AUSTRALIAN RAIL TRACK CORPORATION LTD

Discipline
Engineering Specification

Category
Signalling Construction

Installation of Trackside Equipment

SC 08 01

Applicability

ARTC Network wide	✓
New South Wales	
Western Jurisdiction	
Victoria	

Primary Source

Document Status Record

Status	Date	Prepared	Reviewed	Endorsed	Approved
Issue 1 Revision 0	Mar 05	R Crooks N Fletcher T Moore	Standards & Systems J Cowie	GM Infrastructure & Performance M Owens	Safety Committee 14/11/2005

List of Amendments

Issue	Date	Clause	Description
	13.08.10	ALL	Superseded by Appendix 1 – ESC-04-01; ESC-07-01

Contents

1. General 5
1.1 Scope 5
1.2 Safety 5
1.3 Occupational Health & Safety 5
1.4 Drawings 5
1.5 Definitions 5
1.6 Quality of Work 6
1.7 Submissions for Approval 6
1.8 Referenced Documents 6
1.8.1 Australian Standards 6
1.8.2 ARTC Specifications 6
1.9 Special Conditions 6
2. Signals 6
2.1 General 6
2.1.1 Signal Location 6
2.1.2 Signal “Out of Use” Marking 7
2.1.3 Security 7
2.2 Signal Ladders and Landings 7
2.3 Signal Installation 7
2.3.1 Structure Gauge 7
2.3.2 Signal Sighting and Positioning 8
2.4 Relative Heights of Signals 10
2.5 Tunnel Signal Installation 10
2.6 Alignment of Signals 10
2.6.1 Running Signals 10
2.6.2 Turnout Signals 11
2.6.3 Junction Indicators 11
2.6.4 Subsidiary Signals, Horizontal and Vertical Shunt Signals 11
2.7 Signal and Gantry Foundations 11
2.7.1 Location of Signal and Gantry Foundations 11
2.7.2 Construction of Signal Foundations 11
2.7.3 Construction of Gantry Foundations 12
2.7.4 Backfilling and Leveling Site 12
2.7.5 Foundations Affecting Track Drainage 12
2.7.6 Access to Signals and Gantries from Public Roads 13
2.8 Signal Gantry Cages 13
2.9 Gantry Walkways and Handrails 13
3. Guard Indicators/Warning Lights 14
4. Flashing Lights and Horns (Calling Devices) 14
5. Track Circuit Insulation & Bonding 14
5.1 General 14

5.2 Location of Insulated Joints 15
5.2.1 Location of Insulated Joints at Signals 15
5.2.2 Location of Insulated Joints at Turnouts 15
5.2.3 Location of Insulated Joints at Level Crossings 15
5.2.4 Location of Other Insulated Joints 15
5.3 Track Circuit Bonding 15
5.3.1 Turnouts 15
5.3.2 Crossovers 16
5.3.3 Connection of Bonds to Rails 16
5.4 Installation of Track Circuit Equipment 16
5.4.1 General 16
5.4.2 Bootleg Risers 16
5.4.3 High Voltage Impulse and Audio Frequency Track Circuits 16
6. Points and Ground Frames 17
6.1 Point Machines 17
6.1.1 Electric Point Machine 17
6.1.2 Ground Frames 19
6.1.3 Releasing Switches 19
6.1.4 Outlying Point Lock 20
6.1.5 HLM Point Lock 20
7. Location Case Foundations and Platforms 20
7.1 General 20
7.2 Construction of Location Case Foundations and Associated Work 20
7.3 Location Cases on Raised Metal Platforms 21
7.4 General Purpose Cases including Emergency Point Machine Lock (EPML)/Emergency Operation Lock (EOL) Boxes 21
7.5 Steps, Ladders and Handrails 21
7.6 Cable Entries to Location Cases 22
7.7 Access to Location Cases 22
8. Communications Cable Termination Cabinet Foundations 22
9. Level Crossings 23
9.1 Road Crossings & Pedestrian Crossings 23
10. Traffic Huts 23
11. Half Pilot Staffs 23
12. Post Mounted Telephones 23
13. Locks 23
Appendix A: Method for Aligning Signals 25
Appendix A1: Signal Sighting Statement & Sighting Forms (incl. Sample) 26
Appendix B: Bonding – Typical Layouts (Series and Parallel) 32
Appendix C: Typical Cable Entries to Location Cases 34

1. General

1.1 Scope

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

Except as otherwise noted in the Particular Specification**,** all items of equipment and all materials required for installation shall be supplied and installed by the Contractor as part of any Contract.

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

1.2 Safety

The Contractor shall at all times during the period of the Contract and to the satisfaction of ARTC, 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.

The Contractor shall ensure that all staff 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.

1.3 Occupational Health & Safety

The Contractors and sub-contractors, if any, shall comply with the relevant safety legislation of the Occupational Health and Safety Act.

1.4 Drawings

The documentation and drawings to be used in the execution of the works shall be the relevant approved Contractors drawings plus any other drawings nominated in this Specification and those of the Particular Specification.

1.5 Definitions

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

ARTC - Australian Rail Track Corporation.

Contractor - A person, company or authority nominated by ARTC or ARTC's Primary Contractor to manage a specific contract.

ARTC's Representative - A person, company or authority nominated by ARTC to make engineering determinations on ARTC's behalf.

To maintain consistency with the National Code of Practice (Ncop) the term Switch has been altered to **Points**, ie switch machine now point machine, Emergency Switch Machine Lock (ESML) now Emergency Point Machine Lock (EPML).

