

# Visibility Requirements for Trains

## Synopsis

This document sets out the mandatory requirements for **visibility** of trains, and supporting guidance information.

**signatures removed from electronic version**

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**Published by:**  
**Rail Safety and Standards Board**  
**Evergreen House**  
**160 Euston Road**  
**London NW1 2DX**

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# Visibility Requirements for Trains

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 Railway Group Standard
 

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 GM/RT2483
 

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 Issue One
 

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 Date June 2004
 

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## Visibility Requirements for Trains

### Part A

#### A1 Issue record

Issue	Date	Comments
One	April 2004	Supersedes the <b>visibility</b> requirements for trains in <a href="#">GM/RT2180</a> issue three. Revised audibility requirements are to be set out in another new Railway Group Standard at a later date. Current audibility requirements will remain in force in <a href="#">GM/RT2180</a> . Supersedes and incorporates the requirements set out in <a href="#">GM/RT2481</a> and the recommendations of GM/RC2680.

Significant changes to [GM/RT2180](#) issue three have been marked by a vertical black line in the adjacent margin.

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

#### A2 Implementation of this document

The publication date of this document is 7 August 2004.

This document comes into force on 2 October 2004.

The dates by which compliance with the requirements of this document is to be achieved are set out in Part B2. Where those dates are later than the date on which this document comes into force, this is to give Railway Group members additional time to plan and commence implementation so as to achieve full compliance by the dates set out in Part B2.

This document supersedes the following Railway Group Standards, either in whole or in part as indicated:

Railway Group Standard	Issue No.	Title	RGS sections superseded by this standard	Date(s) as of which sections are superseded
<a href="#">GM/RT2180</a>	Three	<b>Visibility</b> and Audibility Requirements for Trains	B4 to B10 inclusive	2 October 2004
<a href="#">GM/RT2481</a>	Two	Alignment of Train Head-lamps – Rapid Response	All	2 October 2004 (Document withdrawn as of this date)
GM/RC2680	Two	Code of Practice- <b>Visibility</b> and Audibility Requirements for Trains	B4 to B9 inclusive	2 October 2004

#### A3 Scope of Railway Group Standards

The overall scope of Railway Group Standards is set out in the Railway Group Standards Code. The specific scope of this document is set out in Part B2.

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### A4 Responsibilities

Railway Group Standards are mandatory on all members of the Railway Group\* and apply to all relevant activities that fall into the scope of each Railway Safety Case. If any of those activities are performed by a contractor, the contractor's obligation in respect of Railway Group Standards is determined by the terms of the contract between the respective parties. Where a contractor is a duty holder of a Railway Safety Case then Railway Group Standards apply directly to the activities described in the Safety Case.

\* The Railway Group comprises Network Rail Infrastructure Limited, Rail Safety and Standards Board Limited, and the train and station operators who hold railway safety cases for operation on or related to infrastructure controlled by Network Rail Infrastructure Limited.

Network Rail Infrastructure Limited is also known as Network Rail.

Rail Safety and Standards Board Limited is also known as RSSB.

### A5 Health and safety responsibilities

Each Railway Group member is reminded of the need to consider its own responsibilities to ensure health and safety at work and its own duties under health and safety legislation. RSSB does not warrant 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.

### A6 Supply

Controlled and uncontrolled copies of this document may be obtained from the Corporate Communications Dept, Rail Safety and Standards Board, Evergreen House, 160 Euston Road, London NW1 2DX, telephone 020 7904 7518 or e-mail [enquiries@rssb.co.uk](mailto:enquiries@rssb.co.uk). Railway Group Standards can also be viewed at [www.rssb.co.uk](http://www.rssb.co.uk).

## Visibility Requirements for Trains

### Part B

#### B1 Purpose

This standard contains the mandatory **visibility** requirements for the leading vehicle of a train, so that its approach can be detected in sufficient time for people on or near the line to recognise that it is a train and to move to a position of safety.

The standard also mandates the **visibility** requirements for the rear of a train so that it can be seen in adequate time by the driver of a train or locomotive approaching it from the rear.

#### B2 Application of this document

##### B2.1 To whom the requirements apply

This standard contains requirements that are applicable to duty holders of the train operator category of Railway Safety Case.

##### B2.2 Compliance requirements

Except as stated below the vehicle design requirements mandated in this standard are to be complied with by all vehicles of previously uncertificated designs with a first Certificate of Conformance for Vehicle Design signed on or after 2 October 2004. In addition to this the design requirements shall be complied with by any future vehicles, built to the same design as a vehicle already having Engineering Acceptance, which enter service on Network Rail controlled infrastructure on or after 4 April 2009.

The requirements set out in this document are applicable for all train speeds.

With the exception of section C2.6, and appendices 3.3 and 4.2, all of the requirements set out in this standard are within the scope of Vehicle Acceptance Body approval.

Action to bring existing trains into compliance with the requirements set out in this standard was previously required by [GM/RT2481](#) issue two, and remains a requirement where trains have been previously equipped with head-lamps that conform to the requirements set out in [GM/RT2180](#) issue three with head-lamps according with the maximum train speeds of 225 km/h and 300 km/h (Appendix 5 of this standard details the required head-lamp realignments).

Where trains are being modified in the area covered by the scope of this standard, the design shall be reviewed and where reasonably practicable brought into line with the requirements set out in this standard.

##### B2.2.1 General compliance requirements

After the compliance dates, or after the date by which compliance is achieved (if earlier) Railway Group members shall not deviate from the requirements set out in this standard.

Where it is considered not reasonably practicable to comply with the requirements set out in this standard, authorisation not to comply shall be sought in accordance with section 8 of The Railway Group Standards Code, issue one, January 2004.

