Railway Group Standard

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Route Availability Number for Assessment of Compatibility between Rail Vehicles and Underline Bridges

This document sets out requirements for the derivation and use of the Route Availability number for the assessment of compatibility between the static load characteristics of rail vehicles and the capacity of underline bridges to carry the vertical static loads imposed by the rail vehicles and the associated normal dynamic response of rail bridges.

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Synopsis

This document sets out requirements for the derivation and use of the Route Availability number for the assessment of compatibility between the static load characteristics of rail vehicles and the capacity of underline bridges to carry the vertical static loads imposed by the rail vehicles and the associated normal dynamic response of rail bridges.

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Issue record

Issue	Date	Comments
One	01/12/2000	Original document.
Two	04/09/2010	Replaces issue one. Document recast to align with the processes set out in RIS-8270-RST Assessment of Compatibility of Rolling Stock and Infrastructure. Title amended accordingly.
Three	05/03/2021	Replaces issue two. Document amended to address the amendment and clarification AM002 by withdrawing requirements relating to route compatibility assessment. This content has been transferred to RIS-8706-INS. The document has also been revised to account for research and industry experience in the area of compatibility assessment, and revisions to RIS-8270-RST and associated EN standards.
Four	01/06/2024 [proposed]	Replaces issue 3. Document amended to address industry comments following publication of issue three. It also includes updated references to European Standards.

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Superseded documents

The following Railway Group documents are superseded, either in whole or in part as indicated:

Superseded documents	Sections superseded	Date when sections are superseded
GERT8006 issue three	All	01/06/2024 [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 and guidance for the derivation of Route Availability (RA) numbers for rail vehicles and underline bridges. The RA number is used to determine and communicate the capacity of a route to carry rail traffic based on the assessment of compatibility between rail vehicles and underline bridges.

1.1.2 RIS-8706-INS sets out requirements and guidance on the use of the RA number for the assessment of compatibility between the static load characteristics of rail vehicles and the capacity of underline bridges to carry the vertical static loads imposed by rail vehicles and the associated dynamic increment.

1.2 Introduction

1.2.1 Background

1.2.1.1 This standard includes specific requirements for the derivation of the RA number used to determine the capacity of a route to carry rail traffic based on the compatibility between rail vehicles and underline bridges. This standard also includes the corresponding requirements for categorising the static loading of vehicles by RA number.

1.2.1.2 The RA system provides a consistent and simple method for undertaking an assessment of compatibility of the weight (that is the static load characteristics) of rail vehicles with the load carrying capacity of underline bridges. In the RA system, a vehicle's weight is expressed as an RA number, based on the vehicle's axle loads and axle spacings. Similarly, the load carrying capacity of an underline bridge is expressed as an RA number at the permissible speed(s), based on the application of a generic vehicle load model including a dynamic increment of loading to account for vehicle speed. An infrastructure route section is then assigned an RA number, based on the lowest RA number of any bridge on the infrastructure route section. The route of a train is then assigned an RA number, based on the lowest RA number of the infrastructure route sections forming the route.

1.2.1.3 The RA system was first introduced by the former London and North Eastern Railway (LNER) in 1947 and adopted by the British Railways Board in 1948 at the time of the nationalisation of the railways. Prior to this, individual railway companies used different systems although some of these were based on similar principles.

1.2.1.4 The objective of the RA system was to provide a consistent and simple system that could be used throughout GB for managing the interface between the weight of rail vehicles and the strength of underline bridges to ensure that bridges were not overloaded by rail vehicles. In those days, the heaviest rail vehicles in normal use were steam locomotives.

1.2.1.5 The RA system was based on the load model contained in BS 153, the British Standard for bridge design in use at that time. The RA system involves the use of two load models which are applied as unit loads utilising the ‘ton’ imperial weight unit. These comprise:

a) A load model for 'short loaded lengths' which is formed of two axles of 1.25 tons at a spacing of 6 feet – which is representative of heavy wagon bogies; and
b) A load model for 'other than short loaded lengths' which is formed of 16 axles of 1 ton or 0.75 ton, at spacings varying from 5 feet to 13 feet, plus a uniformly distributed load of 0.1 tons per foot over a length of 218 feet.

1.2.1.6 The RA model is a simple pattern of loading that represents the vehicles using the GB network. It is a more appropriate approximation than the alternative European load models set out in BS EN 15528:2021 which are not as granular or as suitable for locomotives and passenger traffic.

1.2.2 Principles

1.2.2.1 This document sets out requirements that meet the criteria to be 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).

1.2.2.2 The NTRs in this document are used to support:

a) The permission in clause 4.2.7.4(4) of the Infrastructure National Technical Specification Notice (INF NTSN);
b) The permission in Appendix F of the INF NTSN; and
c) The assessment of route level technical compatibility between vehicles and infrastructure including as set out in clause 4.2.2.5 of the OPE NTSN in relation to all vehicles in the train to be in compliance with all the requirements applicable on the routes over which the train will run and for axle load limitations to be respected.

1.2.2.3 Appendix D of the OPE NTSN sets out the requirements for making rail infrastructure related data available to railway undertakings.

1.2.2.4 The description of the operation and traffic management subsystem in Schedule 3 of the Railways (interoperability) Regulations 2011 (as amended) includes procedures for enabling coherent operation of the various structural subsystems including, such as, in particular train composition and traffic planning. The requirements and guidance in this document, RIS-8706-INS and GEGN8616, set out the procedure followed in Great Britain for the purpose of route level assessment of technical static and dynamic compatibility checks between rail vehicles and underline bridges for this purpose.

1.2.3 Structure of this document

1.2.3.1 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'.

1.2.3.2 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 RIS-3215-TOM sets out the industry's agreed process for how information relating to local operating instructions, including the Sectional Appendix used for Network Rail managed infrastructure, is published for the GB mainline railway. It also details the contents of the Sectional Appendix. These include a table (Table A) indicating the permissible speed(s) along a route and route clearance tables (Tables D) for multiple-unit trains, locomotives, locomotive-hauled passenger or parcels trains and freight vehicles. The Sectional Appendix is also used to set out the RA number of infrastructure route sections.

1.2.4.2 Within GERT8000-TW1 requirements are given relating to the maximum number and position of locomotives within a train that affect compatibility between rail vehicles and underline bridges.

1.2.4.3 GERT8000-SP provides the standard terminology for operational speeds which apply to the GB mainline network. Of particular relevance to the compatibility of rail vehicles with underline bridges are references to 'permissible speeds', 'enhanced permissible speeds' and 'differential speeds'. The speed definitions used in this document are consistent with these.

1.2.4.4 BS EN 15663:2017 + A1:2018, specifies reference design masses which represent the loading conditions for particular vehicle types. These design masses are specified for the determination of axle loads for rail vehicles which are applied to underline bridges.

1.2.4.5 BS EN 15528:2021 defines a line classification system for infrastructure managers (IMs) and railway undertakings (RUs) to manage the interface between the load limits for railway vehicles and payload limits for freight wagons and the vertical load carrying capacity of a line. It is the basis for determining technical compatibility between the static load characteristics of rail vehicles and the capacity of underline bridges to carry the vertical static and dynamic loads imposed by the rail vehicles operating on the European Network with the exception of GB. In the update from BS EN 15528:2015 to BS EN 15528:2021 the content dealing with requirements for multiple unit (MU) classes and guidance on the dynamic analysis of bridges was removed. EN 15528:2021 states that the information about dynamic compatibility including Annexes C, D, E and P in EN 15528:2015 will be transferred to a future CEN Technical Report. The informative guidance on speeds which do not require a dynamic compatibility check according to vehicle type and EN 15528 line category has been retained in the new Annex C to EN 15528:2021.

1.2.4.6 The GB mainline infrastructure is not categorised in accordance with BS EN 15528:2021, which is not applicable in GB. This is recognised by the permission in the INF NTSN clause 4.2.7.4(4) for GB to continue using the RA system for route level assessment of technical compatibility between rail vehicles and underline bridges.

1.2.4.7 BS EN 15528:2021 clause 1, states that 'This European Standard does not cover the system used in Great Britain, where all lines and vehicles are classified in accordance with the RA system.' The RA system involves the calculation of RA numbers which performs a similar function to the BS EN 15528:2021 line category. Guidance on the correspondence between line categories according to BS EN 15528:2021 and the RA number is provided in Annex Q of BS EN 15528:2021. The comparisons in Annex Q of BS EN 15528:2021 of the RA number for the given line categories were based on technical studies to provide a simple static equivalence between the RA system in accordance with GERT8006 and line categorisation according to the axle load categorisation system in BS EN 15528:2021. Appendix F of the INF NTSN includes tables which provide correspondence between the RA number and associated speed with the Traffic Codes defined in the NTSN. The relationship between RA numbers and BS EN 15528:2021 line category, speed and different types of traffic is complex and therefore it is not appropriate to compare the contents of the table in the INF NTSN.

