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| Ref   | <b>NR/SP/SIG/10062</b> |
| Issue | 1                      |
| Date  | August 1999            |

# Long Range Colour Light Signals (formerly RT/E/S/10062)

**This temporary front sheet facilitates change to the new Network Rail Standards referencing nomenclature.**

**The Ref above will be formally allocated to this standard when it is next changed in the meantime the contents, date and issue number of this Network Rail Standard are **UNCHANGED** and with immediate effect it should be referred to as “(new ref) formerly (old ref)”.**

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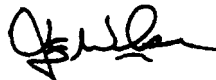


# RAILTRACK LINE SPECIFICATION

## REQUIREMENT SPECIFICATION FOR PERFORMANCE OF LONG RANGE COLOUR LIGHT SIGNALS

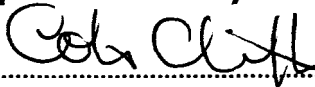
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#### Endorsed by:



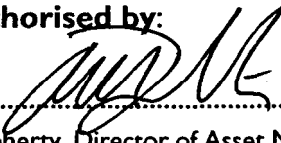
.....  
J. F. Wilson, Professional Head of Signalling

#### Accepted for Issue by:



.....  
C Clifton, Head of Corporate Standards

#### Authorised by:



.....  
A Doherty, Director of Asset Management

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## SUMMARY

This specification is for the performance requirements of long range colour light signals.

## ISSUE RECORD

This specification will be updated when necessary by the distribution of a complete replacement.

Amended or additional parts of revised pages will be marked by a vertical black line in the adjacent right-hand margin.

| Issue | Date        | Comments  |
|-------|-------------|-----------|
| I     | August 1999 | New Issue |

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This specification shall be complied with by suppliers of the signals and by those engaged in the acceptance or type approval thereof.

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## PERFORMANCE OF LONG RANGE SIGNALS

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## 1. SCOPE

### 1.1 Purpose

The purpose of this specification is to define the performance requirements for Long Range Colour Light lineside signals.

### 1.2 Background

Earlier specifications for signals laid down requirements for components which, when assembled, were deemed to comprise an adequate lineside signal. These specifications established no performance requirements and were specifically related to the use of filament lamps.

This is a performance specification which does not prescribe the source of illumination or the means by which the light from that source is presented to the driver.

### 1.3 Overview of Requirement

A block diagram of the context in which the signal operates is shown in Figure 1. Note that the functional elements which are identified need not be physically separate entities.

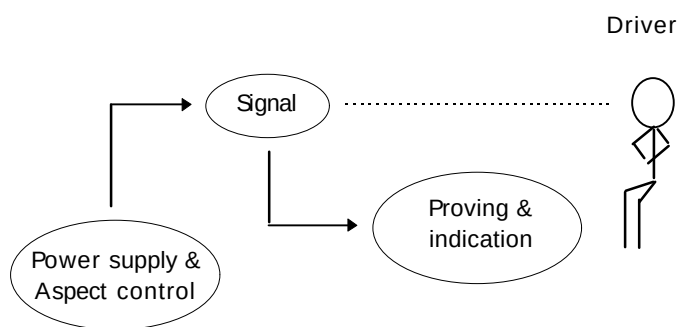


**Figure 1: Signal Context Diagram**

The signal must produce an unambiguous output to the driver.

The signal output to the driver must not indicate a less restrictive aspect than required by the control system.

The principal elements of the signal are as follows:

- A means of converting electrical energy to optical energy for the

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appropriate aspect.

- A means of focusing and filtering (where necessary) the optical energy so that it is of the correct colour and concentrated into a beam(s) appropriate to the type of signal.
- A means of masking so that the shape of the light aperture is appropriate to the type of signal.
- Means of detecting, either directly or indirectly, that the signal is lit.
- Means of terminating and securing the cable connecting the signal to the controlling devices.
- A housing for the components described above to provide environmental protection and maintain the correct spatial relationship between them.
- A means of mounting the signal head on a support structure and aiming the aspect beams correctly; the support structure itself not being the subject of this Requirement Specification.

#### 1.4 Other Specifications to be Considered

The Group Standard for Lineside Signals and Indicators <sup>[1]</sup>, which relates to the existing signal, applies to the signal specified in this document. A list of referenced documents is given at Section 14.

