RAIL SAFETY AND STANDARDS BOARD

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# Lineside Signal and Indicator Product Design and Assessment Requirements

This document sets out requirements and technical parameters for the product design of lineside signals and indicators, and the readability assessment requirements applicable to product certification.

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## Synopsis

This document sets out requirements and technical parameters for the product design of lineside signals and indicators, and the readability assessment requirements applicable to product certification.



**Published by RSSB**

**Issue record**

| Issue | Date | Comments |
|---|---|---|
| One | December 2014 | Original document, superseded GKRT0045 issue three.<br><br>This standard is a result of an analysis of technical compatibility between lineside signalling systems and train operations. The requirements set out in this standard are consistent with the development of products that are capable of being readable, which is a pre-requisite of obtaining an authorisation for placing a new or modified lineside signalling system into service. |
| Two | June 2024 [proposed] | Replaces issue one. This document has been restructured with supporting guidance and rationale from withdrawn GKGN0657 issue one added throughout. Amendment GKRT0057 issue 1 AM001 has been incorporated into this document. |

Revisions have not been marked by a vertical black line in this issue because the document has been revised throughout.

**Superseded documents**

The following Railway Group documents are superseded, either in whole or in part as indicated:

| Superseded documents | Sections superseded | Date when sections are superseded |
|---|---|---|
| GKRT0057 issue one | all | June 2024 [proposed] |
| GKGN0657 issue one | all | June 2024 [proposed] |

**Supply**

The authoritative version of this document is available at www.rssb.co.uk/standards-catalogue. Enquiries on this document can be submitted through the RSSB Customer Self-Service Portal https://customer-portal.rssb.co.uk/

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# Part 1 Purpose and Introduction

## 1.1 Purpose

1.1.1 This document sets out requirements for lineside signalling products to support readability, interpretability and driveability so that the signal aspects and indications they display are capable of being read when those products are used in accordance with their intended application.

1.1.2 This document also specifies the lineside signalling product readability assessment requirements.

## 1.2 Introduction

### 1.2.1 Background

1.2.1.1 Lineside signalling systems are provided by infrastructure managers to convey the following types of information to authorised users involved with train operations:

a) Movement authority information;
b) Routing information;
c) Permissible speed information;
d) Locally monitored infrastructure status information; and
e) Operating instructions.

1.2.1.2 The information is conveyed in the form of signal aspects, route indications, lineside operational signs and other signalling indications.

1.2.1.3 This document specifies the appearance requirements and readability performance assessment requirements for products used as lineside signals and indicators so that the displays they generate are capable of being read by authorised users.

1.2.1.4 Where a design parameter value is shown as 'unspecified' in this standard, the parameter is relevant to technical compatibility but it is not appropriate to specify a constraint as a national rule applicable to all lineside signals or indicators. In these cases, the product design specification assigns a value and tolerance that supports the visibility performance and readability performance intended for that design of signal or indicator.

1.2.1.5 Where a design parameter value is not relevant, it is shown as 'not applicable' in this standard, for example flashing display parameters are not applicable to semaphore signal products.

### 1.2.2 Principles

1.2.2.1 The requirements of this document are based on the following principles.

1.2.2.2 This document sets out requirements that meet the characteristics of national technical rules (NTRs) and are applicable to the Great Britain (GB) mainline railway system. Compliance with NTRs is required under the Railways Interoperability Regulations 2011 (as amended).

1.2.2.3 The NTRs in this document are used for the following purposes:

a) To fill identified open points in National Technical Specification Notices (NTSNs).
b) To support GB or UK specific cases in NTSNs.
c) To support an exemption from an NTSN.
d) To enable technical compatibility between:
    i) Vehicles that conform to the requirements of the NTSN, and the existing control, command and signalling, infrastructure and/or energy subsystem or vehicles.
    ii) Control, command and signalling, infrastructure and/or energy subsystem that conform to the requirements of the NTSN, and the existing vehicles.

### 1.2.3 Structure of this document

1.2.3.1 Where relevant, the national technical rules relating to relevant NTSN parameters have been identified together with the relevant clause from the NTSN.

1.2.3.2 This document sets out a series of requirements that are sequentially numbered. This document also sets out the rationale for the requirement, explaining why the requirement is needed and its purpose and, where relevant, guidance to support the requirement. The rationale and the guidance are prefixed by the letter 'G'.

1.2.3.3 Some subjects do not have specific requirements but the subject is addressed through guidance only and, where this is the case, it is distinguished under a heading of 'Guidance' and is prefixed by the letter 'G'.

### 1.2.4 Related requirements in other documents

1.2.4.1 The following Railway Group Standards contain requirements that are related to the scope of this document:

a) GIRT7033 Lineside Operational Safety Signs
b) GKRT0075 Requirements for Minimum Signalling Braking and Deceleration Distances.

### 1.2.5 Supporting documents

1.2.5.1 The following Railway Group documents support this Railway Group Standard:

a) GEGN8651 Guidance Note for Safe Integration of CCS Systems with Train Operations
b) RIS-0703-CCS Signalling Layout and Signal Aspect Sequence Requirements
c) RIS-0713-CCS Lineside Signalling Layout Driveability Assessment Requirements
d) RIS-0737-CCS Signal Sighting Assessment Requirements
e) RIS-0758-CCS Lineside Signal Aspects and Indications
f) RIS-3451-TOM Train Drivers - Suitability and Medical Fitness Requirement
g) RIS-3452-TOM Train Movement - Medical Fitness Requirements.

## 1.3 Approval and authorisation of this document

1.3.1 The content of this document will be approved by Control, Command and Signalling Standards Committee on 4 April 2024 [proposed].

1.3.2 This document will be authorised by RSSB on 25 April 2024 [proposed].

# Part 2 Introductory guidance

## 2.1 Readability compatibility

**Guidance**

G 2.1.1 Readability is a specific area of technical compatibility at the interface between the lineside signalling system which is managed by an infrastructure manager, and train operations which is managed by railway undertakings.

G 2.1.2 The lineside signalling system contribution to readability is to display signal aspects and indications that are readable. The authorised user contribution to readability is to read what is displayed by the lineside signalling system.

G 2.1.3 Readability has a range, which extends from never readable by anyone, through to readable by some people in some circumstances, to easily readable by everyone in any circumstance.

G 2.1.4 Readability is achieved only when each lineside signalling system display is sufficiently readable in the railway operational context.

G 2.1.5 Product capability on its own is not a guarantee for achieving a sufficient level of readability. Two distinct sets of technical compatibility requirements are relevant to readability compatibility of lineside signal aspects and indications:

a) The technical parameters and readability performance assessment requirements relevant to product design and testing specifications, set out in this standard, so that the displays they generate are capable of being readable; and
b) The technical parameters and readability assessment requirements that are used to confirm that, when the product is used, the signal aspects and indications it generates are readable in the operational context. These requirements are set out in RIS-0737-CCS.

## 2.2 Terminology

**Guidance**

G 2.2.1 The following terms, defined at the end of this document, have very specific meanings in the context of signalling product design and assessment:

a) Display, which is a term used to describe each distinct image that a signalling product is intended to generate
b) Signal aspect / indication, which are terms used to describe the application of each display when the product is used in the operational context to convey information to authorised users
c) Visible, which is a term used to describe the ease and reliability with which signal aspects, indications and signs can be detected by an authorised user
d) Identifiable, which is the term used to describe the extent to which a signal, indicator or sign is capable of being identified
e) Distinguishable, which is the term used to describe the extent to which a signal aspect, indication or sign is capable of being recognised

f) Readable, which is the term used to describe the extent to which an authorised user can read a signal, indicator or sign.

G 2.2.2 Visible, identifiable and distinguishable are system capabilities that are a subset of readable. A signal aspect is readable only when it is visible, identifiable and distinguishable.

G 2.2.3 In some cases a display that is visible before it is distinguishable can be used to advantage within the signalling system.

## 2.3 Readability factors

### Guidance

G 2.3.1 Four sets of factors support and influence lineside signalling system readability:

a) The product hardware parameters set out in *2.4*;
b) The product display parameters set out in *2.5*;
c) The operational context design factors set out in *2.7* and RIS-0737-CCS; and
d) The human factors set out in *2.8*.

G 2.3.2 The guidance for hardware and display parameters, set out in sections *2.4* and *2.5*, are generic to all lineside signals and indicators. Product specific parameters and guidance are set out in *Part 3* of this document.

## 2.4 Product hardware parameters

### Guidance

G 2.4.1 Each product hardware parameter has the potential to influence the level of readability supported by the lineside signalling system when the product is used in the operational context.

G 2.4.2 The relationship between hardware parameters and product capability are identified by tick marks in Table *1*.

G 2.4.3 It is good practice for product design and testing specifications to address all of the relevant product design factors set out in *Part 3*.

| Hardware parameter | Product capability | | | |
|---|---|---|---|---|
| | Signalling hardware | | Signalling displays | |
| | Be visible | Be identifiable | Be visible | Be distinguishable |
| Size | ✓ | | | |
| Colour | | ✓ | | |
| Shape | | ✓ | | |
| Surface gloss | ✓ | | ✓ | |

**Table 1:** Hardware design parameters and product capability

G 2.4.4 Hardware size, colour and shape parameters all have the potential to affect the overall appearance of each type of signal and indicator. The overall appearance of signalling hardware influences the ease that authorised users will be able to detect and identify each lineside signal and indicator in the operational context.

G 2.4.5 In some cases, a distinctive hardware size, colour or shape could be recommended by a signal sighting committee (SSC) in order to make a signal or indicator stand out from surrounding features and therefore help to make it more readable.

G 2.4.6 The overall hardware size helps lineside signals and indicators to be visible. It is not a critical parameter if the dominant visible feature is a lit display.

G 2.4.7 Hardware size takes account of:

a) The readability performance that the product is intended to meet;
b) The range of displays that are generated by the product;
c) The number and arrangement of display elements that make up each display;
d) The design of the optical system;
e) Any physical constraints that the product is intended to overcome, for example limited clearance in a tunnel;
f) Whether or not a separate backboard will be fitted; and
g) The type of structure provided to support the product.

G 2.4.8 It is good practice for products that generate lit displays to be designed to block out visibility of features that would interfere with readability and to provide a strong display contrast ratio. Where the housing does not achieve this on its own, the design specification might specify the requirement for a separate backboard.

G 2.4.9 The surface gloss characteristic affects the light emission or reflection from surfaces. It influences how much luminous power will be detected by an eye looking at the surface from a particular angle of view and therefore affects how bright the surface will appear.

G 2.4.10 Excessive surface gloss can affect the appearance of lineside signals, indicators, and displays and therefore has the potential to reduce the readability of illuminated signalling system displays.

G 2.4.11 Surface gloss is a problem when it adversely affects the appearance of the signalling system display generated by that product. For example, if position light route indicator lamp assemblies are illuminated by sunlight, the authorised user might misread a route indication.

G 2.4.12 BS EN ISO 2813:2014 specifies a standard methodology for measuring the specular gloss of non-metallic paint films at 20˚, 60˚ and 85˚, using a calibrated gloss meter.

G 2.4.13 Specifications for new product types aim to achieve the surface gloss levels set out in Table *2*. These values have been comfortably achieved for colour light signal products using modern paint finishes, when new. Signalling equipment that exceeds these limits has been accepted.

| Measured angle | 20˚ | 60˚ | 85˚ |
|---|---|---|---|
| % surface gloss | <0.1 % | <0.3 % | 3.0 % |

**Table 2:** Example surface gloss values

G 2.4.14 If readability performance is achieved using retroreflective material, the product design specification takes account of the light source that is to be reflected. For example, the specification of reflectorised stop boards, distant boards and retroreflective buffer beams are compatible with the light intensity and distribution from a relevant trainborne headlight.

G 2.4.15 Further requirements for testing retroreflective characteristics are set out in BS EN 12899-1:2007.

G 2.4.16 Optical requirements for rail vehicle head lamps and marker lamps are set out in the Locomotive and Passenger National Technical Specification Notice (LOC & PAS NTSN) and BS EN 15153-1:2020.

## 2.5 Product display parameters

### Guidance

G 2.5.1 Each product display parameter has the potential to influence the level of readability supported by the lineside signalling system when the product is used in the operational context.

G 2.5.2 The relationship between display parameters and product capability are identified by tick marks in Table *3*.

G 2.5.3 It is good practice for product design and testing specifications to address all of the relevant product design factors set out in *Part 3*.

G 2.5.4 Where a signalling system display comprises more than one display element, the appearance of the signalling display is influenced by the overall proportions of what is

displayed, as well as the design values assigned to individual display elements. The parameters are interrelated and product design will consider them in combination.

| Display parameter | Product capability | | | |
|---|---|---|---|---|
| | Signalling hardware | | Signalling displays | |
| | Be visible | Be identifiable | Be visible | Be distinguishable |
| Luminous intensity | | | ✓ | ✓ |
| Size | | | ✓ | ✓ |
| Contrast | | | ✓ | ✓ |
| Colour | | | ✓ | ✓ |
| Shape | | | ✓ | ✓ |
| Flashing or steady | | | ✓ | ✓ |
| Flashing rate | | | | ✓ |
| Flashing pattern | | | | ✓ |
| Number of display elements (including coloured lights, letters or numbers) | | | ✓ | ✓ |
| Display element arrangement | | | ✓ | ✓ |
| Display element spacing | | | | ✓ |

**Table 3:** Display design parameters and product capability

G 2.5.5 Luminous intensity, size and contrast parameters are interrelated and obtaining a balance between these will support the specified readability performance. Optimisation of these parameters helps authorised users to read lineside signalling system displays against a background of other visible objects and lights in the prevailing ambient conditions.

G 2.5.6 Luminous intensity, size and contrast are unspecified in this standard for most lit displays because the values can be specified in combination in order to optimise visibility and readability performance for the intended applications.

G 2.5.7 Before specifying a product that generates a display with significantly different luminous intensity, size and contrast parameters compared with the designs currently in use on the GB mainline railway, it is important to understand the consequence of doing so.

G 2.5.8 Significant variations in luminous intensity, size and contrast along a line of route might constitute a hazard in the operational context. In particular, significant variation in display element size could affect the driver's perception of the distance to the signal or indicator, particularly if indiscriminate use of the product results in frequent transitions. This may be less of a problem if a complete route is fitted with products that generate similar displays.

G 2.5.9 A display that has a smaller display element size could result in the driver perceiving a greater distance than the distance that is actually available, particularly in the absence of other visible stimuli.

G 2.5.10 Because ambient light can negatively affect the readability of signal aspects and indications, the design of optical systems are capable of generating displays that are visible and readable in all foreseeable conditions of natural and artificial lighting in the intended application and context. This may also take account of the effect of sunlight and fog on visibility and readability.

G 2.5.11 Unless a product is intended for use in an environment that has a consistent level of ambient light, for example in a tunnel, the design will be balanced for day and night use.

G 2.5.12 In general, light sources have to be much brighter to be readable in daylight than at night, which can result in displays becoming too bright at night.

G 2.5.13 Excessive luminous intensity can cause discomfort, glare and make displays and indications difficult to read due to the 'bleeding' of the lights into each other. This is a particular problem if the appearance of the display is distinguished by any of the following:

a) The number of display elements, for example a double yellow display;
b) The shape of a display element, for example a symbol or alphanumeric character; or
c) The arrangement of the display elements, for example a banner repeater arm position.

G 2.5.14 The negative effect of excessive luminous intensity is less significant if display appearance is only defined by a single colour or has a steady or flashing appearance.

G 2.5.15 It may be possible to achieve an acceptable balance of luminous intensity, size and contrast area by changing the display element spacing, while not significantly affecting the overall proportions of the display.

G 2.5.16 It could be appropriate to assign different luminous intensity values to different coloured lights. For example, a lower level of luminous intensity might be sufficient to provide a readable yellow display compared with a green display.

G 2.5.17 In some cases, a signal display is made up of a group of display elements, for example a colour light signal double yellow. In these cases, consistent display element size is specified so that the signal display elements appear to be the same size as each other when lit. This provides a consistent appearance to users even if they see the signal display change.

G 2.5.18 In rare cases, the appearance of a display could create a visual illusion where one display element appears to be larger than another display element of the same size. This can be corrected by altering the design so that all display elements appear to be the same size when lit.

G 2.5.19 When a display element is lit, having a consistent level of luminous intensity that does not appear to vary, will support readability.

G 2.5.20 Display contrast is sometimes described in terms of a contrast ratio, which is defined as the ratio of the luminous intensity of the brightest colour to that of the darkest colour, that the system is capable of producing, for example a colour light signal display against a black background. A high contrast ratio is a desired capability of any signalling system display.

G 2.5.21 Optical systems that are designed so that signalling system light sources are not adversely affected by reflection or light leakage, will support readability. For instance:

a) When a display is lit, it is not veiled or washed out by sunlight; and
b) When a display element is not lit, it does not appear to be illuminated.

G 2.5.22 Display element colour and shape are used as a primary means of conveying the meaning of a signal aspect or indication.

G 2.5.23 Colour coordinate requirements for signalling lights are set out in *Part 4*.

G 2.5.24 Colour light signals and signalling indicators only display one colour at a time. This avoids the increased level of misreading due to colour merging.

G 2.5.25 It is good practice for any proposals to implement a new type of signal aspect or indication, or convey an alternative type of information using an existing display, to be supported by evidence that it optimises interpretability and a risk assessment that addresses the risk from misinterpretation.

G 2.5.26 RIS-0758-CCS gives further guidance about misinterpretation risk, including the effect of:

a) Colour distinction from other coloured displays and indications, not limited to railway specific displays but any other display that might be visible in an operational context where the product would be applied, such as traffic lights and street lights; and

b) Concept compatibility between the proposed colour and the information being conveyed.

G 2.5.27 Products capable of generating displays that fulfil the flashing display parameters set out in RIS-0758-CCS, irrespective of whether the flashing appearance is generated by the product itself or by a separate flashing power source, support readability.

G 2.5.28 The flashing rate and flashing pattern combine to provide a distinctive flashing appearance, which helps authorised users to distinguish between a flashing signal display and other light sources that might appear to be flashing. This includes the ability to distinguish between flashing signal displays and signalling displays that might appear to momentarily flash due to intermittent interruptions to visibility, for example intermittent interruptions caused by lineside structures.

G 2.5.29 The appearance of flashing displays can be affected by the technology chosen to generate each display element. For example, flashing displays generated by filament lamps appear to have a transition, whereas LEDs provide a more definite on-off flashing display.

G 2.5.30 In order to provide a consistent appearance, it is good practice for LED signals to mimic the longer apparent mark : space ratio of filament lamps by extending the ON time of each flashing cycle.

G 2.5.31 RIS-0758-CCS provides further rationale and guidance about flashing signal aspects and indications.

G 2.5.32 The alignment and number of display elements help to make signalling system displays visible and distinguishable. For example, the intended appearance of a colour light signal double yellow display is of two yellow lights that are vertically aligned. They are also a primary means of conveying the meaning of a signal aspect or indication.

G 2.5.33 Display element spacing is specified, in order to maintain a consistent proportional appearance of each type of display. This helps signalling displays to be distinguishable.

G 2.5.34 Each colour light signal and indicator display element will typically be generated using either:

a) A single light source, for example a single light source in combination with a lens; or
b) A cluster of individual light sources, for example a matrix of light emitting diodes (LEDs).

