SLOVENSKI STANDARD
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Železniške naprave - Konstrukcijske zahteve za grode železniških vozil - 2. del: Tovorni vagoni

Railway applications - Structural requirements of railway vehicle bodies - Part 2: Freight wagons

Bahnanwendungen - Festigkeitsanforderungen an Wagenkästen von Schienenfahrzeugen - Teil 2: Güterwagen

Applications ferroviaires - Prescriptions de dimensionnement des structures de véhicules ferroviaires - Partie 2: Wagons de marchandises

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ICS:

45.060.20	Železniški vagoni	Trailing stock

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EUROPEAN STANDARD

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Railway applications - Structural requirements of railway vehicle bodies - Part 2: Freight wagons

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
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Foreword

This document (EN 12663-2:2010) 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of an identical text or by endorsement, at the latest by September 2010, and conflicting national standards shall be withdrawn at the latest by September 2010.

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 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(s).

For relationship with EU Directive(s), see informative Annex ZA, which is an integral part of this document.

This European Standard is part of the series EN 12663, *Railway applications — Structural requirements of railway vehicle bodies*, which consists of the following parts:

— *Part 1: Locomotives and passenger rolling stock (and alternative methods for freight wagons)*

— *Part 2: Freight wagons*

This document, together with EN 12663-1, supersedes EN 12663:2000.

The main changes with respect to the previous edition are listed below:

a) the standard has been split into two parts. EN 12663-1 contains validation methods mainly for locomotives and passenger rolling stock but as an alternative to EN 12663-2 also for freight wagons. EN 12663-2 contains validation methods for freight wagon bodies and associated specific equipment based on tests;

b) full scale test methods for freight wagons have been added;

c) the design validation requirements for associated specific equipment have been added;

d) the buffing impact test requirements have been added;

e) a validation programme has been added.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

Introduction

The structural design and assessment of freight wagon bodies depend on the loads they are subject to and the characteristics of the materials they are manufactured from. Within the scope of this European Standard, it is intended to provide a uniform basis for the structural design and assessment of the vehicle body.

The loading requirements for the vehicle body structural design and assessment are based on proven experience supported by the evaluation of experimental data and published information. The aim of this European Standard is to allow the supplier freedom to optimise his design whilst maintaining requisite levels of safety considered for the assessment.

1 Scope

This European Standard specifies minimum structural requirements for freight wagon bodies and associated specific equipment such as: roof, side and end walls, door, stanchion, fasteners and attachments. It defines also special requirements for the freight wagon bodies when the wagon is equipped with crashworthy buffers.

It defines the loads sustained by vehicle bodies and specific equipment, gives material data, identifies its use and presents principles and methods to be used for design validation by analysis and testing.

For this design validation, two methods are given:

— one based on loadings, tests and criteria based upon methods used previously by the UIC rules and applicable only for vehicle bodies made of steel;

— one based on the method of design and assessment of vehicles bodies given in EN 12663-1. For this method, the load conditions to be applied to freight wagons are given in this European Standard. They are copied in the EN 12663-1 in order to facilitate its use when applied to freight wagons.

The freight wagons are divided into categories which are defined only with respect to the structural requirements of the vehicle bodies.

Some freight wagons do not fit into any of the defined categories; the structural requirements for such freight wagons should be part of the specification and be based on the principles presented in this European Standard.

The standard applies to all freight wagons within the EU and EFTA territories. The specified requirements assume operating conditions and circumstances such as are prevalent in these countries.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 12663-1, *Railway application — Structural requirements of railway vehicle bodies — Part 1: Locomotives and passenger rolling stock (and alternative method for freight wagons)*