#### 1.5 Safety Requirements

Throughout this document, Functional Safety Requirements are identified by an **(S)** at the end of the requirement statement.

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## 2. DEFINITIONS

Specific terms and abbreviations used in this specification are defined below:

| Abbreviation        | Term                       | Explanation                                                                                                                                        |
|---------------------|----------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|
|                     | (Signal) Aspect            | A light or combination of lights which has a defined significance to the driver of a train.                                                        |
| Cd                  | Candela                    | Unit of luminous intensity.                                                                                                                        |
|                     | Driver                     | Train driver or any other authorised person on or about the railway required to read signals.                                                      |
|                     | Interlocking               | The logic which defines the aspect to be displayed.                                                                                                |
|                     | Restrictive aspect         | An aspect is restrictive, compared to the reference aspect, if its interpretation by the driver would be a need to stop or be prepared to stop.    |
|                     | Light Aperture             | The individual aperture through which light emerges from the signal.                                                                               |
|                     | Maintenance                | Any activity, either routine or of an exceptional nature, which is carried out so that the product remains or is restored to its correct function. |
| ART <sub>MAX</sub>  | Maximum Active Repair Time | The maximum time from personnel commencing repair work to its satisfactory conclusion and the restoration to service of the item.                  |
| ART <sub>MEAN</sub> | Mean Active Repair Time    | The mean time from personnel commencing repair work to its satisfactory conclusion and the restoration to service of the item.                     |
|                     | Mutilated                  | The light output from a light aperture shall be regarded as mutilated if its readability is compromised.                                           |
|                     | Off (aspect)               | An aspect denoting proceed.                                                                                                                        |
|                     | On (aspect)                | The most restrictive aspect displayed by a signal.                                                                                                 |
|                     | Phantom (aspect)           | An aspect appearing to be lit when not.                                                                                                            |
|                     | Proving (of a signal)      | A safety related feature - the function of detection that a signal aspect is lit.                                                                  |
| SSI                 | Solid State Interlocking   | The UK developed system of processor based interlocking for railway signalling applications.                                                       |

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### 3. MANDATORY FUNCTIONAL REQUIREMENTS

This section provides a statement of the mandatory system features, functionality and levels of performance.

#### 3.1 Driver Interface

##### 3.1.1 Signal Aspects

- 3.1.1.1 Long range colour light signals display aspects using Red, Yellow or Green lights. Three and four aspect signals are by far the most common in use but one and two aspect signals are also required. The most common arrangement of aspects is vertical with the red aspect closest to the driver's line of sight. In a three aspect signal the arrangement of aspects is R - Y - G and in a four aspect signal R - Y - G - Y. However, any combination of aspects may be required for particular circumstances.
- 3.1.1.2 The performance requirements are identical irrespective of the number of aspects displayed by a signal and whether they are displayed through multiple apertures or, where appropriate, a single aperture.
- 3.1.1.3 In addition to the steady aspects there is a requirement for signals to be capable of displaying flashing aspects. The rate and mark space ratio of flashing is specified in GK/RT0031<sup>[1]</sup>. Such display is achieved by feeding the signal with an interrupted power supply; the flashing means is not an integral part of the signal.
- 3.1.1.4 Each lit aspect aperture shall appear to the driver of an approaching train, within the range for which visual resolution is possible, as a circular solid disc of the appropriate colour over the full diameter of the aperture. At very close viewing range, where it can be assumed the train is stationary at the signal, the aspect aperture must still be readable. **(S)**
- 3.1.1.5 All unlit apertures to appear the same and as dark as practically possible. **(S)**
- 3.1.2 Changing aspects
  - 3.1.2.1 In normal operation, there shall be no perceptible period when the signal appears to have no aspect lit or when two aspects of the signal are displayed simultaneously **(S)**.
  - 3.1.2.2 The delay in the commencement of lighting or extinction of aspects after the controlling supply is energised or de-energised shall be not more than 20 ms and the signal shall reach its defined output within 100 ms. The delays in illumination and extinction shall be similar in duration **(S)**.

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## 3.1.3 Positioning of Signals in Relation to Conspicuousness

The intention of the signal sighting process is to ensure that the driver's view of a signal is as good as reasonably practicable.