G 2.5.35 The design of each display element is specified so that it is visible and distinguishable when observed from the required distance in combination with any other light sources that may be displayed at the same time, including:

a) Other display elements that make up the same display;
b) Other associated signalling system displays, for example a colour light signal display in combination with a junction indication; and
c) External light sources and ambient light levels that could affect visibility and readability.

G 2.5.36 Further guidance about eye safety risk assessment of infrared emitting diodes is given in BS EN IEC 62471-7:2023.

G 2.5.37 Further information about the risk from using high energy light sources is given in BS EN 60825-1:2014+A11:2021. Lasing devices are not used to generate signalling displays due to their potential to cause retinal damage.

## 2.6 Product performance

### Guidance

G 2.6.1 Product performance supports readability when a product is implemented in accordance with its intended use and authorised users can reliably read the displayed signal aspects and indications.

G 2.6.2 It is good practice to involve the client and intended users at the product specification stage to identify any potential concerns about the design and the criteria for its intended use, particularly any issues relevant to the human factors associated with readability given in *2.8* and the operational context factors described in RIS-0737-CCS.

G 2.6.3 It is good practice for the product performance specifications to consider:

a) The range of reading times that the product is intended to support;
b) The range of permissible speeds that apply to the lines on which the product is intended to be used;
c) The readability factors given in *2.3*;
d) The range of ambient light levels in which the product is intended to be used; and
e) The visible range and readable range (viewing distance and angle) that the product is intended to support.

G 2.6.4 Some example minimum reading distances for a range of permissible speeds and reading times are set out in Table *4*.

| **Speed** | | **Readable distance (m) = speed × time** | | |
|---|---|---|---|---|
| km/h (mph) | m/s | 8 seconds | 10 seconds | 12 seconds |
| 24 (15) | 6.7 | 54 | 67 | 81 |
| 32 (20) | 8.9 | 71 | 89 | 107 |
| 40 (25) | 11.1 | 88 | 111 | 133 |
| 48 (30) | 13.3 | 106 | 133 | 160 |
| 56 (35) | 15.6 | 125 | 156 | 187 |
| 64 (40) | 17.8 | 142 | 178 | 214 |

| Speed | | Readable distance (m) = speed × time | | |
|---|---|---|---|---|
| 80 (50) | 22.2 | 178 | 222 | 266 |
| 96 (60) | 26.7 | 214 | 267 | 320 |
| 120 (75) | 33.3 | 266 | 333 | 400 |
| 144 (90) | 40 | 320 | 400 | 480 |
| 160 (100) | 44.4 | 352 | 444 | 533 |
| 200 (125) | 55.6 | 445 | 556 | 667 |

**Table 4:** Example reading distances

G 2.6.5 Further guidance about reading times and readable distances is given in RIS-0737-CCS.

G 2.6.6 When designing optical systems for illuminated displays and indications, it is important to consider the effects that ambient conditions could have on visibility and readability performance, these include:

a) Direct sunlight
b) Precipitation
c) Smoke
d) Fog.

G 2.6.7 BS 1376: 1974 provides further guidance on colour stability and atmospheric effects.

G 2.6.8 Readability performance can be influenced by permanent environmental features for example, a high contrast ratio found in a tunnel. In this case, specific product arrangements may be required to optimise readability performance.

G 2.6.9 GB mainline railway practice has previously been to define readability performance using the categories set out in Table *5*. It is not necessary to restrict readability performance to just these five categories; however, if a performance category is specified, maintaining consistency with those set out in Table *5* will be beneficial to avoid misunderstandings with existing signal and indicator designs.

| Category | Readable distance performance (m) | Maximum permissible speed (km/h (mph)) | Typical application |
|---|---|---|---|
| 1 | 800 | 200 (125) | Long-range colour light signal.<br>Junction indicator. |
| 2 | 250 | 96 (60) | Short-range colour light signal.<br>Standard alphanumeric route indicator. |
| 3 | 100 | 24 (15) | Position light signal.<br>Miniature semaphore stop arm and disc.<br>Miniature alphanumeric indicator. |
| 4 | 400 | 160 (100) | Medium range colour light signal.<br>Semaphore main stop arm.<br>Semaphore distant arm. |
| 5 | 65 | Not applicable | Alphanumeric platform indicator. |

**Table 5:** Readability performance categories

## 2.7 Operational context design factors

**Guidance**

G 2.7.1 Operational context factors are relevant to lineside signalling product specifications because readability is also influenced by the position of the signal or indicator relative to:

a) The infrastructure;
b) The trains that operate on that infrastructure;
c) The train driving task; and
d) The environment and ambient conditions.

G 2.7.2 Operational context factors are relevant to the hardware design, manufacture and signal sighting processes because the characteristics of the intended applications are taken into account in order to produce the most suitable solutions.

G 2.7.3 Further guidance about how to configure lineside signals and indicators so that signal aspects and indications are readable in the operational context is set out in RIS-0737-CCS.

## 2.8 Human factors

**Guidance**

G 2.8.1 A signal or indicator that is readable is a precursor to successful achievement of the reading task; however, it does not mean that a person will always successfully read the displayed information, because reading is also influenced by human performance and the operational context.

G 2.8.2 The capability that each authorised user brings to visibility and readability is dependent on the role being performed and the tasks being undertaken. Operational requirements relating to human factors are covered by the following documents:

a) GERT8000 Rule Book;
b) RIS-3751-TOM, which sets out the cognitive and psychomotor skills required to undertake train driver operational tasks;
c) RIS-3452-TOM, which sets out requirements relating to medical fitness; and
d) RIS-3451-TOM, which includes minimum eyesight performance requirements for specified operational roles.

G 2.8.3 Human factors relating to the characteristics and management of authorised users and operational roles are relevant because readability is only achieved when the authorised user can read the displays and indications displayed by the lineside signalling system.

G 2.8.4 Human factors are relevant to the hardware design, manufacture and signal sighting processes because the characteristics of the intended users are taken into account in order to produce the most suitable solutions.

G 2.8.5 Industry guidance on how to integrate and assess human factors as part of design is given in GEGN8613. Applying this guidance will help determine the human factors consideration to be addressed so that signal aspects and indications are readable.

G 2.8.6 Ergonomics of human-system interaction - Part 210: Human-centred design for interactive systems (BS EN ISO 9241-210:2019), provides principles and guidance for applying human centred design to products.

## 2.9 Signal structures

**Guidance**

G 2.9.1 For signal structure design, it is good practice to consider the requirement to optimise visibility and readability in the operational context, as well as the structural requirements for supporting the signalling hardware and providing maintenance access.

G 2.9.2 The size and shape of each signal structure affects the overall appearance of the signalling product that it supports.

G 2.9.3 It is good practice for the surface finish, including the colour, to be specified so the structure does not generate an appearance that could be mistaken for a signal aspect or indication.

G 2.9.4 The colour of signal structures are intended to optimise the visibility and readability of signal aspects and indications.

G 2.9.5 Colour light signal posts are usually coloured silver or grey because the signal head and illuminated display elements combine to generate a display that is sufficiently visible and readable without the need for further enhancement.

G 2.9.6 The upper portion of semaphore signal posts are usually coloured white, silver or grey. A white signal post helps to enhance the visibility of a semaphore signal, especially where it is contrasted against a background feature or structure.

G 2.9.7 Structures that generate or reflect visible light can impair readability of the lineside signal aspect or indication display.

G 2.9.8 Further guidance about hardware surface gloss characteristics is given in *2.4*.

# Part 3 Lineside Signalling Product Design Requirements

## 3.1 Colour light signal heads

### 3.1.1 Display appearance

3.1.1.1 Each colour light signal head display shall have the appearance of an arrangement of either one or two coloured lights, as set out in Table *6*.

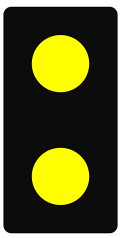
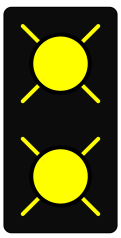
| Display type | Description | Example |
|---|---|---|
| Red | One red display element |  |
| Single yellow | One yellow display element |  |
| Double yellow | Two vertically aligned yellow display elements |  |
| Flashing single yellow | One flashing yellow display element |  |
| Flashing double yellow | Two vertically aligned flashing yellow display elements |  |
| Green | One green display element |  |

**Table 6:** Colour light signal displays

**Rationale**

G 3.1.1.2 The appearance of colour light signal aspects is used to codify movement authority information that is conveyed by the signalling system. A different display appearance would not be understood by authorised users and could imply a different meaning.

**Guidance**

G 3.1.1.3 The display examples set out in Table *6* are for illustrative purposes only and do not imply a particular technology or the number or arrangements of display elements and light sources within the signal head. This detail forms part of the product design specification.

### 3.1.2 Hardware parameters

3.1.2.1 Colour light signal heads shall comply with the hardware parameters set out in Table *7*.

| Design parameter | | Value |
|---|---|---|
| Hardware size | Signal head housing | Unspecified |
| | Backboard | |
| Hardware colour | Forward facing surfaces | BS 4800-2011<br>shade 00-E-53: Black |
| | All other surfaces | Silver or grey |
| Hardware shape (signal head with backboard) | | Unspecified |
| Hardware surface gloss | | Unspecified |

**Table 7:** Colour light signal hardware parameters

**Rationale**

G 3.1.2.2 These design parameters result in a physical appearance that is identifiable to authorised users and supports visibility.

G 3.1.2.3 A black signal head housing and signal backboard:

a) Provides a strong colour contrast ratio for colour light signal displays; and
b) Means that colour light signal displays have a similar appearance irrespective of whether they are displayed in a dark or an illuminated environment.

G 3.1.2.4 The different colour of front-facing and other surfaces helps authorised users to distinguish between the front of a signal that would normally be displaying a signal display and the rear of other signals and indicators that can be ignored.

**Guidance**

G 3.1.2.5 Hardware size parameters for colour light signals are not specified as this would need to take account of all potential performance requirements and applications.

G 3.1.2.6 Typical dimensions for a colour light signal backboard, where the display element radius is 105 mm (nominal), are:

a) Width 600 mm; and
b) Height extending to at least 180 mm above and below the centre line of the outermost display element.

G 3.1.2.7 The size of the backboard provided with each colour light signal is assessed by an Signal Sighting Committee (SSC) before the signal is taken into use.

G 3.1.2.8 The black front-facing surface helps authorised users to detect and identify lineside signals and indicators.

G 3.1.2.9 The hardware shape parameter is not specified as the overall shape of a colour light signal is also affected by the type of signal structure and any other hardware that is fitted to the signal, for example route indicator assemblies.

G 3.1.2.10 It is good practice for colour light signals to have a consistent, regular shape as this helps authorised users to recognise colour light signals when they are viewed against a background of other visible objects. Some example shapes are shown in Figure *1*.

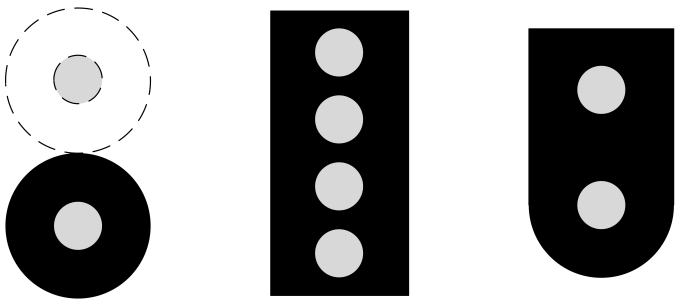


**Figure 1:** Examples of colour light signal head and backboard shapes

G 3.1.2.11 A low surface gloss value enhances the display contrast ratio and reduces the likelihood of misreading that would arise from a more reflective surface. Colour light signal hardware that generates or reflects visible light could impair readability of the colour light signal display.

G 3.1.2.12 Additional guidance regarding product hardware parameters is given in *2.4*.

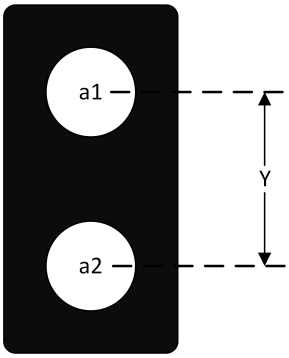
### 3.1.3 Display parameters

3.1.3.1 A colour light signal shall be capable of generating signal displays that meet the parameters set out in Table *8*.

| Design parameter | | Value |
|---|---|---|
| Display element luminous intensity | | Unspecified: Simultaneously lit display elements of the same colour shall have a similar intensity |
| Display element size | | Unspecified: All display elements shall be the same radius (-5 %, +10 %) |
| Display element contrast | | Unspecified |
| Display element colour (See *Part 4*) | Red display | Signal red light |
| | Yellow displays (all types) | Signal yellow light |
| | Green display | Signal green light |
| Display element shape | | Circular disc appearance from >20 m |
| Non-flashing (steady) displays | | Shall be capable of generating a lit display that has an uninterrupted appearance |
| Flashing displays | | Shall be capable of generating displays that comply with the flashing aspect parameters set out in RIS-0758-CCS |
| Number of display elements | | See Table *6* |
| Arrangement of display elements | | See Table *6* |

| Design parameter | | Value |
|---|---|---|
| Spacing of simultaneously illuminated display elements, see Figure 2. | Vertical spacing (double yellow displays) | Y ≤ 5 r (miniature tunnel signals excepted)<br>Y ≤ 8.8 r (miniature tunnel signals only)<br>(where r is the display element radius) |
| | Horizontal spacing | Zero |

**Table 8:** Colour light signal display parameters




**Notes:**

1. a1 and a2 denote two simultaneously displayed, vertically aligned display elements contained within one signal head assembly
2. Dimension Y denotes the distance between vertically presented display element centres (a1 and a2)

**Figure 2:** Colour light signal display element spacing

**Rationale**

G 3.1.3.2 These design parameters result in a display appearance that is visible and distinguishable to authorised users and supports readability.

G 3.1.3.3 Display element colour is one of the methods used to convey the information provided by the signalling system.

G 3.1.3.4 A consistent filled circular shape, when viewed from more than 20 m away, helps authorised users to detect and identify colour light signal aspects from a long distance in the operational context. At a closer distance, authorised users can find it much easier to detect colour light signal aspects.

G 3.1.3.5 Steady displays that appear interrupted can mislead the authorised user, either because the display is not consistently visible or because it appears to be flashing.

G 3.1.3.6 These parameters help authorised users to read the colour light signal aspect and distinguish between a flashing aspect and a steady aspect.

G 3.1.3.7 Compliance with the display element parameters set out in Table 8 mitigates poor readability.

**Guidance**

G 3.1.3.8 Display element luminous intensity, size and contrast parameters are not specified, as these need to take account of all potential performance requirements and applications.

G 3.1.3.9 The similar intensity and size of simultaneously illuminated display elements helps authorised users to recognise that the lights are part of the same colour light signal display.

G 3.1.3.10 Legacy practice for colour light signal displays generated by filament lamps typically use the following:

a) Type SL35 (or equivalent) 12 V d.c. lamp, adjusted to operate at 10.7 (+ / - 0.2) V;
b) Display element radius 105 (-5 / +10) mm; and
c) A signal backboard that is 600 mm (minimum) wide, which extends at least 180 mm above and below the centre line of the light aperture.

G 3.1.3.11 Alternative values may be appropriate to optimise visibility and readability performance in specific operational environments or if an alternative light source technology is used, for example if display elements are generated by a cluster of light emitting diodes.

G 3.1.3.12 Colour light signal products with a display element radius value other than 115 mm have been assessed to be readable and approved for use on the GB mainline railway. A typical display element radius for miniature tunnel signals is 45 mm to 75 mm.

G 3.1.3.13 Colour light signal products that are specified for use in an environment that, by itself, provides a high contrast ratio, for example in a tunnel, may have reduced values of display element luminous intensity and size and may not require a signal backboard.

G 3.1.3.14 If a display element is generated using a cluster of small light sources, for example LEDs, it might not be practicable to generate a display element that appears to be completely circular when it is viewed from a short distance. In this case, a good practice is for the number and layout of light sources to be arranged so that each display element appears to have a circular outline when viewed from more than 20 m away.

G 3.1.3.15 Colour light signal heads can incorporate a feature to generate a display that is readable when the authorised user is less than 20 m from the signal. This might be achieved using either:

a) A separate display element; or
b) A portion of the main display element, for example, a 'hot strip', 'eyebrow' or 'close-up viewing segment'.

G 3.1.3.16 A typical arrangement of display elements within a colour light signal head is shown in Figure *2*.

G 3.1.3.17 Colour light signal head products that generate the correct flashing display appearance when integrated within the overall CCS subsystem support readability.

G 3.1.3.18 The vertical spacing between two simultaneously illuminated display elements within the same signal head is specified so an authorised user can distinguish the display

from the maximum reading distance and range of viewing angles specified for the signal head.

G 3.1.3.19 It is good practice for double yellow displays to have a consistent appearance irrespective of any variation on display element radius.

G 3.1.3.20 In most circumstances, a separation of approximately 5 times the display element radius (r) is sufficient to achieve the required readability performance of the double yellow display. A greater separation could result in an authorised user not associating the two display elements as part of a single display.

G 3.1.3.21 Miniature tunnel signals are read against a dark background and have a significantly reduced display element radius (r). In this case, a greater display element spacing is permitted to optimise readability performance.

G 3.1.3.22 A product specification that takes into account the requirements set out in RIS-0737-CCS for the position of the most restrictive signal aspect relative to driver eye level, will support readability.

G 3.1.3.23 Typical dimensions that are historically applied to colour light signals are set out in Table *9*.

| Signal Type | Separation (Y) | Display element radius |
|---|---|---|
| Long range colour light signal | 510 mm (+20 / -10) | 105 mm (+10 / -5) |
| Miniature tunnel signal | 400 mm | 45 mm |

**Table 9:** Typical colour light signal dimensions

G 3.1.3.24 Further guidance is given in *2.5* about the potential risk that arises from generating a display that has a smaller overall size, particularly in the absence of other visible stimuli.

G 3.1.3.25 Further guidance about horizontal spacing, where separate colour light signal heads are used in combination to display splitting distant cautionary aspects is given in RIS-0737-CCS.

G 3.1.3.26 Additional guidance regarding product display parameters is given in *2.5*.

### 3.1.4 Readability performance

**Guidance**

G 3.1.4.1 Colour light signal aspects are differentiated by:

a) Display element colour;
b) The number of display elements;
c) The arrangement of display elements; and
d) Whether or not the display appears to flash.

G 3.1.4.2 Colour light signal heads are usually configured so that they generate the applicable signal aspect at all times. Exceptions to this include splitting distant applications and approach lit signal applications.

G 3.1.4.3 If a colour light signal head incorporates more than one display element, the signalling system controls are usually designed so that each display type is consistently displayed using the same display element(s).

G 3.1.4.4 Colour light signal aspects may be combined with other lineside signalling displays. Further guidance is given in RIS-0758-CCS.

G 3.1.4.5 If a product is suitable for alternative physical orientation, the verification of this capability will form part of the readability assessment. If the optical system is designed only for a specific orientation, it will normally be recorded in the product specification.

G 3.1.4.6 Visible distance is usually greater than the distance at which colour light signal displays can be reliably read. For example, at long distances, although a double yellow display may be visible, it might not be possible for the authorised user to distinguish between a single yellow aspect and a double yellow aspect.

G 3.1.4.7 Visible distance has the potential to be used to advantage within the signalling system, but excessive visible distance can be a hazard if not properly managed within a signalling layout.

