



SLOVENSKI STANDARD
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Železniške naprave - Preskušanje in simuliranje vozniških karakteristik pri prevzemu železniških vozil - Vozna varnost pri vzdolžnih tlačnih silah

Railway applications - Testing and simulation for the acceptance of running characteristics of railway vehicles - Running safety under longitudinal compressive forces

Bahnanwendungen - Versuche und Simulationen für die Zulassung der fahrtechnischen Eigenschaften von Eisenbahnfahrzeugen - Fahrsicherheit unter Längsdruckkräften

Applications ferroviaires - Essais et simulations en vue de la validation du comportement dynamique des véhicules ferroviaires - Sécurité de circulation sous forces longitudinales de compression

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Railway applications - Testing and simulation for the acceptance of running characteristics of railway vehicles - Running safety under longitudinal compressive forces

Applications ferroviaires - Essais et simulations en vue de l'homologation du comportement dynamique des véhicules ferroviaires - Sécurité de circulation sous forces longitudinales de compression

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COMITÉ EUROPÉEN DE NORMALISATION
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European foreword

This document (prEN 15839:2023) has been prepared by Technical Committee CEN/TC 256 “Railway applications”, the secretariat of which is held by DIN.

This document is currently submitted to the CEN Enquiry.

This document will supersede EN 15839:2012+A1:2015.

This document includes the following significant technical changes with respect to EN 15839:2012+A1:2015:

- OTMs added in the scope, which explain why term vehicle has mostly replaced the term wagon in the standard;
- Requirements for endurable longitudinal compressive forces in EN 15839:2012+A1:2015 kept in the present document and mainly reported in 5.2 for conventional trains. New optional requirements in 5.3, Annex F and Annex G added for endurable compressive forces in high-capacity trains. The reason is to make the link between the present document and the methodology for assessment of high-capacity trains (described in IRS 40421);
- 5.4 and Annex H on assessment of endurable longitudinal compressive force for vehicles with central couplers added;
- 5.5 about special vehicle layout and more particularly 5.5.2 “Permanently coupled units with a drawbar” added;
- Clause 5 “Evaluation of the torsional coefficient of a car body ct^* and 6 “Condition for dispensation from tests or calculations regarding the safety against derailment on twisted track” removed as these sections are already in EN 14363:2016+A2:2022;
- Clause 7 (except 7.2) relocated in Annex B. Some precisions in Annex B added 7.2 relocated in Annex C. Dispensation for wagon with 3 axle bogies and OTMs added. Dispensation for OTMs comes from EN 14033-1:2017;
- Possibility to assess endurable longitudinal compression force with simulation added in 5.1 and Annex E.

Introduction

Due to the operating conditions of braking or propelling, high longitudinal compressive forces can occur between some coupled freight vehicles. These forces can be safety related especially in S-shaped curves with small radii under some conditions depending also on the design of the coupling.

This document defines the acceptance process to be followed by vehicles that are operated in a way that high longitudinal compressive forces may occur in the trains.

The establishment of this document was based on currently existing rules, practices, and procedures to define acceptance criteria ensuring running safety under the existing operating conditions. It provides a defined testing interface between vehicle design, track layout and braking operation. Investigations according to this document are not necessary if operating practice shows that running safety is achieved without them.

The following principles are applied:

- a) the railway system requires comprehensive technical rules to ensure an acceptable interaction of vehicle and track;
- b) due to the numerous national and international regulations new railway vehicles are tested and homologated before putting them into service. In addition, existing acceptance are checked when operating conditions are extended;
- c) in view of the significance of international traffic, the harmonization of existing regulations is required. In some cases, additional rules are required as well: an update of existing regulations is also needed due to the considerable progress achieved in the field of railway-specific methods for measuring, evaluation, and data processing;
- d) it is of particular importance that the existing level of safety and reliability is not compromised even when changes in design and operating practices are demanded.

This document is derived in essential parts from UIC 530-2:2011, which is based on practical tests performed in ERRI-B12.

Variations from the conditions specified in this document are allowed as specified by Article 7 of Directive 2016/797/EU.

For national or multilateral operations, the infrastructure managers concerned may authorize variations to the defined conditions.

1 Scope

This document defines the assessment of endurable longitudinal compressive forces (LCF) of a vehicle. The endurable longitudinal compressive force is a parameter depending on the vehicle design. It is used to estimate the risk of derailment as a result of being subjected to these forces, under operating conditions.