##### B2.2.2 Exclusions from the application of this standard

Road-rail vehicles and rail mounted maintenance machines do not need to comply with the requirements set out in this standard.

The requirements of Technical Specification for Interoperability (TSI) take precedence over Railway Group Standards and TSI requirements are to be followed where there is a conflict between Railway Group Standards and TSIs.

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## B3 Definitions

### Leading vehicle

For the purpose of this document, a leading vehicle is a vehicle intended to be the first vehicle in a train formation when travelling in its normally designated direction but excluding vehicles being propelled during shunting movements.

### On-track machine

Any rail-mounted machine, whose primary function is for the renewal, maintenance, inspection or measurement of the infrastructure, meeting the requirements set out in GM/RT2400 and permitted by the Rule Book to be moved, either self-propelled or in train formation, outside of a possession. This definition includes all vehicles classified as on-track machines in accordance with section 6.4 of [GM/RT2000](#) issue two.

### Shunting locomotive

Any rail vehicle primarily designed for shunting with a maximum speed of 30 mph.

### Vehicle axis

The longitudinal axis of the vehicle.

### Visibility

For the purpose of this document, **visibility** is defined as the physical characteristics of an approaching train which enable it to be seen at a pre-determined distance by a person whose eyesight and colour vision when assessed are found to be normal as set out in [GE/RT8067](#).

### Visual range

The maximum distance in metres for which the atmospheric properties are such that a black object of large size can be seen in daylight. Large in this sense means that the object would be resolved by the human eye at the viewed distance.

## B4 Introduction

### B4.1 **Visibility** on approach

#### B4.1.1 Recognising a train

An approaching train needs to be clearly visible and recognisable by virtue of both:

- a) the front-end colour
- b) the presence and layout of its lit front-end lamps.

It is necessary for both these features to be present, and to be of a distinctive pattern in order to avoid confusion with nearby road vehicle lamps or body colours, or other moving objects.

#### B4.1.2 Distance and time

An approaching train running at its maximum design speed needs to be visible on straight and level track for at least 25 seconds in order to allow people (for example track workers) on or near the line time to move to a position of safety.

To enable the speed and distance of approach of a slow moving train to be judged, the positions and spacing of the lamps need to give an indication of the width of the vehicle.

#### B4.1.3 Ambient conditions

Except when the visual range is reduced to less than 1,500 m the **visibility** of a train needs to be such that the requirements set out in section B4.1.2 are met in daylight, darkness and in all intermediate lighting conditions. This is achieved by following the requirements set out in this standard.

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### B4.2 **Visibility** from the rear

Except when the visual range is reduced to less than 1,500 m, the rear of a train needs to be visible on straight and level track from a distance of at least 400 m to the driver of a train approaching from the rear. This is achieved by following the requirements set out in this standard.



# Visibility Requirements for Trains

## Part C

### Design requirements

#### C1 Front-end colour

##### C1.1 General

The forward facing front-end of the leading vehicle of a train shall display an area of yellow colour meeting the requirements set out in section C1.2.

##### C1.2 Detailed requirements

###### C1.2.1 The front-end colour

The colour shall be yellow as specified by any of the following paint colours:

- a) RAL 1003, RAL 1004, RAL 1018, RAL 1021, or RAL1023 from the RAL Classic Colour Collection
- b) BS 4800 Item 08E51
- c) BR81 Item 202
- d) NCS (Natural colour system) target value 1080-Y 10-R or 1475-Y 11R
- e) EC 222.69.79 in the Eurocolour table.

Conformance shall be assessed by confirmation that the particular colour has been applied using the manufacturers specification and applied using the manufacturers approved process. No measurement of the colour when applied to the vehicle is necessary.

Where vinyls and gel coats are used to achieve yellow colour the colour shall be a reasonable match to the yellow colours listed above. Conformance shall be assessed by visual comparison. No measurement of the colour when applied to the vehicle is necessary.

Appendix 6 section 6.1 sets out guidance on achieving compliance with this section.

###### C1.2.2 Area of yellow

Except as set out in C1.3 and C1.4 of this standard and except where the vehicle has an end gangway, there shall be a minimum forward facing continuous area of yellow surface of 1 m<sup>2</sup> with a minimum dimension of 0.6 m when viewed, at a large distance, head on from in front of the vehicle. It shall be permissible to divide the yellow surface by elements of an end gangway if necessary. Each section of a divided yellow surface shall have a substantially uninterrupted yellow area not less than 0.4 m<sup>2</sup>, with a minimum dimension of 0.6 m.

Where the minimum required area or dimension exceeds that which is available on the front-end of the leading vehicle of the train, the yellow warning panel shall be provided over the maximum practicable area (not including active optical surfaces, for example windscreen and head, marker and tail-lamps).

Appendix 6 section 6.1 sets out guidance on achieving compliance with this section.

##### C1.3 Shunting locomotives and independent snowploughs

These vehicles shall have, so far as is practicable, all forward-facing surfaces painted yellow colour with black diagonal stripes. The stripes shall be applied at a nominal angle of 45° from the vertical. The width of each stripe, measured at 90° to the edge of the stripe, shall be in accordance with Table 1 (set out in Appendix 1). The distance between adjacent stripes shall be the same as the width of the stripes.

Appendix 6 section 6.2 sets out guidance on achieving compliance with this section.

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### C1.4 Self propelled snowploughs

These vehicles shall receive the same end treatment as for independent snowploughs insofar as it is practical.

## C2 Front-end lamps

### C2.1 Fixed head-lamps

The forward facing front-end of the leading vehicle of a train shall be fitted with no fewer than two fixed head-lamps. At least one head-lamp shall be suited for day-time operation and at least one other for night-time operation. Only one fixed head-lamp is required to be lit at any time but additional lamps of both types are permissible on either side of the vehicle front.

