

Railway applications — Structural requirements of railway vehicle bodies

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National foreword

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- present to the responsible European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;
- monitor related international and European developments and promulgate them in the UK.

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

Members of the UK Committee have expressed concern that the term “operator”, as used in this European Standard, may require clarification in the UK context. In the United Kingdom, it is currently the infrastructure controller who sets the technical standards (following industry consultation) with which the opetator complies.

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Summary of pages

This document comprises a front cover, an inside front cover, the EN title page, pages 2 to 20, an inside back cover and a back cover.

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Foreword

This European Standard 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of an identical text or by endorsement, at the latest by January 2001, and conflicting national standards shall be withdrawn at the latest by January 2001.

This European Standard 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).

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland 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 designer freedom to optimize his design whilst maintaining requisite levels of safety.

This European Standard defines no specific arithmetical techniques in order not to affect the developments in analysis methods and permit innovative developments by vehicle designers and operators. Changes due to advances in scientific knowledge and technology will be taken into account at suitable intervals through revisions and/or supplements.

1 Scope

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

This European Standard specifies the loads vehicle bodies shall be capable of sustaining, identifies how material data shall be used and presents the principles to be used for design verification by analysis and testing.

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

These structural requirements should not be confused with operating requirements. It is the responsibility of the operator to decide as to which structural category railway vehicles shall be designed. Some vehicles may not fit into any of the defined categories; the structural requirements for such railway vehicles should be specified by the operator using 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.

2 Definitions

For the purpose of this European Standard, the following definitions apply:

2.1 Railway vehicle body

It comprises the main load carrying structure above the suspension units. It includes 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.

2.2 Operator of railway vehicles

The organization which has the responsibility for defining the technical requirements for the railway vehicle in order that it will perform the intended operation in consideration of acceptance criteria.

2.3 Designer of railway vehicles

The organization which has responsibility for designing the railway vehicle to satisfy the technical requirements of the operator.

2.4 Vehicle masses

2.4.1 Mass of the vehicle body in working order m_1

The mass in working order m_1 consists of the completely assembled vehicle body with all mounted parts. This includes the full operating reserves of water, sand, fuel, foodstuffs etc. and the overall weight of staff.

2.4.2 Maximum payload m_2

The maximum payload m_2 is to be determined dependent on the type of vehicle. For freight vehicles, it corresponds to the allowed mass of the goods. For passenger rolling stock, it depends on the number of seats for passengers and on the number of passengers per m^2 in the standing areas. These values are fixed by the operator, taking into account any statutory regulations, and give the mass for the payload and the number of passengers which are allowed to be transported in these vehicles.

Typical weights for passengers:

- long distance 80 kg per passenger with luggage;
- commuter/suburban 70 kg per passenger.

Typical passenger densities in standing areas:

- long distance 2 to 4 passenger per m^2 ;
- commuter/suburban 5 to 10 passengers per m^2 .

Typical luggage area loading:

- 300 kg per m^2 .

2.4.3 Mass of the bogie or running gear m_3

The mass of one bogie or running gear m_3 is the mass of all equipment below and including the body suspension. The mass of linking elements between vehicle body and bogie or running gear shall be apportioned between m_1 and m_3 .