G 3.1.4.8 A focused and correctly aligned signal light beam will typically generate a display that appears brightest when it is observed from a train travelling on the line to which it applies. Signals on other lines will therefore appear less bright. This feature can help authorised users to identify which signal is applicable to the train being operated and reduce the potential for distracting authorised users operating trains on other lines.

G 3.1.4.9 Although an optical system incorporating a lens is not mandatory, it can be advantageous in terms of optimising readability in the operational context, particularly where the infrastructure layout includes multiple parallel lines.

G 3.1.4.10 A focused signal light beam can also help to support readability performance in degraded ambient conditions for example, fog.

G 3.1.4.11 Unless a signal is intended to be read when observed from a wider angle, the optical system would typically be designed to emit a signal light beam that has a spread of about 3˚ in the horizontal plane and 1.5˚ in the vertical plane.

G 3.1.4.12 In some cases, typically where the signal has a sharply curved approach, a wider angle beam spread might be required to achieve the required reading distance. 'Spread light' signals typically emit a light beam that has a 30˚ horizontal beam spread.

## 3.2 Position light signals

### 3.2.1 Display appearance

3.2.1.1 Each position light signal display shall have the appearance of an arrangement of two coloured lights, as set out in Table *10*.

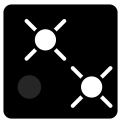
| Display type | Description | Example |
|---|---|---|
| PLS red ON | Two horizontally aligned red display elements |  |
| PLS yellow ON | Two horizontally aligned yellow display elements |  |
| PLS steady OFF | Two white display elements aligned in the upper quadrant position |  |
| PLS flashing OFF | Two flashing white display elements aligned in the upper quadrant position |  |

**Table 10:** Position light signal displays

**Rationale**

G 3.2.1.2 The appearance of position light signal aspects is used to codify movement authority information that is conveyed by the signalling system. A different display appearance would not be understood by authorised users and could imply a different meaning.

**Guidance**

G 3.2.1.3 The display examples set out in Table *10* are for illustrative purposes only and do not imply a particular technology or the number or arrangements of display elements and light sources within the position light signal. This detail forms part of the product design specification.

### 3.2.2 Hardware parameters

3.2.2.1 Position light signals shall comply with the hardware parameters set out in Table *11*.

| Design parameter | | Value |
|---|---|---|
| Hardware size | | Unspecified |
| Hardware colour | Forward facing surfaces | BS 4800-2011<br>shade 00-E-53: Black |
| | All other surfaces | Silver or grey |

| Design parameter | Value |
|---|---|
| Hardware shape | Unspecified |
| Hardware surface gloss | Unspecified |

**Table 11:** Position light indicator hardware parameters

**Rationale**

G 3.2.2.2 These design parameters result in a physical appearance that is identifiable to authorised users and supports visibility.

G 3.2.2.3 A black signal background:

a) Provides a strong colour contrast ratio for position light signal displays; and
b) Means that position light signal displays have a similar appearance irrespective of whether they are displayed in a dark or an illuminated environment.

G 3.2.2.4 The different colour of front-facing and other surfaces helps authorised users to distinguish between the front of a signal that would normally be displaying a signal aspect and the rear of other signals and indicators that can be ignored.

**Guidance**

G 3.2.2.5 Hardware size parameters for position light signals are not specified as this would need to take account of all potential performance requirements and applications.

G 3.2.2.6 The hardware shape parameter is not specified as the overall shape of a position light is also affected by the type of signal structure and any other hardware that is fitted to the signal, for example route indicator assemblies.

G 3.2.2.7 It is good practice for position light signals to have a consistent, regular shape as this helps authorised users to recognise position light signals when they are viewed against a background of other visible objects. Some example shapes are shown in Figure *3*.

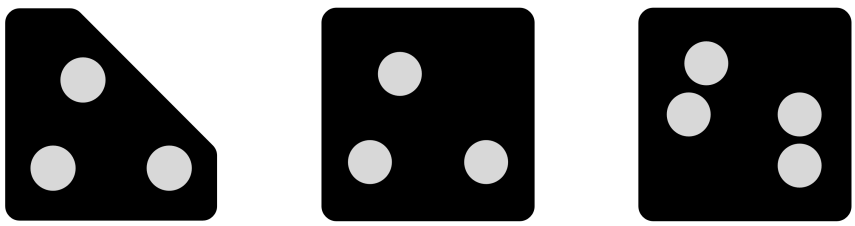


**Figure 3:** Examples of position light housing shapes

G 3.2.2.8 A low surface gloss value enhances the display contrast ratio and reduces the likelihood of misreading that would arise from a more reflective surface. Position light signal hardware that generates or reflects visible light, could impair readability of the position light signal display.

G 3.2.2.9 Additional guidance regarding product hardware parameters is given in *2.4*.

### 3.2.3 Display parameters

3.2.3.1 Position light signals shall be capable of generating signal displays that meet the parameters set out in Table *12*.

| Design parameter | | Value |
|---|---|---|
| Display element luminous intensity | | Unspecified: Simultaneously lit display elements of the same colour shall have a similar intensity |
| Display element size | | Unspecified: Both display elements shall be the same radius |
| Display element contrast | | Unspecified |
| Display element colour (See *Part 4*) | PLS red ON display | Signal red light |
| | PLS yellow ON display | Signal yellow light |
| | PLS OFF displays | Signal white light |
| Display element shape | | Circular disc appearance from >10 m |
| Steady displays | | Shall be capable of generating a lit display that has an uninterrupted appearance |
| Flashing displays | | Shall be capable of generating displays that comply with the flashing aspect parameters set out in RIS-0758-CCS |
| Number of display elements | | Two |
| Arrangement of display elements | PLS ON displays | Horizontally aligned |
| | PLS OFF displays | Aligned 45° above horizontal in a clockwise direction |

| Design parameter | Value |
|---|---|
| Spacing of simultaneously illuminated display elements | 5 x r (where r is the light source radius) |

**Table 12:** Position light indicator display parameters

**Rationale**

G 3.2.3.2 These design parameters result in a display appearance that is visible and distinguishable to authorised users and supports readability.

G 3.2.3.3 Display element colour is one of the methods used to convey the meaning of the information provided by the signalling system.

G 3.2.3.4 A consistent filled circular shape, when viewed from more than 10 m away, helps authorised users to detect and identify position light signal aspects from a long distance in the operational context. At a closer distance, authorised users can find it much easier to detect position light signal aspects.

G 3.2.3.5 Steady displays that appear interrupted can mislead the authorised user, either because the display is not consistently visible or because it appears to be flashing.

G 3.2.3.6 These parameters help authorised users to read the position light signal aspect and distinguish between a flashing aspect and a steady aspect.

G 3.2.3.7 The display element spacing is specified so that all position light signal displays have a consistent appearance, irrespective of any variation in display element size.

G 3.2.3.8 Compliance with the display element parameters set out in Table *12* mitigates poor readability.

**Guidance**

G 3.2.3.9 Display element luminous intensity, size and contrast parameters are not specified, as these need to take account of all potential performance requirements and applications.

G 3.2.3.10 The similar intensity and size of simultaneously illuminated display elements helps authorised users to recognise that the lights are part of the same position light signal display.

G 3.2.3.11 Legacy practice for position light signal displays generated by individual signal lamps typically uses the following:

a) 110 V a.c. lamp; and
b) Signal lens of radius 50 mm.

G 3.2.3.12 Alternative light source technology, for example displays generated by LEDs, may mean that alternative values are appropriate to optimise readability performance.

G 3.2.3.13 If a display element is generated using a cluster of small light sources, for example LEDs, it might not be practicable to generate a display element that appears to be completely circular when it is viewed from a short distance. In this case, a good

practice would be for the number and layout of light sources to be arranged so that each display element appears to have a circular outline when viewed from more than 10 m away.

G 3.2.3.14 Position light signal products that generate the correct flashing display appearance when integrated within the overall CCS subsystem support readability.

G 3.2.3.15 The number, colour and arrangement of display elements helps authorised users to:

a) Detect and identify position light signals at locations where the signalling layout includes other types of signal and indicator; and
b) Differentiate between stop and proceed displays.

G 3.2.3.16 In most circumstances, a separation of approximately 5 times the display element radius (r) is sufficient to achieve the required readability performance.

G 3.2.3.17 Additional guidance regarding product display parameters is given in *2.5*.

### 3.2.4 Readability performance

**Guidance**

G 3.2.4.1 Position light signal aspects are differentiated by:

a) Display element colour;
b) The arrangement of display elements; and
c) Whether or not the display appears to flash.

G 3.2.4.2 Position light signal products are used in the following applications:

a) An independent shunting signal that continuously displays the relevant ON or OFF aspect;
b) A limit of shunt signal that continuously displays the ON aspect; and
c) A subsidiary position light signal that is normally extinguished and only displays an OFF aspect in combination with a colour light signal red aspect.

G 3.2.4.3 Position light signal aspects are used to convey information associated with slow speed movements – typically 24 km/h (15 mph) or less.

G 3.2.4.4 Position light signal aspects may be combined with other lineside signalling displays.

G 3.2.4.5 Further guidance about the appearance of subsidiary position light signal aspects is given in RIS-0758-CCS.

G 3.2.4.6 To optimise readability performance, the specification of readable angle considers whether the position light signals are:

a) Mounted at ground level, on a lineside signal post or above the structure gauge on a signal gantry; or
b) Provided on sharply curved lines.

## 3.3 Banner repeater signals

### 3.3.1 Display appearance

3.3.1.1 Each banner repeater indicator display shall have the appearance of a black bar displayed against a circular illuminated area, as set out in Table 13.

| Display type | Description | Example |
|---|---|---|
| Banner ON | A black band, horizontally aligned, displayed against a lit white background |  |
| White banner OFF | A black band, aligned in the upper quadrant position and displayed against a lit white background |  |
| Green banner OFF | A black band, aligned in the upper quadrant position and displayed against a lit green background |  |

**Table 13:** Banner repeater indicator displays

#### Rationale

G 3.3.1.2 The appearance of banner repeater aspects is used to codify movement authority information that is conveyed by the signalling system. A different display appearance would not be understood by authorised users and could imply a different meaning.

G 3.3.1.3 The distinctive appearance is intended to help authorised users distinguish banner repeater indications from other types of signalling system displays.

#### Guidance

G 3.3.1.4 The display examples set out in Table 13 are for illustrative purposes only and do not imply a particular technology or the number or arrangements of display elements and light sources within the indicator. This detail forms part of the product design specification.

### 3.3.2 Hardware parameters

3.3.2.1 Banner repeater indicator heads shall comply with the hardware parameters set out in Table 14.

| Design parameter | Value |
|---|---|
| Hardware size | Unspecified |

| **Design parameter** | | | **Value** |
|---|---|---|---|
| Hardware colour | Banner repeater head housing: forward facing surfaces | | BS 4800-2011 shade 00-E-53: Black |
| | Banner repeater head housing: all other surfaces | | Silver or grey |
| | Banner arm | | BS 4800-2011 shade 00-E-53: Black |
| Hardware shape | Banner repeater head housing | | Rectangular or circular when viewed from the front |
| | Display area | Banner arm | Rectangular |
| | | Illuminated background | Circular |
| Hardware surface gloss (housing) | | | Unspecified |

**Table 14:** Banner repeater indicator hardware parameters

**Rationale**

G 3.3.2.2 These design parameters result in a physical appearance that is identifiable to authorised users and supports visibility.

G 3.3.2.3 A black surround:

a) Provides a strong colour contrast ratio for banner repeater indicator displays; and
b) Means that banner repeater indicator displays have a similar appearance, irrespective of whether they are displayed in a dark or an illuminated environment.

G 3.3.2.4 The different colour of front-facing and other surfaces helps authorised users to distinguish between the front of a banner repeater indicator that would normally be displaying an indication and the rear of other signals and indicators that can be ignored.

G 3.3.2.5 A rectangular or circular housing shape for a banner repeater indicator helps authorised users to identify single and splitting banner repeater indicators when they are viewed against a background of other visible objects.

G 3.3.2.6 The circular display area containing a centrally pivoted banner arm results in a display that mimics a semaphore signal arm contrasted against an illuminated background.

G 3.3.2.7 Compliance with the display element parameters set out in Table *14* mitigates poor readability.

**Guidance**

G 3.3.2.8 Hardware size parameters for banner repeater indicators are not specified as this would need to take account of all potential performance requirements and applications.

G 3.3.2.9 A black banner arm provides a strong colour contrast against the illuminated background.

G 3.3.2.10 A low surface gloss value enhances the display contrast ratio and reduces the likelihood of misreading that would arise from a more reflective surface finish. Banner repeater indicator hardware that generates or reflects visible light, could impair readability of the banner repeater indicator display.

G 3.3.2.11 Additional guidance regarding product hardware parameters is given in *2.4*.

### 3.3.3 Display parameters

3.3.3.1 Banner repeater indicator heads shall be capable of generating displays that meet the display appearance parameters set out in Table *15* and shown in Figure *4*.

| Design parameter | | Value |
|---|---|---|
| Display element luminous intensity | Illuminated background | Unspecified: Both halves of the illuminated background shall have a similar intensity |
| Display element size (See Figure *4*) | Banner arm | a = 0.4b (+/- 10 %) |
| | Illuminated background | b = Unspecified |
| Display element contrast | | Unspecified |
| Display element colour (See *Part 4*) | Green background | Signal green light (Three-state banner repeater indicators only) |
| | White background | Signal white light |
| Display element shape | Illuminated background | Bifurcated circular disc appearance |
| | Banner arm | Rectangular appearance |

| Design parameter | | | Value |
|---|---|---|---|
| Non-flashing (steady) displays | | | The banner repeater indicator shall be capable of generating a lit display that has an uninterrupted appearance |
| Flashing displays | | | Banner repeater indications shall not appear to flash |
| Number of display elements | | | See Table *13* |
| Arrangement of display elements | Angle of banner arm | ON display | Horizontal |
| | | OFF display | Turned in a clockwise direction about the centre point of the illuminated background at an angle of 45° |
| | Position of banner arm | | Centrally positioned against illuminated background |

**Table 15:** Banner repeater indicator display parameters

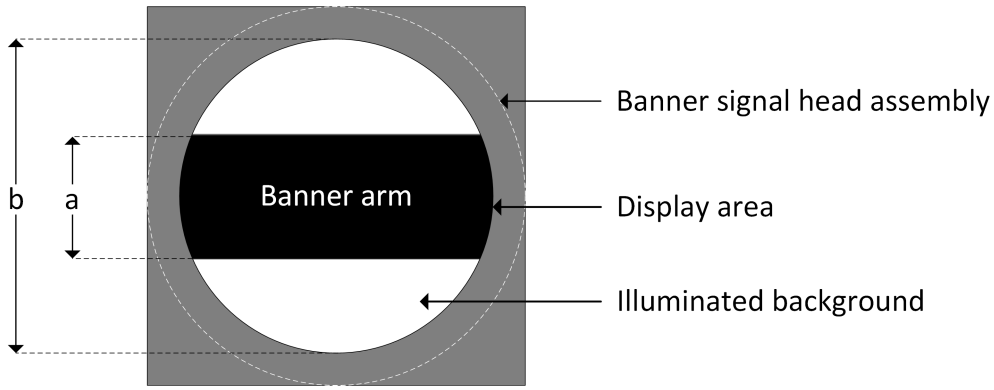



**Figure 4:** Banner repeater indicator parameters

**Rationale**

G 3.3.3.2 These design parameters result in a display appearance that is visible and distinguishable to authorised users and supports readability.

G 3.3.3.3 The proportional relationship between the size of the banner arm (dimension a) and the size of the illuminated background (dimension b):

a) Helps authorised users to detect the position of the banner arm; and
b) Means that banner signal displays have a consistent appearance, irrespective of the overall size of the hardware.

G 3.3.3.4 The colour of the illuminated background is one of the methods used to convey the meaning of each banner repeater indicator indication provided by the signalling system.

G 3.3.3.5 A consistent circular background appearance helps authorised users to detect and identify banner repeater indicator indications from a long distance in the operational context. At a closer distance, authorised users can find it much easier to detect banner repeater indicator indications.

G 3.3.3.6 Steady displays that appear interrupted can mislead the authorised user, either because the display is not consistently visible or because it appears to be flashing.

G 3.3.3.7 The central position of the banner arm relative to the illuminated background means that the proportions of the illuminated area either side of the banner arm appear as equal sized segments. This helps to make the position of the banner arm visible.

G 3.3.3.8 Compliance with the display element parameters set out in Table *15* mitigates poor readability.

**Guidance**

G 3.3.3.9 Display element luminous intensity, size and contrast parameters are not specified, as these need to take account of all potential performance requirements and applications.

G 3.3.3.10 The consistent level of intensity throughout the display supports the appearance and readability of banner repeater indicator displays.

G 3.3.3.11 Typical values for dimensions a and b as shown in Figure *4* are set out in Table *16*.

| Application | Dimension a | Dimension b |
|---|---|---|
| Standard size equipment | 200 (+0 / -12) mm | 500 (+/- 12) mm |
| Miniature size equipment | Approx. 60 mm | Approx. 150 mm |

**Table 16:** Banner repeater typical dimensions

G 3.3.3.12 It is good practice for the contrast to be as high as possible without creating glare. The black background combined with the illuminated signal is intended to provide a high contrast ratio.

G 3.3.3.13 The banner arm that appears as a black silhouette against an illuminated circular background will help authorised users to distinguish banner repeaters from other signals and indicators.

G 3.3.3.14 If a display element is generated using a cluster of small light sources, for example LEDs, it might not be practicable to generate a display element that appears to be completely circular when it is viewed from a short distance. In this case, a good practice would be for the number and layout of light sources to be arranged so that the overall display appears to be circular when viewed from more than 20 m away.

G 3.3.3.15 Where the appearance of the banner arm is reproduced using the matrix of light sources that generate the illuminated background, it is advantageous for the number and position of each light source to result in a banner arm that appears to be rectangular and the same size in both the ON and OFF positions.

G 3.3.3.16 There is no requirement in RIS-0758-CCS for a banner repeater to display a flashing indication.

G 3.3.3.17 The consistent appearance of banner repeater indicator displays helps authorised users to detect the position of the banner arm and, therefore, which display is being presented.

G 3.3.3.18 Further guidance about horizontal spacing, where separate banner repeater indicators are used in combination to display splitting banner repeater indications, is given in RIS-0737-CCS.

G 3.3.3.19 Additional guidance regarding product display parameters is given in *2.5*.

### 3.3.4 Readability performance

**Guidance**

G 3.3.4.1 Banner repeater indicator indications repeat the movement authority information conveyed by the next main signal and, where two are provided in combination on the approach to a junction signal, repeat the routing information. A different appearance would not be understood by authorised users and could imply a different meaning.

G 3.3.4.2 Banner repeater indicators are typically applied in two forms:

a) A two-state banner repeater indicator that generates either:
   i) The banner ON indication; or
   ii) The white banner OFF indication.
b) A three-state banner repeater indicator that generates:
   i) The banner ON indication; or
   ii) The white banner OFF indication; or
   iii) The green banner OFF indication.

G 3.3.4.3 Banner repeater indicator indications are differentiated by:

a) Banner arm alignment (either horizontal or angled at 45°); and
b) The colour of the illuminated background (either white or green).

G 3.3.4.4 Banner repeater indicator indications are typically generated using a matrix of coloured light sources.

