

Signal Sighting and Position

ESS-04-01

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1.0	18 Apr 24		Clarified the minimum sighting distance requirements and other minor changes. Document renumbered from ESC-04-01.

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Table of Contents

Table of Contents	2
1 Introduction.....	4
1.1 Purpose.....	4
1.2 Scope	4
1.3 Document Owner	4
1.4 Roles and Responsibilities	4
2 Signal Sighting Design Requirements	5
2.1 Overview	5
2.2 Sighting Distance - Primary.....	5
2.2.1 <i>Minimum Sighting Distance - Primary</i>	5
2.2.2 <i>Maximum Sighting Distance - Primary</i>	6
2.3 Stopped Train Position.....	7
2.4 Positioning of Signals - Secondary	7
2.4.1 <i>Station Platforms - Secondary</i>	7
2.4.2 <i>Level crossings - Secondary</i>	8
2.4.3 <i>Environment Issues - Secondary</i>	8
2.5 Parallel Positioning of Signals - Secondary	8
2.6 Foreground, Interference and Obstruction - Secondary	8
2.7 Background, Interference and Distraction - Secondary	8
2.8 Interface with Existing Signals Primary.....	9
2.9 Structural Clearances - Primary.....	9
2.10 Heights of Signals - Primary.....	9
2.11 Safety and Environment - Secondary	9
2.12 Position - Secondary	10
2.13 Hoods - Secondary	10
2.14 Close Viewing - Primary.....	10
2.15 Alterations to Existing Signals, Indicators and Signs - Secondary	10
2.16 Preliminary Design Site Survey - Primary.....	10
2.17 Controlled & Maintained Document - Primary.....	10
3 Signal Sighting Working Group.....	11
3.1 Requirement.....	11
3.2 Composition	11
3.3 Signal Sighting Review Process	11

Table of Contents

3.4 Unacceptable and Undesirable Signal Sighting.....11

3.5 Other Considerations12

3.6 Records and Decisions12

3.7 Agreement by Stakeholders.....12

3.8 Review by Design Engineer and Design Authority12

4 Appendix 1 - Summary of Signal Sighting Information.....13

5 Appendix 2 - Signal Sighting Form (example only)14

1 Introduction

1.1 Purpose

This standard provides guidelines to facilitate the positioning of all new and altered signals, point indicators, Train Authority indicators and nominated signs so that they afford train drivers adequate advance sighting and convey a clear and unambiguous message. The standard also includes all the processes to ensure that this is achieved and maintained while the item is in operation.

The term signals in this standard shall be synonymous with signals, point indicators, Train Authority indicators and nominated signs (notice boards).

1.2 Scope

This standard applies to all the nominated items on the ARTC network in addition to any obstruction which may interfere with the sighting of existing signals. The standard covers the performance requirements and the activities to achieve these requirements.

1.3 Document Owner

The Head of Engineering Standards is the Document Owner. For any query, initial contact to be made at standards@artc.com.au.

1.4 Roles and Responsibilities

The Design Authority for the Signalling aspects of the project is responsible for ensuring that all the activities detailed in this standard are undertaken and the outcomes detailed in this standard are achieved and that there is documentary evidence of these.

The Design Engineer for the signalling aspects of the project is responsible for ensuring that the Signal Plan is produced at the Preliminary Design Stage and includes the results of initial site survey and signal location engineering requirements. The Design Engineer is responsible for producing the Signal Sighting Forms in accordance with the approved templates and including the specific information for the Signal Sighting Working Group. The Design Engineer is responsible for managing the Signal Sighting forms and their related information throughout the design life cycle.

The Delivery Project Manager is responsible for arranging the Signal Sighting Working Group, selecting and inviting representatives, arranging the on-site work and all its safety requirements and ensuring that the documentation is completed and returned to the Design Engineer. The Delivery Project Manager is responsible for checking and endorsing the Signal Sighting Forms and arranging for endorsement by the ARTC representatives for Operations and Asset Management (signals).