1.6 Quality of Work

The standard of materials and workmanship shall ensure that the installed equipment is fit for purpose, over the lifetime of the asset, in its physical and operational environment, in terms of Safety, Reliability and Maintainability.

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.

1.7 Submissions for Approval

Where alternatives or new equipment types are proposed, the matter shall be submitted by the Contractor with documented justification in writing, in accordance with ARTC's PP122 acceptance process for "New Equipment and Systems" approval.

1.8 Referenced Documents

The following standards and documents are referenced in this specification:

1.8.1 Australian Standards

AS1657 Fixed Platforms, walkways, stairways and ladders

1.8.2 ARTC Specifications

SC 02 01 Install of Equipment Racks & Termination of Cables & Wiring

SC 03 01 Level Crossing Equipment

SC 04 01 Small Buildings Location/Terminal & General Purpose Cases

SC 06 01 Lightning and Surge Protection Requirements

SC 09 01 Construction of Cable Route & Associated Civil Works

1.9 Special Conditions

When working in the vicinity of or adjacent to overhead electrified areas, Special Conditions shall apply.

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 verified by the Signal Sighting Group on the relevant signal sighting forms. (Appendix A1)

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 Signal "Out of Use" Marking

Immediately following the installation of any not as yet commissioned colour light signal or a colour light signal is taken out of use, an open weave hession bag or white cross shall be fitted and secured to the front of the signal.

The bag or cross shall remain in place until such time as the signal is commissioned into use. The bag or white cross shall be such that they readily facilitate the testing of the signal without removing the bag or white cross.

In the case of semaphore signals, the arm shall be removed and the lense covered in a similar manner to that for colour light signals.

In all cases lamps shall be removed from any signal that is taken out of use and shall not be fitted into signals until such time as they are ready for test and commissioning.

In addition, all signal lighting circuits must be isolated in both legs by the removal of the circuit links pins and fuses. This requirement applies during the:

- decommissioning of redundant signals;
- pre-test installation period for new signals; and
- following any testing process prior to commissioning.

2.1.3 Security

All equipment shall be fitted and secured with construction padlocks immediately 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

There is no specific requirement for the provision of signal ladders or landings on free standing signals.

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.

2.3.2 Signal Sighting and Positioning

2.3.2.1 Signal Location

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 included in ARTC's Signal Sighting Statement are met. (Appendix A1.)

The centre of the signal mast shall be located no closer than 3.0 metres from the running face of the nearest rail. 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.

The selection of location shall take into account the requirements of the Signal Sighting Statement in Appendix A1.

2.3.2.2 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.
- An approach view for a *minimum* of 6 seconds sighting at line speed.
- Be clear of interruptions for at least 4 seconds

Distances, which equate to 6 seconds at various speeds, are given in Table 1.0.

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.