G 3.3.4.5 Some legacy designs use a moveable banner signal arm which is positioned in front of a white illuminated background.

G 3.3.4.6 Two-state banner repeater indicators continuously generate the white illuminated background, which means that the authorised user can detect the position of the banner arm in order to read which indication is being displayed.

G 3.3.4.7 Three-state banner repeater indicators continuously generate an illuminated background which changes colour between white and green depending on which indication is being displayed.

G 3.3.4.8 Banner repeater indicator indications are presented either on their own or in pairs. They are always displayed independently of any other type of signal aspect or indication. Further guidance about the appearance of splitting banner repeater indicator indications is given in RIS-0758-CCS.

G 3.3.4.9 Banner repeater indicators are used in the following applications:

a) To repeat the next main signal aspect on lines where the permissible speed is up to 200 km/h (125 mph);
b) To provide a signal ON/OFF indication at a station as part of a train dispatch system and to repeat the signal aspect displayed by the platform starting signal. In this case, the indication is only intended to be read when authorised users are either located on a station platform or in the normal driving position when the train is stationary; or
c) As a banner junction indicator to provide the driver with route indication at the same time as the associated signal aspect. Banner junction indicators have a similar appearance to preliminary route indicators but are considered as a banner for control and sighting requirements.

G 3.3.4.10 It is good practice for banner repeater indicators, that are intended to be read by drivers, to be specified so that:

a) The illuminated background colour is distinguishable when viewed from a distance equivalent to 8 s (minimum) at the permissible speed; and
b) The position of the banner arm is readable when viewed from a distance equivalent to 5 s (minimum) at the permissible speed.

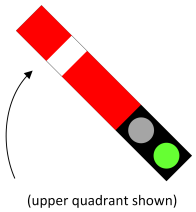
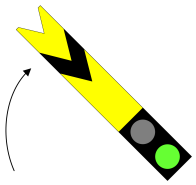
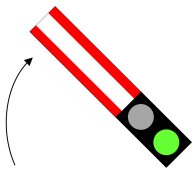
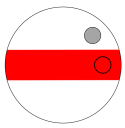
G 3.3.4.11 It is intended that authorised users can distinguish the position of the banner arm in order to read the banner ON and white banner OFF indications.

G 3.3.4.12 It is intended that authorised users can identify the green banner OFF without distinguishing the banner arm position, because the green illuminated background is always associated with a banner arm in the OFF position.

## 3.4 Semaphore signals

### 3.4.1 Display appearance

3.4.1.1 Each semaphore signal display shall have the appearance of the relevant coloured signal arm / disc and a coloured semaphore signal light, as set out in Table *17*.

| Display type | Description | Example |
|---|---|---|
| Stop arm ON | Stop arm horizontal and one red lit display element |  |
| Stop arm OFF | Stop arm in upper quadrant or lower quadrant position and one green lit display element |  (upper quadrant shown) |
| Distant arm ON | Distant arm horizontal and one yellow lit display element |  |
| Distant arm OFF | Distant arm in upper quadrant or lower quadrant position and one green lit display element |  (upper quadrant shown) |
| Subsidiary arm ON | Subsidiary arm horizontal and one red lit display element |  |
| Subsidiary arm OFF | Subsidiary arm in upper quadrant or lower quadrant position and one green lit display element |  (upper quadrant shown) |
| Shunting disc ON | Disc horizontal and one red lit display element |  |

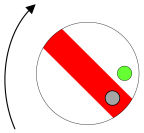
| Display type | Description | Example |
|---|---|---|
| Shunting disc OFF | Disc in upper quadrant or lower quadrant position and one green lit display element |  (upper quadrant shown) |

**Table 17:** Semaphore signal displays

**Rationale**

G 3.4.1.2 The appearance of semaphore signal arms and semaphore signal lights is used to codify the movement authority information that is conveyed by the signalling system. A different display appearance would not be understood by authorised users and could imply a different meaning.

**Guidance**

G 3.4.1.3 The display examples set out in Table *17* are for illustrative purposes only and do not imply a particular design or a requirement for upper quadrant signals. This detail forms part of the product design specification.

### 3.4.2 Hardware parameters

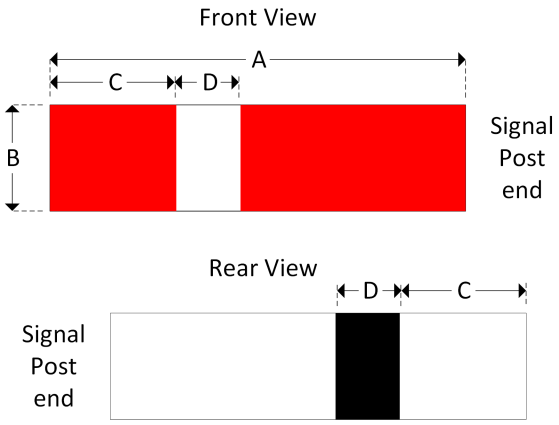
3.4.2.1 Semaphore signal arms and signal lights shall comply with the hardware parameters set out in Table *18* and shown in Figures *5*, *6*, *7* and *8*.

| Design parameter | | | Value |
|---|---|---|---|
| Hardware size | Stop arm | Upper quadrant | See Figure *5* |
| | | Lower quadrant | Unspecified |
| | Distant arm | Upper quadrant | See Figure *6* |
| | | Lower quadrant | Unspecified |
| | Subsidiary arm | Upper quadrant | See Figure *7* |
| | | Lower quadrant | Unspecified |
| | Disc | Upper quadrant | See Figure *8* |
| | | Lower quadrant | Unspecified |
| | Spectacle plate | | Unspecified |

| **Design parameter** | | | **Value** |
|---|---|---|---|
| Hardware shape | Stop arm | Upper quadrant | Rectangular |
| | | Lower quadrant | |
| | Distant arm | Upper quadrant | See Figure *6* |
| | | Lower quadrant | |
| | Subsidiary arm | Upper quadrant | Rectangular |
| | | Lower quadrant | |
| | Disc | Upper quadrant | Circular |
| | | Lower quadrant | |
| | Spectacle plate | | Unspecified |
| Hardware colour | Signal arm | Red elements | BS 4800-2011 shade 04-E-53: Poppy |
| | | Yellow elements | BS 4800-2011 shade 08-E-51: Golden yellow |
| | | Black elements | BS 4800-2011 shade 00-E-53: Black |
| | | White elements | BS 4800-2011 shade 00-E-55: White |
| | Signal light assembly | | Black or grey |
| | Spectacle plate assembly | | Black or grey |
| | Signal back board #1 | | BS 4800-2011 shade 00-E-55: White |
| Hardware surface gloss | Signal arm | | Enamelled finish #2 |
| | Signal back board | | Unspecified |

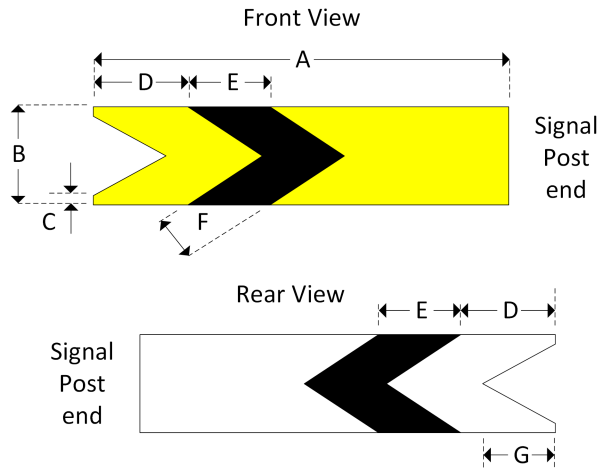
| Design parameter | Value |
|---|---|
| #1 Where provided | |
| #2 Semaphore signal arms shall not use retroreflective material | |

**Table 18:** Semaphore signal hardware parameters



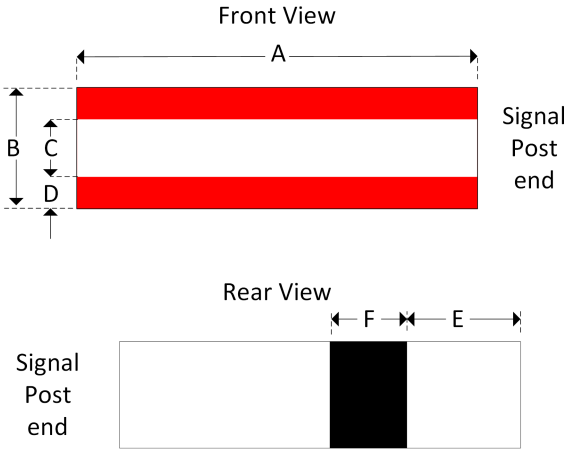

| Parameter | Dimension (mm +/-5%) | |
|---|---|---|
| | Main | Miniature |
| A | 1060 | 533 |
| B | 260 | 159 |
| C | 318 | 152 |
| D | 178 | 115 |

**Figure 5:** Upper quadrant stop arm dimensions



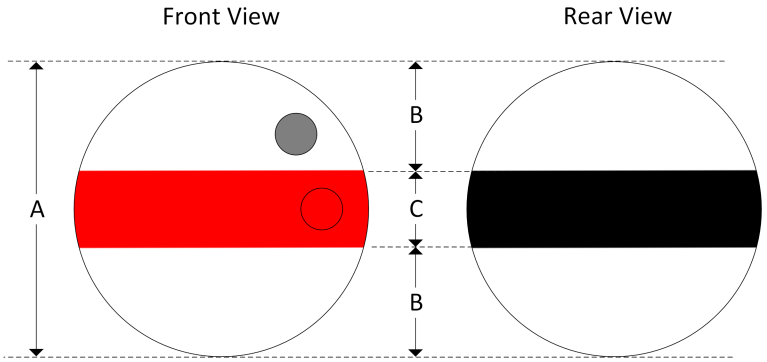

| Parameter | Dimension (mm +/-5%) |
|---|---|
| A | 1060 |
| B | 260 |
| C | 25 |
| D | 241 |
| E | 210 |
| F | 102 |
| G | 190 |

**Figure 6:** Upper quadrant distant arm dimensions




| Parameter | Dimension (mm +/-5%) |
|---|---|
| A | 533 |
| B | 159 |
| C | 77 |
| D | 41 |
| E | 152 |
| F | 115 |

**Figure 7:** Upper quadrant subsidiary arm parameters




| Parameter | Dimension (mm +/-5%) |
|---|---|
| A | 394 |
| B | 146 |
| C | 102 |

**Figure 8:** Upper quadrant shunt disc parameters

**Rationale**

G 3.4.2.2 These design parameters result in a physical appearance that is identifiable to authorised users and supports visibility.

G 3.4.2.3 The dimensions shown in Figures *5*, *6*, *7* and *8* are consistent with the standard mechanical signalling equipment drawings produced by British Railways.

G 3.4.2.4 The colour pattern on the front face of each signal arm helps authorised users to:

a) Differentiate between different types of signal arm; and
b) Identify which line the signal arm applies to, particularly when the signal is in the ON position.

G 3.4.2.5 The black and white colour of the rear of semaphore signal arms helps authorised users to distinguish between the front of a semaphore signal arm and the rear of other semaphore signals that can be ignored.

G 3.4.2.6 The enamelled surface finish is based on existing practice, which is known to support sufficient readability in daylight and ease of maintenance.

G 3.4.2.7 Compliance with BS 4800:2011 red and yellow shades means that stop and distant signal arms have a consistent colour appearance.

**Guidance**

G 3.4.2.8 The size of semaphore signal arms and discs helps them to be visible in daylight.

G 3.4.2.9 The consistent overall size of each type of signal arm and disc helps authorised users to read and interpret the information conveyed by each signal display, particularly where a signal or signal structure includes multiple signal arms of different types.

G 3.4.2.10 The dimensions relating to the colour pattern on each signal arm face helps authorised users to identify the applicability of signal arms within the signalling layout.

G 3.4.2.11 Because the visible colour of a signal arm can be adversely affected by back-lighting, the appearance of stop arms and distant arms is also differentiated by their shape. This means that each signal arm is identifiable when it is observed as a silhouette.

G 3.4.2.12 Retroreflective materials are not applied to semaphore signal arms / discs because trials have demonstrated that the specified colour appearance of the signal arm is adversely affected by the reflected light.

G 3.4.2.13 It is good practice for the size and position of the spectacle plate to be compatible with the movement of the signal arm, so that the relevant coloured spectacle is positioned in front of the fixed signal light when the arm is in the ON and OFF position, taking account of permitted movement tolerances.

G 3.4.2.14 Lower quadrant signal arms are only provided by exception, for example where an existing signalling layout incorporates lower quadrant signals.

G 3.4.2.15 It is good practice for lower quadrant signalling hardware to be manufactured using the relevant historical mechanical design drawings.

G 3.4.2.16 The unspecified parameters for lower quadrant signals can be addressed by reference to legacy design drawings that are relevant to the intended design.

G 3.4.2.17 Additional guidance regarding product hardware parameters is given in *2.4*.

### 3.4.3 Display Parameters

3.4.3.1 Semaphore signal arms and signal lights shall be capable of generating displays that meet the display parameters set out in Table *19*.

| Design parameter | | Value |
|---|---|---|
| Display element luminous intensity | Signal arm | See Table *18* 'hardware surface gloss' |
| | Signal light | Unspecified |
| Display element size | Signal arm | See Table *18* 'hardware size' |
| | Signal light | Unspecified |
| Display element contrast | Signal backboard | Unspecified |
| | Signal light | Unspecified |
| Display element colour | Signal arm | See Table *18* 'hardware colour' |
| | Red lit display element | Signal red light |
| | Yellow lit display element | Signal yellow light |
| | Green lit display element | Signal green light |
| Display element shape | Signal arm | See Table *18* 'hardware shape' |
| | Signal light | Circular disc appearance |
| Steady displays | | The semaphore signal light unit shall be capable of generating a lit display that has an uninterrupted appearance |
| Flashing displays | | Semaphore signal lit displays shall not appear to flash |
| Number of display elements | | See Table *17* |

| Design parameter | | Value |
|---|---|---|
| Signal arm alignment | ON displays | Horizontal (+5˚ /-5˚) |
| | Upper quadrant OFF displays | Left-hand end of signal arm raised 45˚ (+20˚ /-10˚) above horizontal |
| | Lower quadrant OFF displays | Left-hand end of signal arm lowered 45˚ (+20˚ /-10˚) below horizontal |
| Spacing of display elements | | Unspecified |

**Table 19:** Semaphore signal display parameters

**Rationale**

G 3.4.3.2 These design parameters result in a display appearance that is visible and distinguishable to authorised users and supports readability.

G 3.4.3.3 Display element colour is the method used to convey the information provided by the signalling system in dark ambient conditions.

G 3.4.3.4 A consistent circular appearance helps authorised users to detect and identify semaphore signal lights when they are displayed against a background of other visible light sources in the operational context.

G 3.4.3.5 Semaphore signal lit displays that appear interrupted can mislead the authorised user, either because the display is not consistently visible at night or because it appears to be flashing.

G 3.4.3.6 The permitted alignment angle tolerances provide for mechanical adjustment and temperature changes.

G 3.4.3.7 Compliance with the display element parameters set out in Table *19* mitigates poor readability.

**Guidance**

G 3.4.3.8 It is good practice to provide intensified signal lights to increase the level of luminous intensity if readability of the semaphore signal equipment is to be compatible with colour light signal displays within the same layout.

G 3.4.3.9 Where provided, white coloured semaphore signal backboards increase the contrast ratio.

G 3.4.3.10 Semaphore signal lights and spectacle glasses that are designed so that semaphore signal displays are visible in dark ambient conditions, support readability. There is no requirement for semaphore signal lights to be readable in daylight.

G 3.4.3.11 Semaphore signal lights are usually generated using a fixed light source of either a filament lamp or LEDs, in combination with a coloured spectacle glass, which moves in front of the light source when the signal is operated to the ON and OFF positions.

G 3.4.3.12 A spectacle glass colour that is compatible with the colour coordinates of the light generated by the semaphore signal lamp, will generate the correct display colour for the signal and support readability.

G 3.4.3.13 Signal ON and OFF displays are distinguished by the angle of the signal arm relative to horizontal.

G 3.4.3.14 A signal arm that is positioned outside of the alignment angle tolerances is considered to be in the 'wrong' position and might not display the correct signal light at night.

G 3.4.3.15 Further guidance about the dimensions relating to the spatial relationship between multiple semaphore signal arms is given in RIS-0737-CCS.

G 3.4.3.16 Additional guidance regarding product display parameters is given in *2.5*.

### 3.4.4 Readability performance

**Guidance**

G 3.4.4.1 Semaphore signal hardware consists of two distinct interconnected parts:

a) A signal arm or disc which pivots between ON and OFF positions; and
b) A spectacle frame holding two different coloured glasses which move in front of a permanently illuminated lamp. Usually this is directly attached to the signal arm.

G 3.4.4.2 The signal arm is displayed horizontally in its most restrictive ON display; other angles indicate less restrictive OFF displays as set out in Table *19*.

G 3.4.4.3 The appropriately coloured signal light, depending on the arm's position, is illuminated from behind using the signal lamp.

G 3.4.4.4 Semaphore signal arms are differentiated by:

a) Size
b) Shape
c) Colour patterns.

G 3.4.4.5 Semaphore ON and OFF aspects are differentiated by:

a) Signal arm or disc alignment (by day); and
b) Signal light colour (at night).

G 3.4.4.6 Semaphore signal aspects are displayed either independently or in combination with other semaphore signal aspects and / or alphanumeric indications.

G 3.4.4.7 Semaphore signals can be controlled using either:

a) A direct mechanical connection to a mechanical lever frame; or
b) A semaphore signal machine driven by electrical signal controls.

G 3.4.4.8 Semaphore signals are designed so that a failure of the connection between the controlling mechanism and the signal arm causes the signal arm to return to / remain in the ON position.

G 3.4.4.9 Further guidance about the appearance of semaphore signals that include multiple signal arms is given in RIS-0758-CCS.

G 3.4.4.10 Semaphore signal aspects are designed be readable at all times of the day and night. The signal arm will be readable in daylight conditions and the semaphore signal light will be readable at all other times.

G 3.4.4.11 The semaphore signal light is typically designed to emit a signal light beam that has a spread of about 5° in the horizontal and vertical planes.

G 3.4.4.12 Semaphore main stop signal and distant signal aspects are displayed on lines where the permissible speed is up to 160 km/h (100 mph).

G 3.4.4.13 Semaphore shunting signal aspects are only associated with slow speed train movements, typically 24 km/h (15 mph) or less.

## 3.5 Lineside sign signals

### 3.5.1 Display appearance

3.5.1.1 Each lineside sign signal display shall have the appearance of one of the reflectorised images set out in Table *20*.

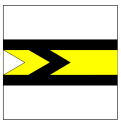
| Display type | Description | Example |
|---|---|---|
| Stop board | A red spot displayed against a white background associated with the word 'Stop' |   |
| Fixed distant board | An image of a semaphore distant signal arm in the ON position centrally displayed against a white background |  |
| Retroreflective buffer beam | A white horizontal stripe centrally displayed against a red background |  |

**Table 20:** Lineside sign signal displays

**Rationale**

G 3.5.1.2 The appearance of stop boards, fixed distant boards and retroreflective buffer beams is used to codify the movement authority information conveyed at a specific operational location. A different display appearance would not be understood by authorised users and could imply a different meaning.

