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Železniške naprave - Kategorizacija prog za upravljanje vmesnika med dopustnimi obremenitvami vozil in infrastrukturo

Railway applications - Line categories for managing the interface between load limits of vehicles and infrastructure

Bahnanwendungen - Streckenklassen zur Bewerkstelligung der Schnittstelle zwischen Lastgrenzen der Fahrzeuge und Infrastruktur

Applications ferroviaires - Catégories de ligne pour la gestion des interfaces entre limites de charges des véhicules et de l'infrastructure

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Railway applications - Line categories for managing the interface between load limits of vehicles and infrastructure

Applications ferroviaires - Catégories de ligne pour la gestion des interfaces entre limites de charges des véhicules et de l'infrastructure

Bahnanwendungen - Streckenklassen zur Bewerkstelligung der Schnittstelle zwischen Lastgrenzen der Fahrzeuge und Infrastruktur

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Foreword

This document (EN 15528:2008+A1:2012) 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of an identical text or by endorsement, at the latest by April 2013, and conflicting national standards shall be withdrawn at the latest by April 2013.

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 20 August 2012.

This document will supersede EN 15528:2008.

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

[A1] This document has been prepared under a mandate given to CEN/CENELEC/ETSI 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. 〈A1〉

According to the CEN/CENELEC Internal Regulations, the national standards organisations 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

Existing European railway infrastructure consists of elements designed for different purposes. Most civil engineering railway infrastructure was built before the introduction of CR-INS-TSI and Eurocodes for the design of structures.

This European Standard defines a line classification system for infrastructure managers and railway undertakings to manage the interface between load limits for railway vehicles and payload limits for freight wagons and the vertical load carrying capacity of a line.

The line classification system takes into account parameters such as:

— axle load (P),

— mass per unit length (p),

— geometrical aspects relating to the spacing of axles,

— speed

and provides a transparent method for determining whether the vertical loading characteristics of vehicles are compatible with the load carrying capacity of lines on the network.

1 Scope

This European Standard describes methods of classification of existing and new railway lines and the categorisation of vehicles. The standard specifies the technical requirements for ensuring the compatibility of the interface between vehicle and infrastructure. The standard is suitable for use on freight, passenger and mixed traffic lines and contains requirements relevant to:

— classification of the vertical load carrying capacity of railway infrastructure;

— design of railway vehicles;

— determination of payload limits of freight wagons.

A summary of the classification of infrastructure and categorisation of vehicles is given in Annex B.

The assessment of the vertical load carrying capacity of civil engineering structures, track, sub-grade and earthworks by the use of the load models defined in Annex A permits the classification of infrastructure into line categories.

This European Standard identifies on which lines vehicles are compatible to the infrastructure under normal operation conditions without further checks regarding vertical load effects.

The methodology described in this European Standard is not valid for high speed rail traffic. Tilting traffic and the working of rail mounted plant and cranes etc. are also outside the scope of this European Standard. This European Standard does not cover the system used in Great Britain, where all lines and vehicles are to be classified in accordance with the RA (Route Availability) System. A guide to the equivalent categories in accordance with this European Standard is given in Annex C.

This European Standard does not cover requirements relating to the maximum total mass or maximum length of a train.

The requirements of this European Standard do not replace regulations relating to e.g. dynamic wheel/rail contact force limits, vehicle ride considerations, vehicle structural design limitations, etc.

2 Normative references

〚A1〛 The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies. 〚A1〛

EN 1991-2:2003, *Eurocode 1: Actions on structures — Part 2: Traffic loads on bridges*

prEN 15663, *Railway applications — Vehicle Mass definition*

3 Terms and definitions

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

3.1
classification of infrastructure
statement of the load carrying capacity of infrastructure on a line by allocation of a line category

3.2
categorisation of vehicles
statement of the loading characteristics of a railway vehicle, according to the combination of axle loads and axle spacing, by allocation of a line category

3.3
compatibility
line category of a vehicle (or the payload limit of a wagon) is less than or equal to the classification of the line

3.4
wheel load Q
static vertical wheel/rail contact forces divided by acceleration due to gravity

3.5
wheel load Q_i
wheel load Q of the axle i

3.6
axle load P
sum of the static vertical wheel forces exerted on the track through a wheelset or a pair of independent wheels divided by acceleration of gravity

3.7
axle load P_i
axle load P of the axle i

3.8
design mass
mass of vehicle equipped with all the consumables and occupied by all staff which it requires in order to fulfil its function plus the exceptional payload defined according to prEN 15663

3.9
intended equal axle loads of a vehicle P_{ieV}
axle loads of a vehicle designed to be equal