Table 1.0

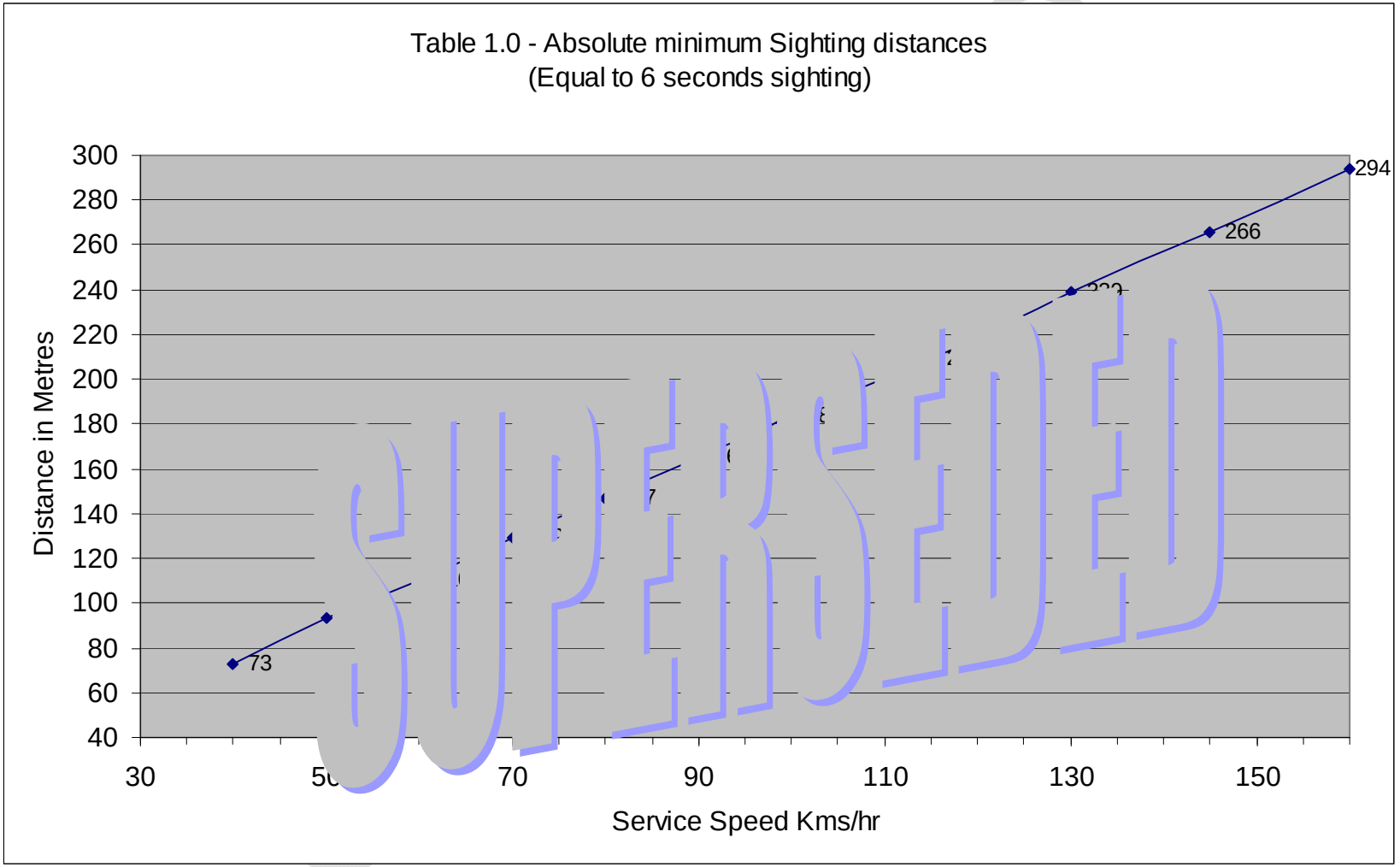


Table 1.0 - Absolute minimum Sighting distances
(Equal to 6 seconds sighting)
Distance in Metres
300
280
260
240
220
200
180
160
140
120
100
80
60
40
30
70
90
110
130
150
Service Speed Kms/hr
73
266
294
SUPERSEDED

2.4 Relative Heights of Signals

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

For bi-directional running on double line sections, adjacent signals shall be of equal height.

Colour light signals shall be positioned with the A arm (top) red aspect as near as practical to driver's eye level, and the centre line of the most restrictive aspect will normally be at 4.2m above rail level.

In situations where signals are mounted on a gantry, cantilever or bracket structure, the most restrictive aspect shall be sited at a height above rail level in accordance with the limitations of the applied Structure Guage on the corridor on which the signals are used.

2.5 Tunnel Signal Installation

Tunnel Signals shall be fixed to the tunnel wall through the bracket provided on the signal using either Stainless Steel "Chemset" anchors of the appropriate type for the conditions (e.g. wet walls) or "Dynabolt" or similar masonry 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 - 30mm at the closest point and shall be mounted so that the top red aspect is between 2250mm and 2550mm above rail level. The signal shall be vertical in both planes.

2.6 Alignment of Signals

The signal shall be aligned to provide the train driver with optimum sighting of signal indications. The method of conducting signal alignment is contained in Appendix A.

The final check of satisfactory signal alignment shall be carried by the train crew of an operational train subsequent to the commissioning of the signal/s.

This operational check shall be carried out in the approaching direction in daylight hours and where possible with the sun in front of the signal.

A noted record of this operational alignment check shall be made and a copy retained as part of the contract quality documentation associated with the commissioning.

2.6.1 Running Signals

The alignment distances assume that 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.

In situations where incandescent lamps are used, 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.

2.6.2 Turnout Signals

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.

2.6.3 Junction Indicators

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.

2.6.4 Subsidiary Signals, Horizontal and Vertical Shunt Signals

Subsidiary signals and horizontal and vertical shunt signals (ground position 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.

2.7 Signal and Gantry Foundations

2.7.1 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 above 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.

2.7.2 Construction of Signal Foundations

The foundations for post mounted signals shall be of sufficient size, shape and depth in ground to support fully dressed signals and resist wind velocities to 160kph, in the terrain category applicable to the location without the need to rely on staying, bracing or the ladder for support.

Ground mounted shunt signal foundations shall be of sufficient size shape and depth in ground to support the signal and any route indicators attached thereto subject to the minimum depth in ground being 600 mm and the minimum cross section being 350 mm diameter.

For sites such as on ash banks or on the top of retaining walls the Contractor shall supply engineer’s drawings detailing the proposed signal foundation structures. Track retaining walls may be drilled or bored to anchor signal foundations but shall not be cut away or otherwise disturbed.

The foundations may be pre cast concrete or cast in situ. Foundation bolts shall be not less than 24mm diameter galvanized steel for signal masts and not less than 16mm for ground position signals. The bolts shall be installed in the foundations in a manner that enables the signal masts or ground mounted signals to be bolted on and removed without disturbing the foundations.

The signal mast holding-down bolts shall be installed vertically in the foundation castings and the top surface of foundations shall be completely level.

Provision shall be made in the foundations for cable entry conduits of not less than 50 mm diameter. In the case of cast in situ foundations, the cable entry shall be cast into signal foundations.

That portion of signal foundations visible above ground shall be neatly finished with smooth surfaces free of voids and shall have chamfered edges.

Square foundations shall be parallel to the track.

For signals in cuttings the Contractor shall, where necessary, cut back and shore the bank to provide space for the signal foundation. Adequate retaining walls shall be built wherever there is a danger of erosion or subsidence of the bank or cutting due to the signal placement.

In areas of solid rock it will be permissible for the signal mast holding-down bolts to be grouted into the rock. The rock shall be excavated to a depth of at least 200 mm and a concrete cap shall be keyed into this to form the signal foundation to the required height relative to rail level. Holding down bolts shall be keyed a further 300 mm into the rock.

2.7.3 Construction of Gantry Foundations

Gantry foundations shall be of such a size and depth to adequately support the gantry, signal cages, signals, walkway and handrail, incidental loadings from maintenance personnel, overhead wiring loads (where applicable) and resist wind loadings, in the terrain category applicable to the location.