G 3.5.1.3 The word 'Stop' enhances the appearance of stop boards and makes them easier to identify.

**Guidance**

G 3.5.1.4 The display examples set out in Table *20* are for illustrative purposes only and do not imply a particular design. This detail forms part of the product design specification. For example, the design of the retroreflective buffer beam is intended to be compatible with the buffer stop equipment.

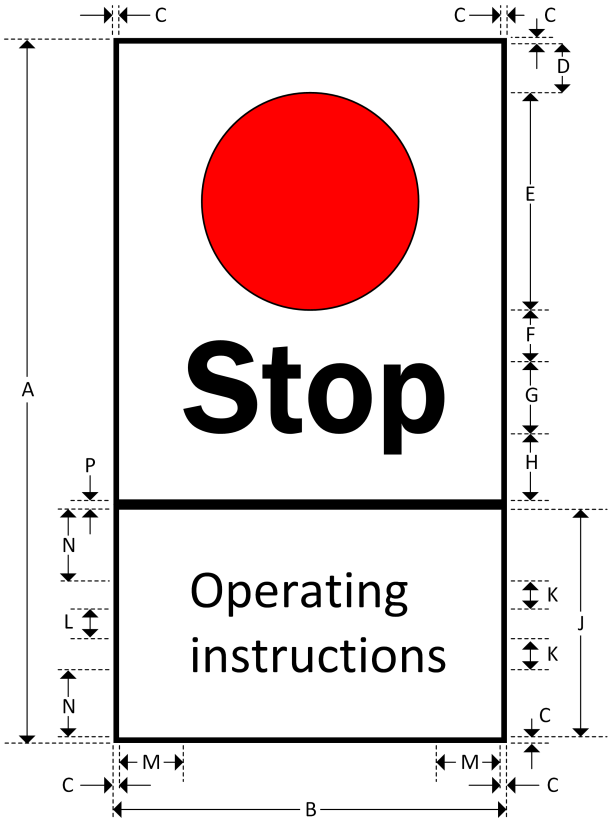
### 3.5.2 Hardware parameters

3.5.2.1 Stop boards, fixed distant boards and retroreflective buffer beams shall comply with the hardware parameters set out in Table *21* and shown in Figures *9*, *10* and *11*.

| Design parameter | | Value |
|---|---|---|
| Hardware size | Stop board | See Figure *9* |
| | Distant board | See Figure *10* |
| | Retroreflective buffer beam | See Figure *11* |
| Hardware shape | Stop board | Rectangular |
| | Distant board | Square |
| | Retroreflective buffer beam | Rectangular |
| Hardware colour | Front face | BS 4800:2011 shade 04-E-53: Poppy |
| | | BS 4800:2011 shade 08-E-51: Golden yellow |
| | | BS 4800-2011 shade 00-E-53: Black |
| | | BS 4800-2011 shade 00-E-55: White |
| | Rear face | Grey |

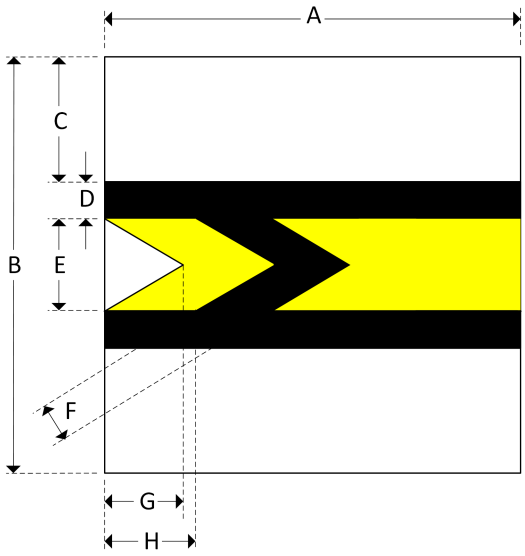
| Design parameter | | Value |
|---|---|---|
| Hardware surface gloss | Front face | Retroreflectivity performance shall be no worse than that associated with Class RA2 retroreflective material, as defined in BS EN 12899-1:2007 |
| | Rear face | Unspecified |

**Table 21:** Lineside sign signal hardware parameters



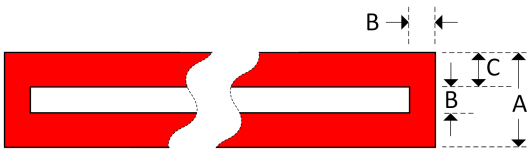

| Parameter | Dimension (mm +/-5%) | | |
|---|---|---|---|
| | Large | Medium | Small |
| A | 1650 (min) | 1300 (min) | 700 (min) |
| B | 900 | 700 | 400 |
| C | 10 | 10 | 5 |
| D | 120 | 100 | 55 |
| E | 500 | 400 | 220 |
| F | 120 | 100 | 50 |
| G | 180 | 140 | 80 |
| H | 150 | 120 | 65 |
| J | 540 (min) | 400 (min) | 210 (min) |
| K | 65 | 50 | 30 |
| L | 65 | 50 | 30 |
| M | 130 (min) | 100 (min) | 60 (min) |
| N | 130 | 100 | 60 (min) |
| P | 20 | 20 | 10 |

**Figure 9:** Stop board dimensions




| Parameter | Dimension (mm +/-5%) |
|---|---|
| A | 900 |
| B | 900 |
| C | 270 |
| D | 80 |
| E | 200 |
| F | 85 |
| G | 170 |
| H | 205 |

**Figure 10:** Distant board dimensions




| Parameter | Dimension (mm +/-5%) |
|---|---|
| A | 275 (min) |
| B | 75 |
| C | 100 |

**Figure 11:** Buffer beam dimensions

**Rationale**

G 3.5.2.2 These design parameters result in a physical appearance that is identifiable to authorised users and supports visibility.

G 3.5.2.3 The dimensions specified in Figures *9*, *10*, and *11* are consistent with the readability of reflectorised lineside signs, subject to the availability of sufficient ambient or artificial light.

G 3.5.2.4 Large, medium and small stop boards allow for site specific application constraints. The selection is subject to signal sighting assessment.

G 3.5.2.5 The shape of the stop board and fixed distant board is specified so that all of these signs have a consistent appearance.

G 3.5.2.6 Compliance with the BS 4800:2011 red colour shade means that the stop board red spot has a colour appearance that is similar to that specified for semaphore stop signal arms.

G 3.5.2.7 Compliance with the BS 4800:2011 yellow colour shade and the distant board colour pattern means that the fixed distant symbol has a colour appearance that is similar to that specified for semaphore distant signal arms.

G 3.5.2.8 The grey colour of the rear of lineside signs helps authorised users to distinguish between the front and rear of other signals and signs.

G 3.5.2.9 Lineside sign signals that meet the requirements for Class RA2 retroreflective material, as defined in BS EN 12899-1:2007, are readable when illuminated by a train headlight if they are correctly aligned.

**Guidance**

G 3.5.2.10 The shape of the retroreflective buffer beam is intended to be compatible with the buffing plate of buffer stop systems. The overall shape of the retroreflective buffer beam can be adapted so that it is compatible with the buffer stop infrastructure to which it is fitted.

G 3.5.2.11 The surface of signs conforming to BS EN 12899-1:2007 typically incorporate a series of spherical glass beads. Light passes through the front surface of a glass bead and reflects off a mirrored surface behind the bead. The beam then passes back through the front surface and is refracted as it leaves the bead, returning towards the original light source.

G 3.5.2.12 The amount of returned light can be measured when the sign is illuminated at a variety of angles. The results are given as candela / lux (cd/lx).

G 3.5.2.13 Tables in BS EN 12899-1:2007 set out the requirements with Class RA2 being a higher performance specification. This is in line with the normal European method of identifying different performance levels (the higher the number, the higher the performance) but reverses the UK's previous identification of Class 1 and Class 2 sheetings, as defined in BS 873-6:1983, where Class 1 was the highest level.

G 3.5.2.14 Requirements for rail vehicle head lamps and marker lamps are set out in the Locomotive and Passenger National Technical Specification Notice (LOC & PAS NTSN) and BS EN 15153-1:2020.

G 3.5.2.15 Additional guidance regarding product hardware parameters is given in *2.4*.

### 3.5.3 Display parameters

3.5.3.1 Stop boards, fixed distant boards and retroreflective buffer beams shall be capable of generating displays that meet the display appearance parameters set out in Table *22*.

| Design parameter | Value |
|---|---|
| Display element luminous intensity | See Table *21* 'hardware surface gloss' |
| Display element size | See Table *21* 'hardware size' |

| Design parameter | Value |
|---|---|
| Display element contrast | See Table *21* 'hardware colour' |
| Display element colour | See Table *21* 'hardware colour' |
| Non-flashing / flashing displays | Not applicable |
| Number of display elements | See Table *20* |
| Arrangement of display elements | Font = Transport Medium Alphabet |
| Spacing of display elements | See Figures *9*, *10* and *11* |

**Table 22:** Lineside sign signal display parameters

**Rationale**

G 3.5.3.2 These design parameters result in a display appearance that is visible and distinguishable to authorised users and supports readability.

**Guidance**

G 3.5.3.3 The Transport Medium Alphabet and defined spacing allow easy readability for black letters on white backgrounds.

### 3.5.4 Readability performance

**Guidance**

G 3.5.4.1 Stop boards, fixed distant boards and retroreflective buffer beams are differentiated by:

a) Size
b) Shape
c) Colour patterns.

G 3.5.4.2 Stop boards usually include additional wording to convey operational instructions to the authorised user. These are typically provided immediately beneath the stop sign as shown in Figure *9*.

G 3.5.4.3 Further design requirements for lineside operational signs are set out in GIRT7033.

## 3.6 Junction indicators

### 3.6.1 Display appearance

3.6.1.1 Each junction indication shall have the appearance of a straight bar of white light, as set out in Table *23*.

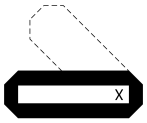
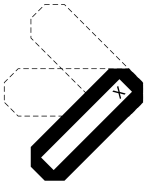
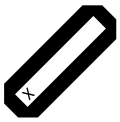
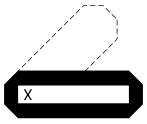
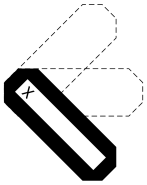
| Display type | Description | Example |
|---|---|---|
| Position 1 | Left-hand white bar - raised |  "X" denotes the PIVOT end |
| Position 2 | Left-hand white bar - horizontal |  |
| Position 3 | Left-hand white bar - lowered |  |
| Position 4 | Right-hand white bar - raised |  |
| Position 5 | Right-hand white bar - horizontal |  |
| Position 6 | Right-hand white bar - lowered |  |

**Table 23:** Junction indicator displays

**Rationale**

G 3.6.1.2 The angle of the bar of light is used to codify routing information being conveyed by the signalling system on the approach to a diverging junction. A different appearance would not be understood by authorised users and could imply a different meaning.

**Guidance**

G 3.6.1.3 The display examples set out in Table *23* are for illustrative purposes only and do not imply a particular technology or the number or arrangements of light sources within the indicator. This detail forms part of the product design specification.

### 3.6.2 Hardware parameters

3.6.2.1 Junction indicators shall comply with the hardware parameters set out in Table *24*.

| Design parameter | | Value |
|---|---|---|
| Hardware size | | Unspecified |
| Hardware colour | Forward facing surfaces | BS 4800-2011<br>shade 00-E-53: Black |
| | All other surfaces | Silver or grey |
| Hardware shape | | Unspecified |
| Hardware surface gloss | | Unspecified |

**Table 24:** Junction indicator hardware parameters

**Rationale**

G 3.6.2.2 These design parameters result in a physical appearance that is identifiable to authorised users and supports visibility.

G 3.6.2.3 A black indicator background:

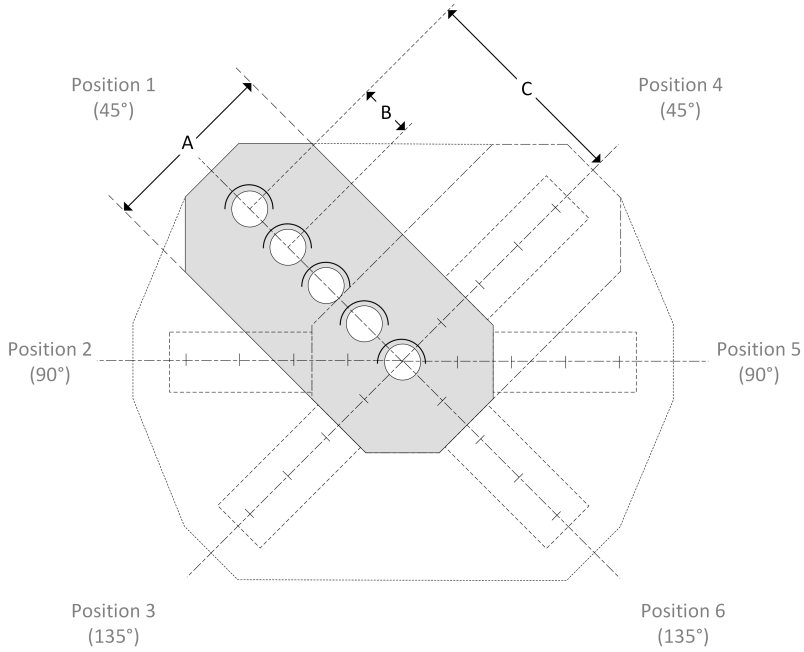
a) Provides a strong colour contrast ratio for junction indications; and
b) Means that junction indications have a similar appearance, irrespective of whether they are displayed in a dark or an illuminated environment.

G 3.6.2.4 The different colour of front-facing and other surfaces helps authorised users to distinguish between the front of an indicator that can be displaying an indication and the rear of other signals and indicators that can be ignored.

**Guidance**

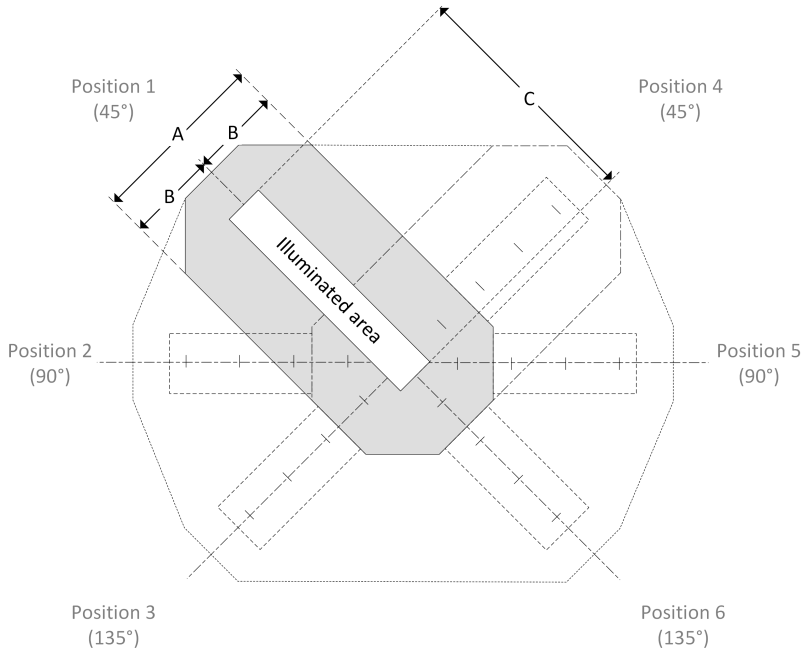
G 3.6.2.5 Hardware size parameters for junction indicators are not specified as this would need to take account of all potential performance requirements and applications.

G 3.6.2.6 Dimensions shown in Figures *12* and *13* represent existing practice for junction indicator hardware dimensions.




| Parameter | Dimension (mm) |
|---|---|
| A | 600 min |
| B | 176 min |
| C | 704 min – 764 max between centreline of lenses |

**Figure 12:** Junction indicator dimensions using five separate light sources




| Parameter | Dimension (mm) |
|---|---|
| A | 600 min |
| B | 300 min |
| C | 704 min – 764 max |

**Figure 13:** Junction indicator dimensions using a bar of light

G 3.6.2.7 The black front-facing surface helps authorised users to detect and identify junction indicators.

G 3.6.2.8 The hardware shape parameter is not specified as the overall shape of a junction indicator is also affected by the type of signal structure and any other hardware that is fitted to the signal, for example route indicator assemblies.

G 3.6.2.9 It is good practice for junction indicators to have a consistent, regular shape as this helps authorised users to recognise junction indicators when they are viewed against a background of other visible objects.

G 3.6.2.10 A low surface gloss value enhances the display contrast ratio and reduces the likelihood of misreading that would arise from a more reflective surface. Junction indicator hardware that generates or reflects visible light, could impair readability of the junction indicator display.

G 3.6.2.11 Additional guidance regarding product hardware parameters is given in *2.4*.

### 3.6.3 Display parameters

3.6.3.1 Junction indicators shall be capable of generating displays that meet the display parameters set out in Table *25*.

| Design parameter | | Value |
|---|---|---|
| Display element luminous intensity | | Unspecified<br>Simultaneously lit display elements shall have a similar intensity |
| Display element size | Length of illuminated area | Unspecified |
| | Width of illuminated area | Unspecified<br>Separate display elements shall be the same radius (-5 %, +10 %) |
| Display element contrast | | Unspecified |
| Display element colour (See *Part 4*) | <20 % of the illuminated area at the pivot end | Lunar white light |
| | Remainder of the illuminated area | Lunar white light |
| Display element shape | | A bar of light |
| Steady displays | | A lit display that has an uninterrupted appearance |

| Design parameter | | Value |
|---|---|---|
| Flashing displays | | Junction indications shall not appear to flash |
| Number of display elements | | One (see Table 23) |
| Arrangement of display elements | Position 1 | Left-hand end raised 45° above horizontal |
| | Position 2 | Horizontal |
| | Position 3 | Left-hand end lowered 45° below horizontal |
| | Position 4 | Right-hand end raised 45° above horizontal |
| | Position 5 | Horizontal |
| | Position 6 | Right-hand end lowered 45° below horizontal |
| Spacing of display elements | | Not applicable |

**Table 25:** Junction indicator display parameters

**Rationale**

G 3.6.3.2 These design parameters result in a display appearance that is visible and distinguishable to authorised users and supports readability.

G 3.6.3.3 Lunar white light helps junction indications to be readable because it is a slightly different colour of white compared with other white lights in the operational context.

G 3.6.3.4 The indication is displayed in the form of a bar of light, to mimic the direction of the diverging route that the indication applies.

G 3.6.3.5 Steady displays that appear interrupted can mislead the authorised user, either because the display is not consistently visible or because it appears to be flashing.

G 3.6.3.6 Compliance with the display element parameters set out in Table 25 mitigates poor readability.

**Guidance**

G 3.6.3.7 Display element luminous intensity, size and contrast parameters are not specified, as these need to take account of all potential performance requirements and applications.

G 3.6.3.8 The similar intensity and size of simultaneously illuminated display elements helps authorised users to recognise that the lights are part of the same junction indicator display.

G 3.6.3.9 The bar of light can be generated by means of either:

a) A line of five light points orientated as shown in Figure *12*; or
b) A bar of light as shown in Figure *13*.

G 3.6.3.10 The bar of light, shown in Figure *13*, can be made up of a large number of small discrete light sources.

