SLOVENSKI STANDARD
SIST EN 15227:2008+A1:2010

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Železniške naprave - Zahteve za zagotavljanje pasivne varnosti vagonskih grodov pri trčenju

Railway applications - Crashworthiness requirements for railway vehicle bodies

Bahnanwendungen - Anforderungen an die Kollisionssicherheit von Schienenfahrzeugkästen

Applications ferroviaires - Exigences en sécurité passive contre collision pour les structures de caisses des véhicules ferroviaires

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45.060.01	Železniška vozila na splošno	Railway rolling stock in general

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COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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Foreword

This document (EN 15227:2008+A1:2010) 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of an identical text or by endorsement, at the latest by May 2011 and conflicting national standards shall be withdrawn at the latest by May 2011.

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 2010-09-28.

This document supersedes EN 15227:2008.

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 organizations of the following countries are bound to implement this European Standard: 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, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and 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 last means of protection when all possibilities of preventing an accident have failed. It provides a framework for determining the crash conditions that railway vehicle bodies should be designed to withstand based on the most common accidents and associated risks.

The requirements are compatible with those of EN 12663. The static compression load requirements on the vehicle ends, required by EN 12663, are intended to provide a basic structural integrity to the occupied areas in a collision-type accident. This European Standard adds to the basic strength requirement by setting additional requirements for structural passive safety in order to increase occupant safety.

1 Scope

This European Standard applies to new designs of locomotives and passenger carrying rolling stock as defined in categories C-I to C-IV of Clause 4 taking into consideration the recommendations given in Annex E on the application of the standard (migration rule). It is intended to protect vehicle occupants, through the preservation of structural integrity, and does not extend to other railway employees and customers who are not in vehicles, or to third parties. The specified requirements relate to the technical and operational conditions of use that prevail in the CEN member countries. The design of new vehicles for use in passenger trains is based on operations with compatible rolling stock that also meet this standard. It is recognised that operational requirements will require new crashworthy and existing non-crashworthy vehicles to exist in the same train unit but such combinations of vehicles are not required to comply with this European Standard.

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, buffing systems etc. They 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.

The requirements do not cover all possible accident scenarios but provide a level of crashworthiness that will reduce the consequences of an accident, when the active safety measures have been inadequate. The requirement is to provide a level of protection by addressing the most common types of collision that cause injuries and fatalities.

The applicable design collision scenarios, and suitable parameters for normal European operations, are given in Clause 5. Annex A gives additional information regarding the derivation of the scenarios and describes situations when they may need to be modified and the processes that should then be followed.

This European Standard identifies common methods of providing passive safety that may be adopted to suit individual vehicle requirements. This European Standard also specifies the characteristics of reference obstacle models for use in the design collision scenarios. Not all vehicles in a train unit have to incorporate energy absorption provided that passenger train configurations formed entirely of new vehicle designs comply as a whole with this European Standard.

This European Standard also specifies the requirements 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 referenced documents are necessary for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced documents (including any amendments) applies.

EN 12663, *Railway applications — Structural requirements of railway vehicle bodies*

3 Terms and definitions

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

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

3.2
broadly acceptable risk
level of risk that is regarded as not significant in the context in which it is experienced

3.3
collision mass
is taken as the design mass in working order plus the mass of 50 % of seated passengers

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
crushing
excessive plastic deformation that significantly reduces the volume created by the vehicle structure

3.7
design collision scenario (= limiting collision scenario/case)
most severe collision/case for each given scenario that it is appropriate to protect against and so is applicable for design purposes on the basis of the collision accident analysis; see [1], [5]

3.8
driving trailer
non-powered vehicle fitted with a driving cab and which is designed to operate in general traffic and not as part of a fixed configuration train unit

3.9
energy absorbing device
device which is attached to, but not part of the vehicle structure and is designed to deform in a controlled manner and absorb energy (e.g. energy absorbing coupler)

3.10
fixed seat
permanent seat in the cab that is occupied during normal operation (e.g. cannot be folded away when not in use)

3.11
full size test
test on the structure of interest with the test specimen formed from all relevant full size components

3.12
locomotive
self-propelled vehicle with an operational driving cab at both ends (or single cab for operation in both directions), the function of which is only to provide motive power for a rake of vehicles, and which is designed to operate in general traffic and not as a permanent part of a fixed configuration train unit

3.13
net contact force
difference between the longitudinal forces acting on opposite ends of the vehicle (i.e. the algebraic sum of the longitudinal force) at any instant of time

3.14
normal European operating conditions
operating conditions comparable to those described by the documents listed in the bibliography

3.15
operator
organisation which has responsibility for defining the technical requirements for the railway vehicle in order that it will perform the intended operation and meet the acceptance criteria

3.16
passive safety
systems which reduce the consequences of an accident should it occur

3.17
plastic deformation/permanent deformation
deformation associated with stresses above the material yield or proof stress and which is not recoverable when the load is removed

3.18
power head
self-propelled vehicle with an operational driving cab at one end only, the function of which is only to provide motive power for a rake of vehicles, and which is designed to operate in general traffic and not as a permanent part of a fixed configuration train unit

3.19
reference train
train configuration that is used for the assessment and validation of vehicles (including locomotives, power heads and driving trailers) that do not form part of a fixed rake

NOTE See Annex D.

3.20
regulations
requirements stipulated in legislation, standards and other documents mandated by legislation

3.21
supplier
organisation which has responsibility for supplying the railway vehicle to satisfy the regulations and functional requirements of the operator

3.22
survival space
volume of the vehicle body containing the occupants which has to be maintained during the limiting collision (e.g. the occupied areas, but not including flexible gangways)

NOTE See also 6.3.

