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3	8/4/2025	Draft 3 finalised comments and incorporated peer review feedback

Preface

This standard was prepared by the Lineside Signals, Indicators and Signal Signage Development Group, overseen by the RISSB Infrastructure Standing Committee.

Objective

The objective of this Standard is to seek to achieve a common level of safety and performance across all operators, encourage good practice in human factors issues and achieve economies of scale by encouraging a reduction in the differences between the signalling equipment and materials used in the various rail networks in Australia.

Compliance

There are four types of provisions contained within Australian Standards developed by RISSB:

(a) Requirements.

(b) Recommendations.

(c) Permissions.

(d) Constraints.

Requirements – it is mandatory to follow all requirements to claim full compliance with the Standard. Requirements are identified within the text by the term ‘shall’.

Recommendations – do not mention or exclude other possibilities but do offer the one that is preferred. Recommendations are identified within the text by the term ‘should’.

Recommendations recognize that there could be limitations to the universal application of the control, i.e. the identified control is not able to be applied or other controls are more appropriate or better.

Permissions – conveys consent by providing an allowable option. Permissions are identified within the text by the term ‘may’.

Constraints – provided by an external source such as legislation. Constraints are identified within the text by the term ‘must’.

For compliance purposes, where a recommended control is not applied as written in the standard it could be incumbent on the adopter of the standard to demonstrate their actual method of controlling the risk as part of their WHS or Rail Safety National Law obligations. Similarly, it could also be incumbent on an adopter of the standard to demonstrate their method of controlling the risk to contracting entities or interfacing organisations where the risk may be shared.

RISSB Standards address known hazards within the railway industry. Hazards, and clauses within this Standard that address those hazards, are listed in Appendix A.

Appendices in RISSB Standards may be designated either “normative” or “informative”. A "normative" appendix is an integral part of a Standard and compliance with it is a requirement, whereas an "informative" appendix is only for information and guidance.

Commentary

Commentary *C Preface*

This Standard includes a commentary on some of the clauses. The commentary directly follows the relevant clause, is designated by ‘C’ preceding the clause number and is printed in italics in a box. The commentary is for information and guidance and does not form part of the Standard.

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Section 1 Scope and general

1.1 Scope

This document applies to new and modified lineside signals, indicators and signal signage.

The document covers materials, design, construction, testing, commissioning and maintenance of lineside signals, indicators and signal signage.

Temporary signage (e.g., for speed restrictions) is not covered by this standard.

Interfacing systems such as cab signalling, train protection, and electric traction infrastructure, as well as level crossing requirements, are not covered by this standard unless specifically related to lineside signals.

1.2 Normative references

The following documents are referred to in the text in such a way that *some* or all of their content constitutes requirements of this document:

- AS 1397, *Continuous Hot-Dip Metallic Coated Steel Sheet and Strip-Coatings of Zinc and Zinc alloyed with Aluminium and Magnesium*
- AS 1657, *Fixed Platforms, Walkways, Stairways and Ladders - Design, Construction and Installation*
- AS 1744, *Standard Alphabets for Road Signs*
- AS 1768, *Lightning Protection*
- AS 1874, *Aluminium and Aluminium Alloys - Ingots and Castings*
- AS 4791, *Hot-Dip Galvanized (zinc) Coatings on Ferrous Open Sections, Applied by an In-Line Process*
- AS 4792, *Hot-Dip Galvanized (zinc) Coatings on Ferrous Hollow Sections, Applied by a Continuous or a Specialized Process*
- AS 7507, *Rolling Stock Outlines*
- AS 7631, *Railway Infrastructure – Sighting*
- AS 7632, *Railway Infrastructure – Signage*
- AS 7717, *Signal Testing and Commissioning Management*
- AS 60529, *Degrees of Protection Provided by Enclosures (IP Code)*
- AS/NZS 1170.2:2021, *Structural Design Actions – Part 2: Wind actions*
- AS/NZS 2144, *Traffic Signal Lanterns*
- AS/NZS 3000, *Wiring Rules*
- BS EN 50121-4:2006/IEC 62236-4:2008, *Railway applications - Electromagnetic compatibility – Part 4: Emission and immunity of the signalling and telecommunications apparatus*
- BS 1376:1974, *Specification for Colour of Light Signals*
- *AREMA Communications & Signals Manual – Part: 7.1.10*

NOTE:

Documents for informative purposes are listed in a Bibliography at the back of the Standard.

1.3 Defined terms and abbreviations

For the purposes of this document, the following terms and definitions apply:

1.3.1

bi-colour signal
single-unit signal light capable of displaying two different colour aspects from the one housing

1.3.2
FPM
flashes per minute

1.3.3
ladder
structure with treads or rungs, with or without stiles and handrails

1.3.4
landing
level area used to provide access to a stairway or ladder or located at an intermediate level in a system of stairways or ladders

1.3.5
platform
area provided for access or working which is elevated above the surrounding floor or level

1.3.6
position of safety
place where no track worksite protection is provided and is either:

(a) a properly constructed refuge to an approved design;

(b) behind the safety line on a platform;

(c) a place where a structure or physical barrier has been erected to provide protection but includes subways and overhead bridges; or

(d) a place that is not on or near the track

1.3.7
primary user
person or group who would most frequently need to sight and act upon the information shown on a sign or signal

1.3.8
PVC
polyvinyl chloride

1.3.9
readability
ease with which the information shown on a sign or signal can be read and understood

1.3.10
reducing plates
components used to modify the size of the light aperture which help focus or limit light output

1.3.11
required reading time
time necessary for the reader to:

(a) identify the presence of a sign (conspicuity);

(b) read and understand the information presented by the sign (readability); and

(c) determine what action, if any, is required and when (decision)

1.3.12
response time
time elapsing between the beginning of the application of a stimulus and the beginning of a person's response to it

1.3.13
RGS
railway group standard

1.3.14
RMS
root mean square

1.3.15
SI
international system of units

1.3.16
signal sighting committee
group comprising of nominated representatives of the operator and infrastructure manager (rail traffic crew and engineering) who agree and define suitable locations for railway signals

1.3.17
sun phantom
false light signal created by radiation from the sun striking a signal light

1.3.18
tri-colour signal
single-unit signal light capable of displaying three different colour aspects from the one housing

1.3.19
visibility
state of being able to see or be seen, and the distance required to be in this state as determined by light and weather conditions

Section 2 Materials

2.1 Signal light units in operational and environmental conditions

Colours and luminous intensity of both LED and incandescent signal light units shall be tested according to acceptable recognized standards such as AS/NZS 2144 and by laboratories which are independently accredited as having the competence to carry out the type of measurements involved.

Selection of equipment materials shall be based on the environment and conditions expected for the installation location and be approved by the RIM.

2.2 Types of luminaires

2.2.1 Maximum luminance

Light intensity shall be suitable for both daylight and night-time viewing at the rated distance as per AS 7631 without the need for active dimming of lights.

The luminous intensity of an outdoor signal shall not be so high to cause visual discomfort to rail traffic crew (RTC) positioned in front of the signal.

To limit glare, luminous intensity shall not exceed 750 candela from any single aspect.

Where more than the main and subsidiary signal aspect are combined and simultaneously displayed on a signal, the brightness levels of displayed lights shall be such that the brighter aspect or indication shall not make the other unreadable when observed from the normal viewing distance of the subsidiary aspect or indication.

