SLOVENSKI STANDARD
oSIST prEN 15528:2020

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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 Behandlung 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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English Version

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 Behandlung der Schnittstelle zwischen Lastgrenzen der Fahrzeuge und Infrastruktur

This draft European Standard is submitted to CEN members for enquiry. It has been drawn up by the Technical Committee CEN/TC 256.

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Recipients of this draft are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

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

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Contents

European foreword

This document (prEN 15528:2020) has been prepared by Technical Committee CEN/TC 256 “Railway application”, the secretariat of which is held by DIN.

This document is currently submitted to the CEN Enquiry.

This document will supersede EN 15528:2015.

This document has been prepared under a standardization request given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive 2016/797/EU.

For relationship with EU Directive 2016/797/EU, see informative Annex ZA, which is an integral part of this document.

Significant technical changes between this document and EN 15528:2015 are:

— All information about dynamic compatibility was deleted including Annexes C, D, E and P (in future part of a TR prepared by TC250/SC1/WG 3/ TG DIBRST);

— For coaches and multiple units an additional categorization is introduced for different values of standing passengers per m^2 in the load case Design mass with exceptional payload (MXD) according to EN 15663:2017+A1:2018;

— Clarification of the informative character of Annex F about speeds which do not require additional dynamic compatibility checks.

Introduction

The existing European heavy rail system consists of elements designed for varying historical requirements. Most civil engineering elements of the heavy rail system were built before the introduction of the Technical Specifications for Interoperability (TSIs) and the Eurocodes for the design of structures.

This document defines a line classification system to manage the interface between the load limits for rail vehicles and the 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);

— geometrical aspects relating to the spacing of axles;

— mass per unit length (p);

— 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.

The line classification system utilizes a suite of line categories defined in this standard by a load model.

1 Scope

This document is applicable to the lines with standard track gauge (1435°mm) and wider track gauges of the heavy rail system and the vehicles that are operated on these lines, except portable trolleys as defined by EN 13977 and maintenance vehicles (e.g. rail mounted plant, cranes) in their working or travelling modes (see EN 14033-2).

This document describes methods of classification of existing and new lines of the heavy rail system and the categorization of rail vehicles.

This document gives guidance to a reliable and established management of the interface between rail vehicles and the heavy rail network and does not impose any requirements on either vehicles or infrastructure.

The application of this document enables to ensure the static route compatibility between a rail vehicle and the heavy rail network with respect to the vertical load carrying capacity.

It contains requirements relevant to:

— classification of the vertical load carrying capacity of lines of the heavy rail network;

— allocation of rail vehicles to line categories (categorization);

— determination of payload limits of freight wagons.

Out of the scope of this document are:

— assessments of compatibility based on the parameter axle load alone;

— compatibility checks for cases where an additional dynamic analysis is required (for example according to EN 1991-2:2003, 6.4.4);

— requirements relating to the maximum total mass or maximum length of a train;

— the system used in Great Britain, where all lines and vehicles are 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 M;

— the publication of line categories.

The requirements of this document do not replace any regulations related to running behaviour of vehicles described by the assessment quantities for running safety, track loading and ride characteristics (see EN 14363).

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 1991-2:2003, *Eurocode 1: Actions on structures - Part 2: Traffic loads on bridges*

EN 15663:2017+A1:2018, *Railway applications - Vehicle reference masses*

EN 15877-1, *Railway applications — Marking on railway vehicles — Part 1: Freight wagons*

3 Terms, definitions, symbols and abbreviated terms

3.1 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1.1
associated maximum speed
local maximum speed for which the line category is valid

3.1.2
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 *g*

Note 1 to entry: In this standard "load" and "force" are described with units of "mass" (kg or t).

3.1.3
axle load
P_i
axle load *P* of the axle *i*

3.1.4
axle spacing
design values of the distances between the centres of adjacent axles

3.1.5
bending moment
designation of an internal force of a beam as used in structural design

3.1.6
categorisation of vehicles
statement of the vertical loading characteristics of a railway vehicle, according to the combination of axle loads and axle spacing, by allocation of a line category

3.1.7
classification of infrastructure
statement of the load carrying capacity of infrastructure on a line by allocation of a line category and related speed information

3.1.8
compatibility
demonstration of the satisfactory interface between the load effects of the vehicles and the load capacity of the infrastructure

3.1.9
design mass under exceptional payload
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 in EN 15663:2017+A1:2018

3.1.10
length over buffers
L
length over buffers or between coupling planes in case of no buffers

3.1.11
line
track or tracks between two locations forming a part of the heavy rail network

3.1.12
line category
designation of the specific load model based on reference wagons

3.1.13
line speed
general maximum speed of traffic on a route

3.1.14
load limit
maximum allowable payload for a wagon related to each line category

3.1.15
load model
defined by a specific formation of reference wagons

3.1.16
locomotive
traction vehicle that is not intended to carry a payload

Note 1 to entry: In this standard, power heads are considered as locomotives.