The invited representatives from the project team, ARTC and the Rail Operator are responsible to ensure that they undertake the Signal Sighting review in accordance with this standard and any additional ARTC Engineering Instruction and Guidelines which may be applicable.

2 Signal Sighting Design Requirements

2.1 Overview

The position of all new and altered signals, point indicators, Train Authority indicators and nominated signs (notice boards) will be considered by a Signal project group during a initial site survey during the Preliminary Design Phase of the project. The signal project group will consider signal design requirements and engineering requirements with regard to proposed signal locations. The driver's approach view must be the prime consideration, but regard must also be given to the signalling arrangements, maintenance requirements and construction requirements.

Where the signal location is at the optimal distance and there are no adverse issues identified related to requirements detailed in this standard, then the position of the signal is considered to meet all requirements and there is no requirement to attempt to achieve a better position. The items for guidance included in this standard cover positions permitted for the placement of signals and positions that should be avoided where alternatives are reasonably practicable. The assessment of these should be considered on the basis of the impact on the operations of all trains, of individual trains, on impact on signalling capacity (headway), signal engineering and exceptional situations. It may be necessary to assess the impact on a weighted average of types of trains in order to determine what is reasonably practicable in a given situation. When assessing issues, the **Primary** items take precedence over the **Secondary** items.

2.2 Sighting Distance - Primary

The available sighting distance for a signal is a balance between ensuring that the driver has adequate time to view the signal and perceive the meaning of the aspect and the driver having an earlier viewing and not having an updated viewing at the time that the train passes the signal.

2.2.1 Minimum Sighting Distance - Primary

Signals shall be positioned to give drivers of signal sighting for a minimum of 8 seconds. However, the preference is to provide 10 seconds of signal sighting where it is reasonably practical,. 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. 20% interruption permitted should be spread out across the total sighting distance of the signal and shall not be concentrated in the last 8 seconds. Interruption within the last 8 seconds shall not be more than 1.6 seconds.

Signal Sighting Design Requirements

Service Speed KPH:	Distance Metres for 8 seconds:	Distance Metres for 10 seconds:
40	89	111
50	111	139
60	133	167
70	156	194
80	178	222
90	200	250
100	222	278
110	244	306
120	267	333
130	289	361
140	311	389

Table 1 - Minimum Sighting Distances (Equal to eight (8) seconds sighting)

Where these timing guidelines cannot be achieved, but the Signal project 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 Signal project group shall record their decision and reasoning as part of the site survey report.

The signal shall generally be positioned so that the centre beam is aligned towards a point 3 metres above the left hand running rail at the nominated sighting point. Exceptionally, other circumstances may require the signal to be aligned to the point where the signal is first sighted.

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

2.2.2 Maximum Sighting Distance - Primary

Selection of the type of signal luminaire should allow for the distance associated with the optimal timing of 10 seconds. Selection of a luminaire should not be on the basis of providing excessive sighting distance compared to the distance for the optimal timing.

Where there is an absence of geographic markers for the driver (e.g. Nullabor) or the signal is not significant against the horizon or the sun may be directly behind the signal then the application of long range luminaries is acceptable.

The standard range luminaire should be the default unit. The short range luminaire should be used where there is a requirement to control the risk of read through to the signal in advance. The long range or extended range should only be nominated where there are exceptional requirements. The basis for such a recommendation is to be determined on the Signal Sighting Form.

If the distance between two successive running signals is greater than 4km and more than 2 times the service braking distance, then the sighting distance of the second signal should be greater than the minimum sighting distance detailed in section 2.2.1 based on the risk assessment and considering the available overlap distance. Risk assessment shall include representative of train drivers, train operations, signal maintenance representative and design engineers.

2.3 Stopped Train Position

Where it is reasonably practicable to adopt an alternative position, signals that display a stop aspect should not be positioned where they will cause trains to be stopped on viaducts, steep gradients, in tunnels, across level crossings (including pedestrian crossings) or with only part of the train in a platform. Signals where reasonably practicable should not be located within track curves, where possible repositioning at the start of the curve is acceptable.