2.2.2 Chromaticity

The observed colour of the light emitted from signals shall be within the specified chromaticity limits of BS 1376 or *AREMA Communications & Signals Manual*, Part 7.1.10, as set out in Table 2-1.

Table 2-1 Chromaticity Limits

Colour	Chromaticity Boundary Definitions		LED Dominant Wavelength (λ)
	BS 1376	AREMA C&S Manual	
Red (Wayside signals)	Class C, y ≤ 0.295	y ≤ 0.288 y ≥ 0.998-x	630 nm to 650 nm
Red (Subsidiary/shunt)	Class C, y ≥ 0.280 y ≤ 0.300	y ≤ 0.296 y ≥ 0.998-x	630 nm to 650 nm
Yellow	Class B	y ≤ 0.430 y ≥ 0.384 y ≥ 0.862 to 0.783x x ≥ 0.554	590 nm to 595 nm
Green	Class C	y ≥ 0.506 – 0.519x y ≥ 0.150 + 1.068x y ≤ 0.817-x	500 nm to 510 nm

Colour	Chromaticity Boundary Definitions		LED Dominant Wavelength (λ)
White	Class C	x ≥ 0.285 x ≤ 0.440 y = 0.050 + 0.750x y = 0.150 + 0.640x	Not Applicable
Blue/Purple	Class A	x ≤ 0.179 y ≤ 0.209 y ≤ 0.734x + 0.088 Tr/Tw is not greater than 0.006	460 nm to 481 nm
Lunar White	Class C y ≥ 0.300 y ≤ 0.420	x ≤ 0.441 x ≥ 0.329 y ≤ 0.510x +0.186 y ≥ 0510x + 0.170	Not Applicable
Light Blue		x ≥ 0.17 x ≤ 0.22 y = 0.14 y = 0.18	

2.2.3 Pulse rate for flashing signals

Signal aspects may be either steady or time-varying.

Time-varying signal aspects may be either:

(a) flashing – alternating between fully 'on' and 'off' states with an equal mark-space ratio; or

(b) pulsating – 'on' with a periodic short dark period.

Flashing aspects shall have a frequency of approximately 60 fpm, equivalent to equal light and dark periods, each of approximately 500 ms.

Pulsating aspects shall have a frequency of approximately 70 fpm, equivalent to light and dark periods of approximately 630 ms and 210 ms respectively.

Light intensity during the 'dark' may be fully out or reduced to a distinctly recognisable level.

2.3 Veiling reflections and sun-phantom

Signal light units shall be arranged, shaped or finished to avoid undesirable reflections, conforming to the requirements specified in AS 2144.

Sun-phantom produced by each aspect of signal light units shall conform to the requirements specified in AS 2144.

2.4 Electrical performance

Each signal light shall be electrically isolated from all other signal lights and the signal head grounded for a voltage rating of 250 Vrms.

Compliance shall be confirmed by testing and inspection of the insulation, with resistance greater than 100 MΩ achieved when measured at 500 V using an approved insulation test instrument.

All aspects within a bi-colour or tri-colour signal light module shall have independent and electrically isolated power supplies.

Active and neutral connections shall be electrically isolated from each colour aspect in the same signal light module and from all other aspects in the same signal head.

The current drawn by an LED signal module shall be temperature independent over the stated operating temperature range of the module.

Signal Light units shall comply with the requirements of recognized EMC standards for railway application, such as EN 50121 or IEC 62236-4.

AC-fed LED light units shall be designed to minimize the effects of coupled voltages causing unwanted aspects to be illuminated.

AC-fed LED signal lights operating from a 110/120 V AC supply shall have an effective operating voltage range of 90 V to 135 V 50 Hz, without significant variation in luminous intensity.

110/120 V AC LED signal lights shall produce no light output at input voltages less 40 V AC.

DC fed LED signal lights shall operate over the specified operating voltage range applicable to their nominal voltage rating without significant variation in luminous intensity.

12 V DC lights shall have an operating range of 8 V to 15 V. 24 V DC lights shall have an operating range of 16 V to 30 V.

12 V DC LED signal lights shall produce no light output at input voltages less 5 V DC. 24 V LED signal lights shall produce no light output at input voltages less 10 V DC.

2.5 Signal head and fittings

Signal head and fittings shall be designed to withstand the maximum wind loadings as set out in AS/NZS 1170.2.

The following elements of the signal head fittings shall be in accordance with the requirements in AS 2144:

(a) access to and sealing of the optical systems;

(b) materials and methods of construction; and

(c) surface finishes.

The material used for signal heads shall be a medium strength, high corrosion resistant aluminium alloy to AS 1874 or AS 1734.

Signal light heads shall be weatherproof, insect proof and dust proof under service conditions in accordance with the requirements in AS 60529.

Signal light heads shall be manufactured with the provision for ventilation by means of suitable filtered breather openings and sealing to prevent internal damage to wiring or components due to the ingress of moisture, insects and being subjected to heat.

Sealing of LED signal light units shall achieve as a minimum the protection level specified by AS 60529. All accessible parts of the signal shall have a method to secure the access from unauthorized persons.

2.6 Signal structure

Design for the construction of signal foundations and signal structures shall be certified by a professional structural engineer who is registered with a relevant Australian engineering registration board.

The complete structure of signal gantries, signal cantilevers, standalone signal masts, tilt signal masts and tunnel signal mountings shall be hot dip galvanized in accordance with AS 1397, AS/NZS 4791 and AS/NZS 4792 with a galvanized coating weight of 450 g per square metre.

Signal cantilevers, standalone signal masts, tilt signal masts, signal foundations and associated fittings shall be designed to withstand the maximum wind loadings as set out in AS/NZS 1170.2.

Signal masts for railway networks in metropolitan and suburban areas should be manufactured from heavy steel tube with a minimum outside diameter of 140 mm and a minimum wall thickness of 5.4 mm.

Movement of a tilt the signal mast shall be achieved by one person safely and shall not infringe the minimum structure gauge for signals.

The tilt mast shall have a means of being secured and locked in the upright position to prevent unauthorized operation.

Gantries shall be designed to accommodate dead load from the structure, cages, signals, walkway and handrails, live loading from maintenance personnel and the maximum wind loadings as set out in AS/NZS 1170.2.

The signal gantry cage shall be either pre-drilled for lamp 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.

2.7 Signal mast foundation

The foundations shall be of sufficient size to support:

(a) the signal mast;

(b) incidental loading from maintenance personnel; and

(c) resist wind loadings as defined in the terrain category applicable to the location and for wind speeds as specified in AS/NZS 1170.2:2021 *Structural design actions, Part 2: Wind actions*.

The foundations may be precast concrete/prefabricated or cast in situ to meet the RIMs requirements.

2.7.1 Concrete mast foundations

Bolts for mounting type approved signal posts or ground mounted signals should be cast into signal foundations.

The signal post holding-down bolts should be installed vertically in the foundation castings with the top surface of foundations completely level.

Cable entry conduits should be cast into signal foundations during manufacturing for precast concrete foundation and during construction for cast in situ foundation.

The diameter of the conduits shall be determined during the design process and approved by the RIM.

The portion of signal foundation visible above ground should achieve as smooth surface, free of voids and should have chamfered edges.

