Rail Industry Standard
RIS-8273-RST
Issue: One **Draft:** 1c
Date: June 2022 [proposed]

Assessment of Compatibility of Rolling Stock and Infrastructure - Gauging and Stepping Distances

Synopsis

This document sets out requirements and responsibilities for the assessment of gauging compatibility and of stepping distances between rolling stock and infrastructure.

Published by RSSB

Issue record

Issue	Date	Comments
One	June 2022 [proposed]	Original document.

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

Superseded documents

The following Railway Group documents are superseded, either in whole or in part as indicated:

Superseded documents	Sections superseded	Date when sections are superseded
GERT8273 Issue One	All	June 2022 [proposed]

Supply

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

Contents

List of Figures

Part 1 Purpose and Introduction

1.1 Purpose

1.1.1 This document sets out requirements for assessing route compatibility of rolling stock and infrastructure with respect to gauging and to stepping distances from train to platform.

1.1.2 RIS-8270-RST 'Route Level Assessment of Technical Compatibility between Vehicles and Infrastructure' sets out requirements and responsibilities for the assessment of compatibility between rolling stock and infrastructure, and the arrangements by which the assessment of compatibility is undertaken. It also identifies those responsible for managing that assessment.

1.1.3 This document sets out requirements and responsibilities for the assessment of gauging compatibility between rolling stock and infrastructure, the arrangements by which the assessment of gauging compatibility is undertaken and identifies those responsible for managing that assessment.

1.1.4 This document is also applicable when assessing gauging compatibility between rolling stock and rolling stock, or infrastructure and infrastructure, where the assets concerned are the responsibility of more than one infrastructure manager or railway undertaking.

1.1.5 This document also sets out requirements and responsibilities for the assessment of stepping distances between rolling stock and platforms, the arrangements by which the assessment is undertaken and identifies those responsible for managing that assessment.

1.2 Application of this document

1.2.1 Compliance requirements and dates have not been specified because these are the subject of internal procedures or contract conditions.

1.2.2 If you plan to do something that does not comply with a requirement in this RIS, you can ask a Standards Committee to comment on your proposed alternative. If you want a Standards Committee to do this, please submit your deviation application form to RSSB. You can find advice and guidance on using alternative requirements on RSSB's website www.rssb.co.uk.

1.3 Health and safety responsibilities

1.3.1 Users of documents published by RSSB are reminded of the need to consider their own responsibilities to ensure health and safety at work and their 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.

1.4 Structure of this document

1.4.1 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'.

1.4.2 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'.

1.5 Approval and authorisation of this document

1.5.1 The content of this document will be approved by Rolling Stock Standards Committee on April 2022 [proposed].

1.5.2 This document will be authorised by RSSB on April 2022 [proposed].

Part 2 Gauging processes

2.1 Gauging processes

2.1.1 The assessment of gauging compatibility shall be carried out when new, modified or cascaded vehicles are proposed for use on a route, or when operating conditions (loading condition, speed or cant deficiency) are changed for existing vehicles.

2.1.2 The assessment of gauging compatibility shall be carried out when modifications are made to the track or infrastructure.

2.1.3 The demonstration of gauging compatibility shall be carried out using one of the following processes:

a) Standard vehicle gauges (section 2.2)
b) Absolute gauging (section 2.3)
c) Comparative gauging (section 2.4)
d) Hybrid gauging (section 2.5).

2.1.4 The two areas of gauging compatibility, lower sector and upper sector, shall be assessed.

Rationale

G 2.1.5 The processes set out in this document provide a robust assessment of gauge compatiblity which balances the need for adequate clearance with the aim of maximising the available space for transport of passengers or freight.

Guidance

G 2.1.6 RIS-8270-RST 'Route Level Assessment of Technical Compatibility between Vehicles and Infrastructure' sets out requirements and responsibilities for the assessment of compatibility, the wider regulatory context for this assessment and the involvement of affected parties in the assessment.

G 2.1.7 There are two fundamental scenarios for assessing gauging compatibility based on whether the asset already exists or is being designed:

a) Introducing or altering an asset to be compatible with existing assets, for example cascading a rolling stock fleet to a different route. In this case, the assessment will take the form of using the existing information on the asset. This may include the existing gauging information for the rolling stock and the national gauging database for the infrastructure. This situation provides a limited opportunity to alter the rolling stock or infrastructure.
b) Building a new asset, for example building new rolling stock or a new platform, when the new asset is built to the relevant standards, but compatibility is still assessed against other, possibly non-conforming, existing assets.

G 2.1.8 The processes described have been developed over many years to balance the need for adequate clearance with the aim of maximising the available space for transport of passengers or freight.

G 2.1.9 The lower sector and upper sector have different associated clearance requirements, see GIRT7073, and different requirements for equipment designed to be in contact or in close proximity, for example automatic warning system magnets and receivers or overhead line equipment and pantographs.

G 2.1.10 It is important that there are always positive clearances between train and train, or train and infrastructure (excluding items designed to be in contact). In order to provide this, control measures become progressively more stringent as clearances decrease. Thus, where large clearances exist, few control measures are in place. Where small clearances exist, controls are in place to achieve acceptable operational clearances. Clearances are categorised as normal, reduced or special reduced. Appendix *A* of this document gives further guidance on clearances.

G 2.1.11 Where gap fillers are used on either rolling stock or infrastructure, for example to reduce gaps at the platform train interface, it is important to use the appropriate datum in assessing gauge clearance. More information on this is given in Appendix *B*.

G 2.1.12 The track on which trains run is not normally fixed, and the concept of 'effective position of the track' is used in gauging analysis to ensure that clearance calculations take account of the likely variation in track position. Consideration of the effective position of the track takes account of the range of positions and inclinations that the track may be expected to occupy in the course of its normal maintenance cycle. Effective position of the track considers lifts and lowers, slues, cant variations and sidewear affecting the effective running line of the vehicles consistent with the track position controls in place. Datum plates and track fixity parameters, as used for example on slab track, are intended to constrain the amount a track may move during its service life.

G 2.1.13 Track is maintained to the requirements set out in GCRT5021 to provide track geometry for the smooth and reliable running of trains. Where no specific reference points or position controls are in place, it is assumed that the track can move during its normal maintenance cycle and make full use of the available allowances.

G 2.1.14 The concept of effective position used in gauging analysis takes account of the likely position of the track between maintenance interventions. Where reliance is placed upon the application of reduced and special reduced clearances, then more rigorous regimes of track position monitoring and control are used.

G 2.1.15 The monitoring and measurement of infrastructure for the determination of clearance is undertaken in ways consistent with the accuracy of the original survey and the determined clearance, such as using similar equipment or data analysis techniques.

