepers shall be bolted through tie plate and timber with galvanised bolts, headlock washers, flat washers and nuts.

The nuts shall be uppermost and be secured with "Loctite 242" or equivalent

The tie plate shall be attached to and insulated from the plate securing the stock rail to the sleeper.

Point machine brackets for concrete or steel sleepers are normally supplied with studs welded to the bracket. Nuts and flat washers shall be used to secure the points machine to the bracket and the nuts shall be secured with "Loctite 242" or equivalent.

Where machines are bolted directly through steel sleepers, nuts shall be uppermost and secured with "Loctite 242" or equivalent.

The point machine brackets on concrete sleepers shall be attached to the sleeper with bolts or screw spikes or coach screws according to the type of insert provided in the sleeper.

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.

The point machine location relative to the stock rail and to the tip of the switch shall be as shown on the manufacturers standard point layout drawings applicable to the type of point machine and type of turnout.

Where a standard layout drawing is not available a design for a suitable layout shall be prepared by the Contractor prior to installation.

Connections between the point machine and switches shall be to details referenced on the standard points layout drawings where these are applicable.

Where the referenced details are unsuitable, detailed designs for the connections are to be prepared by the Contractor. Every effort shall be made to use or adapt items referenced on the standard layouts.

The point 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 point machine for emergency operation.

Where there is insufficient space to locate the point 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 tolerated.

The point machine cable entry shall be sealed with neutral cure silicon sealant after cable termination to prevent moisture and insect entry.

The point machine shall be identified in a manner equivalent to existing practice or as a minimum by a black aluminium identification plate with 75mm white lettering / numbering.

This identification plate shall contain the Point number and separately identify the Normal and Reverse positions of the points by the letters “R” and “N”.

These identification plates shall be mounted between the running rails and affixed to the centre of the sleeper immediately in advance of the toe of the points.

If there are multiple ends with the same number, the end identification, “A”, “B” etc. e.g. 55A, 55B shall be included.

5.1.1 Points Equipment Cabling

From buried cable routes, the cables to the points equipment shall remain buried then be brought up to the ground surface adjacent to the equipment cable entry point in UV stabilized, flexible, heavy duty, orange PVC conduit and be secured to the point equipment by way of a cable entry gland or adaptor.

From ground level troughing (GLT) which is within the track formation, the cable from the GLT to the points equipment shall be run in surface mounted UV stabilized flexible, heavy duty, orange PVC conduit and be secured to the point equipment by way of a cable entry gland or adaptor.

Where the cable descends from the GLT into the ground, 100 mm HDPE Class 12 (orange) pipe shall be provided.

Similar requirements shall apply to steel troughing routes.

5.2 Ground Frames

The layout of ground frame and channel rodding runs, including compensation shall be drawn up with a copy retained on the site installation documentation for future referencing by ARTC’s representative and for use during the Testing and Commissioning process.

All of the equipment and all tools and/or plant necessary for the installation of the ground frames and all associated connections to points shall be provided as part of the installation and includes but is not limited to:

- Ground frame
- Channel rodding
- “A” frames and rollers
- Cranks and compensators
- Mounting Blocks / Foundations

- Back drives if necessary
- Miscellaneous nuts/bolts/ferrules etc.

5.2.1 Ground Frame Bases

Ground Frame bases shall consist of a concrete slab of not less than 200 mm thick with suitable bolts cast into the slab for securing the ground frame in position.

The bolts shall be of sufficient length to permit 25 mm of timber packing between the ground frame and the concrete.

The operating platform for the ground frame shall consist of either a pre-cast concrete channel section or a steel fabrication with Gridmesh or similar decking.

The minimum width of the platform shall be 600 mm or the width of the ground frame plus 200 mm whichever is greater. Minimum length of the platform shall be 1200 mm. A step at the end or one side of the platform shall be provided for access purposes.

Cable arrangement to point detectors of ground frame operated points shall be similar to that required for electric point machines.

5.3 Releasing Switches

The releasing switch and associated telephone (where provided) shall be mounted on a suitable post, equivalent to a 100 NB pipe, bolted to a concrete foundation similar to that used for a dwarf signal. The releasing switch (that part which contains the handle and pushbutton) should be 1400 – 1500 mm above ground level. Provision of a junction box at the base of the post is optional.

5.4 Outlying Point Lock

The Outlying Point lock shall be mounted on the timber or concrete sleepers in accordance with manufacturers' requirements and shall be fixed in a similar manner to that of an Electric Point Machine in Section 6.1.1.

Cable arrangement to Point locks shall be similar to that required for electric point machines in Section 6.1.2.1.