1.2.4.8 The RA system is recognised as the basis for categorisation of route availability in GB and this is acknowledged in BS EN 15528:2021 as well as in the INF NTSN. However, the Control Command and Signalling National Technical Specification Notice (CCS NTSN) requires the implementation over time of the European Rail Traffic Management System (ERTMS) together with the onboard European Train Control System (ETCS). ERTMS allows for the definition of different static speed restrictions for defined categories that are supervised by the ETCS onboard system. One of these speed restriction categories is axle load, which over a particular track section is mainly categorised according to the line categories defined in BS EN 15528:2015 in order of, first, increasing axle load and, second, increasing average mass per metre of the corresponding reference wagons (A, HS17, B1, B2, C2, C3, C4, D2, D3, D4, D4XL, E4 and E5).

1.2.4.9 Although GB does have explicit permission in the INF NTSN to continue using the RA system for describing and specifying the load carrying capacity of existing structures, this permission has not been recognised in the CCS NTSN, where axle loads are categorised according to BS EN 15528:2015. Speed control of different trains over underline bridges using ETCS will be possible, but in the absence of assessment data for infrastructure in terms of the axle load categories in BS EN 15528:2015, control of axle load and speed using the RA system will continue to be the basis upon which vehicle and underline bridge route level assessment of technical compatibility is undertaken on the GB mainline railway.

1.2.5 Supporting documents

1.2.5.1 Information on the permitted maximum trailing load by weight and length of freight trains is provided in the documentation set out in the section on Operational Rules in the Network Statement published by Network Rail.

1.3 Approval and authorisation of this document

1.3.1 The content of this document was approved by the Infrastructure Standards Committee on 12th March 2024 [proposed]

1.3.2 This document was authorised by RSSB on 5th April 2024 [proposed]

Part 2 Requirements for Capacity of Underline Bridges and Routes

2.1 Derivation of RA numbers of underline bridges

2.1.1 RA number: Permissible speed at an underline bridge

2.1.1.1 For each underline bridge, the RA number of the bridge shall be derived at the permissible speed at the underline bridge location based on its assessed capacity taking into account the dynamic increment of the static load applied to the bridge.

2.1.1.2 The permissible speed shall be the maximum permitted speed for the location of the bridge in accordance with Table A of the Sectional Appendix used for Network Rail managed infrastructure.

2.1.1.3 Where differential permissible speeds are stated in the Sectional Appendix for the location of the bridge, the permissible speed shall be taken as the higher value excluding any permissible speeds which apply to train categories specified by letters and excluding any enhanced permissible speeds.

Rationale

G 2.1.1.4 The RA number is used to categorise the capacity of underline bridges to carry the weight of rail vehicles operating at the permissible speed(s) at underline bridge locations on the GB mainline railway. This RA number enables a comparison to be made with the RA numbers derived for rail vehicles operating over a route as a means of checking the static load compatibility between rail vehicles and underline bridges.

Guidance

G 2.1.1.5 The permissible speed(s) are set out in Table A of the Sectional Appendix in accordance with the options permitted by GERT8000-SP. At any one location, there is between one and a maximum of three permissible speeds given. Where there is more than one permissible speed given in Table A of the Sectional Appendix for the location of an underline bridge, the higher permissible speed applicable to passenger, parcels and postal trains (loaded or empty) and light locomotives is used (after excluding any permissible speeds which are applicable to vehicle categories specified by letters and any enhanced permissible speeds). This is to provide a consistent basis for the determination of permissible speed across the remainder of the network, including where only one value of permissible speed may apply at some locations. In this way, a single RA number of a bridge can be established by the IM for route level assessment of technical compatibility between vehicles and underline bridges and the information communicated to RUs.

G 2.1.1.6 In practice, this is complicated by the fact that particular vehicles are permitted to run at different speeds (e.g. heavy vehicles at slower speeds and lighter vehicles at higher speeds). This is because of the complex interaction between rail vehicles and underline bridges which can result in the application of a load to the bridge of varying magnitude according to the static vehicle loading characteristics (such as axle load and spacing) and speed of travel.

G 2.1.1.7 Consequently, any lower values of speed for particular vehicles defined elsewhere in the Sectional Appendix (for example a particular class of locomotive in Table D) are disregarded for the purposes of determining the RA number of the underline bridge.

G 2.1.1.8 The following other possible permissible speeds are disregarded for the purpose of determining the RA number at an underline bridge location:

a) Any lower differential permissible speed for all other traffic (that is other than passenger, parcels and postal trains (loaded or empty) and light locomotives);
b) Any permissible speed which is applicable to train categories specified by letters; and
c) Any enhanced permissible speeds (Class 221 or Class 390 in tilting mode for example).

G 2.1.1.9 Examples of permissible speeds at the location of an underline bridge are shown in Figure 1. For all the examples shown, the permissible speed used to determine the RA number of the bridge determined in accordance with clause 2.1.1 is 50 mph.

G 2.1.1.10 Figure 1 illustrates how the permissible speed is determined across the network on a consistent basis for determining the RA number of a bridge where there is more than one permissible speed at a bridge. As can be seen from the diagram, for the examples shown, the faster than 50 mph 'permissive permissible speeds' are disregarded and the slower than 50 mph 'restrictive permissible speeds' are also disregarded.

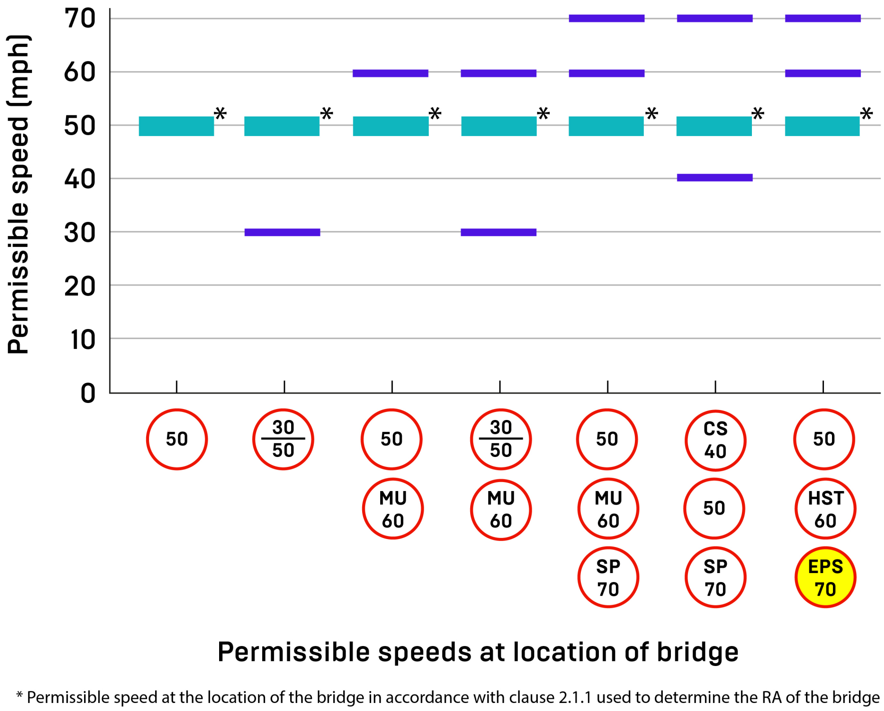

Figure 1: Examples illustrating the determination of the permissible speed in accordance with clause 2.1.1 for determining the RA number of a bridge

2.1.2 RA number: Differential speeds at an underline bridge

2.1.2.1 The relationship between speed and RA number shall be determined for any lower differential permissible speeds and permissible speeds applicable to vehicle categories specified by letter over the bridge, excluding CS and enhanced permissible speeds, taking into account the dynamic increment of the static vehicle load applied to the bridge.

Rationale

G 2.1.2.2 The RA number of each underline bridge at a particular speed provides the information needed to establish compatibility with different rail vehicle classifications (by speed) at their permissible speeds.

Guidance

G 2.1.2.3 For the mixed traffic situation that exists on the GB mainline railway, more than one permissible speed value for different rail vehicle classifications may be listed in the Sectional Appendix (used for Network Rail managed infrastructure) for an underline bridge. These are referred to as differential permissible speeds and permissible speeds applicable to vehicle categories specified by letter. This reflects the fact that different rail vehicle classifications (e.g. passenger or freight) generate a different dynamic load increment on an underline bridge at different speeds and this needs to be taken into account.