2.8 Ladders and landings

Ladders attached to signal structures for maintenance access shall be supplied and installed complete with rungs, landings supports, safety barriers, connection points and bodyguards.

These shall be in accordance with the requirements of the relevant:

(a) workplace health and safety act and regulations;

(b) type-approved design of the RIM; and

(c) in accordance with the requirements in AS/NZS 1657.

Walkways, handrails and netting on signal gantries shall comply with the relevant requirements of AS/NZS 1657.

Flooring of signal cages, landings and walkways shall comply with the relevant requirements of AS/NZS 1657, and any additional design stipulations of the RIM.

2.9 Signage

AS 7632 requirements shall be complied with for all:

(a) sign material specifications;

(b) backplate requirements;

(c) retro-reflective materials and reflectorising characteristics;

(d) letter and numeral dimensions;

(e) letter and numeral layout;

(f) signs with an instruction to driver which supplements safeworking rules (e.g., 'drivers must not pass this signal');

(g) signs of a specialized nature (e.g., advisory speed signs, and pantograph down sign); and

(h) limit of authority boards.

Messages on working boards, limit boards and stop boards in train order working infrastructure shall be treated as supplementary instructions to safe working rules under all operational modes.

Letter and numeral dimensions shall comply with the requirements for Series C, Series D or Series E in AS 1744.

Series C in AS 1744 shall only be used for common words where sign space is limited.

A sign without a border shall be provided to each running signal.

The sign shall be securely mounted on the signal, below the upper or main running signal head and in approximately the same vertical plane as the signal lights.

All signal sighting requirements shall comply with AS 7631.

The sign shall be reflectorized, to ensure recognition of a signal in the event of a total light failure.

2.10 Main signal heads and subsidiary signal heads

The nominal diameter of signal aspects for main signal heads should be 200 mm. In a tunnel system with insufficient clearance for the installation of a post mounted signal, the nominal diameter of signal aspects for main signal heads should be 100 mm.

The nominal diameter of signal aspects for subsidiary signal heads should be 140 mm. In a tunnel system with insufficient clearance for the installation of post mounted signals, the nominal diameter of signal aspects for subsidiary signal heads should be 45 mm.

Signal heads should be designed to facilitate replacement of a light unit through the rear of the lamp head.

Signal indications shall be clearly readable in all light conditions as detailed in Table 2-2.

Table 2-2 Signal Indication Ranges

Asset	Range	Distance
Main signal head	Short	150 m
Main signal head	Medium	500 m
Main signal head	Intermediate	1,000 m
Main signal head	Long range	1,500 m
Main signal head	Tunnel systems	300 m
Subsidiary heads		150 m

Bi-colour or tri-colour LED signal heads shall comply with the requirements of readable distances achieved by multi-light main signal heads as per Table 2-2.

To achieve clear readability of multi-lamp aspects at long sighting distances, signals and lamp heads shall be arranged to provide the minimum spacing between lights as shown Table 2-3.

Table 2-3 Signal Head Spacing

Asset	Distance	Boundary lights/markers
Double head signals	1,200 mm	between red lights
Single head signals	1,000 mm	between red and marker light
Gantry-mounted signal heads	900 mm	between red lights
Tri-colour gantry-mounted signals	900 mm	between lights, but may reduce to 750 mm in extreme cases to improve sighting
Tunnel signals	600 mm	between red lights

2.11 Signal head brackets

2.11.1 Signal head brackets on posts

Signal head brackets shall be arranged and attached to a signal post so that one person can carry out adjustments for signal alignment and focusing.

Signal head brackets shall be designed to rotate 360 degrees around the signal post.

Where it is necessary to rotate a signal head bracket for signal alignment or maintenance, the bracket shall be locked and supported in its vertical position.

Signal head brackets shall be designed and positioned to provide sufficient clearance from signal posts to permit lamp head doors to be fully opened.

Signal head brackets shall provide vertical and horizontal adjustments in addition to being able to rotate around the signal post.

Adjustment of the signal head shall be infinitely variable by screw thread.

2.11.2 Signal head brackets on tunnel walls

Signal head brackets shall be designed and installed to provide sufficient clearance from the tunnel wall to permit signal head doors to be fully opened.

Signal head brackets shall provide vertical and horizontal adjustments for signal alignment and focusing.

Positioning within a rail tunnel shall allow for adjustment of the signal head to be infinitely variable by screw thread

2.12 Profile of signals

The primary objective of a signal aspect is that it is understandable by the intended users. The following requirements should be assessed by RIMs for any new infrastructure or upgrades to existing networks.

The following shall be determined and approved by the requirements of the RIM:

(a) The stagger of the signal heads

(b) The requirement for and positioning of the 'A' light in a rail tunnel installation

(c) Subsidiary signal heads on post mounted signals

(d) Buffer stop signal

Signal heads shall be mounted as per the following requirements, unless otherwise specified by the RIM:

(e) The upper and lower signal heads of a double light automatic signal shall be vertically staggered.

(f) The signal head and the marker light of a single light automatic signal, which has a marker light, shall be vertically staggered.

(g) Signal heads and marker or 'A' light of signals mounted on tunnel walls shall be vertically aligned one above the other.

(h) Main heads of controlled signals shall be vertically aligned one above the other.

(i) If a subsidiary signal head is provided at a controlled signal mounted on a gantry or cantilever, the subsidiary signal head should be mounted at the side of the main signal heads.

(j) Route indicators, junction indicators and turnout repeaters shall be mounted immediately above the corresponding signal heads.

A human factors approach shall be taken when designing and installing new and upgraded signalling equipment to reduce the risk of installation that could cause misreading of signal aspect by RTC.

This shall be achieved by ensuring the main aspects of all signals simultaneously visible have matched light intensity.

2.13 Signal background

All signal heads shall be fitted with a signal background, except tunnel signals and ground mounted signals.

Signal backgrounds shall be manufactured from a durable resilient material.

The background material shall be designed to limit distortion resulting from excessive wind and extreme temperatures.

The paint finishes and colours of signal backgrounds should be matt black on the front face and semi-gloss white on the rear of the background.

Signal backgrounds for main signal heads shall be a minimum of 600 mm wide, unless the signal is positioned at a location with limited structural clearance.

Signal backgrounds of main signal heads positioned at locations of limited structural clearance shall be a maximum of 450 mm wide.

The top edge of a signal background for a main signal head shall be a minimum of 200 mm above the top aspect.

Signal background of main head shall be projected below the bottom aspect an approved length determined by the RIM.

Signal background of a subsidiary signal head shall be 450 mm diameter.

2.14 Signal hoods

All signal aspects and indicators shall be fitted with hoods, excluding tunnel signals.

Hoods may be fitted to individual lights, or to multiple lights in the one signal head.

The hoods shall be made from aluminium alloy at least 1.6 mm thick.

The proposed position of the signal in relation to the sun shall be considered and the use of extended hoods shall be considered where necessary to reduce the possibility of phantom indications and improve sighting. Reducing plates shall not be affixed to hoods.

Where there is no reasonable alternative, stencils may be secured to the hood, incorporating at least four points of attachment. The design shall be such that there will be no light spillage from the top, bottom or sides of the stencil arrangement.

The minimum length and cover for hoods shall be as per Table 2-4.