In this regard, consideration should be given to the impact on a whole train. For example where a 1500m train is 100m into a rising grade, this would have minor impact on the train starting from a stand. Whereas a 1500m train that was on a grade but the loco was on the level would have difficulty in starting from a stand.

2.4 Positioning of Signals - Secondary

Signals shall, normally and 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 (wrong sided):

- To address OHS needs for maintainers, see conditions below;
- At station platforms so that the signal is located immediately adjacent to the platform and on the side of the track where the platform is;
- if there is no other viable alternative;
- Where the track centres do not permit the signal being placed between two tracks;
- Where special sighting requirements make the left hand side unsuitable.

When the Signal project 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 their line (or that a driver on an adjacent line will view the signal as being applicable to their line). The likelihood of any such misreading must be minimal before the proposal is agreed. For the purpose of assessing this item, it is reasonable to assume that the train driver knows whether the train is on the right or left hand side of a pair of tracks.

Where there is a crossing loop or passing lane in single line territory, then it is acceptable to locate the signal for the right hand side track on the right hand side to minimise the positioning of signals between the two tracks. This is usually associated with signals for both tracks being located at the same kilometrage.

Where there is bidirectional working on double track, then it is acceptable to locate the signal for the right hand side track on the right hand side to minimise the positioning of signals between two tracks. This should be associated with signals for both tracks being located at the same kilometrage.

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.

2.4.1 Station Platforms - Secondary

Signals controlling the departure of trains from platforms shall be positioned to fall within the train cab sightlines, for all normal stopping positions of the trains in the platform, including trains in dead end sidings. Where this cannot be achieved then co-acting signals may be required.

2.4.2 Level crossings - Secondary

Signals on the approach to level crossings should preferably be positioned 200 metres from the level crossing. New signals shall not be placed closer than 100 metres to the level crossing. Where this cannot be achieved then special consideration shall be given to the non-conditioning of the level crossing operation for a stopped signal.

2.4.3 Environment Issues - Secondary

Signals at which trains are likely to be regularly stopped must, where reasonably practicable, be positioned to avoid environmental nuisance to line side neighbours. Account must also be taken of other local conditions such as the likelihood of vandalism to trains or pilferage that may occur from stationary trains.

2.5 Parallel Positioning of Signals - Secondary

Where lines running parallel are signalled in the same direction, the signals for each line shall generally be placed opposite each other. However, on curves due consideration must be given to ensure that a signal not applicable to a line is not viewed for a disproportionate amount of time before the applicable signal can be sighted. In cases where several parallel lines are signalled for movements in the same direction, consideration may be given to arranging the signals in a distinctive arrangement (or provision of line identification signs at the approach to it) to enable the drivers to correctly identify the signal applying to the line on which their train is running.

In general signals located on adjacent lines shall employ the same luminaire technology unless it is clear they cannot be viewed together.

2.6 Foreground, Interference and Obstruction - Secondary

In all cases the foreground when approaching the signal is to be viewed and must be considered.

When positioning any signal, indicator or sign the Signal project group must consider the possibility of obstructions to the driver's sighting of the signal. The signal must be positioned so that the full signal including any associated junction or subsidiary indicators is visible to approaching drivers. Particular care must be taken to ensure that misleading signals aspects cannot be given due to indicators or subsidiary aspects being obscured while proceed aspects are visible. Where signal gantries are involved, it should be ensured that opposing gantry cages and structures do not obscure signal viewing. Viewing shall take into account:

- Fixed obstructions interfering with sighting, eg cuttings, platform structures, retaining walls, foliage, and structures.
- Other trains:- whether acceptable sighting is available with another train approaching on an adjacent track, notably on right hand curves; whether acceptable sighting is available with rolling stock standing on sidings, notably on left hand curves; whether acceptable sighting is available with a train standing in an adjacent loop or passing lane.
- Adjacent lighting:- whether road traffic lights, street lights, floodlights will overpower the signal aspect or tend to mislead the train driver.