G 2.1.2.4 There is no requirement to determine the RA number for enhanced permissible speeds (as defined in GERT8000-SP) because these speeds typically exceed the limits of validity of the RA system set out in *A*. In these circumstances, vehicle/underline bridge compatibility is checked on an individual train formation loading basis. It is good practice to record the outcome of the individual compatibility checks, in accordance with RIS-8706-INS at EPS and CS speeds in Table D of the Sectional Appendix.

G 2.1.2.5 There is no requirement to determine the RA number for the CS speed (as defined in GERT8000-SP) because CS speeds only apply to a limited number of vehicles and vehicle/underline bridge compatibility is checked on an individual vehicle basis to maximise the speed at which the vehicle is compatible with underline bridges.

2.1.3 RA number: Method for derivation

2.1.3.1 Derivation of the RA number of an underline bridge shall be undertaken in accordance with the method set out in *Appendix A* except where assignment of an RA number is permitted by the IM (see *2.1.4*) .

Rationale

G 2.1.3.2 The RA number enables the categorisation of underline bridges on the GB mainline railway in respect of their capacity to carry the weight of rail vehicles.

Guidance

G 2.1.3.3 Appendix A of this document includes the load models used for determination of the RA number of an underline bridge and rail vehicles. Each model in Figures *2* or *3* and *4* or *5*, has the same geometric arrangement of point loads and point load magnitudes, except that the values in Figures *2* or *3* are expressed in imperial units (as explained in *1.2.1*) and the values in Figures *4* or *5* are expressed in metric units. This reflects the introduction of the metric system of units from the 1970s onwards.

G 2.1.3.4 When determining the RA number of an underline bridge, it is important to take account of the dynamic enhancement of the static vehicle load due to the passing of rail vehicles at speed, the structural form, details and behaviour of the bridge, its constituent materials and the condition of the bridge. Additionally, the load effects from centrifugal loading, nosing, traction and braking (which are all a function of the vertical load of a rail vehicle) are taken into account when deriving the RA number of an underline bridge.

G 2.1.3.5 The RA number of an underline bridge, together with an associated value of permissible speed, is a measure of its load carrying capacity.

2.1.4 RA number: Assignment of an RA number

2.1.4.1 The RA number for a permissible speed at a bridge shall be assigned based on current knowledge of the structure taking into account; the condition, use, constituent materials and behaviour and structural form and details and either:

a) The original design loading for a modern bridge; or
b) Where there is long term satisfactory frequent use at the assignment loading, the assessed capacity at the same permissible speed of a comparable bridge.

Rationale

G 2.1.4.2 Where there is current knowledge of the condition, use, constituent materials, behaviour, structural form and details of an underline bridge, it is possible to assess the bridge's capacity to resist the loading by rail vehicles that will operate over the bridge at their permissible speed, without the need for assessment calculations in certain cases.

Guidance

G 2.1.4.3 The assigned RA number of a modern bridge may be based on the original design loading where the current knowledge of the structure does not warrant consideration of a reduction in capacity. Where the current knowledge of the structure warrants consideration of a reduction in capacity, the method for the derivation of the RA number of the bridge should be based on *2.1.3.1*.

G 2.1.4.4 For the purpose of *2.1.4* a modern bridge should be taken as a bridge designed to a modern limit state design code, for example CP110, BS 5400 and the Eurocodes, and:

a) For simply supported spans RU rail loading defined in either British Rail Technical Note 27, BS 5400 Part 2 1978, BS 5400 Part 2 2006, BD37/88 or BD37/01 (RU rail loading is identical to Load Model 71); or
b) For simply supported spans Load Model 71 rail loading set out in BS EN 1991-2: 2003 clause 6.3.2(2)P;
c) For continuous spans in addition to (a) or (b) Load Model SW/0 as set out in UIC Leaflet UIC 776-1R 4th and 5th Editions (only for definition of SW/0 and not for the partial safety factor on SW/0 loading), BS 5400 Part 2 2006, BD37/01 or EN 1991-2: 2003 clause 6.3.3(3)P;
d) For Load Model 71 and Load Model SW/0 rail loading an alpha value (multiplication factor) of at least 1.1 in accordance with EN 1991-2:2003 clause 6.3.2(3)P for bridges designed to the Eurocodes (not applicable to bridges designed to CP110 or BS 5400).

2.2 Derivation of RA numbers of infrastructure route sections

2.2.1 RA number: Permissible speed of an infrastructure route section

2.2.1.1 The RA number of the infrastructure route section at the permissible speed shall be determined.

2.2.1.2 The RA number of the infrastructure route section shall be the minimum of the RA numbers of the bridges on the infrastructure route section, taking into account the permissible speeds on the infrastructure route section.

2.2.1.3 Where more than one permissible speed is stated in the Sectional Appendix for the infrastructure route section, the greater permissible speed shall be taken as the higher value of any differential speed excluding any permissible speeds shown with letters and excluding any enhanced permissible speeds.

2.2.1.4 The IM shall determine and communicate the variation in the RA number with permissible speeds shown with letters excluding the CS speed and excluding enhanced permissible speeds for an infrastructure route section.

Rationale

G 2.2.1.5 For each infrastructure route section on the GB mainline railway, the RA number is used to categorise the capacity of underline bridges on the infrastructure route section to carry the weight of rail vehicles operating at the permissible speeds for the underline bridges on the infrastructure route section. This RA number enables a comparison to be made with the RA numbers derived for rail vehicles operating over the infrastructure route section.

Guidance

G 2.2.1.6 For Network Rail's managed infrastructure, the permissible speed is set out in Table A of the Sectional Appendix according to the options permitted in GERT8000-SP. Any speed restrictions given elsewhere in the Sectional Appendix are generally not applicable to all traffic and are to be disregarded for the purpose of determination of the permissible speed for an infrastructure route section. The RA number for underline bridges is also dependent on differential speeds on the infrastructure route section. This is the case where more than one permissible speed value is listed in the Sectional Appendix for an underline bridge. These are referred to as differential speeds and reflect the fact that different rail vehicle classifications according to speed have a different total static load and dynamic impact on an underline bridge. This is reflected in the variation of RA number with differential speed values listed in Network Rail’s Network Statement, for example.

G 2.2.1.7 Permissible speeds as defined in GERT8000-SP are also included in the Sectional Appendix for train types specified by letters (HST, MU or SP for example). Enhanced permissible speeds are permitted for tilting trains (Class 390 and 221 for example) where higher speeds for trains travelling around curves are possible.

G 2.2.1.8 Enhanced permissible speeds and the CS speed are excluded because bridge/ vehicle compatibility has been previously checked for these permissible speeds on an individual real train formation/ individual vehicle loading basis respectively to maximise the speed at which these vehicles are compatible with existing bridges.

G 2.2.1.9 Network Rail's Network Statement section on weight limits provides guidance on the relationship between RA number and speed. This guidance includes the general relationship between RA and permissible speed and the load carrying capacity of bridges at permissible speeds shown with letters. Where the IM provides national guidance on the relationship between RA number and speed, for example in the Network Statement or Sectional Appendix, this is taken into account in deriving the RA of the infrastructure route section.

G 2.2.1.10 The RA numbers are published in the Sectional Appendix. The RA number for an infrastructure route section is based on the lowest number for bridges on the infrastructure route section, subject to loading from rail vehicles operating at their permissible speeds as set out in Table A of the Sectional Appendix. The published RA number at the permissible speed for an infrastructure route section is the baseline against which route level assessment of technical compatibility for rail vehicles is undertaken and proposals for network change relating to the load carrying capability of the network can be judged.

G 2.2.1.11 The Sectional Appendix contains the RA number value for the permissible speed. Where Table A of the Sectional Appendix gives more than one permissible speed the RA number is for the higher differential permissible speed, unless explicitly stated otherwise, in which case the RA number for other permissible speeds is provided. The higher differential permissible speed excludes any permissible speeds for vehicle categories which are specified by letter and any enhanced permissible speeds.

G 2.2.1.12 Specific requirements relating to the production of information related to local operating instructions, including the Sectional Appendix, are set out in RIS-3215-TOM. This information includes route clearance tables for multiple-unit trains, locomotives, locomotive-hauled passenger or parcels trains and freight vehicles.

2.3 Review and maintenance of data on RA number of bridges and infrastructure route sections

Guidance

G 2.3.1 The OPE NTSN sets out the requirements for making rail infrastructure related data available to railway undertakings. The infrastructure manager is responsible for the correctness of the data. In Great Britain the data on the RA number of infrastructure route sections is provided for this purpose.

