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Application of the WAG NTSN and NOI NTSN to the Design of Freight Wagons

This document provides guidance on the application of the Rolling Stock - Freight Wagon National Technical Specification Notice (WAG NTSN) and on the application of Rolling Stock - Noise National Technical Specification Notice (NOI NTSN) for the design of freight wagons for use on the GB mainline railway.

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Synopsis

This document provides guidance on the application of the Rolling Stock - Freight Wagon National Technical Specification Notice (WAG NTSN) and on the application of Rolling Stock - Noise National Technical Specification Notice (NOI NTSN) for the design of freight wagons for use on the GB mainline railway.

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Issue record

Issue	Date	Comments
One	December 2010	Original document. Supersedes GMGN2589 and parts of GMRT2101.
Two	September 2013	Replaces GMGN2688 issue one. Incorporates the output from a review of design guidance for wagons and how standard British practice meets the Wagon Technical Specification for Interoperability (WAG TSI). Inclusion of new guidance on the interpretation of the WAG TSI for wagons for use on the Great Britain (GB) mainline railway.
Three	June 2024	Replaces issue two. Reflects changes in legislation since the publication of issue two, including the implementation of NTSNs in GB instead of TSIs. Adds new guidance on the application of specific requirements of the NOI NTSN to the design of freight wagons. Document restructured.

This document has been extensively amended. Only revisions that have been deemed as significant have been indicated with a vertical black line.

Superseded documents

The following Railway Group documents are superseded, either in whole or in part as indicated:

Superseded documents	Sections superseded	Date when sections are superseded
GMGN2688 issue two, Guidance on Designing Rail Freight Wagons for use on the GB Mainline Railway	All	June 2024

Supply

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Part 1 Purpose and introduction

G1.1 Purpose

G1.1.1 This document gives guidance on the application of the Rolling Stock - Freight Wagons National Technical Specification Notice (WAG NTSN) and the Rolling Stock - Noise National Technical Specification Notice (NOI NTSN) for the design of rail freight wagons for use on the Great Britain (GB) mainline railway. This document does not set out requirements.

G1.2 Background

G1.2.1 This document gives guidance on interpreting the requirements of the WAG NTSN and of the NOI NTSN, which replaced the Rolling Stock - Freight Wagons Technical Specification for Interoperability (WAG TSI) and Rolling Stock - Noise Technical Specification for Interoperability (NOI TSI) respectively in the United Kingdom (UK) as of 1 January 2021.

G1.2.2 National Technical Specification Notices (NTSNs) are published by the Secretary of State pursuant to regulation 3B of the Railway (Interoperability) Regulations 2011 (RIR). These NTSNs replace and substantially reproduce the provisions of Technical Specifications for Interoperability (TSIs) except where there are GB-specific alternatives which are identified as specific cases in the relevant NTSNs.

Principles

G1.2.3 New freight wagons, or existing wagons which undergo upgrade or renewal, built for use on the GB mainline railway must comply with requirements set out in, or called up by, the WAG NTSN and the NOI NTSN in order to achieve authorisation by the Office of Rail and Road (ORR). The ORR fulfills the role of the safety authority as described in the NTSNs.

G1.2.4 This document provides guidance on interpretation and application of relevant requirements from the WAG and NOI NTSNs to facilitate the process of designing and building wagons for use on the GB mainline railway, for example in cases where the NTSN wording could be misinterpreted due to ambiguity, or where there are UK specific cases.

G1.2.5 Where appropriate, this document also provides guidance on historical design solutions that have been successfully used on the GB mainline railway.

G1.2.6 This document does not provide guidance on vehicles that are beyond the scope of the WAG NTSN. This is particularly the case for on-track plant and on-track machines.

G1.2.7 The guidance in this document is specific to the 'GB mainline railway' and might not be appropriate to other parts of the mainline railway in GB, for example High Speed 1 (HS1). If it is intended to use a wagon in GB on any railway besides the GB mainline railway then it will be important to consider the application of the NTSNs to that network, particularly in situations where there is a UK specific case.

G1.2.8 As the WAG NTSN is based on the WAG TSI the guidance provided in this document complements the *Guide for the application of the WAG TSI* produced by the European

Union Agency for Railways (ERA). This document does not replicate existing guidance in the *Guide for the application of the WAG TSI*. Attention has been drawn to some areas where the *Guide for the application of the WAG TSI* is particularly relevant to the GB mainline railway but other areas may also be useful. Where there is conflict or contradiction between this document and the *Guide for the application of the WAG TSI*, the guidance in this document takes precedence.

G1.2.9 Some of the EN and ISO standards referenced in the NTSN have been superseded. Where application of the standard is explicitly required in the NTSN then the referenced version is used; where the standard is provided for information then the latest version can be used.

G1.2.10 The guidance in this document is applicable to freight wagons that are to be operated domestically in GB. Requirements for freight wagons used on international services are set out in the Convention concerning International Carriage by Rail (COTIF). Requirements for freight wagons that are to be used within the European Union (EU) are set out in the WAG and NOI TSIs. There is no mutual recognition within the EU of authorisation of vehicles against the NTSNs, so wagons to be used within the EU are required to be authorised against the requirements of the TSIs. This document does not give guidance on COTIF or on the WAG or NOI TSIs, although in many cases the technical requirements are identical, except where UK specific cases exist or where changes have been made to the TSI following the publication of the respective NTSN.

Structure of the WAG NTSN

G1.2.11 The WAG NTSN consists of twelve articles and an annex. The twelve articles set out the relationship between the WAG NTSN and Railways (Interoperability) Regulations, the situations in which the WAG NTSN is to be complied with, some specific permissions and limitations for the issuing of certificates of verification against the requirements of the WAG NTSN and obligations of authorities. Technical requirements are contained in the annex. The annex is divided into seven chapters, the first three of which are informative and contain no mandatory requirements, and seven appendices.

G1.2.12 Chapter 1, Introduction, sets out the purpose of the WAG NTSN and its technical and geographical scope. Its geographical scope is the network of the whole GB rail system and therefore includes elements of the system that are beyond the scope of the GB mainline railway, for example HS1.

G1.2.13 Chapter 2, Scope and Definition of Subsystem, defines the rolling stock - freight wagon subsystem and its interfaces with other subsystems.

G1.2.14 Chapter 3, Essential Requirements, sets out how the WAG NTSN has covered the essential requirements defined in the Railways (Interoperability) Regulations 2011 for the rolling stock - freight wagon subsystem.

G1.2.15 Chapter 4, Characterisation of the Subsystem, sets out the main technical requirements for the rolling stock - freight wagon subsystem, and is dealt with in detail in this guidance note.

G1.2.16 Chapter 5, Interoperability Constituents, deals with interoperability constituents (ICs). These ICs are assessed and certificated separately, then incorporated into the wagon subsystem.

G1.2.17 Chapter 6, Conformity Assessment and UK Verification, deals with the assessment of conformity of ICs and the verification of the subsystem. The assessment modules to be used for assessment of conformity and UK verification are set out in the Modules for the procedures for assessment of conformity or suitability for use and UK verification NTSN (Modules NTSN).

G1.2.18 Chapter 7, Implementation, deals with implementation of the WAG NTSN and specific cases.

G1.2.19 Appendices. Appendix A and Appendix B are both unused. Appendix C contains a list of optional requirements. The remaining appendices contain further information to support the contents of chapters 1 to 7.

Structure of the NOI NTSN

G1.2.20 The structure of the NOI NTSN is similar to that of the WAG NTSN (see *page 8*) in that it consists of a number of articles followed by an annex which contains the technical requirements. The annex is divided into the same seven chapters as the WAG NTSN and five appendices.

G1.3 User's responsibilities

G1.3.1 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.

G1.3.2 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.

G1.3.3 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.

G1.3.4 Users and duty holders remain responsible at all times for assessing the suitability, adequacy and extent of any measures they choose to implement or adopt and RSSB does not accept, and expressly disclaims, all and any liability and responsibility except for any liability which cannot legally be limited.

G1.4 Structure of this document

G1.4.1 Guidance is provided as a series of sequentially numbered clauses. The title of each section of this document includes, if relevant, the number of the relevant section of the WAG or NOI NTSN.

G1.4.2 Relevant requirements from chapter 4 and relevant appendices of the WAG NTSN and NOI NTSN are reproduced with a grey background in this document. Not all NTSN clauses are reproduced in this document. Those clauses which are not referred to in this guidance note are still relevant, but are not reproduced here as no further guidance is applicable

G1.4.3 Sufficient NTSN text is reproduced to put the guidance in context but not all the NTSN text is included.

G1.4.4 Appropriate text applicable to conformity assessments (NTSN chapter 6) and specific cases (NTSN chapter 7) is also reproduced together with the relevant text on technical requirements from NTSN chapter 4 followed by relevant guidance. Guidance on selected text from the articles is provided where this is relevant to particular technical requirements or conformity assessments.

G1.4.5 Specific responsibilities and compliance requirements are laid down in the relevant RGS or NTSN.

G1.5 Approval and authorisation of this document

G1.5.1 The content of this document was endorsed by Freight Technical Committee on 29 February 2024.

G1.5.2 The content of this document was approved by Rolling Stock Standards Committee on 14 March 2024.

G1.5.3 This document was authorised by RSSB on 26 April 2024.

Part 2 Guidance on the requirements of the WAG NTSN

G2.1 Introduction to technical requirements clauses (4.1)

4 Characterisation of the subsystem **4.1 Introduction**
The GB rail system, to which the Railways (Interoperability) Regulations 2011 applies and of which freight wagons form a part, is an integrated system whose consistency shall be verified. This consistency shall be checked in particular with regard to the specifications of the rolling stock subsystem and the compatibility with the network (section 4.2), its interfaces in relation to the other subsystems of the GB rail system in which it is integrated (sections 4.2 and 4.3), as well as the initial operating and maintenance rules (sections 4.4 and 4.5). The technical file, as set out in regulation 17(2) of and Schedule 4 to the Railways (Interoperability) Regulations 2011, shall contain in particular design related values concerning the compatibility with the network.

Guidance

G 2.1.1 Chapter 4 of the WAG NTSN sets out the main technical requirements for freight wagons and interfaces to the other subsystems. The contents of chapter 4 are dealt with in detail where guidance is necessary in the following sections of this Part 2.

G2.2 Functional and technical specifications of the subsystem (4.2)

4.2 Functional and technical specifications of the subsystem

4.2.1 General

In light of the essential requirements in Chapter 3, the functional and technical specifications of the subsystem 'rolling stock — freight wagons' are grouped and sorted out in the following points of this Chapter:

- Structures and mechanical parts
- Gauging and vehicle track interaction
- Brake
- Environmental conditions
- System protection.

Except where this is strictly necessary for the interoperability of the GB rail system and to meet the relevant essential requirements, the functional and technical specifications of the freight wagon and its interfaces do not impose the use of any particular technical solutions.

When the functional and technical specifications that are necessary in order to achieve interoperability and to meet the essential requirements, have not been developed concerning a particular technical aspect, this aspect is identified as an open point in the relevant point. All open points are listed in Appendix A.

In Appendix C a set of conditions is specified. The conformity with this set of conditions is optional. If this option is selected, the conformity shall be assessed by an approved body within the UK verification procedure.

Provision may be made for UK specific cases for each NTSN. Such provisions are indicated in Chapter 7.

As far as possible the assessment procedure for the requirements in Section 4.2 is defined in Chapter 6. In these cases the text of section 4.2 makes a reference to the corresponding points and sub points clauses of Chapter 6. If for a particular basic parameter the separation of requirements and assessment procedures is not feasible, no reference is given.

Guidance

G 2.2.1 There is no requirement for compliance with Appendix C of the WAG NTSN, which sets out a number of optional requirements. These optional requirements are for wagons which are intended to be compatible with International Union of Railways (UIC) requirements for wagon operation across continental Europe, and are not necessary for wagons to be operated on the GB mainline railway. Application of the requirements contained in Appendix C of the WAG NTSN could result in a wagon that is sub-optimal for use on the GB mainline railway.

G 2.2.2 Compliance with the requirements of the WAG NTSN does not guarantee compatibility with any particular route of operation on the GB mainline railway. The process of assuring route compatibility is not part of the process of achieving vehicle

authorisation and is beyond the scope of the WAG NTSN and this guidance note. This guidance note does however, where appropriate, provide guidance on particular design characteristics that have historically been successful in supporting route compatibility of freight wagons. Further guidance on wagon design for route compatibility is given in Appendix *A*. RIS-8270-RST sets out requirements and guidance on the route compatibility process.

G2.3 End coupling (4.2.2.1.1)

4.2.2.1 Mechanical interface **4.2.2.1.1 End coupling**
The end coupling is the mechanical interface between units forming a train. The coupling system shall be designed in a way that no human presence between the units to be coupled/uncoupled shall be required whilst either one unit is moving. End couplings shall be resilient and capable of withstanding the forces in accordance with the defined design operating state of the unit.

Guidance

G 2.3.1 RIS-2780-RST sets out requirements for coupling systems for use on the GB mainline railway, including the design of end coupling to be used. The WAG NTSN does not specify the use of any particular end coupling design. Typically, end couplings used on wagons on the GB mainline railway consist of buffers and a screw coupling system, though some other designs are also employed, for example 'knuckle' couplers.

G 2.3.2 RSSB research project T1256 (2022) reviewed both the strength rating of drawgear in use on the GB mainline railway and the method of assessing loads on couplers when in service, with the aim of increasing the loads that can be hauled within a single train. The project also developed a tool that incorporated the revised coupler ratings to calculate the maximum loads that can be safely hauled on particular routes. Further information is given in the T1256 project report and in RSSB Technical Note TN103.

G 2.3.3 Appendix C of the WAG NTSN sets out requirements for a UIC manual coupling system by reference to BS EN 15566:2009+A1:2010 and BS EN 15551:2009+A1:2010, which define standard UIC dimensions for buffers and screw coupling systems. Compliance with BS EN 15566:2009+A1:2010 and BS EN 15551:2009+A1:2010 is not mandated by the WAG NTSN.

G 2.3.4 Both BS EN 15566:2009+A1:2010 and BS EN 15551:2009+A1:2010 have been superseded by newer versions, although these newer versions are not yet referenced in the WAG NTSN. The newer versions of BS EN 15566 and BS EN 15551 contain a national foreword that sets out how compliance with the dimensions described within those standards would result in outcomes which are not desirable for operation on the GB mainline railway.

G 2.3.5 Historically, a limit of 250 kN has been applied for the forces on buffers and drawgear when operating on the following track geometry on the GB mainline railway:

a) Straight track to 75 m radius curve, with no transition (see *G 2.3.7*);
b) Continuous curve of 75 m radius; and
c) Reverse ('S') curve of 120 m radius with 3 m intermediate straight (see *G 2.3.11*).

Note: BS EN 15566 and BS EN 15551 employ the same limit of 250 kN but do not consider curves with a radius below 150 m.

G 2.3.6 Assessment of the forces on the buffers and screw coupling system on the track geometry described in *G 2.3.5* is generally performed with the screw couplings adjusted such that the buffer faces are just in contact when the vehicle is on straight and level track, or with the Instanter coupling in the 'short' position.

G 2.3.7 Achievement of the 250 kN limit on the track geometry described in *G 2.3.5 a)* has historically resulted in the use on the GB mainline railway of couplings that differ from the UIC requirements set out in BS EN 15566 and BS EN 15551 in one or more of the following ways:

a) Convex radius of the buffer head spherical working surface of 1250 mm, instead of the UIC standard of 2750 mm;
b) Buffer length of 520 mm, instead of the UIC standard of 620 mm;
c) Buffer stroke of 114 mm, instead of the UIC standard of 105 mm.

Note: The differences in buffer length and buffer stroke have been used to meet certain infrastructure requirements for specific wagons (usually tank wagons)

G 2.3.8 A correspondingly shorter screw coupling system is used if the shorter, 520 mm length, buffers are used. This protects against damage to the components, for example due to the transmission of excessive compressive forces through the screw coupling system. However difficulties in obtaining screw coupling systems to the GB design have been reported.

G 2.3.9 Further guidance is given in Annex D of BS EN 16839:2022, including references for the design of coupling assembly components for use on the GB mainline railway.

G 2.3.10 BS EN 15551 categorises buffers according to their dynamic energy capacity. Traditionally the GB mainline railway has used category C buffers to provide greater protection for the wagon and load with the track geometry set out in *G 2.3.5*. In the event of a collision, category C buffers can absorb more energy than category A or B buffers, and therefore are generally used on wagons used for the carriage of dangerous goods.

G 2.3.11 75 mm has historically been considered the minimum amount of overlap between buffer heads to be maintained in order to prevent buffer locking on the track geometry in *G 2.3.5 c)*. This overlap defines the minimum buffer head size. The minimum buffer head size to provide an overlap of 75 mm can be calculated for the track geometry in *G 2.3.5 c)* using the methodology described in BS EN 16839:2022 and considering nominal vehicle dimensions. This does not take into account any suspension movement tolerances.

G 2.3.12 Whilst buffer height limits are set out in RIS-2780-RST, a target buffer height of 1054 mm is suggested for new wagons in tare condition. This allows some scope both for upward adjustment and for suspension settlement under payload.

G2.4 Inner coupling (4.2.2.1.2)

4.2.2.1.2 Inner coupling
The inner coupling is the mechanical interface between elements forming a unit. The inner coupling shall be resilient and capable of withstanding the forces in accordance with the defined design operating state of the unit. The joint between two elements sharing the same running gear, is covered by point 4.2.2.2. The longitudinal strength of the inner coupling(s) shall be equal to or higher than the one of the end coupling(s) of the unit.

Guidance

G 2.4.1 The intent of clause 4.2.2.1.2 of the WAG NTSN is for the inner coupling to be no more likely to fail, causing a train division due to lack of longitudinal strength, than any other unit coupling.

G 2.4.2 It is good practice for the the longitudinal strength of the inner coupling(s) to be higher than that of the end couplings of the unit. This means that any coupling failure is more likely to occur at the vehicle ends, which can simplify the recovery of the affected vehicles.

G 2.4.3 RIS-2780-RST sets out requirements for coupling systems for use on the GB mainline railway.

