SLOVENSKI STANDARD
SIST EN 15227:2020

01-junij-2020

Nadomešča:
SIST EN 15227:2008+A1:2010

Železniške naprave - Zahteve za zagotavljanje varnosti železniških vozil pri trčenju

Railway applications - Crashworthiness requirements for rail vehicles

Bahnanwendungen - Anforderungen für die Kollisionssicherheit von Schienenfahrzeugen

Applications ferroviaires - Exigences de sécurité contre collision pour véhicules ferroviaires

Ta slovenski standard je istoveten z: **EN 15227:2020**

ICS:

45.060.01	Železniška vozila na splošno	Railway rolling stock in general

SIST EN 15227:2020 **en,fr,de**

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 15227

April 2020

ICS 45.060.01

Supersedes EN 15227:2008+A1:2010

English Version

Railway applications - Crashworthiness requirements for rail vehicles

Applications ferroviaires - Exigences de sécurité contre collision pour véhicules ferroviaires

Bahnanwendungen - Anforderungen für die Kollisionssicherheit von Schienenfahrzeugen

This European Standard was approved by CEN on 10 February 2020.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CEN members are the national standards bodies of 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, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and United Kingdom.

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

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

Ref. No. EN 15227:2020 E

Contents

Page

European foreword

This document (EN 15227:2020) 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 October 2020, and conflicting national standards shall be withdrawn at the latest by October 2020.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 15227:2008+A1:2010.

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 2016/797/EU.

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

Additionally to a general editorial reordering of clauses and text the technical changes with respect to the previous edition are listed below:

a) applicable vehicle types (1);

b) modified definitions and examples for crashworthiness design categories (5.1);

c) definition of train sets to be assessed (5.2);

d) assessment of train set which is only operated in one direction (5.2);

e) mandatory requirement of initial vertical offset for design collision scenario 1 for all crashworthiness design categories (5.4.1);

f) new definition of collision mass in accordance with EN 15663 mass definitions (5.4.1);

g) new requirements for locomotives with heavy duty couplers (5.4.2 and C.2);

h) mandatory requirement for locomotives with centre cabs to fulfil design collision scenario 3 (5.4);

i) additional design collision scenario for crashworthiness design category C-IV (5.4.5 and C.6);

j) new requirement for support condition of side windows at vehicle ends (6.3.1);

k) exclusion of gangways from survival space (6.3.2);

l) mandatory requirement that the survival space for the driver shall be inside the cab (6.3.1);

m) modified definition for driver’s seat survival space envelopes (6.3.5);

n) elimination of deceleration limits for design collision scenario 3 (6.4.1);

o) modified deceleration limits and modified deceleration assessment method for design collision scenarios 1 and 2 (6.4.1);

p) modified requirement for obstacle deflectors with respect to gauge limits (6.5.1);

q) new requirements for lifeguards (6.6);

r) new requirement for tests of structures or components mounted at intermediate ends (B.1.1)

s) modified obstacle geometry for design collision scenario 3 for crashworthiness design category C-III (C.3);

t) modified reference train for coach design (D.4);

u) new train definition for coach design limited to specific leading vehicles (D.5).

v) alignment of terms and definitions to prEN 17343:2019.

If a vehicle has been successfully assessed using the previous edition of this standard, and the technical changes of the new edition of EN 15227 do not affect this assessment, the vehicle can be regarded to conform to the new standard. Otherwise, if the vehicle needs to be reassessed, it is sufficient to assess only the modified technical requirements and new requirements.

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, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

Introduction

The objective of the passive safety requirements described in this European Standard is to reduce the consequences of collision accidents. The measures considered in this European Standard provide the means of protection when all possibilities of preventing an accident have failed. It provides a framework for determining the crash conditions that rail vehicle bodies can be designed to withstand, based on the most common collisions and associated risks.

This European Standard adds to the basic strength requirement defined in EN 12663-1:2010+A1:2014 by setting additional requirements for structural passive safety in order to increase occupant safety in case of collisions.

In the event of a collision, application of this European standard provides protection for the occupants of new designs of crashworthy vehicles through the preservation of structural integrity, reducing the risk of overriding and limiting decelerations. This protection does not extend to interactions between the occupants and the vehicle interior or to occupants of other rail vehicles, to other railway employees and customers who are not in vehicles, or to third parties.

1 Scope

This document specifies crashworthiness requirements applicable to new designs of:

— locomotives,

— driving vehicles operating in passenger and freight trains;

— passenger rail vehicles operating in passenger trains (such as trams, metros, mainline trains).

This document identifies common methods of providing passive safety that can be adapted to suit individual vehicle requirements.

This document specifies the characteristics of reference obstacle models for use with the design collision scenarios.

This document also specifies the requirements and methods for demonstrating that the passive safety objectives have been achieved by comparison with existing proven designs, numerical simulation, component or full-size tests, or a combination of all these methods.