G 2.3.2 RIS-8270-RST requires that RUs and IMs maintain, update and make freely available to relevant parties the available data that describes their asset characteristics relevant to technical compatibility.

G 2.3.3 The accuracy and currency of the published RA number data and associated speeds is critical for the assessment of compatibility between rail vehicles and underline bridges.

G 2.3.4 The accuracy and currency of the RA number and speed data is verified through a programme of bridge assessments to check:

a) The assessed capacity at the permissible speed provides at least the published RA capacity of the infrastructure route section at the permissible speed; and
b) The assessed capacity at the permissible speeds for vehicle categories specified by letters provides at least the published RA capacity of the bridge (or infrastructure route section as applicable) at the permissible speeds for vehicle categories specified by letters; and
c) Identification of the long span bridges on the network and the rail vehicles for which compatibility has been assessed.

G 2.3.5 An assessment programme typically comprises:

a) First time assessments of bridges where an assessment has not been carried out; and

b) Assessment reviews or repeat assessments to update knowledge of load carrying capacity on a cyclical basis.

G 2.3.6 The assessment reviews/ repeat assessments and frequency of assessment reviews/ repeat assessments typically take into account:

a) The margin of load capacity in excess of the published capacity;
b) The risk of change in load carrying capacity due to change in the bridge condition; and
c) Whether there has been a significant change in structural knowledge since the design or last assessment.

G 2.3.7 Where a significant change in the bridge condition is identified, an evaluation of the significance of any change in load carrying capacity is undertaken.

G 2.3.8 In addition, the RA numbers of underline bridges and infrastructure route sections are reviewed and amended in the following circumstances:

a) Whenever it is proposed to change a permissible speed of all or particular rail vehicles at an underline bridge location; and
b) Whenever the load carrying capacity of an underline bridge is known to have changed.

G 2.3.9 Where there is a proposed change to the enhanced permissible speed of vehicles or a CS permissible speed, the load carrying capacity of the affected bridges is checked using the actual vehicle loading pattern for these train formations/ vehicles.

G 2.3.10 Where the permissible speed, differential speed, or speed applicable to vehicle categories specified letters (excluding CS), is proposed to be changed, the IM establishes whether the RA numbers of underline bridges and infrastructure route sections need to be updated as part of the proposed changes.

Part 3 Requirements for Static Load Characteristics of Rail Vehicles

3.1 Requirements for Static Load Characteristics of Rail Vehicles

3.1.1 Derivation of RA number: Rail vehicle type

3.1.1.1 For each type of rail vehicle operated, or intended to be operated, the RA number of the rail vehicle shall be determined in accordance with requirements set out in *Appendix A*.

Rationale

G 3.1.1.2 The RA number is the measure used by the GB mainline rail industry to categorise the static load of rail vehicles. This RA number enables a comparison to be made with the RA numbers derived for underline bridges on a route as a means of checking the static load compatibility between rail vehicles and underline bridges.

Guidance

G 3.1.1.3 The RA number is used for determination of compatibility of rail vehicles with underline bridges on a route. It is the comparison between the RA number of a rail vehicle with the RA number of the route (based on the RA number of underline bridges on the route) at the permissible speed of the vehicle, that determines the outcome of a route level assessment of technical compatibility for the vehicle.

G 3.1.1.4 *Appendix A* provides the load models used for determination of the RA number and describes the required steps involved in the calculation process. Calculation is frequently undertaken using proprietary software that is available for this purpose.

3.1.2 Derivation of RA number: Vehicle load for passenger carrying vehicles

3.1.2.1 The RA number for multiple units, coaches and other vehicles that carry passengers, shall be derived for the loading condition design mass under exceptional payload in accordance with BS EN 15663:2017+A1:2018.

Rationale

G 3.1.2.2 In order to determine the static loading characteristics of a rail vehicle on a consistent basis, it is necessary to specify the requirements for determining the mass of the vehicle. Different mass conditions apply according to the type of vehicle set out in BS EN 15663:2017+A1:2018.

Guidance

G 3.1.2.3 The value adopted for the design mass of multiple units, coaches and other vehicles that carry passengers is intended to reflect the worst credible loading condition taking account of overcrowding and perturbed operation.

G 3.1.2.4 Guidance on the application of BS EN 15663:2017+A1:2018 is provided in *Appendix B*.

3.1.3 Derivation of RA number: Vehicle load condition for freight vehicles

3.1.3.1 The RA numbers for freight vehicles shall be derived for the following vehicle loading conditions:

a) Design mass under normal payload; and
b) Design mass in working order for the unladen (or tare) conditions.

Rationale

G 3.1.3.2 In order to determine the static loading characteristics of a rail vehicle, it is necessary to know the load conditions to be used in determining the mass of the vehicle. Different mass conditions according to the type of vehicle are relevant in accordance with the relevant industry standard BS EN 15663:2017+A1:2018.

Guidance

G 3.1.3.3 For freight vehicles, the design mass under normal payload represents the worst loading condition on a frequent basis.

G 3.1.3.4 It may also be appropriate to consider different loading conditions for the calculation of the RA number for the movement of freight vehicles around the GB mainline railway. Such a case can arise where the freight vehicle is planned to travel with a reduced payload (partially laden) to be compatible with the infrastructure or for travelling in the unladen (tare) condition without the operating restrictions which may be applicable to vehicles loaded to the design mass under normal payload. Where it is planned to travel in a partially laden condition, the design mass can be determined for the appropriate loaded condition. The basis for definition of rail vehicle design masses is set out in BS EN 15663:2017+A1:2018. Appendix B provides further guidance on the use of this standard for the purposes of this document.

G 3.1.3.5 In the case of freight vehicles, it may be appropriate to establish separate maximum speeds for different payload conditions, including the design mass under normal payload (fully laden) or design mass in working order (unladen or tare condition). Where the RA number of a freight vehicle is dependent on different maximum speeds and different payload conditions, it is important for the purposes of route level assessment of technical compatibility to know the conditions upon which the RA number and maximum speed depend.

3.1.4 Derivation of RA number: Vehicle load condition for locomotives and similar powered vehicles

3.1.4.1 The RA number for locomotives, power cars and powered vehicles with no payload and that do not carry passengers, shall be derived for the loading condition design mass under working order in accordance with BS EN 15663:2017+A1:2018.

Rationale

G 3.1.4.2 In order to determine the static loading characteristics of a rail vehicle on a consistent basis, it is necessary to specify the requirements for determining the mass of the vehicle. Different mass conditions apply according to the type of vehicle set out in BS EN 15663:2017+A1:2018.

Guidance

G 3.1.4.3 For locomotives, power cars and powered vehicles with no payload and that do not carry passengers the design mass under working order represents the worst loading condition on a frequent basis (for example; full consumables).

G 3.1.4.4 Guidance on the application of BS EN 15663:2017+A1:2018 is provided in *Appendix B*.

3.1.5 Derivation of RA number: Vehicle load condition for other vehicles

3.1.5.1 The RA number for infrastructure construction and maintenance vehicles and on-track machines shall be derived for the loading condition design mass under normal payload with an additional allowance for the mass of design consumables including staff in accordance with BS EN 15663:2017+A1:2018.

3.1.5.2 The RA number for other powered vehicles with a payload comprising of only design consumables that do not carry passengers shall be derived for the loading condition design mass under working order in accordance with BS EN 15663:2017+A1:2018.

3.1.5.3 The RA number for other non-powered vehicles with a payload excluding passengers shall be derived for the loading condition design mass under normal payload with an additional allowance for the mass of design consumables including staff in accordance with BS EN 15663:2017+A1:2018.

Rationale

G 3.1.5.4 In order to determine the static loading characteristics of a rail vehicle on a consistent basis, it is necessary to specify the requirements for determining the mass of the vehicle. Different mass conditions apply according to the type of vehicle set out in BS EN 15663:2017+A1:2018.

Guidance

G 3.1.5.5 Infrastructure construction and maintenance vehicles and on-track machines are treated as freight vehicles with additional allowances for the mass of staff and consumables.

G 3.1.5.6 Other powered vehicles that do not carry any payload are treated as locomotives.

G 3.1.5.7 Guidance on the application of BS EN 15663:2017+A1:2018 is provided in *Appendix B*.