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

EN 15551:2009, *Railway applications — Railway rolling stock — Buffers*

EN 15663, *Railway applications — Definition of vehicle reference masses*

3 Terms and definitions

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

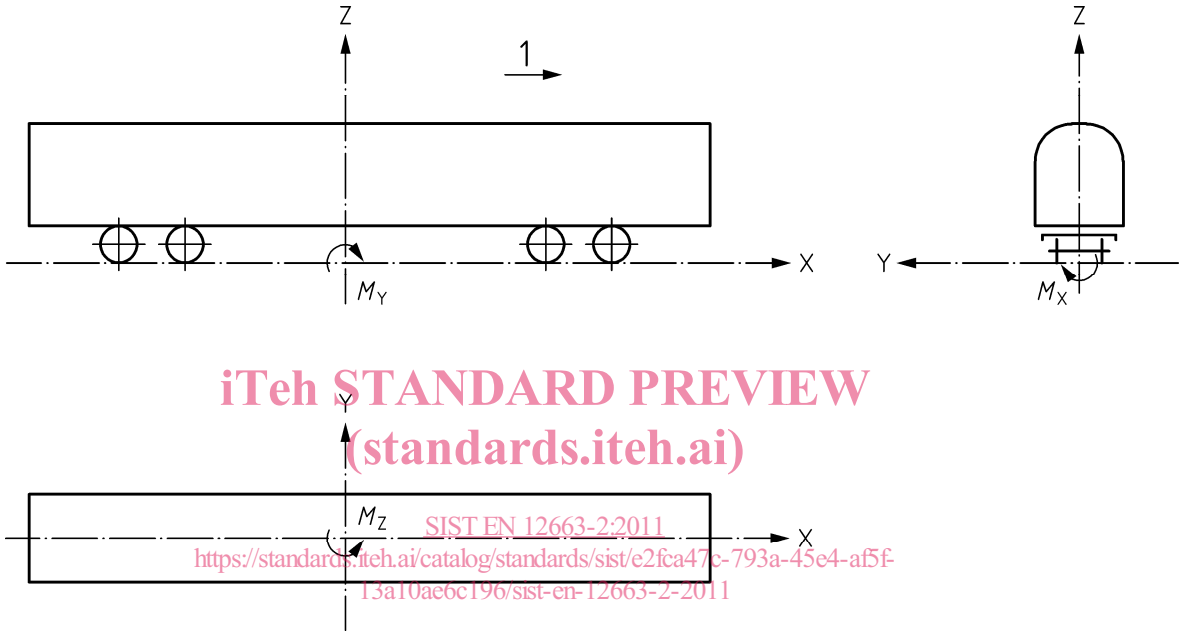
3.1
freight wagon body
main load carrying structure above the suspension units including all components which are affixed to this structure which contribute directly to its strength, stiffness and stability

NOTE Mechanical equipment and other mounted parts are not considered to be part of the vehicle body though their attachments to it are.

3.2
equipment attachment
fastener and any associated local load carrying substructure or frame which connects equipment to the vehicle body

4 Coordinate system

The coordinate system is shown in Figure 1. The positive direction of the x-axis (corresponding to vehicle body longitudinal axis) is in the direction of movement. The positive direction of the z-axis (corresponding to vehicle vertical axis) points upwards. The y-axis (corresponding to vehicle transverse axis) lies in the horizontal plane completing a right hand coordinate system.



Key

1 direction of movement
X longitudinaldirection
Y lateral direction
Z vertical direction
M moment

Figure 1 — Vehicle coordinate system

5 Load cases

5.1 Categories of freight wagons

For the application of this European Standard, all freight wagons are classified in categories.

The classification of the different categories of freight wagons is based only upon the loadings of the vehicle bodies.

NOTE It is the responsibility of the customers to decide as to which category railway vehicles should be designed. There are differences between customers whose choice of the category should take into account the shunting conditions and system safety measures. This is expected and should not be considered as conflicting with this European Standard.

The choice of category from the clauses below shall be based on the load cases as defined in the tables in 5.2.

All freight wagons in this group are used for the transportation of goods. Two categories have been defined:

— Category F-I e.g. vehicles which can be shunted without restriction;

— Category F-II e.g. vehicles restricted in hump and loose shunting.

5.2 Load cases

5.2.1 General

The loads defined in Table 2 to Table 5 shall be considered in combination with the load due to 1 g vertical acceleration of the mass m_1.

The vehicle masses to be used for determining the design load cases are defined in Table 1.

Table 1 — Definition of the design masses

Definition	Symbol	Description
Design mass of the vehicle body in working order	m_1	The design mass of the vehicle body in working order according to EN 15663 without bogie masses.
Design mass of one bogie or running gear	m_2	Mass of all equipment below and including the body suspension. The mass of linking elements between vehicle body and bogie or running gear is apportioned between m_1 and m_2.
Normal design payload	m_3	The mass of the normal design payload as specified in EN 15663.

NOTE For freight wagons the exceptional payload and the normal design payload m_3 are the same (see EN 15663).

Where the load cases include loads that are distributed over the structure, they shall be applied in analysis and tested in a manner that represents the actual loading conditions to an accuracy commensurate with the application and the critical features of the structure.

