BRITISH STANDARD

BS EN 15663:2009

Railway applications — Definition of vehicle reference masses

ICS 01.040.45; 45.060.01

BSI British Standards

National foreword

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A list of organizations represented on this committee can be obtained on request to its secretary.

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Bahnanwendungen - Fahrzeugmassedefinitionen

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Foreword

This document (EN 15663:2009) has been prepared by Technical Committee CEN/TC 256 “Railway Applications”, the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by November 2009, and conflicting national standards shall be withdrawn at the latest by November 2009.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This standard aims to support the TSIs and European standards on the calculation of vehicle masses.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive 2008/57/EC.

For relationship with EU Directive 2008/57/EC, see informative Annex ZA, which is an integral part of this document.

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Introduction

To define the design, testing and operation of vehicles in general and their main constituent parts it is necessary to clearly specify the associated states of loading. In the past different descriptions and definitions of vehicle masses and load states have been given in national and international standards and the meaning has been different. With the introduction of Interoperability and the increased importance of European standards it has become necessary to have a common set of reference masses on which the assessment of loads and performance can be based. This European Standard provides such a set of vehicle reference masses and describes how each is to be derived.

1 Scope

The purpose of this document is to define a set of reference masses that can be used as a common starting point for specifying the requirements for the design, testing, delivery acceptance, marking and operation of rail vehicles. It is not the intention of this European Standard to change the dimensioning of vehicle system components by the definition of these common reference masses. However, when the relevant standards are revised or new ones developed, the masses to be used in these vehicle system component standards as the basis for the design should be expressed as a function of the reference mass states defined in this standard. Until the standards are changed the existing criteria continue to apply.

This document covers all types of rail vehicles.

For the purpose of vehicle mass definitions rolling stock is divided into three vehicle groups which are:

— high speed and other long distance trains;

— passenger vehicles other than high speed and long distance trains, including metro and tramway;

— freight vehicles (wagons and freight motored units).

Locomotives are treated as passenger vehicles without payload.

The specification of the technical requirements of the railway vehicle should contain the information to which vehicle group it belongs.

NOTE “Long distance” includes all passenger trains not intended to be used on commuter and suburban services. In this standard, commuter is understood as: for the French network: RER; for the German network: S-Bahn.

The masses defined in this European Standard are as follows (see Clause 2):

a) dead mass;

b) design mass;

   1) design mass, in working order;

   2) design mass under normal payload;

   3) design mass under exceptional payload;

c) operational mass;

   1) operational mass, in working order;

   2) operational mass under normal payload.

These masses are defined with respect to the whole vehicle, but they can also apply to a specific system or component.

2 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

2.1 Mass definitions

2.1.1
dead mass
mass of the vehicle in the “as built” condition without consumables and without staff

NOTE Dead mass corresponds to the mass of a complete vehicle as built with all permanently installed components including parts subject to wear in the "new state" (e.g. discs, brake pads, wheels…) but with no consumables (e.g. combustibles, sand, food and beverage, clean and waste water). It includes the interior fittings and furniture, operating fluids (e.g. insulating fluids, cooling fluids, heating fluids, transmission fluids lubricants, batteries electrolyte…), catering equipment (e.g. utensils, cutlery and table linen…), tools and emergency equipment. See also Clause 3.

2.1.2
design mass
mass to be considered for the design of the vehicle and its components

2.1.2.1
design mass in working order
mass of the vehicle equipped with all the consumables and occupied by all the staff, which it requires in order to fulfil its function but empty of any payload (i.e. dead mass + consumables + staff)

NOTE 1 Consumables are defined in Table 2 column A.

NOTE 2 This state is also described as the unladen mass or tare weight.

2.1.2.2
design mass under normal payload
design mass of the vehicle in working order plus the normal design payload

NOTE The normal design payload is defined in Tables 3, 4 and 5, columns A. It is typical of the highest payload seen on a regular basis and it is determined by the type of rolling stock and / or the level of comfort associated with the type of service being provided.

2.1.2.3
design mass under exceptional payload
design mass of the vehicle in working order plus the exceptional payload

NOTE The exceptional payload is defined in Tables 3, 4 and 5, columns A. It is determined by the type of rolling stock and it is the maximum payload that can be transported and will be experienced only under exceptional conditions (e.g. exceptional number of passengers). It represents the design limit for operation of the vehicle.