Unless otherwise specified in the Particular Specification the Contractor shall supply Engineer's drawings and detailing the requirements for the construction of all gantry foundations. The provisions of those drawings shall be strictly adhered to in the construction of the foundations.

Retaining walls shall not be disturbed without written approval.

2.7.4 Backfilling and Leveling Site

When the signal and gantry foundations are installed, the Contractor shall backfill the foundations, level the site and remove any surplus spoil.

Where telephones are installed at signals and signal gantries, safe and easy access shall be provided to all such telephones and, if necessary a walkway from the track to the signal telephone shall be formed for drivers access.

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

2.7.5 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 provide alternative drainage arrangements. These could include drainage ducts through the foundations or ducts or channels around the foundations.

2.7.6 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 SC 04 01 “Small Buildings etc” and SC 09 01 “Construction of Cable Route & Associated Civil Works”.

2.8 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.

The cage shall be provided with an access ladder not less than 375 mm wide over stiles. The stile section to be not less than 50mm x 10mm with 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 also 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 250mm maximum intervals.

2.9 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 AS1657.

3. Guard Indicators/Warning Lights

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

Guard indicators may be mounted on station buildings or awnings provided these are not heritage listed 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 guard indicator should be clamped to the building; drilling or welding for fixture is to be avoided.

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.

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

4. Flashing Lights and Horns (Calling Devices)

Where indicated by the signal design, rotating/flashing blue lights and warning horns shall be provided to act as maintainers/drivers calling devices. Horns shall be duplicated if necessary to provide bi-directional audibility.

The calling devices shall be located where indicated on the Signalling plan or as nominated by the Signal Lighting Group on the Sighting form.

The rotating flashing light or strobe shall be equivalent to Hella model 2RL002-03 and horns shall be equivalent to RVB model 4100-008.

The calling devices shall not be mounted in any position that will obscure or reduce the clarity of any signal indication and if mounted on a location or building roof shall have the mounting arrangement suitably sealed to prevent any possibility of moisture entry to the location or building.

Maintenance access shall be provided to calling devices but either the access or the devices shall be secured to prevent unauthorised access, theft or vandalism.

Flashing Lights shall be covered or wrapped in black opaque woven or reinforced material until brought into use.

5. Track Circuit Insulation & Bonding

5.1 General

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

Track circuit trackside equipment shall be installed on mounting posts in accordance with the requirements of Section 5.4.

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 SC 02 01 "Install 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 OH&S.

5.2 Location of Insulated Joints

5.2.1 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 center 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.

5.2.2 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 center of the insulated joint shall be positioned such that it is centered between sleepers.

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

5.2.3 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 10m from the edge of the roadway in order to minimize delays to road users.

5.2.4 Location of Other Insulated Joints

These shall be located in accordance with the position shown on the clearly dimensioned Signalling 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.

5.3 Track Circuit Bonding

5.3.1 Turnouts

Track circuit bonding in turnouts shall be provided as indicated in the full Series bonding arrangement shown in Appendix B - Figure 2.

“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 SC 02 01 – Installation of Equipment Racks and Termination of Cables and Wiring: Appendix A – Procedure 1 and 2.

5.3.2 Crossovers

Full parallel bonding on crossovers shall be provided as indicated in Appendix B - Figure 3. with the bonds connected back along the main line as shown to provide maximum broken rail protection on the main line.

5.3.3 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.

5.4 Installation of Track Circuit Equipment

5.4.1 General

This section of the Standard Specification provides for the installation of track circuit equipment and cables in accordance with this Specification and that of SC 09 01 “Construction of Cable Routes & Associated Civil Works” and SC 02 01 “Install of Equipment Racks and Termination of Cables and Wiring”.

5.4.2 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.

5.4.3 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.

Design life of the posts, the method of securing in ground, and conduits and cable supports shall be a minimum of 25 years.

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

6. Points and Ground Frames

6.1 Point Machines

6.1.1 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 stockrail 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.

Where 60 kg, 9.15m switches or greater are used in a turnout, back-drives shall be provided as shown on the relevant standard layout drawings.

Where tangential turnouts are used any back-drives supplied with the turnout shall be installed in accordance with details provided by the turnout supplier.

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 center 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.

6.1.1.1 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.

6.1.2 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.

6.1.2.1 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.

6.1.3 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 telephone shall normally be mounted behind the releasing switch at approximately 1250 – 1400 mm above ground level. 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.

6.1.4 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.

6.1.5 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.

7. Location Case Foundations and Platforms

7.1 General

This section of the Standard Specification sets out the basic requirements for foundations and associated concrete structures and should be read in conjunction with Specifications SC 04 01 " Small Buildings Location/Terminal & General Purpose Cases" and SC 09 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.

7.2 Construction of Location Case Foundations and Associated Work

Drawings Nos. SC 09 01/08,09,10,11 & 12 in Appendix C 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.

7.3 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.

The platforms shall comply with the relevant parts of AS1657. In addition each platform shall be capable of carrying a minimum of six (6) persons in addition to the location cases (s) and shall not bend, distort or sway or vibrate under this load and any combination of this load and wind loading (from passing trains).

Metal supporting posts shall be securely anchored in concrete foundations and where the ground is sandy or uncompacted, foundations shall be strip footings rather than individual footings under each post.