G 2.1.16 The following tolerances and parameters are managed by the infrastructure manager, who has the responsibility to specify limits, and maintain within these limits:

a) Lateral track alignment tolerance
b) Vertical track alignment tolerance
c) Static cross level error
d) Rail sidewear
e) Rail headwear

f) Track gauge variation from standard (1435 mm) gauge.

G 2.1.17 Track roughness is managed by the infrastructure manager, who has the responsibility to specify maintenance limits and maintain the track geometry within these limits. However, since they implicitly affect the dynamic performance of the vehicle, these limits are mutually agreed between the infrastructure manager and the railway undertaking.

G 2.1.18 RIS-2773-RST and GMRT2173 state that the infrastructure manager will provide track data for use in gauging calculations.

G 2.1.19 A set of suitable track data files (known as 'Track for Gauging files' TfG) for 60 mph (100 km/h), 70 mph (110 km/h), 90 mph (140 km/h), 100 mph (160 km/h), 125 mph (200 km/h) and 140 mph (225 km/h), are available from Network Rail and further details are set out in RIS-2773-RST.

G 2.1.20 The following tolerances and parameters are managed by the railway undertaking, who has the responsibility to specify limits, and maintain within these limits:

a) Suspension performance parameters
b) Suspension creep
c) Wheel tread wear
d) Wheel flange wear
e) Wheel flange to rail clearance for standard (1435 mm) gauge
f) Height setting tolerances
g) Vehicle build tolerances
h) Vehicle maintenance tolerances
i) Dynamic performance based on track tolerances and parameters.

G 2.1.21 In the case of cant excess, intermediate speeds can be associated with minimum clearance on the inside of curves. In the case of cant deficiency, permissible or enhanced permissible speeds are generally associated with minimum clearances on the outside of curves.

2.2 Using standard vehicle gauges

2.2.1 Where routes have been published by the infrastructure manager as compatible with a standard vehicle gauge, rolling stock conforming to that standard vehicle gauge shall be deemed to be compatible with the infrastructure on the route.

2.2.2 Where the standard vehicle gauge does not include the whole vehicle, compatibility shall only apply to the portion of the vehicle for which the gauge is applicable.

Rationale

G 2.2.3 Using compatible lower sector and upper sector gauges is a way of demonstrating compatibility using the standard vehicle gauge process.

Guidance

G 2.2.4 GERT8073 defines standard vehicle gauges and the associated application rules for rolling stock and for infrastructure.

G 2.2.5 For current standard vehicle gauges, GERT8073 sets out the information to enable the gauges to be applied safely.

G 2.2.6 Where the use of standard vehicle gauges does not provide compatiblity for the whole vehicle then other gauging processes set out in this document are used to demonstrate compatibility for the remaining aspects.

G 2.2.7 In some locations restrictions apply to compatibility of certain gauges, which it is important to take into account.

2.3 Absolute gauging

2.3.1 Where absolute gauging is used, the vehicle swept envelope (as set out in GMRT2173) shall be compared with the measured infrastructure and track position (as set out in GIRT7073).

Rationale

G 2.3.2 The absolute gauging process is the calculation of clearance between the swept envelope of the rolling stock and the infrastructure along a route.

Guidance

G 2.3.3 Absolute gauging is a complex process, and usually involves the use of specialised computer software tools to analyse the large amounts of rolling stock and infrastructure data and to perform a large number of numerical calculations.

G 2.3.4 The other gauging processes described in this section, when they are appropriate, are generally simpler to undertake than absolute gauging but may be less optimal in use of space.

G 2.3.5 Rolling stock is described by a series of vehicle profiles specific to each vehicle type, which may vary along the length of the vehicle.

G 2.3.6 There are typically many thousands of infrastructure profiles for each route; each item of infrastructure being measured either by hand or by automated measuring systems.

G 2.3.7 The local conditions (for example track curvature, installed cant, line speed, track fixity) are used to determine the swept envelope of rolling stock and the minimum clearance at every location, and this information is used to assess the gauging compatibility of the rolling stock and infrastructure.

G 2.3.8 Where an item of infrastructure has significant length (for example station platforms), a number of infrastructure profiles will be generated to describe it. The infrastructure profiles are normally held in a database along with a record of the local conditions at each location.

G 2.3.9 Corresponding information about the movement characteristics of the vehicle under all likely operating conditions is used, so that the swept envelope of the vehicle can be calculated for any given set of local conditions. This information about rolling stock is also normally held in a database.

G 2.3.10 The basic elements to undertake the absolute gauging process include:

a) A continuously maintained database of infrastructure profiles and associated track parameters
b) Vehicle gauging data and associated parameters applicable to rolling stock operating or planned to operate on the route
c) Gauging rules applicable to both rolling stock and infrastructure.

G 2.3.11 As the absolute gauging process makes a unique comparison of the swept envelope of the rolling stock and the infrastructure at every location on a route, it enables the rolling stock to be built to the maximum possible dimensions which the infrastructure along the route can accommodate. However, many calculations are undertaken, and regular measurements of the infrastructure are used to maintain the infrastructure database.

G 2.3.12 More information on clearance is given in Appendix *A*.

2.4 Comparative gauging

2.4.1 When comparative gauging is to be used, the swept envelopes shall have been produced using the process set out in GMRT2173 or, for vehicles already in service, GMRT2149 Issue 2 or Issue 3.

2.4.2 Vehicles chosen as comparators shall have been demonstrated to have gauging compatibility with the affected route(s) by evidence of either:

a) Significant and regular traffic on the route(s) being considered
b) Gauging compatibility in accordance with this document or its predecessor GERT8273.

2.4.3 An assessment shall be carried out to determine the suitability of the comparator vehicle(s) taking into account the following factors as a minimum:

a) Loading characteristics
b) Service pattern
c) Comparable failure conditions
d) Relevant incident history.

2.4.4 The swept envelope(s) of the candidate vehicle shall be compared with those of the comparator vehicle(s) for conditions of vehicle loading, track curvature, speed and cant deficiency or excess representing the full range of operating conditions for the route.

2.4.5 When all swept envelopes of the candidate vehicle are within the swept envelopes of the selected comparator vehicle, or vehicles, then gauging compatibility shall be deemed to be achieved.

2.4.6 Any reduced or special reduced clearances for the comparator vehicle(s) shall also be allocated to the candidate vehicle, together with confirmation from the infrastructure manager that the associated measures remain in place.

Rationale

G 2.4.7 The comparative gauging process provides for the demonstration of gauging compatibility by comparing the 'candidate' vehicle with a 'comparator' vehicle or vehicles demonstrated to have gauging compatibility with a route(s).