G2.5 Strength of unit (4.2.2.2)

4.2.2.2 Strength of unit
The structure of a unit body, any equipment attachments and lifting and jacking points shall be designed such that no cracks, no significant permanent deformation or ruptures occur under the load cases defined in Chapter 5 of EN 12663-2:2010. Joining techniques shall be deemed to be covered by the demonstration of conformity in accordance to point 6.2.2.1. In case of a rake of a rail compatible system composed of separate rail bogies connected to compatible road vehicles, the load cases may differ from those mentioned above, due to their bi- modal specification; in such a case, the load cases considered shall be described by the applicant based on a consistent set of specifications with consideration of the specific conditions of use related to train composition, shunting and operation. The demonstration of conformity is described in point 6.2.2.1. The jacking positions shall be marked on the unit. The marking shall comply with point 4.5.14 of EN 15877-1:2012. Note: Joining techniques are deemed to be covered as well by the demonstration of conformity in accordance to point 6.2.2.1.

6.2.2.1 Strength of unit
The demonstration of conformity shall be in accordance with chapters 6 and 7 of EN 12663-2:2010, or alternatively with chapter 9.2 of EN 12663-1:2010+A1:2014. Regarding joints, a recognised verification procedure shall exist to ensure at the production phase that no defect may decrease the intended mechanical characteristics of the structure.

Guidance on vehicle structure

G 2.5.1 RIS-2780-RST sets out requirements and guidance to support compliance with clause 4.2.2.2 of the WAG NTSN.

G 2.5.2 Clause 4.2.2.2 of the WAG NTSN does not limit the methodology used to that of BS EN 12663-2:2010. BS EN 12663-2:2010 explains that the load cases defined therein, and referred to in clause 4.2.2.2 of the WAG NTSN, are also copied in BS EN 12663-1:2010+A1:2014, which can be used as an alternative to BS EN 12663-2:2010 for freight wagons.

G 2.5.3 The method set out in BS EN 12663-1:2010+A1:2014 has traditionally been applied on the GB mainline railway. The use of the approach set out in BS EN 12663-2:2010 is based on UIC methods and involves the physical testing of a prototype wagon which could result in damage to the vehicle tested.

G 2.5.4 On the GB mainline railway, more onerous values of calculation factors than the values set out in BS EN 12663-1:2010+A1:2014 have historically been applied for some load conditions. The historic GB mainline railway values can continue to be used as a more robust alternative. The relevant load cases are:

a) Vertical proof load case: a dynamic factor of 2.0 has historically been used for freight vehicles. It is good practice to apply this higher dynamic factor as permitted in footnote *a* of Table 9 in BS EN 12663-1:2010+A1:2014.
b) Vertical fatigue load case: a vertical acceleration factor of 1±0.4 has historically been used for freight vehicles. It is good practice to apply this higher dynamic factor as permitted in footnote *b* of Table 17 in BS EN 12663-1:2010+A1:2014.
c) Lateral fatigue load case: clause 2.2.3 of RIS-2780-RST issue 1.1 sets out the requirements for this load case.
d) Local lifting / jacking point load case: RIS-2780-RST gives guidance on this topic, including on the value of safety factor to apply.

G 2.5.5 If BS EN 12663-1:2010+A1:2014 is used, additional guidance on the design of wagon equipment is given in clause 7 of BS EN 12663-2:2010.

G 2.5.6 If components are not called up in other documents (for example brake beams), it is appropriate for the load cases for equipment attachments set out in BS EN 12663-1:2010+A1:2014 or BS EN 12663-2:2010 to be applied to the component centre of mass.

G 2.5.7 The load cases set out in BS EN 12663-1:2010+A1:2014 or BS EN 12663-2:2010 and the guidance on calculation factors given in *G 2.5.4* consider only loads from the operation of the wagon on the railway network. Freight wagons could also be subject to additional loads depending on their purpose, for example:

a) Vibration, for example during loading of powders;
b) Shock loading, for example during loading of hopper wagons or steel slab or coil carrying wagons.

It is beyond the scope of this document to offer guidance on any such additional loads, but it will be important to account for them in the vehicle design.

G 2.5.8 BS EN 12663-2:2010 sets out requirements for the load bearing capabilities of wagon floors, to accommodate vehicles used in the loading process, such as trolleys or forklift trucks.

Guidance on load restraint devices for intermodal load units

G 2.5.9 Three types of load restraint device are used to secure intermodal load units, that is containers or swap bodies, on wagons on the GB mainline railway. These load restraints are:

a) Twistlocks
b) Auto locks
c) Spigots (fixed and fold-down varieties).

G 2.5.10 BS EN 12663-2:2010 sets out requirements for the strength of devices to secure intermodal load units. BS EN 12663-2:2010 does not contain any requirements for fatigue strength of such devices, but historic practice on the GB mainline railway has been to ensure that the equipment can withstand the fatigue loads arising when the maximum gross mass of the intermodal load unit carried is subjected to the accelerations in Table *1* and the resulting force is applied at the base plane of the intermodal load unit. The load restraint devices are considered to withstand the

fatigue loads if the probability of failure is no more than 2.5 % when the damage from the three fatigue load cases is summed for 10^7 cycles.

Direction	Acceleration	Restraining locations	Notes
Longitudinal	± 0.2 *g*	Four	
Transverse	± 0.2 *g*	Four	
Vertical	± 0.4 *g*	Four	Spigots do not provide any restraint, or experience any loading, in the upward vertical direction.

Table 1: Fatigue loads for intermodal unit load restraints

G 2.5.11 Information on the positioning of load restraint devices for intermodal load units was previously set out in UIC 571-4, which has now been withdrawn and superseded by IRS 50571-4:2022. UIC 571-4 also set out the dimensions for spigots and arrangements for fold-down spigots.

G 2.5.12 GERT8073 sets out requirements for the fixity of load restraint devices.

G 2.5.13 If fold-down spigots are used, these are orientated to fold outwards, with the hinges on the outer edge of the wagon. Installing the spigots with this orientation helps to provide retention against the overturning of containers in high winds. There have been instances, such as those investigated in Rail Accident Investigation Branch (RAIB) reports 12/2009 and 19/2015, of containers being blown from wagons which have had spigots installed to fold inwards, as the inward movement can disengage the spigot head from the engagement point of the load unit. UIC 571-4 sets out a maximum permitted in-service inward tilt of 2° for all spigots.

G 2.5.14 Compared to other securing devices, spigots can allow additional variation in the lateral position of the load unit which it is important to take into account when checking the gauge compatibility of the loaded wagon.

G 2.5.15 Spigots are not suitable for carrying intermodal load units with a mass below 1.6 tonnes, because such load units are not heavy enough to ensure stability.

G2.6 Integrity of unit (4.2.2.3)

4.2.2.3 Integrity of the unit
The unit shall be designed so that all movable parts intended to close an aperture (access doors, tarpaulin, lids, hatches, etc.) are prevented against an unintentional movement of these parts. Locking devices shall indicate their status (open/closed) and shall be visible outside the unit.

Guidance

G 2.6.1 Unintentional movement includes not just opening of the movable part but also other movement such as deflection under load. The guidance in the following sections *G 2.6.2* to *G 2.6.5* can support achieving the requirements of clause 4.2.2.3 of the WAG NTSN.

G 2.6.2 BS EN 12663-2:2010 sets out load cases for assessing the deflection of movable parts of the wagon, including sliding doors and sliding walls, that simulate forces due to shifting of the carried load and forces due to aerodynamic effects of passing trains. Whilst the acceptance criteria set out in BS EN 12663-2:2010 are concerned with permanent deformation, the same loads can be used to assess movement or deflection when applied, for example to establish if deflections under load could cause gauge infringement.

G 2.6.3 If the load cases in BS EN 12663-2:2010 produce deflections which could cause gauge infringement, the installation of suitable internal load restraints can protect against this.

G 2.6.4 Designing the wagon to avoid permanent deformation or deterioration in elements of the sliding door or its movement and securing mechanisms will help to maintain the effective functioning of these elements and security of the wagon contents.

G 2.6.5 For hopper doors, the use of primary and secondary locking systems can help prevent a single point failure causing the doors to open.

G2.7 Gauging (4.2.3.1)

4.2.3.1 Gauging
This point concerns the rules for calculation intended for sizing the rolling stock to run on one or several networks without interference risk. The compliance of a unit with the intended reference profile including the reference profile for the lower part shall be established by one of the methods set out in EN 15273-2:2013+A1:2016. The kinematic method, as described in EN 15273-2:2013+A1:2016 shall be used to establish conformity, if any, between the reference profile established for the unit and the respective target reference profiles G1, GA, GB and GC including those used for the lower part GI1 and GI2.

Guidance

G 2.7.1 There is no requirement to declare a target reference profile G1, GA, GB, GC, GI1 or GI2. If no target reference profile is declared then there is no requirement to use the kinematic method described in BS EN 15273-2:2013+A1:2016 to establish conformity. Normally these reference profiles will not be appropriate for wagons for use on the GB mainline railway, hence use of the kinematic method in BS EN 15273-2:2013+A1:2016 will not be required. The national foreword to BS EN 15273-2:2013+A1:2016 gives further guidance on the application of the European standard in GB.

G 2.7.2 Wagons for use on the GB mainline railway are traditionally built to conform with upper and lower sector gauges set out in GERT8073 using the method described in GMRT2173.

G 2.7.3 For the upper sector, wagons are built to the W6a upper gauge, whilst wagons capable of carrying intermodal load units, that is ISO containers or swap bodies, are built to the W7 to W12 range of upper gauges.

G 2.7.4 For the lower sector, wagons are built to the lower sector vehicle gauge (LSVG). LSVG was derived to provide normal clearances with the standard lower sector infrastructure gauge (LSIG). Requirements for wheelset dimensions set out in GMRT2466 are compatible with the LSVG.

G 2.7.5 It is advisable for wagons with doors or other movable elements on the underside, such as hopper wagons, to be designed so that the movable elements remain within gauge when in all positions. This will support wagons to be able to continue in operation or be transported on the railway if the equipment becomes defective. Supplementary controls, such as warning labels advising that the wagon is not to be moved on the mainline railway with the doors open, are likely to be necessary to support the safe operation of wagons which are not designed in this way.

G 2.7.6 Standard static wagon gauges, set out as W gauges in GERT8073, define a permissible vehicle size for a given distance between bogie centres (or wheelsets, for wagons with two axles only) and overall length. There are application rules for each wagon gauge which inform about taking allowances (e.g. for component wear) and tolerances into account. It is important that these application rules are complied with for the wagon being reviewed, so that in-service movements / displacements will not exceed the values specified. When creating a build gauge from the static wagon gauge, it is also important to consider the effect of underframe camber in order to prevent the gauge being exceeded by the upper portion of the wagon in tare condition, or with a lightweight load.

G2.8 Load carrying capacity of lines (4.2.3.2)

4.2.3.2 Compatibility with load carrying capacity of lines
The vertical loading characteristics of the unit shall be determined in order to check compatibility with the load carrying capacity of lines. The permissible payload a unit may carry, for axle loads up to and including 25 t, shall be determined by application of clauses 6.1 and 6.2 of EN 15528:2015.

Guidance

G 2.8.1 BS EN 15528:2015 sets out a system used to determine compatibility between vehicle loading and the load-carrying capability of underline bridges. A different system, known as route availability (RA), is currently used on the GB mainline railway for this purpose, and clause 4.2.7.4 of the Infrastructure NTSN (INF NTSN) permits the use of the RA system in GB.

G 2.8.2 Route availability is expressed as an RA number. GERT8006 sets out requirements and guidance for the calculation of the RA number for rail vehicles. RIS-8706-INS sets out requirements and guidance on the use of the RA number to assess compatibility between rolling stock and underline bridges.

G 2.8.3 Calculation of the wagon's RA number is not required for authorisation, but is necessary for ensuring route compatibility as part of the process of placing a vehicle in service. Calculation of the RA number in advance, for example at the design stage, will help to verify that the wagon is compatible with expected routes of operation.

G 2.8.4 The RA number of a wagon will depend on its loading condition, so is determined for tare, laden and any relevant intermediate load conditions. For some routes, a lower RA number might facilitate operations or reduce limitations, so limiting payload to obtain a lower RA number could be advantageous.

G 2.8.5 The classification system described in BS EN 15528:2015 is used by the European Train Control System (ETCS) to manage compatibility of rolling stock and underline structures. ETCS is not able to use the RA system. Most structures on the GB mainline railway have not been classified according to the EN 15528 system and there is no reliable conversion between the two methods so assumptions have to be made where ETCS is used. The classification of rolling stock according to the EN system can be taken into account in ETCS implementation.

G 2.8.6 Some other networks in GB are already using the BS EN 15528:2015 system, for example HS1 and HS2.

G2.9 Train detection system compatibility (4.2.3.3)

4.2.3.3 Compatibility with train detection systems
If the unit is intended to be compatible with one or more of the following train detection systems, this compatibility shall be established according to the provisions of ERA/ERTMS/033281 and CCS NTSN. a) train detection systems based on track circuits; b) train detection systems based on axle counters; c) train detection systems based on loop equipment.

Guidance

G 2.9.1 It is permitted for rolling stock not to be declared compatible with any of the listed train detection systems, and for rolling stock not to comply with any requirements relating to this clause.

G 2.9.2 Appendix D of the WAG NTSN references rev. 4.0 of ERA/ERTMS/033281 (CCS NTSN Index 77). ERA/ERTMS/033281 sets out the interoperability requirements related to compatibility of train detection systems with other subsystems.

G 2.9.3 GKRT0028 sets out the National Technical Rules (NTRs) for train detection system compatibility between existing subsystems, including freight wagons, that do not conform to the requirements in NTSNs and new, upgraded or renewed subsystems, including freight wagons, conforming to NTSNs.

G 2.9.4 GMRT2466 and GMRT2173 set out the NTRs for the relevant parameters for freight wagons that provide rolling stock compatibility with the existing infrastructure of the GB mainline railway.

G 2.9.5 The majority of existing axle counters currently on the GB mainline railway are covered by the requirements of ERA/ERTMS/033281 (CCS NTSN Index 77). Information on older types of axle counters which might not conform to ERA/ERTMS/033281 is given in Network Rail document NR/GN/SIG/50011.

G2.10 Axle bearing condition monitoring (4.2.3.4)

4.2.3.4 Axle bearing condition monitoring

It shall be possible to monitor the axle bearing condition either by:

- line side detection equipment, or
- on-board equipment.

If the unit is intended to be capable of being monitored by line side equipment on the 1 435 mm track gauge network the unit shall be compliant with clauses 5.1 and 5.2 of EN 15437-1:2009 in order to ensure sufficient visibility.

If the unit is intended to be capable of being monitored by on-board equipment, the following requirements shall apply:

- This equipment shall be able to detect a deterioration of any of the axle box bearings of the unit.
- The bearing condition shall be evaluated either by monitoring its temperature, or its dynamic frequencies or some other suitable bearing condition characteristic.
- The detection system shall be located entirely on board the unit, and diagnosis messages shall be available on board the unit.
- The diagnosis messages delivered and how they are made available shall be described in the operating documentation set out in section 4.4 of this NTSN, and in the maintenance rules described in section 4.5 of this NTSN.

Guidance

G 2.10.1 RIS-2714-RST sets out requirements and guidance for rolling stock to support compatibility with infrastructure-based condition monitoring equipment used on the GB mainline railway.

G 2.10.2 Inboard axle bearings are not visible to the majority of line-side detection equipment, so for wagons that are constructed with inboard axle bearings, clause 4.2.3.4 of the WAG NTSN requires the use of on-board monitoring equipment. Further guidance is given in RIS-2714-RST.

G 2.10.3 The use of inboard axle bearings increases the size of bearing needed. Guidance on axle design is set out in BS 8535:2011 and BS 5892-8:2012.

G2.11 Resistance to derailment on twisted track (4.2.3.5)

4.2.3.5 Running safety
The dynamic behaviour of a vehicle has a strong influence on safety against derailment, running safety and track loading.

4.2.3.5.1 Safety against derailment running on twisted track
The unit shall be designed to ensure safe running on twisted track, taking into account specifically the transition phase between canted and level track and cross level deviations. The demonstration of conformity is described in point 6.2.2.2.

6.2.2.2 Safety against derailment running on twisted track
The demonstration of conformity shall be carried out in accordance with chapters 4, 5 and 6.1 of EN 14363:2016.

7.3.2.3. Safety against derailment running on twisted track (point 4.2.3.5.1)
('P') The limitations to the use of Method 3 set out in EN 14363:2016 clause 6.1.5.3.1 are not applicable for units that are intended for national use on the UK mainline network only. This specific case does not prevent the access of NTSN compliant rolling stock to the national network.

Guidance

G 2.11.1 The UK specific case in clause 7.3.2.3 of the WAG NTSN permits the use of Method 3 as set out in BS EN 14363:2016+A2:2022 with no limitations on flange angle. Method 3 as set out in BS EN 14363:2016+A2:2022 can therefore be applied when using the P5 wheel profile.

G 2.11.2 Method 3 as set out in BS EN 14363:2016+A2:2022 is equivalent to the historic GB mainline railway method of determining wheel unloading on twisted track, formerly documented in GMRT2141.

G 2.11.3 Meeting the tests in Method 3 of BS EN 14363:2016+A2:2022 is generally sufficient for demonstrating compatibility with the GB mainline railway twisted track. For vehicles that will carry intermodal load units, that is ISO containers or swap bodies, an additional test with offset loading is required as set out in GMRT2141. This is in order to maintain compatibility with the existing infrastructure of the GB mainline railway.

G 2.11.4 GMGN2641 sets out further guidance to support meeting the requirements in GMRT2141.

G 2.11.5 Requirements for the calculation of the amount of bogie and vehicle twist, which determine the size of the packing pieces used in the wheel unloading test, are set out in BS EN 14363:2016+A2:2022.

G 2.11.6 Measurement of wheel unloading is sometimes referred to as ΔQ/Q.

G2.12 Dynamic behaviour (4.2.3.5.2)

4.2.3.5.2 Running dynamic behaviour

The unit shall be designed to provide safe movement up to the maximum design speed.

The running dynamic behaviour of a unit shall be proven either by:

- following the procedures set out in Chapters 4, 5 and 7 of EN 14363:2016, or
- performing simulations using a validated model.