The area under and extended up to 1000 mm beyond the extremities of the raised platforms shall be covered with 50 mm of concrete. The area under the raised platform shall be enclosed to prevent the build-up of rubbish and the growth of grass or scrub underneath which could put location case contents and associated cables at risk in the event of fires, etc.

7.4 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.

7.5 Steps, Ladders and Handrails

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

Handrails to AS1657 shall be provided on all steps and around the foundations of all location cases that are located on embankments, etc or where the safety of

maintenance or construction staff could be at risk from accidentally stepping off an above ground structure.

Handrails shall also be required at ground level location cases where staff could step back into a track drain, culverts, etc and on the track side of the location case where the location case is within 3600 mm of the nearest rail of any track.

Stairs and ladders to location cases shall comply with the requirements of AS1657 in respect to selection of step type ladders or rung type ladders, stile, tread and rung sizes and the provision of safety cages and intermediate platforms.

Steps shall be not less than 600 mm wide and ladders shall be 450 mm wide.

7.6 Cable Entries to Location Cases

Cable entries to all concrete location case foundations shall comply with the requirements set out in Section 7.2 and the Typical drawings contained in Appendix C.

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.

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.

7.7 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 SC 09 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 OH&S requirements.

8. 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.

9. Level Crossings

9.1 Road Crossings & Pedestrian Crossings

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

- Specification SC 03 01 “Level Crossing Equipment”.
- plus any additional drawing(s) or site plan(s) which may be issued by ARTC.

10. Traffic Huts

The location of and cabling arrangements to traffic huts shall be provided where shown on the Signalling plans and/or on detailed site survey plans.

The foundations for traffic huts shall be constructed as detailed on the applicable drawings with cable entries built in to suit the cabling requirements and site conditions.

11. Half Pilot Staffs

Where mounted on separate posts, cabling arrangements to half pilot staffs shall be provided where shown on the Signalling plan or detailed site survey plans. The half pilot staff box shall normally be mounted 1200 – 1400 mm above ground on a suitable metal post.

12. Post Mounted Telephones

Telephone mounting posts and associated cabling shall be provided where shown on the Signalling plans or on site survey plans.

The telephone shall be mounted 1250 – 1400 mm above ground level on a suitable metal post.

13. Locks

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.

Appendix A: Method for Aligning Signals

The alignment of all signals should be carried out in daylight.

The signal shall be viewed from a distance of approximately 300m, or at the maximum sighting distance, or from the signal in the rear, whichever distance is the lesser, 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 indication beam is approximately horizontal with the sighting carried out using the green indication.

The lamp-case should then to be rotated side to side and vertically and subsequently secured/locked at the position of maximum visibility.

If a focusing ring is fitted adjust the ring and insert the locking pin.

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. On curved sections of track, 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 15m and 50m from the signal.

Gantry Mounted Signals

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 about 10m – 15m 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 may be necessary.

Appendix A1: Signal Sighting Statement & Sighting Forms (incl. Sample)

1 Issue Record

This statement will be updated when necessary.

2 Purpose

This statement sets out the guidelines to facilitate the positioning of all new and altered Signals and Point Indicators so that they afford train drivers adequate advance sighting and convey a clear and unambiguous message.

3 Scope

This statement applies to all Signals and Point Indicators on the ARTC network.

4 Signal Sighting

4.1 Group

Requirement

The position of all new and altered Signals and Point Indicators will be considered by a Signal Sighting Group convened for the purpose.

The driver's approach view must be the prime consideration, but regard must also be given to the Signalling arrangements.

Composition

A Signal Sighting Group shall consist of persons who have the competence to meet the engineering and train driver requirements in the sighting of signals.

Decisions and Records

The decisions of the sighting group will be recorded on a signal sighting form.

Each signal sighting form when complete in all respects will be signed by all members of the sighting group.

5 Arrangements and Positioning of Signals

General Sighting Distance

Signals should be normally positioned to give drivers an approach view for a minimum of 6 seconds and be clear of interruptions for at least 4 seconds. Where these timing guidelines cannot be achieved, but the sighting group is satisfied that an adequate approach view is achieved (i.e. the signal is viewed for long enough for the driver to assimilate the aspect and indications displayed by the signal), the sighting group shall record their decision and reasoning on the signal sighting form.

Sighting distance must be considered with respect to the view of the whole signal.

Positioning of Signals

Running signals shall where reasonably practicable, be positioned on the left hand side of the line as seen in the direction of approach.

Signals may also be located on the right hand side of the line if there is no other viable alternative. When the Signal Sighting group considers a proposal to site a signal on the right hand side of the running line, full consideration must be given to the likelihood that the driver will view the signal as not being applicable to his line (or that a driver on an adjacent line will view the signal as being applicable to his line). The likelihood of any such mis-reading must be minimal before the proposal is agreed.

In all cases, and particularly when signals are mounted on gantries or on the right hand side of the line, care must be taken to ensure that confusion does not arise as to which line the signal applies.

Parallel Positioning of Signals

Where lines running parallel are signalled in the same direction, the signals for each line shall generally be placed opposite each other.

Background, Interference and Distraction

In all cases the background against which the signal is to be viewed must be considered.

When sighting any signal or indicator the sighting group must consider the possibility of it being misinterpreted by drivers or interfering with the Signalling on other lines.

Structural Clearances

Signals must be positioned to afford structural clearance between all parts of the signal and adjacent lines.

Interface with Existing Signals

Consideration must be given to the implications of mixing signals of higher light intensity aspects with signals of lower light intensity aspects to avoid the possibility of confusion.