3.2 Derivation of RA numbers of a rail vehicle

3.2.1 Relevant rail vehicle data

3.2.1.1 For each type of rail vehicle that is operated or intended to be operated, the following data shall be determined:

a) The maximum speed of the rail vehicle;
b) Details of the spacings between the axles and the distance between each end of the rail vehicle and the adjacent axle;

c) Axle loads for the relevant vehicle load condition in accordance with *3.1.2* or *3.1.3* or *3.1.4* or *3.1.5* and
d) The maximum height of the centre of gravity of the rail vehicle under the relevant vehicle load condition identified in *3.1.2* or *3.1.3* or *3.1.4* or *3.1.5*.

Rationale

G 3.2.1.2 The listed data is used for determination of the RA number of a vehicle and for undertaking underline bridge/rail vehicle route level assessment of technical compatibility, such as for a Stage 2 compatibility check in accordance with RIS-8706-INS.

Guidance

G 3.2.1.3 The key static load characteristics of rail vehicles that influence its RA number are established in accordance with *3.1* and *3.2*. Increases in the axle load and variability in the axle spacing and length of vehicles will have a significant impact on the magnitude of the load effects that an underline bridge experiences. The height of the centre of gravity of a rail vehicle will significantly affect the distribution of vertical wheel load between rails particularly for trains travelling around curves.

G 3.2.1.4 Maximum speed and design masses under different payload conditions of a rail vehicle are defined terms. The RA number, maximum speed, axle spacings, vehicle length and axle loads of a rail vehicle, describe the parameters which most influence the loading applied to an underline bridge.

G 3.2.1.5 The maximum speed includes the normal maximum operating speed. Where the proposed speed for vehicle testing purposes exceeds the normal operating speed this speed needs to be advised.

G 3.2.1.6 In the case of freight vehicles, it may also be appropriate to establish separate maximum speeds and/or other RA numbers for operation under different payload conditions, including the fully laden, partially laden or unladen (tare) condition.

3.2.2 Rail vehicle data: Vehicle end

3.2.2.1 The end of the rail vehicle shall be taken as the face of the buffers or, for rail vehicle ends with no buffers, midway between the headstock of the rail vehicle and the headstock of a rail vehicle of the same type coupled to it (the coupling plane).

Rationale

G 3.2.2.2 This requirement defines the plane which represents the end of a rail vehicle to enable the length of a rail vehicle to be established.

Guidance

G 3.2.2.3 To determine the length of a rail vehicle, the plane which represents the vehicle end is identified. The data provided in accordance with *3.2.1* can be used for this purpose. The distance between each end of a rail vehicle and the adjacent axle is not always the same at both ends of the vehicle. This can be the case for the determination of the length and end axle distance of rail vehicles with and without buffers.

3.3 Review and maintenance of data on RA number of rail vehicles

Guidance

G 3.3.1 RIS-8270-RST requires that RUs and IMs maintain, update and make freely available to relevant parties the available data that describes their asset characteristics relevant to technical compatibility.

G 3.3.2 The accuracy of the RA number of a vehicle and the vehicle data is critical for the assessment of compatibility between rail vehicles and underline bridges.

G 3.3.3 The RA number of a vehicle and vehicle data determined in accordance with this document are reviewed and amended as necessary in the following circumstances whenever it is proposed to:

a) Change the design mass or payloads of the rail vehicle, or the distribution of mass or payloads between axles;
b) Change the details of the spacings between axles or the distance between each end of the rail vehicle and the adjacent axle, for example when fitting an alternative design of bogie to a freight wagon;
c) Alter the maximum speed of a rail vehicle in any payload condition.

G 3.3.4 The RA number of vehicles and vehicle data is used by an IM when reviewing the compatibility of changes to the infrastructure with existing rail traffic.

Part 4 Application of this document

4.1 Scope

4.1.1 If a change to a rail vehicle or an underline bridge (structural subsystem) is considered new, renewal or upgrade as defined in the Railways (Interoperability) Regulations 2011 (as amended), then all or part of the rail vehicle or underline bridge (structural subsystem) is required to comply with the Rolling Stock, Rolling Stock (Freight) and Infrastructure NTSNs and other relevant NTSNs and NTRs, unless given exemptions allowed for in the Regulations.

4.1.2 The requirements of this document apply to all new and modified (excluding like-for-like replacement of components) parts of the subsystem where 4.1.1 applies to the subsystem.

4.1.3 The requirements of this document also apply to existing bridges, infrastructure route sections and vehicles, and changes to these assets that affect the RA value, to enable the route level assessment of technical compatibility.

4.2 Exclusions from scope

4.2.1 The requirements in this document are not applicable to On-track Plant 'working' and 'travelling' in possessions.

4.3 General enter into force date

4.3.1 The requirements in this document enter into force from 07 September 2024.

4.4 Exceptions to general enter into force date

4.4.1 There are no exceptions to the general enter into force date.

4.5 Applicability of requirements for projects already underway

4.5.1 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.

4.6 Deviations

4.6.1 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.

4.6.2 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).

4.7 User's responsibilities

4.7.1 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.

4.7.2 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.

4.7.3 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.

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Appendices

Appendix A Method for Derivation of RA numbers

The content of this appendix is required by *2.1.3.1* and *3.1.1.1*.

A.1 Limits of validity of the RA system

A.1.1 Application of the RA system for categorisation of rail vehicles and underline bridges shall be undertaken within the limits of validity of the RA method as follows:

a) For underline bridges with spans of up to 50 m;
b) For rail vehicles operating at speeds up to and including:
   i) 60 mph for any vehicle with a RA number of RA9 or higher;
   ii) 75 mph for freight vehicles;
   iii) 100 mph for rail vehicles other than freight vehicles, but including non-passenger carrying coaching stock (for example vehicles used for carrying parcels or mail);
   iv) 75 mph for vehicles in iii) with regularly repeating single axles;
   v) 100 mph for two coupled locomotives; and
   vi) 75 mph for three, four or five coupled locomotives.
c) For rail vehicles operating in accordance with the requirements of Rule Book modules GERT8000-TW1 and GERT8000-SP;
d) For route level assessment of technical compatibility between vehicles and underline bridges carried out in accordance with RIS-8706-INS.

Rationale

G A.1.2 Route level assessment of technical compatibility on the basis of RA numbers is only possible where the conditions for application of the RA system for categorisation of rail vehicles and underline bridges, plus the minimum requirements for compatibility assessment, are achieved. Further stages of compatibility assessment are undertaken where this is not the case.

Guidance

G A.1.3 The RA system comprises, amongst other things, of:

a) The derivation of RA numbers for underline bridges and permissible speed data;
b) The derivation of RA numbers and associated vehicle data for rail vehicles; and
c) Minimum requirements for undertaking compatibility checks at route level between the load carrying capacity of underline bridges taking account of speed and the static loading characteristics of rail vehicles.

G A.1.4 The RA system is limited to bridges with spans up to 50 m because the RA number of vehicles is determined using only simply supported spans up to 50 m. It is known that there are a number of vehicles whose loading exceeds 20 load model units (RA load units) on spans above 50 m and it would be confusing to RUs if this limit were to be changed and the RA number of existing vehicles increased as a consequence. In practical terms, this limit is considered acceptable due to the limited number of bridges on the network with spans in excess of 50 m. The guidance on the application of the static load model in GA2.2.4 for determining the RA number of continuous spans, and for adverse influence line lengths covering more than one span, mitigates against the risk of the RA number of rail vehicles only being derived from consideration of load effects on a simply supported span.

G A.1.5 Bridges with spans greater than 50 m are referred to as 'long span underline bridges'.

G A.1.6 Where the limits of validity of the RA system are met, the RA numbers derived in accordance with this standard are used for the route level assessment of technical compatibility between rail vehicles and underline bridges. RIS-8706-INS sets out requirements and guidance for the assessment of compatibility at route level on the GB mainline railway.

G A.1.7 Requirements and guidance for further stages of compatibility assessment where demonstration of compatibility is not possible on the basis of RA numbers are included in RIS-8706-INS.

G A.1.8 Where the operating speed of a vehicle exceeds the limits of validity in *A1.1*, RIS-8706-INS requires in addition to the normal vehicle / bridge compatibility checks an additional Stage 3 compatibility assessment based on a dynamic analysis check. GEGN8616 provides detailed guidance on carrying out the additional Stage 3 compatibility assessment.

A.2 Derivation of RA number of an underline bridge

A.2.1 Derivation of RA number: Load model and its application

A.2.1.1 The load model set out in *A.4* (or its metric conversion shown in *A.5*) shall be applied to every track on the underline bridge and positioned on each track to give the most severe effect for the underline bridge element being considered.

A.2.1.2 The load model for short loaded lengths (for example *Figure 4*) shall be used where it produces a more onerous load effect than the load model for other than short loaded lengths (for example *Figure 3*).