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 12663-1:2010+A1:2014, *Railway applications - Structural requirements of railway vehicle bodies - Part 1: Locomotives and passenger rolling stock (and alternative method for freight wagons)*

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

prEN 17343:2019, *Railway applications — General terms and definitions*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in prEN 17343:2019 and the following apply.

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

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

3.1
active safety
systems and measures which take actions that aim to prevent a collision occurring

3.2
collision mass
effective vehicle mass used for collision simulations

3.3
collision speed
v_C
velocity difference between trains or train and obstacle at the start of the collision

3.4
crashworthiness
ability to mitigate the consequences of a collision in a controlled manner and reduce the risk of injury to the occupants

3.5
crumple zone
part of the vehicle body (usually at the vehicle ends) which is designed to deform in a controlled manner and absorb energy

3.6
design collision scenario
collision scenario that is applicable for design and assessment

3.7
energy-absorbing device
device which is attached to the vehicle structure, designed to deform in a controlled manner and absorb energy

EXAMPLE Energy-absorbing coupler

3.8
full-size test
test where the specimen is made using full-size components from the vehicle being assessed

3.9
heavy duty coupler
centre couplers conforming to the Willison or Janney principles

EXAMPLES SA3 coupler (Willison), AAR coupler (Janney)

Note 1 to entry: AAR: Association of American Railroads

3.10
leading end
end of a vehicle which in normal service can be the front of a train

3.11
level crossing speed
v_{LC}
applicable rail vehicle speed at level crossing

3.12
lifeguard
structural element positioned in front of a wheel with the objective of preventing small obstacles from passing between the wheel and the rail

3.13
normal European operating conditions
operating conditions comparable to those described by the documents listed in the bibliography

3.14
obstacle deflector
device mounted on the leading ends of vehicles to limit the consequences of striking an obstruction on the track

3.15
passive safety
structural design characteristics intended to reduce the consequences of a collision

3.16
survival space
space to be preserved for passengers and staff inside a rail vehicle for the design collision scenarios

3.17
reference train
train configuration that is used for the assessment and validation of locomotives, power heads, driving trailers and coaches that do not form part of a train set

4 Crashworthiness design of rail vehicle structures

4.1 General principles

The risk of train collisions is primarily controlled by active safety systems and/or operational procedures. Where these systems are inadequate due to particular circumstances or due to external events, structural crashworthiness provides a set of passive safety measures that will reduce the consequences of an accident.

The objective is to provide a level of protection consistent with the most common collisions and associated risks through the application of the design collision scenarios specified in this document. It is not practical to design vehicle structures to protect the occupants against all possible accidents or to consider all possible vehicle combinations.

Normal European operating conditions are assumed. The design of new vehicles for use in passenger trains assumes operations with compatible rolling stock that also meet this European standard. It is recognized that operational requirements may require new crashworthy and existing non-crashworthy vehicles to exist in the same train but such combinations of vehicles are not required to comply with this European Standard.

The applicable design collision scenarios, and suitable parameters for normal European operations are given in 5.3.

Annex A gives additional information regarding the derivation of the design collision scenarios and describes situations when they may need to be modified and the processes that should then be followed.

If the operational conditions are such that a design collision scenario cannot occur, or there is evidence that the probability of it occurring or the associated risk is so low as to be broadly acceptable, there is no need to consider this design collision scenario in the vehicle design. These conditions should be set out in the vehicle specification.

NOTE Train control systems which segregate different types of traffic on the same system or modes of traffic that are segregated by infrastructure (e.g. no level crossings) can satisfy this requirement.

If the system has characteristics that result in significant collision risks that are not addressed by the design collision scenarios considered in this European standard, they should also be considered in the form of additional design collision scenarios, which should form part of the vehicle specification.

The requirements apply to the vehicle body, and to those mechanical elements directly associated with it that may be used to absorb energy in a collision, such as couplers, drawgear and buffing systems. The requirements do not cover the safety features of doors, windows, system components or interior features except for specific issues relating to the preservation of survival space.

Not all vehicles in a train have to incorporate energy absorption, provided that passenger train configurations formed entirely of new vehicle designs comply as a whole with this European Standard.

4.2 Crashworthiness design objectives

To provide protection for the occupants of rail vehicles in the event of a collision, the requirements take into account the following objectives:

— absorption of collision energy in a controlled manner;

— reduction of the risk of overriding;

— maintenance of survival space and structural integrity of occupied areas;

— limiting deceleration;

— reduction of the risk of derailment and the consequences of hitting a track obstruction.

Specific requirements and assessment criteria to demonstrate that these objectives are satisfied are set out in Clauses 5, 6 and 7 (see 4.3).

As a by-product of providing occupant protection, the level of damage to the vehicle body is likely to be reduced in accidents. If more restrictive limits are intended to be placed on damage resulting from any of the design collision scenarios set out in Clause 5, these should be part of the vehicle specification and do not form part of the safety requirements set out in this European Standard.