5.2.2 Longitudinal static loads for the vehicle body in buffer and/or coupling area

Table 2 — Compressive force at buffer height and/or coupler height

Force in kilonewtons

Freight vehicles	
Category F-I	**Category F-II**
2 000 [a]	1 200 [a]

[a] Compressive force applied to draw gear stop "c" if this draw gear stop is used (see Figure 4).

When the compressive force is applied at the buffer axis, then half of the value shall be used for each buffer axis.

Table 3 — Compressive force below buffer and/or coupling level

Force in kilonewtons

Freight vehicles	
Category F-I	**Category F-II**
1 500 [a]	900 [a]
[a] 50 mm below buffer centre line.	

Table 4 — Compressive force applied diagonally at buffer level (if side buffers are fitted at one or both ends of a single vehicle)

Force in kilonewtons

Freight vehicles	
Category F-I	**Category F-II**
400	

For coupling wagons with a draw bar, one force is applied at the location of the buffer and the second is applied in the axis of the wagon, see Figure 2.

Figure 2 — Coupling wagon with draw bar

For coupling wagons with diagonal buffers one force is applied at the location of the side buffer and the second is applied at the location of the diagonal buffer, see Figure 3.

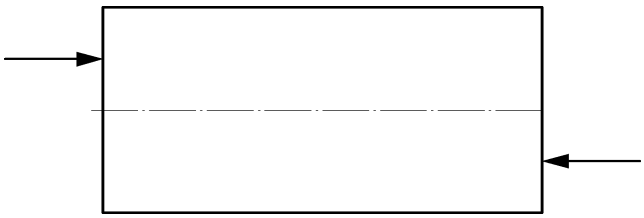


Figure 3 — Coupling wagon with diagonal buffers

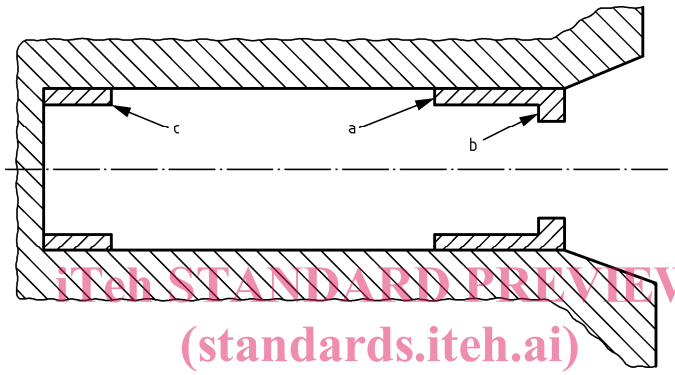
Table 5 — Tensile force in coupler area

Force in kilonewtons

Freight vehicles	
Category F-I	**Category F-II**
1 500 [a]	
1 000 [b]	

[a] Tensile force of 1 500 kN applied to the draw gear stops "a" if this draw gear stop is used, see Figure 4.

[b] Tensile force of 1 000 kN applied to the draw gear stops "b" if this draw gear stop is used and for other types of coupler attachments, see Figure 4.



Key

a see Table 5

b see Table 5

c see Table 2

Figure 4 — Draw gear stops

5.2.3 Vertical static loads for the vehicle body

5.2.3.1 Maximum operating load

The maximum operating load as defined in Table 6 corresponds to the exceptional payload of the vehicle.

Table 6 — Maximum operating load

Load in newtons

Freight vehicles	
Category F-I	**Category F-II**
$1{,}3 \times g \times (m_1 + m_3)$ [a]	

[a] If the application produces a higher proof load (e.g. due to dynamic effects or loading conditions) then a higher value shall be applied and defined in the specification.

5.2.3.2 Lifting and jacking

The forces in Table 7 and Table 8 represent the lifted masses. The equations are given for a two-bogie freight vehicle. The same principle shall be used for freight vehicles with other suspension configurations.

If in some operational requirements, the mass to be lifted does not include the full payload or bogies, the values of m_2 and m_3 in the following tables shall be set to zero or reduced to the specified value.

Table 7 — Lifting and jacking at one end of the vehicle at the specified lifting positions

Load in newtons

Freight vehicles	
Category F-I	**Category F-II**
$1{,}0 \times g \times (m_1 + m_2 + m_3)$	

NOTE The other end of the vehicle should be supported in the normal operational condition.