Table 2-4 Minimum Length and Cover for Signal Hoods

Indication	Length (mm)	Cover
Main line 200 mm nominal dia. See Note 1 and Note 2.	375	>225°
Subsidiary 127 or 140 dia. and repeater (each indication)	200	>225°
Route indicator - small. 125 mm	300	Top and both sides – also divider between indications
Route indicator - large. 400 mm	500	Top and both sides
Turnout repeater	500	Top and both sides
'Co', 'u' and 'a' lights. See Note 5.	375	>225°
Repeater	500	Top and both sides
Guards indicator. See Note 3.	200	>225°
Warning light (outdoor circular). See Note 3.	200	>225°

NOTE 1:

Minor variations to hood dimensions may be permitted by the RIM to suit particular location and visilbility issues.

NOTE 2:

A one-piece hood covering all indications in the lamp head, 375 mm long at the top and tapering to 300 mm long at the bottom, should be used in place of individual hoods on each indication where main line signals are installed on a gantry.

NOTE 3:

Fit hoods where necessary.

Section 3 Design

3.1 Trackside location of signal masts and structures

3.1.1 Spacing from track

All signals shall be installed within the defined rail corridor.

The structure gauge applicable to the location of signals shall be as specified in AS 7507, or as specified by the RIM.

All parts of signal structures or ground mounted signals shall be designed to clear the structural envelope specified.

Signal structures may be installed within the danger zone for optimum signal sighting.

No parts of a signal gantry shall foul the structural envelope that is applicable to the overhead traction or lighting structures.

Access points for gantry structures should be installed outside the danger zone.

A tilt signal mast shall not be positioned such that its movement or maintainer would be in foul of the structural envelope for standard signal structures.

Minimum spacing of a signal structure from the track should be subjected to the widest dynamic envelope identified for a particular section of railway line.

3.1.2 Spacing from other equipment

A tilt signal mast shall be positioned such that its movement would not cause damage to other trackside equipment, cable routes, services or any part of the tilt mast.

A tilt signal mast shall be positioned such that its movement would not interfere with any safe access to equipment and any safety recess located in the rail corridor.

Signals protecting facing points should be placed at least 15 m from the toe of the points.

The design and positioning of the signal structures should limit the risk of impact by flooding as per AS 7636.

Designers shall assess the positions of existing cable routes, services, drainage pits and cable pits when positioning lineside signals.

Designers shall assess the position of existing overhead line equipment (OHLE) masts, above ground assets and infrastructure when positioning lineside signals.

The concrete landing for ladders used on signal masts should be designed to minimize interference with drainage and other equipment.

If a new signal is required to be installed at a position that will cause interference to existing cable routes, services, drainage pits and cable pits, diversion or protection measures should be incorporated into the design.

If two opposing signals are installed at the same location, spacing between the two signals should allow unrestricted access to maintenance access ladders.

For railways on which a balise type train protection system is installed or is planned to be installed, the signal should normally be placed as per the balise reading requirements.

In cab signalling systems, marker boards should be installed at the start of routes and at the limit of authority.

Designers shall incorporate and document environmental and heritage issues when positioning lineside signals.

3.1.3 Signal height from rail level

Except where otherwise permitted, the main signal head(s) of post mounted running signals should be positioned:

(a) to provide a stop aspect (the bottom red) as close as practical to RTC eye level;

(b) in accordance with the requirements of the structure gauge; and

(c) having regard to the different types of rail traffic likely to pass the signal.

The height of stop aspect on post mounted running signals should meet the RIMs requirements.

Where it is necessary to increase the height of a running signal above the standard height for that class of signal (for instance to achieve the necessary sighting distance), then the signal sighting committee shall assess factors that could prevent RTC from observing and reacting to a signal.

If a signal is to be located at a point where the track has a cant greater than 90 mm, then the top of the rail head reference should be obtained using a level horizontal datum off the measured rail and without reference to the height of the opposite rail.

Signal heads of independent post mounted shunt signals should be installed 1.5 m above rail level, and subject to sighting and operating requirements.

3.1.4 Signal access

Safe access shall be designed for the inspection and maintenance of the structural integrity of all parts of signal masts and structures.

The design of maintenance access shall ensure that maintenance staff are protected within a ladder cage or gallery ring when working on equipment 2 m above ground level.

The design shall incorporate a flat service area around tilt masts to allow room for maintenance workers to safely lower and raise the tilt masts from a position of safety.

A tilt mast in the lowered position should be landed on a flat working service area on which maintenance workers can safely carry out maintenance works on the signal heads.

3.1.5 Signals on embankment or viaduct

Where signal structures are installed in cuttings or embankments, steps or ramps shall be constructed in accordance with AS 1657 to allow safe access for maintenance.

Where a signal is situated on an embankment, viaduct or similar location and the landing of the signal structure is less than 900 mm from the edge of a platform, the risk of falls shall be minimized by engineered protection measures such guard rails, protective screens or a fall arrest system.

When the design of the maintenance access for a signal structure includes a ladder only, protective screens should extend to the full height of the access ladder, or higher where required.

Where the signal incorporates a platform, the protective screen, if provided, should extend to a minimum of 1 meter above the deck of the topmost platform.

3.1.6 Ladders, landings and platforms

A concrete landing shall be designed for ladders to signal posts and signal gantries in accordance with the relevant requirements of the standard AS/NZS 1657.

Access platforms to signal light heads shall be designed to facilitate maintenance and inspection staff from under the lamp head.

Signal light heads should not be accessed from platforms, landings or ground level at a distance of 1.5 m below the lamp heads.

Ladders to signal gantries and cantilevers shall be fitted with a lockable anti-climbing device on the structure to restrict unauthorized access.

A guard rail or gate shall be fitted across the access to a signal gantry at the ladder opening. The opening guard rail or gate may be either sliding or hinged.

A safety chain or bar should be provided across the ladder opening to the platform on signal masts.

Where platforms are not provided at the top of the ladder, ladder gallery rings should be fitted unless the ladder is at a height of less than 2 m.

The gallery rings where fitted should be braced from the ladder on both sides to prevent movement.

3.1.7 Signal structure construction

Foundations for signal structures shall be of sufficient size and depth to support:

(a) the structure,

(b) cater for incidental loading from maintenance personnel; and

(c) resist wind loadings, in terrain category applicable to the location and for wind speeds as specified by the RIM.

When an upgrade or modification is carried out on existing signals, e.g., adding a route indicator to an existing signal, calculations shall be carried out to confirm that the existing signal foundation is adequate to support the additional loading.

Signal structures shall not rely on staying, bracing or the ladder to support its stability in wind speeds as specified by the RIM.

3.2 Electrical clearances

The OHLE of the electric traction system is the conductor or conductive part which is intended to be energized in normal use.

By convention this does not include the running rails and parts connected to them.

The following shall be read in conjunction with the RIMs requirements:

(a) Signals shall not be located where any part of the signal structure and access including an open-door panel or the safety chain/bar is within reach of the OHLE for installations in greenfield sites.

(b) Where space is not available in a brownfield site, an approved barrier in the form of protective cages or screens shall be provided to prevent inadvertent contact with OHLE.

(c) The minimum safety clearance from a standing surface (e.g., landing of a signal post) shall be defined by the RIM.