Safety and Environment

Where it is reasonably practicable to adopt an alternative location, signals will not be positioned where they will cause trains to be stopped on bridges or steep gradients, in tunnels or across level crossings (including pedestrian crossings).

Position

When on a straight mast, colour light signals will be positioned with the A arm (top) red aspect as near as practical to driver's eye level, and the center line of the most restrictive aspect will normally be at 4.2m above rail level. They should be as near as possible to the running edge with the center line of the post normally no closer than 3.0m to the nearest rails. When mounted on a gantry, cantilever or bracket structure, the most restrictive aspect shall be sited at a height above the rail level determined by the ARTC.

Hoods

The proposed position of the signal in relation to the sun must be considered and the use of extended hoods should be considered where necessary to reduce the possibility of phantom indications and improved sighting.

Close Viewing Segments (Hot Spots)

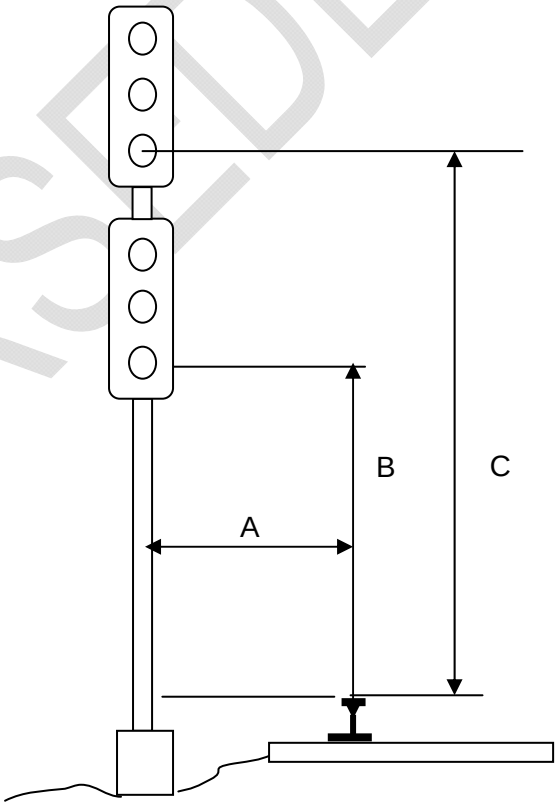
The required orientation of close viewing segments to maximize the sighting of the signal from trains standing in close proximity must be indicated on the signal sighting form.

Signal Sighting Form	
Serial Number:	
Recommendations of Meeting Held	
Location	Line
Signal No.	Kilometerage Proposed
Kilometerage Existing	Kilometerage Agreed
Permissible/Actual Line Speeds	Movement from planned position Reason:
Plan No. File No.	Background Interference
Actual Sighting Distance	
Confusion with other signals	Reading through risk
Obstructions affecting approach view	Environmental
Distance to signal ahead visible	Hot spot; State clock position
Re inspection required, reason/when	

Special Requirements/Remarks

Attendance

Name	Signature	Representing	Tel No.	Fax No.

<table>
<tr><td colspan="4">Show the following information of the dimensioned drawing below:</td></tr>
<tr><td colspan="2">Position of signal in relation to lines</td><td colspan="2">Type of structure</td></tr>
<tr><td colspan="2"></td><td colspan="2"></td></tr>
<tr><td colspan="4">Changes, existing / proposed</td></tr>
<tr><td colspan="2"></td><td colspan="2">Vertical stagger on parallel lines</td></tr>
<tr><td rowspan="3">Dimensions</td><td>Rail to mast centre</td><td>A</td><td></td></tr>
<tr><td>Rail to lower red Aspect</td><td>B</td><td></td></tr>
<tr><td>Rail to top red Aspect</td><td>C</td><td></td></tr>
<tr><td colspan="2"></td><td colspan="2">Hot spot</td></tr>
<tr><td colspan="2">EXISTING</td><td colspan="2">PROPOSED</td></tr>
<tr><td colspan="2"></td><td colspan="2"> 
</td></tr>
</table>

EXAMPLE ONLY

Signal Sighting Form				
Serial Number: ***ARTC 001***				
Recommendations of Meeting Held				
Location ***Valhalla***		Line ***Adelaide to Melbourne***		
Signal No. ***VA401***		Kilometerage Proposed ***43.900***		
Kilometerage Existing ***44.444***		Kilometerage Agreed ***43.950***		
Permissible/Actual Line Speeds 130KPH		Movement from planned position Reason: Sighting restricted by embankment		
Plan No. File No.		Background Interference *None*		
Actual Sighting Distance ***400m***				
Confusion with other signals None		Reading through risk None		
Obstructions affecting approach view *Trees at side of track*		Environmental No effects		
Distance to signal ahead visible *N/A*		Hot spot; State clock position *N/A LED signal head*		
Re inspection required, reason/when ***None***				
Special Requirements/Remarks				
LED signal head.				
Trees to be cut back on approach to signal				
Attendance				
Name	**Signature**	**Representing**	**Tel No.**	**Fax No.**
B Fittler		***ARTC***	***12345678***	
L Daley		***RSA***	***32967423***	
W Lewis		***NR***	***55598769***	
A Langer		***ASR***	***09876543***	