In normal operation during daylight the day-time head-lamp shall be lit, and during the hours of darkness the night-time head-lamp shall be lit.

The head-lamp optical centres shall be positioned as set out in Appendix 2.

The night-time head-lamp shall be located on the right hand side of the vehicle when facing the front of the vehicle. The head-lamps shall comply with the luminous intensity requirements set out in Appendix 3.

### C2.2 Marker-lamps

The forward facing front-end of the leading vehicle of a train shall be fitted with three marker-lamps, in a triangular format as set out in Appendix 2 (lamp optical centres within the boxes). It is permitted for one marker-lamp to be the fixed head-lamp in use. The marker-lamps shall comply with the luminous intensity requirements set out in Appendix 3.

### C2.3 Control

#### C2.3.1 Switching arrangements

The driver shall be able to switch the lamps on and off, and between modes shown below, from the normal driving position:

- a) all lamps off
- b) marker-lamps only (white marker lights at the front and red tail-lamps at the rear)
- c) day-time running
- d) night-time running
- e) tail-lamps only at the front end.

Appendix 6 section 6.3 sets out guidance on achieving compliance with this section.

#### C2.3.2 Simultaneous lighting of tail and front-end lamps at one end of the vehicle

With the exception of shunting locomotives it shall not be possible to light tail-lamps and front-end lamps simultaneously at the same end of the vehicle.

### C2.4 Hazard warning

To enable a driver to warn oncoming trains of a perceived hazard, the driver shall be able to control either all front lamps or two head-lamps such as to cause simultaneous flashing at a frequency of  $40 \pm 10\%$  cycles per minute. The difference between the maximum and minimum intensities shall be such that it is clearly perceptible to the driver of an oncoming train that the lights are flashing.

The control for the hazard warning shall be distinctive and a means of reminding the driver that it is switched on shall be provided.

Appendix 6 section 6.4 sets out guidance on achieving compliance with this section.

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## C2.5 Operational check

A system shall be provided whereby the operation of all fixed front-end lamps is continuously monitored and any failure of a fixed front-end lamp is indicated to the driver at his normal driving position.

## C2.6 Minimum operational requirement

A train shall be designed for three front lamps to be lit when it is in service. However, in the event of failure of a lamp it is permissible, pending replacement of the lamps, to continue operation in accordance with the requirements set out in [GE/RT8000](#).

## C2.7 Portable head-lamps

Portable head-lamps shall meet the requirements set out in Appendix 3 section 3.3 but compliance with sections C2.3 to C2.5 is not required.

Portable head-lamps shall be designed for use in each of the following circumstances:

- a) there is no electric supply on the leading vehicle of a train
- b) the front-end lamps of the leading vehicle consist only of fixed marker-lamps with no head-lamps
- c) the fixed head-lamp on the leading vehicle has failed.

Appendix 6 section 6.6 sets out guidance on achieving compliance with this section.

## C2.8 Shunting locomotives

Shunting locomotives shall be equipped with tail-lamps and marker-lamps, there is no requirement for head-lamps. One marker-lamp and one tail-lamp shall be lit at both ends of the locomotive when on shunting duties.

## C2.9 Steam locomotives

Steam locomotives shall as a minimum be fitted with a lit portable head-lamp.

## C3 Tail-lamps

### C3.1 Minimum operational requirement

A train shall be designed for the display of either two fixed tail-lamps or a single flashing lamp. However, in the event of failure of a lamp it is permissible, pending replacement of the lamps, to continue operation in accordance with the requirements set out in [GE/RT8000](#).

### C3.2 Configurations

The **visibility** set out in section B4.2 shall be achieved by the use of either or both of the following configurations:

- a) as a minimum, two fixed tail-lamps giving a steady light
- b) one portable tail-lamp that flashes at  $120 \pm 10\%$  cycles per minute.

#### C3.2.1 Fixed tail-lamps

When fixed tail-lamps are used, their centres shall be positioned within the boxes set out in Appendix 2.

### C3.3 Intensity of tail-lamps

All tail-lamps shall have the luminous intensity performance set out in Appendix 4.

### C3.4 Avoiding obstructions

All tail-lamps shall be positioned on the vehicle so that the light they emit is not obstructed.

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### C4 Maintaining performance

#### C4.1 Yellow areas

To maintain **visibility** of the approach of the train, there shall be arrangements in place to maintain the yellow areas in order to prevent them being obscured or significantly changing colour.

#### C4.2 Lamp systems

##### C4.2.1 Cleaning and maintenance

A system shall be provided to verify the alignment of the head-lamps. The alignment system shall be separate from the train and used at a frequency appropriate to maintain the optical axes of the head-lamps within a tolerance of  $\pm 0.2^\circ$ .

Fixed and portable lamp systems shall be subject to a cleaning regime to enable their optical performance to meet the requirements set out in this document.

The requirements set out in this section (C4.2.1) shall be contained within the certificated maintenance plan.

Appendix 6 section 6.7 sets out guidance on achieving compliance with this section.

##### C4.2.2 Battery condition

Portable lamps shall have a battery condition indicator system that provides a visual warning when the emitted light level is not complying with the requirements set out in this standard.

Appendix 6 section 6.8 sets out guidance on recommended battery life for portable lamps.

### C5 Lamp brackets

#### C5.1 General

All vehicle ends that are likely to be at the leading end of a train and not fitted with two day-time and two night-time head-lamps shall have a lamp bracket able to support rigidly a portable head-lamp.