G 3.6.3.11 A small gap within the bar of light, as shown in Figure *14*, can be acceptable for mechanical design purposes, provided that it does not compromise the appearance of the bar of light.

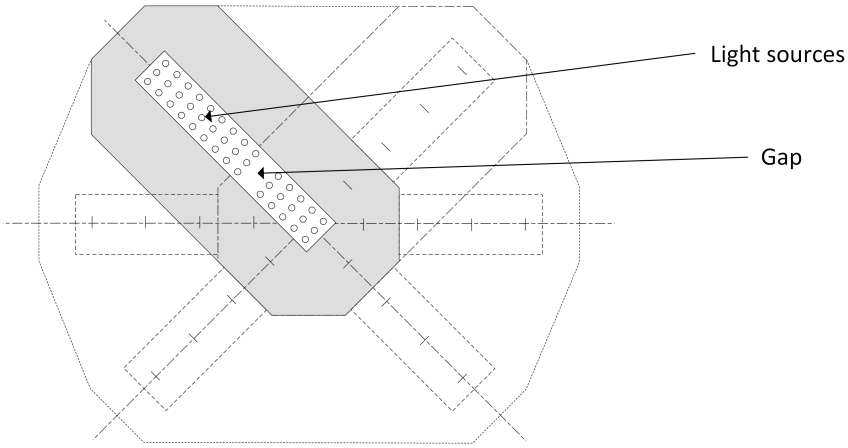



**Figure 14:** Junction indicator example of discrete light sources

G 3.6.3.12 There is no requirement in RIS-0758-CCS for a junction indicator to display a flashing indication.

G 3.6.3.13 An appearance of more than one white bar would not be understood by the authorised user.

G 3.6.3.14 The consistent appearance of junction indications helps authorised users to distinguish which indication is being displayed.

G 3.6.3.15 A left-hand junction indicator that displays position 2 will typically be provided with an indicator that displays position 1, because there would be at least two left-hand routes.

G 3.6.3.16 A left-hand junction indicator that displays position 3 will typically be provided with indicators that display positions 1 and 2, because there would be three left-hand routes.

G 3.6.3.17 A right-hand junction indicator that displays position 5 will typically be provided with an indicator that displays position 4, because there would be at least two right-hand routes.

G 3.6.3.18 A right-hand junction indicator that displays position 6 will typically be provided with indicators that display positions 4 and 5, because there would be three right-hand routes.

G 3.6.3.19 Further guidance about the spatial relationship between junction indications and colour light signal displays is given in RIS-0737-CCS.

G 3.6.3.20 Additional guidance regarding product display parameters is given in *2.5*.

### 3.6.4 Readability performance

**Guidance**

G 3.6.4.1 A row or matrix of separate light sources is considered to provide the appearance of a bar of light.

G 3.6.4.2 Left-hand and right-hand junction indications have a similar appearance, which means that in the operational context authorised users also use its position relative to the junction signal aspect to differentiate between a left-hand and a right-hand divergence.

G 3.6.4.3 Further guidance about the overall appearance and functionality of junction signal aspects and junction indications in the operational context is given in RIS-0758-CCS.

G 3.6.4.4 Junction indications are always displayed in combination with a colour light junction signal aspect. The junction indication is only displayed when a relevant diverging route is set at the associated junction.

G 3.6.4.5 It is good practice for junction indicators to be specified so that when they are displayed in combination with the relevant colour light signal aspects, the generated displays are capable of supporting the junction signal reading time. Further guidance about readable distance and the reading times associated with a range of permissible speeds is given in *2.6*.

G 3.6.4.6 It is advantageous for maximum visible distance performance to be specified for junction indicators because, in some circumstances, visibility can be used to advantage within signalling layouts. For example, where a junction signal is fitted with only one junction indication, being visible can be sufficient to convey the routing information needed by the authorised user.

## 3.7 Alphanumeric indicators and preliminary junction indicators

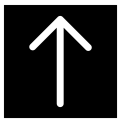
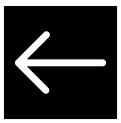
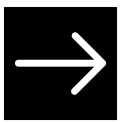
### 3.7.1 Display appearance

3.7.1.1 Each alphanumeric indication shall be displayed as one, two or three alphanumeric characters displayed against a black background, as set out in Table *26*.

| Display type | Description | Example |
|---|---|---|
| Alphanumeric | A combination of alphanumeric characters, horizontally displayed against a black background |  (Examples only) |

**Table 26:** Alphanumeric indication displays

3.7.1.2 Each preliminary junction indication shall be displayed in the form of an arrow against a black background or in a dark environment, as shown in Table *27*.

| Display type | Description | Example |
|---|---|---|
| Position 0 arrow | White arrow - vertical |  |
| Position 1 arrow | Left-hand white arrow - raised |  |
| Position 2 arrow | Left-hand white arrow - horizontal |  |
| Position 3 arrow | Left-hand white arrow - lowered |  |
| Position 4 arrow | Right-hand white arrow - raised |  |
| Position 5 arrow | Right-hand white arrow - horizontal |  |

| Display type | Description | Example |
|---|---|---|
| Position 6 arrow | Right-hand white arrow - lowered |  |

**Table 27:** Preliminary junction indication displays

**Rationale**

G 3.7.1.3 The appearance of alphanumeric characters are used to codify the routing, infrastructure status or operational instruction information being conveyed by the signalling system. A different display appearance would not be understood by authorised users and could imply a different meaning.

G 3.7.1.4 The appearance of arrow symbols are used to codify the routing information being conveyed at a signal ahead. A different form of symbols would not be understood by authorised users and could imply a different meaning.

**Guidance**

G 3.7.1.5 The display examples set out in Tables *26* and *27* are for illustrative purposes only and do not imply a particular technology or the number or arrangement of light sources within the indicator. This detail forms part of the product design specification.

### 3.7.2 Hardware parameters

3.7.2.1 Alphanumeric indicators and preliminary junction indicators shall comply with the hardware parameters set out in Table *28*.

| Design parameter | | Value |
|---|---|---|
| Hardware size | | Unspecified |
| Hardware colour | Forward facing surfaces | BS 4800-2011<br>shade 00-E-53: Black |
| | All other surfaces | Silver or grey |
| Hardware shape | | Rectangular when viewed from the front |
| Hardware surface gloss | | Unspecified |

**Table 28:** Indicator hardware parameters

**Rationale**

G 3.7.2.2 These design parameters result in a physical appearance that is identifiable to authorised users and supports visibility.

G 3.7.2.3 A black indicator background:

a) Provides a strong colour contrast ratio for illuminated indications; and
b) Means that alphanumeric indications and preliminary junction indications have a similar appearance, irrespective of whether they are displayed in the operational context.

G 3.7.2.4 The different colour of front-facing and other surfaces helps authorised users to distinguish between the front of an indicator that can be displaying an indication and the rear of other signals and indicators that can be ignored.

G 3.7.2.5 A rectangular housing shape for alphanumeric indicators and preliminary junction indicators helps authorised users to recognise alphanumeric indicators and preliminary junction indicators when they are viewed against a background of other visible objects.

**Guidance**

G 3.7.2.6 Hardware size parameters for alphanumeric indications and preliminary junction indications are not specified as this would need to take account of all potential performance requirements and applications.

G 3.7.2.7 Hardware size considerations include:

a) The character size required to achieve the readability performance specification that the product is intended to meet; and
b) The permitted signal aspect and route indication combinations set out in RIS-0703-CCS.

G 3.7.2.8 The black front-facing surface helps authorised users to detect and identify lineside signals and indicators.

G 3.7.2.9 When an alphanumeric indicator or a preliminary junction indicator is not displaying an indication, the absence of the indication might be interpreted by an authorised user.

G 3.7.2.10 A low surface gloss value enhances the display contrast ratio and reduces the likelihood of misreading that would arise from a more reflective surface. Alphanumeric and preliminary junction indicator hardware that generates or reflects visible light, could impair readability of the indicator display.

G 3.7.2.11 Additional guidance regarding product hardware parameters is given in *2.4*.

### 3.7.3 Display parameters

3.7.3.1 Alphanumeric indicators and preliminary junction indicators shall be capable of generating displays that meet the display parameters set out in Table *29*.

| Design parameter | | Value |
|---|---|---|
| Display element luminous intensity | | Unspecified<br>Simultaneously lit display elements shall have a similar intensity |
| Display element size | | Unspecified |
| Display element contrast | | Unspecified |
| Display element colour (See *Part 4*) | | Signal white light |
| Display element shape | Font type | Unspecified |
| | Alphanumeric character type | 1 2 3 4 5 6 7 8 9 0<br>A B C D E F G H I J K L M N O P<br>R S T U V W X Y Z |
| | Arrow type | Unspecified |
| Steady displays | | A lit display that has an uninterrupted appearance |
| Flashing displays | | Alphanumeric indications and preliminary route indications shall not appear to flash |
| Number of display elements | Alphanumeric characters | One, two or three |
| | Arrow | One |

| **Design parameter** | | **Value** |
|---|---|---|
| Arrangement of display elements | Multiple alphanumeric characters | Horizontally aligned within the display area |
| | Position 0 arrow | Vertical arrow |
| | Position 1 arrow | Left-hand arrow aligned 45° above horizontal |
| | Position 2 arrow | Horizontal left-hand arrow |
| | Position 3 arrow | Left-hand arrow aligned 45° below horizontal |
| | Position 4 arrow | Right-hand arrow aligned 45° above horizontal |
| | Position 5 arrow | Horizontal right-hand arrow |
| | Position 6 arrow | Right-hand arrow aligned 45° below horizontal |
| Display element spacing | Multiple alphanumeric character spacing | Unspecified |
| | Arrow | Not applicable |

**Table 29:** Alphanumeric and preliminary junction indication parameters

**Rationale**

G 3.7.3.2 These design parameters result in a display appearance that is visible and distinguishable to authorised users and supports readability.

G 3.7.3.3 Signal white light is specified so that when an indication is visible but not yet readable, it does not mislead the observer into misreading the indication as a different type of coloured light indication or a signal display that use other colours.

G 3.7.3.4 A consistent appearance of alphanumeric characters comprising the Modern English alphabet and the Arabic numeral system helps authorised users identify alphanumeric indicators from a long distance in the operational context. At a closer distance, authorised users can find it much easier to detect alphanumeric indicator indications.

G 3.7.3.5 Character Q is not used within the signalling system because its appearance is too similar to numeral 0. For similar reasons, the letters I, J and O are non-preferred and are not usually displayed on their own.

G 3.7.3.6 A maximum of three alphanumeric characters is permitted because a greater number would not be readable in the operational context.

G 3.7.3.7 A maximum of one arrow at a time per display is permitted because authorised users would not understand the meaning of multiple arrows.

G 3.7.3.8 Steady displays that appear interrupted can mislead the authorised user, either because the display is not consistently visible or because it appears to be flashing.

G 3.7.3.9 Compliance with the display element parameters set out in Table *29* mitigates poor readability.

**Guidance**

G 3.7.3.10 Display element luminous intensity, size and contrast parameters are not specified, as these need to take account of all potential performance requirements and applications.

G 3.7.3.11 The similar intensity and size of simultaneously illuminated display elements helps authorised users to recognise that multiple characters are part of the same combined alphanumeric display.

G 3.7.3.12 Excessive brightness at night can cause glare and make the indications difficult to read due to the 'bleeding' of the lights into each other.

G 3.7.3.13 Some legacy types of alphanumeric indicators display indications have a lunar white light colour specification.

G 3.7.3.14 Gill Sans Light is a font typically used in signalling system displays. It is good practice for alphanumeric indications to approximate to Gill Sans Light to the extent that the hardware technology allows, so that alphanumeric indications have a consistent appearance.

G 3.7.3.15 A specified character spacing that supports readability helps authorised users identify each individual character or number.

G 3.7.3.16 A minimum character spacing of 20 % of character height is typically used with Gill Sans Light characters. A different font might specify a different character spacing.

G 3.7.3.17 Arrow heads that appear similar to the examples set out in Table *27* provide a consistent appearance to preliminary junction indications.

G 3.7.3.18 Further guidance about using different character sizes to help drivers correctly interpret which type of movement authority is available is given in RIS-0758-CCS.

G 3.7.3.19 There is no requirement in RIS-0758-CCS for an alphanumeric indicator or preliminary junction indicator to display a flashing indication.

G 3.7.3.20 Authorised users read alphanumeric indications from left to right. Vertically displayed characters could be mistakenly read as separate displays.

G 3.7.3.21 The consistent appearance of junction indications helps authorised users to distinguish which arrow indication is being displayed.

G 3.7.3.22 Additional guidance regarding product display parameters is given in *2.5*.

### 3.7.4 Readability performance

**Guidance**

G 3.7.4.1 Alphanumeric indications are differentiated by the particular characters being displayed which relate to the routing information provided by the signalling system.

G 3.7.4.2 Alphanumeric indicators are used in the following applications:

a) An alphanumeric route indicator fitted to a main junction signal;
b) An alphanumeric route indicator fitted to a shunting or subsidiary signal;
c) An independent alphanumeric indicator; and
d) An alphanumeric indicator positioned with other lineside signalling equipment.

G 3.7.4.3 Alphanumeric indicators are typically used to display:

a) Alphanumeric route indications in combination with colour light signal and semaphore main stop signals;
b) Alphanumeric route indications in combination with position light signals and semaphore shunting signals;
c) Preliminary junction indications; and
d) Independently displayed alphanumeric indications.

G 3.7.4.4 Alphanumeric indicators are designed so that the relevant indication can be switched on and off by the signalling system. In most cases the normal state is unlit.

G 3.7.4.5 It is good practice for alphanumeric indicators to be specified so that generated displays are capable of supporting the reading time when they are displayed either on their own or in combination with other signalling system displays.

G 3.7.4.6 The design specification will typically take account of reading time and line speed if the alphanumeric indicators are intended to be used in applications where they will be read by drivers. Further guidance about alphanumeric indications, including permitted combinations, is given in RIS-0758-CCS.

G 3.7.4.7 Preliminary junction indications are differentiated by the orientation of the arrow symbol.

G 3.7.4.8 Preliminary junction indications are normally displayed independently of other signalling system displays.

G 3.7.4.9 Preliminary junction indicators that support readability are specified so that generated displays are capable of supporting the reading time when they are displayed on their own.

G 3.7.4.10 It is advantageous for maximum visible distance performance to be specified for alphanumeric indicators because, in some circumstances, visibility can be used to advantage within signalling layouts. For example, where a junction signal has only one route indication, being visible can be sufficient to convey the routing information needed by the authorised user.

## 3.8 Coloured light signalling indicators

### 3.8.1 Display appearance

3.8.1.1 Each coloured light signalling indicator shall have the appearance of one coloured display element, as set out in Table *30*.

| Display type | Description | Example |
|---|---|---|
| Flashing red light | One flashing red display element |  |
| Flashing white light | One flashing white display element |  |
| White light | One white display element |  |
| Yellow light | One yellow display element |  |
| Blue light | One blue display element |  |
| Flashing blue light | One flashing blue display element |  |

**Table 30:** Coloured light signalling indication displays

**Rationale**

G 3.8.1.2 The appearance of coloured light signalling indicators is used to codify information conveyed by the signalling system. A different display appearance would not be understood by authorised users and could imply a different meaning.

**Guidance**

G 3.8.1.3 The display examples set out in Table *30* are for illustrative purposes only and do not imply a particular technology or the number or arrangements of light sources within the indicator. This detail forms part of the product design specification.

### 3.8.2 Hardware parameters

3.8.2.1 Coloured light signalling indicators shall comply with the hardware parameters set out in Table *31*.

| Design parameter | | Value |
|---|---|---|
| Hardware size | | Unspecified |
| Hardware colour | Forward facing surfaces | BS 4800-2011<br>shade 00-E-53: Black |
| | All other surfaces | Silver or grey |
| Hardware shape | | Unspecified |
| Hardware surface gloss | | Unspecified |

**Table 31:** Coloured light signalling indicator hardware parameters

**Rationale**

G 3.8.2.2 These design parameters result in a physical appearance that is identifiable to authorised users and supports visibility.

G 3.8.2.3 A black indicator background:

a) Provides a strong colour contrast ratio for illuminated indications; and
b) Means that coloured light signalling indicator displays have a similar appearance irrespective of whether they are displayed in a dark or an illuminated environment.

G 3.8.2.4 The different colour of front-facing and other surfaces helps authorised users to distinguish between the front of an indicator that would normally be displaying an indication and the rear of other signals and indicators that can be ignored.

**Guidance**

G 3.8.2.5 Hardware size parameters for colour light signalling indicators are not specified as this would need to take account of all potential performance requirements and applications.

G 3.8.2.6 The black front-facing surface helps authorised users to detect and identify lineside coloured light signalling indicators.

G 3.8.2.7 The hardware shape parameter is not specified as the overall shape of a colour light signalling indicator is also affected by the type of structure and any other hardware that is fitted with the indicator.

G 3.8.2.8 It is good practice for colour light signalling indicators to have a consistent, regular shape as this helps authorised users to recognise colour light signalling indicators when they are viewed against a background of other visible objects. Some example shapes are shown in Figure *15*.

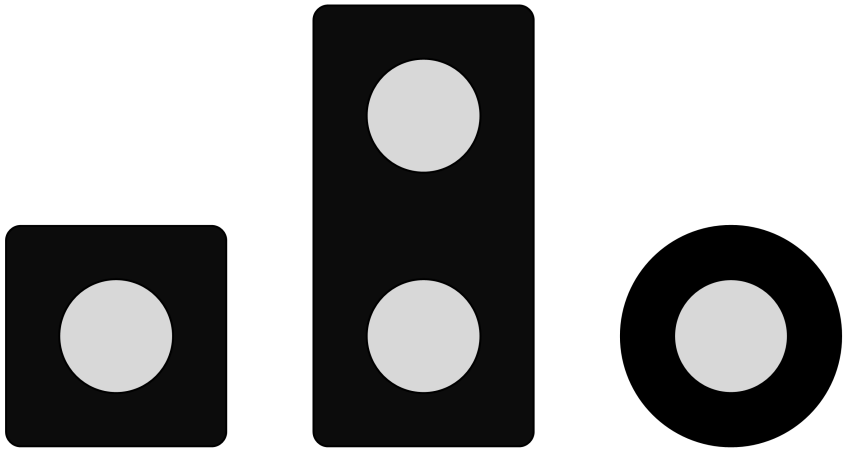


**Figure 15:** Examples of colour light indicator housing shapes

G 3.8.2.9 A low surface gloss value enhances the display contrast ratio and reduces the likelihood of misreading that would arise from a more reflective surface finish. Coloured light signalling indicator hardware that generates or reflects visible light, could impair readability of the colour light signal display.

G 3.8.2.10 Additional guidance regarding hardware parameters can be found in *2.4*.

### 3.8.3 Display Parameters

3.8.3.1 Coloured light signalling indicators shall be capable of generating displays that meet the parameters set out in Table *32*.

| Design parameter | Value |
|---|---|
| Display element luminous intensity | Unspecified |
| Display element size | Unspecified |
| Display element contrast | Unspecified |

| Design parameter | | Value |
|---|---|---|
| Display element colour (See *Part 4*) | Flashing red | Signal red light |
| | Flashing white | Signal white light |
| | Steady white | |
| | Flashing blue | Signal blue light |
| | Steady blue | |
| | Yellow | Signal yellow light |
| Display element shape | | Circular disc appearance from >10 m |
| Steady light | | A lit display that has an uninterrupted appearance |
| Flashing display | | Shall be capable of generating flashing displays that comply with the flashing indication parameters set out in RIS-0758-CCS |
| Number of display elements | | One |
| Arrangement of display elements | | Not applicable |
| Spacing of display elements | | Not applicable |

**Table 32:** Coloured light signalling indicator display parameters

**Rationale**

G 3.8.3.2 These design parameters result in a display appearance that is visible and distinguishable to authorised users and supports readability.