(d) Where the relevant minimum safety clearances from a standing surface cannot be achieved, a barrier in the form of protective cages or screens shall be placed between the live parts and the standing surface.

(e) The barrier shall be designed to withstand the maximum wind loadings as set out in AS/NZS 1170.2.

(f) The barrier shall be made of suitably sized conductive mesh with a minimum IP2X rating as described in AS 60529.

(g) The electrical clearance between the barrier and DC live parts shall be defined by the RIM.

(h) The electrical clearance between the barrier and AC live parts shall be defined by the RIM.

(i) Where the barrier is in the form of a screen, it shall meet the requirements of the RIM.

(j) Signals should not encroach on the RIMs minimum safe approach distances for live electrical equipment

3.3 Signal sighting

3.3.1 Signal sighting – General requirements

The RTC approaching a signal at maximum allowable speed shall have sufficient time to identify, observe and interpret the information being displayed.

Signal sighting requirements as part of the design of signalling infrastructure shall be as per AS 7631.

Signal sighting committee requirement are established in AS 7631.

3.3.2 Signal sighting times and distances

Signals should be positioned to give RTC an approach view for the optimum timing requirements specified by the relevant RIM.

The minimum signal sighting distance shall be equal to the distance travelled by rail traffic travelling at line speed in the specified minimum sighting time.

The minimum signal sighting time shall be 8 s, or as otherwise determined according to the standards of the relevant RIM.

The minimum signal sighting distance shall provide the RTC the minimum signal sighting time at the line speed and include the specified allowance, such as speed tolerances, if specified in the standards of the relevant RIM.

If the visibility of any signal is affected by sighting obstructions, the required signal sighting distance of the signal should be extended as one of mitigation measures.

Where the maximum attainable speed of all rail traffic on the approach to the signal is less than the line speed, it should be permissible to calculate the minimum sighting distance based on the attainable speed.

In four or five aspect signalling systems, where the least restrictive aspect of a signal is a caution aspect, it should be permissible to calculate the minimum sighting distance based on the expected speed, e.g., medium speed in a speed signalling system of rail traffic as appropriate to the aspect being displayed.

Minimal interruptions to signal sighting caused by masts, signal structures or equipment should be excluded when determining the compliance to the minimum sighting distance.

Sighting in the final 50-metre approach to signals shall not be interrupted and where the requirement cannot be achieved by running signals, the RIM shall assess and incorporate the following risk mitigation strategies into the design:

(a) relocation of the signals;

(b) installation of co-acting signals; or

(c) installing repeater signals.

Subsidiary aspects, independent shunt signals and fixed red signals should be aligned to provide the best visibility for the final 50-metre approach. Indicators, such as route indicators and speed indicators, offering additional information to that provided by the main signal aspects, shall be designed and installed with the minimum signal sighting time as for the main signal aspect.

Messages on marker boards shall be treated as per the RIMs safe working rules for cab signalling systems under degraded mode.

3.3.3 Signal luminaire type

Signal light units of new signals, compatible replacement or signal upgrades shall be LED type.

Where signals are upgraded or new signals added, the design shall assess the need to avoid situations where it is possible for a new signal to be viewed together with other existing signals employing different luminaire technology, leading to the risk of RTC misreading signal indications.

Installations shall not include a mixture of luminaire types, either LED and incandescent, or mixtures of long-, medium- and/or short-range LED luminaires.

3.3.4 Selection of ranges of signal luminaire

Selection of the type of signal luminaire should accommodate the following design factors:

(a) minimum sighting time
(b) line speed
(c) signal spacing
(d) the presence of interference and obstructions to signal visibility
(e) ambient visibility

Short-range luminaires should be used where there is a requirement to control the risk of read through to the signal in advance.

Medium-range luminaires should be the default unit to be used except where sighting requirements dictate otherwise.

Long-range luminaire should only be used if there is a requirement to mitigate the issues of poor visibility due to environmental and geographical reasons.

Where the main signal head and the subsidiary signal head are mounted on the same signal post, the light output intensity of the subsidiary signal head shall not be more than 60% of the main signal head. In this case the sighting distance of the subsidiary signal head shall exceed 300 m in daylight conditions.

The design shall ensure subsidiary signals and main signals maintain enough separation to stop the washout of a signal aspect.

3.3.5 Signal heights and sighting factors

Stop aspects of post mounted running signals should be as close as practical to RTCs eye level.

Guidelines for exceptions should include, but not be limited to, the following:

(a) Where it is necessary to observe an aspect over the top of rail traffic on an adjacent track;
(b) Where it is necessary to observe an aspect over a rise;
(c) Where features in the background could interfere with proper viewing of the signal; and

(d) Where it is necessary to observe the aspect which would otherwise be obscured by physical lineside obstructions such as the face of a rock cutting or the locality of bridge piers, etc.

3.3.6 Multiple track signal design factors

Parallel signals located on adjacent lines shall employ the same luminaire technology unless determined the signal aspects cannot be viewed together.

The design shall incorporate the arrangement positioning, heights and signage of parallel signals to ensure RTC correctly identify the signal applying to the line on which their rail traffic is running.

3.3.7 Signal read-through

The possibility of RTC when approaching a restrictive aspect on a signal being able to see and being misled by a less restrictive aspect on another signal further ahead, or across to one side, shall be considered.

3.3.8 Close viewing signal sighting

The following close viewing requirements of signal sighting for that signal shall be incorporated into signal infrastructure design:

(a) The RTC should have a clear view of signals from 20 m to the 6-second sighting point.

(b) Signal sighting should be achieved by RTC when rail traffic is stationary within 13 m of the signal or at the stop marker on the platform.

(c) The short range signal light units have the widest viewing angle and are the most suitable for close range viewing.

(d) The assessment of sighting distance shall accommodate reduced visibility during daylight of gantry mounted signals (approximately 20 m of the gantry).

(e) If rail traffic is required to pull up to a gantry mounted signal (e.g., at a platform), the provision of a co-acting signal should be incorporated into the design.

3.3.9 Signal sighting hazards and controls

Where it is necessary to position signals which does not comply with the signal sighting requirements:

(a) the risk implications of each non-compliance shall be assessed;

(b) appropriate control measures shall be implemented to reduce identified risks so far is as reasonably practicable; and

(c) appropriate control measures shall be implemented to ensure no intolerable risks remain.

Where minimal flexibility occurs in the rail traffic stopping position (e.g., platforms), a second signal head used as a co-acting signal, positioned within the line of visibility of RTC should be included.

3.3.10 General visibility

Lights, particularly from the flashing aspects of signals should be designed to minimize light pollution to neighbouring properties adjacent to the rail corridor

Signal design shall minimize the risk that the position of the signal lights could cause a distraction to road vehicle drivers on adjacent road traffic lanes.

3.3.11 Documentation of signal sighting

The signalling design representative shall provide the approved signalling arrangement plans and prepare the signal sighting forms.

Any non-compliance to the requirements of relevant standards of the relevant railway authorities shall be documented.

All information gathered from the site inspections shall be recorded in the signal sighting forms and the approved signal sighting checklists.

The decisions of the signal sighting working group shall also be recorded on the signal sighting forms.

The signal sighting forms shall be signed by all representatives to confirm the information from the site inspections and the decision of the signal sighting committee.

