SLOVENSKI STANDARD
SIST EN 12663-1:2010+A1:2015

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Železniške naprave - Konstrukcijske zahteve za grode železniških vozil - 1. del: Lokomotive in potniška železniška vozila (tudi alternativna metoda za tovorne vagone)

Railway applications - Structural requirements of railway vehicle bodies - Part 1: Locomotives and passenger rolling stock (and alternative method for freight wagons)

Bahnanwendungen - Festigkeitsanforderungen an Wagenkästen von Schienenfahrzeugen - Teil 1: Lokomotiven und Personenfahrzeuge (und alternatives Verfahren für Güterwagen)

Applications ferroviaires - Prescriptions de dimensionnement des structures de véhicules ferroviaires - Partie 1 : Locomotives et matériels roulants voyageurs (et méthode alternative pour wagons)

Ta slovenski standard je istoveten z: **EN 12663-1:2010+A1:2014**

ICS:

45.060.20	Železniški vagoni	Trailing stock

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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Foreword

This document (EN 12663-1:2010+A1:2014) 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of an identical text or by endorsement, at the latest by June 2015, and conflicting national standards shall be withdrawn at the latest by June 2015.

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 includes Amendment 1 approved by CEN on 2014-09-23.

[A1] This document supersedes EN 12663-1:2010. [A1]

The start and finish of text introduced or altered by amendment is indicated in the text by tags [A1] [A1].

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 [A1] EU Directive 2008/57/EC [A1].

For relationship with [A1] EU Directive 2008/57/EC [A1], 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 method for freight wagons)*

— *Part 2: Freight wagons*

[A1] *deleted text* [A1]

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, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

Introduction

The structural design of railway vehicle bodies depends 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 of the vehicle body.

The loading requirements for the vehicle body structural design and testing 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.

1 Scope

This European Standard specifies minimum structural requirements for railway vehicle bodies.

This European Standard specifies the loads vehicle bodies should be capable of sustaining, identifies how material data should be used and presents the principles to be used for design validation by analysis and testing. This European Standard applies to locomotives and passenger rolling stock. EN 12663-2 provides the verification procedure for freight wagons and also refers to the methods in this standard as an alternative for freight wagons.

The railway vehicles are divided into categories which are defined only with respect to the structural requirements of the vehicle bodies. Some vehicles may not fit into any of the defined categories; the structural requirements for such railway vehicles should be part of the specification and be based on the principles presented in this European Standard.

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

In addition to the requirements of this European Standard the structure of all vehicles associated with passenger conveyance may generally be required to have features that will protect occupants in the case of collision accidents. These requirements are given in EN 15227.

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 10002-1, *Metallic materials — Tensile testing — Part 1: Method of test at ambient temperature*

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

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

[A1›

EN 16404:2014, *Railway applications — Re-railing and recovery requirements for railway vehicles* ‹A1]

3 Terms and definitions

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

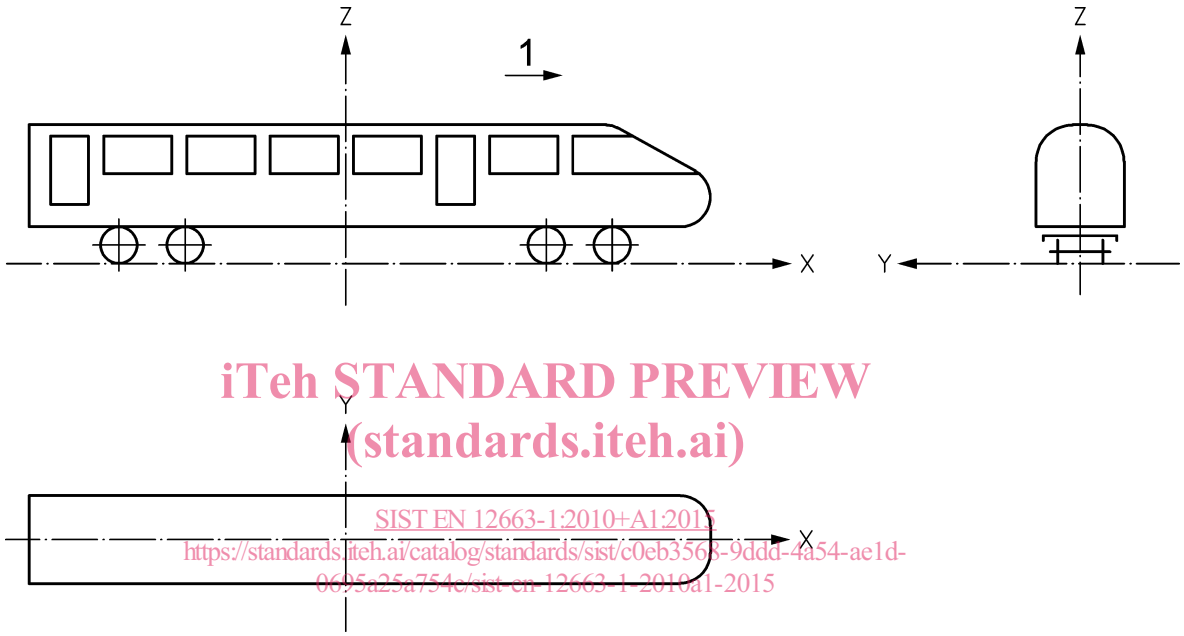
3.1
railway vehicle body
main load carrying structure above the suspension units including all components which are affixed to this structure which contribute directly to its strength, stiffness and stability