The demonstration of conformity is described in point 6.2.2.3.

Running dynamic behaviour is permitted to be assessed at interoperability constituent level in accordance with point 6.1.2.1. In this case a specific test or simulation at subsystem level is not required.

6.1.2.1 Running gear

The demonstration of conformity for running dynamic behaviour is set out in EN 16235:2013.

Units equipped with an established running gear as described in chapter 6 of EN 16235:2013 are presumed to be in conformity with the relevant requirement provided that the running gears are operated within their established area of use.

The assessment of the bogie frame strength shall be based on clause 6.2 of EN 13749:2011.

6.2.2.3 Running dynamic behaviour

On-track tests

The demonstration of conformity shall be carried out in accordance with chapters 4, 5 and 7 of EN 14363:2016.

The combination of the highest equivalent conicity and speed for which the unit meets the stability criterion in chapters 4, 5 and 7 of EN 14363:2016 shall be recorded in the report.

7.3.2.4. Running dynamic behaviour (point 4.2.3.5.2)
Specific case UK for Great Britain ("P") Base condition for use of simplified measuring method specified in EN 14363:2016 clause 7.2.2 should be extended to nominal static vertical wheelset forces (PF0) up to 250 kN. For technical compatibility with the existing network it is permissible to use national technical rules amending EN 14363:2016 and notified for the purpose of running dynamic behaviour. This specific case does not prevent the access of NTSN compliant rolling stock to the national network.

Assessment options

G2.12.1 Clause 4.2.3.5.2 of the WAG NTSN permits running dynamic behaviour to be assessed at either the subsystem (that is, vehicle) level or at the IC (that is, running gear) level. The Guide for the application of the WAG TSI sets out, in Figure 9 of that document, the different options for verification of the running dynamic behaviour of a wagon. An adapted version of Figure 9 from the Guide for the application of the WAG TSI is shown in figure *1*.

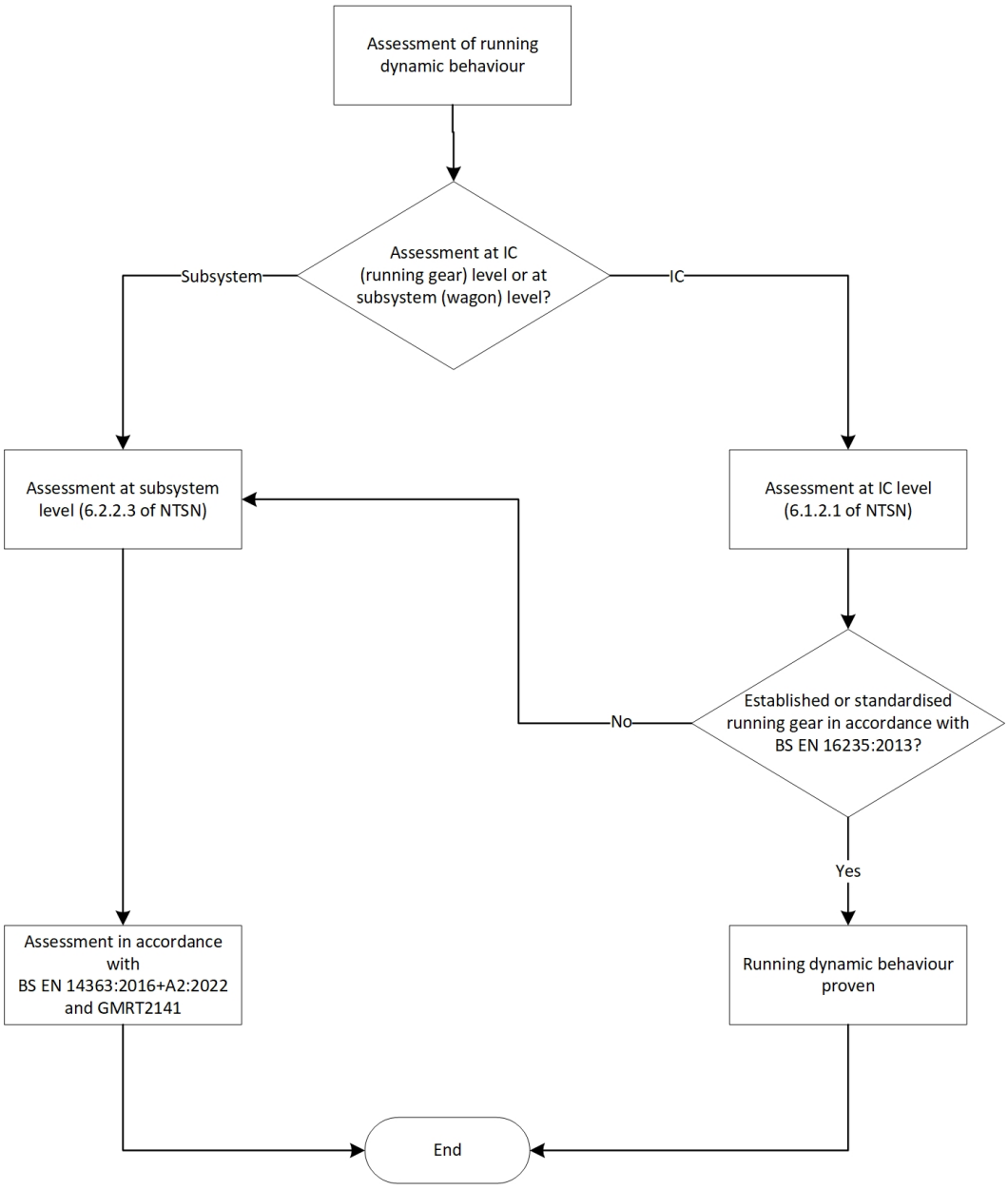


Figure 1: Options for verification of wagon running dynamic behaviour

Assessment at IC level

G2.12.2 BS EN 16235:2013 sets out criteria for running gear to be considered to be established or standardised. This includes consideration of the characteristics of the wagon on which the running gear is installed. A description of what constitutes running gear is given in clause 4.2.3.6 of the WAG NTSN.

Assessment at subsystem level

G2.12.3 The WAG NTSN requires the use of BS EN 14363:2016+A2:2022 for assessment of wagon dynamic behaviour. However, clause 7.3.2.4 of the WAG NTSN provides a UK specific case permitting the use of NTRs which amend BS EN 14363:2016+A2:2022.

These NTRs are documented in GMRT2141 for compatibility with the historic GB mainline railway network.

G2.12.4 GMRT2141 issue 4.1, Appendix A, provides an alternative method for the on-track test to the methods set out in BS EN 14363:2016+A2:2022. GMRT2141 issue 4.1, Appendix B sets out evidence to demonstrate that the test methods in the two standards can be considered to provide equivalent safety. Therefore, for conventional vehicles operating solely on the GB mainline railway, the on-track test in GMRT2141 issue 4.1, Appendix A, is permitted to be used in place of the Normal measuring method or Simplified measuring method in BS EN 14363:2016+A2:2022.

G2.12.5 Only one of the methods, as set out either in GMRT2141 issue 4.1, Appendix A or in BS EN 14363:2016+A2:2022, can be used for assessment of any wagon; it is not permitted to mix elements of the methods from the two standards.

G2.12.6 Further guidance on the application of BS EN 14363:2016+A2:2022 and GMRT2141 is given in Appendix *F*.

G2.12.7 A vehicle dynamic model allows for simulation to be used to assess things that it is not possible to check during physical testing, such as:

a) A greater variety of track conditions;
b) Variations in suspension parameters;
c) Failed components.

The validation options for the vehicle model are set out in BS EN 14363:2016+A2:2022. GMRT2141 issue 4.1, Appendix E also sets out options for validating a vehicle model in relation to the cyclic top susceptibility assessment and provides further guidance.

G2.12.8 Actual tests of failed components would normally only be carried out for components that are more vulnerable than the historical normal failure rate. For example, historically it is not normal to test with a broken spring, only if the design has a spring that is considered more likely to break would a wagon be tested with a broken spring. For extension of assessment of existing designs or running gear to new designs of wagon an assessment could be made to show that any component is not subject to a duty cycle more onerous than existing design.

Guidance

G 2.12.9 It is good practice for the suspension to be designed to cater for loading conditions of full load ± 30 % and tare load ± 50 %, to allow for dynamic displacement caused by track irregularities.

G 2.12.10 The risk of derailment due to end loads has been found to significantly increase if the ratio of wheelbase to length over buffers is below 0.54.

G 2.12.11 For two-axle wagons, a long wheelbase can present problems in negotiating small radius track curves.

G 2.12.12 Appendix *A* of this document sets out typical wagon dimensions for different load and speed configurations that have historically achieved broad, although not universal, route compatibility. However the minimum dimension of 4572 mm (15 ft) set out in Appendix A for the wheelbase of two-axle wagons having axle loads of 20.5 tonne

and above has been found to be a wheelbase dimension susceptible to riding problems on jointed track and to the effects of cyclic top. Careful selection of the suspension is important for the design of a wagon which has a wheelbase that is a sub-multiple of rail lengths (normally 60 ft). Further guidance is set out in Appendix A of this document and in UIC 530-2.

G2.13 Bogie structural design (4.2.3.6.1)

4.2.3.6.1 Structural design of bogie frame
The integrity of the structure of a bogie frame, all attached equipment and body to bogie connection shall be demonstrated based on methods as set out in point 6.2 of EN 13749:2011. The integrity of the structure of a bogie frame is permitted to be assessed at interoperability constituent level in accordance with point 6.1.2.1. In this case a specific test or simulation at subsystem level is not required.

Guidance

G 2.13.1 RIS-2780-RST sets out requirements and guidance for the structural design of bogies to support the use of BS EN 13749:2011.

G 2.13.2 When designing bogies it is important that the design is compatible with the use of wheelskates, which are used to enable recovery of a rail vehicle with a damaged wheelset. RIS-2780-RST sets out requirements and guidance to support compatibility of rail vehicles and wheelskates.

G2.14 Wheelsets (4.2.3.6.2)

4.2.3.6.2 Characteristics of wheelsets
The wheelset assembly shall be able to transmit forces and torque between the fitted parts in accordance with the area of use. The geometric dimensions of the wheelsets, as defined in Figure 1, shall be compliant with limit values specified in Table 3. These limit values shall be taken as design values and shall be stated as in-service limit values in the maintenance file described in Section 4.5. The demonstration of conformity is described in point 6.1.2.2.

6.1.2.2 Wheelset
The demonstration of conformity for the mechanical behaviour of the wheelset assembly shall be carried out according to clause 3.2.1 of EN 13260:2009+A1:2010, which defines limit values for the axial assembly force and the associated verification test.

7.3.2.5 Characteristics of wheelsets, wheels and axles (points 4.2.3.6.2 and 4.3.2.6.3)
Specific case UK for Great Britain ("P") For units intended to operate solely on the railway network of Great Britain the characteristics of the wheelsets, wheels and axles may be in accordance with the national technical rules. This specific case does not prevent the access of NTSN compliant rolling stock to the national network.

Guidance

G 2.14.1 The WAG NTSN sets out requirements and design and maintenance dimensional limits for wheelsets in accordance with BS EN 13260:2009+A1:2010 with tread profiles set out in BS EN 13715:2020.

G 2.14.2 Wheelsets are permitted to operate on the GB mainline railway when maintained in accordance with the WAG NTSN requirements and limits.

G 2.14.3 The specific case in clause 7.3.2.5 of the WAG NTSN permits the characteristics of the wheelsets, wheels and axles to be in accordance with NTRs, rather than the requirements set out in the WAG NTSN. GMRT2466 sets out those rules and defines GB mainline railway-specific tread profiles with corresponding operating limits.

G 2.14.4 RIS-2766-RST sets out further requirements and guidance for wheelsets for use on the GB mainline railway.

G 2.14.5 Figure 1 (reproduced below as Figure *2*) and Table 3 of the WAG NTSN include a description of, and requirements for, a wheelset front-to-front dimension, S_R, and a back-to-back distance, A_R. The front-to-front dimension is not employed for wheelsets that follow the NTRs set out in GMRT2466. The back-to-back distances given in the WAG NTSN do not apply to wheelsets used on the GB mainline railway as these dimensions are for measurement at rail level in a laden condition and so allow for axle bending, whereas back-to-back limits used on the GB mainline railway are measured at axle level in a laden condition and do not need to consider axle bending. GMRT2466 sets out requirements for measurement of back-to-back dimensions of wheelsets with GB mainline railway tread profiles.

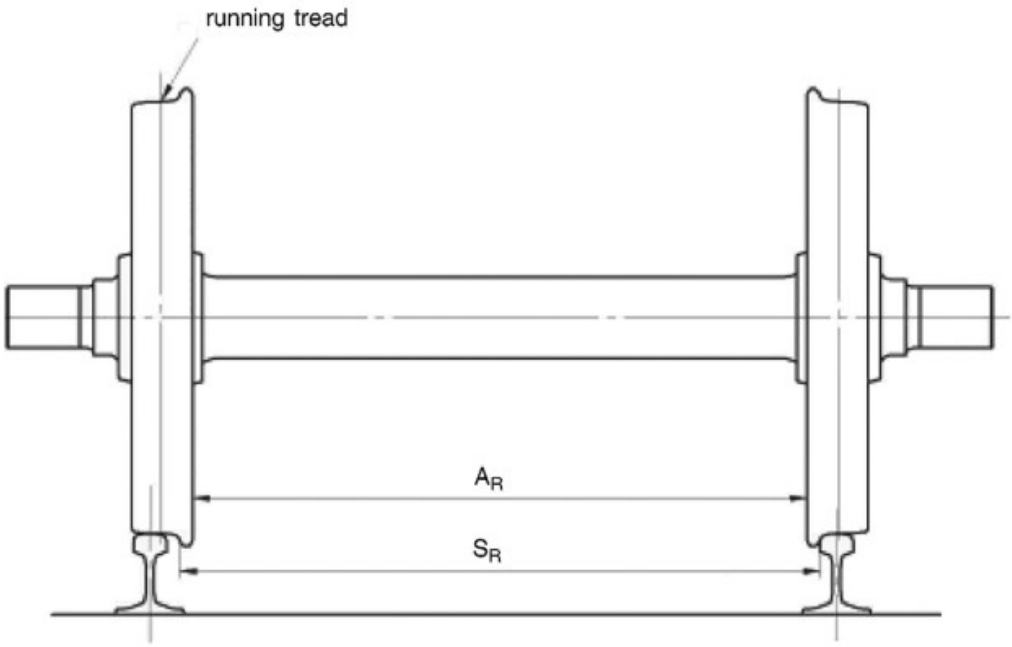


Figure 2: Wheelset dimensions in the WAG NTSN

G2.15 Wheels (4.2.3.6.3)

4.2.3.6.3 Characteristics of wheels
The geometrical dimensions of the wheels as defined in Figure 2 shall be compliant with limit values specified in Table 4. The demonstration of conformity is described in point 6.1.2.3.

6.1.2.3 Wheel
(a) Forged and rolled wheels: The mechanical characteristics shall be proven following the procedure as specified in clause 7 of EN 13979-1:2003+A1:2009+A2:2011. If the wheel is intended to be used with brake blocks acting on the wheel running surface, the wheel shall be thermo mechanically proven by taking into account the maximum braking energy foreseen. A type test, as described in clause 6.2 of EN 13979-1:2003+A1:2009+A2:2011 shall be performed in order to check that the lateral displacement of the rim during braking and the residual stress are within the specified tolerance limits. The decision criteria of residual stresses for forged and rolled wheels are set out in EN 13979-1:2003+A1:2009+A2:2011.

6.1.2.3 Wheel
(b) Other types of wheels: Other types of wheels are permitted for units in national use. In that case the decision criteria and the fatigue stress criteria shall be specified in national technical rules.
A verification procedure shall exist to ensure at the production phase that no defects may adversely affect safety due to any change in the mechanical characteristics of the wheels. The tensile strength of the material in the wheel, the hardness of the rim, the fracture toughness (only for tread-braked wheels), the resistance to impact, the material characteristics and the material cleanliness shall be verified. The verification procedure shall specify the batch sampling used for each characteristic to be verified.

7.3.2.5 Characteristics of wheelsets, wheels and axles (points 4.2.3.6.2 and 4.3.2.6.3)
Specific case UK for Great Britain ("P") For units intended to operate solely on the railway network of Great Britain the characteristics of the wheelsets, wheels and axles may be in accordance with the national technical rules. This specific case does not prevent the access of NTSN compliant rolling stock to the national network.

Guidance

G 2.15.1 Clause 7.3.2.5 of the WAG NTSN permits the use of NTRs for the properties of wheels, rather than the requirements set out in the WAG NTSN. NTRs for wheels are set out in GMRT2466. RIS-2766-RST sets out further requirements and guidance for wheels for use on the GB mainline railway.

G 2.15.2 Figure 2 (reproduced below as Figure *3*) and Table 4 of the WAG NTSN include a description of, and requirements for, a face of the flange dimension, q_R. The face of the flange dimension is not employed for wheels that follow the NTRs set out in GMRT2466.

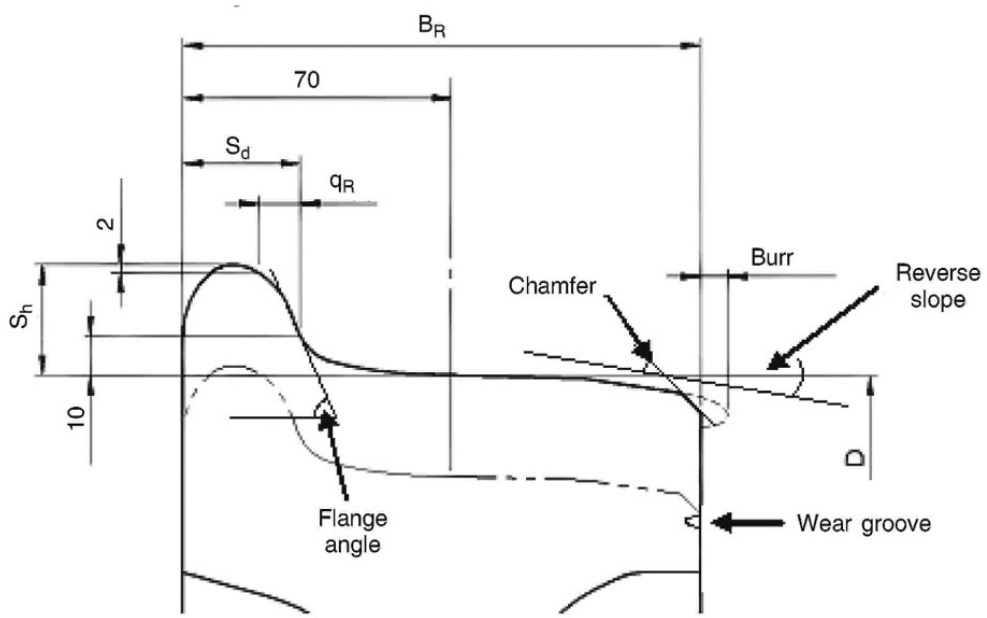


Figure 3: Wheel tread dimensions in the WAG NTSN

G 2.15.3 Table *2* summarises experience of the use of different wheel profiles on freight wagons on the GB mainline railway.