Table 8 — Lifting and jacking the whole vehicle at the specified lifting positions

Load in newtons

Freight vehicles	
Category F-I	**Category F-II**
$1{,}0 \times g \times (m_1 + 2 \times m_2 + m_3)$	

For lifting and jacking with displaced support, the load case of Table 8 shall be considered with one of the lifting points displaced vertically relative to the plane of the other three supporting points. For this analysis the amount of vertical displacement of the fourth lifting point relative to the other three lifting points shall be considered to be 10 mm or to be equal to the offset which just induces a lift off of one of the lifting points which ever is smaller. If necessary a higher degree of offset shall be part of the specification.

5.2.3.3 Superposition of static load cases for the vehicle body

In order to demonstrate a satisfactory static strength, as a minimum the superposition of static load cases as indicated in Table 9 shall be considered.

Table 9 — Superposition of static load cases for the vehicle body

Load in newtons

Superposition cases	Freight vehicles Category F-I, F-II
Compressive force and vertical load	Table 1 and $g \times (m_1 + m_3)$
	Table 2 and $g \times (m_1 + m_3)$
Compressive force and minimum vertical load	Table 1 and $g \times m_1$
Tensile force and vertical load	Table 4 and $g \times (m_1 + m_3)$
Tensile force and minimum vertical load	Table 4 and $g \times m_1$

5.2.4 Static loads at interfaces

5.2.4.1 Load cases for body to bogie connection

The body to bogie connection shall sustain the loads due to 5.2.3.1 and 5.2.3.2.

It shall also sustain separately, in combination with those due to 1 g vertical acceleration of the vehicle body mass m_1, the loads arising from:

a) the maximum bogie acceleration in the x direction according to the corresponding category of Table 10;

b) the lateral force per bogie corresponding to the transverse force as defined in EN 13749 or 1 g applied on the bogie mass m_2 whichever is the greater.

5.2.4.2 Load cases for equipment attachments

In order to calculate the forces on the fastenings during operation of the vehicle, the masses of the components are to be multiplied by the specified accelerations in Table 10, Table 11 and Table 12. The load cases shall be applied individually.

As a minimum additional requirement, the loads resulting from the accelerations defined in Table 10 or Table 11 shall be considered separately in combination with the load due to 1 g vertical acceleration and the maximum loads which the equipment itself may generate. The load defined in Table 12 includes the dead weight of the equipment. If the mass of the equipment, or its method of mounting, is such that it may modify the dynamic behaviour of the freight vehicle, then the suitability of the specified accelerations shall be investigated. Especially for container transports, the effect of cross winds on containers' attachment shall be considered.

Table 10 — Accelerations in x-direction

Acceleration in metres per square second

Freight vehicles	
Category F-I	**Category F-II**
$\pm 5 \times g$	

Table 11 — Accelerations in y-direction

Acceleration in metres per square second

Freight vehicles	
Category F-I	**Category F-II**
$\pm 1 \times g$	

Table 12 — Accelerations in z-direction

Acceleration in metres per square second

Freight vehicles	
Category F-I	**Category F-II**
$(1 \pm c) \times g$ [a]	

[a] c = 2 at the vehicle end, falling linearly to 0,5 at the vehicle centre.

5.2.5 Fatigue load cases

5.2.5.1 Track induced loading

Table 13 and Table 14 give empirical vertical and lateral acceleration levels, suitable for an endurance limit approach for design and assessment of freight wagons consistent with normal European operations.

Table 13 — Acceleration in y-direction

Acceleration in metres per square second

Freight vehicles	
Category F-I	**Category F-II**
$\pm 0{,}2 \times g$	

Table 14 — Acceleration in z-direction

Acceleration in metres per square second

Freight vehicles	
Category F-I	**Category F-II**
$(1 \pm 0{,}3) \times g$ [a] [b]	
[a] For freight vehicle with double stage suspension $(1 \pm 0{,}25) \times g$.	
[b] If the application produces a higher load (e.g. due to dynamic effects or loading conditions) then a higher value shall be applied and defined in the specification.	

5.2.5.2 Fatigue loads at interfaces of equipments attachments

Equipment attachments shall withstand the loading caused by accelerations due to vehicle dynamics plus any additional loading resulting from the operation of the equipment itself. Acceleration levels may be determined as described in 5.2.5.1. For normal European operations, empirical acceleration levels for items of equipment which follow the motion of the body structure are given in Table 15, Table 16 and Table 17. The number of load cycles shall be 10^7 each.

Table 15 — Accelerations in x-direction

Acceleration in metres per square second

Freight vehicles	
Category F-I	**Category F-II**
$\pm 0{,}3 \times g$	