G 2.4.8 An assessment is carried out to determine the suitability of the comparison and identify changes in the risk profile and any necessary mitigations.

Guidance

G 2.4.9 The choice of suitable comparator vehicle(s) is a key part of the use of comparative gauging.

G 2.4.10 Comparative gauging for a passenger vehicle is generally undertaken with other passenger vehicle(s) as the comparator(s).

G 2.4.11 It is unlikely that a passenger vehicle can be comparatively gauged by comparing with a freight vehicle or a freight vehicle with a passenger vehicle. This is because:

a) Passenger vehicle and freight vehicle suspension arrangements and failure modes are significantly different
b) The nature of freight loading and passenger loading has different management arrangements.

G 2.4.12 Locomotives may be comparatively gauged by comparing with other locomotives.

G 2.4.13 Given the range of On-Track Machines and their potential network-wide but less frequent in-traffic running, comparative gauging assessments for such candidate and comparator vehicles are undertaken on a case-by-case approach.

G 2.4.14 In order to demonstrate that the introduction of the candidate vehicle would not import risk above that of the operation of the comparator, the assessment of suitability of the comparator(s) would usually consider factors including:

a) Frequencies of the proposed candidate and proposed comparator(s) operation
b) History of operation of the proposed comparator
c) Clearances to the proposed comparator (if known) and the arrangements for the management of clearances
d) The speed at which the proposed comparator and candidate vehicles travel past structures and vehicles on adjacent tracks
e) Any significant difference in expected behaviour in cross-winds
f) Effects of failure modes on swept envelopes.

G 2.4.15 When selecting a comparator, industry practice is that the determination of significant and regular traffic takes into account a number of factors, including:

a) The lines travelled on a route, including junctions
b) The platforms called at, for example a terminal station might have many platforms
c) The loading pattern, including:
   i) Comparable loading conditions and loading calculations

ii) Loading is the same for each line, for example a vehicle might travel with tare loading only on part of the route for maintenance.

d) The number of times rolling stock has travelled over a route and how recently

e) Experience of travelling over a range of track qualities, seasonal movements, monitoring and maintenance cycles.

2.5 Hybrid gauging

2.5.1 When hybrid gauging is used, gauging compatibility shall be achieved through any combination of using standard vehicle gauges, absolute gauging or comparative gauging.

2.5.2 When assessing a clearance using hybrid gauging, all of the rules associated with each process (standard vehicle gauges, absolute gauging or comparative gauging) shall be applied to the respective part of the vehicle or infrastructure location.

Rationale

G 2.5.3 When gauging compatibility is not demonstrated through any of the three methods individually then hybrid gauging may enable compatibility to be demonstrated.

Guidance

G 2.5.4 Guidance on the different gauging processes is given in the relevant clauses.

G 2.5.5 Possible examples of the use of hybrid gauging include:

a) Use of a standard vehicle gauge for the lower sector with comparative gauging for the upper sector

b) Use of comparative gauging with absolute gauging for any excedences of the comparator gauge

c) Vehicle built to a standard vehicle gauge with use of absolute gauging for any exception structures.

Part 3 Platform Stepping Distances

3.1 General

3.1.1 Assessment of platform stepping distances shall be carried out when any of the following changes to infrastructure are proposed:

a) A change is made to the platform edge arrangements including:
   i) Building a new platform or extending an existing platform
   ii) Altering the height or offset of platform copers.
b) For track adjacent to platforms, a design change is made to the track position relative to the platform edge.

3.1.2 Assessment of platform stepping distances shall be carried out when either of the following changes to rolling stock are proposed:

a) Different passenger rolling stock for revenue service is to be introduced onto a route
b) A design change is made to the passenger rolling stock that affects stepping distances.

3.1.3 Assessment of platform stepping distances shall be carried out using the following stages:

a) Determine and gather relevant platform edge, track characteristics and footstep arrangement data (see *3.2*)
b) Record stepping distances (see *3.3*)
c) Assess risks and mitigations (see *3.4*).

Rationale

G 3.1.4 The stepping distance between the rolling stock footstep and the station platform is a key interface for the passenger. Assessing the magnitude of this stepping distance, based on accurate information, enables the resulting risk to be understood and managed. Changes to rolling stock or infrastructure (platforms or track) may affect the stepping distance.

Guidance

G 3.1.5 RIS-8270-RST 'Route Level Assessment of Technical Compatibility between Vehicles and Infrastructure' sets out requirements and responsibilities for the assessment of compatibility, the wider regulatory context for this assessment and the involvement of affected parties in the assessment.

G 3.1.6 Ordinary maintenance activity does not trigger a new assessment of stepping distances.

G 3.1.7 If assessing gauging compatibility using comparative gauging, then stepping distances are still assessed, as it is possible that there could be differences in the passenger footstep arrangements.

G 3.1.8 There are two cases typically considered for the calculation of platform stepping distances:

a) Using the target platform position for demonstration of rolling stock compliance with GMRT2173
b) Using surveyed dimensions for platforms on routes where the vehicle requires permission to operate in passenger service to assess and manage risk.

G 3.1.9 When calculating stepping distance to the target platform position (case (a)), the platform nominal dimensions are used without consideration of the platform height build tolerance; therefore the actual stepping distance may exceed the specified limit.

G 3.1.10 When calculating stepping distance to the surveyed platform dimensions (case (b)), the measured dimensions are used without consideration of survey tolerances.

G 3.1.11 Stepping distances are not considered for platform ramps.

G 3.1.12 Where gap fillers are used on either rolling stock or platform to reduce gaps, it is important to use the appropriate datum in assessing stepping distance. The position of this datum depends on whether the gap filler is fixed or deployable and whether it is, or is not, intended to be used as a step. More information on this is given in Appendix *B*.

G 3.1.13 For accessibility and to reduce the potential consequences of an accident at the platform / train interface, it is important that excessive platform stepping distances are avoided so far as reasonably practicable, and if not reasonably practicable, that appropriate mitigations are put in place.

G 3.1.14 The platform stepping distance has a vertical component (step) and a horizontal component (gap). It is likely that a combination of factors will influence the suitability of the stepping distance for a range of passengers including:

a) Passenger accessibility capabilities
b) Whether they are carrying, for example luggage, baby buggies or equipment
c) Time allowed for boarding and alighting, for example at terminal stations
d) Footfall and passenger flows
e) Lighting and underfoot conditions.

G 3.1.15 In many cases, a large gap can present more of a hazard than a large step, as falling down the gap is likely to have more severe consequences than falling over a step.