The final signal sighting forms and signal sighting checklists shall be produced and be neat and accurate and shall contain all the information gathered from the final site inspection.

The final signal sighting forms and signal sighting checklists shall form part of the signal design reports.

Where special restrictions apply to aspects of signals due to signal sighting requirements this shall be clearly identified in individual signal sighting forms.

New works or any alternation to existing works that can affect the visibility of existing signals shall be individually recorded in signal sighting forms.

3.4 Signal electrical design

3.4.1 Lightning and surge protection

Lightning protection and earthing shall be installed to all signals and signal structures in accordance with AS 1768.

The protection shall not affect the performance of signal lights and ensure earth loops are not created.

3.4.2 Signal light (lamp) proving requirements

Signal light proving functions shall be provided in accordance with the requirements specified in the signalling principles of the relevant RIM.

LED light units shall be deemed to have failed if:

(a) the signal light (lamp) proving module detects a shut-down status; or

(b) the current level being below a pre-set threshold level for more than a specified time period.

Lamp proving threshold levels shall be able to accommodate the different operating currents of different colour light units operating at the same apparent brightness.

Incandescent lamps shall be deemed to have failed if the lamp proving module detects the current level being below a preset threshold level for more than a specified time period.

3.4.3 Interfacing with existing signals

For a new signal with incandescent lamps in an existing interlocking area, the lamp out indication of the new signal should be integrated into the relevant existing lamp failure alarm circuit in the interlocking.

3.4.4 Signal design documentation

Special restrictions apply to cabling or wiring of signal light operating circuits shall be clearly noted in the circuit drawings of lamp operating circuits.

The circuit should show the LED type and range of the unit to be used.

3.4.5 Signal feed cabling - cable length limits

The design shall assess the following factors which can limit the length of tail cables parallel to the railway line distance between a signal and its signal control relay or signal control modules:

(a) Limiting induced voltages from AC overhead traction supply or any adjacent high voltage power distribution line to a level that will be inadequate to illuminate the lamps;

(b) Restricting induced voltages from AC overhead traction supply or any adjacent high voltage power distribution line, to ensure the safety of staff;

(c) Reducing electromagnetic interference in electronic circuits;

(d) Limiting capacitive coupling between signal cable conductors in signal with common returns and single-cut controls;

(e) Limiting voltage drops between the equipment housing and the signal; and

(f) Facilitating testing and maintenance.

Section 4 Construction

4.1 Site survey

A site survey shall be performed to verify the locations of existing equipment and confirm the proposed positions of all relocated or new equipment.

The location of all existing cables, utilities, drains and all other underground services in the area to be excavated, including water, storm water, sewerage, and gas should be located and marked. Checks shall be carried out to ensure that no underground services exist within 1 m distance of the proposed work location

4.2 Signal structure construction

Existing retaining walls shall not be cut away or otherwise disturbed for the construction of signal structures without the written approval of the relevant RIM.

Retaining walls shall be built where it is necessary to cut back and shore the bank to provide space for the signal foundation, and there is a danger of erosion or subsidence of the bank or cutting due to the signal placement.

Foundation design and structure design for signal post, signal gantry and signal cantilever shall be certified by a professional engineer registered with a relevant Australian engineering registration board in the appropriate discipline.

A concrete landing shall be constructed for ladders to signal posts and signal gantries in accordance with the relevant requirements of the standard AS/NZS 1657.

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

Footings for foundations of signal masts and gantries shall be excavated to the specified sizes and depths.

If a foundation or landing is to be located such that it would obstruct existing or proposed track drainage arrangements, alternative drainage arrangements shall be provided.

The use of mechanical digging or boring machines for excavation within 2 m of high voltage cables or 1 m of other existing underground cables and services shall not be permitted.

Excavation within 2 m of high voltage cables or within 1 m of other existing underground services shall be carried out using hand tools.

Excavation for installation of signals near tracks shall be securely shored to prevent the sides of the excavation from collapsing.

Masts shall be wedged, shimmed or packed on foundations to achieve levelling then grouted between foundation and mast foot.

When the signal and gantry foundations are installed and approved, the foundations shall be backfilled to level the site and any surplus spoil shall be removed.

Welding to or drilling of signal structures after fabrication and erection, to attach signals, signal cages, walkways, handrails, ladders, notice plates, telephones, cable trays or cable shall not be permitted.

Environmental impacts due to installation of signals shall be evaluated during signal structure design. Installation of signals shall comply with the conditions specified in the relevant approved environmental documents.

Access to locations where signals are installed shall comply with the relevant requirements of the standard AS/NSZ 1657:1992.

4.3 Installation of signals

Signals shall be fitted with the aspects as shown in the signalling arrangement plans, signal sighting form and signalling circuits

Mounting and arrangement of signal light units shall be in accordance with the approved assembly plans and signal sighting forms.

Signal head doors shall be fitted with padlocks and locked immediately after the signal is erected.

Signal light units not in service shall be de-energized, suitably bagged by black heavy duty durable PVC/hessian type bags, pointed away from track and/or have crosses installed in front of the signals in accordance with the requirements of the relevant RIM.

Any surplus holes in the signal masts shall be plugged with a non-corrosive plug.

4.4 Signal mast wiring and terminations at base

Signal mast wiring should comply where possible with the requirements in AS/NZS 3000, *Wiring Rules*. RIMs shall risk assess the requirements for their own organizational local needs.

The RIM may specify that terminals be provided in the base of the signal mast for the termination of signal tail cables.

Alternatively, tail cables may be run through the base and mast to terminate directly in each signal lamp head.

In either case, all wiring between the lamp head and signal base shall be double insulated for its entire length.

All cable openings in the signal mast and lamp heads shall be finished with rounded edges, grommets or other means as approved by the RIM to prevent damage to the signal wiring

Where lamp heads are mounted on brackets, wiring to the lamp head shall be installed in suitable conduit to provide protection from mechanical and weather damage.

Negative looping from signal base to signal light units should not be allowed.

4.5 Inspections during construction

Installation Inspections shall be carried out to ensure that:

(a) The foundations for signals and signal gantries are constructed at the position indicated on the corresponding signal sighting forms;

(b) Signal foundations are constructed at the distance from rail and height above rail shown on the corresponding signal sighting forms; and

(c) Gantry foundations are constructed at the location shown on the corresponding signal sighting forms and at the distance from nearest rail and height relative to rail level as shown on the corresponding engineering plans for the gantry.

4.6 Inspections after construction

Inspections shall be conducted to ensure that the signal installation is complete and conforms to the relevant approved signalling installation specifications.

Signal profile and positioning shall be verified and documented as per the requirements of the RIM.

Conformances of signal sighting, structural clearance and electrical clearance of signals and signal structures shall be verified and documented.

The provision of safe access for maintenance shall be verified and documented.

Type, rating and configuration of components shall be verified and documented.

Installation of relevant signage shall be verified and documented.

Workmanship and physical condition of signal equipment, cable routes and terminations shall be verified and documented.

Section 5 Testing and commissioning

5.1 Management and planning

If a change in signalling circuits, data or infrastructure affects the display of aspects then indications and sequences shall be tested.

For testing and commissioning requirements, refer to AS 7717.

Railway organizations and contractors undertaking signalling projects shall ensure that projects are adequately resourced for their respective parts with competent personnel who are able to perform their allocated duties.