Profile	Description	Comments
P1	The 1 in 20 coning of the P1 profile is required to ensure the lateral stability of the older types of wagon with simple suspensions.	The use of this profile on new designs is now discouraged, because modern profiles result in better ride quality.
P5	The P5 profile, with a 60˚ flange angle and a thicker flange, when compared with the P6 profile, gives a reduced wheelset / track lateral clearance which has been found to promote improved lateral ride.	Wagons fitted with Y25 type bogies and derivatives of this bogie, for example FBT6, Y33, and AM3 bogies, have used this profile successfully.
P6	The flange of the P6 profile incorporates a 68˚ flange angle, important on torsionally stiff wagons with positively located wheelsets. Use of the 68˚ flange angle means that a higher lateral / vertical wheel force ratio can be sustained before flange climbing occurs. The problem of poor lateral ride quality, found when this profile has been used with certain types of suspension, has prevented its widespread use.	This profile was extensively used in the past for wagons up to 95 km/h (60 mph). For bogie wagons, which operate at speeds in excess of 95 km/h (60 mph), the use of P5 profiles is recommended.

Profile	Description	Comments
P8	The P8 profile has a worn (hollow) tread in addition to a worn flange (68°) and thus during service the profile changes shape very little. This profile with suitable wheelset yaw stiffness ensures good curving performance with a resultant reduction in flange wear on large and medium radius curves and also gives vehicle stability over very high mileage when applied to appropriate suspension types.	New suspensions specially designed to accept high conicity wheel tread profiles, for example 25.4 tonne axle load taperleaf and cross-braced bogies, LTF and TF25 bogies.
P10	The P10 profile is geometrically identical to the EN 13715 S1002/h28/e32.5/6.7 % profile (derived from UIC leaflet 510-2).	Two-axle and bogie wagons in international traffic having a wheel diameter in the range 760 mm to 1000 mm. Also as an alternative to P5 for Y25 type bogies in domestic traffic only.
P12	A development of the P8 profile with changes to the flange root profile to improve initial wear and reduce rolling contact fatigue.	None
S1002SW	Modified version of P10 profile with larger flanges, to assist negotiation of obtuse crossings.	UIC profile used by vehicles with small wheel diameters, that is below 760 mm.

Table 2: Use of wheel tread profiles on freight wagons on the GB mainline railway

G 2.15.4 The use of an appropriate wheel tread profile is important for vehicle ride performance with the chosen suspension arrangement. The suitability of a tread profile and suspension arrangement combination on a vehicle is able to be demonstrated by a dynamic study. Guidance on the suitability of tread profiles can be obtained from a technically competent authority. Section *G2.12* gives guidance on vehicle ride performance.

G 2.15.5 All wheels on a vehicle have the same profile.

G 2.15.6 The reference to clause 4.3.2.6.3 in clause 7.3.2.5 of the WAG NTSN is an error. The correct reference is 4.2.3.6.3.

G2.16 Axles (4.2.3.6.4)

4.2.3.6.4 Characteristics of axles
The characteristics of the axle shall ensure the transmission of forces and torque in accordance with the area of use. The demonstration of conformity is described in point 6.1.2.4. The traceability of axles shall take into account the findings of the ERA Task force on Freight Maintenance (see '*Final report on the activities of the Task Force Freight Wagon Maintenance*' published on the ERA website http://www.era.europa.eu).

6.1.2.4 Axle
In addition to the requirement for the assembly above, the demonstration of conformity of the mechanical resistance and fatigue characteristics of the axle shall be based on Clauses 4, 5 and 6 of EN 13103:2009 + A2:2012. The decision criteria for the permissible stress are specified in Clause 7 of EN 13103:2009 + A2:2012. A verification procedure shall exist to ensure at the production phase that no defects may adversely affect safety due to any change in the mechanical characteristics of the axles. The tensile strength of the material in the axle, the resistance to impact, the surface integrity, the material characteristics and the material cleanliness shall be verified. The verification procedure shall specify the batch sampling used for each characteristic to be verified.

7.3.2.5 Characteristics of wheelsets, wheels and axles (points 4.2.3.6.2 and 4.3.2.6.3)
Specific case UK for Great Britain ("P") For units intended to operate solely on the railway network of Great Britain the characteristics of the wheelsets, wheels and axles may be in accordance with the national technical rules. This specific case does not prevent the access of NTSN compliant rolling stock to the national network.

Guidance

G 2.16.1 Clause 7.3.2.5 of the WAG NTSN permits the use of NTRs for the properties of axles, rather than the requirements set out in the WAG NTSN. NTRs for axles are set out in GMRT2466. RIS-2766-RST sets out further requirements and guidance for axles for use on the GB mainline railway.

G 2.16.2 Historically the axle journal size has been designed to suit the load applied. As a guide the combinations of journal size and load shown in Table *3* have previously been successfully used.

Axle journal diameter / mm	Load on axle / tonne	Notes
120	18	None
130	20.5	Type A: 217 mm long
130	22.5	Type B: 191 mm long
140	23	None
150	25.4	None

Table 3: Historical data of axle journal size and applied load

G2.17 Axle bearings (4.2.3.6.5)

4.2.3.6.5 Axle boxes/bearings
The axle box and the rolling bearing shall be designed with consideration of mechanical resistance and fatigue characteristics. Temperature limits reached in service relevant for the hot box detection shall be defined. The demonstration of conformity is described in point 6.2.2.4.

6.2.2.4 Axle box/bearings
The demonstration of conformity for mechanical resistance and fatigue characteristics of the rolling bearing shall be in accordance with clause 6 of EN 12082:2007+A1:2010. It is permitted to use other standards for the above demonstration of conformity where the EN standards do not cover the proposed technical solution; in that case the approved body shall verify that the alternative standards form part of a technically consistent set of standards applicable to the design, construction and testing of the bearings. Only standards that are publicly available can be referred to in the demonstration required above. In the case of bearings manufactured according to a design developed and already used to place products on the market before the entry into force of relevant NTSNs applicable to those products, the applicant is allowed to deviate from the demonstration of conformity above and refer to design review and type examination performed for previous applications under comparable conditions instead; this demonstration shall be documented and is considered as providing the same level of proof as type examination according to module SB or design examination according to module SH1.

Guidance

G 2.17.1 Requirements and guidance for axleboxes and bearings to support compatibility with infrastructure-based bearing monitoring equipment are set out in RIS-2714-RST.

G 2.17.2 Further requirements for axle bearing condition monitoring are set out in clause 4.2.3.4 of the WAG NTSN. Guidance on clause 4.2.3.4 of the WAG NTSN is set out in section *G2.10*.

G2.18 Wheelsets for variable track gauge use (4.2.3.6.6)

4.2.3.6.6 Automatic variable gauge systems

4.2.3.6.7 Running gear for manual change of wheelsets

Guidance

G 2.18.1 The content of sections 4.2.3.6.6 and 4.2.3.6.7 of the WAG NTSN is only applicable to wagons that are designed to be able to operate on two or more track gauges. For wagons that are only intended to be used on the GB mainline railway, these sections can be ignored.

G2.19 Brakes (4.2.4)

4.2.4 Brake **4.2.4.1 General**
The purpose of the train brake system is to ensure that: — the train's speed can be reduced, — the train's speed can be maintained on a slope, — the train can be stopped within the maximum allowable braking distance, and that — the train can be immobilised. Primary factors that influence the braking performance and the braking process are: — the braking power, — the train mass, — the speed, — the allowable braking distance, — the available adhesion, and — the track gradient. The brake performance of a train is derived from the individual brake performance of each unit in the train.

Guidance

G 2.19.1 Clause 4.2.4.1 of the WAG NTSN makes a series of statements about the train brake system and does not set out any requirements. The statements concern the train formation rather than each of the units, for example freight wagons, that form the train.

G 2.19.2 Table 4 sets out the colouring of vehicle-end air brake couplings on existing wagons on the GB mainline railway. The use of the same colours on new or modified wagons will provide consistency with the existing fleet. Different colours might be in use on wagons operating in continental Europe.

Pipe description	Valve and handle colour	Coupling head colour
Train brake pipe	Red	Red
Main reservoir pipe	Yellow	Yellow
Through air pipe	White	Red

Table 4: Colour coding of air pipe connections

G 2.19.3 Typically freight wagons used on the GB mainline railway are equipped only with a train brake pipe.

G 2.19.4 The main reservoir pipe coupling head typically used on the GB mainline railway differs from that used in continental Europe in that it incorporates a sealing star valve and is in the opposite orientation. GB mainline railway main reservoir pipe coupling heads are not compatible with those used in continental Europe without an adapter. Details of the GB mainline railway coupling head incorporating the star valve for the main reservoir pipe are shown in BS EN 15807:2021 Figure A.2.

G 2.19.5 Details of the coupling head for the train brake pipe and through air pipe are shown in BS EN 15807:2021 Figure 2.

G2.20 Brake safety requirements (4.2.4.2)

4.2.4.2 Safety requirements
The braking system contributes to the safety level of the railway system. Therefore the design of the braking system of a unit has to undergo a risk assessment in accordance with Commission Implementing Regulation (EU) No 402/2013 considering the hazard of complete loss of the brake capability of the unit. The severity level shall be deemed as catastrophic when: — it affects the unit alone (combination of failures), or — it affects the brake capability of more than the unit (single fault). The fulfilment of the conditions of C.9 and C.14 of Appendix C is presumed to be in conformity with this requirement.

Guidance

G 2.20.1 There is no requirement to apply Appendix C of the WAG NTSN in order to satisfy this requirement.

G 2.20.2 Condition C.9 of Appendix C to the WAG NTSN sets out requirements for compatibility with the EN-UIC brake system. The automatic air brake system historically used on the GB mainline railway is based on the same safety principles as the EN-UIC brake system but with different performance requirements and faster release response times. Therefore the use of braking systems which have a proven history of use on the GB mainline railway is also a presumption of conformity with this requirement.

G 2.20.3 Condition C.14 of Appendix C to the WAG NTSN sets out requirements for thermal capacity of a wagon brake system. These requirements are based around a scenario of an alpine descent and are not appropriate for the GB mainline railway. Further guidance on brake thermal capacity is given in section *G2.24*.

G 2.20.4 It is possible for other equipment, for example pneumatically powered doors, to be supplied with air from the wagon's main reservoir pipe. If this is the case, it is important that the other equipment does not negatively affect the outcome of the risk assessment or the safety of the braking system.

G2.21 Brake functional and technical requirements (4.2.4.3)

4.2.4.3 Functional and technical requirements **4.2.4.3.1 General functional requirements**
The brake equipment of the unit shall provide the functions of braking such as the application and the release of the brake, upon a transmitted signal. The brake shall be: — continuous (the brake application or release signal is transmitted from a central command to the whole train by a control line), — automatic (an inadvertent disruption of the control line shall lead to brake activation on all units of the train bringing each part to stand still), — disengageable, which enables its release and isolation.

Guidance

G 2.21.1 GMRT2045 issue four Appendix J gives guidance on the principles of pneumatically controlled friction brake systems that have historically been employed on the GB mainline railway and satisfy the general functional requirements set out in clause 4.2.4.3.1 of the WAG NTSN.

G 2.21.2 Although GB mainline railway brake systems have been designed to the same safety principles as EN-UIC systems, the pressures and timings of pneumatic brake equipment for GB mainline railway rail vehicles described in GMRT2045 issue four Appendix J are different to those used in brake equipment designed to comply with UIC requirements.

G 2.21.3 It is not a requirement of the WAG NTSN to comply with any of the brake equipment pressures or timings of the historic GB mainline railway brake system design, or the EN-UIC brake system design. However choosing to design the wagon brake system to the pressures and timings of the historic GB mainline railway brake system will in many cases help to ensure operational compatibility with other wagons and locomotives in use on the GB mainline railway. In some cases it might instead be appropriate to design to the EN-UIC brake system specifications, for example for wagons that are to be used in international traffic.

G 2.21.4 BS EN 14198:2016+A2:2021 sets out requirements and guidance for the design of braking systems on wagons, although pressures and timings therein might only be applicable to EN-UIC brake systems.

G2.22 Service brake performance (4.2.4.3.2.1)

4.2.4.3.2 Brake performance **4.2.4.3.2.1 Service brake**
The brake performance of a train or a unit is its ability to decelerate. It is the result of the braking power available to decelerate the train or unit within defined limits and all factors involved in the conversion and dissipation of energy including train resistance. The brake performance of a unit shall be calculated in accordance with one of the following documents: — EN 14531-6:2009, or — UIC 544-1:2014. The calculation shall be validated by tests. Brake performance calculation in accordance with UIC 544-1 shall be validated as set out in UIC 544-1:2014.

Guidance

G 2.22.1 The WAG NTSN does not set out requirements for braking performance. GMRT2045 sets out braking performance requirements, including the maximum allowable braking distance at different speeds, for individual wagons for compatibility with national signalling system requirements.

G 2.22.2 The brake performance calculation methods set out in BS EN 14531-6:2009 are appropriate for wagons for use on the GB mainline railway. It is not possible for vehicles to operate on the GB mainline railway unless braking performance data has been entered in the Total Operations Processing System (TOPS). GMRT2045 sets out how this brake force data is calculated.

G 2.22.3 GMRT2045 sets out requirements for tests to validate freight wagon brake performance calculations.

G 2.22.4 The contents of UIC 544-1:2014 leaflet are now set out in BS EN 16834:2019.

G 2.22.5 It is possible for other equipment, for example pneumatically powered doors, to be supplied with air from the wagon's main reservoir pipe. If this is the case, it is important that the other equipment does not negatively affect the wagon's braking performance, including when in a degraded condition.

G2.23 Parking brake performance (4.2.4.3.2.2)

4.2.4.3.2.2 Parking brake
A Parking Brake is a brake used to prevent parked rolling stock moving under the specified conditions taking into account the place, wind, gradient and rolling stock loading state, until intentionally released. If the unit is equipped with a parking brake, the following requirements shall be met: — the immobilisation shall remain until intentionally released, — where it is not possible to identify the state of the parking brake directly, an indicator showing the state shall be provided on both sides on the outside of the vehicle, — the minimum parking brake force considering no wind, shall be determined by calculations as defined in Clause 6 of EN 14531-6:2009, — the parking brake of a unit shall be designed considering a wheel/rail (steel/steel) adhesion factor not higher than 0,12.

Guidance

G 2.23.1 There is no requirement to fit a parking brake on a wagon, but the requirements of clause 4.2.4.3.2.2 of the WAG NTSN apply if a parking brake is fitted.

G 2.23.2 If no parking brake is fitted, the risk associated with parked rolling stock moving will be managed by alternative means. Such alternative means are not required to be assessed to support authorisation of the wagon for placing on the market. It is good practice to consider with other parties, such as the entity in charge of maintenance (ECM) or railway undertaking (RU), whether alternative means are available and practicable when deciding whether or not to install a parking brake.

G 2.23.3 Historic practice for the GB mainline railway has been to fit a parking brake to every individual freight wagon or semi-permanently coupled wagon formation.

G 2.23.4 Factors for consideration when designing parking brake systems include:

a) The maximum static mass which the parking brake will secure and the maximum gradient on which it will be applied;
b) The potential for compounding with the service brake if this is subsequently applied; and
c) Any effects of changes in the load state of the vehicle after the parking brake has been applied, such as:
    i) The effect on braking performance if the load increases;
    ii) Any effect on the ability to release an applied parking brake; and
    iii) Potential damage to brake components.

G 2.23.5 Historic practice for the GB mainline railway has been to paint the handbrake application handle, lever or wheel white, so that it is readily visible to staff.

G 2.23.6 Parking brake interlocks with the power brake and associated isolating devices can be fitted.

G2.24 Brake thermal capacity (4.2.4.3.3)

4.2.4.3.3 Thermal capacity
The brake equipment shall be able to withstand one emergency brake application without any loss of brake performance due to thermal or mechanical effects. The thermal load that the unit is capable of withstanding without any adverse loss of brake performance due to thermal or mechanical effects, shall be defined and expressed in terms of speed, axle load, gradient and brake distance. The demonstration of conformity is described in point 6.2.2.6. A slope of 21 ‰ at 70 km/h during 40 km may be considered as the reference case for the thermal capacity which results in a braking power of 45 kW per wheel during 34 minutes for a nominal wheel diameter of 920 mm and an axle load of 22,5 t. There may be other relevant reference cases available for use.

6.2.2.6 Thermal capacity
Calculations, simulations or tests shall demonstrate that the temperature of the brake block, brake pad or brake disc does not exceed their thermal capacity. The following shall be taken into account: (a) concerning the emergency brake application: the critical combination of speed and payload considering straight and level track, minimum wind and dry rails; (b) concerning the continuous brake application: — the range up to the maximum braking power, — the range up to the maximum speed, and — the corresponding brake application time.

Guidance

G 2.24.1 There is no requirement to use the reference case suggested in the WAG NTSN. The reference case suggested in the WAG NTSN is derived from an alpine descent and is appropriate for pan-European operation but does not reflect operation on the GB mainline railway.

G 2.24.2 Historic GB mainline railway parameters for thermal capacity have been the drag braking requirements of maintaining a speed of 100 km/h (60 mph) on a gradient of 1 in 70 for a distance of 36 km (22 miles), representing the route from Perth to Inverness.