3.1.3.1 The signal aspect will normally be viewed against a dark background to improve conspicuity of the aspect. Exceptionally, this background will be a feature of the location of the signal head e.g. where a signal is mounted in a tunnel or near the entrance to a tunnel. Normally, the head, with a backboard if required, shall combine to provide an artificial background.

3.1.3.2 This artificial background shall be painted or otherwise coloured matt black and shall extend at the sides and above the aspect or aspects as shown in Figure 3.

## 3.1.4 Sighting and Viewing Angle

The drawing, Figure 2, is included to illustrate the terms used to describe the beams and sectors which compose the light output from the signal.

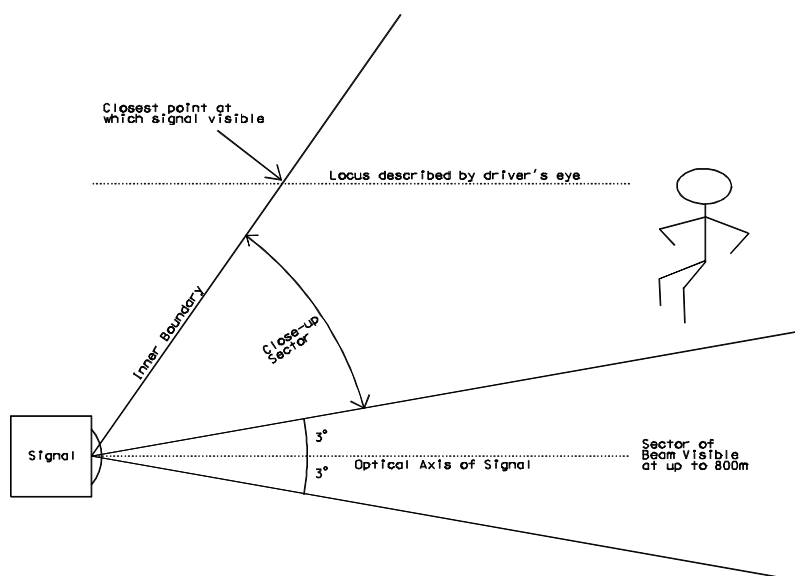


**Figure 2: Terms Used to Describe Beams & Sectors (Plan View)**

- 3.1.4.1 The long range beam of each aspect will be a narrow beam, normal to the signal head face and approximately circular in cross section.
- 3.1.4.2 The aspects of the signal shall appear as a continuous, steadily increasing light(s) to a driver approaching the signal on straight track.
- 3.1.4.3 The optical axes of all the aspects shall be parallel to each other and normal to the signal face within the tolerance shown in clause 3.4.5.5.

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- 3.1.4.4 To maintain continuity of readability of the signal as the train approaches the signal, the light output of the signal shall be graduated so as to reduce as the angle of view from the optical axis increases, outside the 6° solid angle. **(S)**
- 3.1.4.5 There shall be a close up sector which shall be readable by the driver from the point at which the long range beam ceases to be effective to a point 2m from the signal measured parallel to the optical axis. At the shortest ranges this beam may be asymmetric in relation to the optical axis of the signal. **(S)**
- 3.1.4.6 The close up viewing arrangements shall take into account that the signal may be viewed from either left or right sides and from above or below (a single viewing point per signal). Any use of hoods or screening on the signal face must allow for this close viewing requirement. **(S)**
- 3.1.4.7 The design of the signal face must ensure that the aspects are not obscured by the build up of falling or driven snow (driven by wind or passing traffic). The red aspect (or other most restrictive aspect) must take priority in being protected if appropriate to a particular design. **(S)**
- 3.1.5 Light Output
- 3.1.5.1 Colours of aspects shall be as defined in Group Standard GK/RT0031<sup>[1]</sup> and shall remain within specification over the life of the signal. The light output from each aspect shall be within the appropriate colour specification at all times when the aspect is lit in any of the environmental conditions under which the signal is required to operate as set out in Section 13. **(S)**
- 3.1.5.2 The shape of the aspects of the signal, as seen by the driver, shall be approximately circular. Specifically the maximum diameter shall not be greater than 120% of the minimum diameter.
- 3.1.5.3 There shall be an appearance of uniform brightness over the area of light apertures at short range as well as at longer range.
- 3.1.5.4 The light output of each aspect of the signal shall comply with the requirements set out in Table 1 over the life of the signal. For a flashing aspect the light output values apply during the whole of the lit phase of the flashing cycle, so far as is practicable. The values quoted apply to the solid angle of the main beam of width 6° **(S)**.