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 connect 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 body vertical axis) points upwards. The y-axis (corresponding to vehicle body transverse axis) is in the horizontal plane completing a right hand coordinate system.



Key

1 driving direction
X longitudinal direction
Y lateral direction
Z vertical direction

Figure 1 — Vehicle body coordinate system

5 Structural requirements

5.1 General

Railway vehicle bodies shall withstand the maximum loads consistent with their operational requirements and achieve the required service life under normal operating conditions with an adequate probability of survival.

The capability of the railway vehicle body to sustain required loads without permanent deformation and fracture shall be demonstrated by calculation and/or testing as described by the validation programme in Clause 9.

The assessment shall be based on the following criteria:

a) exceptional loading defining the maximum loading which shall be sustained and a full operational condition maintained;

b) margin of safety as defined in 5.4.3 and 5.4.4, such that the exceptional load can be considerably exceeded before catastrophic fracture or collapse will occur;

c) service or cyclic loads being sustained for the specified life without detriment to the structural safety;

〚A1〛

d) loads due to re-railing and recovery operations without catastrophic failure. 〚/A1〛

The data defining the expected service conditions shall be part of the specification. From this data all significant load cases shall be defined in a manner that is consistent with the acceptance criteria.

NOTE Where appropriate, stiffness criteria as defined in 5.5 should be part of the specification.

The requirements of this European Standard are based on the use of metallic materials and requirements defined in 5.4.2, 5.4.3 and 5.6 and Clause 7 and Clause 8 are specifically applicable only to such materials. If different (non-metallic) materials are being used, then the basic principles of this standard shall still be applied and suitable data to represent the performance of these materials shall be used.

The load cases used as the basis of vehicle body design shall comprise the relevant cases listed in Clause 6.

All formal parameters are expressed as SI basic units and units derived from SI basic units. The acceleration due to gravity g is - 9,81 m/s^2.

5.2 Categories of railway vehicles

5.2.1 Structural categories

For the application of this European Standard, all railway vehicles are classified in categories.

The classification of the different categories of railway vehicles is based only upon the structural requirements of the vehicle bodies.

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

Due to the specific nature of their construction and different design objectives there are three main groups, namely locomotives (L), passenger vehicles (P) and freight wagons (F). The three groups may be subdivided further into categories according to their structural requirements.

The categories for freight wagons are extracted from EN 12663-2.

The choice of category from the clauses below shall be based on the structural requirements as defined in the tables in Clause 6.

5.2.2 Locomotives

To this group belong all types of locomotives and power units whose sole purpose is to provide tractive motion and are not intended to carry passengers.

— Category L e.g. locomotives and power units.

5.2.3 Passenger vehicles

To this group belong all types of railway vehicles intended for the transport of passengers, ranging from main line vehicles, suburban and urban transit stock to tramways.

Passenger vehicles are divided into five structural design categories into which all vehicles may be allocated. The five categories are listed below, with an indication of the types of vehicle generally associated with each:

— Category P-I e.g. coaches;

— Category P-II e.g. fixed units and coaches;

— Category P-III e.g. underground, rapid transit vehicles and light railcar;

— Category P-IV e.g. light duty metro and heavy duty tramway vehicles;

— Category P-V e.g. tramway vehicles.

5.2.4 Freight wagons

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 excluded in hump and loose shunting.

5.2.5 Other types of vehicles

Some railway vehicles may not fit the descriptions associated with the above mentioned categories (e.g. the standard open bogie van for conveyance of motor vehicles may be treated as a P-I vehicle). The appropriate category for the structural requirements of such railway vehicles should be part of the specification.