Rationale

G A.2.1.3 The conditions for application of the load model are provided to support determination of the maximum load carrying capacity of an underline bridge.

Guidance

G A.2.1.4 In order to determine the maximum load carrying capacity of an underline bridge, the load model is located on each and every track simultaneously in the most onerous position for the critical part(s) of the bridge. Parts of the load model which produce relieving load effects (for example to reduce the maximum unfavourable load effect) are ignored.

A.2.2 Derivation of RA number: Application of load model to continuous bridges and continuous bridge elements

A.2.2.1 For continuous bridges and continuous bridge elements, the load model set out in *A.4* (or its metric conversion shown in *A.5*) shall be applied separately and simultaneously to the parts of the spans that produce unfavourable effects only.

A.2.2.2 The load model for short loaded lengths (e.g. *Figure 4*) shall be used where it produces a more onerous load effect than the load model for other than short loaded lengths (e.g. *Figure 3*).

A.2.2.3 The load model shall be positioned to give the most severe effects on each loaded length.

Rationale

G A.2.2.4 The conditions for application of the load model are provided to support determination of the maximum load carrying capacity of a continuous underline bridge and of continuous bridge elements.

Guidance

G A.2.2.5 The RA number for rail vehicles has been determined by applying the load model to only simply supported spans. To guard against the risk of real vehicles producing a greater load effect on continuous spans than a single application of the load model, the load model is applied to each adverse length of the influence line, for the element of the bridge being considered (without restriction to the number of times the load model is applied).

G A.2.2.6 Where an adverse length of an influence line extends over two spans, for example for the bearing reaction at an intermediate bearing, the load model is applied to each span.

G A.2.2.7 For each application of the load model the most onerous portion of the load model is applied in the most onerous position with relieving effects ignored. The most critical load model is applied to an adverse part of the influence line for the load effect under consideration with the selection of the most critical load model for one adverse length independent of the selection for another adverse length.

G A.2.2.8 As a result either the same or a mix of different load models (load model for short loaded lengths or load model for other than short loaded lengths) are applied to the adverse sections of the influence line.

A.2.3 Derivation of RA number: Determination of maximum number of units

A.2.3.1 The maximum number of units of such loading which each structural element within the underline bridge subject to significant rail loading has the capacity to carry shall be determined.

A.2.3.2 When determining the maximum number of units, account shall be taken of the dynamic increment of such loading at the permissible speed and the condition and the structural form, details and behaviour of the bridge.

A.2.3.3 The maximum number of units of such loading that the bridge has the capacity to carry shall be taken as the minimum value of the number of units determined for each structural element in *A.2.3.1*.

A.2.3.4 This number shall be rounded down to the next integer and ten shall be subtracted.

A.2.3.5 The resulting integer shall be called the RA number of the underline bridge at that speed.

Rationale

G A.2.3.6 For determination of the maximum RA number of an underline bridge, account is taken of the condition and response of the bridge to the dynamic effects of loading from rail vehicles.

Guidance

G A.2.3.7 The increment of additional load applied to the static effects of the load model due to dynamic effects at the permissible speed has to be taken into account when determining the RA number representing the load capacity of the underline bridge. The value used for permissible speed is in accordance with *2.1*.

G A.2.3.8 The RA number, calculated in accordance with *A.2.3.4*, represents the maximum static weight of the rail vehicle. For example, if the maximum number of load model units which the underline bridge has the assessed capacity to carry at a given speed is 18.7, the RA number of the underline bridge for that speed is 18 – 10 = 8.

A.3 Derivation of RA number of a rail vehicle

A.3.1 Derivation of RA number: Rail vehicle formation

A.3.1.1 Rail vehicles of the type being considered shall be taken as coupled together into a train at least 100 m long.

A.3.1.2 For vehicles that travel in a fixed formation, including a multiple unit, sufficient fixed formation units shall be coupled together to form a train at least 100 m long.

A.3.1.3 For vehicles that travel in a fixed formation, including a multiple unit, exceeding 100 m in length the train considered shall comprise of at least two fixed formation units.

Rationale

G A.3.1.4 The minimum length for formation of rail vehicles into a train is specified for the derivation of its RA number. This is to ensure the length of train considered is at least twice the maximum bridge span of 50 m.

G A.3.1.5 Whilst the requirement to couple vehicles or fixed formations to form a train at least 100 m long covers the normal critical cases, the requirement in *A 3.1.3*, for example, covers a possible critical case of the loading produced by the adjacent coupled ends of fixed formations (where a formation has a length exceeding 100 m).

Guidance

G A.3.1.6 None

A.3.2 Derivation of RA number: Formation of rail vehicles with asymmetric axle spacing or axle loads

A.3.2.1 In the case of rail vehicles with asymmetric axle spacing or axle loads (for example rail-mounted cranes), and in the case of fixed formation multiple-unit trains, the rail vehicles or multiple-units shall be taken as coupled together in the orientation giving the most severe effect for the simply supported span length under consideration.

Rationale

G A.3.2.2 The conditions for formation of rail vehicles with asymmetric axle spacing or axle loading are defined for the determination of the maximum load effects on a simply supported span length.

Guidance

G A.3.2.3 The determination of the RA number of the vehicle is based on the most onerous configurations of vehicles permitted in a train formation.

A.3.3 Derivation of RA number: Rail vehicle loading conditions

A.3.3.1 The vehicle loading conditions to be used shall be as set out in *3.1.2* or *3.1.3* or *3.1.4* or *3.1.5*.

Rationale

G A.3.3.2 The loading condition for different rail vehicle types is defined in *3.1.2* or *3.1.3* or *3.1.4* or *3.1.5* to enable the calculation on a consistent basis of the loading used to determine the RA number of a vehicle.

Guidance

G A.3.3.3 Use of standard loading conditions for rail vehicles will ensure consistency in the approach for determining the maximum static loading effects from rail vehicles.

A.3.4 Derivation of RA number: Bending moment and end shear determination for train of rail vehicles

A.3.4.1 The maximum bending moment and end shear shall be determined for the train of rail vehicles acting on simply supported spans varying in length from 1 m to 50 m.

Rationale

G A.3.4.2 The maximum load effects (bending moment and end shear force) from a train of rail vehicles acting on simply supported spans from 1 m to 50 m are determined for the derivation of the RA number of a rail vehicle.

Guidance

G A.3.4.3 For each span length, the number of locations throughout the span adopted for the calculation of bending moments and shear forces along the span due to the train of rail vehicles, is selected to ensure that the maximum bending moment and shear force within the span can be determined. Alternatively exact solutions or iterative techniques may be used.

G A.3.4.4 The step in position of the train of vehicles or RA load model needed to identify the maximum shear force or bending moment within the span will vary according to span length. Smaller steps in position will be appropriate for short spans, and near the position at which the train of vehicles generates a maximum load effect, to ensure that the effect of critical axles is picked up to enable an accurate determination of the maximum load effects. The step in position of the train should also include cases where an axle in the train is positioned on the span at the location where the maximum bending moment or maximum shear force is being determined. Maximum load effects often occur at 'loading events' where an axle in the train is located at the location being considered.

G A.3.4.5 Sufficient increments in span length are used to identify the worst case (maximum) RA number of the vehicle for spans varying from 1 m to 50 m. The former BR standard GCTT0138 suggested intervals of 1 ft for span increments but this is not always necessary for the longest spans.

A.3.5 Derivation of RA number: Equivalent Uniformly Distributed Load (EUDL) calculation for train of rail vehicles

A.3.5.1 Using these maximum values of bending moment and shear force derived in accordance with *A.3.4.1*, a corresponding EUDL that produces these maximum values, shall be determined for each span from 1 m to 50 m using the same units as those used to define the load model set out in *A.4* or *A.5*.

Rationale

G A.3.5.2 The maximum calculated values of bending moment and shear force are used to determine the values of EUDL acting on simply supported beams with spans from 1 m to 50 m.

Guidance

G A.3.5.3 Based on the calculated maximum bending moment or shear force for each span, the EUDL for the train of rail vehicles is determined assuming a simply supported beam subject to an EUDL.

A.3.6 Derivation of RA number: Bending moment and end shear determination for static load model

A.3.6.1 The maximum bending moment and end shear force shall also be determined for the static load model set out in *A.4* or *A.5* acting on simply supported spans varying in length from 1 m to 50 m.

A.3.6.2 The load model for short loaded lengths (for example *Figure 4*) shall be used where it produces a greater bending moment than the load model for other than short loaded lengths (for example *Figure 3*) for a particular length of span. This methodology shall also be used for selecting the load model for determining the maximum end shear.