G2.25 Wheel slide protection (WSP) (4.2.4.3.4)

4.2.4.3.4 Wheel slide protection (WSP)
Wheel slide protection (WSP) is a system designed to use the maximum available adhesion by decreasing, holding or increasing the brake force to prevent wheel sets from locking and uncontrolled sliding. Thereby the stopping distance shall be optimised. If an electronic WSP-control is used negative effects caused by malfunctions of WSP shall be reduced by suitable system design processes and technical configuration. The WSP shall not alter the functional characteristics of the brakes. The vehicle's air equipment shall be dimensioned such that the air consumption of the WSP does not impair the performance of the pneumatic brake. The design process of the WSP shall take into account that the WSP has no detrimental effect on the constituent parts of the vehicle (brake gear, wheel tread, axle boxes, etc.). The following types of units shall be fitted with WSP: — types of units equipped with all types of brake blocks except composite brake blocks, for which the maximum mean utilisation of adhesion is greater than 0,12, — types of units equipped with disc brakes only and/or with composite brake blocks, for which the maximum mean utilisation of adhesion is greater than 0,11.

Guidance

G 2.25.1 Other than for vehicles which satisfy the conditions set out at the end of clause 4.2.4.3.4 of the WAG NTSN there is no mandatory requirement to install WSP on freight wagons.

G 2.25.2 BS EN 15595:2018 sets out requirements for WSP equipment. Further guidance on optimisation of WSP equipment for operation on the GB mainline railway is given in GMGN2695.

G2.26 Brake blocks (friction elements) (4.2.4.3.5)

4.2.4.3.5 Friction elements for wheel tread brakes
The friction element for wheel tread brakes (i.e. brake block) generates brake forces by friction when engaged with the wheel tread. If wheel tread brakes are used the characteristics of the friction element shall contribute reliably to achieving the intended brake performance. The demonstration of conformity is described in point 6.1.2.5 of this NTSN.

6.1.2.5 Friction elements for wheel tread brakes

The demonstration of conformity of friction elements for wheel tread brakes shall be carried out by determining the following friction element properties in accordance with the European Railway Agency (ERA) technical document ERA/TD/2013-02/INT version 3.0 of 27.11.2015 published on the ERA website (http://www.era.europa.eu):

— dynamic friction performance (chapter 4);

— static friction coefficient (chapter 5);

— mechanical characteristics including properties in respect to shear strength test and flexural strength test (chapter 6).

Demonstration of the following suitabilities shall be carried out in accordance with chapters 7 and/or 8 of the ERA technical document ERA/TD/2013-02/INT version 3.0 of 27.11.2015 published on the ERA website (http://www.era.europa.eu), if the friction element is intended to be suitable for:

— train detection by systems based on track circuits; and/or

— severe environmental conditions.

If a manufacturer does not have sufficient return of experience (according with its own judgement) for the proposed design, the type validation by in-service experience procedure (module CV) shall be part of the assessment procedure for suitability for use. Before commencing in-service tests, a suitable module (CB or CH1) shall be used to certify the design of the interoperability constituent.

The in-service tests shall be organised on request from the manufacturer, who must obtain agreement from a railway undertaking that will contribute to such an assessment.

The suitability for train detection by systems based on track circuits for friction elements intended to be used in subsystems beyond the scope set out in chapter 7 of the ERA technical document ERA/TD/2013-02/INT version 3.0 of 27.11.2015 published on the ERA website (http://www.era.europa.eu) may be demonstrated using the procedure for innovative solutions described in point 6.1.3.

The suitability for severe environmental conditions by a dynamometer test for friction elements intended to be used in subsystems beyond the scope set out in clause 8.2.1 of the ERA technical document ERA/TD/2013-02/INT version 3.0 of 27.11.2015 published on the ERA website (http://www.era.europa.eu) may be demonstrated using the procedure for innovative solutions described in point 6.1.3.

Guidance

G 2.26.1 Chapter 5 of the WAG NTSN identifies friction elements for wheel tread brakes (that is, brake blocks) as interoperability constituents.

G 2.26.2 As interoperability constituents, further provisions for brake blocks are contained in the articles which precede the Annex of the WAG NTSN. Relevant articles are duplicated in Table *5*.

Article 8
1. A UK certificate of verification for a subsystem that contains interoperability constituents which do not have an EC or UK declaration of conformity or suitability for use may be issued during a transition period ending on 1 January 2024, provided the provisions set out in Section 6.3 of the Annex are met. 2. The production or upgrade/renewal of the subsystem using non-certified interoperability constituents shall be completed within the transition period set out in paragraph 1, including placing into service. 3. During the transition period set out in paragraph 1: (a) the reasons for non-certification of any interoperability constituents shall be properly identified in the verification procedure referred to in paragraph 1; (b) the Safety Authority shall report on the use of non-certified interoperability constituents in the context of authorisation procedures in their annual report referred to in regulation 20 of the Railways and Other Guided Transport Systems (Safety) Regulations 2006.
Article 8a
1. Notwithstanding the provisions in Section 6.3 of the Annex, a UK certificate of verification may be issued for a subsystem containing components corresponding to the 'friction element for wheel tread brakes' interoperability constituent that does not have an EC or UK declaration of conformity during a transition period ending on 1 January 2024, if the following conditions are met: (a) the component was manufactured before 1 January 2014; and (b) the interoperability constituent has been used in a subsystem that had been approved and placed in service in at least one EU Member State or in the UK before 1 January 2014. 2. The production, upgrade or renewal of any subsystem using non-certified interoperability constituents shall be completed, including granting authorisation for placing into service of the subsystem, before the transition period set out in paragraph 1 expires. 3. During the transition period set out in paragraph 1: (a) the reasons for non-certification of any interoperability constituents shall be properly identified in the verification procedure for the subsystem referred to in paragraph 1; and (b) the Safety Authority shall report in their annual report, as referred to in regulation 20 of the Railways and Other Guided Transport Systems (Safety) Regulations 2006 on the use of non-certified 'friction element for wheel tread brakes' interoperability constituents in the context of authorisation procedures.
Article 8b

1. Until the expiry of their current approval period, 'friction element for wheel tread brakes' interoperability constituents listed in Appendix G of the Annex do not need to be covered by an EC or UK declaration of conformity. During this period, 'friction elements for wheel tread brakes' listed in Appendix G of the Annex shall be deemed to be compliant with this NTSN. 2. After their current approval period expires, 'friction element for wheel tread brakes' interoperability constituents listed in Appendix G of the Annex shall be covered by EC or UK declaration of conformity.
Article 8c
1. Notwithstanding the provisions in Section 6.3 of the Annex, a UK certificate of verification may be issued for a subsystem containing components corresponding to the 'friction element for wheel tread brakes' interoperability constituent that does not have an EC or UK declaration of conformity during a transition period of 10 years after the expiry of the approval period of the interoperability constituent, if the following conditions are met: (a) the component was manufactured before the expiry of the approval period of the interoperability constituent; and (b) the interoperability constituent has been used in a subsystem that had been approved and placed in service or placed on the market in at least one EU Member State or placed in service in the UK before the expiry of its approval period. 2. The production, upgrade or renewal of any subsystem using non-certified interoperability constituents shall be completed, including granting authorisation for placing in service of the subsystem, before the transition period set out in paragraph 1 expires. 3. During the transition period set out in paragraph 1: (a) the reasons for non-certification of any interoperability constituents shall be properly identified in the verification procedure for the subsystem referred to in paragraph 1; and (b) the Safety Authority shall report in their annual report, as referred to in regulation 20 of the Railways and Other Guided Transport Systems (Safety) Regulations 2006, on the use of non-certified 'friction element for wheel tread brakes' interoperability constituents in the context of authorisation procedures.

Table 5: Brake block provisions in the articles of the WAG NTSN

G 2.26.3 The articles quoted in table *5* mean that, for brake blocks which do not hold an EC or UK declaration of conformity, two different approaches apply, depending on whether or not the brake blocks under consideration are listed in Appendix G of the WAG NTSN.

G 2.26.4 No additional restrictions apply to the use of brake blocks which hold an EC or UK declaration of conformity.

Brake blocks listed in Appendix G of the WAG NTSN

G2.26.5 Although Article 8b of the WAG NTSN refers to brake blocks '*listed in Appendix G*', Appendix G of the WAG NTSN does not actually list out any types of brake blocks. Instead it directs the reader to the website of the safety authority, which in GB is the ORR. In turn the ORR website directs the reader to this document. The list of brake blocks in Figure 4 is therefore the list of brake blocks referenced in Article 8b of the WAG NTSN.

Manufacturer	Block designation	Nominal (new) diameter of wheel [mm]	Speed of operation [km/hr]	Axle load [t]	Brake configuration				Wheel material	Certificate of Engineering Acceptance Issued
					Bg		Bgu			
					1	2	1	2		
Knorr Bremse	Problock 804UK*	840	100	25.4	✓	✓			R8	1999
		840	120	20.5		✓			R8	1985
		920	100	22.5	✓	✓			R8	1985
		840	120	22.5			✓		R8	1996
	Problock 903UK**	920	100	22.5				✓	ER7 / R7T	1994
Becorit	929-1	840	120	18	✓				R7	2000
		760	120	18	✓				R7	2000
		920	100	22.5		✓			R7	2000
	K961	920	120	22.5	✓				R8	2001
		920	100	25.4	✓				R7	2006
		840	100	25.4	✓				R8	2002
		840	120	20.5	✓				R8	2002
		840	120	22.5			✓		R8	2002
Futuris	HA30	920	100	25.4	✓				R8	2000
		838 (33")	100	25.4	✓				Cast.	2000
		840	120	20.5	✓				R8	2000
		730	120	20.5	✓					
Cobra	W539	1120	120	21	✓				R7	1996
	W573	920	100	25.4	✓				R8	2000
Ferodo	3325	920	100	22.5	✓				R8	2007
Jurid	816	760	120	18	✓				R7	2000
	838	920	100	22.5	✓				R7	
Abex	229	813	120	20	✓				R7T	2002
		840	120	20	✓				R7T	2002

Figure 4: Table G 4 - Composite brake blocks with a history of use on the GB mainline railway

Note:

* ProBlock 804UK has previously been supplied as TBL 804, COSID 804UK and KB804.

** ProBlock 903UK has also been supplied as TBL 903, COSID 903, KB903 and TMD903.

Note:

1Bg: brake block holder on one side of the wheel (push), containing one brake block (one brake block in total).

2Bg: brake block holder on each side of the wheel (clasp), each containing one brake block (two brake blocks in total).

1Bgu: brake block holder on one side of the wheel (push), containing two brake blocks (two brake blocks in total).

2Bgu: brake block holder on each side of the wheel (clasp), each containing two brake blocks (four brake blocks in total).

G2.26.6 A certificate of verification can be issued for a wagon containing brake blocks which do not have an EC or UK declaration of conformity but which are listed in Figure 4, Table G4, and are therefore in Appendix G of the WAG NTSN, until:

a) The expiry date, if any, of the existing approval, or indefinitely if no expiry date is listed, in accordance with Article 8b; and
b) Ten years after the expiry date of the existing approval, in accordance with Article 8c.

G2.26.7 There are currently no expiry dates for existing approval of any of the brake block types listed in Figure 4, Table G4.

Brake blocks not listed in Appendix G of the WAG NTSN

G2.26.8 A certificate of verification for a wagon containing brake blocks which do not have an EC or UK declaration of conformity and are not listed in Appendix G of the WAG NTSN could be issued until either:

a) 1 January 2024, in accordance with Article 8a; or
b) Ten years after the expiry date of any existing approval period, in accordance with Article 8c.

Use of brake blocks in existing wagons

G2.26.9 All of the guidance in clauses *G 2.26.1* to *G2.26.8* is applicable only to the use of brake blocks in new, upgraded or renewed wagons resulting in the need for a certificate of verification to be issued for the wagon. No restrictions are imposed by the WAG NTSN on the continued use of brake blocks in wagons which are already authorised, or deemed to be authorised, including the like-for-like replacement of brake blocks in the course of routine maintenance.

Guidance on composite brake blocks

G 2.26.10 Composite brake blocks have been used in freight wagons on the GB mainline railway since the mid-1980s. Historically, brake blocks were manufactured from cast iron, and some wagons today continue to use cast iron brake blocks. However, the NOI NTSN imposes limits on the operation of wagons equipped with cast iron brake blocks, unless those wagons are exempted from the requirements of the NOI NTSN. Further guidance on restrictions imposed by the NOI NTSN is given in chapter *G3.5*.

G 2.26.11 The UIC designates composite brake blocks in three categories according to their friction level:

a) High friction level, designated K brake blocks;
b) Medium friction level, designated L brake blocks; and
c) Low friction level, designated LL brake blocks.

G 2.26.12 K blocks are generally used in domestic wagons operated on the GB mainline railway. LL brake blocks were developed as a direct replacement for UIC cast iron brake blocks, and are generally used in wagons in continental Europe. L blocks were developed for use on coaching stock operating at higher speeds than is permitted under UIC rules for K or LL blocks.

G 2.26.13 There have been reports of incidents of ineffective braking involving LL brake blocks operating in extreme winter conditions in Scandinavia. Also the different material properties of LL brake blocks and the cast iron brake blocks they replace mean that the friction coefficient of LL brake blocks is lower at low speeds and at standstill, which can affect parking brake performance.

G 2.26.14 The UIC Design Guide for the use of composite blocks does not allow the use of R8 wheel material, whereas this is common on the GB mainline railway. The UIC standard wheel material is R7, which is also used for GB mainline railway applications.

G2.27 Environmental conditions (4.2.5)

4.2.5 Environmental conditions

The design of the unit, as well as its constituents shall take into account the environmental conditions to which this rolling stock will be subjected to.

The environmental parameters are described in the clauses below. For each environmental parameter, a nominal range is defined, which is the most commonly encountered in Europe, and is the basis for the interoperable unit.

For certain environmental parameters ranges other than the nominal one are defined. In that case, a range shall be selected for the design of the unit.

For the functions identified in the clauses below, design and/or testing provisions taken to ensure that the rolling stock is meeting the NTSN requirements in this range shall be described in the technical file.

Depending on the ranges selected and on provisions taken (described in the technical file), appropriate operating rules could be necessary when the unit designed for the nominal range is operated on a particular line where the nominal range is exceeded at certain periods of the year.

The unit and its constituents shall be designed under consideration of one or several of the following external air temperature ranges:

— T1: – 25 °C to + 40 °C (nominal),

— T2: – 40 °C to + 35 °C, and

— T3: – 25 °C to + 45 °C.

The unit shall meet the requirements of this NTSN without degradation for snow, ice and hail conditions as defined in clause 4.7 of EN 50125-2014, which correspond to the nominal range.

Where more severe 'snow, ice and hail' conditions than considered in the standard are selected, the unit and its constituents shall then be designed to meet NTSN requirements considering the combined effect with low temperature according to the temperature range chosen.

In relation with the temperature range T2 and with the severe conditions for snow, ice and hail, the provisions taken to meet NTSN requirements in these severe conditions shall be identified and verified, in particular design and/or testing provisions considering the following functions:

— Coupling function restricted to the resiliency of couplings.

— Brake function, including brake equipment.

The demonstration of conformity is described in point 6.2.2.7.

6.2.2.7 Environmental conditions
Steel materials are deemed to comply with all the ranges indicated in point 4.2.5 if the material properties are determined down to – 20 ˚C.

Guidance

G 2.27.1 The WAG NTSN defines two environmental parameters, both of which include a nominal condition and permit the use of alternatives to the nominal. The two environmental parameters defined are:

a) External air temperature; and
b) Snow, ice and hail conditions.

G 2.27.2 For the external air temperature parameter, the wagon designer can choose to apply different defined conditions, identified as T2 and T3, as alternatives or in addition to the nominal condition, identified as T1. T2 and T3 are for use in conditions that are colder or hotter than the nominal conditions. It is permitted to apply any combination of the three conditions to a single wagon.

G 2.27.3 It is unlikely that any wagon designed for operation solely on the GB mainline railway would experience the lowest temperatures in the T2 condition in the natural environment. However, temperatures above the 40 ˚C limit of the nominal, T1, condition have been experienced in GB and the frequency of these occurring is forecast to increase.

G 2.27.4 RIS-2780-RST gives guidance on the structural properties of materials, including steels, at high and low temperatures such as those at the lower and upper limits of the T2 and T3 ranges.

G 2.27.5 For the snow, ice and hail conditions parameter, the WAG NTSN does not allow the designer to consider conditions which are less severe than the nominal. Only conditions which are more severe than the nominal can be considered, in which case the conditions are required to be considered in combination with the lowest temperatures in the chosen range(s) for the external air temperature parameter.

G 2.27.6 In addition to the two environmental parameters described in the WAG NTSN, it might also be appropriate to consider other environmental parameters in the design of the wagon. Whilst this is not required to achieve authorisation of the vehicle, it could be used to support the demonstration that the vehicle is safe to operate on a particular route and to achieve safe integration.

G 2.27.7 Typically, crosswinds have been an environmental factor that is considered in the design of freight wagons for use on the GB mainline railway. GMRT2142 sets out requirements for rail vehicles to resist overturning in high wind conditions in GB, including a nominal value of wind speed to be used in assessment. The requirements in GMRT2142 are not mandated for freight wagons as the WAG NTSN is silent on crosswinds, but the requirements in GMRT2142 are applicable to all rail vehicles with conventional cant deficiency and design speeds not exceeding 140 km/h, including freight wagons.

G 2.27.8 In addition to considering overturning in crosswinds, if a wagon is intended to carry a non-enclosed or removable load it is important to consider the suitability of the

means of securing the load in crosswind conditions. Further guidance on the security of intermodal load units is given in *G2.5*.

G2.28 Protection against electrical hazards (4.2.6.2)

4.2.6.2 Protection against electrical hazards **4.2.6.2.1 Protective measures against indirect contact (protective bonding)**
The impedance between vehicle body and the running rail shall be low enough to prevent hazardous voltages between them. Units shall be bonded in accordance with the provisions as described in clause 6.4 of EN 50153:2014.