3.10
mean axle load of a vehicle P_{mV}
average axle load of P_{ieV}

3.11
group of intended equal axle loads of a vehicle P_{ieV}
group of axle loads of axle i of a vehicle designed to be equal

3.12
mean axle load P_{mGV}
average axle load of P_{ieV}

3.13
mass per unit length p
mass of a vehicle divided by length over buffers

3.14
length over buffers L
length between coupling planes when coupled

3.15
axle spacing
design values of the distances between the centres of adjacent axles

3.16
payload limit
maximum allowable payload for a wagon related to each line category

3.17
maximum passenger traffic speed / maximum freight traffic speed
additional information provided by the infrastructure manager giving the general limit to the maximum traffic speed on a line according to the type of traffic

3.18
line speed
general maximum speed of traffic on a route

3.19
associated maximum speed
local maximum speed for which the line category is valid

3.20
reference wagon
virtual vehicle used as a module of loading for a load model defined by axle load, mass per meter and axle spacing

3.21
load model
defined by a specific formation of reference wagons

3.22
line category
denotation of the specific load model based on reference wagons

3.23
series of locomotives
locomotives designed to be equal

4 Classification system

4.1 Definition of line categories

The use of a classification system using line categories permits easy understanding of the load-related compatibility of infrastructure and vehicles.

The line category as the result of the classification process represents the ability of the infrastructure (track, track substructures, earthworks, bridges and structures) to withstand the vertical loads imposed by vehicles on the line or section of line for regular service.

Lines shall be classified into different line categories. Each line category (A, B1, B2, C2, C3, C4, D2, D3, D4, D4xL and also E4 and E5) is defined by the capacity of a line to withstand the loads represented by load models based on reference wagons defined by the three characteristics shown in Annex A:

— axle load;

— mass per unit length;

— geometrical characteristics of the spacing of axles.

Line categories E4 and E5 are defined exclusively for heavy freight wagons. For E4 or E5 traffic a maximum operating speed of 100 km/h is recommended.

For rail vehicles or payload limits categorised above D4 or D4xL it is recommended that the infrastructure manager and railway undertaking consider the use of static and dynamic wheel load measuring devices attached to the track and/or fitted to vehicles to assist with ensuring compliance with the requirements of this European Standard.

The axle and wheel load tolerances described in Clause 6 shall be taken into account when classifying the infrastructure into line categories.

4.2 Correlation between line category and speed

As classification applies to all types of railway vehicles taking their maximum speeds (different passenger and freight train speeds) and line speed into account, additional information defining the maximum speed corresponding to the line classification(s) shall be stated.

As a result of the classification of infrastructure additional information specifying the line classification can be given to cover two or more categories of maximum speed or traffic type (e.g. different maximum speeds and associated line categories for passenger and freight trains) within the same line classification system.

The load models defining line categories cover all railway vehicles as defined in Clause 6, although different types of vehicles (e.g. locomotives and different train types) may have different operating speeds.

NOTE 1 Typical maximum speed categories are shown in Annex D.

When classifying infrastructure lines into line categories, the following options may be used by the infrastructure manager to optimise freight traffic:

Option 1: determination of the line category at maximum freight traffic speed (maximum 120 km/h).

Option 2: determination of the maximum line category at an associated lower speed (less than the maximum freight traffic speed).

The line category and associated maximum speed are to be considered as a single combined quantity. The infrastructure manager may decide how many and which combinations to determine and publish. When additional information is published, the minimum requirement is to publish a single category according to Option 1.

On lines dedicated to freight traffic or mixed traffic lines (passenger train speeds from 80 km/h to 120 km/h maximum) the local line speed shall be taken into account for the classification of the engineering structures (see 5.1) and other relevant infrastructure elements (see 5.2).

On mixed traffic lines with passenger traffic, Option 1 is generally sufficient and appropriate for the optimisation of freight traffic.

NOTE 2 In some situations it may be desirable to determine the line category at a lower speed to maximise the line category in accordance with Option 2. Examples of line category and associated maximum speed are given in Annex F.

In addition, for E4 or E5 lines an associated maximum speed for E4 and E5 traffic shall be stated together with the associated maximum speed for conventional line traffic of line category D4.

For vehicles and locomotives, categorised into the same or lesser line category as the line, running faster than the maximum freight traffic speed, additional checks starting on the basis of the maximum freight traffic speed shall be taken into account for the classification of engineering structures (see 5.1) and other relevant infrastructure elements (see 5.2).

Different combinations of line category with speed for speeds over 120 km/h and up to the maximum line speed shall be in accordance with general technical and operational requirements or restrictions.