3.1.17
locomotive class
reference vehicle with representative locomotive parameters

3.1.18
mass per unit length
p
mass of a vehicle or unit divided by length over buffers

3.1.19
maximum passenger traffic speed/maximum freight traffic speed
additional information giving the general limit to the maximum traffic speed on a line according to the type of traffic

3.1.20
reference wagon
virtual vehicle used as a module of loading for a load model defined by axle load, axle spacing and mass per unit length

3.1.21
multiple unit
MU
fixed formation or railcar that can operate as a train not intended to be reconfigured, except within a workshop environment

3.1.22
passenger carriages
vehicles without traction: coaches, restaurant cars, sleeping cars, couchettes cars, vans, driving trailers, car carriers and similar vehicles, intended to be integrated in a variable formation as passenger train

3.1.23
route
path of a train between two locations of the network along one or more lines

3.1.24
series of locomotives
locomotives designed to be equal (the same axle spacing and the same nominal values for mass m_{nom} and, axle loads $P_{i,nom}$)

3.1.25
shear force
designation of an internal force of a beam as used in structural design

3.1.26
special vehicles
vehicles which are designed for maintenance, inspection or renewal of infrastructure elements or for special transport purposes where the fleet is operated with a low mileage compared to normal railway vehicles including:

a) maintenance vehicles including:
   1) cranes and matching wagons;
   2) on-track machines (see EN 14033 (all parts));
   3) road rail machines (see EN 15746 (all parts));
   4) demountable machines (see EN 15955 (all parts));
   5) trailers (see EN 15954 (all parts));
b) monitoring and inspection vehicles, including:
   1) track inspection vehicles;
   2) catenary inspection vehicles;
c) special transport vehicles, including:
   1) transformer transporter;
   2) crucible transporters;
   3) loaded wagons with more than 8 axles (UIC 502-1)

3.1.27
wheel load
***Q*$_i$**
static vertical wheel/rail contact forces of the wheelset *i* divided by *g*

Note 1 to entry: The terminology in this standard for “load” and “force” is used with the meaning and units of “mass” (kg or t).

3.2 Symbols and abbreviated terms

$2a^*$	bogie spacing between pivot centres within a vehicle	m
$2a^*_{adopted}$	adopted value of $2a^*$ used in Annex P	m
$2a^*_{table}$	$2a^*$ value in tables of Annex P	m
$2a^*_{unit}$	$2a^*$ value of a MU unit used in Annex P	m
$2a^+$	axle spacing in a bogie	m
$2a^+_{table}$	$2a^+$ value in tables of Annex P	m
$2a^+_{unit}$	$2a^+$ value of a MU unit used in Annex P	m
AB	articulated bogie	Unit
a	distance between axles	m
b	distance from end axle to the end of the nearest coupling plane	m
c	distance between two inside axles	m
CB	conventional bogie	—
ETCS	European Train Control System	—
HSLM	High Speed Load Model	—
d_n	distance between axle n and axle (n-1)	m
g	acceleration due to gravity	9,81 m/s^2
L	length over buffers	mm
L_Coa	coach length	m
m	mass	t
m_{nom}	nominal values for mass	t
$m_{nom,excess}$	modified nominal value for mass due to excess of tolerances	t
MU	multiple unit	—
n	axle number	—
p	mass per unit length	t/m
P	axle load	t
P_i	axle load of axle i	t
$P_{i,nom}$	nominal value for axle load of axle i	t
$P_{LineCategory}$	maximum axle load for a Line Category	t
$P_{nom,excess}$	modified nominal value for axle load due to excess of tolerances	t

P_{red}	reduced value of axle load	t
P_{unit}	maximum axle load within the unit	t
Q_i	wheel load of axle *i*	t
Q_{ir}/Q_{il}	wheel load of axle *i* right or left	t
RA	Route Availability	—
SA	single axle	—
s_n	distance between axle *n* and axle 1	m
u_1+u_2	bogie spacing between pivot centres of adjacent vehicles	m
u_3	overhang of end coaches	m
u_{unit}	overhang value of a MU unit used in Annex P	m
u_{table}	overhang value in tables of Annex P	m
UIC	International Union of Railways	—
v	speed	km/h

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 vehicles and infrastructure.

The line category resulting from the classification process for infrastructure represents the ability of the infrastructure (track, track substructures, earthworks, civil engineering structures) to withstand the static vertical loads imposed by vehicles on the line or section of line for regular service.