All vehicle ends that are likely to be at the trailing end of a train and fitted with fewer than two red indicator lamps shall have a lamp bracket able to support rigidly a portable tail-lamp.

#### C5.2 Location of lamp brackets

Except as set out below, the lamp bracket(s) shall be located such that the optical axis of the portable lamp shall be between 1500 mm and 2000 mm above rail level.

Where it is not practicable to meet this requirement, it is permissible for the optical axis of the rear lamp to be as low as 1000 mm. The alignment of the lamp bracket(s) shall be maintained so that the beam direction of a portable head-lamp achieves the luminous intensity requirements set out in Appendix 3.

# Visibility Requirements for Trains

## Appendix 1

The contents of this appendix are mandatory.

### Warning stripes on shunting locomotives and snowploughs

Vehicle maximum design speed	Minimum width of stripe
km/h (mph)	mm
32 (20)	80
50 (30)	120
65 (40)	160
95 (60)	240
Maximum width of diagonal stripes shall be 2 x the appropriate minimum width given in this table.	

**Table 1: Warning stripes on shunting locomotives and snowploughs**

## Visibility Requirements for Trains

### Appendix 2

The contents of this appendix are mandatory.

#### Head, tail and marker-lamp positions

In this appendix the following key applies:

HL = Head-Lamp(s)

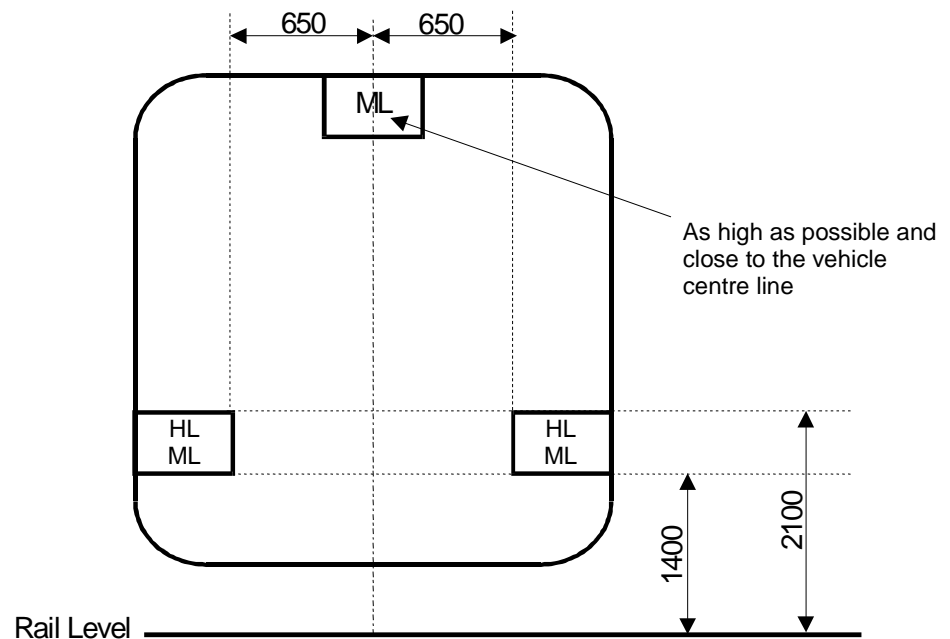
ML = Marker-Lamp

TL = Tail-Lamp

with all dimensions shown in mm.

Lamp optical centres shall be within the boxes.

#### 2.1 Head and marker-lamp positioning for non-tilting trains



**Figure 2.1** Head and Marker Lamp Positions for Non-Tilting Trains (Front View)

There shall be a night-time head-lamp located on the right hand side of the vehicle (when facing the front of the vehicle from the outside) regardless of where other night-time head-lamps are located (if more than one is fitted), see also section C2.1 paragraph 4.

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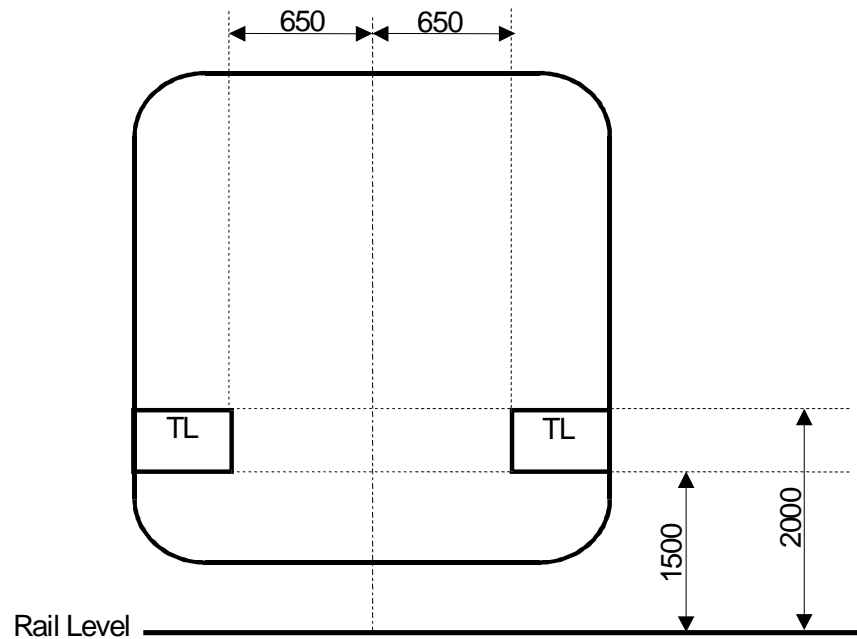
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## Appendix 2 continued