NOTE 1 As operating conditions may vary in several aspects (infrastructure, train configurations etc.), this document defines uniform assessments of endurable longitudinal compressive force per vehicle in specific operating conditions. One of these endurable longitudinal compressive forces is derived from UIC 530-2:2011, which is based on practical tests performed in ERRI-B12. Other endurable longitudinal compressive forces as the outcome of this document are central input parameters in the methodology of IRS 40421. IRS 40421 derives train and operational parameters from the outcome of this document which are vehicle parameters.

This document applies to the following types of vehicles:

- single wagons;
- permanently coupled units with side buffers and screw couplers between the vehicles;
- permanently coupled units with diagonal buffers with screw couplers between the vehicles;
- permanently coupled units with a bar coupler between the vehicles;
- articulated units with three 2-axle bogies;
- wagons with 3-axle bogies; low-floor wagons with eight or more axles (e.g. rolling road wagon);
- vehicles with central couplers;
- on-track machines (OTM) as defined in EN 14033-1:2017.

NOTE 2 This document defines the acceptance process to be followed by vehicles that are operated in a way that high longitudinal compressive forces may occur in the trains due to their operational environment (e.g. train composition, braking regime, track layout). Therefore, vehicles among the previous list which are not subjected to high longitudinal compressive forces may not need to fulfil this document.

The following vehicles are not in the scope of this document:

- articulated wagons with more than three 2-axle bogies;
- locomotives and passenger rolling stocks;
- vehicles that are only operated in passenger trains.

Acceptance criteria and test conditions as well as conditions for simulation and test dispensation are defined in this document.

This document applies principally to vehicles which operate without restrictions on standard gauge tracks in Europe (1 435 mm).

NOTE 3 The influence on railway systems using other gauges is not sufficiently understood to extend the scope of this document to gauges other than standard.

NOTE 4 For wagons with central couplers, a need for assessment of derailment risk due to Longitudinal Forces on other gauges (1 524 mm, 1 600 mm, 1 668 mm) has been expressed. The influence on railway systems using

other gauges is not sufficiently understood. This document only introduces some notions to assess it independently from the gauge.

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 15551:2022, *Railway applications - Railway rolling stock - Buffers*

EN 15566:2022, *Railway applications - Railway Rolling stock - Draw gear and screw coupling*

EN 16235:—,¹ *Railway applications — Testing for the acceptance of running characteristics of railway vehicles — Freight wagons — Conditions for dispensation of freight wagons with defined characteristics from on-track tests according to EN 14363*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 17343:2020 and the following apply.

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

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

3.1

torsional coefficient of vehicle body

relevant parameter for running safety under compressive forces and safety against derailment on twisted track

Note 1 to entry: Test conditions are defined in EN 14363:2016+A2:2022.

3.2

safety against derailment on twisted track

safety of a vehicle against wheel climbing of a guiding wheel whilst negotiating a curved track with limit conditions of twist

Note 1 to entry: Test conditions are defined in EN 14363:2016+A2:2022.

3.3

longitudinal compressive force

longitudinal force which is applied on a vehicle through its interfaces with flanking vehicles

Note 1 to entry: The longitudinal compressive force is depending on many parameters such as the composition of the train, the track layout, the driving manoeuvre, and dynamical parameters.

3.4

endurable longitudinal compressive force

longitudinal force which can be applied on a vehicle under defined conditions related to the flanking wagons and the track layout without exceeding limits specified for wheel lift, lateral axle box force, overlap of buffer plates and axle guard deformation

¹ Under preparation. Stage at the time of publication: prEN 16235:2022.

prEN 15839:2023 (E)**3.5****required endurable longitudinal compressive force**

minimum endurable longitudinal compressive force required for a vehicle to be authorized for use in defined operating conditions

3.6**standard ends**

specific design of the coupling end of a vehicle equipped with side buffers and screw coupling systems

Note 1 to entry: Geometric location of buffers and draw gear is specified in CR TSI RST FW (freight wagons), 4.2.2.1. Characteristics of buffers are specified in EN 15551:2022, characteristics of screw coupling systems are specified in EN 15566:2022.

3.7**permanently coupled unit**

unit consisting of several elements (single vehicles fitted with bogies or single axle running gear), where the elements cannot be operated separately

3.8**articulated unit**

unit consisting of several elements, connected with articulations, and equipped at both ends with side buffers and screw coupling systems as defined in 3.6, where the elements cannot be operated separately

3.9**conventional train**

trains including freight wagons and/or OTMs whose composition characteristics (length, mass, brake regime, maximum speed...) are admitted in international traffic

Note 1 to entry: IRS 40421 presents train compositions admitted in international traffic which are conventional trains.