4.3 Rail vehicle crashworthiness assessment process

For a new rail vehicle, the stages of the crashworthiness assessment process shall be:

— allocation of a crashworthiness design category (see 5.1);

— determination of the relevant train assessment methods (see 5.2 and Annex D) and determination of the applicable design collision scenarios (see 5.3 and 5.4). If non-standard design collision scenarios are required, see Annex A for guidance on the methods that should be adopted;

— validation of the crashworthiness assessment (see Clause 7 and Annex B).

— assessment of the applicable design collision scenarios with respect to the applicable crashworthiness design criteria (see 5.4, Clause 6 and Annex C);

5 Crashworthiness assessment requirements

5.1 Crashworthiness design categories of rail vehicles

For the application of this European standard rail vehicles are classified into crashworthiness design categories. These categories depend on the main characteristics of the rail network infrastructure and on the type of operation.

The appropriate crashworthiness design category or categories shall be defined in the vehicle specification.

Rail vehicles are divided into four categories as indicated in Table 1, with an indication of the type of operation and vehicles generally associated with each.

Table 1 — Crashworthiness design categories of rail vehicles

Category	Definition	Examples of vehicle types
C-I	Vehicles except urban vehicles and trams designed to operate on international, national and regional networks	Locomotives, coaches and trains
C-II	Urban vehicles designed to operate only on a dedicated rail network, with no level crossings and no interface with road traffic	Metro vehicles
C-III	Vehicles designed to operate on urban and/or regional networks, in track-sharing operation, and interfacing with road traffic	Tram-trains, peri-urban trams
C-IV	Trams	

5.2 Train assessment methods

5.2.1 Complete train set method

This method is applicable for train sets and railcars.

When assessing a train set with significantly different vehicle structures at each end, collisions at both ends shall be considered. For impacts between identical train sets only impacts between identical train set ends shall be considered.

When assessing a train set which is only operated in one direction and which has significantly different vehicle structures at each end, then head-on collision impacts at the leading ends and rear-on collisions of a leading end against a non-leading end shall be accounted for.

When assessing a train set which can be assembled and operated in different configurations of a same architecture, the shortest and longest train set shall be considered, e.g. if a train set can be configured to a fixed formation of 4 to 8 vehicles, the formation with 4 vehicles and the formation with 8 vehicles are assessed.

When assessing a train set which can also be operated in a train of two or more train sets, the assessment of only one single train set is sufficient but when assessing a train set with retractable or foldable coupler systems which can also be operated in a train of two or more train sets the assessment of two train sets is necessary.

NOTE The energy absorption devices of coupled train set ends sufficiently decouple the energy required to be absorbed by each train set in case of collisions. At the leading end of the train with retractable or foldable coupler systems the coupler is normally retracted or folded away. The behaviour of these couplers at the intermediate ends during collisions of trains with two or more train sets is demonstrated with the assessment of two train sets.

When assessing a train set which due to its design is always operated as a train of at least two train sets, the minimum number of train sets to form a train shall be assessed.

Some train sets may not have a control cab to lead a train at both ends (for example just a control panel for shunting), but are intended to be always operated as trains in both directions. Therefore the minimum operational train consist will be the one with a control cab positioned at each end.

5.2.2 Reference train method

This method is applicable for locomotives, power heads, driving trailers and coaches which are used with a variable formation of vehicles. For such vehicles applicable reference trains shall be used for the assessment. For applicable reference trains and assessment requirements of different vehicle types see Annex D.

5.2.3 Summary of train assessment methods

The applicable assessment methods and references to Annex D are indicated in Table 2.

Table 2 — Vehicle types and assessment methods

Vehicle types	**Assessment method**
Train sets and railcars	Complete train set method
Locomotives	Reference train method (see D.2 for reference train definitions)
Power heads and driving trailers	Reference train method (see D.3 for reference train definitions)
Coaches	Reference train method (see D.4 and D.5 for reference train definitions)

5.3 Design collision scenarios

In the following, four design collision scenarios are specified. Annex A discusses the derivation and application of the design collision scenarios in more detail.

1. Design collision scenario 1): a leading end impact between two identical trains;

   The moving train is impacting an identical stationary train. Both the moving and stationary train have to be assessed.

   This scenario is also representative of collisions with similar trains fitted with compatible coupling arrangements.

2. Design collision scenario 2): a leading end impact with a different type of rail vehicle;

   Depending on the crashworthiness design category the train to be assessed is colliding with a regional train equipped with a central coupler or a wagon.

   This scenario is representative of collisions with other rolling stock or with buffer stops.

   If the type of rolling stock typically encountered differs from the defined reference obstacles, then Annex A should be used to define more appropriate obstacles.

3. Design collision scenario 3): a leading end impact with a road vehicle;

   The train to be assessed is colliding with a large obstacle at level crossings or, where appropriate, with common urban road traffic obstacles.

   This scenario is representative of collisions with large road vehicles.