2.1.3
operational mass
mass representing the state of the vehicle or whole train in average operational conditions that is appropriate for the assessment of operational issues (see note in 2.1.3.2)

2.1.3.1
operational mass in working order
mass of the vehicle with an average level of consumables and occupied by all the staff, which it requires in order to fulfil its function but empty of any payload (i.e. dead mass plus average consumables plus staff minus half the wear allowance of the parts subject to wear)

NOTE Average consumables are defined in Table 2 column B.

2.1.3.2
operational mass under normal payload
operational mass of the vehicle in working order plus the normal operational payload

NOTE 1 The normal operational payload is defined in Tables 3, 4 and 5, columns B. It is determined by the type of rolling stock and / or the level of comfort associated with the type of service being provided.

NOTE 2 This state may be used to determine such track access conditions as scheduling, energy consumption, vehicle marking, nominal static axle load etc, and LCC calculation.

NOTE 3 Table 1 summarises the relationships between the masses defined in this standard.

Table 1 — Relationship between masses defined in this standard

	"Design mass"	**"Operational mass"**
Dead mass	Vehicle in the "as built" condition without consumable and without staff	
Mass in working order	Dead mass plus consumables plus staff (See Table 2 – column A)	Dead mass plus average consumables plus staff minus half the wear allowance of the parts subject to wear (See Table 2 – column B)
Mass under normal payload	Design mass in working order plus normal design payload (see Tables 3, 4 and 5 columns A)	Operational mass in working order plus normal operational payload (see Tables 3, 4 and 5 columns B)
Mass under exceptional payload	Design mass in working order plus exceptional payload (see Tables 3, 4 and 5 columns A)	**Not applicable**

2.2 Other terms

2.2.1
luggage compartment
closed area, for the carriage of luggage and goods, which is not intended for the transport of passengers

2.2.2
luggage area
area in passenger saloon or vestibule provided specifically for passengers to store luggage and which cannot be used as a standing area

NOTE Overhead racks are not regarded as luggage area.

2.2.3
catering area
area without fixed seats where passengers remain while receiving a service (e.g. bar, or bistro)

NOTE See Clause 5 for guidance how to determine this area.

2.2.4
standing area
unobstructed area which can be used by passenger (e.g. vestibule, corridor, stairways, wheelchair area...)

NOTE See Clause 5 for guidance how to determine this area.

2.2.5
normal seat
a permanent seat in a designated seating area that provides a level of comfort consistent with the type of service being provided

NOTE 1 In some applications seats giving a normal level of comfort can be folded and for the purposes of this standard should be considered as normal seats (not tip up).

NOTE 2 For special applications like sleeping cars, sleeping berths should be considered as normal seats.

2.2.6
tip up seat
basic folding seat fixed to a wall or partition for temporary use

3 Dead mass determination

At the start of a project the dead mass is an estimated value based on the best information available (calculations and weighed components etc.). The value is refined as the project progresses and more accurate information becomes available. The estimated dead mass is to be verified by weighing the first vehicles as they are built.

The dead mass shall be determined on the basis of the average mass of at least the first 5 weighed vehicles of each design (or the full fleet if it is less than 5).

4 Staff and consumables

Table 2 defines how the mass of staff and consumables shall be determined. Annex A provides additional information on consumable densities.

Table 2 — Staff and consumables

<table>
<tr><th rowspan="2">Elements to be taken into account to define masses</th><th colspan="2">Conditions in which the elements are to be taken into account according to the relevant load state</th></tr>
<tr><th>Design mass in working order
(A)</th><th>Operational mass, in working order
(B)</th></tr>
<tr><td>Driver(s)
Train crew
Catering staff</td><td colspan="2">80 kg per person
(including personal equipment and belongings)</td></tr>
<tr><td>Combustibles used as Fuel</td><td>Fuel in tanks “full” (maximum design quantity)</td><td>$^2/_3$ maximum design quantity</td></tr>
<tr><td>Sand</td><td>Sand boxes Full (maximum design quantity)</td><td>$^2/_3$ maximum design quantity</td></tr>
<tr><td>Food and beverages including water for drinking and cooking</td><td>Maximum design quantity</td><td>½ maximum design quantity</td></tr>
<tr><td>Clean water of washbasin supply reservoirs and of toilet supply reservoirs
(Common or independent reservoirs) and dishwashing</td><td rowspan="2">Maximum design quantity of the biggest tank (clean or waste)</td><td rowspan="2">The greater value of :
maximum design quantity of clean water
or
½ design quantity of the waste tank,</td></tr>
<tr><td>Content of the controlled emission toilet (CET) storage tanks with or without recirculation</td></tr>
<tr><td>Washing water for the windscreen</td><td>Specified maximum fluid level</td><td>2/3 full</td></tr>
</table>

For freight vehicles, the operational mass of consumables is the same as the design mass.