3.10**high-capacity train**

trains including freight wagons and/or OTM whose composition characteristics (length, mass, brake regime, maximum speed...) are not commonly admitted in international traffic or not admitted yet in any European country

3.11**central coupler**

central buffer end coupling that works automatically for coupling 2 units together, at least mechanically

Note 1 to entry: A standard on the Digital Automatic Coupler (DAC), which is a specific central coupler for freight operations, is under preparation in the frame of WG33.

3.12**Technical Specification**

document describing specific parameters and/or product requirements as an addition to the requirements of this document

4 Deviations from requirements

If deviating from some points of the requirements of this document for a particular assessment, these deviations shall be reported and explained. Then the influence on the assessment of the vehicle in terms of the acceptance criteria shall be evaluated and recorded. The outcome of this study shall be considered as an integral part of the requirements of this document when applied to the assessment process of the vehicle.

5 Proof of the endurable longitudinal compressive force

5.1 Assessment of endurable longitudinal compressive force

The endurable longitudinal compressive force shall be determined either:

- a) by testing the vehicle according to the specification in Annex B;
- b) by simulations based on models showing credible results for a similar reference vehicle for which test results are available for comparison of simulation and test results. Requirements for the use of simulations are given in Annex E.

5.2 Required endurable longitudinal compressive force for use in conventional trains

For an unlimited operation in conventional trains, the vehicle shall have an endurable longitudinal compressive force higher than:

- 200 kN for vehicles or units equipped with single axle running gear;
- 240 kN for other vehicles.

NOTE These values are based on special test conditions defined in Annex B and proved to be suitable for the running safety of conventional trains. The occurring longitudinal compressive force in operation might exceed these values.

If the vehicle is designed in accordance with the conditions specified in Annex C, neither test nor simulation are necessary to prove its running safety in conventional trains.

Vehicles not compliant with the conditions above may need operational restrictions for their use in European networks.

5.3 Assessment of endurable longitudinal compressive forces for use in high-capacity trains

The longitudinal compressive forces reached in operation depend on many different technical parameters (e.g. composition rules, driving rules, locomotive types, brake characteristics).

High-capacity trains might generate higher longitudinal compressive forces than conventional trains. Therefore, for vehicles incorporated in high-capacity trains, higher endurable longitudinal compressive forces than the ones mentioned in 5.2 might be required.

The determination of the required endurable longitudinal compressive forces of a vehicle under the various operational conditions of high-capacity trains is not part of this document.

NOTE IRS 40421 Appendix B presents a methodology which helps to determine the occurring longitudinal compressive forces and to derive the required endurable longitudinal compressive forces for a vehicle in a high-capacity train.

The additional assessments described in Annex F and Annex G only apply for vehicles used in high-capacity trains requiring higher endurable longitudinal compressive forces than specified in 5.2.

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Annex F proposes a list of scenarios for the assessment of endurable longitudinal compressive forces of a vehicle incorporated in a high-capacity train. These determined endurable longitudinal compressive forces under the specified scenarios shall be documented in the technical documentation of the vehicle.

5.4 Assessment of endurable longitudinal compressive forces for vehicles equipped with central couplers

Annex H gives information about the assessment methodology of endurable longitudinal compressive forces of vehicles equipped with central couplers.

5.5 Special vehicle layout**5.5.1 Permanently coupled units consisting of two 2-axle wagons**

For permanently coupled units consisting of two 2-axle wagons with standard ends at the end of the unit:

- with standard end arrangement at the permanent coupled interface; or
- with 2 diagonal buffers and draw gear according to Figure D.1 at the permanent coupled interface;

each 2-axle wagon shall be assessed independently according to 5.1, 5.2 and 5.3, considering they are equipped with standard ends.

If the height of the permanently coupled end is more than 100 mm below the outer ends, the minimum axle load under the required endurable longitudinal compressive forces according to 5.2 and 5.3 on straight track shall be at least 50 % of the minimum tare weight given in Figure C.1.

5.5.2 Permanently coupled units with a drawbar

For permanently coupled units consisting of wagons with standard ends at the end of the unit, each wagon shall be assessed independently according to 5.1, 5.2 and 5.3, considering they are equipped with standard ends.

Permanently coupled units with a drawbar of several 2-axle wagons are not dispensed from tests or simulation tests.

Wagons with bogies can be equipped with drawbars without additional tests or simulations if the drawbar and its implementation on the unit fulfil technical conditions:

- minimum distancer between articulation points;
- minimum static compressive strength in the direction of the centre of the drawbar;
- minimum static tensile strength;
- stored energy capacity;
- height difference between end coupler and inner coupler location of the articulation point;
- presence of stabilization effect;
- longitudinal play.

NOTE Technical conditions on these parameters are given in UIC 572:2011.