5 Classification of infrastructure

5.1 Civil engineering structures

When classifying a railway line into line categories, the following shall be taken into account:

— load models in accordance with Annex A;

— load carrying capacity of structures supporting the track on the line (see Annex E);

— load models shall be applied to produce the most onerous load effects (e.g. on continuous beams parts of the load model which produce a relieving effect shall be neglected);

— dynamic load effects using the dynamic factor corresponding to the associated maximum speed (see 4.2);

— existing operating and other restrictions relating to different types of traffic, etc.

The method used to determine the load carrying capacity of structures (bridges and other structures supporting the track) shall take account of the condition of the structures and be in accordance with national requirements.

NOTE 1 Examples of typical methods used to determine the load carrying capacity of structures are given in Annex E.

The load models defined in Annex A are for the classification of lines and shall not be used for the design of new structures. For the design of new structures the rail traffic loading given in EN 1991-2 shall be used.

The resulting output of the classification process of each structure on a line is the highest line classification related to an associated maximum speed in accordance with 4.2, subject to any additional limits in other regulations. The resulting output of the classification process for a section of the line is the minimum line classification related to an associated maximum speed taking into account each structure (see also 5.3).

When determining the line classification and maximum operating speed for locomotives and other non passenger carrying power cars, account may be taken of the reduced likelihood of overloading and cargo displacement with locomotives.

This may be taken into account when determining the line category for speeds of operation of locomotives higher than the line categories available for freight operation. The increased dynamic load effects from the higher speed of locomotive operation may be covered by activating additional load carrying capacity, if existing, or compensated for the use of an appropriate reduction in the partial safety factor for railway loading.

NOTE 2 Additional information regarding locomotives with 4 axles and 6 axles to enable optimisation of locomotive speeds within the same line classification is given in Annex J and Annex K respectively. Any reduction in partial safety factors for railway loads is to be in accordance with national requirements.

It may be necessary to specify additional operating restrictions relating to the number or position of locomotives in a train to limit associated traction forces, vertical load effects etc.

To check the adequacy of the allowances for the dynamic increment of loading (in EN 1991-2:2003, Annex C) and to address the potential risk of adverse bridge dynamic effects resulting from resonance etc. between vehicles and infrastructure it is recommended that special studies should be considered for individual vehicles for proposed speeds in excess of:

— 100 km/h to establish an appropriate maximum speed of individual wagons with axle loads greater than 22,5 t;

— 120 km/h to establish an appropriate maximum speed of individual wagons with axle loads of up to 22,5 t;

— 160 km/h (or other value specified in accordance with 4.2) to establish an appropriate maximum speed of individual locomotives or individual passenger multiple units.

5.2 Track constructions, track substructures and earthworks

The load carrying capacity of the track, track substructures and earthworks shall be determined in accordance with national requirements. Typically such methods take account of the type of rail and track components, sleeper spacing, track geometry, track quality, annual tonnage of traffic, inspection and maintenance regimes and other national requirements, etc.

For E4 and E5 traffic the requirements in prEN 15687 are recommended.

In order to establish an appropriate maximum speed for wagons with axle loads greater than 22,5 t for proposed speeds > 100 km/h, special studies should be undertaken to check the dynamic effects on the track.

The infrastructure manager shall determine the correspondence between the local track classification system and the line classification system defined in this European Standard. Annex L shows an example of the correspondence.

The results of the above shall be used to determine the line classification in accordance with this European Standard with respect to the load carrying capacity of the track, track substructures and earthworks.

5.3 Infrastructure classification results

The classification of a line or a section shall be taken as the lesser of:

— line classification of civil engineering structures determined in accordance with 5.1;

— line classification of track, track substructures and earthworks determined in accordance with 5.2;

— relevant associated requirements relating to speed in accordance with 4.2;

— other general requirements relating to maximum permitted speeds for different types of traffic and operating restrictions, etc.;

— additional qualifications relating to the validity of the line classification, etc.

The result of infrastructure classification shall include the permissible line category(ies) and their associated maximum speed(s) of each line or section of line. If necessary, additional speed regulations and operating requirements relating to locomotives (e.g. locomotive classes and associated maximum speed) or traffic types (e.g. maximum speed of freight traffic or passenger traffic) due to this European Standard shall be given subject to any more onerous requirements arising due to other regulations.

Where the line classification is E4 or E5, additional results shall be given for the line category D4.

NOTE Examples of the results of line classification are given in Annex F.

6 Categorisation of railway vehicles

6.1 General rules

The categorisation of a vehicle by line category or payload limit for a freight wagon defined by line category represents the static vertical load effects produced by the freight wagon or vehicle.