G 3.1.16 The Persons with Reduced Mobility National Technical Specification Notice (PRM NTSN) sets out stepping distances where all passengers can board without assistance (designated as universal self-boarding). For a mixed traffic railway, these distances are unlikely to be achieved without deployable footsteps.

G 3.1.17 A wide variety of step / gap distances on a given train service might be a cause of confusion and present a hazard to passengers.

G 3.1.18 To avoid compromising the effect of measures set out in *G 3.4.16*, it is important that:

a) Mitigation measures are reviewed when relevant alterations are made, and announcements and signage modified appropriately
b) Mitigation measures are targeted so that, for example, signage and announcements are not used at locations with smaller steps / gaps.

G 3.1.19 Early consultation between the proposer of the change and affected parties could yield a range of feasible solutions to reduce stepping distances. Industry practice has been to adopt some of the following approaches in addition to the measures set out in *G 3.4.16*.

a) From a passenger rolling stock perspective:

   i) If cascading rolling stock - deploy rolling stock that provides stepping distances no greater than the existing rolling stock
   ii) Modify footstep on the rolling stock.

b) From an infrastructure perspective:

   i) Only use the affected platform if necessary, for example by using an alternative platform that provides less of a stepping distance
   ii) If the platform is significantly lower than nominal 915 mm high - provide a short section of nominal 915 mm high platform, see RIS-7016-INS
   iii) Reconstruct the platform (if practicable)
   iv) Provide a portable step or ramp on the platform.

3.2 Obtain data on platform, track and footsteps

3.2.1 To enable the horizontal gap and vertical step between the train footstep and the platform to be assessed, data shall be obtained using one of the following methods:

a) Direct measurement of the horizontal and vertical distances from the train footstep to the platform with the train stationary in the normal stopping position
b) Use of computer analysis to calculate the horizontal and vertical distances between train footstep and platform from up-to-date data on train footstep, platform position and track layout.

Rationale

G 3.2.2 The vertical step and horizontal gap between the train footstep and the platform depend on the detailed arrangement of the train doorways / footsteps, the platform position and the track position and layout, including any curvature and cant. Data is needed for the evaluation.

Guidance

G 3.2.3 The vertical step and horizontal gap will vary depending on:

a) The rolling stock design, door locations and footstep design
b) The train stopping position on the platform
c) The platform position relative to the track (height and offset)
d) The track position and layout including curvature and cant.

G 3.2.4 The step and gap will be different for each train and for each platform.

G 3.2.5 Normal practice is to use all three dimensions:

a) Vertical step
b) Horizontal gap
c) Diagonal distance.

G 3.2.6 A typical method for direct measurement of the footstep to platform distances is use of a 'triangle' measuring gauge. A number of these exist; some are marked with dimensions whilst others only provide an indication of low / medium / high distances. Actual dimensions allow a better understanding of the risk and any relevant mitigations.

G 3.2.7 Data on platform positions relative to the track and the related track layout is available in the National Gauging Database.

G 3.2.8 Where the platform and vehicle data exist in a suitable form, gauging software can be used to provide information on the range of step-gap dimensions. However, these may not give the same values as a simple measurement, because of the way in which vehicle suspension movement is or is not included.

G 3.2.9 Computer assessments can be particularly useful for comparing situations before and after a change, as the assumptions can be kept the same. A change may be because of platform or track modifications, or the introduction of new or different rolling stock.

G 3.2.10 RSSB Research Project T1037 'Investigation of passenger vehicle footstep positions to reduce stepping distances and gauging constraints' investigated the range of variation or scatter in stepping distance which can occur from calculations, or measurements when realistic variations of conditions are considered. Even for a straight platform with slab track the report suggests that the variation can be ± 25 mm laterally and ± 40 mm vertically. For ballasted track on a straight this could be ± 30 mm laterally and ± 70 mm vertically, so the variation can be large.

G 3.2.11 One of the biggest causes of variation in the step / gap dimensions occurs where the platform edge is variable along the platform length. This may be the case at older platforms, but can be an issue for newer platforms too, particularly if the copers are set out to an actual track alignment rather than to a design alignment.

G 3.2.12 GIRT7020 and RIS-7016-INS provide guidance on setting out of platform copers.

G 3.2.13 Where the data has been checked and the vehicle behaviour is understood, then good agreement (sometimes within ± 10mm), can be achieved between measurements and computer assessment.

G 3.2.14 Old data or inaccurate measurements are not suitable for use when assessing stepping distances and the most accurate available data will give the most robust assessment.

3.3 Record stepping distances

3.3.1 The vertical step, horizontal gap and diagonal distance from each train footstep to each platform shall be recorded based on the data collected as set out in *3.2*.

Rationale

G 3.3.2 The vertical step, horizontal gap and diagonal distance all affect the risk at the platform train interface. These dimensions vary at different locations, and so all locations have to be assessed individually in order for the risk to be understood and managed.

Guidance

G 3.3.3 These measurements will vary along the platform, and so more than one value is generally recorded. It can also be useful to identify locations with higher values to prioritise mitigations.

G 3.3.4 When stepping from / onto a platform, the orientation of a passenger will generally be aligned to the global vertical axis (irrespective of any installed cant or roll of the vehicle body). Therefore the horizontal gap and vertical step are calculated referenced to a global (gravitational) axis system, because these are considered to be the true stepping distances perceived by the passenger. Distances are not measured in the plane of the rails or the plane of the vehicle floor.

G 3.3.5 For situations where the train footstep overhangs the platform the vertical step is relevant, but the other dimensions are not.

G 3.3.6 For calculating the stepping distance the vehicle is considered to be in its static state, in the loading condition used to define the reference ride height (usually tare inflated with new wheels). The suspension is assumed to be infinitely rigid and therefore no suspension deflections are considered when calculating stepping distances on canted track. The effect of vertical vehicle movements, for example from air spring deflation drop, worn wheels or creep, is not included. The vehicle’s nominal dimensions are considered excluding effects such as build tolerances, body sag and height setting tolerances.

G 3.3.7 Horizontal curve overthrows are accounted for in the calculation; for a bogie vehicle the extra overthrow from the bogie wheelbase is included. Vertical curve overthrows are not considered. The stepping distances are calculated from the centre of the treadplate / passenger footstep.

G 3.3.8 The wheels are taken as having new wheel profiles, with new wheel diameters. No flange-to-rail lateral gap is considered in the calculation.

G 3.3.9 Track positional tolerances are typically not considered.

G 3.3.10 Where the stepping distance is calculated to a curved-nose coping stone, the stepping point is taken as the intersection point of lines extending laterally along the platform top and vertically upwards from the coper nose.