5.2 Recovery, removal and site clean-up works

Decommissioned signals scheduled for removal shall be rendered in such a way that it cannot be mistaken for a valid or failed operational signal.

Acceptable methods for rendering a signal safe may include one or more of the following:

(a) Removal of lamps and identifying the signal as 'out of use' by affixing of a white diagonal cross in front of the signal head;

(b) Covering of the signal head with a secure black heavy duty durable PVC/hessian type bags; and/or

(c) Rotating and securing the signal head at right angles to the line of track.

Recovery and removal of decommissioned signals shall be planned as part of the testing and commissioning activities.

Demolition of signal gantries and cantilevers and other demolition works which require the use of powered mobile plants shall be carried out as per safeworking rules of the RIM.

A competent demolition supervisor shall be assigned to plan and manage the demolition of signal gantries and cantilevers.

The methods for dismantling and recovery shall not cause damage to any new or remaining items of equipment.

Where signal posts and signal gantries are to be removed, the foundations should be treated as follows:

(d) Precast foundations should be completely removed from the site and the excavated hole backfilled and compacted as per the relevant requirements of the civil standard; and

(e) Foundations which have been cast on site should have the steelwork cut off flush with the top of the concrete, the concrete foundation excavated, removed, backfilled and compacted as per the relevant requirements of the civil standard.

Upon removal of redundant signals and equipment housings, the site area should be cleared of all project and associated waste.

5.3 Disposal

Safe railway operations shall be maintained at all times prior to disposal of decommissioned equipment.

Inappropriate re-use of decommissioned equipment should be prevented prior to disposal. Disposal of decommissioned equipment should not cause any public hazards.

Section 6 Monitoring and Maintenance

6.1 Maintenance of sighting distances and alignment of signals and signs

Inspections shall be carried out as per planned schedules to verify that the visibility and alignment have not been adversely affected.

Safe access shall be available and verified for the maintenance of all signal light heads of a signal, and for the inspection of the structural integrity of all parts of signal masts and structures.

Inspection of signals shall include checks of:

(a) the alignment of signal light units and indicators;

(b) the signal sighting distances;

(c) the close-up viewing of the signal;

(d) evidence of ground settlement affecting the signal structure;

(e) conditions of signal light units and indicators;

(f) interference and obstructions to signal visibility; and

(g) clear legibility of nameplate under daylight and night conditions.

Inspection of signs shall include checks for:

(h) presence, i.e. in the correct location and with the correct text;

(i) state, i.e. upright, undamaged and facing the correct direction; and

(j) clear legibility under daylight and night conditions.

The approved signal sighting records shall be used to confirm the correctness of the signal sighting distances and alignment.

All results and findings from inspections shall be recorded and reported in accordance with the relevant RIM maintenance procedures.

Any proposed change to environment, including building, structures, lighting, line speed increases, stopping positions of rail traffic and vegetation, in the vicinity of the signals shall be submitted to the RIM for review so that the effect of the change to the visibility of signals can be assessed.

The RIM shall arrange for all reports received regarding proposed changes to, or deficiencies in, signal visibility to be initially assessed by authorized staff.

The RIM shall ensure that, where recommended after initial assessment, a signal sighting working group is arranged to assess a proposed change of, or a reported deficiency in, signal visibility.

All results and findings from inspections shall be recorded and reported in accordance with maintenance procedures.

6.2 LED partial failure (degradation)

For new infrastructure or compatible upgrades to existing infrastructure, the detection of partial failure shall be made by appropriate circuitry monitoring the current flows and hence the overall intensity based on the theoretical intensities of the various LED types used.

For new infrastructure or compatible upgrades to existing infrastructure, each signal light shall operate such that the aspect shall be deemed to have failed if the current flow becomes lower than 50% of rated current or the intensity of the signal light cannot be sighted correctly.

The RIM should assess these requirements against existing infrastructure and consider upgrading where reasonably practicable.

6.3 Maintenance of signal heads

Inspections shall be carried out as per planned schedules to examine:

(a) signal heads, hoods and background for degradation of protective surface coating, including evidence of corrosion and loss of structural integrity;

(b) signal head seal for evidence of damage or degradation;

(c) lock and hinges for indications of seizing when operated, and for corrosion;

(d) tightness of fastenings for signal heads and hoods; and

(e) condition of the lens.

During inspection, signal heads shall be examined for evidence of vermin or insect nesting/infestation. Reporting the findings or removal of nests shall be carried out as required.

During inspections, cleaning, lubrication, replacement and tightening of parts on signal heads shall be carried out as required.

6.4 Electrical maintenance

Inspections shall be carried out as per planned schedules to check:

(a) condition of wires and cables;

(b) tightness of electrical connections; and

(c) voltages at terminals for lamp operating circuits.

During inspections, cleaning terminals, tightening connections and replacement of wires and cables shall be carried out as required.

Insulation test of wires and tail cables shall be carried out if there is any suspicion or evidence of degradation of insulation.

6.5 Tilt and telescopic signal mast maintenance

The upright and lowered-down mechanisms of tilt and telescopic signal masts shall be checked as part of the programmed maintenance schedule.

Detection of the mast being upright may be specified by the RIM.

Inspections shall be carried out as per schedules to check:

(a) condition of masts;

(b) all fastenings on the mast are torqued and or secured to manufacturers specifications; and

(c) smoothness of all rotatable parts.

During inspections, cleaning, lubrication, replacement and tightening of parts on the masts shall be carried out as required.

6.6 Incandescent lamp units

Inspections shall be carried out as per planned schedules to check that:

(a) lamps are secure in lamp holders; and

(b) both filaments of twin filament lamp if applicable are burning; or

(c) changeover function if applicable of filaments works properly.

During inspections, cleaning and replacement of parts shall be carried out as required.

6.7 Lamp replacement

The replacement lamp shall be firstly inspected to be the correct type and not damaged. Voltages at terminals for lamp operating circuits shall be measured and recorded.

Operation of lamps shall be checked to confirm that:

(a) both filaments of twin filament lamp if applicable are burning; or

(b) changeover function if applicable of filaments works properly.

Status of lamp proving functions on signal control system shall be checked to confirm the restoration of their normal status.

6.8 Led light and indicator unit maintenance

Inspections shall be carried out as per planned schedules to examine:

(a) LEDs for flickering, or failed LEDs when the signal is illuminated;

(b) LEDs for the number of failed LEDs not exceeding the specified limit;

(c) cover of light units for signs of damage and of water ingress; and

(d) resistors and surge protection devices for damage and overheating.

The RIM shall determine the percentages of failed/dark LEDs at which the signal will require:

(e) planned replacement; and

(f) immediate replacement

During inspections, cleaning, replacement and adjustment of parts shall be carried out as required.

6.9 Semaphore signal maintenance

Inspections shall be carried out as per planned schedules.

The inspection shall verify that all movable parts move freely and without excessive lost motion.

During the inspection, signal blade, lens, reflector, roundels, glass and lamps shall be checked for any defect and shall be cleaned as necessary to ensure good indications.

During the inspection, the release values of hold clear devices shall be measured. During the inspection, the switching response times of arms shall be measured.

During the inspection, electric parts, other than electric motor, shall be checked as per the relevant requirements of Section 6.3 Electrical Maintenance in this Standard.