The permissible line category or the permissible payload of vehicles shall be determined such that the maximum bending moments and shear forces on a single beam of any span length throughout the span for

any position of load across the span do not exceed the values calculated for the load models defined in Annex A.

The load models together with an unlimited number of the vehicle being categorised shall be used in the calculations.

Simply supported spans from 1,0 m to 100,0 m shall be checked. The maximum span increments shall not exceed the values in Table 1.

Table 1 — Maximum span increments depending on span length

span range (m)	maximum span increment (m)
1,0 to 10,0	0,2
10,0 to 20,0	1,0
20,0 to 60,0	2,0
60,0 to 100,0	5,0

NOTE An example of the application of the method is given in Annex G.

The vehicle mass shall be taken as the design mass under exceptional payload according to prEN 15663.

When determining the maximum axle loads, measured axle loads shall be taken into account. Where any of the items specified in prEN 15663 are not included in the measured weights, adjustments shall be made.

Re-evaluation of the payload-weight tables for freight wagons and a re-categorisation of other vehicles types shall be undertaken when the weight of a vehicle is increased or the distribution of axle loads changed. The measured vehicle weight for the modified vehicle shall be used to confirm the calculations.

Changes in axle load of up to 100 kg from the original, whether as a result of technical alterations or a change in distribution between axles may be neglected for the purposes of vehicle categorisation.

The ratio of the two wheel loads on each axle shall not exceed 10/8 = 1,25. However, the sum of both wheel loads shall not exceed the axle load relevant for line category. For locomotives additional requirements are given in 6.3.

6.2 Freight wagons

6.2.1 Specific rules for freight wagons

The compatibility of freight wagons and their loads with the load capacity of lines can be determined by their geometrical and load characteristics, i.e. axle spacing, axle load and mass per unit length.

The payload limit according to line category shall be determined according to 6.1.

The maximum allowable payload and axle load for each type of wagon corresponding to each line category can be calculated as shown in Annex G. Alternatively, values for permissible axle loads for 4- and 6-axle wagons are given in Annex H and Annex I, which can be used to determine the maximum permitted payloads.

The above payload limits are only valid if the permissible payload is evenly distributed over the length of the wagon. In the case of longitudinally displaced or unevenly distributed loading, the payload shall be reduced, so that the value of the permissible axle load is not exceeded.

As an exception 20 t axle loads may be exceeded by up to 0,5 t on Category C lines for:

— 2-axles long wagons with 20 t axle loads and 14,10 m < length over buffers < 15,50 m to bring their payload up to 25 t;

— wagons designed for 22,5 t axle loads to offset the extra tare incurred in making them suitable for such axle loads.

In practice, the maximum permissible mass per wheel shall be 11,1 t.

6.2.2 Resulting load limits for freight wagons

The results of the calculation of the maximum payload of a wagon for each line category determined according to 6.1 and 6.2.1 shall be recorded in a load limit table as shown in Annex G.

Where lower load limits are required by specific regulations[1)] these lower values shall be used.

Groups of wagons with the same equipment shall be identified within each major manufacturing series (e.g. wagons with air brakes, wagons with air brakes and gangway fitted with a screw brake). For each group of wagons, the average tare shall be determined and used in the calculations. Alternatively, the measured weight of an individual wagon can be used to determine the payload limit for the corresponding wagon.

The tare of a wagon shall be calculated with new wheels and new brake block shoes, all removable equipment and the maximum liquid quantity (fuel, refrigerant etc.) rounded up to the nearest tenth of a tonne.

The corresponding payload marked on the load limit table shall be rounded down to the nearest tenth of a tonne.

6.3 Locomotives including power heads

6.3.1 General

Locomotives and power heads etc. characterised by carrying no passengers, mainly equipped with powered wheelsets, shall be categorised into line categories.

The most onerous axle load distribution of each vehicle shall be determined by measurement and taken into account in the categorisation. When a vehicle is modified, its line category shall be re-evaluated.

Geometrical characteristics with intended axle loads of the design mass shall be used for categorisation to determine the line category of a vehicle.

The tolerances for the measured weights of vehicles shall be:

— individual weights of each locomotive in a series shall not exceed 3 % of the design mass, and

— maximum upper tolerance of the axle load is 5 % of the intended axle load, and

— load of the wheels measured on one side of the vehicle shall not differ by more than ± 4 % from the average of the measured wheel loads on both sides, and

— load difference between the right and the left wheel of each axle shall be within ± 5% from the measured axle load.

The values of the intended design mass and intended axle loads shall be the same within a series of locomotives.

1) RID regulations (Annex I to Appendix B of the COTIF) of the RIV agreement (Appendix II, Loading guidelines).