### 2.2 Tail-lamp positioning for tilting and non-tilting trains

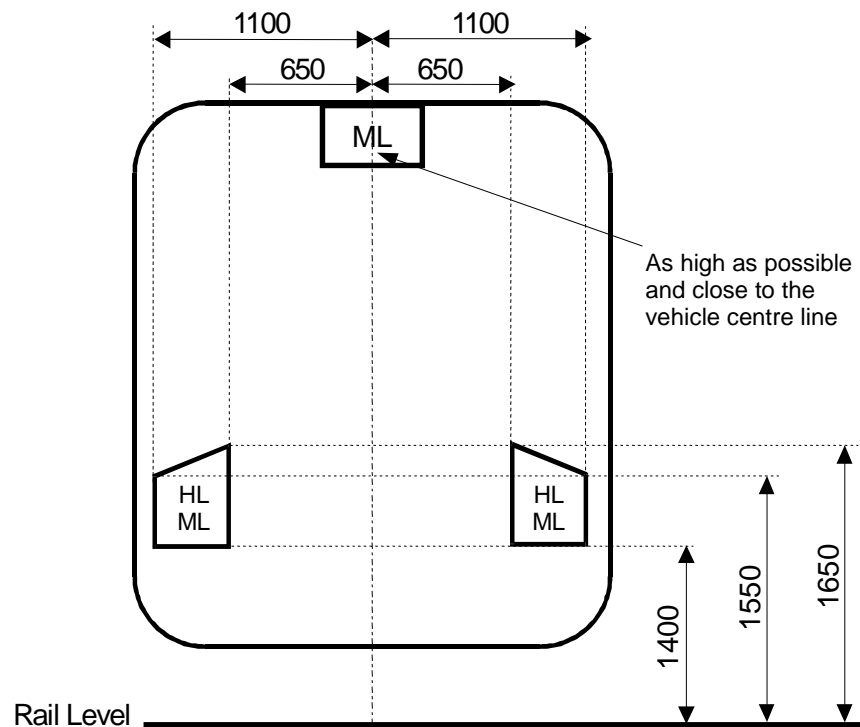


**Figure 22** Tail Lamp Positioning for Tilting and Non-Tilting Trains (Rear View)

## Visibility Requirements for Trains

### Appendix 2 continued

#### 2.3 Head and marker-lamp positioning for tilting trains



**Figure 23** Head and Marker Lamp Positioning for Tilting Trains (Front View)



# Visibility Requirements for Trains

## Appendix 3

The contents of this appendix are mandatory.

### Requirements for head, tail and marker-lamps

#### 3.1 Requirements for day-time fixed head-lamps

In the following tables, vertical and lateral values of luminous intensity are relative to the optical axis of each system. This axis is set out in tables 2 - 8 inclusive. (The following notation is used: U = up; D = down; L = left; R = right).

Angle above optical axis, at all angles to the left and right	Maximum luminous intensity (cd)
>4°U	1,200
>3°U to 4°U	4,000
>2°U to 3°U	13,000
>1°U to 2°U	90,000

**Table 2: Fixed day-time head-lamps for tilting trains and non-tilting trains**

Type: Continuously on (when selected) Colour: BS 1376 Signal White Class B with restriction of the x co-ordinate under the CIE 1931 Colour System less than or equal to 0.45  Lit area: 16,000 mm <sup>2</sup> to 43,000 mm <sup>2</sup> when viewed 'head on' in front Minimum dimension of lit area: (when viewed 'head on') 80 mm Substantially evenly lit front surface			
	Minimum luminous intensities (cd) at specified angles with reference to the optical axis		
	5°L to >2°L	2°L to 2°R	>2°R to 5°R
1°U to >0°U	9,000	50,000	9,000
0°U,D to 1°D	9,000	50,000	9,000
>1°D to 2°D	9,000	9,000	9,000

**Table 3: Fixed day-time head-lamps on tilting and non-tilting trains for maximum train speed greater than 97 km/h (60 mph)**

## Visibility Requirements for Trains

### Appendix 3 continued

Type: Continuously on (when selected) Colour: BS 1376 Signal White Class B with restriction of the x co-ordinate under the CIE 1931 Colour System less than or equal to 0.45  Lit area: 16,000 mm <sup>2</sup> to 43,000 mm <sup>2</sup> when viewed 'head on' in front Minimum dimension of lit area: (when viewed 'head on') 80 mm Substantially evenly lit front surface			
	Minimum luminous intensities (cd) at specified angles with reference to the optical axis		
	5°L to >2°L	2°L to 2°R	>2°R to 5°R
1°U to >0°U	6,000	35,000	6,000
0°U,D to 1°D	6,000	35,000	6,000
>1°D to 2°D	6,000	6,000	6,000

**Table 4: Fixed day-time head-lamps on non-tilting trains for speeds of up to and including 97 km/h (60 mph)**

### 3.2 Requirements for night-time fixed head-lamps

Angle above optical axis, at all angles to the left and right	Maximum luminous intensity (cd)
>4°U	400
>3°U to 4°U	1000
>2°U to 3°U	1,200
>1°U to 2°U	5,000

**Table 5: Fixed night-time head-lamps for tilting trains and non-tilting trains**

Type: Continuously on (when selected) Colour: BS 1376 Signal White Class B with restriction of the x co-ordinate under the CIE 1931 Colour System less than or equal to 0.45  Lit area: 16,000 mm <sup>2</sup> to 43,000 mm <sup>2</sup> when viewed 'head on' in front Minimum dimension of lit area: (when viewed 'head on') 80 mm Substantially evenly lit front surface			
	Minimum luminous intensities (cd) at specified angles with reference to the optical axis		
	5°L to >2°L	2°L to 2°R	>2°R to 5°R
1°U to >0.5°U	300	2,000	300
0.5°U to >0°U	500	2,000	500
0°U,D to 1°D	4,500	32,000	4,500
>1°D to 2°D	4,500	4,500	4,500