EXAMPLE ONLY

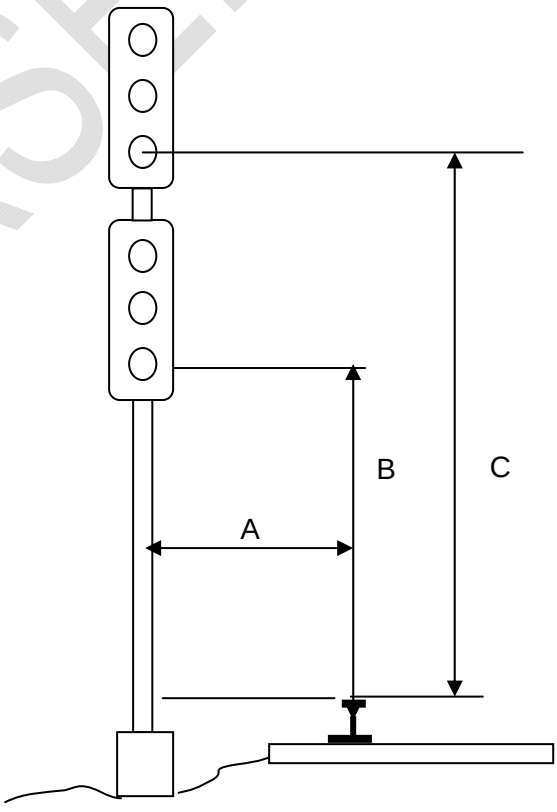
<table>
<tr><td colspan="4">Show the following information of the dimensioned drawing below:</td></tr>
<tr><td colspan="2">Position of signal in relation to lines

Left hand side</td><td colspan="2">Type of structure

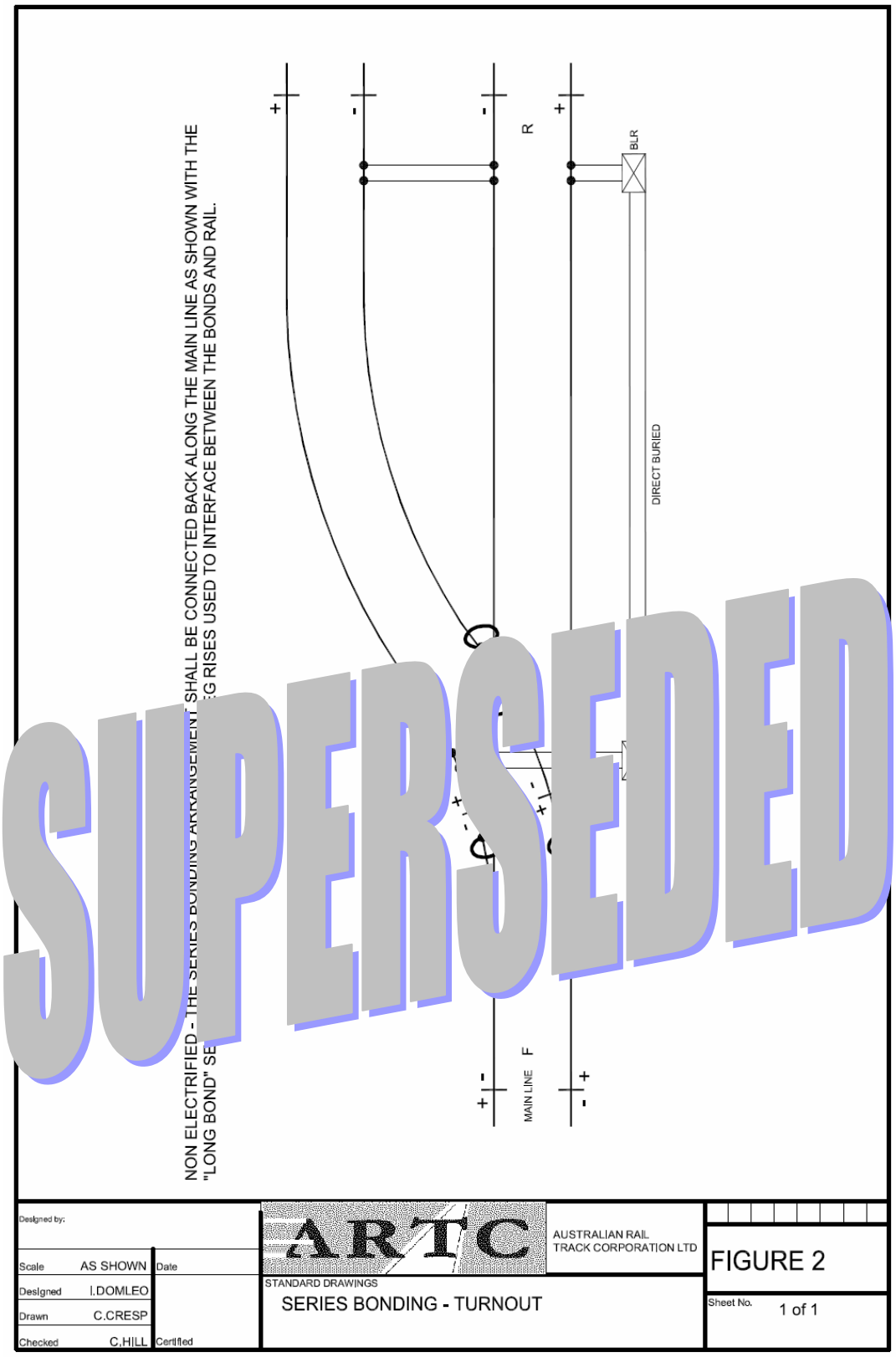
Straight post - LED head</td></tr>
<tr><td colspan="4">Changes, existing / proposed