G 3.8.3.3 Display element colour is the method used to convey the meaning of each indication.

G 3.8.3.4 A consistent filled circular appearance, when viewed from more than 10 m away, helps authorised users to detect and identify coloured light signalling indications when they are displayed in the operational context. At a closer distance, authorised users can find it much easier to detect coloured light signalling indications.

G 3.8.3.5 Steady displays that appear interrupted can mislead the authorised user, either because the display is not consistently visible or because it appears to be flashing.

G 3.8.3.6 These parameters help authorised users to read the colour light signalling indicator aspect and distinguish between a flashing aspect and a steady aspect.

G 3.8.3.7 Compliance with the display element parameters set out in Table *32* mitigates poor readability.

**Guidance**

G 3.8.3.8 Display element luminous intensity, size and contrast parameters are not specified, as these need to take account of all potential performance requirements and applications.

G 3.8.3.9 Colour light signalling indicator products that generate the correct flashing display appearance when integrated within the overall CCS subsystem, support readability.

G 3.8.3.10 The information conveyed by each coloured light indication is denoted by colour and whether or not the indication appears to flash rather than the number of lights.

G 3.8.3.11 Additional guidance regarding display parameters can be found in *2.5*.

---

### 3.8.4 Readability performance

**Guidance**

G 3.8.4.1 Coloured light signalling indications are differentiated by:

a) Display element colour; and
b) Whether or not the indication appears to flash.

G 3.8.4.2 It is good practice for colour light signalling indicators to be specified so that all generated displays are capable of supporting the required reading time.

G 3.8.4.3 The flashing red indication at a locally monitored level crossing system is typically readable when the train reaches the special speed restriction sign, which can be up to 600 m from the indicator. Historical practice has been to specify a 600 m readable distance for the flashing red indication.

G 3.8.4.4 The flashing white indication at a locally monitored level crossing system is typically readable before the train reaches the special speed restriction sign, which can be up to 600 m from the indicator. Historical practice has been to specify a 800 m readable distance for the flashing white indication.

G 3.8.4.5 Coloured light indicators are designed so that the relevant indication can be switched on and off by the signalling system.

G 3.8.4.6 Coloured light signalling indications may be displayed on their own or in combination with another coloured light indication, a lineside sign signal and a lineside operational sign.

G 3.8.4.7 Further rationale and guidance about coloured light signalling indications is given in RIS-0758-CCS.

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## 3.9 Loading / unloading indicators

### 3.9.1 Display appearance

3.9.1.1 Each loading / unloading indicator display shall have the appearance of three coloured display elements displayed against a black background, as set out in Table *33*.

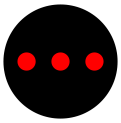
| Display type | Description | Example |
|---|---|---|
| ON | Three red lights aligned horizontally |  |
| Position 1 | Three white lights aligned at 45° left hand raised |  |
| Position 0 | Three white lights aligned vertically |  |
| Position 4 flashing | Three flashing white lights aligned at 45° right hand raised |  |

**Table 33:** Loading / unloading indications

**Rationale**

G 3.9.1.2 The appearance of each loading / unloading indication is used to codify the operational information that is conveyed by the signalling system. A different display appearance would not be understood by authorised users and could imply a different meaning.

**Guidance**

G 3.9.1.3 The display examples set out in Table *33* are for illustrative purposes only and do not imply a particular technology or the number or arrangements of light sources within the indicator. This detail forms part of the product design specification.

### 3.9.2 Hardware parameters

3.9.2.1 Loading / unloading indicators shall comply with the hardware parameters set out in Table *34*.

| Design parameter | | Value |
|---|---|---|
| Hardware size | | Unspecified |
| Hardware colour | Forward facing surfaces | BS 4800-2011<br>shade 00-E-53: Black |
| | All other surfaces | Silver or grey |
| Hardware shape | | Circular or rectangular when viewed from the front |
| Hardware surface gloss | | Unspecified |

**Table 34:** Loading / unloading indicator hardware parameters

**Rationale**

G 3.9.2.2 These design parameters result in a physical appearance that is identifiable to authorised users and supports visibility.

G 3.9.2.3 A black indicator background:

a) Provides a strong colour contrast ratio for illuminated indications; and
b) Means that the indications have a similar appearance, irrespective of whether they are displayed in a dark or an illuminated environment.

G 3.9.2.4 The different colour of front-facing and other surfaces helps authorised users to distinguish between the front of an indicator that would normally be displaying an indicator display and the rear of other signals and indicators that can be ignored.

G 3.9.2.5 A circular or rectangular housing shape for loading / unloading indicators helps authorised users to recognise loading / unloading indicators when they are viewed against a background of other visible objects.

**Guidance**

G 3.9.2.6 Hardware size parameters for loading / unloading indicators are not specified as this would need to take account of all potential performance requirements and applications.

G 3.9.2.7 The black front-facing surface helps authorised users to detect and identify loading / unloading indicators.

G 3.9.2.8 A consistent indicator housing shape helps authorised users to identify loading / unloading indicators when they are viewed in the operational context.

G 3.9.2.9 Existing products use a circular housing arrangement of filament lamps. An alternative arrangement would be to display the indication using an arrangement of LED clusters within a circular or rectangular housing - similar to a banner repeater indicator housing.

G 3.9.2.10 A low surface gloss value enhances the display contrast ratio and reduces the likelihood of misreading that would arise from a more reflective surface finish. Loading / unloading indicator hardware that generates or reflects visible light, could impair readability of the indicator display.

G 3.9.2.11 Additional guidance regarding hardware parameters can be found in *2.4*.

### 3.9.3 Display parameters

3.9.3.1 A loading / unloading indicator shall be capable of generating displays that meet the parameters set out in Table *35*.

| **Design parameter** | | **Value** |
|---|---|---|
| Display element luminous intensity | | Unspecified<br>Simultaneously lit display elements shall have a similar intensity |
| Display element size | | Unspecified |
| Display element contrast | | Unspecified |
| Display element colour (See *Part 4*) | Red | Signal red light |
| | Flashing white | Signal white light |
| | Steady white | |
| Display element shape | | Circular |
| Steady displays | | A lit display that has an uninterrupted appearance |
| Flashing display | | Shall be capable of generating flashing displays that comply with the flashing indication parameters set out in RIS-0758-CCS |
| Number of display elements | | Three |

| Design parameter | | Value |
|---|---|---|
| Arrangement of display elements | ON | Horizontal alignment |
| | Position 1 | Aligned at 45°, left-hand end raised |
| | Position 0 | Vertical alignment |
| | Position 4 (flashing) | Aligned at 45°, right-hand end raised |
| Spacing of display elements | | Unspecified |

**Table 35:** Loading / unloading indicator display parameters

**Rationale**

G 3.9.3.2 These design parameters result in a display appearance that is visible and distinguishable to authorised users and supports readability.

G 3.9.3.3 Display element colour is one of the methods used to convey the information provided by the signalling system.

G 3.9.3.4 A consistent filled circular shape helps authorised users to detect and identify loading / unloading indications from a long distance in the operational context. At a closer distance, authorised users can find it much easier to detect loading / unloading indications.

G 3.9.3.5 Steady displays that appear interrupted can mislead the authorised user, either because the display is not consistently visible or because it appears to be flashing.

G 3.9.3.6 These parameters help authorised users to read the loading / unloading indicator aspect and distinguish between a flashing aspect and a steady aspect.

G 3.9.3.7 The three display elements combine to give the distinctive appearance of a fragmented coloured bar. A different number and arrangement of lights could be misinterpreted as a junction indication or a signal display.

G 3.9.3.8 Compliance with the display element parameters set out in Table *35* mitigates poor readability.

**Guidance**

G 3.9.3.9 Display element luminous intensity, size and contrast parameters are not specified, as these need to take account of all potential performance requirements and applications.

G 3.9.3.10 The similar intensity and size of simultaneously illuminated display elements helps authorised users to recognise that the lights are part of the same display.

G 3.9.3.11 A specified display element spacing that provides an appearance of three distinct points of light, supports readability.

G 3.9.3.12 Additional guidance regarding display parameters can be found in *2.5*.

### 3.9.4 Readability performance

**Guidance**

G 3.9.4.1 Loading / unloading indications are differentiated by:

a) Display element colour;
b) Alignment of display elements; and
c) Whether or not the indication appears to flash.

G 3.9.4.2 Loading / unloading indicators are used to communicate train movement requirements between a local operator and the driver of a train that is being loaded or unloaded.

G 3.9.4.3 It is intended that the driver is able to read the indication being displayed and react quickly in controlling the movement of the train. Loading / unloading indicators are typically provided in multiple and arranged so that the driver can read the indication displayed by at least one of the indicators at all times.

G 3.9.4.4 A sequence of indicators is typically provided up to 100 m apart along the applicable line.

G 3.9.4.5 Loading / unloading indicators are usually switched off with no indication displayed, and are only switched on for a specific train operation.

G 3.9.4.6 Loading / unloading indications can be displayed on their own or in combination with another signal or a lineside operational sign.

# Part 4 Light Parameters

## 4.1 Light colours

4.1.1 Illuminated displays generated by lineside signalling products shall comply with the light colour specifications set out in Table *36*.

| Display colour | BS 1376:1974 Table 1 | | | Applicable to (GKRT0057 table reference) |
|---|---|---|---|---|
| | BS 1376:1974 reference | Colour class | Additional chromaticity limits applicable to lineside signalling products | |
| Signal red | Figure 2 | C | 'y' not greater than 0.295 | Colour light signal (see Table *6*) |
| | | | 'y' between 0.280 and 0.300 | Position light signal (see Table*10* ) |
| | | | | Semaphore signal: (see Table *17*) |
| | | | | Signalling indicator (see Table *30* and Table *33*) |
| Signal yellow | Figure 3 | B | Not applicable | Colour light signal (see Table *6*) |
| | | | | Position light signal (see Table *10*) |
| | | | | Signalling indicator (see Table *30*) |
| | | C | Not applicable | Semaphore signal (see Table *17*) |

| Display colour | BS 1376:1974 Table 1 | | | Applicable to (GKRT0057 table reference) |
|---|---|---|---|---|
| | BS 1376:1974 reference | Colour class | Additional chromaticity limits applicable to lineside signalling products | |
| Signal green | Figure 1 | C | Not applicable | Colour light signal (see Table *6*) |
| | | | | Banner repeater (see Table *13*) |
| | | | | Semaphore signal (see Table *17*) |
| Signal white | Figure 1 | C | Not applicable | Banner repeater (see Table *13*) |
| | | | | Alphanumeric / preliminary junction indicator (see Table *26* and Table *27*) |
| | | | | Signalling indicator (see Table *30* and Table *33*) |
| Signal blue | Figure 1 | A | Not applicable | Signalling indicator (see Table *30*) |
| Lunar white | #1 | | 'x' between 0.300 and 0.420 | Junction indicator (see Table *23*) |
| #1 Lunar white is a subset at the blue end of class C signal white | | | | |

**Table 36:** Signalling light colour specifications

**Rationale**

G 4.1.2 BS 1376:1974 specifies the display colours set out in Table *36* using a set of values and equations set out in BS 1376:1974 Table 1, and a set of chromaticity coordinate diagrams shown in BS 1376:1974 Figures 1, 2 and 3.

G 4.1.3 These colour specifications result in a display appearance that is visible and distinguishable to authorised users and supports readability.

G 4.1.4 The signal red restriction on coordinate 'y' moves the limit away from the yellow end of the spectrum and therefore reduces the likelihood that an authorised user will misread a red display as a yellow display.

G 4.1.5 The 'y' coordinates specified for signal red displays are more restrictive than class C in order to:

a) Provide a consistent colour appearance at each signal or indicator; and
b) Maintain a strong colour separation from the purple end of the spectrum.

G 4.1.6 The class B signal yellow is furthest from the red end of the signal yellow spectrum and therefore reduces the likelihood that an authorised user will misread a yellow display as a red display.

G 4.1.7 The class C signal yellow is specified for semaphore distant signal lights to maintain a strong colour separation from the green end of the spectrum. It is good practice for isolated distant signals to maintain a strong colour distinction between the green OFF and yellow ON displays.

G 4.1.8 The class C signal green is far enough from the white and blue ends of the spectrum to be readable and supports a strong colour distinction from class B red signal. The risk arising if an authorised user misreads a green signal aspect is less than the risk associated with displays that are used to convey restrictive information.

G 4.1.9 The class C signal white is far enough from the red end of the spectrum to provide a strong colour distinction between red and white indications, which are sometimes displayed by the same indicator. It also reduces the likelihood that an authorised user will read a yellow signal aspect or indication when a white indication is displayed.

G 4.1.10 Signal blue only includes a class A colour specification.

G 4.1.11 The chromaticity limits specified for lunar white displays are more restrictive than class C signal white in order to:

a) Provide a consistent colour appearance;
b) Maintain a strong colour separation from the yellow and green ends of the spectrum; and
c) Reduce the likelihood that an authorised user will misread a route indication as a yellow signal aspect or indication.

G 4.1.12 Compliance with the display colours set out in Table *36* mitigates poor readability.

**Guidance**

G 4.1.13 The chromaticity coordinate diagrams, included in BS 1376:1974, specify each colour using up to three ranges, which are described as colour classes A, B and C.

G 4.1.14 A colour meeting class A has the widest range of chromaticities and embraces the more restrictive ranges designated as classes B and C.

G 4.1.15 Class C colour coordinate ranges are specified for most lineside signalling displays because it helps them to become easily distinguishable when viewed from long distances. A less restrictive range would reduce how reliably authorised users will be able to distinguish display colours.

G 4.1.16 The chromaticity limits specified for colour light signal products are more restrictive than other red displays because they are generally associated with the longest reading distances.

G 4.1.17 The more restrictive chromaticity limits applicable to colour light signals are consistent with BS 1376:1974 Table 2.

G 4.1.18 Where the light source does not provide the specified colour by itself, an arrangement of coloured lenses / filters can be used to achieve the correct colour specification.

G 4.1.19 BS 1376:1974 clause 2 includes the definition for each signal light colour and further guidance that explains why red, yellow and green colours are used.

G 4.1.20 BS 1376:1974 also provides further guidance about:

a) Signal light colour specifications;
b) How signal light colours are generated;
c) The recognised methods of testing and measurement that can be used to support product assessment processes; and
d) The difficulties associated with using signal blue.

G 4.1.21 It is good practice for asset management systems to take account of gradual colour degradation that could affect ongoing compliance with this requirement after products are taken into operational use.

## 4.2 Light properties

4.2.1 Lit displays shall not use polarised light.

**Rationale**

G 4.2.2 Polarised light has the potential to affect readability if authorised users wear approved sunglasses.

G 4.2.3 Polarised light has the potential to cause some people to perceive an alternative colour in certain viewing conditions due to the response of the human eye.

**Guidance**

G 4.2.4 There is no guidance associated with this requirement.

# Part 5 Product Performance Assessment Requirements

## 5.1 Product performance evaluation strategy

**Guidance**

G 5.1.1 The product performance evaluation strategy is part of the overall product acceptance strategy.

G 5.1.2 A product performance evaluation strategy includes everything that is necessary to inform a decision about whether actual product performance meets the requirements set out in the product performance specification.

G 5.1.3 Consultation with the following stakeholders before the evaluation takes place can benefit the efficient application of the product performance evaluation strategy:

a) Infrastructure manager(s);
b) Client(s); and
c) Intended users, such as railway undertakings and train driver representatives.

G 5.1.4 It is good practice for the product performance evaluation strategy to be documented and include:

a) Information about the product to be evaluated, including:
    i) Product identity and version;
    ii) Product performance specification;
    iii) The intended use of the product;
    iv) The scope of authorisation being sought; and
    v) The record of product conformity assessment, including, where relevant, non-compliance certificates and verification of the appropriateness of parameter values that are listed unspecified in *Part 3* of this standard.
b) The scope of assessments needed in order to reach a decision that the product meets its performance specification, including:
    i) The displays and display combinations to be assessed; and
    ii) Any specific performance claims to be assessed, for example visible distance performance.
c) The methodology for assessing the probability of phantom displays and product readability performance, including:
    i) The standard against which each assessment will be carried out;
    ii) Any additional assessment criteria to be applied, for example phantom ratio and angle of illumination;
    iii) Laboratory tests;
    iv) Simulation tests using human assessors; and
    v) Operational trials.
d) Assessment dependencies.
e) Assessment resources.
f) Requirements for independence.
g) Requirements for assessment plans.

h) Requirements for recording assessment results.
i) Acceptance (pass / fail) criteria to be applied to the assessments.

## 5.2 Phantom display performance

5.2.1 The display element luminous intensity ratio of light source to phantom display shall be 5:1 or greater when tested in accordance with BS EN 12368:2015, 8.4.

**Rationale**

G 5.2.2 Phantom displays adversely affect readability compatibility if they are capable of being misread as a correctly displayed signal aspect or indication. Phantom displays also constitute a hazard to train operations. The 5:1 ratio is intended to militate against the hazard of an unintended phantom display being perceived as a valid signal and acted on by a driver.

G 5.2.3 Compliance with the intensity ratio of light source to phantom display, mitigates poor readability.

**Guidance**

G 5.2.4 The readability performance assessment process set out in *5.3* is not comprehensive enough to reach a decision on the probability of phantom displays being inadvertently generated by the product under assessment.

G 5.2.5 BS EN 12368:2015 specifies the methodology for testing road traffic light displays, using an external light source positioned 10° directly above the display element. This methodology is suitable for testing railway signalling equipment. A good test plan includes a range of test angles that take account of the intended use of the product in the railway operational context.

G 5.2.6 BS EN 12368:2015 Table 6 classifies the results of each test in terms of light source: phantom ratio (Is:Iph) values, ranging from 1:1 (Class 1) to 16:1 (Class 5).

G 5.2.7 An example set of light source: phantom ratio values for a colour light signal product are set out in Table *37*.

| **Minimum ratio Is:Iph when measured on-axis, for the specified angles of the external light source** | | | | |
|---|---|---|---|---|
| Angles of external light source | 0° to each side of axis | 2° to each side of axis | 5° to each side of axis | 10° , 15° and 20° to each side of axis |
| 20° above axis | 16 | 16 | 16 | 16 |
| 15° above axis | 16 | 16 | 16 | 16 |
| 10° above axis | 16 | 16 | 16 | 16 |
| 5° above axis | 10 | 10 | 12 | 16 |

| **Minimum ratio Is:Iph when measured on-axis, for the specified angles of the external light source** | | | | |
|---|---|---|---|---|
| 2˚ above axis | 5 | 8 | 10 | 16 |
| On-axis | - | 5 | 10 | 16 |

**Table 37:** Example light source: phantom ratio values for a colour light signal head

G 5.2.8 For the purposes of testing phantom colour and phantom intensity, the characteristics of the light source would normally comply with the following:

a) Physical size and test distance are arranged such that the angle subtended by the light source at the test signal is between 0.5˚ to 0.6˚. This corresponds to the sun which subtends 0.56˚ from the earth;
b) Colour temperature is between 3,000 K and 4,000 K. This corresponds to sunlight at sunrise / sunset in a clear sky; and
c) Spectrally continuous through the visible wavelength range 380 – 780 nanometres.