Each line category (a10, a12, a14, A, B1, B2, C2, C3, C4, D2, D3, D4, D5, D4xL and also E4 and E5, E6) is defined by a load model based on reference wagons defined by the characteristics given in Annex A:

— axle load;

— geometrical characteristics of the spacing of axles;

— length of the vehicle.

The value “mass per unit length” of the reference wagon is determined from the above parameters.

4.2 Correlation to types of vehicles

The load effects of different vehicle types are compared to the load models defining the different line categories.

All types of vehicles and freight wagons with their corresponding payload are covered by the line categories A, B1, B2, C2, C3, C4, D2, D3, D4.

Line categories D5, E4, E5 and E6 are defined exclusively for heavy freight wagons.

Locomotives can be covered by:

— line categories B1, B2, C2, C3, C4, D2, D3, D4 and D4xL (plus optional detailed specification for axle spacing ranges);

— locomotive classes L4 and L6.

Passenger carriages and Multiple Units can be covered by:

— line categories a10, a12, a14, B1, C2, D2 (plus optional detailed specification for axle spacing and vehicle lengths). Line categories a10, a12 and a14 have been specially developed for light rail vehicles with up to 14 t axle loads.

For rail vehicles or wagons with payload limits categorized above D4 or D4xL it is recommended to 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.

4.3 Correlation between line category and speed

4.3.1 Introduction

The classification of infrastructure applies to all types of railway vehicles, which can have different maximum speeds (e.g. freight and passenger traffic). Additional information defining the maximum speed corresponding to the line category 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 combinations (e.g. different maximum speeds and associated line categories for passenger and freight trains).

NOTE Examples illustrating information about line classification and relationship with speed are given in Annex F.

The combinations used for publication should be in accordance with legal, technical and operational requirements (e.g. ETCS speed levels).

The local line speed shall be taken into account for the classification of engineering structures (see 5.1) and other relevant infrastructure elements (see 5.2).

The line category and associated maximum speed shall be considered as a single combined quantity.

4.3.2 Freight traffic

When classifying infrastructure lines into line categories, the line category at maximum freight traffic speed (maximum 120 km/h) shall be determined.

120 km/h corresponds to the maximum speed for conventional freight traffic and is the limit of validity for freight traffic using line categories. In excess of 120 km/h individual checks shall be carried out.

Optionally, an additional higher line category at an associated lower speed (less than the maximum freight traffic speed) may be determined.

In some situations it may be desirable to determine the line category at a lower speed to maximize the line category.

In addition, for D5, E4, E5 or E6 lines, an associated maximum speed for such traffic shall be stated together with the associated maximum speed for conventional line traffic of line category D4.

4.3.3 Mixed traffic and passenger traffic

On mixed traffic lines with passenger traffic, the line category at maximum freight traffic speed in 4.3.2 is generally sufficient and appropriate for the optimization of freight traffic.

For vehicles and locomotives, categorized into the same or lesser line category as the line, and which run 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).

For speeds over 120 km/h and up to the maximum line speed, the different combinations of line categories-with speed shall be in accordance with general technical and operational requirements or restrictions.

Line Categories as classification information for speeds over 120 km/h may be related to vehicle types or types of traffic. Additional dynamic compatibility checks at different speed levels for different vehicle types may be required to demonstrate compatibility (see 5.1 and Annex F). Such dynamic checks are outside of the scope of this standard.

5 Classification of infrastructure

5.1 Civil engineering structure

When classifying a railway line into line categories, the load carrying capacity of structures supporting the track on the line shall be determined and expressed using the load models of Annex A taking speed into account. The speed(s) and where relevant traffic types shall be in accordance with 4.2 and 4.3.

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 existing structures and be in accordance with national requirements.

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

The assessment of the load capacity of structures shall take the following into account:

— load models and combination of vehicles 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 (e.g. using the dynamic factor for real trains in EN 1991-2:2003, Annex C);

— partial safety factors for railway loading due to mass tolerances and potential overloading (see 6.2);

— existing operating and other restrictions relating e.g. to different types of traffic.

When determining the line classification and maximum operating speed for locomotives, account may be taken of the reduced likelihood of overloading and cargo displacements (in comparison with other traffic types). Any reduction in partial safety factors for railway loads should be in accordance with national requirements.

The load models defined in Annex A are for the classification of lines and are not to 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 shall satisfy the requirements of Clause 4.

To address the potential risk of adverse bridge dynamic effects, resulting from resonance and other excessive dynamic effects in the structure, the need to carry out additional dynamic checks shall be considered according to the risk arising from the combination of vehicle type and speed.

NOTE 2 Annex D provides guidance on combinations of vehicle type and speed which do not require dynamic compatibility checks on existing bridges.