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| Colour | Luminous Intensity on the Optical Axis and at up to and including 3 degrees |         |
|--------|-----------------------------------------------------------------------------|---------|
|        | Minimum                                                                     | Maximum |
| Red    | 850 Cd                                                                      | 1700 Cd |
| Yellow | 2600 Cd                                                                     | 6150 Cd |
| Green  | 850 Cd                                                                      | 1950 Cd |

**Table 1: Light Output of Aspects (Main Beam)**

#### 3.1.6 Additional Requirements for Light Output at Short Range

This section specifies the light output requirements for the close up view of the signal at minimum range and the transition between this and the long range beam.

3.1.6.1 The close up sector shall have an angular width, in the plane perpendicular to the optical axis of the signal, of approximately 56°. **(S)**

3.1.6.2 In the horizontal plane the close up sector shall have a similar angular width such that the signal is readable at the minimum viewing distance of 2m measured parallel to the optical axis of the signal (the inner boundary) and at all points between that minimum distance and the point at which the long range beam is visible to a driver. **(S)**

| Colour | Minimum Luminous Intensity |
|--------|----------------------------|
| Red    | 0.35 Cd                    |
| Yellow | 1.1 Cd                     |
| Green  | 0.35 Cd                    |

**Table 2: Light Output Values (Close up sector, inner boundary)**

#### 3.1.7 Visibility

The steady light aspects and the on period of the flashing aspects shall not exhibit visible flicker or any perceptible step or sudden change. This requirement shall apply for any viewing angle where the signal is required to be readable and under partial failure conditions such as those which would give rise to non-urgent alarm condition. **(S)**

#### 3.1.8 Phantom Aspects

3.1.8.1 The design shall minimise the risk of phantom aspects being displayed. The

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risk is that some light emanating from the colour source of an unlit aspect is seen. An aspect aperture must not emit a light greater than 1% of its specified minimum light output when lit or  $10 \text{ Cd.m}^{-2}$ , measured over a nominal  $500 \text{ mm}^2$  circular area, whichever is the less, when no light should be displayed. These limits also apply to a flashing aspect during the dark phase of the flashing cycle. **(S)**

3.1.8.2 Phantom aspects may also arise due to the reflection of coloured light cast on the signal face and aspect apertures such as may occur where signals face the setting or rising sun. Reflected light must be minimised and or be dispersed away from the aperture beam. This must be done equally for all apertures both in regard to reflected luminance and colour. **(S)**

3.1.8.3 The above requirements also apply to aspects that are not commissioned. Where specific action is required at installation to ensure compliance with this requirement then the supplier should state the required action in the installation manual. **(S)**

## 3.2 Signalling System Interface

### 3.2.1 Electrical Parameters

Two versions of signals are specified, operating from nominal 110V AC or low voltage DC.

3.2.1.1 The maximum power consumption for any signal displaying any single aspect, whether flashing or steady, shall not exceed 50W. The maximum power consumption for any signal displaying a double yellow aspect, whether flashing or steady, shall not exceed 100W. Any power taken by the signal head for control, monitoring or heating purposes etc. must not cause these maxima to be exceeded. These ratings are at 50Hz +4% -6%.

3.2.1.2 For the 110V AC version the design must recognise that the lineside signalling supply is poorly regulated. The nominal voltage of 110V may vary between the limits +10% and -20%. At a particular site, the voltage may be further subject to short term variations (up to 24 hours) by +/-10V. The performance of the signal shall be maintained with the supply at any voltage within these ranges. **(S)**

3.2.1.3 To allow a signal to operate within these parameters, input connections may be provided with appropriate voltage input tapping ranges.

3.2.1.4 The low voltage DC version of the signal shall operate on a nominal voltage of 12 volts. However, because of the design of the external circuitry the open circuit voltage of the supply may rise to 16V, i.e. the nominal voltage may vary between 12V and 16V. At a particular site, the voltage may be further subject to short term variations (up to 24 hours) by +/-10%. **(S)**