Rationale

G A.3.6.3 The maximum load effects (bending moment and end shear force) due to the static load model(s) acting on simply supported spans from 1 m to 50 m are determined for derivation of the RA number of a rail vehicle.

Guidance

G A.3.6.4 See guidance to *A.3.4*.

G A.3.6.5 Either the same load model (for example *Figure 3*) or different load models (*Figure 3* and *Figure 4*) are used to determine the maximum bending moment and end shear load effect for a particular span depending upon which is the more onerous.

A.3.7 Derivation of RA number: EUDL calculation for static load model

A.3.7.1 Using these values, derived in accordance with *A.3.6.1* and *A.3.6.2*, a corresponding EUDL shall be determined for each span from 1 m to 50 m.

Rationale

G A.3.7.2 The maximum calculated values of bending moment and shear force are used to determine the values of EUDL acting on simply supported beams with spans from 1 m to 50 m.

Guidance

G A.3.7.3 Based on the calculated maximum bending moments or shear forces for each span between 1 m and 50 m, subject to loading from the static load model(s), the EUDL for the static load model is determined assuming a simply supported beam subject to an EUDL.

G A.3.7.4 These EUDL values represent one unit of the load models set out in *A.4* or *A.5*.

A.3.8 Derivation of RA number: Number of load model units representing train of rail vehicles

A.3.8.1 For bending moment for each span length, the EUDL value derived from applying the train of rail vehicles shall be divided by the EUDL value for the same span length for one unit of the load model set out in *A.4* or *A.5* to derive the number of load model units representing the train of vehicles. This shall be repeated for end shear force for each span length.

Rationale

G A.3.8.2 For the same span length, the quotient of the EUDL values determined from a train of rail vehicles and the EUDL for a single unit of the static load model set out in *A.4* or *A.5*, is the basis for determination of the number of load model units for a particular train.

Guidance

G A.3.8.3 The maximum result obtained from division of the EUDL for a train by the corresponding EUDL for a single unit of the static load model in *A.4* or *A.5*, represents the maximum number of load model units due to a train of rail vehicles.

A.3.9 Derivation of RA number: Determination of RA number of rail vehicle

A.3.9.1 The maximum number of load model units, from taking into account both bending moment and end shear force, derived in accordance with *A.3.8.1*, shall be rounded up to the next largest integer and ten shall be subtracted.

A.3.9.2 The resulting integer shall be called the RA number of the rail vehicle type (or multiple-unit type).

A.3.9.3 Values less than one shall be reported as RA 1.

Rationale

G A.3.9.4 The requirement sets out the method for achieving consistency in determining the calculated RA number of the rail vehicle.

Guidance

G A.3.9.5 The calculated RA number is obtained by rounding it up to the next largest integer and subtracting ten. For example, if 18.3 load model units represents the train of rail vehicles, the RA number of the rail vehicle type is 19 – 10 = 9.

A.4 Load model for deriving RA number using imperial units

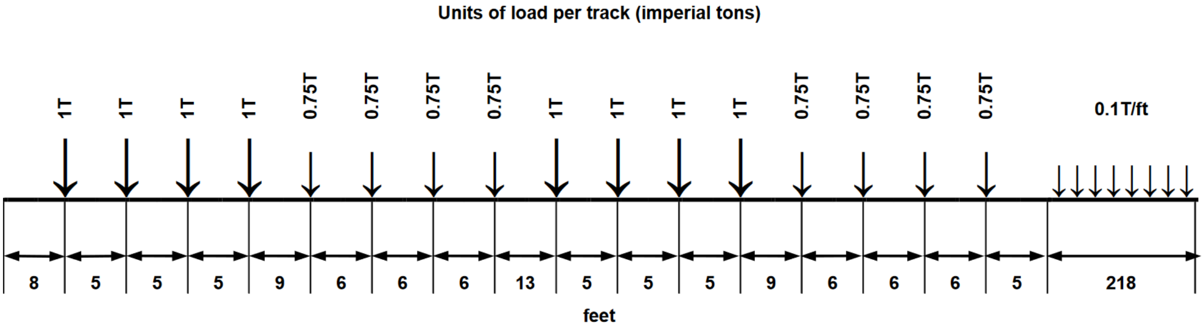

Figure 2: Load model for other than short loaded lengths (imperial, not to scale)

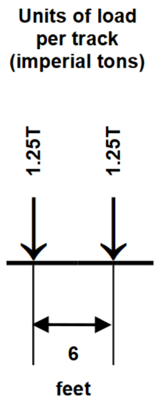

Figure 3: Load model for short loaded lengths (imperial, not to scale)

A.5 Load model for deriving RA number using load model in A.4 converted to metric units (kilonewtons/metres)

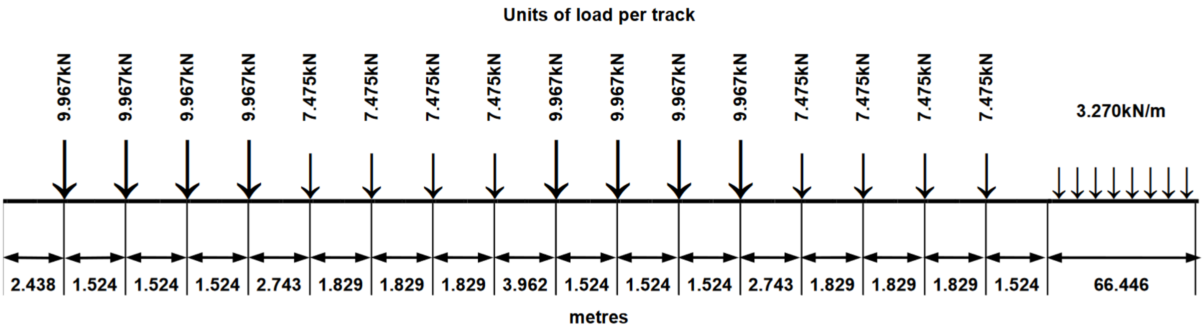

Figure 4: Load model for other than short loaded lengths (metric, not to scale)

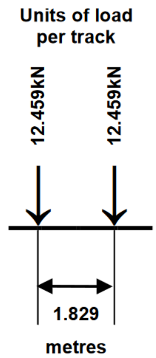

Figure 5: Load model for short loaded lengths (metric, not to scale)

Appendix B Guidance on the interpretation of BS EN 15663:2017 + A1:2018 for GB rail applications

The content of this appendix is provided for guidance only.

B.1 Design masses

Guidance

G B.1.1 The terms and definitions for loading of rail vehicles in this document are consistent with those used in BS EN 15663:2017+A1:2018 which also specifies reference states meeting these definitions.

G B.1.2 The vehicle loading conditions used for the determination of the RA number of a vehicle are set out in *3.1.2*, *3.1.4*, *3.1.3* and *3.1.5* of this document.

B.2 Design mass in working order and normal payload

Guidance

G B.2.1 The 'reference masses' meeting the definitions of 'design mass in working order' and 'design mass under normal payload' (in the case of freight vehicles) are specified in BS EN 15663:2017+A1:2018.

G B.2.2 The design mass under normal payload can be determined in accordance with BS EN 15663:2017+A1:2018 utilising 160 kg/m^2 in passenger standing and catering areas for high speed and long distance trains and 280 kg/m^2 in standing areas for passenger vehicles other than high speed or long distance units. The same value is taken in both passenger standing areas and catering areas to reflect GB passenger behaviour, where frequently there can be no difference between standing occupancy rates in these two areas.

B.3 Design mass under exceptional payload

B.3.1 Design mass under exceptional payload: According to type of rolling stock

Guidance

G B.3.1.1 The 'design mass under exceptional payload' is determined by the type of rolling stock (vehicle category) and the payload that will be experienced under 'exceptional conditions'. The vehicle categories used are defined in Table 3 of BS EN 15663:2017+A1:2018. To determine the design mass under exceptional payload, Tables 7 and 8 of BS EN 15663:2017+A1:2018 define the values to be used.

B.3.2 Design mass under exceptional payload: Passenger loading in seated and standing areas

Guidance

G B.3.2.1 BS EN 15663:2017 + A1:2018 specifies that 100 % of normal seats should be considered occupied when determining the design mass under exceptional payload, but does not explicitly specify the numbers of passengers to be considered in standing areas although it provides some guidance.