3.4 Assessment of risks and mitigations

3.4.1 To determine the risk to passengers, and any mitigations that are required to demonstrate compatibility,assessment of platform stepping distances shall consider the range of horizontal gap, vertical step and diagonal distance from the train footsteps to the platform at each location where the train is intended to call.

Rationale

G 3.4.2 Station platforms and train footsteps vary across the network giving rise to a wide range of step and gap dimensions which affect the resulting risk and mitigations.

Guidance

G 3.4.3 Parties involved in assessing the risk of stepping distances might include the infrastructure manager, station facility lease holder and any railway undertakings who use the platform.

G 3.4.4 Stepping distances are not normally assessed from doorways not used by passengers.

G 3.4.5 There is no definition of a good step or gap. This will vary for different passenger groups depending on many factors, such as, but not limited to, familiarity with the journey, adults, children, physical fitness, eyesight, luggage, buggies, distraction.

G 3.4.6 Stepping distances on curved platforms vary depending on the location of the train doors and whether the platform is on the outside or inside of the curve. Horizontal stepping distances are generally particularly large on the outside of a curve for doors towards the centre of the vehicle and on the inside of a curve for doors at the vehicle ends. Vertical stepping distances can also increase for platforms on the outside of a curve where the track cant causes the train to lean away from the platform.

G 3.4.7 There is no agreed limit value for the stepping distance(s) from footstep to actual platform. Several attempts have been made to undertake research to determine a suitable limit value for different passenger groups, but this work has not been successful. RSSB Research Project T1080 is one recent example.

G 3.4.8 The key principle is to measure the actual situation and assess the stepping distance in context.

G 3.4.9 A number of different approaches are used to assess the stepping distance. Many operators use a form of the measuring triangle gauge. This method may assume that the vertical step and the horizontal gap are of equal importance, but this is not always the case.

G 3.4.10 There is evidence to show, though firm data is lacking, that a large horizontal gap may pose a greater safety issue than a large vertical step. The reason is that a large horizontal gap presents a wider ‘gap’ for a passenger, or their belongings, to fall through. In contrast, a large vertical step appears to have more of an impact on performance, as it means passengers require more time to board and alight. This relationship between vertical stepping distance and platform dwell times was investigated in RSSB Research Project T1166 ‘Minimising the impact of ‘high & tight’ platforms on the overall PTI step / gap dimensions’.

G 3.4.11 Some of the measuring triangles do not provide absolute values and, as noted above, these measurements are likely to vary along the platform and between measurements.

G 3.4.12 It is important to consider all different possible train configurations, including orientation of the unit, as the door location along the platform may vary considerably. Experience also shows that doors toward the centre of a trainset are less likely to have a large horizontal gap as platform curvature is often worse towards platform ends.

G 3.4.13 Any measurement or computer assessment only gives an indication of the stepping distance, and these are not appropriate to use as precise values or to compare with go or no-go values. Using either the current (GMRT2173) or previous (GMRT2149) dimensions as ‘limits’ is not appropriate, though these or other values can be useful targets.

G 3.4.14 The level of crowding on the platform, the location of entrances, exits, waiting areas, retail outlets etc relative to train doors will also affect the risk associated with a given step or gap.

G 3.4.15 On Greater Anglia, where new trains with lower floors and sliding steps are now in service, they have developed an additional gauge for assessing whether the remaining gap and step are consistent with the PRM NTSN dimensions for ‘unassisted boarding’.

G 3.4.16 For individual platforms, where platform stepping distances have been significantly greater than at other platforms called at by a particular train service, it has been industry practice to implement some of the following measures:

a) 'Mind the gap' markings on platforms
b) On train warning announcements
c) On platform warning announcements
d) Staff attendance.

Appendices

Appendix A Guidance on Clearance

A.1 The purpose of clearance

Guidance

G A.1.1 The purpose of clearance is to ensure that trains are able to safely pass infrastructure and other trains. Clearance is provided between trains and the infrastructure for a number of reasons, including:

a) When using dynamic computer simulations, maximum vehicle movements are often specified as the mean + 2.12 standard deviations (which was deemed to correspond approximately to the root mean square value). Since peak movements caused by discrete track features can lead to movements beyond this value, clearance is used to accommodate the additional movement
b) Uncertainty of tolerances and allowances is another area to be considered. Some values are approximations or assumptions, particularly those associated with the movement of track, although routine aggregation of tolerances and allowances generally accommodates isolated 'outliers'
c) Unknowns in the gauging system – although understanding of the components of gauging is increasing, and in particular the characterisation of components is now quite advanced, there are, nevertheless, minor components or inaccuracies that are routinely ignored. As calculation techniques become more sophisticated, allowances for such parameters in clearances are likely to become smaller.

G A.1.2 Clearances are calculated under conditions leading to the generation of the minimum clearance. Examples of typical conditions would be considering the maximum movement of the vehicle (or gauge) towards the outside of curved track and towards the inside of curved track as a result of installed cant and dynamic movements.

A.2 The nature of clearance

Guidance

G A.2.1 The gauging process is statistical in its nature. As such, calculated clearances exist to a degree of certainty which is seldom calculated. However, there is no such thing as an exact clearance.

G A.2.2 Limits of clearance have been established to regulate infrastructure monitoring, and relate to the level of certainty that has evolved through the application of allowances and tolerances. A margin of safety related to the local risk regime is typically reflected in the clearances being managed at a particular location.

G A.2.3 Uncertainty techniques have been developed which may enable a more detailed risk assessment of clearances to be made and, as such, generate usable space that conventional techniques might not allow. However, the application of such techniques needs to be in line with other areas of risk in consultation with the infrastructure manager.

A.3 Clearance regimes

Guidance

G A.3.1 Normal clearance provides for 100 mm of space around the dynamic swept envelope of a vehicle in the upper sector and 50 mm of space around the dynamic swept envelope in the lower sector, reduced to 40 mm in platform areas.

G A.3.2 The lower sector extends to 1100 mm above rail level (ARL), and is designed to accommodate infrastructure items, such as platforms (where it is important to minimise stepping distances) and bridge girders. Platforms with height in excess of 1100 mm ARL are therefore technically in the upper sector, but would normally be considered to be lower sector items.

G A.3.3 Where normal clearances cannot be achieved, it is useful to identify the associated region of the vehicle affected, for example the cant rail, waistline or solebar or other body mounted equipment. Knowing the region of the vehicle helps to understand the potential issues involved and the appropriateness of the management regime, particularly when comparing to other existing vehicles operating on the route.