2.5 Coordinate system

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

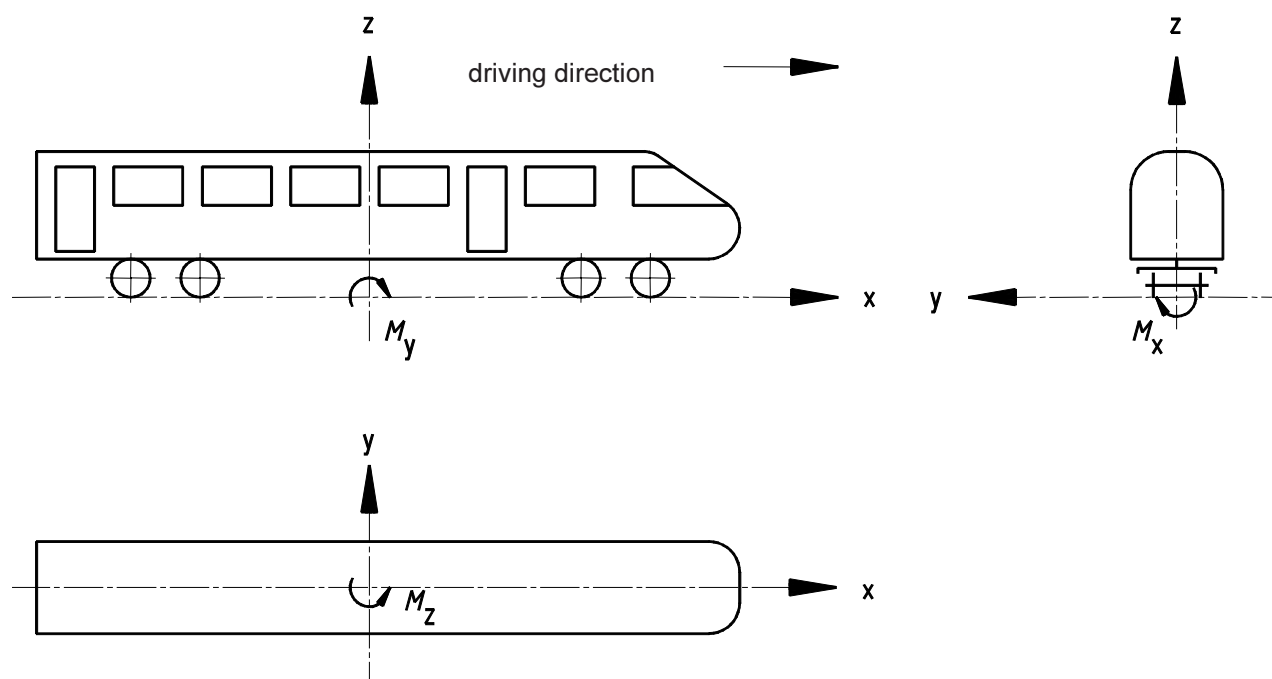


Figure 1 - Vehicle coordinate system

3 Structural requirements

3.1 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 not sustain permanent deformation and fracture shall be demonstrated by calculation and/or testing (see clause 6). 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) acceptable margin of safety, such that if the exceptional load is exceeded, catastrophic fracture or collapse will not occur;
- c) stiffness, such that the deformation under load and the natural frequencies of the structure meet limits as determined by the operational requirements;
- d) service or cyclic loads being sustained for the specified life without detriment to the structural safety.

The operator shall supply data defining the expected service conditions. In conjunction with the operator, it is the task of the designer to identify all significant load cases in a meaningful way from these data and to ensure that the design satisfies them.

Where a vehicle body is a development of an earlier design for which the safety has been demonstrated, and similar service conditions apply, then earlier data may be used, supported by comparative evidence. Areas of significant change shall be re-analysed and/or tested.

The requirements of this European Standard are based on the use of metallic materials and requirements defined in 3.4.2, 3.4.3 and 3.6 and clauses 5 and 6 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. The designer shall ensure that he has suitable data to represent the performance of the materials. He shall adopt methods and requirements such that they are applied in a manner consistent with the current state of knowledge.

The load cases used as the basis of vehicle body design shall comprise the relevant cases listed in clause 4.

All formal parameters are expressed as SI basic units and units derived from SI basic units. The gravitational acceleration g is $-9,81 \text{ m/s}^2$.

3.2 Categories of railway vehicles

3.2.1 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. It is the responsibility of the operators to decide as to which category railway vehicles shall be designed. There will be differences between operators. This is to be expected and should not be considered as conflicting with this European Standard. Some railway vehicles may not fit into any of the defined categories. The structural requirements for such railway vehicles should be specified by the operator using the principles presented in this standard.

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

The choice of category from the clauses below shall be based on the structural requirements as defined in the tables in clause 4. These structural requirements should not be confused with the operating requirements. The track gauge is also not a determinant for the choice of category.

3.2.2 Freight vehicles

All vehicles 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 from hump and loose shunting.