B.3.3 Design mass under exceptional payload: Equivalent GB train category

Guidance

G B.3.3.1 In Great Britian, 'high speed and long distance trains' are understood to be the same as inter-city trains with the following characteristics:

a) Formed of passenger vehicles with single doors at one or both ends of the vehicle (for example Class 390), rather than passenger vehicles with more than two doors or with pairs of doors and with vestibules typical of commuter trains, so reducing the likelihood of standing areas being occupied to the highest densities;
b) Travel at 90 mph or higher for a significant part of their journey; and
c) Not primarily used for commuting (noting that some long distance services can effectively become commuter services in the vicinity of large cities).

B.3.4 Design mass under exceptional payload: GB value for high-speed/long distance passenger loading

Guidance

G B.3.4.1 A standing passenger loading of at least 320 kg/m² (4 passengers / m²) is assumed for all areas of high speed and long distance trains.

B.3.5 Design mass under exceptional payload: GB passenger loading value for trains other than high-speed/long distance

Guidance

G B.3.5.1 In Great Britian, a standing passenger loading of at least 450 kg/m² (6.4 passengers / m²) is assumed.

G B.3.5.2 BS EN 15663:2017+A1:2018 notes that 'for certain types of service where particular values for payload in standing areas could be specified' include 'double deck vehicles' and 'vehicles with only end access' where payload values could be lower, and 'vehicles for heavily loaded commuter services' where 'a higher payload value can be required'.

G B.3.5.3 In exceptional situations, for example trains with longitudinal seating layouts with a wide passageway along a vehicle, a higher value of passenger loading in the range permitted by Table 8 of BS EN 15663:2017+A1:2018 is often utilised with supporting justification provided for the proposed value.

B.3.6 Design mass under exceptional payload: Passenger loading for tip up seat areas

Guidance

G B.3.6.1 BS EN 15663:2017+A1:2018 states that 'tip up seats' are not assumed to be occupied 'except when otherwise specified by the operator for the service being provided'. In Great Britian, tip up seats are treated as if they are not occupied by seated passengers, and that the space they would have occupied is part of the standing area subject to standing passenger loading.

Definitions

assessed capacity	The determination of the safe load carrying capacity of an underline bridge at an associated line speed taking into account the physical condition, constituent materials and and the structural form, details and behaviour of the bridge. The term includes site inspection with site measurements or site examination and the carrying out of calculations and checks.
axle load	The total vertical load exerted by both wheels on an axle on to the track caused by the weight of the vehicle, including the self-weight of the wheels and the axle.
bridge	A structure of one or more spans greater than 1800 mm whose prime purpose is usually to carry traffic or services across an obstruction or gap.
capacity (of an underline bridge)	The capacity of an underline bridge to carry safely the vertical static and dynamic loads due to different types of rail vehicles, taking into account the bridge's physical condition, constituent materials and the structural form, details and behaviour of the bridge.
design mass in working order [technical]	The design mass in working order as set out in *BS EN 15663:2017+A1:2018*. The design mass in working order is the dead mass of the vehicle plus design consumables including all the staff but empty of any payload. For freight vehicles, the state is also described as the unladen mass or tare weight.
design mass under exceptional payload	The design mass under exceptional payload as set out in *BS EN 15663:2017+A1:2018*. The design mass under exceptional payload is the design mass of the vehicle in working order plus the exceptional payload. It is determined by the type of rolling stock and it includes the maximum payload that can be transported and will be experienced only under exceptional conditions (for example an exceptional number of passengers). It represents the design limit for operation of the vehicle.
design mass under normal payload	The design mass under normal payload as set out in *BS EN 15663:2017+A1:2018*. The design mass under normal payload is the design mass of the vehicle in working order plus the normal design payload. **Note:** There are no exceptional payload reference states for freight vehicles. The payload for freight vehicles is always taken as the maximum payload specified for the freight vehicle.
eurocodes	A set of structural design codes for building and civil engineering works
infrastructure route section	Comprises a number of track sections each of which has individually defined characteristics.

loaded length (of a structural member)	The length of the appropriate influence line within which the rail vehicle loads produce adverse effects.
long span bridge	An underline bridge of which one or more spans of the bridge exceeds 50 m in length. Where an underline bridge is supported on bearings, the span is measured by reference to the longest length of any one track supported between the bearings. For arch underline bridges, the span is the longest distance between springings measured parallel to the tracks.
maximum speed [of a rail vehicle]	The maximum speed at which a rail vehicle is designed to run, as determined by the characteristics of the rail vehicle.
maximum speed [of a train]	The maximum speed at which a train is able to run, as determined by the lowest maximum speed of any rail vehicle which is included in the formation of the train.
permissible speed	The authorised maximum speed over a section of line, either for all trains or (where differential or enhanced permissible speeds are applied) for specific types of trains, as set out in the Sectional Appendix.
rail vehicle	A single locomotive, on-track machine (including cranes), freight wagon or passenger vehicle, or a number of freight wagons or passenger vehicles which normally operate coupled together in fixed formation (for example a passenger multiple unit or a crane).
route	The physical path of a journey to be undertaken by a vehicle or a collection of vehicles, where the path is comprised of a number of track sections, each of which has individually defined characteristics.
Route Availability (RA) Number	The number derived in accordance with the provisions of GERT8006 to express either of the following: a) The rail vehicle load carrying capacity of an underline bridge or infrastructure route section. b) The static load characteristics of a rail vehicle type. For on-track machines, the static load characteristics of the rail vehicle are those applicable to the on-track machine in its running mode outside of a possession.
underline bridge	A bridge structure of one or more spans (including viaducts) which carries the railway over an obstacle, such as a highway.

References

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

RGSC 01	Railway Group Standards Code
RGSC 02	Standards Manual

Documents referenced in the text

RSSB documents

GERT8000-SP	Speeds
GERT8000-TW1	Preparation and movement of trains
RIS-3215-TOM	Weekly Operating Notice, Periodical Operating Notice and the Sectional Appendix
RIS-8270-RST	Route Level Assessment of Technical Compatibility between Vehicles and Infrastructure
GEGN8616	Guidance on evaluating excessive dynamic effects in underline bridges
RIS-8706-INS	Route Level Assessment of Technical Compatibility between Rail Vehicles and Underline Bridges

Other references

BD37/88 and BD37/01	Loads for Highway Bridges, Design Manual for Highway Bridges (based on BS5400 Part 2 and includes the rail loading to be used for the design of railway bridges)
British Rail Technical Note 27	Design Loading and Load Factors for Railway Bridges, Civil Engineering Department, Revised August 1974
BS 153:Part 3A:October 1972	Specification for steel girder bridges - Part 3A Loads
BS 5400	British Standard code of practice for the design and construction of steel, concrete and composite bridges
BS 5400 Part 2; 1978 and 2006	Steel, concrete and composition bridges - Specification for loads
BS EN 15528:2015	Railway applications - Line categories for managing the interface between load limits of vehicles and infrastructure
BS EN 15528:2021	Railway applications - Line categories for managing the interface between load limits of vehicles and infrastructure
BS EN 15663:2017+A1:2018	Railway applications - Vehicle reference masses

BS EN 1991-2: 2003	Eurocode 1: Actions on structures – Part 2: Traffic loads on bridges
CP110	BSI Code of practice for the structural use of concrete
Network Statement 2025	Network Rail. Version 2.0. November 2023
UIC Leaflet 776-1R 4th Edition	Loads to be considered in railway bridge design, International Union of Railways, Paris, 1994
UIC Leaflet 776-1R 5th Edition	Loads to be considered in railway bridge design, International Union of Railways, Paris, 2006
CCS NTSN	Command Control and Signalling National Technical Specification Notice (CCS NTSN). Published by the Secretary of State on 1 January 2021 pursuant to regulation 3B of the Railways (Interoperability) Regulations 2011. This Notice replaces and substantially reproduces the provisions of Commission Regulation (EU) 2016/919 of 27 May 2016 (the CCS TSI) and includes relevant amendments made by Commission Implementing Regulation (EU) 2019/776 which came into force in June 2019
INF NTSN	Infrastructure National Technical Specification Notice (INF 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) 1299/2014 of 18 November 2014 (the INF TSI) and includes relevant amendments made by Commission Implementing Regulation (EU) 2019/776 which came into force in June 2019
OPE NTSN	Operation and Traffic Management National Technical Specification Notice (OPE 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 Decision 2012/757/EU of 14 November 2012 (the OPE TSI), and includes relevant amendments made by Commission Regulation (EU) 2015/995 of 8 June 2015 and Commission Implementing Regulation (EU) 2019/773 which came into force in June 2019
SI 2006/599	The Railways and Other Guided Transport Systems (Safety) Regulations 2006
SI 2011/3066	Railways (Interoperability) Regulations 2011 (as amended)