Guidance

G 2.28.1 Clause 6.4 of BS EN 50153:2014+A2:2020 sets out a requirement for there to be at least two protective bonding paths between a vehicle body and the return conductor of the Energy subsystem (that is, the running rail). However the normative Annex A of BS EN 50153:2014+A2:2020 sets out a special national condition permitting the use of a single bonding path for vehicles that operate over the 750 V direct current (dc) third rail system.

G 2.28.2 RIS-2715-RST sets out further requirements and guidance on vehicle bonding for operation on routes with 25 kV alternating current (ac) electrification, including guidance on suitable cross-sectional area for bonding cables.

G 2.28.3 GMRT2113 and GMGN2613 set out further requirements and guidance on vehicle bonding for operation on routes with 750 V dc third rail electrification.

G 2.28.4 Historically, industry practice has been to provide 95 mm^2 bonding cable for vehicles that travel over lines equipped with 750 V dc third rail electrification.

G2.29 Lamp brackets (4.2.6.3)

4.2.6.3 Attachment devices for rear-end signal
On all units designed to receive a rear-end signal, two devices at the end of the unit shall provide for the installation of two lamps or two reflective plates as set out in Appendix E at the same height above rail and not higher than 2 000 mm. The dimensions and clearance of these attachment devices shall be as described in Figure 11 of EN 16116-2:2013.

Guidance

G 2.29.1 Operational rules set out in GERT8000-TW4 require that there must always be a minimum of 9 metres barrier distance between the last wagon carrying toxic gases and the rear of the train, and that tail lamps are not to be attached to tank wagons carrying toxic gases. Wagons used for the transportation of toxic gases are therefore

not permitted to be used as the last vehicle of a train, and lamp brackets or adaptors are not required for such vehicles.

G 2.29.2 RIS-3781-TOM gives guidance on the principals of segregation of dangerous goods that underpin the restrictions set out in GERT8000-TW4.

G 2.29.3 Section *G2.32* gives guidance on the requirements for the rear end signal (tail lamp) used on the GB mainline railway. To meet these requirements, wagons can have a GB-type lamp bracket fitted as shown in GMRT2131, or an adaptor between the UIC signal bracket and GB mainline railway lamp provided. The UIC signal bracket is described in UIC 532.

G2.30 Health and safety conditions (4.7)

4.7 Health and safety conditions
The provisions for health and safety of staff required for the operation and maintenance of units are covered by essential requirements 1.1.5, 1.3.1, 1.3.2, 2.5.1 and 2.6.1 set out in Schedule 2 of the Railways (Interoperability) Regulations 2011. In particular, the following points of Section 4.2 specify provisions for health and safety of staff: — point 4.2.2.1.1: End coupling, — point 4.2.6.1: Fire safety, — point 4.2.6.2: Protection against electrical hazards. If the unit is fitted with a manual coupling system, a free space for shunters during coupling and uncoupling shall be provided. All protruding parts deemed a hazard to operational staff shall be clearly indicated and/or fitted with protective devices. The unit shall be equipped with footsteps and handrails except in those cases it is not intended to be operated with staff on-board, e.g. for shunting.

Guidance

G 2.30.1 It is not common practice for wagons to operate with staff on-board on the GB mainline railway or in depots, so in many cases the NTSN will not mandate the installation of footsteps and handrails. However this clause does not prohibit the fitment of such devices, for example for access when the wagon is stationary. If any access equipment is installed, it is important to consider any risks this could pose including to staff or to trespassers, for example if the wagon is parked under live overhead line equipment (OLE).

G 2.30.2 Requirements for handrails, including loading requirements, for the GB mainline railway are set out in GMRT2100 and RIS-2780-RST. The *Guide for the application of the WAG TSI* refers to EN 16116-2:2013, however the load cases in BS EN 16116-2:2013 are lower than those set out in GMRT2100 and RIS-2780-RST. It is good practice to apply the GB mainline railway loading requirements.

G 2.30.3 It is good practice for steps and handrails to be in a colour that makes them appear conspicuous, so that they can be readily identified by staff in poor light conditions.

G2.31 Additional optional conditions (Appendix C)

Appendix C Additional optional conditions
The compliance with the following set of conditions C.1 to C.18 is optional. If the applicant selects this option, an approved body has to assess the compliance within the UK verification procedure.

Guidance

G 2.31.1 The optional requirements set out in Appendix C are for wagons which are intended to be compatible with UIC requirements for wagon operation across continental Europe, and are not necessary for wagons to be operated on the GB mainline railway. Application of the requirements contained in Appendix C of the WAG NTSN could result in a wagon that is sub-optimal for use on the GB mainline railway.

G2.32 Rear-end signal (Appendix E)

5.3.5 Rear-end signal
The rear-end signal, as described in Appendix E, is an independent IC. There are no requirements in Section 4.2 dealing with the rear-end signal. Its assessment by the approved body is not part of the UK verification of the subsystem.

Appendix E Rear-end signal
1. Lamps The colour of tail lamps shall be in accordance with clause 5.5.3 of EN 15153-1:2013+A1:2016. The tail lamp shall be designed to display a lighting intensity in accordance with table 8 of EN 15153-1:2013+A1:2016. The lamp shall be suitable to be attached to units complying with the attachment devices and the clearance set out in point 4.2.6.3. The lamp shall be equipped with: — a switch (on/off), — a warning light which indicates the battery status.
2. Reflective plates

Guidance

G 2.32.1 The OPE NTSN sets out requirements for freight trains to display red lights as the rear end signal.

G 2.32.2 Requirements for portable tail lamps for use on the GB mainline railway are set out in GMRT2131. The specification for GB mainline railway portable tail lamps differs from that in BS EN 15153-1:2013+A1:2016. The use of portable tail lamps conforming to the specification in GMRT2131 is permitted by the OPE NTSN.

G 2.32.3 The WAG NTSN does not require any tail lamp to be supplied with a freight wagon. The use of tail lamps, and reflective plates, is an operational matter and is dealt with in the OPE NTSN.

Part 3 Guidance on the requirements of NOI NTSN for freight wagons

G3.1 Introduction to technical requirements clauses (4.1, 4.2)

4.1. Introduction
This Chapter sets out the optimal level of harmonisation related to specifications on the rolling stock subsystem intended to limit the noise emission of the GB rail system and to achieve interoperability.

4.2. Functional and technical specifications of the subsystems
The following parameters have been identified as critical for the interoperability (basic parameters): (a) 'stationary noise'; (b) 'starting noise'; (c) 'pass-by noise'; (d) 'driver's cab interior noise'. The corresponding functional and technical specifications allocated to the different categories of rolling stock are set out in this section. In case of units equipped with both thermal and electric power the relevant limit values under all normal operation modes shall be respected. If one of these operation modes foresees the use of both thermal and electric power at the same time the less restrictive limit value applies. There are UK specific cases indicated in Section 7.3. The assessment procedures for the requirements in this section are defined in the indicated points and sub points of Chapter 6.

Guidance

G 3.1.1 Only the parameters (a) 'stationary noise' and (c) 'pass-by noise' are applicable to freight wagons.

G 3.1.2 No noise limits are specified for freight wagons for parameters (b) 'starting noise' and (d) 'driver's cab interior noise', so those sections of the NOI NTSN are not included in the following guidance.

G3.2 Stationary noise (4.2.1)

4.2.1. Limits for stationary noise

The limit values for the following sound pressure levels under normal vehicle conditions concerning the stationary noise allocated to the categories of the rolling stock subsystem are set out in Table 2:

(a) the A-weighted equivalent continuous sound pressure level of the unit ($L_{pAeq,T[unit]}$);

(b) the A-weighted equivalent continuous sound pressure level at the nearest measuring position i considering the main air compressor ($L^{i}_{pAeq,T}$); and

(c) the AF-weighted sound pressure level at the nearest measuring position i considering impulsive noise of the exhaust valve of the air dryer (L^{i}_{pAFmax}).

The limit values are defined at a distance of 7,5 m from the centre of the track and 1,2 m above top of rail.

Table 2

Limit values for stationary noise

Category of the rolling stock subsystem	**$L_{pAeq,T\ [unit]}$ [dB]**	**$L^{i}_{pAeq,T}$ [dB]**	**L^{i}_{pAFmax} [dB]**
Wagons	65	n.a.	n.a.

The demonstration of conformity is described in point 6.2.2.1.

6.2.2.1. Stationary noise

The demonstration of conformity with the limit values on stationary noise as set out in point 4.2.1 shall be carried out in accordance with Sections 5.1, 5.2, 5.3, 5.4, 5.5 (without clause 5.5.2), 5.7 and clause 5.8.1 of EN ISO 3095:2013.

Guidance

G 3.2.1 As an alternative to the requirements for vehicle testing set out in clause 6.2.2.1 of the NOI NTSN, the NOI NTSN also permits a simplified evaluation for vehicles that meet certain criteria. Further details and guidance on this simplified evaluation are set out in section *G3.4*.

G3.3 Pass-by noise (4.2.3)

4.2.3. Limits for pass-by noise

The limit values for the A-weighted equivalent continuous sound pressure level at a speed of 80 km/h ($L_{pAeq,Tp,(80\ km/h)}$) and, if applicable, at 250 km/h ($L_{pAeq,Tp,(250\ km/h)}$) concerning the pass-by noise allocated to the categories of the rolling stock subsystem are set out in Table 4. The limit values are defined at a distance of 7,5 m from the centre of the track and 1,2 m above top of rail.

[...]

Table 4

Limit values for pass-by noise

Category of the rolling stock subsystem	**$L_{pAeq,Tp\ (80\ km/h)}$ [dB]**	**$L_{pAeq,Tp\ (250\ km/h)}$ [dB]**
Wagons (normalised to APL = 0,225)	83	n.a.

The demonstration of conformity is described in point 6.2.2.3.

Note: APL is the number of axles divided by the unit length over the buffers.

6.2.2.3. Pass-by noise

The demonstration of conformity with the limit values on pass-by noise as set out in point 4.2.3 shall be carried out in accordance with points 6.2.2.3.1 and 6.2.2.3.2.

6.2.2.3.1. Test track conditions

The tests shall be performed on a reference track as defined in Section 6.2 of EN ISO 3095:2013. However, it is permitted to carry out the test on a track that does not comply with the reference track conditions in terms of acoustic rail roughness level and track decay rates as long as the noise levels measured in accordance with point 6.2.2.3.2 do not exceed the limit values set out in point 4.2.3. The acoustic rail roughness and the decay rates of the test track shall be determined in any case. If the track on which the tests are performed does meet the reference track conditions, the measured noise levels shall be marked 'comparable', otherwise they shall be marked 'non-comparable'. It shall be recorded in the technical file whether the measured noise levels are 'comparable' or 'non-comparable'. The measured acoustic rail roughness values of the test track remain valid during a period starting 3 months before and ending 3 months after this measurement, provided that during this period no track maintenance has been performed which influences the rail acoustic roughness. The measured track decay rate values of the test track shall remain valid during a period starting 1 year before and ending 1 year after this measurement, provided that during this period no track maintenance has been performed which influences the track decay rates. Confirmation shall be provided in the technical file that the track data related to the type's pass-by noise measurement were valid during the day(s) of testing, e.g. by providing the date of last maintenance having an impact on noise. Furthermore, it is permitted to carry out tests at speeds equal to or higher than 250 km/h on slab tracks. In this case the limit values shall be 2 dB higher than those set out in point 4.2.3.
6.2.2.3.2. Procedure
The tests shall be carried out in accordance with the provision in Sections 6.1, 6.3, 6.4, 6.5, 6.6 and 6.7 (without 6.7.2) of EN ISO 3095:2013. Any comparison against limit values shall be carried out with results rounded to the nearest integer decibel. Any normalisation shall be performed before rounding. The detailed assessment procedure is set out in points 6.2.2.3.2.1, 6.2.2.3.2.2 and 6.2.2.3.2.3.
6.2.2.3.2.2. Wagons

For wagons two classes of maximum operational speed are distinguished:

(1) If the maximum operational speed v_{max} of the unit is lower than or equal to 80 km/h, the pass-by noise shall be measured at its maximum speed. The measured pass-by noise value $L_{pAeq,Tp(vtest)}$ shall be normalised to a reference APL of 0,225 m^{-1} $L_{pAeq,Tp\ (APLref)}$ using formula (3). This value shall not exceed the limit value $L_{pAeq,Tp(80\ km/h)}$ as set out in point 4.2.3.

Formula (3):

$L_{pAeq,Tp\ (APLref)} = L_{pAeq,Tp(vtest)} - 10 * \log(APL_{wag}/0{,}225\ m^{-1})$

APL_{wag} = Number of axles divided by the length over the buffers [m^{-1}]

v_{test} = Actual speed during the measurement

(2) If the maximum operational speed v_{max} of the unit is higher than 80 km/h, the pass-by noise shall be measured at 80 km/h and at its maximum speed. Both measured pass-by noise values $L_{pAeq,Tp(vtest)}$ shall be normalised to the reference speed of 80 km/h and to a reference APL of 0,225 m^{-1} $L_{pAeq,Tp(APL\ ref,\ 80\ km/h)}$ using formula (4). The normalised value shall not exceed the limit value $L_{pAeq,Tp(80\ km/h)}$ as set out in point 4.2.3.

Formula (4):

$L_{pAeq,Tp\ (APLref,\ 80\ km/h)} = L_{pAeq,Tp(vtest)} - 10 * \log(APL_{wag}/0{,}225\ m^{-1}) — 30 * \log(v_{test}/80$ km/h)

APL_{wag} = Number of axles divided by the length over the buffers [m^{-1}]

v_{test}= Actual speed during the measurement

Guidance

G 3.3.1 As an alternative to the requirements for vehicle testing set out in clause 6.2.2.3 of the NOI NTSN, the NOI NTSN also permits a simplified evaluation for vehicles that meet certain criteria. Further details and guidance on this simplified evaluation are set out in clause *G3.4*.

G 3.3.2 80 km/h is equal to 50 mph. Clause 6.2.2.3.2.2 of the NOI NTSN requires that, if a wagon has a maximum permitted speed of greater than 50 mph, testing is conducted at both 50 mph and the wagon's maximum permitted speed. Formula 4 in the NOI NTSN then normalises the results of each of the tests to a reference condition based on both number of wheelsets per unit length and speed. It is the normalised values that are required to be within the limit value set out in Table 4 of the NOI NTSN.

G 3.3.3 Clauses 6.2.2.3.2.1 and 6.2.2.3.2.3 of the NOI NTSN set out requirements for the testing of *EMU, DMUs, locomotive and coaches* and *OTMs* respectively so are deliberately omitted here.

G3.4 Simplified evaluation process (6.2.3)

6.2.3. Simplified evaluation

Instead of the test procedures as set out in point 6.2.2, it is permitted to substitute some or all of the tests by a simplified evaluation. The simplified evaluation consists of acoustically comparing the unit under assessment to an existing type (further referred to as the reference type) with documented noise characteristics.

The simplified evaluation may be used for each of the applicable basic parameters 'stationary noise', 'starting noise', 'pass-by noise' and 'driver's cab interior noise' autonomously and shall consist of providing evidence that the effects of the differences of the unit under assessment do not result in exceeding the limit values set out in Section 4.2.

For the units under simplified evaluation, the proof of conformity shall include a detailed description of the noise relevant changes compared to the reference type. From this description, a simplified evaluation shall be performed. The estimated noise values shall include the uncertainties of the applied evaluation method. The simplified evaluation can either be a calculation and/or simplified measurement.

A unit certified on the basis of the simplified evaluation method shall not be used as a reference unit for a further evaluation.

If the simplified evaluation is applied for pass-by noise, the reference-type shall comply with at least one of the following:

— Chapter 4 and for which the pass-by noise results are marked 'comparable'

— Chapter 4 of Decision 2011/229/EU and for which the pass-by noise results are marked 'comparable'

— Chapter 4 of Decision 2006/66/EC

— Chapter 4 of Decision 2008/232/EC.

In case of a wagon whose parameters remain, compared to the reference type, within the permitted range of Table 7 it is deemed without further verification that the unit complies with the limit values on pass-by noise as set out in point 4.2.3.

6.2.3. Simplified evaluation

Table 7

Permitted variation of wagons for the exemption from verification	
Parameter	**Permitted variation (compared to the reference unit)**
Max. unit speed	Any speed up to 160 km/h
Type of wheel	Only if equally or less noisy (acoustic characterisation i. a. w. Annex E of EN 13979-1:2011)
Tare weight	Only within the range of +20 % / -5 %
Brake block	Only if variation does not result in higher noise emission.

Guidance

G 3.4.1 The simplified evaluation process enables vehicles to be assessed against the requirements of the NOI NTSN without undergoing the full testing requirements set out in section 6.2.2 of the NOI NTSN. Under the simplified evaluation process, the assessment is performed by comparison against a reference vehicle that has already been shown to satisfy either the NOI NTSN requirements or the requirements of a predecessor NOI TSI.

G 3.4.2 For freight wagons, if the differences between the wagon being assessed and the reference wagon are within the ranges set out in Table 7 of the NOI NTSN, no further evaluation of pass-by noise is required. The NOI NTSN does not impose any other limitations on the level of similarity required between the wagon being assessed and the reference wagon beyond those in Table 7.

G 3.4.3 It is still possible to apply the simplified evaluation for pass-by noise to a wagon for which the differences to the reference type are beyond the ranges set out in Table 7 of the NOI NTSN, so long as the other criteria described in section 6.2.3 of the NOI NTSN are met.

G 3.4.4 Table 7 of the NOI NTSN permits an exemption from verification of the applicability of the simplified assessment for any variation, versus the reference wagon, of the maximum permitted speed of the wagon being assessed, up to a maximum speed of 160 km/h (100 mph). This is despite the requirements in clause 6.2.2.3.2.2 of the NOI NTSN which require testing at both 80 km/h and the wagon's maximum permitted speed.

G3.5 Brake equipment for operation on quieter routes

Article 5a
From 8 December 2024, wagons within the scope of the Wagon NTSN which are not covered by point 7.2.2.2 of the Annex to this NTSN shall not be operated on the quieter routes.

7.2.2. Additional provisions for the application of this NTSN to existing wagons
The restriction of the operation set out in Article 5a of this Regulation shall not apply to wagons mostly operated on lines with a gradient of more than 40 ‰, wagons with a maximum operating speed higher than 120 km/h, wagons with a maximum axle load higher than 22,5 t, wagons exclusively operated for infrastructure works and wagons used in rescue trains. If a wagon is being equipped with quieter brake blocks as defined in point 7.2.2.1 and no noise sources are added to the wagon, then it shall be assumed that the requirements of point 4.2.3 are met without further testing.