2.7 Background, Interference and Distraction - Secondary

In all cases the background against which the signal is to be viewed must be considered. Background lighting, whether road traffic lights, floodlights, advertising lights, commercial lighting will overpower or merge with the signal aspect to mislead the train driver.

Signal Sighting Design Requirements

When positioning any signal, indicator or sign the Signal project group must consider the possibility of it being misinterpreted by drivers or interfering with the signalling on other lines.

2.8 Interface with Existing Signals Primary

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. If this is proposed, it must be specifically addressed in the Preliminary Design report and site survey. It shall also be included in the Signal Sighting Working Group forms.

The possibility of read through of signal aspects must also be considered. In particular, the possibility of a driver approaching a restrictive aspect signal being able to see, and be misled by, a less restrictive aspect on a signal further ahead, or across to one side must be considered.

To minimise this issue the lowest suitable range LED unit shall be chosen consistent with the sighting distance requirement and with the ability to sight the signal against the background in all situations including all times of the day and weather situations. LED signal units may be short range < 0.5 km or standard range > 0.5 km. These meet the optimal signal sighting requirements. The alternatives are long range > 1.0 km or extended range > 2.3 km. These should only be used to meet special requirements for a location.

2.9 Structural Clearances - Primary

Signals must be positioned to afford structural clearance between all parts of the signal, its associated structure and screens, and adjacent lines using the kinematic envelope.

2.10 Heights of Signals - Primary

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. The main red indication (upper red on double aspect signals) shall be the datum point for height measurements.

The nominal height of the signal main red indication is in line with the driver's eye position. While this varies between locomotives and diesel multiple units, the weighted average is 4.2 metres above rail level.

When on a straight mast, colour light signals for speed signalling will be positioned with the A arm (top) red aspect as near as practical to the driver's eye level, and the centre line of the most restrictive aspect will normally be at 4.2 m above the rail level.

2.11 Safety and Environment - Secondary

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).

On lines with Overhead electrification or adjacent to Overhead electrification, signals and signal structures must be positioned so that all parts of the signal structure have the minimum electrical clearances to OHS structures or train pantographs.

On electrified lines, signals that display a stop aspect must be located sufficiently far from an air gap to ensure that a train is not brought to rest with its pantograph in the air gap section. Signals must not be located within 100 metres on the approach side of air gaps and sectioning switches.

2.12 Position - Secondary

Signals should be as near as possible to the running edge with the centre line of the post preferably no closer than 3.0m to the running face of 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. Where there are restrictions to the lateral position of the signal then an analysis of the applicable loading gauge and the structure gauge kinematic envelope of the trains shall be undertaken to determine the minimum distance from the closest edge of the signal and the running face of the nearest rail.

2.13 Hoods - Secondary

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. Signals facing due East or West should be avoided where possible and otherwise mitigation measures undertaken to ensure clear visibility in all sun light conditions is achieved.

2.14 Close Viewing - Primary

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.

Where a train is often at stop at a signal, then the close up viewing requirements shall be considered. The viewing angle of the luminaire shall be selected for this requirement. The short range LED signals have the widest viewing angle and are the most suitable for the close range viewing.

Train driver shall have substantially clear view of signal at all locations from 20m to 6s sighting point.

2.15 Alterations to Existing Signals, Indicators and Signs - Secondary

Where there is a change to an existing signal such as the addition of an indicator or change to the type of luminaire, then the Signal Project group shall review the sighting issues to ensure that they do not affect the original sighting determination. If there is a significant change then the issue should also be referred to a Signal Sighting Working Group

2.16 Preliminary Design Site Survey - Primary

The Signal project group shall examine all the factors detailed above in reviewing the proposed signal position. The proposed signal positions shall be pegged as the initial site survey progresses. The following information shall be recorded during the site survey: distance to running face of closest rail, height of signals, height of foundations with respect to rail level, distance from agreed position to nearest fixed object such as a kilometrage post.