5 Standing area calculation

The standing area is calculated with tip up seats and folding tables in closed position and by taking into account half the projected area of internal stairways.

The standing area does not include:

a) projected areas of normal seats (including backs and armrests) on the floors plus a 300 mm deep area for the feet of the seated passengers, which extends over the full width of the seat;

NOTE 1 Where experience in a type of service indicates that a smaller depth allowance for feet is appropriate, this smaller value should be used.

b) projected areas of fixed tables on the floors;

c) area restricted to drivers and other train crew and/or areas where standing is prohibited;

d) steps and other areas that are only used when boarding or alighting;

e) areas, except stairways, that due to their limited dimensions (width or length under 300 mm), are unsuitable for standing;

f) areas where the height is less than 1 850 mm;

NOTE 2 Where experience in a type of service indicates that a lower height is acceptable to passengers the standing area shall be based on the usage for the type of operation

g) areas which are used for toilets, washing areas or similar.

6 Payloads

6.1 Payloads for high speed and long distance trains

The payloads to be used for the different masses are given in Table 3.

Table 3 — Payloads for high speed and long distance trains

	(A) **"Design mass"**	**(B)** **"Operational mass"**
Normal payload	**Normal design payload** Passenger mass = 80 kg (including luggage). 100 % of normal seats occupied tip up seats not counted except when otherwise specified by the operator for the service being provided 0 kg/m^2 (0 passenger/m^2) in standing areas 300 kg/m^2 in luggage compartments	**Normal operational payload** Passenger mass = 80 kg (including luggage) 80 % of the normal payload passenger design mass (seated and standing) 150 kg/m^2 in luggage compartments

	0 kg/m2 in luggage areas (this luggage is included in the passenger mass) 100 kg /m^2 (1,25 passenger/m^2) in catering areas. This load is transferred from other parts of the train when passengers seek catering services and shall not be included in the calculations concerning the mass of the whole train.	0 kg/m^2 in luggage areas 0 kg/m^2 in catering areas [a]. The load is transferred from other parts of the train when passengers seek catering services and shall not be included in the calculations concerning the mass of the whole train.
Exceptional payload	Passenger mass = 80 kg (including luggage). 100 % of normal seats occupied tip up seats not counted except when otherwise specified by the operator for the service being provided 160 to 320 kg/m^2 (2 to 4 passengers/m^2) in standing areas (see paragraph below) 160 to 320 kg/m^2 (2 to 4 passengers/m^2) in catering areas (see paragraph below) 300 kg/m^2 in luggage compartment 0 kg/m^2 in luggage areas (this luggage is included in the passenger mass)	**Not applicable**
[a] according to HS TSI Rolling Stock		

The standing passenger loading of 320 kg/m² for exceptional payload is typical of the loadings occurring in European countries. For certain types of service, the exceptional payload may be less than this. At the request of the organization which has the responsibility for defining the technical requirements for the vehicle a standing payload of less than 320 kg/m² is permissible and should be used if it is applicable for the particular service (e.g. HS TSI Class 1, sleeping cars,….).

6.2 Payloads for passenger vehicles other than high speed and long distance trains

The payloads to consider for the different masses are given in Table 4.

Table 4 — Payloads for passenger vehicles other than high speed or long distance trains

	(A) **"Design mass"**	**(B)** **"Operational mass"**
Normal payload	**Normal design payload** passenger mass = 70 kg (luggage to be considered as defined below) hand luggage needs not to be considered 100 % of normal seats occupied, tip up seats not counted except when otherwise specified by the operator for the service being provided 280 kg/m^2 (4 passengers/m^2) in standing and	**Normal operational payload** passenger mass = 70 kg (luggage to be considered as defined below) hand luggage needs not to be considered 80 % of the normal payload passenger design mass (seated and standing)

	catering areas 300 kg/m^2 in luggage compartments 100 kg/m^2 on each surface of the luggage areas	 150 kg/ m^2 in luggage compartments 80 kg/m^2 on each surface of the luggage areas
Exceptional payload	passenger mass = 70 kg (luggage to be considered as defined below) hand luggage needs not to be considered 100 % of normal seats occupied, tip up seats not counted except when otherwise specified by the operator for the service being provided 500 kg/m^2 in standing and catering areas except when otherwise specified by the operator (see paragraph below) 300 kg/m^2 in luggage compartments 100 kg/m^2 on each surface of the luggage areas	**Not applicable**