3.23
TEN
Trans European Network as defined in EC Directives 1996/48/EC, 2001/16/EC and 2004/50/EC

3.24
train unit
operational configuration of a single rake of coupled vehicles to be considered by this European Standard

3.25
V_{lc}
maximum train unit operational speed at a level crossing (the lower of the maximum train unit speed and the designated line speed)

4 Crashworthiness design categories of railway vehicles

For the application of this standard railway vehicles are classified into crashworthiness design categories. These categories depend on the main characteristics of the railway infrastructure and on the type of operation. The operator has to define the appropriate vehicle design category in the procurement documents of new projects.

Railway 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 railway vehicles

Category	Definition	Examples of vehicle types
C-I	Vehicles designed to operate on TEN routes, international, national and regional networks (which have level crossings)	Locomotives, coaches and fixed train units
C-II	Urban vehicles designed to operate only on a dedicated railway infrastructure, with no interface with road traffic	Metro vehicles
C-III	Light rail vehicles designed to operate on urban and/or regional networks, in track-sharing operation, and interfacing with road traffic	Tram trains, peri-urban tram
C-IV	Light rail vehicles designed to operate on dedicated urban networks interfacing with road traffic	Tramway vehicles

5 Design collision scenarios

It is recognised that it is impractical to design the vehicle structure to protect the occupants in all possible accident situations or to consider all possible vehicle combinations. The requirement is to provide a level of protection consistent with the common collision risks.

The design collision scenarios specified below are not the only cases occurring on the infrastructure of public rail transport in Europe, but they represent the most common collision situations and those that result in most of the casualties. Annex A discusses the derivation and application of the collision scenarios in more detail.

1) A front end impact between two identical train units;

2) a front end impact with a different type of railway vehicle;

3) train unit front end impact with a large road vehicle on a level crossing;

4) train unit impact into low obstacle (e.g. car on a level crossing, animal, rubbish).

Table 2 summarises these design collision scenarios with respect to the different vehicle crashworthiness design categories and the different operational conditions that are to be used for the crashworthiness validation. Table 3 lists the performance requirements for obstacle deflectors.

Table 2 — Collision scenarios and collision obstacles

Design collision scenario	Collision obstacle	Operational characteristics of requirement	Collision Speed - km/h				Collision partner and conditions
			C-I	C-II	C-III	C-IV	
1	Identical train unit	All systems	**36**	**25**	**25**	**15**	Identical train unit
2	80 t wagon	Mixed traffic with vehicles equipped with side buffers.	**36**	n.a.	**25**	n.a.	See C.1 for wagon specification
	129 t regional train	Mixed traffic with vehicles with a central coupler	n.a.	n.a.	**10**	n.a.	See C.2 for representation of regional train
3	15 t deformable obstacle	TEN and similar operation with level crossings	V_{lc} **– 50** **≤ 110**	n.a.	**25**	n.a.	See C.3 for representation of large obstacle
	3 t rigid obstacle	Urban line not isolated from the road traffic	n.a.	n.a.	n.a.	**25**	See C.4 for representation of obstacle
4	Small, low obstacle	Obstacle deflector requirements to be achieved	See Table 3	n.a.	See Table 3	n.a.	See also 6.5

Table 2 application rules:

— colliding train units and obstacles are un-braked on straight and level track;

— when assessing a train unit with different vehicles at each end, only impacts between identical vehicles shall be considered under Scenario 1, but both ends shall be considered;

— heavy haul locomotives used only for freight operations and fitted with centre couplers conforming to the Willison (e.g. SA3) or Janney (AAR standard) principle are omitted from meeting the requirements of Scenarios 1 and 2.

Table 3 — Obstacle deflector performance requirements

Operational speed [a]	**≥ 160 km/h**	**140 km/h**	**120 km/h**	**100 km/h**	**≤ 80 km/h**
Static load at centre line [b]	300 kN	240 kN	180 kN	120 kN	60 kN
Static load at 750 mm lateral distance from centre line [b]	250 kN	200 kN	150 kN	100 kN	50 kN

[a] For operational speeds different from the given values, the force values may be interpolated.

[b] Details of the application of these loads and the performance characteristics of the obstacle deflector are given in 6.5.1.

If there are no crashworthiness requirements specified in regulations and the normal European operating conditions assumed by this European Standard do not apply, it shall be the responsibility of the operator to determine the applicable scenarios and the appropriate limiting design case for each (see Annex A).

The vehicles shall be designed to satisfy those design collision scenarios that correspond to the operational conditions they are expected to experience. 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 the scenario in the vehicle design.

NOTE Train control systems which segregate different types of traffic on the same system may satisfy this requirement. Locomotives with centre cabs may have an inherent broadly acceptable risk under Scenario 3.

If the system has characteristics that result in significant collision risks (relative to the above) not already covered, they shall also be considered in the form of additional design collision scenarios.

If vehicles cannot operate up to the collision speeds specified in this European Standard (e.g. shunting locomotives) the crashworthiness requirements need not be applied.

If assessing a single locomotive, power head, driving trailer or coach, which is not part of a fixed train unit, a reference train shall be used for design purposes in each of the above scenarios. Annex D specifies the choice of reference trains and the scope of approval that is possible without further re-assessment.

6 Structural passive safety

6.1 General principles

To the extent required by this European Standard the following measures shall be employed to provide protection of occupants in the event of a collision:

— reduce the risk of overriding;

— absorb collision energy in a controlled manner;