**Table 6: Fixed night-time head-lamps on tilting trains for maximum train speeds greater than 97 km/h (60 mph)**

# Visibility Requirements for Trains

## Appendix 3 continued

Type: Continuously on (when selected) Colour: BS 1376 Signal White Class B with restriction of the x co-ordinate under the CIE 1931 Colour System less than or equal to 0.45  Lit area: 16,000 mm <sup>2</sup> to 43,000 mm <sup>2</sup> when viewed 'head on' in front Minimum dimension of lit area: (when viewed 'head on') 80 mm Substantially evenly lit front surface			
	Minimum luminous intensities (cd) at specified angles with reference to the optical axis		
	5°L to >2°L	2°L to 2°R	>2°R to 5°R
1°U to >0°U	500	2,000	500
0°U,D to 1°D	4,500	32,000	4,500
>1°D to 2°D	4,500	4,500	4,500

**Table 7: Fixed night-time head-lamps on non-tilting trains for maximum train speeds greater than 97 km/h (60 mph)**

Type: Continuously on (when selected) Colour: BS 1376 Signal White Class B with restriction of the x co-ordinate under the CIE 1931 Colour System less than or equal to 0.45  Lit area: 16,000 mm <sup>2</sup> to 43,000 mm <sup>2</sup> when viewed 'head on' in front Minimum dimension of lit area: (when viewed 'head on') 80 mm Substantially evenly lit front surface			
	Minimum luminous intensities (cd) at specified angles with reference to the optical axis		
	5°L to >2°L	2°L to 2°R	>2°R to 5°R
1°U to >0°U	300	1,200	300
0°U,D to 1°D	3,000	26,000	3,000
>1°D to 2°D	3,000	3,000	3,000

**Table 8: Fixed night-time head-lamps on non-tilting trains for speeds of up to and including 97 km/h (60 mph)**

## Visibility Requirements for Trains

### Appendix 3 continued

#### 3.3 Requirements for portable head-lamps

Mode: Continuously on (when selected) Colour: BS 1376 Signal White Class B with restriction of the x co-ordinate under the CIE 1931 Colour System less than or equal to 0.45  Lit area: 10,000 mm <sup>2</sup> to 12,000 mm <sup>2</sup> when viewed 'head on' in front Minimum dimension of lit area: (when viewed 'head on') 66 mm Maximum dimension of lit area: (when viewed 'head on') 120 mm Beam shape: Circular; no secondary maxima			
Luminous intensity: Portable head-lamp: for maximum speed of 120 km/h (75 mph)			
Vertical	Horizontal	Minimum luminous intensity (cd)	Maximum luminous intensity (cd)
All angles up to and including 5° from the axis		600	1200

**Table 9: Requirements for portable head-lamps**

Note: The above specification reflects the type of portable head-lamp currently available. If a portable headlamp were to be produced where the alignment characteristics could be guaranteed to meet the normal alignment requirements for head-lamps (as set out in Appendix 5 of this document) then the higher luminous intensity values for fixed head-lamps could be utilised (as set out in Appendix 3 section 3.1 of this document).

#### 3.4 Requirements for marker-lamps

Type: Continuously on (when selected) Colour: BS 1376 Signal White Class B with restriction of the x co-ordinate under the CIE 1931 Colour System less than or equal to 0.45  Lit area: 8,000 to 12,000 mm <sup>2</sup> Minimum dimension of lit area: (when viewed 'head on') 66 mm Maximum dimension of lit area: (when viewed 'head on') 200 mm Position: Close to lateral extremes of vehicle front; >650 mm from vehicle centre line Beam shape: Circular or elliptical; no secondary maxima Evenly lit front surface			
Luminous intensity: Lower marker-lamps			
Vertical	Horizontal	Minimum luminous intensity (cd)	Maximum luminous intensity (cd)
0° U, D	0° L, R	300	600
0° U, D	5° L, R	100	200
5° U, D	0° L, R	100	200
The upper marker-lamp should have luminous intensity values of 50% those given in this table.			

**Table 10: Requirements for marker-lamps**

# Visibility Requirements for Trains

## Appendix 4

The contents of this appendix are mandatory.

### Requirements for tail-lamps

#### 4.1 Requirements for tail-lamps

The intensity of tail-lamps shall comply with Table 11 for fixed tail-lamps and Table 12 for portable tail-lamps.

Type: Continuously on (when selected) Colour: BS 1376 Signal Red Class B or Class C Lit area: 8,000 mm <sup>2</sup> to 15,000 mm <sup>2</sup> Minimum dimension of lit area: (when viewed 'head on') 66 mm Maximum dimension of lit area: (when viewed 'head on') 150 mm Beam shape: Elliptical with no secondary maxima			
Luminous intensity: Fixed tail-lamp			
Vertical	Horizontal	Minimum luminous intensity (cd)	Maximum luminous intensity (cd)
0° U, D	0° L, R	100	250
0° U, D	5° L, R	40	120
5° D	0° L, R	40	120
5° U	0° L, R	40	120

**Table 11: Requirements for fixed tail-lamps**

#### 4.2 Requirements for portable tail-lamps

In the following tables, vertical and lateral values of luminous intensity are relative to the optical axis of each system. This axis is parallel to the vehicle axis. (The following notation is used: U = up; D = down; L = left; R = right).