The standing passenger loading for exceptional payload is typical of the loadings occurring in European countries. Depending on the type of service the exceptional payload varies from 350 kg/m² to 700 kg/m² (5 to 10 passengers/m²). At the request of the organization which has the responsibility for defining the technical requirements for the vehicle a deviation from the 500 kg/m² value is permissible within this range and shall be used if it is applicable for the particular service. For instance:

a) for certain types of double deck vehicles and suburban vehicles (e.g. with only end access) a lower standing payload could be appropriate when agreed by the operator,

b) for certain types of commuter services a higher standing payload may be required.

6.3 Payloads for freight vehicles

The payloads to consider for the different masses are given in Table 5.

Table 5 — Payloads for freight vehicles

	(A) **“Design mass"**	**(B)** **“Operational mass”**
Normal payload	Maximum payload specified for the vehicle	Maximum payload specified for the vehicle

There are no partially loaded or exceptional payload reference states for freight vehicles. The payload is always taken as the maximum payload specified for the vehicle.

The maximum payload is specified in the load table of the vehicle.

The vehicle mass in working order plus this payload is also described as the vehicle laden mass.

Annex A
(informative)

Densities

If specific information is not available the densities indicated in Table A.1 may be used to determine the corresponding masses.

Table A.1 — Density by product

Products	Densities (in kg/dm^3)
Diesel fuel	0,84
Paraffin-free fuel	0,80
Electrolyte	1,2
Ethylene glycol	1,115
Cooling liquid with antifreeze	1,04
Lubricant oil	0,95
Insulating oil	0,91
Dry sand	1,5

Annex ZA
(informative)

Relationship between this European Standard and the Essential Requirements of Directive 2008/57/EC

This European Standard has been prepared under mandates given to CEN/CENELEC/ETSI by the European Commission and the European Free Trade Association to provide a means of conforming to Essential Requirements of the New Approach Directive 2008/57/EC[1)].

Once this standard is cited in the Official Journal of the European Communities under that Directive and has been implemented as a national standard in at least one Member State, compliance with the clauses of this standard given in Table ZA.1 for High Speed Rail and Tables ZA.2 and ZA.3 for Conventional Rail confers, within the limits of the scope of this standard, a presumption of conformity with the corresponding Essential Requirements of that Directive and associated EFTA regulations.

Table ZA.1 — Correspondence between this European Standard, the HS TSI RST, published in the Official Journal on 26 March 2008, and Directive 2008/57/EC

Clause(s)/sub-clause(s) of this European Standard	Chapter/ § of the TSI	Essential Requirements of Directive 2008/57/EC	Comments
The whole standard is applicable	4.2.2.3.3 Strength of vehicle structures. Specifications (simple load cases and design collision scenarios) 4.2.3.2 Rolling stock dynamic behaviour. Static axle load 4.2.4.1 Braking. Minimum braking performance 4.2.8.1 Traction and electrical equipment. Traction performance requirements	1 General Requirements Clauses 1.1.2 and 1.1.3 Safety Clause 1.5 Technical compatibility 2.4 Requirements Specific to Rolling Stock Subsystem Clause 2.4.3 § 3 Technical compatibility	

1) Official Journal of the European Communities No L 191 of 18.7.2008

Table ZA.2 — Correspondence between this European Standard, the CR TSI RST Freight Wagon dated July 2006, published in the Official Journal on 8 December 2006, and Directive 2008/57/EC