G A.3.4 Reduced clearance is an option where normal clearances are not the most appropriate solution for that site. However, reduced clearances require an enhanced inspection regime to ensure (particularly) that track movements remain within acceptable bounds and, as such, represent a more expensive option to the infrastructure manager. Further, locations with reduced clearances use a more detailed recording and management regime.

G A.3.5 Special reduced clearance is an option where a reduced clearance is not the most appropriate solution for the site. However, special reduced clearances are associated with an even more enhanced inspection regime and, as such, represent a very expensive option to the infrastructure manager, as they require an even more detailed recording and management regime. Effectively, special reduced clearances allow very little margin for error and are thus extremely well analysed.

G A.3.6 It is normal practice to allow reduced clearances in the lower sector to vehicles running with suspension failure (such as in the case of air spring deflation). This is based upon the low frequency of occurrence and operational controls and, accordingly, the reduced clearance having minimal effect on the risk.

G A.3.7 GIRT7073 sets out a requirement for additional clearances at window level. This requirement is maintained to recognise that there is still a significant number of different types of rolling stock operating with opening windows allowing passengers to lean out, but also opening windows in cabs are provided for train crew to look out of the train. Rolling stock with opening windows allowing passengers to lean out include Mk 3 coaches and heritage coaches, typically Mk 2 and Mk 1 coaches. Many cabs have opening windows for train crew use.

A.4 Equipment that needs to be in close proximity or to be in contact

A.4.1 General

Guidance

G A.4.1.1 GIRT7073 sets out requirements for positioning infrastructure and maintaining the position of track relative to infrastructure in order to achieve gauge compatibility with rolling stock. Certain items of infrastructure equipment need to be in close proximity to rolling stock for the system to operate. The locations for the different elements of such equipment are given in GIRT7073.

G A.4.1.2 GERT8073 sets out requirements for positioning of vehicle components that need to be in close proximity to or be in contact with infrastructure.

A.4.2 Types of equipment that need to be in close proximity or contact

Guidance

G A.4.2.1 GIRT7073 provides information on types of equipment that need to be in close proximity or in contact during operation .

A.4.3 Equipment requiring continuous contact

Guidance

G A.4.3.1 In cases where continuous contact is required, for example pantographs and overhead line equipment, the infrastructure guides the parts of the rolling stock contacting it in one plane (vertical in this case), but not in others. In cases such as shoegear and conductor rails, the collector shoe is able to drop off the conductor rail at certain locations and remains within a defined swept envelope under these conditions.

G A.4.3.2 Gauging assessments recognise the existence of current collection systems. GIRT7073 sets out positional requirements for current collection systems in the lower sector. The infrastructure manager is responsible for maintaining the position of the particular equipment within defined tolerances, which usually take the form of a height and offset from track centreline. Where different systems need to be in a similar position at the same location, for example guard rails and conductor rails, the infrastructure manager takes into account the requirements for each system and gauging considerations to decide the arrangement.

A.4.4 Installation arrangements

Guidance

G A.4.4.1 There are essentially two types of installation arrangements:

a) Track mounted equipment
b) Non-track mounted equipment.

G A.4.4.2 Track mounted equipment will move with the track (as it moves under traffic or is maintained), and therefore some track tolerances are not taken into account.

G A.4.4.3 Non-track mounted equipment takes into account all relevant allowances.

A.4.5 Control, command and signalling equipment

Guidance

G A.4.5.1 Control, command and signalling equipment includes a range of assets, such as contact ramps, magnets and detection devices that interact with systems mounted on vehicles.

G A.4.5.2 The positioning of such equipment respects the functionality of the system, provides for other systems to operate and respects gauge requirements. The gauging considerations for the positioning of this equipment are, to some extent, managed by the following typical installation approaches:

a) Generally, these systems are installed in the track centreline slightly above the running surface
b) By positioning the vehicle mounted receivers close to the axle centrelines, their geometrical overthrow values become very small, or even negligible.

A.4.6 Check rails

Guidance

G A.4.6.1 Like the contact ramps, check rails are designed for contact; in this case with the flange back of the wheels.

G A.4.6.2 In the vertical direction, the check rail generally does not project outside the gauge used. In specific locations raised check rails may require additional analysis.

A.4.7 Conductor rail

Guidance

G A.4.7.1 The conductor rail system is, in most cases, track mounted and requires contact from the shoegear mounted on the vehicle. The position of the conductor rail system additionally takes account of the electrical insulating requirements between the live parts and any other structure, see GLRT1212.

Appendix B Guidance on platform gap fillers

B.1 Datum positions

Guidance

G B.1.1 On the GB mainline mixed traffic network, there is always a horizontal gap and / or a vertical step between the platform and the train footstep. This gap and step are required to achieve appropriate gauge clearance for the range of vehicles passing the platform, but can present challenges for passengers boarding or alighting from trains.

G B.1.2 Various forms of gap fillers exist, either passive or active, which may assist in reducing the horizontal gap. These gap fillers have a range of different characteristics as set out below.

G B.1.3 Gap fillers may be installed either on the platform or on the train and may be:

a) Either fixed / passive (permanently part of the platform / train) or moving / deployable
b) Either rigid or deformable
c) Designed to be either stepped on or not stepped on
d) Either level with the platform/train vestibule or at a different height
e) Either designed to be contacted by the other part of the system (platform contact for train-mounted systems or train contact for platform-mounted systems) during normal operation or designed not to be contacted.

G B.1.4 RSSB Research Project T1054, evaluated platform gap fillers to reduce the risk at the platform / train interface and is a useful reference document.

G B.1.5 Existing infrastructure-mounted examples include Heathrow Express fixed gap fillers fixed to the platform edge which are:

a) Fixed
b) Deformable
c) Not intended to be stepped on
d) Slightly lower than both the platform and the train footstep
e) Not designed to contact the vehicle.

G B.1.6 Existing vehicle mounted deployable, rigid steps intended to be stepped on are used on Classes 373, 374, 390, and 755. None of these systems is designed to contact the platform.

G B.1.7 Platform edge datum positions and vehicle footstep datum positions are used in the assessment of:

a) Gauge clearance between train and infrastructure (including the platform)
b) Stepping distance between train footstep and platform.

G B.1.8 Where gap fillers are considered for use, it is important that assessments of both gauge clearances and stepping distances use agreed datum positions.

G B.1.9 It is important to recognise that the datum position used for the assessment of gauge clearance may not be the same as the datum position used for the assessment of stepping distance.

G B.1.10 The decision matrix and flowcharts below provide a consistent set of decision criteria for determining the relevant datum positions.