Mode: Flashing (120 cycles/min $\pm$ 10%) Duration of flash 25 $\pm$ 5 milliseconds Colour: BS 1376 Signal Red Class B or Class C Lit area: 8,000 mm <sup>2</sup> to 12,000 mm <sup>2</sup> Minimum dimension of lit area: (when viewed 'head on') 66 mm Maximum dimension of lit area: (when viewed 'head on') 120 mm Beam shape: Elliptical with no secondary maxima The front of a portable tail-lamp case (that is to say the surface of the case that faces a train approaching from the rear) shall exhibit a red retro-reflective rectangular surface with a minimum retro-reflective area of 14,000 mm <sup>2</sup> and a minimum dimension of 95 mm.			
Luminous intensity (mean over duration of flash): Portable tail-lamp			
Vertical	Horizontal	Minimum luminous intensity (cd)	Maximum luminous intensity (cd)
0° U, D	0° L, R	100	250
0° U, D	5° L, R	40	120
5° U	0° L, R	40	120
5° D	0° L, R	20	60

**Table 12: Portable tail-lamps**

## Visibility Requirements for Trains

### Appendix 4 continued

The minimum coefficients of retro-reflection shall be as in Table 13, in accordance with publication CIE 54: 1982.

Entrance angles (Beta 1) (Beta 2)	-5° 0°	15° 0°	40° 0°
Observation angle (Alpha) minutes of arc			
12	215	150	25
20	150	95	22
30	45	25	18
Rotation angle (Epsilon)	0°	0°	0°

**Table 13: Minimum coefficients of retro-reflection of red panel on portable tail-lamp (cd/m<sup>2</sup>)/lux**

Co-ordinates	x	y
Red limit on the spectrum locus	0.690	0.310
Amber limit on the spectrum locus	0.655	0.345
Desaturated/red boundary limit	0.595	0.315
Desaturated/amber boundary limit	0.569	0.341

**Table 14: Colour co-ordinates of red panel on portable tail-lamp (BS 873: Part 6: 1983)**

The luminance factor of the retro-reflector shall be greater than 0.03.

# Visibility Requirements for Trains

## Appendix 5

The contents of this appendix are mandatory.

### Head-lamp axis adjustments

Head-lamps conforming to [GM/RT2180](#) issue three shall have their head-lamp axis set to the values stated in tables 15 and 16 below:

Maximum train speed for trains equipped with 300 km/h head-lamps	Axis adjustment Day-time head-lamp	Axis adjustment Night-time head-lamp
200 km/h (125 mph)	0.5° below the vehicle axis	1.0° below the vehicle axis
160 km/h (100 mph)	1.0° below the vehicle axis	1.5° below the vehicle axis
125 km/h (75 mph)	1.5° below the vehicle axis	2.0° below the vehicle axis

**Table 15: Optical axis settings for [GM/RT2180](#) issue three head-lamps designed for speeds up to and including 300 km/h for different vehicle maximum speeds**

Maximum train speed for trains equipped with 225 km/h head-lamps	Axis adjustment Day-time head-lamp	Axis adjustment Night-time head-lamp
200 km/h (125 mph)	0.5° below the vehicle axis	No adjustment
160 km/h (100 mph)	1.0° below the vehicle axis	0.5° below the vehicle axis

**Table 16: Optical axis settings for [GM/RT2180](#) issue three head-lamps designed for speeds up to and including 225 km/h for different vehicle maximum speeds**

The lateral axis of the head-lamp shall remain parallel to the vehicle axis.

The requirements set out in this appendix are to be applied to existing head-lamps conforming to issue three of [GM/RT2180](#) (section B2.2).

Head-lamps with above axis intensities non compliant with tables 2 and 5 of this standard shall have their head-lamp axis set such that the intensity values are achieved at the installed alignment. Such installations shall not make the remaining intensity values non-compliant.

## Visibility Requirements for Trains

### Appendix 6

*The contents of this appendix are advisory (non-mandatory).*

#### Supporting guidance

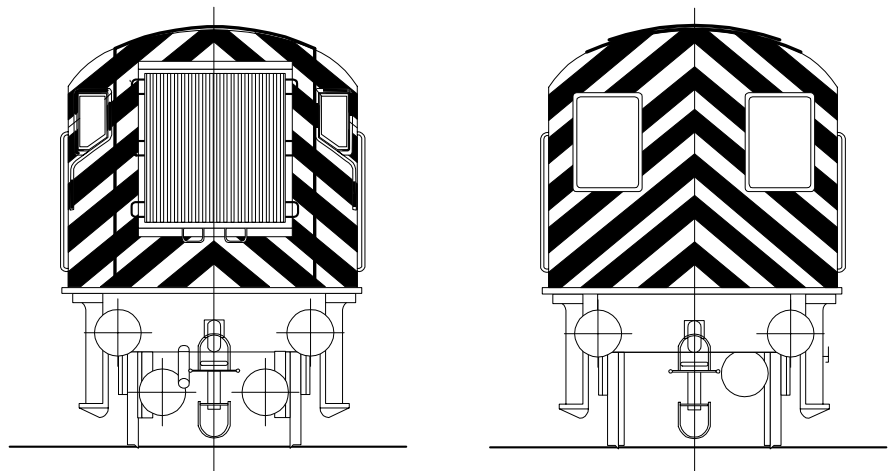
*This appendix sets out approved ways of meeting some of the mandatory requirements contained in the text of the document.*

##### 6.1 Area of yellow

*The word substantially has been used (in section C1.2.2 of this standard) in describing the yellow area to indicate that minor interruptions to the continuous area, such as panel joint or seals of a different colour (not exceeding 10 mm in width) and similar such interruptions are acceptable.*

##### 6.2 Shunting locomotives and independent snowploughs

*Figure 6.1 indicates a recommended method of meeting the requirements set out in section C1.3.*