2.17 Controlled & Maintained Document - Primary

The agreed Signal Sighting Form shall be a maintained document with the signal design drawings. Control of the drawings shall be in accordance with Signal Documentation Processes. The Signal Sighting Form shall be available for the ongoing maintenance of the signal to ensure that the original sighting requirements are maintained.

3 Signal Sighting Working Group

3.1 Requirement

The position of all new and altered signals and point indicators will be considered by a Signal Sighting Working Group convened for the purpose.

The Signal Sighting Working Group allows for input from Train Operator driver representatives into the positioning of signal. The driver's approach view must be the prime consideration, but regard must also be given to the signalling arrangements and site engineering requirements.

3.2 Composition

A Signal Sighting Working Group shall consist of persons who have the competence to meet the engineering and train driver operating experience requirements in the sighting of signals. It should include representatives from:

- ARTC Operations and Safety;
- ARTC Infrastructure Management (Signals maintenance representatives);
- ARTC Signals Project Group – signals site construction;
- ARTC Signals Project Group – signals design representative;
- Customer representation (train operators who have significant operations on the respective line). The Train Operator representatives on the Signal Sighting Working Group shall be nominated by the Train Operator and have experience in the train driver requirements for signal sighting and in the requirement of this standard.

3.3 Signal Sighting Review Process

The Design Engineer shall provide the base information for the Signal Sighting Working Group on the nominated Forms. This shall be consistent with the approved Signal Plan. The Signal Sighting Working Group will use this information to confirm or otherwise nominate issues and proposed amendments. All these comments shall be recorded on the forms.

3.4 Unacceptable and Undesirable Signal Sighting

Signal sighting shall be regarded as unsuitable when:-

- Local conditions are exceptional and such that it is reasonable to predict that drivers may have particular difficulty in properly observing the signal aspect during the optimal approach sighting distance;
- The train driver being unable to respond to the signal aspect appropriately.
- The train driver having responded to previous signals appropriately, has visibility of the signal constrained leading to an inability to stop at the signal when required to do so.
- The signal will not be visible to the driver when the train is stationary at a platform or when the train is stationary within 13 metres of the signal.
- The signal will not be visible to the driver when the train is stationary at a loop or similar situation where the train is routinely stationary within 13 metres of the signal.

Signal sighting may be regarded as undesirable when:-

- Trains frequently approach a signal with restricted sighting, having received a caution indication at the previous signal, and it would be advantageous to advise the driver, before the signal becomes visible, that the signal cleared to prevent unnecessary slowing of the train.
- The signal is a junction signal and the sighting is such that the driver would be required to slow the train more than is necessary for the diverging route.

3.5 Other Considerations

In addition to providing for the driver's view of the signal, selection of location shall also take into account safe access to the signal for drivers to alight and use driver operated trackside equipment such as push button where provided. Safe access to the signal shall be provided.

3.6 Records and Decisions

The final Signal Sighting Forms shall be produced and be neat and accurate. They shall contain all information gathered from the site inspections. They shall be signed by all representatives to confirm the information from the site inspection.

The decisions of the Signal Sighting Working Group will also be recorded on [ESS0401F-01 Signal Sighting form](#). Each Signal Sighting form when complete in all respects will be signed by all members of the Signal Sighting working group.

The Signal Sighting forms shall be returned to the Design Engineer and will form part of the Design Reports.

3.7 Agreement by Stakeholders

If agreement by attendees of the signal sighting cannot be obtained, then the matter should be referred to the Infrastructure Manager.

The Project Delivery Manager and the Design Engineer will assess all the issues and make a recommendation to the Infrastructure Manager for a decision with advice to stakeholders of the decision.