During the inspection, the electric motor and its associated parts, shall be checked to ensure:

(a) free working of the arms;

(b) correct locking operation of the arms; and

(c) no excessive overrun of the motor and gear train when the signal arm returns to the stop position.

During the inspection, all mechanical levers and associated parts shall be checked to ensure:

(d) free working of the arms;

(e) correct locking operation of the arms; and

(f) adjustment to ensure the arm returns to the stop position.

During inspections, cleaning, lubrication, replacement and adjustment of parts shall be carried out as required.

6.10 Signal structure maintenance

Inspections shall be carried out as per the maintenance schedules to check the condition of:

(a) signal structures;

(b) ladders, platforms and landings of signal structures;

(c) foundation for signal structure; and

(d) access to signal structures.

The inspection shall check for any symptoms of rusting and potential trapping hazards.

6.11 Maintenance planning

Each of the relevant RIM shall have a documented maintenance plan to cover the maintenance of lineside signals, indicators and signage.

6.12 Mechanical points indicators

During the inspection, all mechanical levers and associated parts shall be checked to ensure:

(a) free working of all moving parts and blades;

(b) correct locking operation; and

(c) adjustment to ensure the blades return to the correct position.

Appendix A Hazard Register (Informative)

The following hazards are addressed by this standard:

Hazard No.	Hazard Description
9.1.2.1	Incorrect design
9.6.1.3	Equipment not interfacing with existing equipment/design
9.10.1.1	Inadequate operational distances in positioning of signals
9.10.1.2	Signalling Principles does not match operating scenarios
9.10.1.3	Failure to consider signal sighting
9.10.1.4	Incorrect signals being specified (e.g., range, spread)
9.10.1.5	Supply voltage not matching signal specification
9.10.1.7	Pickup in cables incorrectly lighting aspects
9.10.1.8	Inadequate isolation between aspects
9.10.1.9	Misreading of route indicators
9.10.1.10	Inadequate transient protection & earthing
9.10.1.11	Misreading Signals
9.10.1.14	Maintenance not being considered
9.10.1.15	Interfaces with physical rail infrastructure
9.10.1.16	EH&S (Environmental, Health and Safety) hazards
9.10.1.17	Designer competency
9.10.1.18	Inadequate consideration of failure modes
9.10.1.19	Design not taking account of technology (e.g., tilt masts)
9.10.1.20	The ability to read signs in time
9.10.1.27	The placement of signals in relation to driver misjudgement
9.10.1.28	Designs not being correct or meeting standards and principles or operations requirements
9.10.1.30	Inadequate spacing of signal lights on one mast
9.14.1.4	Cable damaged in above ground cable routes, post construction
9.14.1.5	Cables damaged during installation in routes
9.15.1.4	Routes impacting on or impacted by 3rd party services
9.19.1.2	Poor construction
9.19.1.3	Incorrect position
9.19.1.5	Damage to equipment

Hazard No.	Hazard Description
9.23.1.1	Latent conditions preventing installation of signal at design locations
9.23.1.2	Heritage, aboriginal, rare frogs and bio site imperatives and regulations
9.23.1.3	Signals relating to EH&S and site facilities
9.23.1.4	Absence of safe access to locations for installation or future maintenance
9.23.1.5	Inadequate clearance to rolling stock outline
9.23.1.6	Interaction with other facilities and utilities
9.23.1.7	Incorrect or inadequate materials
9.23.1.9	Sightings do not meet standards due to other infrastructure changes
9.23.1.11	Locomotive or rolling stock being different and not compatible with signal sighting
9.23.1.12	Community dissatisfaction with location of signals
9.23.1.14	Competencies and resources (people and things)
9.32.1.1	Documents being out of date
9.32.1.2	Design not being finished
9.32.1.3	Installation being incomplete
9.32.1.15	Scope definition between contractors and the Railway remaining inadequately defined (who tests what)
9.32.1.17	Resource availability (including competencies, experience)
9.32.1.20	Incorrect final sighting and aligning of signals
9.42.1.1	Managing trains around failed signals leading to incidents
9.42.1.2	Signals displaying incorrect indications
9.42.1.3	Signals displaying no indication
9.42.1.4	Drivers passing signals at stop
9.52.1.1	Signals being obstructed by vegetation, building or other obstruction leading to SPAD
9.52.1.2	Safe access to signals not being provided, leading to injury
9.52.1.3	Poor reliability leading to train delays or wrong side failure causing accident
9.52.1.4	Signal failure resulting in train delays or safety incident
9.52.1.5	Signals fall over leading to maintainer injuries or collisions with trains
9.58.1.3	Unprotected electrical voltages
9.62.1.1	Inadequate management of decommissioned signals until they are removed
9.62.1.2	Redundant concrete signal bases causing derailment of track machines
9.62.1.3	Inaccurate documentation (including control system data) for the removal of signals

Bibliography (Informative)

The following referenced documents are used by this Standard for information only:

- AS 1743, *Road Signs – Specifications*
- AS/NZS 1906, *Retro reflective Materials and Devices for Road Traffic Control Purposes Part 1: Retro reflective Sheeting*
- IEC 60050, *International Electrotechnical Vocabulary*
- BS 469:1995, *Specification for Railway Signal Lamps*
- BS EN 50122-1:2011, *Railway applications - Fixed installations - Part 1: Protective provisions relating to electrical safety and earthing*
- BS EN 50126:1999/IEC 62278:2002, *Railway applications - The specifications and demonstration of reliability, availability, maintainability and safety*
- BS EN 50128:2011/IEC 62279:2002, *Railway applications - Communications, signalling and processing systems - Software for railway control and protection systems*
- BS EN 50129:2003, *Railways applications - Communications, signalling and processing systems - Safety related electronic systems for signalling*
- BS EN 50159:2001/IEC 62280:2002, *Railway applications - Communications, signalling and processing systems - Safety-related communication in closed/open transmission systems*
- *BS EN 62290-1:2006/IEC 62290-1:2006, Railway applications - Urban guided transport management and command/control systems - Part 1: System principles and fundamental concepts*
- *Network Rail Standard RT/E/C/11600, Issue 1, Aug 2000*
- RGS GE/RT 8025, *Electrical Protective Provisions for Electrified Line, Issue 1, Oct 2001*
- RGS GE/RT 8034, *Maintenance of Signal Visibility, Issue 1, Feb 2002*
- RGS GE/RT 8037, *Signal Positioning and Visibility, Issue 1, Dec 2003*
- RGS GE/RT 8048, *Positioning and Labelling of Lineside Telephones, Issue 1, Feb 2002*
- *RGS GK/RT 0036, Transition Between Lineside Signalling Systems, Issue 2, Sep 2011*
- RGS GK/RT 0039, *Semaphore and Mechanical Signalling, Issue 1, Jul 1997*
- RGS GK/RT 0045, *Lineside Signals, Indicators and Layout of Signals, Issue 3, Dec 2012*
- RGS GL/RT 0075, *Lineside Signal Spacing and Speed Signage, Issue 2, Sep 2011*
- RGS GK/RT 0186, *Safety Requirements of Signal Post Telephone Systems, Issue 1, Oct 1996*
- *Sydney Train SMS-06-GD-3066, Safety Management System Guide: Managing Construction Hazards, Version 1.1, 23 Aug 13*