5.5 HLM Point Lock

The Point lock shall be mounted on the timber or concrete sleepers in accordance with manufacturers' requirements and shall be fixed in a similar manner to that of an Electric Point Machine in Section 6.1.1.

Cable arrangement to Point locks shall be similar to that required for electric point machines in Section 6.1.2.1.

5.6 Swing Nose Crossings

Swing nose crossings shall be mounted onto purpose built chair plates. The chair plates shall be mounted on to concrete sleepers in accordance with manufacturers' requirements and shall be fixed in a similar manner to that of an Electric Point Machine in Section 6.1.1.

Cable arrangement to Point locks shall be similar to that required for electric point machines in Section 6.1.2.1.

6 Location Case Foundations and Platforms

6.1 General

This section of the document sets out the basic requirements for foundations and associated concrete structures and should be read in conjunction with Specifications ESC-07-04 Small Buildings, Location Cases, Terminal Cases & General Purpose Cases and ESC-11-01 Construction of Cable Routes & Associated Civil Works.

Additional provisions may be necessary at difficult sites such as on high banks or in swampy areas. All location cases shall have secure foundations and safe and convenient access provided to the location case for maintenance and construction staff.

“Foundation” shall include both the concrete area under and the concrete surrounding the location case.

“Platform” shall include the metal platform, the associated supporting steelwork and handrails and ladders/steps, for locations on sloping sites or where the location case is to be elevated to avoid local flooding.

Concrete or brick retaining walls shall be provided where necessary to form a secure level area for location case foundations.

In low lying areas, the local flood history shall be determined and the top of the location case base shall be at a height not lower than the recorded or projected 100 year flood level.

When determining the position of a location case WHS and safe access requirements must be considered.

The final position of the location case is to be reviewed and agreed by the relevant Maintenance representative or Infrastructure Manager.

6.2 Construction of Location Case Foundations and Associated Work

Drawings Nos SC 09 01/08, 09, 10, 11 & 12 in ESC-11-01 illustrate acceptable arrangements for the construction of a location case foundation on level, stable ground with the cable entries from a buried cable route, ground level and steel troughing on posts respectively.

For sloping or unstable sites the specific proposals shall be prepared for approval, but the layout and method of cable entry shall, as far as possible, be similar to those indicated on the drawings referred to above. In areas of sloping or unstable sites, retaining walls forming part of the location case foundations shall be provided as necessary.

Care shall be taken to ensure that location case foundations and location case platform foundations do not impede drainage and do not lead to scouring or erosion.

The base of location cases shall be not less than 300 mm above the concrete area surrounding the location cases.

6.3 Location Cases on Raised Metal Platforms

Where it is not practical to install concrete foundations for location cases such as on steeply sloping sites and over culverts, etc. approved raised metal platforms shall be provided.

6.4 General Purpose Cases including Emergency Point Machine Lock (EPML)/Emergency Operation Lock (EOL) Boxes

An EPML and EOL box is normally provided near points to house the points crank handle or EOL key and other equipment for use in emergency. Points control circuitry is wired to a contact in the box such that when the crank handle or key is removed from its enclosure a contact is activated causing the power to be disconnected from the points motors.

The EPML/EOL boxes and mounting posts complete with cable entries for the EPML/EOL shall be provided together with the cable route and cabling from the location case or relay room as applicable.

Note: At some sites the EPML/EOL boxes may be installed on the relay room wall and in such cases the installation of EPML/EOL boxes and cabling will not form part of the work covered by this specification.

6.5 Steps, Ladders and Handrails

Where location cases are installed above ground level fixed steps or ladders shall be provided where necessary to provide easy and safe access for maintenance and construction staff.

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.

6.6 Cable Entries to Location Cases

Cable entries to all concrete location case foundations shall comply with the requirements set out in Section 5.2

Cable entries to location cases on raised platforms shall be purpose designed to suit the particular location. The cables between ground level and the platform shall be encased in 100 mm diameter PVC or HDPE pipes or in steel troughing or in enclosed cable tray. Pipes, trough or tray shall be securely fixed at ground and platform level.

Cable entries to location cases, relay rooms and trackside equipment boxes shall have sufficient protection in place to prevent the ingress of rodents and insects.

Cables in the vertical plane shall be secured at intervals of not greater than 600 mm to prevent the cables from sagging and causing undue pressure on cables at bends or on cable terminations in the location cases.

6.7 Access to Location Cases

Access shall be available to all location cases from the track in the immediate vicinity unless otherwise indicated on the specific Signal Sighting Form.