**Figure 6.1 Example of use of yellow and black warning stripes on shunting locomotives**

*In respect of vehicles with curved ends the markings should be applied so that they are perceived as uniform stripes when viewed, at a large distance, head on in front of the vehicle.*

##### 6.3 Control

*Below is a suggested switching arrangement that complies with section C2.3.1 of this document.*

<b>Suggested driver's switch positions for head and marker-lamps</b>	
<b>Switch position</b>	<b>Lamps lit</b>
1	None
2	All markers and night-time head-lamp(s)
3	All markers
4	All markers and day-time head-lamp(s)



# Visibility Requirements for Trains

## Appendix 6 continued

*On-track machines formed in multiple, should be considered as a single unit and not as separate vehicles when considering switching arrangements for lamps.*

*The controls of the front and tail-lamps and all working lamps (for example flood lamps, foot step illuminators) should be separate and clearly identified.*

### 6.4 Hazard warning

*The driver's switch should be coloured orange with an unfilled black triangle.*

*The switch should illuminate when operated, flashing with the lamps to remind the driver that the hazard warning is in operation.*

### 6.5 Portable head-lamps

*Portable head-lamps conforming to BR Specification BR/TS0629 meet the **visibility** requirements set out in section C2.7 of this document.*

*When in use on a train, portable lamps should be fitted on lamp brackets on the rail vehicle at the head or rear of the train. Portable lamps should not be dropped on to any hard surface.*

*Portable lamps should be inspected at intervals of, say, not more than six months in order to establish their condition and continued fitness for purpose. The inspections should be carried out by competent staff. Records should be kept showing date of inspection, location, defects found and action taken. After inspection, each lamp should be marked with the date up to which it may continue in service before the next inspection is due.*

*Defective lamps should be sent to a qualified repairer. Before any lamp is returned to service after repair it should be checked that it conforms with appropriate equipment specification.*

### 6.6 Portable tail-lamps

*Portable tail-lamps complying with BR Specification BR/TS0630 meet the **visibility** requirements set out in Appendix 4 section 4.2 of this document.*

*The following is an approved method of measurement of the retro-reflective panel required on the front of a portable tail-lamp.*

*The measurement should be achieved using the apparatus described in BS 873 Part 1: 1983 section 6.2, and using the procedure set out in section 6.3 of the same British Standard. However, the following exceptions should apply:*

- a) the illuminant D65 should be used to illuminate the reflector's surface*
- b) the reflector's surface should be illuminated at 0° from the surface's normal, and the light reflected from that surface at 45° from the surface's normal should be measured.*

### 6.7 Lamp cleaning and maintenance

*The alignment of head-lamps should be verified using a suitable calibrated alignment system. This system should either:*

- a) consist of a target which is perpendicular to the longitudinal axis of the train and marked with appropriate angular markings corresponding to the angles in the standard or*
- b) consist of a self-contained alignment system with angular calibration corresponding to the angles in the standard.*

*Fixed lamps should be designed and installed to ensure that they are:*

- i) capable of operating in ambient temperatures between - 25°C and + 40°C*

## Visibility Requirements for Trains

- ii) *able to accommodate any internal temperature rise and any accumulated condensation that may occur due to variations in temperature*
- iii) *able to have consumable components changed without special tools*
- iv) *easily cleaned inside and outside to maintain optical performance.*

*The head and marker-lamps should be mounted behind (or the lens, where fitted, should be made from) clear, scratch and impact resistant material.*

*The tail-lamps should be mounted behind (or the lens, where fitted, should be made from) scratch and impact resistant material, designed to give uniform distribution of light across the whole of the lens surface without bright spots.*

*Different lamps may be combined in the same mountings, and lamps with multiple filaments may be used, providing that the **visibility** requirements are maintained.*

*The light units when fitted to the vehicle should be of a weatherproof construction according to the requirements set out in BS EN 60529 IP66.*

*Each head-lamp should be provided with fine screw adjustments of head-lamp alignment. These adjustments should not alter as a result of any of the vibrations normally generated on a moving rail vehicle. The integrity of waterproofing should not be impaired by the installation of this adjustment.*

### **6.8 Portable lamp battery condition**

*It is recommended that batteries should be designed to provide no less than 18 hours of continuous use.*

# Visibility Requirements for Trains

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## References

The Railway Group Standards Code

### Railway Group Standards and other Railway Group Documents

<b>GE/RT8000</b>	Master Rule Book
<b>GE/RT8067</b>	Personal Track Safety
<b>GM/RT2000</b>	Engineering Acceptance of Rail Vehicles
<b>GM/RT2180</b>	<b>Visibility</b> and Audibility Requirement for Trains
<b>GM/RT2400</b>	Design of On-Track Machines
<b>GM/RT2481</b>	Alignment of Train Head-Lamps – Rapid Response

The Catalogue of Railway Group Standards and the Railway Group Standards CD-ROM give the current issue number and status of documents published by RSSB. This information is also available from [www.rssb.co.uk](http://www.rssb.co.uk).

### Other References

<b>CIE 54</b>	Retro-Reflection: Definition and Measurement
<b>CIE 1931</b>	Standard Colorimetric Observer
<b>BR81</b>	Specification of Paint for Rolling Stock
<b>BR/TS0629</b>	Equipment Specification for Portable Head Lamp System
<b>BR/TS0630</b>	Equipment Specification for Portable Tail Lamp System
<b>BS 873</b>	Road Traffic Signs and Internally Illuminated Bollards
<b>BS 1376</b>	Specification for Colours of light signals
<b>BS 4800</b>	Paint Colours for Building Purposes
<b>BS EN 60529</b>	Degrees of Protection Provided by Enclosures (IP code)