7.2.2.1 Quieter brake blocks
A quieter brake block is a brake block belonging to one of the following categories: — Brake block listed in Appendix G of the WAG NTSN; — Brake block assessed in accordance with the procedure set out in Appendix F of this NTSN.

7.2.2.2 Wagons operated on quieter routes
Wagons belonging to one of the categories below can be operated on the quieter routes: — Wagons holding an EC declaration of verification against Commission Decision 2006/66/EC concerning the technical specification for interoperability relating to the subsystem 'rolling stock — noise' of the trans-European conventional rail system; — Wagons holding an EC declaration of verification against Commission Decision 2011/229/EU concerning the technical specifications of interoperability relating to the subsystem 'rolling stock – noise' of the trans-European conventional rail system; — Wagons holding a UK declaration of verification against this NTSN — Wagons holding an EC declaration of verification against Commission Implementing Regulation (EU) 2019/774 and used in the UK before 1 January 2021; — Wagons fitted with quieter brake blocks as defined in point 7.2.2.1 or brake discs for the service brake function; — Wagons fitted with composite brake blocks listed in Appendix E for the service brake function. The operation of these wagons on the quieter routes shall be limited in accordance with the conditions described in this appendix.

G3.5.1 General

Guidance

G 3.5.1.1 Article 5a of the NOI NTSN prohibits the operation, after 8 December 2024, of wagons that do not meet certain criteria on parts of the GB mainline railway determined to be 'quieter routes'. Further articles in the NOI NTSN set out the criteria for quieter routes and the process for identifying quieter routes. These articles are not reproduced here.

G 3.5.1.2 Clause 7.2.2. of the NOI NTSN sets out criteria for wagons to be excluded from the prohibition of operation on quieter routes. Such wagons are permitted to operate on quieter routes. The criteria for exclusion can broadly be described as:

a) Operation in conditions that are beyond the limits of UIC certification of composite brake blocks (steeper gradient, higher speed, heavier axle load); or
b) Operation for the purpose of ensuring smooth operation of the rail system (infrastructure maintenance, train rescue).

G 3.5.1.3 Clause 7.2.2.2 of the NOI NTSN sets out the criteria for non-excluded wagons to be permitted to operate on quieter routes. These criteria can be summarised as:

a) Declared as compliant with the requirements of the NOI NTSN or a predecessor NOI TSI; or
b) Equipped with specific braking equipment.

G 3.5.1.4 For non-excluded wagons that do not hold a declaration of verification against a NOI NTSN or NOI TSI, the specific types of braking equipment that are required in order to be permitted to operate on quieter routes are:

a) Quieter brake blocks (see section *G3.5.2*);
b) Historic composite brake blocks (see section *G3.5.3*); or
c) Disc brake equipment (no further guidance).

G 3.5.1.5 There is no requirement for wagons that hold a declaration of verification against a NOI NTSN or NOI TSI to be equipped with any of the specific types of braking equipment.

G 3.5.1.6 In addition, the particular implementation rules in clause 7.4.2. of the NOI NTSN permit non-excluded wagons that satisfy certain alternative criteria to also operate on quieter routes on the GB mainline railway, even if those wagons do not satisfy the criteria set out in clause 7.2.2.2 of the NOI NTSN. Further guidance on the particular implementation rules is given in section *G3.6*.

G3.5.2 Quieter brake blocks

Guidance

G 3.5.2.1 Clause 7.2.2.1 of the NOI NTSN defines a quieter brake block as either:

a) A brake block of a type that is listed in Appendix G of the WAG NTSN; or
b) A brake block of a type that has been assessed in accordance with the procedure in Appendix F of the NOI NTSN.

G 3.5.2.2 Appendix G of the WAG NTSN is the list of fully approved composite brake blocks. Further guidance on Appendix G of the WAG NTSN is given in clause *G2.26*.

G 3.5.2.3 Currently, it is not possible to assess a brake block in accordance with Appendix F of the NOI NTSN because there is no Appendix F in the published version of the NOI NTSN. In the published version of the NOI TSI, Appendix F is entitled '*Assessment of acoustic performance of a brake block*' but the assessment procedure is stated to be an open point. An assessment procedure is expected to be defined when the NOI NTSN is next revised.

G3.5.3 Historic composite brake blocks

Guidance

G 3.5.3.1 Appendix E of the NOI NTSN lists historic composite brake blocks for international use. These are types of brake blocks that have previously been approved for use in accordance with a UIC procedure. As such it is possible that there has been little use of these brake blocks on the GB mainline railway.

G 3.5.3.2 Appendix E of the NOI NTSN states that wagons equipped with the brake blocks listed '*are allowed to be used on the quieter routes within their area of use*'. The brake blocks listed in Appendix E of the NOI NTSN can therefore be used domestically on quieter routes as well as internationally.

G3.6 Particular Implementation Rules

7.4.2. Particular rules for wagons operated on quieter routes (point 7.2.2.2)
(h) Particular rules for wagons operated on quieter routes of Great Britain ('P') For units intended to operate solely on the GB Network, where existing wagons are equipped with composite brake blocks published in GMGN 2688 it shall be permitted to operate on quieter routes ('T') The following types of existing wagons equipped with cast iron brake blocks intended to operate on the GB Network shall be permitted to operate on quieter routes: — Wagons equipped with a non-UIC braking system for which there are no compatible silent brake blocks available for retrofitting until 31 December 2030. — Wagons with a designed braking distance of 810m or less from 60 mph in brake mode G (goods timing)/75 mph in brake mode P (passenger timing), where those wagons are operated in trains with other wagons which have stopping distances in accordance with the relevant UK(GB) national technical rules, until 31 December 2030 — Wagons used exclusively for the transport of nuclear products until 31 December 2050.

Guidance

G 3.6.1 The particular implementation rules are effectively specific cases but are given a different title because they are concerned with the use of the vehicles rather than their design.

G 3.6.2 The particular implementation rules are classified as either:

a) Permanent, identified by 'P'; or
b) Temporary, identified by 'T'

G 3.6.3 The permanent particular implementation rule effectively duplicates the definition of quieter brake blocks in *G 3.5.1.1 a)*, as both ultimately refer to the list of composite brake blocks in Figure *4*.

G 3.6.4 The temporary particular implementation rules apply to wagons equipped with cast iron brake blocks. The wagon characteristics set out in the particular implementation rules describe wagons for which the conversion from cast iron to composite brake blocks is more complicated than assumed under the UIC rules and guidelines which informed the design of LL brake blocks.

G 3.6.5 A non-UIC braking system, referred to in the first temporary particular implementation rule, is one which does not fully satisfy the requirements set out in clause 9 of Appendix C to the WAG NTSN. Such braking systems are beyond the scope of the UIC LL brake block specifications.

G 3.6.6 Leaflet UIC 541-4 sets out the requirements for wagons with an EN-UIC braking system to be able to be equipped with UIC-certified composite brake blocks, either

because the brake block is certified as interchangeable or by demonstrating compatibility, for example through testing. For wagons which do not conform to those requirements there are no compatible silent brake blocks available for retrofitting, therefore the wagons are within the scope of the temporary particular implementation rule.

G 3.6.7 The braking distances quoted in the second temporary particular implementation rule reflect the braking performance of vehicles equipped with a UIC braking system as set out in clause 9 of Appendix C to the WAG NTSN. GB mainline railway wagons, with braking performance in accordance with GMRT2045, have historically had longer stopping distances. The release timings of the EN-UIC braking system are also generally longer than on GB mainline railway wagons.

G 3.6.8 When wagons with an EN-UIC braking system are operated together with GB mainline railway wagons with longer stopper distances and quicker brake release timings, proportionately more energy is transferred to the brakes of the wagons with the EN-UIC braking system. The effect of this is more significant the smaller the proportion of EN-UIC-braked wagons in the train. If the wagons in question are equipped with cast-iron brake blocks this energy can be effectively dissipated as heat through the wheel and brake block. However, if equipped with composite brake blocks less energy can be dissipated through the brake blocks so there is a risk of excessive heating of the wheel.

G 3.6.9 The risk of excessive heating described in *G 3.6.8* can be mitigated by restricting the operation of EN-UIC-braked wagons such that they are not inter-mixed with GB mainline railway wagons with brake performance in accordance with GMRT2045. The temporary particular implementation rule applies to wagons which do not have their operation restricted in this way.

G 3.6.10 The third temporary particular implementation rule, for wagons used exclusively for the transport of nuclear products, is due to the risks associated with such transport and the consequent specific assurance requirements.

Appendices

Appendix A Guidance on wagon dimensions

A.1 Introduction

Guidance

G A.1.1 This appendix gives guidance on values of axle load, vehicle overhang, axle spacing, wheel diameters and maximum speeds relevant to rail freight wagon design.

G A.1.2 Observation of this guidance will help to achieve optimum route access for the wagon design concerned.

A.2 Dimension relative to axle spacings and loads

Guidance

G A.2.1 Information on wagon dimensions related to axle spacings and loads is set out in Figure *5* for bogie wagons and Figure *6* for two-axle wagons.

G A.2.2 Historically, the use of these dimensions has resulted in the optimum route availability for vehicles having the axle weight specified.

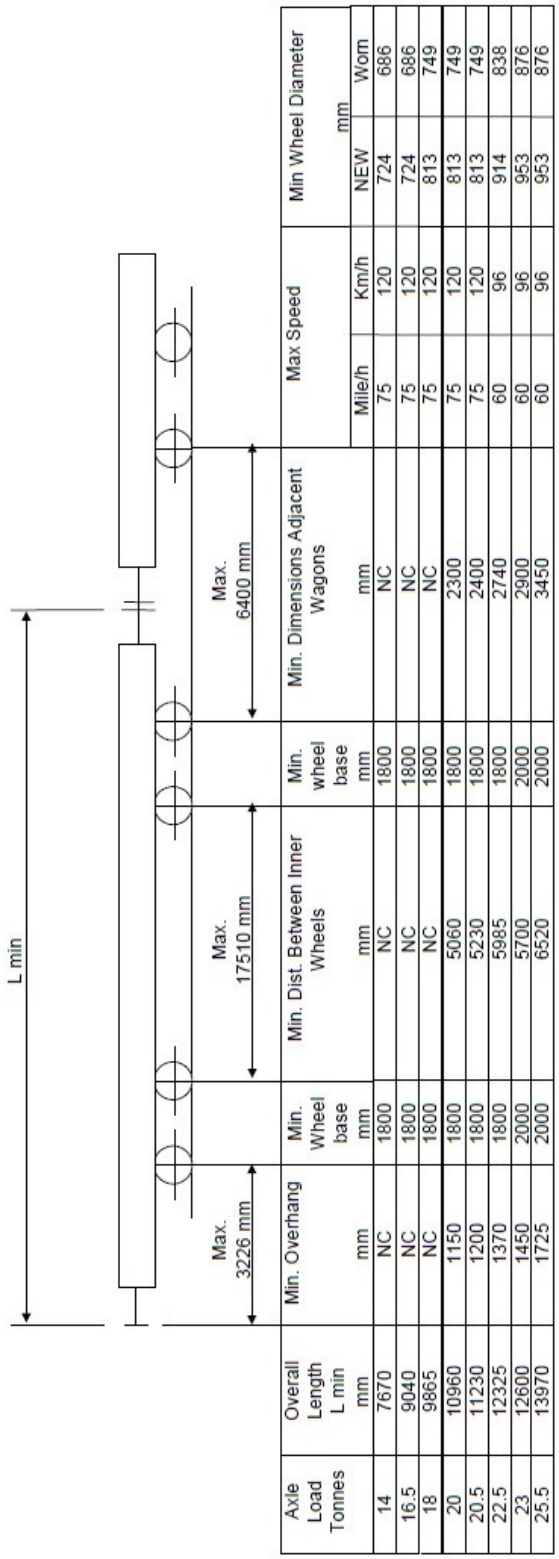
G A.2.3 Vehicles that have been designed to be compatible with the axle spacings and loads shown in Figure *5* or Figure *6* have had extensive, but not universal, route availability. Guidance on route availability is given in section *G2.8*. Some railway structures have more onerous restrictions, sometimes with no diversionary routes, for example, the Royal Albert Bridge, Saltash, such that only vehicles with greater axle spacings or reduced axle loadings are able to achieve compatibility with these railway structures. It is the responsibility of the railway undertaking to ensure that the rail vehicles in traffic are compatible with the routes of operation.

G A.2.4 The dimensions applicable to wagons with axle loads that are between the values shown in Figure *5* and Figure *6* are those associated with the next higher axle load in the respective figure.

G A.2.5 The majority of the dimensions set out in Figure *5* and Figure *6* are determined by compatibility with infrastructure structural requirements. Other requirements, such as vehicle dynamic behaviour have not been considered in their development. The values in Figures *5* and *6* are provided as guidance only, and do not remove the project entity's obligations for wagon designs to comply with applicable standards. Wagons conforming to the minimum dimensions set out might not necessarily operate satisfactorily at the speeds shown in Figure *5* and Figure *6*, which are subject to satisfactory ride and braking performance.

G A.2.6 The wheel diameters and axle loads set out in UIC 510-2, for the range 1000 mm diameter to 760 mm diameter, are suitable for operation on the GB mainline railway with the axle spacing set out in Figure *5* and Figure *6*.

A.3 Bogie wagons



Axle Load Tonnes	Overall Length L min	Min. Overhang	Min. Wheel base	Min. Dist. Between Inner Wheels	Min. wheel base	Min. Dimensions Adjacent Wagons	Max Speed		Min Wheel Diameter mm	
	mm	mm	mm	mm	mm	mm	Mile/h	Km/h	NEW	Worn
14	7670	NC	1800	NC	1800	NC	75	120	724	686
16.5	9040	NC	1800	NC	1800	NC	75	120	724	686
18	9865	NC	1800	NC	1800	NC	75	120	813	749
20	10960	1150	1800	5060	1800	2300	75	120	813	749
20.5	11230	1200	1800	5230	1800	2400	75	120	813	749
22.5	12325	1370	1800	5985	1800	2740	60	96	914	838
23	12600	1450	2000	5700	2000	2900	60	96	953	876
25.5	13970	1725	2000	6520	2000	3450	60	96	953	876

Figure 5: Limiting dimensions - bogie wagon

Guidance

G A.3.1 The maximum distance between the inner wheelsets of a bogie wagon is 17510 mm, and the maximum end overhang, from the outer wheelsets to the buffer face, is 3226 mm. These values are to achieve maximum compatibility with existing track circuit and signalling equipment. A larger overhang of up to up to 4200 mm is also permitted, although with additional safety analysis, as set out in GMRT2173 (see section *G2.9*). The maximum dimensions quoted for inner wheelbase and overhang are separately determined and cannot necessarily be jointly used to develop a vehicle of maximum dimensions.

G A.3.2 It is also important to consider the effects of the wagon wheelbase and overhang dimensions on vehicle gauging (see section *G2.7*) and its ability to safely negotiate small radius curves (see section *G2.3*).

G A.3.3 A minimum end overhang is quoted for axle loads above 18 tonnes; the use of smaller overhangs with these axle loads can result in more restrictive RA ratings, as the RA rating is based on axle load and axle spacing. At axle loads of 18 tonnes or lower the minimum overhang is not critical to infrastructure requirements. However it is important to consider whether any part of the bogie projects beyond the back plane of the 'Berne rectangle'. Requirements for the 'Berne rectangle' are set out in BS EN 16839:2022, which includes special national conditions for GB in its Annex D.

G A.3.4 The values of minimum wheel diameter given for each axle load in figure *5* are for guidance only and the actual minimum wheel diameter is controlled by the requirements set out in BS EN 14363:2016+A2:2022 and GMRT2141 (see section *G2.12*). Some wagons and bogies exhibit good dynamic characteristics despite the wheel diameters being below those set out in Figure *5* for each axle load. For example, some wagons with TF 25 bogies with 25.4 tonne axle load and 840 mm diameter wheels are suitable for operation at up to 60 mile/h.

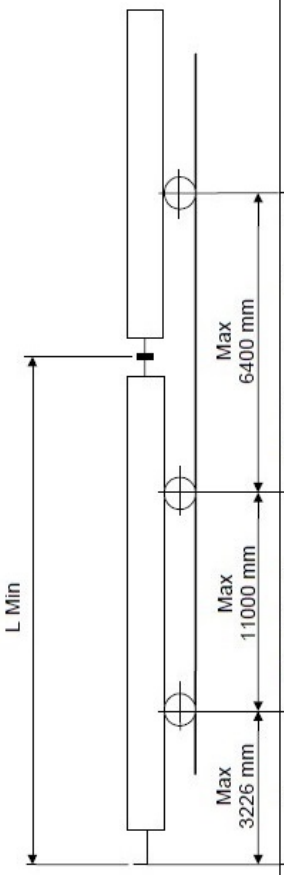
G A.3.5 If it is proposed to use existing three-piece bogies on new wagons, it is important to include details of the sidebearer arrangements as part of the design review and to demonstrate by calculation the relationship between bogie unsprung mass, wheel diameter and static / dynamic wheel forces in order to provide assurance of acceptable levels of track forces.

G A.3.6 Careful selection of bogie rotational resistance helps to provide acceptable flange wear and ensure bogie / wagon lateral stability within the operating speed range and wagon service life. Non-resilient sidebearers have previously not been suitable but the use of resilient sidebearer assemblies can help the wagon meet the ΔQ/Q and rotational resistance requirements in service.

G A.3.7 Experience has shown that the stiff single chevron type (64 ton / inch) sidebearer is unsuitable on aggregate and similar wagons due to the increased sidebearer loads resulting from small amounts of wear of the centre pivot components. If these components are proposed to be used on other wagons it will be important to demonstrate their suitability, for example by long-term pivot wear predictions and ΔQ/Q calculations.

A.4 Two-axle wagons

Note: Vehicle dynamics requirements could preclude the building of new two-axle vehicles for use on the GB mainline railway.