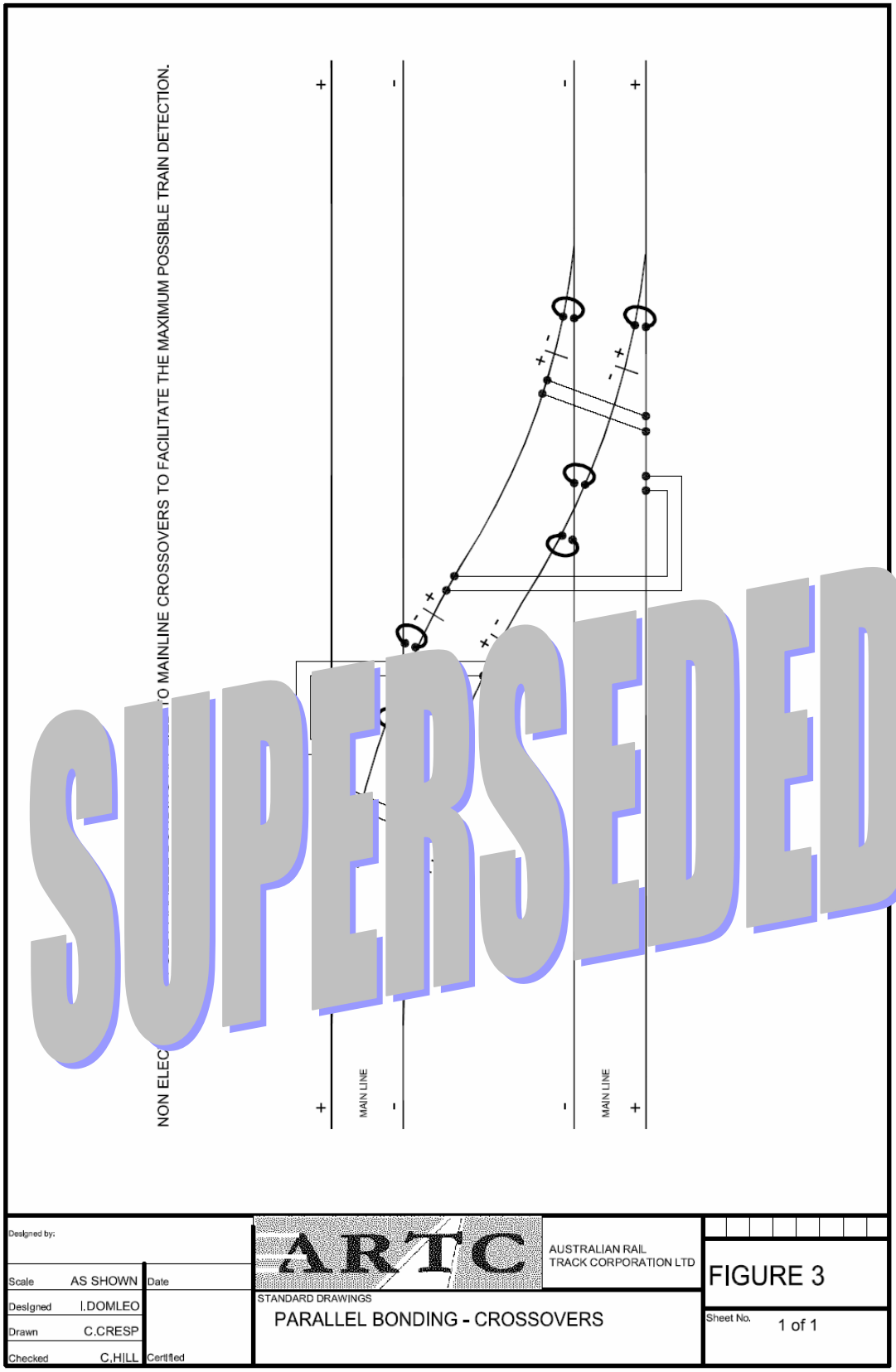
Replace semaphore with C/L reposition to improve sighting</td></tr>
<tr><td colspan="2" rowspan="2"></td><td colspan="2">Vertical stagger on parallel lines

N/A</td></tr>
<tr><td rowspan="4">Dimensions</td><td>Rail to mast centre</td><td>A</td><td>3.0M</td></tr>
<tr><td>Rail to lowest Aspect</td><td>B</td><td>3.2M</td></tr>
<tr><td>Rail to top red Aspect</td><td>C</td><td>4.2M</td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td colspan="2"></td><td colspan="2">Hot spot

N/A</td></tr>
<tr><td colspan="2">EXISTING</td><td colspan="2">PROPOSED</td></tr>
<tr><td colspan="2"></td><td colspan="2"> 
</td></tr>
</table>

Appendix B: Bonding – Typical Layouts (Series and Parallel)




NON ELEC TO MAINLINE CROSSOVERS TO FACILITATE THE MAXIMUM POSSIBLE TRAIN DETECTION.
MAIN LINE
MAIN LINE
SUPERSEDED
Designed by:
Scale AS SHOWN
Date
Designed I.DOMLEO
Drawn C.CRESP
Checked C.HILL
Certified
ARTC
AUSTRALIAN RAIL TRACK CORPORATION LTD
STANDARD DRAWINGS
PARALLEL BONDING - CROSSOVERS
FIGURE 3
Sheet No. 1 of 1

Appendix C: Typical Cable Entries to Location Cases

Refer to Construction of Cable route Specification **SC 09 01 – Appendix C**