G B.1.11 The following design considerations are relevant, and guidance is given on issues to consider for the various options:

a) Is the gap filler mounted on the vehicle or on the infrastructure?
b) Is the gap filler fixed (passive) or moveable (active)?
   i) If active, then failure modes and controls are considered.
c) Is the gap filler rigid or deformable?
   i) It is assumed that a deformable gap filler will not be intended as a step.
d) Is the gap filler intended to be stepped on?
   i) If so, then a tolerance of ± 10 mm is suggested for it to be level with the footstep / platform to which it is attached.
e) Is the gap filler intended to be contacted in normal operation?
   i) If on a platform, then contacted by the vehicle or vehicle footstep
   ii) If on a vehicle, then in contact with the platform edge.
f) What failure modes are considered?
   i) This may include failure modes of the deployable gap filler
   ii) This may include other failure modes, for example, vehicle suspension conditions.
g) Are there any specific inspection/maintenance requirements for the other party to undertake?
   i) If so, has the other party accepted the implications?

G B.1.12 Figure *1*, Figure *2*, Figure *3*, and Figure *4* below describe a decision-making process to determine datum positions for gauge clearance and stepping distance, using the points listed above. A wide range of other issues are also considered for any potential gap filler installation.

G B.1.13 To use the table in Figure *1* for a given design of installation, select the appropriate column from the upper part of this table, the lower parts then indicate the datum positions.

Platform/Vehicle?	Platform mounted											Vehicle mounted										
Fixed/deployed?	Fixed						Deployable					Fixed						Deployable				
Rigid/Deformable?	Rigid				Deformable		Rigid					Rigid				Deformable		Rigid				
Intended as step?	Step		No step		No step		Step		No step			Step		No step		No step		Step		No step		
Designed to contact?	Y	N	Y	N	Y	N	Y	N	Y	N		Y	N	Y	N	Y	N	Y	N	Y	N	
Gauging datum:																						
Coper / veh edge							Y	Y	Y	Y								Y	Y	Y	Y	
Gap filler edge	Y	Y	Y	Y	Y	Y						Y	Y	Y	Y	Y	Y					
Stepping datum:																						
Coper / veh edge			Y	Y	Y	Y			Y	Y				Y	Y	Y	Y			Y	Y	
Gap filler edge	Y	Y					Y	Y				Y	Y					Y	Y			

Figure 1: Decision process for Gap Fillers – datum position for gauging, datum position for stepping