Where a public road runs alongside the railway line and location cases are positioned inside the boundary fences a personnel access gate shall be provided from the public road for maintenance

and fault finding purposes, in accordance with ESC-11-01 Construction of Cable Routes & Associated Civil Works.

Paths and safety handrails shall, where necessary, be provided between the access gates and location cases.

Where pre-existing gates are to be used for access to the location cases, the paths, steps and handrails shall be upgraded to comply with this Specification and/or the relevant Australian Standards and WH&S requirements.

7 Communications Cable Termination Cabinet Foundations

Communications cable termination cabinets are generally Krone or Rittal type cabinets unless otherwise approved.

Communications cable termination cabinets shall be provided in the cable route at railway stations and other locations where stated in the Particular Specification or indicated on communications cable route diagrams or as required. Communication facilities for stations and other buildings will be fed from these cabinets.

The cable termination cabinet foundation shall consist of a concrete slab 1800 mm x 1800 mm by 100 mm thick with 100 mm diameter pipes or a ground level trough (GLT) set into the concrete to provide access for the cables into the cabinet.

A raised concrete base or steel frame 450 mm high shall be provided on the concrete slab to support the cable termination cabinet. The steel framed plinth shall be enclosed in steel sheeting of not less than 2 mm thick.

On sloping or uneven sites retaining walls as necessary to support the foundations shall be provided. Safety rails shall also be provided where necessary to prevent staff from accidentally stepping off foundation platforms into drains or gullies or down embankments.

Access shall be provided to all communications cable termination cabinets similar to that provided for location cases.

8 Level Crossings

8.1 Road Crossings & Pedestrian Crossings

Level crossing signal and signage installation shall be installed by the Contractor in accordance with:

- Engineering (Signalling) Standard ESC-03-01 Level Crossing Equipment.
- Any additional drawing(s) or site plan(s) which may be issued by ARTC, the RTA or Local Council.

9 Security of Equipment

Construction locks shall be provided so that all relay rooms, walk-in enclosures, location cases and trackside equipment can be locked following installation.

Sufficient keys for these locks shall be supplied to permit access for ARTC's representatives to carry out inspections on the progress and quality of the work.

The construction locks will be replaced by the Contractor with lock hardware that is compatible with ARTC's series of security locks relevant to the rail corridor on which they are to be used. These

replacement locks shall be supplied and fitted by the contractor following the commencement of the testing process to preclude unauthorized construction access.

10 Appendix A: Typical Cable Entries to Location Cases

Refer to Construction of Cable Route Standard **ESC-11-01.**

11 Appendix B: 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 should 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 signal head to point towards the viewer and vertically align the signal head 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 signal head 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 signal head 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. There must be unobstructed and clear visibility of the signal indication for 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.

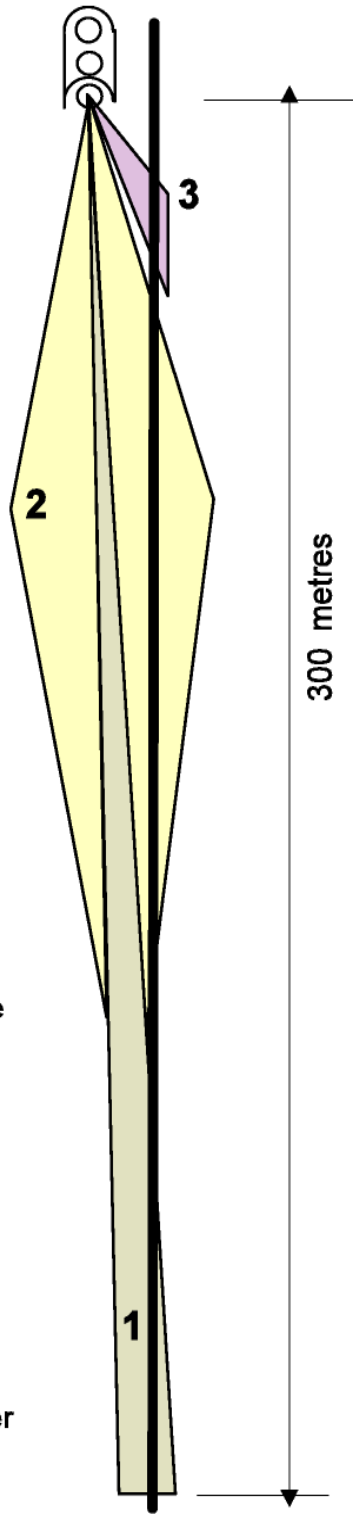
A gantry mounted signal will not normally be visible in daylight within approximately 10 to 15 metres of the gantry. If a train is required to pull right up to a gantry mounted signal (e.g. at a platform), a co-acting indicator signal will usually be necessary.