Axle Load Tonnes	Overall Length L min mm	Min Overhang mm	Min. Wheel base mm	Min. Dimensions Adjacent wagons mm	Max Speed		Min. Wheel Diameter	
					Mile/h	Km/h	NEW	WORN
18	5792	1067	3658	2134	75	120	813	749
20.5	7314	1371	4572	2743	75	120	813	746
23	7314	1371	4572	2743	60	96	953	876
25.5	7620	1524	4572	3048	60	96	953	876

Figure 6: Limiting dimensions - two-axle wagon

Guidance

G A.4.1 The maximum end overhang dimension of 3226 mm, indicated on Figure *6*, is to avoid infringement of track circuiting and signalling. However, this maximum dimension could reduce the ability of the wagon to safely negotiate small radius curves. A larger overhang of up to up to 4200 mm is also permitted, although with additional safety analysis, as set out in GMRT2173 (see section *G2.9*).

G A.4.2 Smaller values of overhang, below the minimum values indicated on Figure *6*, can be used, with a minimum dimension equal to half of the wheelbase of a bogie with the same axle load (see Figure *5*). For example if the axle load is 25.4 tonnes, the minimum dimension would be 1000 mm. In such a case, there is a corresponding increase of the minimum distance over buffers as prescribed.

G A.4.3 It is important that no part of the wheel projects beyond the headstock at any time.

G A.4.4 The worn wheel diameters are used to derive the permissible static wheel loads. It is possible to control the permissible static wheel load by increasing the worn wheel diameter and controlling this through the maintenance regime for the wagon type.

Appendix B Guidance for the Design, Construction and Testing of All Tank Wagons

B.1 General

Guidance

G B.1.1 The content of this appendix has been withdrawn pending review. Guidance on the requirements set out in the Regulations concerning the International Carriage of Dangerous Goods by Rail (RID) can be obtained from a dangerous goods safety adviser.

Appendix C Guidance for the Design and Construction of Tanks for Rail Wagons for the Carriage of Dangerous Goods

C.1 General

Guidance

G C.1.1 The content of this appendix has been withdrawn pending review. Guidance on the requirements set out in the Regulations concerning the International Carriage of Dangerous Goods by Rail (RID) can be obtained from a dangerous goods safety adviser.

Appendix D Pressure Relief Devices

D.1 General

Guidance

G D.1.1 The content of this appendix has been withdrawn pending review. Guidance on the requirements set out in the Regulations concerning the International Carriage of Dangerous Goods by Rail (RID) can be obtained from a dangerous goods safety adviser.

Appendix E Design of Filling Lids

E.1 General

Guidance

G E.1.1 The content of this appendix has been withdrawn pending review. Guidance on the requirements set out in the Regulations concerning the International Carriage of Dangerous Goods by Rail (RID) can be obtained from a dangerous goods safety adviser.

Appendix F Application of BS EN 14363:2016+A2:2022

F.1 Extension of acceptance and extent of assessment to be performed

Guidance

G F.1.1 The European foreword to BS EN 14363:2016+A2:2022 sets out the relationship between that standard and previous standards in the same field, including the acceptability of vehicles authorised against previous standards for use as a reference vehicle for extension of acceptance. Further details are set out in Annex U of BS EN 14363:2016+A2:2022, which details the extent of testing to be performed to support extension of acceptance, depending on the safety factor λ. For these purposes, vehicles that have previously been approved to GMRT2141 are considered to have a safety factor λ of greater than 1.1.

G F.1.2 Demonstration of conformity of running dynamic behaviour against the requirements of BS EN 14363:2005 was identified as an open point in previous versions of the WAG TSI. That open point was closed by the publication of BS EN 14363:2016+A2:2022, which incorporated the European Union Agency for Rail (ERA) Technical Document ERA/TD/2012-17/INT.

F.2 Test route

Guidance

G F.2.1 If it is chosen to apply the method set out in BS EN 14363:2016+A2:2022, the track geometry on the GB mainline railway means that there is no need to apply test zones three (small radius curves) and four (very small radius curves) for vehicles that will operate only on the GB mainline railway. This is in accordance with footnote c of Table 2 in BS EN 14363:2016+A2:2022. Further details on this are given in the report PB025305 (2015) *Comparison of the dynamic running behaviour assessment in GM/RT2141 and BS EN 14363.*

G F.2.2 If testing is performed in accordance with BS EN 14363:2016+A2:2022 the results will be invalid if the track sections used do not satisfy the requirements set out in BS EN 14363:2016+A2:2022 for the stability test and test zones one and two.

G F.2.3 If the alternative test method given in Appendix A of GMRT2141 is being used, the requirements for selecting the test track and route are set out in that document, along with further guidance and good practice.

G F.2.4 GMRT2141 contains a requirement to assess a vehicle's susceptibility to cyclic top. For this reason, including jointed track on the test route is no longer a specific requirement within GMRT2141. Cyclic top is not considered in BS EN 14363:2016+A2:2022.

F.3 Test track geometry and rail inclination

Guidance

G F.3.1 BS EN 14363:2016+A2:2022 contains requirements for the range of track geometry to be employed on the test route. If the alternative on-track test method is being used

then GMRT2141 issue four, Appendix A, contains the requirements and guidance for the track geometry.

G F.3.2 The 2005 edition of EN 14363 included a requirement to test on two different rail inclinations. This requirement has been removed in the 2016 edition. Equivalent conicity data is required by BS EN 14363:2016+A2:2022 for stability testing, but not for the other test zones. Checking performance on relatively tight rail gauge, such as below 1433 mm, can give an indication of performance in high conicity conditions.

F.4 Load condition

Guidance

G F.4.1 BS EN 14363:2016+A2:2022 sets out requirements for testing and assessment to be performed in 'empty' and 'laden' conditions. It might also be appropriate to undertake testing in a partially laden condition, for example if:

a) This has historically been undertaken for a design of wagon or running gear used as a reference for an extension of acceptance;
b) Suspension with non-linear characteristics is being used; or
c) The vehicle could be subject to uneven or offset loading, such as container flat wagons which could have lateral and/or longitudinal load imbalances.

G F.4.2 The worst case is typically the tare condition, but for wagons with non-linear suspensions the worst case can occur in other conditions. For wagons with high-rate springs that contact only when laden, the worst case can be when the vehicle is partially laden at a load slightly higher or lower than that which is just sufficient to contact the high-rate springs.

Definitions

cyclic top	A series of regular dips in the vertical alignment of one or both rails. They may not always be apparent visually because other top irregularities may obscure the cyclic pattern. Cyclic irregularities in track geometry have the potential, when combined with a vehicle's natural vertical response for a given speed and load, to cause a derailment.
dangerous goods	Substances and articles the carriage of which is prohibited by RID, or authorised only under the conditions prescribed therein. Source: *RID*
entity in charge of maintenance of a vehicle (ECM)	An ECM is registered as an ECM for a vehicle in the national vehicle register, and can include people or organisations such as railway undertakings, infrastructure managers, keepers or maintenance organisations. Source: *ROGS*
GB mainline railway	'Mainline railway' has the meaning given to it in the Railways and Other Guided Transport Systems (Safety) Regulations 2006 (as amended) and the associated exclusions. 'GB mainline railway' is the mainline railway network excluding any railway in Northern Ireland, the Channel Tunnel, the dedicated high-speed railway between London St Pancras International Station and the Channel Tunnel, and any other exclusions determined by the Secretary of State.
intermodal load unit	Goods container used in intermodal transport. Typically either shipping containers or swap bodies.
interoperability constituent (IC)	An elementary component, group of components, subassembly or complete assembly of equipment incorporated or intended to be incorporated into a subsystem. Interoperability constituents are placed on the market with an intended area of use and are assessed for conformity independently of the subsystem.
National Technical Rule (NTR)	A technical rule used for implementing the essential requirements in the circumstances listed in *RIR*.
National Technical Specification Notice (NTSN)	Document published by the Secretary of State pursuant to regulation 3B of the Railways (Interoperability) Regulations 2011 (as amended) which sets out the standards, technical specifications and technical rules in use in the United Kingdom as amended or varied from time to time. These may be standards to be complied with in relation to the design, construction, placing in service, upgrading, renewal, operation and maintenance of the parts of the rail system. For the purposes of these Regulations, the essential requirements for a project subsystem conforms with applicable National Technical Specification Notices and National Technical Rules. Source: *RIR*

Route Availability (RA)	The assessed capacity of the underline bridges on a route to carry the vertical static and dynamic loads of rail vehicles or the static load characteristic of a rail vehicle type expressed as a route availability (RA) number as set out in GERT8006.
specific case	A special provision in relation to the technical specifications for a subsystem or an interoperability constituent to allow for its compatibility with the rail system, which is set out in an NTSN or an NTR and described in that NTSN or that NTR as a 'UK specific case'.
Union Internationale des Chemins de Fer (UIC)	Railway standards organisation now known as The Worldwide Railway Organisation.

References

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

RGSC 01	Railway Group Standards Code
RGSC 02	Standards Manual

Documents referenced in the text

Railway Group Standards

GERT8006	Route Availability Number for Assessment of Compatibility between Rail Vehicles and Underline Bridges
GERT8073	Application of Standard Vehicle Gauges
GKRT0028	Infrastructure Based Train Detection Interface Requirements
GMRT2045	Compatibility Requirements for Braking Systems of Rail Vehicles
GMRT2100	Rail Vehicle Structures and Passive Safety
GMRT2113	Rolling Stock Subsystem and Interfaces to DC Conductor Rail Energy Subsystem
GMRT2141	Permissible Track Forces and Resistance to Derailment and Roll-Over of Railway Vehicles
GMRT2142	Resistance of Railway Vehicles to Roll-Over in Gales
GMRT2173	Size of Vehicles and Position of Equipment
GMRT2466	Railway Wheelsets

RSSB documents

GERT8000-TW4	Preparation and Working of Freight Trains
GMGN2613	Guidance on Rolling Stock Subsystem and Interfaces to DC Conductor Rail Energy Subsystem
GMGN2641	Guidance Note on Vehicle Static Testing
GMGN2695	Guidance on Testing of Wheel Slide Protection Systems Fitted on Rail Vehicles
RIS-2714-RST	Axle Bearing Condition Monitoring
RIS-2715-RST	Rolling Stock Subsystem and Interfaces to AC Energy Subsystem
RIS-2766-RST	Rail Industry Standard for Wheelsets
RIS-2780-RST	Rail Vehicle Structures
RIS-3781-TOM	Requirements for the operation of freight trains and the conveyance of dangerous goods by any train

RIS-8270-RST	Route Level Assessment of Technical Compatibility between Vehicles and Infrastructure
TN103	Freight Coupler Loads
RIS-8706-INS	Route Level Assessment of Technical Compatibility between Rail Vehicles and Underline Bridges

Other references

BS 5892-8:2012	Railway rolling stock materials - Railway applications. Wheelsets and bogies. Powered and non-powered wheelsets with inboard bearings. Product requirements
BS 8535:2011	Railway applications. Wheelsets and bogies. Powered and non-powered axles with inboard bearings. Design method
BS EN 12082:2007+A1:2010	Railway applications. Axleboxes. Performance testing
BS EN 12561-4:2011	Railway applications. Tank wagons - Devices for top filling and emptying of liquid products
BS EN 12561-6:2011	Railway applications. Tank wagons - Manholes
BS EN 12663-1:2010+A1:2014	Railway applications. Structural requirements of railway vehicle bodies - Locomotives and passenger rolling stock (and alternative method for freight wagons)
BS EN 12663-2:2010	Railway applications. Structural requirements of railway vehicle bodies - Freight wagons
BS EN 13103:2009+A2:2012	Railway applications. Wheelsets and bogies. Non-powered axles. Design method
BS EN 13260:2009+A1:2010	Railway applications. Wheelsets and bogies. Wheelsets. Product requirements
BS EN 13715:2020	Railway applications. Wheelsets and bogies. Wheels. Tread profile
BS EN 13749:2011	Railway applications. Wheelsets and bogies. Method of specifying the structural requirements of bogie frames
BS EN 13979-1:2003+A2:2011	Railway applications. Wheelsets and bogies. Monobloc wheels. Technical approval procedure - Forged and rolled wheels
BS EN 14363:2016+A2:2022	Railway applications. Testing and Simulation for the acceptance of running characteristics of railway vehicles. Running Behaviour and stationary tests
BS EN 14531-6:2009	Railway applications. Methods for calculation of stopping and slowing distances and immobilization braking - Step by step calculations for train sets or single vehicles
BS EN 15153-1:2013+A1:2016	Railway applications. External visible and audible warning devices for trains - Head, marker and tail lamps

BS EN 15273-2:2013+A1:2016	Railway applications. Gauges - Rolling stock gauge
BS EN 15437-1:2009	Railway applications. Axlebox condition monitoring. Interface and design requirements - Track side equipment and rolling stock axlebox
BS EN 15528:2015	Railway applications. Line categories for managing the interface between load limits of vehicles and infrastructure
BS EN 15551:2009+A1:2010	Railway applications. Railway rolling stock. Buffers
BS EN 15566:2009+A1:2010	Railway applications. Railway rolling stock. Draw gear and screw coupling
BS EN 15595:2018	Railway applications. Braking. Wheel slide protection
BS EN 15807:2021	Railway applications. Pneumatic half couplings
BS EN 15877-1:2012	Railway applications. Marking on railway vehicles - Freight wagons
BS EN 16116-2:2013	Railway applications. Design requirements for steps, handrails and associated access for staff - Freight wagons
BS EN 16235:2013	Railway application. Testing for the acceptance of running characteristics of railway vehicles. Freight wagons. Conditions for dispensation of freight wagons with defined characteristics from on-track tests according to EN 14363
BS EN 16834:2019	Railway applications. Braking. Brake performance
BS EN 16839:2022	Railway applications. Rolling stock. Head stock layout
BS EN 50125-1:2014	Railway applications. Environmental conditions for equipment - Rolling stock and on-board equipment
BS EN 50153:2014+A2:2020	Railway applications. Rolling stock. Protective provisions relating to electrical hazards
BS EN ISO 3095:2013	Acoustics. Railway applications. Measurement of noise emitted by railbound vehicles
CCS NTSN (2021)	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
	Procedures for Inspection Bodies - Testing and Inspection of UK Tanks
ERA/ERTMS/033281	Interfaces between control-command and signalling trackside and other subsystems

ERA/TD/2012-17/INT	Application of EN 14363:2005 – modifications and clarifications
ERA/TD/2013-02/INT version 3.0	Friction elements for wheel tread brakes for freight wagons
Guide for the application of the WAG TSI	Application Guide GUI/WAG TSI/2021
HS LOC&PAS TSI (2008)	2008/232/EC: Commission Decision of 21 February 2008 concerning a technical specification for interoperability relating to the rolling stock sub-system of the trans-European high-speed rail system (notified under document number C(2008) 648)
INF NTSN (2021)	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
IRS 50571-4:2022	Wagons for combined transport - Vertical transhipment - Characteristics
Modules NTSN (2021)	National Technical Specification Notice on Modules for the procedures for assessment of conformity or suitability for use and UK verification (modules). Published by the Secretary of State on 1 January 2021 pursuant to regulation 3B of the Railways (Interoperability) Regulations 2011 and comes into force on implementation period (IP) completion day (as defined in regulation 39(1) of the European Union (Withdrawal Agreement) Act 2020). This notice replaces and replacing Commission Decision 2010/713(EU) of 9 November on modules for the procedures for assessment of conformity, suitability for use and EC verification to be used in the technical specifications for interoperability
NOI NTSN (2021)	Noise National Technical Specification Notice (NOI 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) 1304/2014 of 26 November 2014 (the NOI TSI) and includes relevant amendments made by Decision 2008/232/EC of 21 February 2008 and repealing Decision 2011/229/EU of 4 April 2011, and Commission Implementing Regulation (EU) 2019/774 which came into force in June 2019
NOI TSI (2006)	2006/66/EC: Commission Decision of 23 December 2005 concerning the technical specification for interoperability relating to the subsystem rolling stock — noise of the trans-European conventional rail system (notified under document number C(2005) 5666)

NOI TSI (2011)	2011/229/EU: Commission Decision of 4 April 2011 concerning the technical specifications of interoperability relating to the subsystem 'rolling stock – noise' of the trans-European conventional rail system (notified under document C(2011) 658)
NR/GN/SIG/50011	Methodology for the Demonstration of Compatibility with Axle Counters
OPE NTSN (2021)	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
PB025305	'Comparison of the dynamic running behaviour assessment in GM/RT2141 and BS EN 14363' July 2015, available on Spark
RAIB Report 12/2009	Detachment of containers from freight wagons near Cheddington and Hardendale, 1 March 2008
RAIB Report 19/2015	Container detachments at Scout Green, Cumbria, 7 March 2015 and near Deeping St Nicholas, Lincolnshire, 31 March 2015
Regulation (EU) 2019/774	Commission Implementing Regulation (EU) 2019/774 of 16 May 2019 amending Regulation (EU) No 1304/2014 as regards application of the technical specification for interoperability relating to the subsystem 'rolling stock — noise' to the existing freight wagons (Text with EEA relevance.)
Regulation (EU) 402/2013	Commission implementing regulation (EU) no 402/2013 on the common safety method for risk assessment and repealing Regulation (EC) 352/2009
RID	Regulations concerning the International Carriage of Dangerous Goods by Rail - Convention concerning International Carriage by Rail (COTIF) Appendix C
SI 2011/3066	Railways (Interoperability) Regulations 2011 (as amended)
T1256 RSSB (2022)	Guidance on the Limits of Freight Train Trailing Length as Governed by Coupler Strength
UIC 530-2	Wagons - Running safety
UIC 532	Trailing stock. Signal lamp brackets. Coaches. Fixed electric signal lamps
UIC 541-4	Brakes - Composite brake blocks - General conditions for certification and use
UIC 544-1 (2014)	Brakes - Braking Performance

UIC 571-4	Standard wagons - Wagons for combined transport - Characteristics
WAG NTSN (2021)	Rolling Stock (Freight Wagons) National Technical Specification Notice (WAG 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) 321/2013 of 13 May 2013 (the WAG TSI), and includes relevant amendments made by Commission Regulation (EU) 1236/2013 of 2 December 2013 and Commission Implementing Regulation (EU) 2019/776 which came into force in June 2019