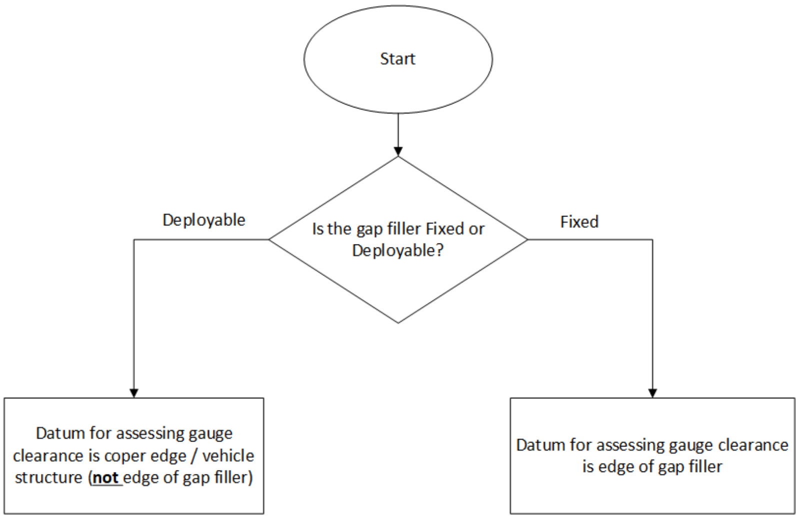

Figure 2: Flowchart for gauge clearance considerations

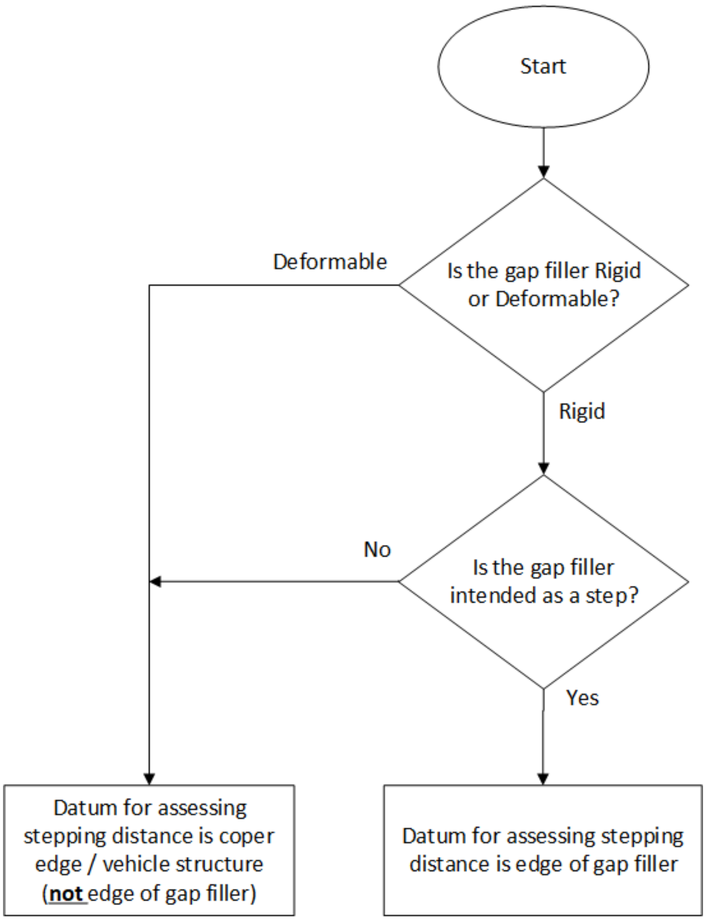

Figure 3: Flowchart for assessing stepping distance

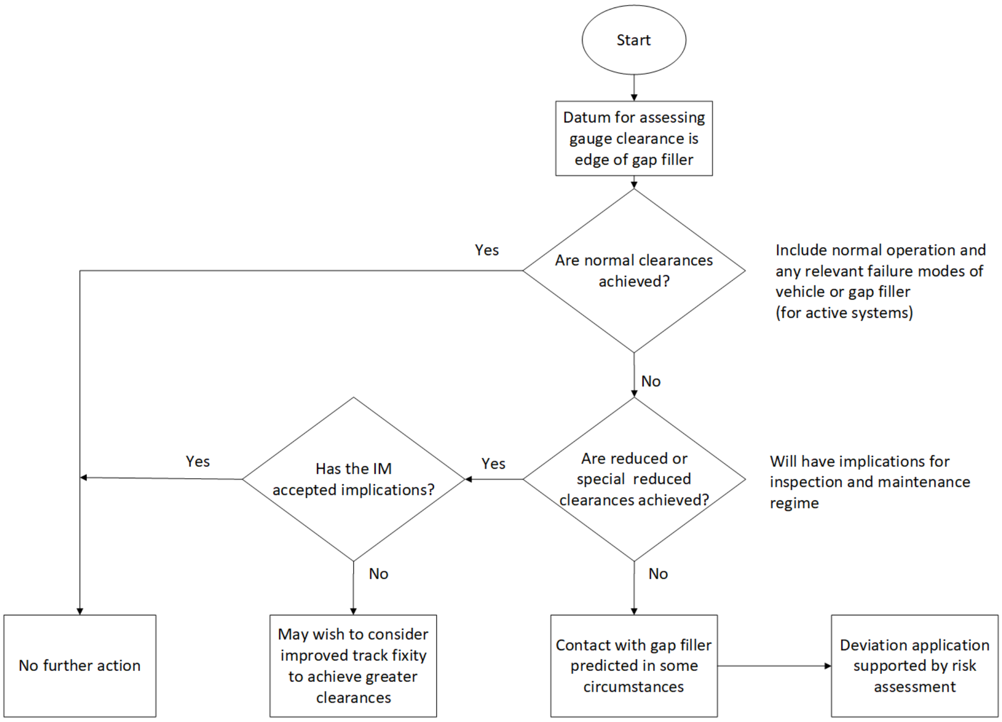

Figure 4: Flowchart for gauging considerations

Definitions

absolute gauging	Absolute gauging of a vehicle is a full assessment of clearances on a section of track between the vehicle and fixed infrastructure, and between the vehicle and vehicles on adjacent tracks.
clearance	The minimum calculated distance between the swept envelope of a vehicle and fixed infrastructure or between the swept envelopes of two vehicles on adjacent tracks.
comparative gauging	The process of comparing the swept envelopes of a vehicle new to a route, with the swept envelopes of a vehicle or vehicles which have been demonstrated to be able to use the proposed route.
gauge	Used to refer to a vehicle gauge or structure gauge where the context makes it clear which is meant. See ‘vehicle gauge’.
gauging	The process by which swept envelopes of a vehicle or a standard vehicle gauge are used to determine clearances on a section of track between the vehicle and fixed infrastructure and between the vehicle and vehicles on adjacent tracks.
gauging compatibility	Compatibility of the swept envelopes of vehicles through the space limitations of track intervals and relative positions of adjacent structures. Also includes the compatibility of passenger footstep position with platform edge position and the consideration of the interface between power and signalling systems.
hybrid gauging	A combination of standard vehicle gauges, comparative or absolute gauging.
infrastructure	For the purpose of this document, track and structures in combination. Compare with ‘structure’.
lower sector	The area up to and including 1100 mm above the plane of the rails. See also ‘upper sector’.
normal clearance	clearance between a structure and a vehicle or between passing vehicles which does not require specific controls on the position of the track, but which does require the relative locations of structures and adjacent tracks to be monitored and maintained.
overthrow	A geometric projection of a vehicle when on curved track.
plane of the rails	An imaginary surface coplanar with the top of both rails of a track.
reduced clearance	A clearance, less than a normal clearance, which requires special measures to maintain tracks relative to adjacent tracks and structures.
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.

section of track	Track bounded by identified limits such as junctions, terminals or points at which there is a significant change in traffic flow or permissible speed.
special reduced clearance	A clearance, less than a reduced clearance, which requires a specific risk assessment to be undertaken and the implementation of appropriate controls to demonstrate that risks have been reduced to as low as reasonably practicable (ALARP).
standard vehicle gauge	An outline drawing or specification of a notional vehicle, which prescribes maximum permissible vehicle and loading dimensions, certain suspension displacements, and certain curve overthrow limitations, for example, W6a gauge.
structure	An element of the infrastructure adjacent to, or crossing over, a railway track. So far as this document is concerned 'structures' include, but are not limited to the list below (compare with 'infrastructure'): (a) Train control and communications equipment, for example, signals. (b) Station platforms. (c) Overhead line equipment supporting structures at earth potential, but excluding insulators. (d) Civil engineering structures such as retaining walls, tunnels and bridges. (e) Other isolated structures. (f) Temporary works.
swept envelope	A cross-sectional profile, taken at right angles to the track, enclosing all dynamic movements, static deflections and overthrows of all points along the surface of the vehicle that can reasonably be expected to occur under the appropriate range of operating conditions as it sweeps past a theoretical track location. A family of swept envelopes is required to define a vehicle's behaviour on a route. The swept envelopes referred to within this document exclude the effects of track tolerance and rail sidewear previously included in kinematic envelopes developed under GMRT2149 or earlier documents. A process for defining a swept envelope can be found in GMRT2173.
upper sector	The area above 1100 mm above the plane of the rails. See also 'lower sector'.
vehicle gauge	The maximum envelope that a vehicle conforming to the gauge is permitted to occupy statically and dynamically, which prescribes maximum permissible vehicle and loading dimensions, certain suspension displacements, and certain curve overthrow limitations, for example, W6a gauge.

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

Railway Group Standards

GKRT0028	Infrastructure Based Train Detection Interface Requirements
GLRT1212	DC Conductor Rail Energy Subsystem and Interfaces to Rolling Stock Subsystem
GMRT2149	Requirements for Defining and Maintaining the Size of Railway Vehicles
GMRT2173	Requirements for the size of vehicles and position of equipment
GCRT5021	Track System Requirements
GIRT7020	GB Requirements for Platform Height, Platform Offset and Platform Width
GIRT7073	Requirements for the size and position of infrastructure
GERT8073	Requirements for the Application of Standard Vehicle Gauges

RSSB documents

RIS-2773-RST	Format for Vehicle Gauging Data
RIS-7016-INS	Interface between Station Platforms, Track, Trains and Buffer Stops
RIS-8270-RST	Route Level Assessment of Technical Compatibility between Vehicles and Infrastructure
T1037	Investigation of passenger vehicle footstep positions to reduce stepping distances and gauging constraints
T1054	Evaluating platform gap fillers to reduce risk at the platform/train interface
T1080	Step-gap influences on accidents at the platform train interface
T1166	Minimising the impact of 'high & tight' platforms on the overall PTI step / gap dimensions

Other references

PRM NTSN	Persons of Reduced Mobility National Technical Specification Notice