11.1 Incandescent (Lamp) 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.



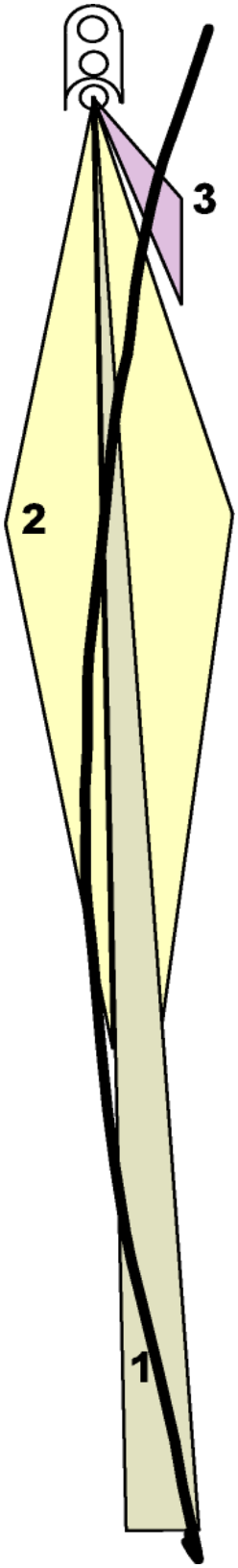
When focusing the signal, the viewer should be at a point approximately 300 metres from the signal.

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.

11.2 Incandescent (Lamp) Signal Alignment - Gently Curved Approach



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.

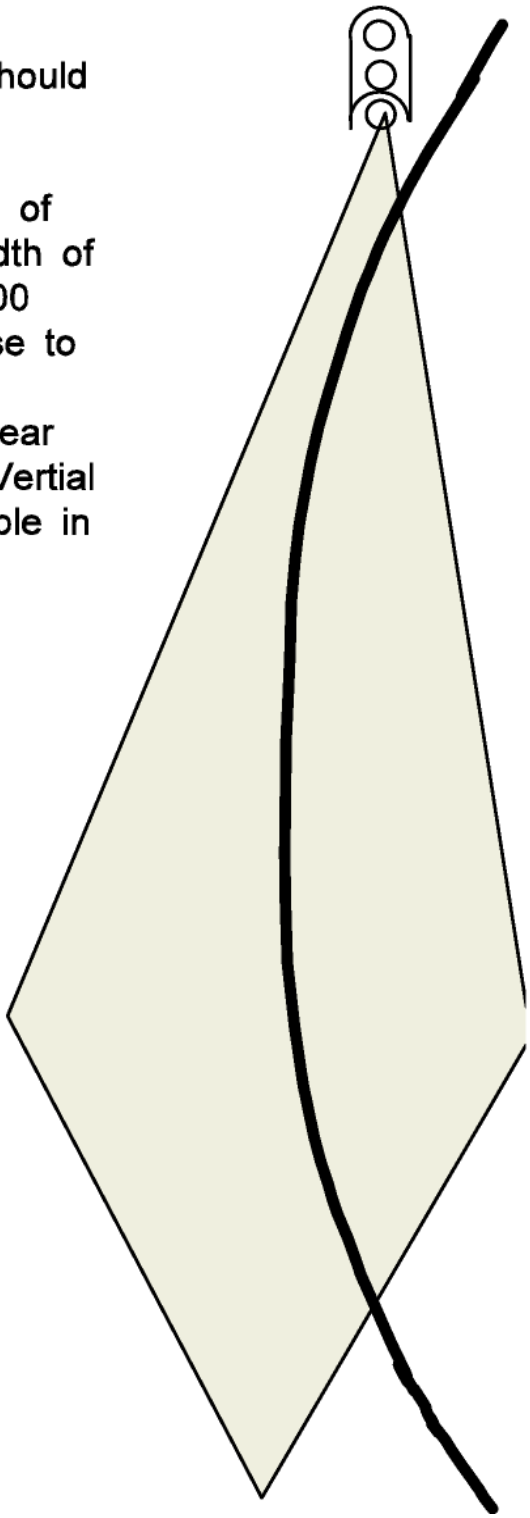
A full lens indication will only be visible from within the main part of the beam. A partial indication only will be visible from within the wider spread part of the beam.

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.

11.3 Incandescent (Lamp) Signal Alignment - Sharply 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.