3.8 Review by Design Engineer and Design Authority

The Design Engineer and the Design Authority shall review the results from the Signal Sighting Working Group. They shall confirm that they are in accordance with this standard and with other applicable ARTC standards.

If there are deviations from these standards, then an Engineering Waiver shall be submitted covering the deviations.

4 Appendix 1 - Summary of Signal Sighting Information

Signal sighting forms may be formulated to suit individual projects or locations.

The following information shall, however be shown on all signal sighting forms irrespective of format:

- Dwg No. - to be consistent with the Signal Design CB number
- Project – Name of the signalling project
- Location – Name of the location e.g. Albury
- Signal No – Identification of the signal as detailed on the Signal Plan
- Design Location (km) – proposed location as detailed on the Signal Plan
- Actual Location (km) – Agreed position after review by Signal sighting working group
- “A” - Distance, centreline of signal to running face of rail
- “B” Height of (top) red indication from rail level
- “C” – Height of rail level from ground level at the base of the signal
- Sketch showing signal (include dressing where required)
- Sketch showing location of signal relative to lines and direction
- Type of lens required (standard or spread)
- Position of signal LHS or RHS of track
- Background size (standard or narrow)
- Line speed for the approaching train
- The sighting distance of the signal (accurate to +/-20 metres)
- Any signage relevant to the signal
- Background interference – comments to be written
- Foreground interference – comments to be written
- Other Signals – comments on potential interference or read through
- Any special requirements, e.g. foundations, access

The form shall be signed by a Signal sighting working group, which consists of persons who have the competence to meet the engineering and train driver requirements in the sighting of signals and includes representatives from Maintenance, ARTC Operations, Operators representatives and other representatives as appropriate.

5 Appendix 2 - Signal Sighting Form (example only)



Engineering & Systems (Signal) Form

Form number: ESS0401F-01

ESS-04-01 Signal Sighting & Position

Signal Sighting Form – 3 Aspect Signal

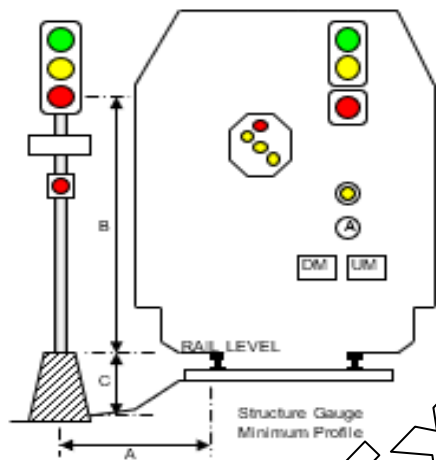
Drawing No: _____ Rev: _____ Sheet: _____

Project: _____

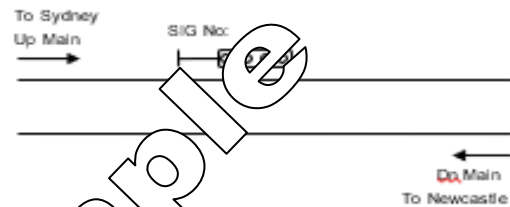
Location Name: _____ Signal Plan No: _____

Signal No: _____ Signal Plan Date: _____

Profile:



Signal Plan Extract:



Other Sighting Comments:

Note: Height of Signal is to the Topmost Mainline Red indication	A	mm	Line Speed:	Kph
	B	mm	Minimum Required Sighting Distance:	meters
	C	mm	Actual Available Sighting Distance:	meters
			Signal Background Size:	Standard / Narrow

Design Location: _____ Actual Location: _____

Position of Signal to Track: LHS / RHS _____ Lens Type: _____

Signage: _____ Signal Plate: _____

Background Interference: _____ Foreground Interference: _____

Remarks (Sighting Restrictions, Special Foundation Requirements, Access Restrictions):

Sighting Working Group Reps:	Name:	Signature:	Date:
Signal Project Engineer			
Signal Maintenance Rep			
Signal Design Rep			
Operations Rep			
Driver Rep			