Chapter/§/annexes of this European Standard	Chapter/§/ annexes of the TSI	Corresponding text, articles/§/annexes of the Directive 2008/57/EC	Comments
Chapter 1 Scope Chapter 2 Terms and definitions Chapter 3 Dead mass determination Chapter 4 Staff and consumables Chapter 6 Payloads Chapter 6.3 Payloads for freight vehicles	Chapter 4 Characterisation of the subsystem 4.2. Functional and technical specifications of the subsystem 4.2.2. Structures and mechanical parts 4.2.2.3 Strength of main vehicle structure and securing of freight 4.2.2.4 Doors closing and locking 4.2.3 Vehicle track interaction and gauging 4.2.3.2 Static axle load and linear load 4.2.3.4 Vehicle dynamic behaviour 4.2.4 Braking 4.2.4.1 Braking performance 4.3 – Functional and technical specifications of the interfaces 4.3.2 Control and Command and Signalling subsystem 4.3.2.1 Static axle load, dynamic wheel load and linear load 4.3.2.4 Braking Chapter 5 Interoperability constituents 5.4 Constituents performances and specifications 5.4.2.1 Bogie and running gear Chapter 6 Assessment of conformity and/or suitability for use of the constituents and verification of the subsystem 6.2 Subsystem conventional rail rolling stock freight wagons 6.2.1 Assessment procedures	Annex III, Essential Requirements, - General Requirements – Clauses Clause 1.1.1 Safety Clause 1.4 Environmental protection Clause 1.5 Technical compatibility - Requirements Specific to Rolling Stock Subsystem Clause 2.4.3 Technical compatibility	Vehicle mass definition is not a specific requirement in the TSI but the standard permits a consistent approach in applying the requirements of the quoted clauses in the TSI.

Table ZA.2 *(continued)*

Clauses/§/annexes of this European Standard	Chapter/§/ annexes of the TSI	Corresponding text, articles/§/annexes of the Directive 2008/57/EC	Comments
	Annex B Structures and mechanical parts, Marking of freight wagons Annex D Vehicle track interaction and gauging, Static axle load, dynamic wheel load and linear load Annex CC Structure and mechanical parts, Sources of fatigue loading Annex YY Structures and mechanical parts, Strength requirements for certain types of wagon components		

Table ZA.3 — Correspondence between this European Standard, the CR TSI Locomotive and Passenger Rolling Stocks (Preliminary draft Rev 1.0 dated 27 August 2008) and Directive 2008/57/EC

Clause(s)/sub-clause(s) of this European Standard	Chapter/ § of the TSI	Essential Requirements of Directive 2008/57/EC	Comments
The whole standard is applicable	4.2.2.10 Structure and mechanical parts. Load conditions and weighted mass 4.2.3.2 Axle load 4.2.3.5.1 Running gear Structural design of bogie frame 4.2.3.5.2 Running gear. Wheelsets 4.2.4.1 Braking. General 4.2.8.1.1 Traction and electrical equipment. Traction performance. General	1.General Requirements Clauses 1.1.2 and 1.1.3 Safety Clause 1.5 Technical compatibility 2.4 Requirements Specific to Rolling Stock Subsystem Clause 2.4.3 §3 Technical Compatibility	prEN 15663:April 2007 is quoted in the TSI for load conditions and weighted mass of the structure and mechanical parts. The CR TSI Locomotives and Passenger RST is still a draft subject to change without notice

WARNING — Other requirements and other EU Directives may be applicable to the product(s) falling within the scope of this standard.

Bibliography

[1] EN 12663, *Railway Applications — Structural requirements of railway vehicle bodies*

[2] EN 12299, *Railway applications — Ride comfort for passengers — Measurement and evaluation*

[3] EN 13103, *Railway applications — Wheelsets and bogies — Non powered axles — Design method*

[4] EN 13104, *Railway applications — Wheelsets and bogies — Powered axles — Design method*

[5] EN 13749, *Railway applications — Wheelsets and bogies — Methods of specifying structural requirements of bogie frames*

[6] EN 13979-1, *Railway applications — Wheelsets and bogies — Monobloc wheels — Technical approval procedure — Part 1: Forged and rolled wheels*

[7] EN 13452-1, *Railway applications — Braking — Mass transit brake systems — Part 1: Performance requirements*

[8] EN 13452-2, *Railway applications — Braking — Mass transit brake systems — Part 2: Methods of test*

[9] EN 14363, *Railway applications — Testing for the acceptance of running characteristics of railway vehicles — Testing of running behaviour and stationary tests*

[10] EN 15179, *Railway applications — Braking — Requirements for the brake system of coaches*

[11] EN 15528, *Railway applications — Line categories for managing the interface between load limits of vehicles and infrastructure*

[12] NF F 01-301, *Matériel roulant ferroviaire — Masses et états de charge des véhicules moteurs et des véhicules remorques à voyageurs*

[13] DIN 25008, *Schienenfahrzeuge — Grundsätze für die Bestimmung der Fahrzeugmassen — Begriffe, Formelzeichen, Werte*

[14] GM/RT2100, (Issue 3) *Structural Requirements for Railway Vehicles*

[15] UIC 566, *Loadings of coach bodies and their components*

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