5.3 Uncertainties in railway design parameters

5.3.1 Allowance for uncertainties

The uncertainties described in the following clauses may be allowed for by adopting limiting values of parameters or by incorporating a safety factor into the design process. This safety factor, designated S, shall then be applied when comparing the calculated stresses to the permissible stress as indicated in 5.4.

NOTE In the design process the following should be considered with respect to criticality of the component failure: consequence of failure, redundancy, accessibility for inspection, detection of component failure, maintenance interval, etc.

The value of S shall be chosen to include the cumulative effect of all uncertainties not otherwise taken into account.

5.3.2 Loads

All loads used as the basis for vehicle body design shall incorporate any necessary allowance for uncertainties in their values. The loads specified in Clause 6 include this allowance. If the design loads are derived from on-track tests or other sources of information an allowance for uncertainty shall be used.

5.3.3 Material

For design purposes, the minimum material property values as defined by the material specification shall be used. Where the material properties are affected, for example, by:

— rate of loading;

— time (e.g. by material ageing);

— environment (moisture absorption, temperature, etc.);

— welding or other manufacturing processes,

appropriate new minimum values shall be determined.

Similarly, the S-N curve (Woehler curve) used to represent the fatigue behaviour of material shall incorporate the above effects and shall represent the lower bound of data scatter as defined in 7.3.

5.3.4 Dimensional tolerances

It is normally acceptable to base calculations on the nominal component dimensions. It is necessary to consider minimum dimensions only if significant reductions in thickness (due to wear, etc.) are inherent in the function of the component. Adequate protection against corrosion is an integral part of the vehicle specification. The loss of material by this cause can normally be neglected.

5.3.5 Manufacturing process

The performance characteristics exhibited by material in actual components may differ from those derived from test samples. Such differences are due to variations in the manufacturing processes and workmanship, which cannot be detected in any practicable quality control procedure.

5.3.6 Analytical accuracy

Every analytical procedure incorporates approximations and simplifications. The application of analytical procedures to the design shall be consciously conservative.

5.4 Demonstration of static strength and structural stability

5.4.1 Requirement

It shall be demonstrated by calculation and/or testing, that no significant permanent deformation or fracture of the structure as a whole, of any individual element or of any equipment attachments, will occur under the prescribed design load cases. The requirement shall be achieved by satisfying the yield or proof strength (according to 5.4.2). If the design is limited by the ultimate strength and/or the stability condition (according to 5.4.3 and/or 5.4.4) these shall be satisfied as well. The validation process is described in Clause 9.

When comparing the calculated or measured stress to the permissible stress, the utilisation of the component shall be less than or equal to 1 according to the following general equation:

$$U = \frac{R_d S}{R_L} \leq 1$$

where

U is the utilisation of the component;

R_d is the determined result from calculation or test;

S is a design safety factor (see 5.3);

R_L is the permissible or limit value.

NOTE The equation is sometimes expressed as:

$$\frac{R_L}{R_d} \geq S$$

5.4.2 Yield or proof strength

Where the design is verified only by calculation, S_1 shall be 1,15 for each individual load case. S_1 may be taken as 1,0 where the design load cases are to be verified by test and/or correlation between test and calculation has been successfully established.

Under the static load cases as defined in 6.1 to 6.5, the utilisation shall be less than or equal to 1 as given by the following equation:

$$U = \frac{\sigma_c S_1}{R} \leq 1$$

where

U is the utilisation;

S_1 is the safety factor for yield or proof strength;

R is the material yield (R_{eH}) or 0,2 % proof stress (R_{p02}), in newtons per square millimetre (N/mm^2) (as defined in EN 10002-1) and taking into account any relevant effects as described in 5.3.3;

σ_c is the calculated stress, in newtons per square millimetre (N/mm^2).

In determining the stress levels in ductile materials, it is not necessary to satisfy the above criteria at features producing local stress concentration. If the analysis does incorporate local stress concentrations, then it is permissible for the theoretical stress to exceed the material yield or 0,2 % proof limit. The areas of local plastic deformation associated with stress concentrations shall be sufficiently small so as not to cause any significant permanent deformation when the load is removed. Methods of treatment of local stress concentrations during calculation are given in Annex A and during test are given in 8.2.2.

5.4.3 Ultimate failure

It is necessary to provide a margin of safety between the exceptional design load and the load at which the structure will fail. This is achieved by introducing a safety factor S_2 such that the utilisation shall be less than or equal to 1 as given by the following equation:

$$U = \frac{\sigma_c S_2}{R_m} \leq 1$$

where

U is the utilisation;

S_2 is the safety factor for ultimate failure;