## 5.3 Readability performance assessment

### 5.3.1 The assessment criteria

5.3.1.1 Readability performance shall be assessed against the following for each signalling display generated by the product:

a) Readable distance range;
b) Readable horizontal angle range relative to the centre axis of the emitted light; and
c) Any other specific performance claims relevant to visibility and readability compatibility.

**Rationale**

G 5.3.1.2 Lineside signalling system readability is verified using a two-stage assessment process comprising:

a) Product readability performance assessment, which confirms that a new or modified product will generate displays that are capable of being readable when the product is used in accordance with its authorisation; and
b) Signal sighting assessment, which is used to confirm that lineside signals and indicators are configured using authorised products and that all displayed signal aspects and indications are readable in the operational context.

**Guidance**

G 5.3.1.3 It is good practice for the manufacturer and client to consult on the readability performance assessment plan before the readability performance assessment takes place.

G 5.3.1.4 The readability performance assessment plan typically includes:

a) Product performance evaluation strategy reference.
b) Resource requirements, including:
    i) Assessment facilitator role;
    ii) Assessment technician role;
    iii) Readability performance assessor role;
    iv) Assessment time and location;
    v) Assessment facilities; and
    vi) Relevant tools and test equipment.
c) Requirements prior to assessment, including:
    i) Verification of assessors, including eyesight performance; and
    ii) Arrangements for familiarisation.
d) Test criteria:
    i) The requirements set out in *Part 5* of this standard; and
    ii) Additional tests not covered by requirements.
e) Pass / fail criteria.
f) Methods of recording assessment results.

G 5.3.1.5 It is good practice for the assessment facility to reproduce the typical conditions under which the product is intended to be used.

G 5.3.1.6 The assessment facility will typically have enough space to accommodate the maximum specified visible and readable distance and angles.

G 5.3.1.7 RIS-0737-CCS sets out the requirements for the signal sighting assessment process.

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### 5.3.2 Assessors' criterion

5.3.2.1 Readability performance assessors shall have eyesight that just meets the minimum performance requirement for authorised users set out in RIS-3451-TOM.

**Rationale**

G 5.3.2.2 The minimum eyesight requirement is specified because this is the worst possible case and if the product meets the performance requirements in this circumstance, it will be readable by all authorised users.

G 5.3.2.3 Compliance with this requirement provides standardised assessment conditions for all products so that the results of the assessment are comparable with each other.

**Guidance**

G 5.3.2.4 The selection and number of assessors is determined by the following factors:

a) The requirement to support an objective assessment by selecting assessors who are independent from the product development process;
b) Previous experience of readability assessment, which can provide benefit if the assessors have an understanding of what constitutes an acceptable level of readability;

c) Knowledge and experience of how train drivers read lineside signal aspects and indications, and the train driving task;
d) An ability to recognise any unusual visual features that would cause problems in the operational context; and
e) Eye contrast sensitivity, which varies between individuals and can affect the test result if an assessor has a greater propensity to be affected by glare. Contrast sensitivity tends to decline as people get older.

G 5.3.2.5 Spectacles that are prescribed to adjust the actual visual acuity of the assessors can be used to achieve the eyesight performance criteria required for the assessment. This might entail reducing the assessor's eyesight performance to meet the criteria.

### 5.3.3 The assessment

5.3.3.1 Each display being assessed shall be:

a) Shown at least five times; and
b) Observed by three independent assessors.

**Rationale**

G 5.3.3.2 Multiple presentations of the displays are used in combination with multiple assessors to reduce the likelihood of subjective bias in the assessment.

**Guidance**

G 5.3.3.3 The displays are typically assessed by all of the assessors at the same time.

G 5.3.3.4 It is good practice for the assessors to not have prior knowledge of the order in which the displays will be presented.

G 5.3.3.5 It is acceptable to familiarise the assessors with the displays before the assessment is started.

G 5.3.3.6 If the visible background to the product being assessed is a neutral colour with no complex patterns, such as grey, green, blue, white or black, this will provide a standardised assessment environment where all product assessment results are comparable with each other.

### 5.3.4 Ambient lighting conditions

5.3.4.1 Readability performance shall be assessed when visibility under ambient conditions is 1000 m or better.

5.3.4.2 The assessment shall establish that each display is visible and readable at night and in dark environments.

5.3.4.3 Unless the assessment is for a product that is only intended for use in a consistently dark environment, the assessment shall establish that each display will be visible and readable in a range of Great Britain (GB) daylight conditions.

**Rationale**

G 5.3.4.4 Standardised assessment conditions for all products provide assessment results that are comparable with each other. The majority of signalling products are designed to be readable at less than 1000 m.

G 5.3.4.5 Compliance with these requirements helps authorised users read the displays during hours of darkness and in a permanently dark environment such as in a tunnel.

G 5.3.4.6 In an operational context, authorised users will read the displays in a range of GB daylight conditions.

G 5.3.4.7 Compliance with the ambient lighting requirements mitigates poor readability in a range of lighting conditions.

**Guidance**

G 5.3.4.8 If a product is intended to be used in a dark environment, such as in a tunnel, it is advantageous for the product performance assessment facility to be capable of reproducing those conditions.

G 5.3.4.9 Lighting conditions during hours of darkness in the absence of artificial light approximates to <1 lux.

G 5.3.4.10 The use of a consistent light level range for daylight conditions helps to maintain a reasonable level of assessment consistency. 10,000 lux – 25,000 lux approximates to overcast conditions when the sun is directly overhead and also shade under a clear sky. 110,000 lux approximates to bright sunlight.

G 5.3.4.11 High ambient lighting conditions, such as bright sunlight, has the potential to reduce readability of signs and signals. Signals aspects colours may also appear differently in bright sunlight.

G 5.3.4.12 Artificial lighting can be used to simulate adverse lighting conditions, such as direct sunlight when the sun is low in the sky, where this is not achievable using outdoor viewing tests.

G 5.3.4.13 Further information about measuring visibility over land is provided by the National Meteorological Office and Archive Fact Sheet 17.

G 5.3.4.14 The European Commission Scientific Committee on Newly Identified Health Risks (SCENIHR) report 'Health Effects of Artificial Light', published in 2012, identifies the risks associated with exposure to artificial light. Precautions include frequent breaks for assessors, and acclimatisation to the level of bright light exposure.

## 5.4 Readability performance assessment: pass / fail criteria

5.4.1 A display shall be deemed to be visible when all three performance assessors independently distinguish between display presented and display not presented for every test.

5.4.2 A display shall be deemed to be readable when all three performance assessors independently distinguish which display is being generated for every presentation.

**Rationale**

G 5.4.3 The combination of multiple presentations and multiple assessors is intended to minimise the likelihood of subjective bias in the assessment.

**Guidance**

G 5.4.4 It is good practice for the results of each performance assessment to be independently recorded by each assessor, for example using a pre-prepared tick sheet.

G 5.4.5 The assessment facilitator will normally put measures in place to maintain independence between assessors during the tests.

G 5.4.6 The assessment facilitator reviews and collates the assessment results recorded by each assessor to decide whether the product meets its readability performance specification.

G 5.4.7 The record of assessment will typically include the following details:

a) Product information, including:
    i) Product identity and version; and
    ii) Product design specification reference and version.
b) Assessment details, including:
    i) Assessment strategy and plan reference;
    ii) Which displays were assessed;
    iii) Assessor details, including assessor organisation and names of assessors;
    iv) Date(s) of assessment;
    v) Location of assessment;
    vi) Assessment facility / environment, for example inside / outside;
    vii) Nature of the background; which can include a photographic record;
    viii) Configuration of the test; which can include a diagram or photographic record;
    ix) Measured ambient light levels at the time of the test; and
    x) If outside, a description of the weather conditions and position of the sun relative to the display.
c) The readability assessment decision, including:
    i) The displays and display combinations that were assessed to be readable; and
    ii) Any displays and display combinations that failed the assessment.

G 5.4.8 If the product fails the assessment, it is good practice for the assessment facilitator to seek to understand the reasons, such as:

a) The product design is deficient as currently specified, in which case the assessment facilitator will typically report the scope of deficiency to the manufacturer; and
b) A failure to agree. In this case the assessment facilitator may seek to clarify whether the result is a borderline failure or a definitive failure. In the case of a borderline failure, the assessment facilitator can repeat the test in order to reach a definitive decision.

G 5.4.9 It is good practice to record the following:

a) Any limitations on product use arising from the assessment; and
b) Any observations regarding generation of false or irregular displays.

# Part 6 Application of this document

## 6.1 Scope

6.1.1 The requirements of this document apply to all new and modified equipment used to implement lineside signals and indicators.

6.1.2 The requirements of this document apply to all work that affects lineside signals and indicators, whether new or altered.

6.1.3 Action to bring existing lineside signals and indicators into compliance with the requirements of this document is not required.

6.1.4 Where it is known, or becomes known, that existing lineside signals and indicators do not comply with the requirements of this document, action to bring them into compliance is required as follows:

a) When a lineside signal or indicator is renewed as a whole.
b) When any major component of a lineside signal or indicator is replaced.

## 6.2 Exclusions from scope

6.2.1 There are no exclusions from the scope specified in *6.1*.

## 6.3 General enter into force date

6.3.1 The requirements in this document enter into force from 1st September 2024, except where exceptions to the general enter into force date are specified.

## 6.4 Exceptions to general enter into force date

6.4.1 There are no exceptions to the general enter into force date specified in *6.3*.

6.4.2 It is permissible to designate specific infrastructure projects, at an advanced stage of development when this document comes into force, for which compliance with the requirements of this document applicable to the design, construction and commissioning of new or altered infrastructure is not mandatory. When designating such projects, the following shall be considered:

a) Its responsibilities under its current safety authorisation.
b) The stage reached by the project at the time this document comes into force (for example, approval in principle).
c) Whether compliance is necessary to ensure compatibility with other parts of the infrastructure.
d) Whether compliance is necessary to facilitate the safe working of the railway system having regard to changes to related requirements mandated on another infrastructure manager or a railway undertaking.
e) The economic impact of compliance, but subject to its current safety authorisation in relation to the infrastructure in question.

6.4.3 Where any designations are made for infrastructure projects, those projects shall continue to meet the equivalent requirements in the RGSs applying to the project before the designation.

## 6.5 Applicability of requirements for projects already underway

6.5.1 The Office of Rail and Road (ORR) can be contacted for clarification on the applicable requirements where a project seeking authorisation for placing into service is already underway when this document enters into force.

## 6.6 Deviations

6.6.1 Where it is considered not reasonably practicable to comply with the requirements of this document, permission to comply with a specified alternative should be sought in accordance with the deviation process set out in the Railway Group Standard Code.

6.6.2 In the case where NTSN compliance is required for a new, renewed or upgraded vehicle or structural subsystem, the process for any exemptions needed is set out in the Railways (Interoperability) Regulations 2011 (as amended).

## 6.7 User's responsibilities

6.7.1 Industry experts representing railway industry stakeholders are involved in the process for settling the content of documents which are prepared in accordance with the procedures set out in the Railway Standards Code and Manual.

6.7.2 Users of documents published by RSSB are expected to be competent or should take specialist advice before following or applying any practices or principles contained within them and are reminded of the need to consider their own responsibilities to ensure safe systems of work and operation, health and safety at work and compliance with their own duties under health and safety legislation. While documents published by RSSB can be used to help inform and devise safe practices and systems of work, their content has not been designed or prepared for:

a) reliance by any specific person or organisation;
b) application or use in all possible operational or working environments.

6.7.3 No representation, warranty, guarantee, confirmation or other assurance is given or made (whether expressly or implicitly) that compliance with all or any documents published by RSSB is sufficient in itself to ensure safe systems of work or operation or to satisfy such responsibilities or duties.

6.7.4 Users and duty holders remain responsible at all times for assessing the suitability, adequacy and extent of any measures they choose to implement or adopt and RSSB does not accept, and expressly disclaims, all and any liability and responsibility except for any liability which cannot legally be limited.

## Definitions

| | |
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| appearance [signalling system displays] | The visible characteristics of each type of lineside signalling hardware and signalling system display. |
| authorised user | A competent person who is responsible for an operational role that includes reading and interpreting the information displayed by the lineside signalling system. The operational roles are defined in GERT8000 Rule Book. |
| circular disc | A circular image filled with one colour. |
| detect | The initial part of the reading process when an authorised user observes a visible signalling system feature without necessarily being able to identify that it is applicable or distinguish what is being displayed. |
| display [noun] | The overall appearance of the image generated by a product or feature, which is at lineside or in-cab. |
| display element | A single light source or group of light sources that make up all or part of a signal aspect or indication. For example, a junction indicator may comprise five display elements, each comprising one or more light sources. |
| distinguishable | The extent to which a signal aspect, indication or sign is capable of being distinguished, ranging from not distinguishable to easily distinguishable. |
| distinguish | The final stage of the reading process when an authorised user recognises what is being displayed on the basis of its appearance. |
| identifiable | The extent to which a signal, indicator or sign is capable of being identified, ranging from not identifiable to easily identifiable. |
| identify/identifying [lineside signs, lineside signals and indicators] | The stage of the reading process when an authorised user is able to confirm that a lineside signal, indicator or sign is relevant to the task being performed. |
| interpret/interpreting [signalling system displays] | The action of understanding the information conveyed by the lineside sign, signal aspect or indication after it has been read. (For example, understanding that a red signal aspect means ‘limit of MA’.) |
| interpretable [signalling system displays] | The extent to which the information conveyed by a lineside sign, signal aspect or indication can be reliably interpreted, ranging from not interpretable to easily interpretable. |
| light source | A device serving as a source of illumination within a display element (for example, a light emitting diode or a filament lamp). |
| lineside signalling hardware | Hardware that is approved or authorised for lineside signalling system applications. |
| lit | The state of a signalling product when it is generating visible light. |

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| lower quadrant position | A display comprising either a semaphore signal arm or an arrangement of lit display elements that is aligned so that the left-hand end of the display is positioned below the right-hand end of the same display, when viewed from the front. |
| luminous intensity | A photometric measure of light travelling in a given direction. It describes the amount of light that passes through or is emitted from a particular area, and falls within a given solid angle. The SI unit for luminous intensity is candela (cd). One candela is equivalent to one lumen per steradian. |
| read [signalling system displays] | The process of detecting, identifying and distinguishing the relevant lineside signalling display or display combination. Reading is a precondition to a driver interpreting the information conveyed by the lineside signalling system. |
| readability [lineside signalling] | The ease and reliability with which signal aspects, indications and signs can be read by an authorised user throughout the range of operational and ambient conditions applicable to that hardware, within the operational context and while performing typical required duties. This ranges from never readable to always readable. |
| readable [lineside signalling system] | A qualitative statement indicating that an authorised user can read the signal. A signal or a sign is considered readable if a person just meeting the eyesight requirements for their role, is able to consistently and reliably identify displayed aspects, indications and sign, when observing the hardware under the conditions in which an authorised user will view it, in clear weather conditions, by day and by night. |
| signal aspect/indication | A display of specified appearance that is used to convey a specific set of information to a user. |
| signal head/indicator | A type of signal hardware that houses the signal light source housing. |
| signal light source | The feature used to generate the signal light. |
| signal light | A light of a particular colour specification, which is defined in BS 1376:1974. |
| surface gloss | A characteristic of a surface that influences the level of luminous intensity resulting from specular reflection and diffuse reflection, measured in gloss units (GUs). |
| upper quadrant position | A display comprising either a semaphore signal arm or an arrangement of lit display elements, aligned so that the left-hand end of the display is positioned above the right-hand end of the same display, when viewed from the front. |
| visibility | The ease and reliability with which something can be seen throughout the range of applicable operational and ambient conditions, within the operational context and while the observer is |

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| | performing typical required duties. This ranges from never visible to always visible. Visibility is a precursor to readability. |
| visible [lineside signalling asset] | The ease and reliability with which signal aspects, indications and signs can be detected by an authorised user throughout the range of operational and ambient conditions applicable to that hardware, within the operational context and while performing typical required duties. This ranges from never visible to always visible. |

## References

The Standards catalogue gives the current issue number and status of documents published by RSSB: http://www.rssb.co.uk/standards-catalogue.

| | |
|---|---|
| RGSC 01 | Railway Group Standards Code |
| RGSC 02 | Standards Manual |

### Documents referenced in the text

#### Railway Group Standards

| | |
|---|---|
| GEGN8613 | Application of human factors within safety management systems |
| GERT8000 | Rule Book |
| GIRT7033 | Lineside Operational Safety Signs |
| GKRT0075 | Requirements for Minimum Signalling Braking and Deceleration Distances |

#### RSSB documents

| | |
|---|---|
| RIS-0703-CCS | Signalling Layout and Signal Aspect Sequence Requirements |
| RIS-0713-CCS | Lineside Signalling Layout Driveability Assessment Requirements |
| RIS-0737-CCS | Rail Industry Standard for Signal Sighting Assessment Requirements |
| RIS-0758-CCS | Lineside Signal Aspects and Indications |
| RIS-3451-TOM | Train Drivers - Suitability and Medical Fitness Requirements |
| RIS-3452-TOM | Train Movement - Medical Fitness Requirements |
| RIS-3751-TOM | Rail Industry Standard for Train Driver Selection |

#### Other references

| | |
|---|---|
| BS 1376:1974 | Specification for Colours of Signal Lights |
| BS 4800:2011 | Colour chart |
| BS 873-6:1983 | Road traffic signs and internally illuminated bollards. Specification for retroreflective and non-retroreflective signs |
| BS EN 12368:2015 | Traffic control equipment. Signal heads |
| BS EN 12899-1:2007 | Fixed, vertical road traffic signs. Fixed signs |
| BS EN 15153-1:2020 | Railway applications. External visible and audible warning devices. Head, marker and tail lamps for heavy rail |
| BS EN 60825-1:2014+A11:2021 | Safety of Laser Products – Part 1: Equipment Classification and Requirements |

| | |
|---|---|
| BS EN ISO 2813:2014 | Paints and varnishes. Measurement of specular gloss of non-metallic paint films at 20°, 60° and 85° |
| BS EN ISO 9241-210:2019 | Ergonomics of human-system interaction. Human-centred design for interactive systems |
| BS EN IEC 62471-7:2023 | Photobiological safety of lamps and lamp systems - Part 7: Light sources and luminaires primarily emitting visible radiation |
| LOC&PAS NTSN | Locomotive and Passenger National Technical Specification Notice (LOC&PAS NTSN). Published by the Secretary of State on 1 January 2021 pursuant to regulation 3B of the Railways (Interoperability) Regulations 2011. This NTSN replaces and substantially reproduces the provisions of Commission Regulation (EU) 1302/2014 (the LOC&PAS TSI), and includes relevant amendments made by Commission Implementing Regulation (EU) 2019/776 which came into force in June 2019. |
| National Meteorological Office and Archive Fact Sheet 17 | |
| Health Effects of Artificial Light | The European Commission Scientific Committee on Newly Identified Health Risks (SCENIHR) report 'Health Effects of Artificial Light', 2012 |

**Other relevant documents**

| | |
|---|---|
| GEGN8651 | Guidance Note for Safe Integration of CCS Systems with Train Operations |