SLOVENSKI STANDARD
oSIST prEN 16207:2021

01-december-2021

Železniške naprave - Zavore - Funkcionalna merila in merila za zmogljivost elektromagnetnih zavornih sistemov za železniška vozila

Railway applications - Braking - Functional and performance criteria of Magnetic Track Brake systems for use in railway rolling stock

Bahnanwendungen - Bremse - Anforderungen an Funktion und Leistungsfähigkeit von Magnetschienenbremssystemen für Schienenfahrzeuge

Applications ferroviaires - Freinage - Critères pour la fonction et la performance des systèmes de freinage magnétiques pour véhicules ferroviaires

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If this draft becomes a European Standard, 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.

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European foreword

This document (prEN 16207:2021) 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 16207:2014+A1:2019.

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(s) / Regulation(s).

For relationship with EU Directive(s) / Regulation(s), see informative Annex ZA, which is an integral part of this document.

In comparison with the previous edition, the following technical modifications have been made:

a) normative references have been updated;

b) requirements for end pieces of magnet elements (see 5.5) have been modified;

c) requirements for control of the MTB (5.10) have been modified;

d) content of the Table C.1 “List of end pieces and main dimensions” has been updated;

e) new normative Annex D “Validation process for new end pieces of MTB” has been added;

f) Annex ZA has been updated in accordance with Directive (EU) 2016/797.

1 Scope

This document specifies the functionality, position, constraints and control of a magnetic track brake system (MTB system) installed in bogies for use in emergency braking and in low adhesion conditions on Mainline Trains with speeds up to 280 km/h. It covers high suspension types of MTB only and not high/low and low suspension type of MTB.

This document also contains test methods and acceptance criteria for an MTB system. It identifies interfaces with electrical equipment, bogie, track and other brake systems.

On the basis of the existing international and national standards, additional requirements are defined for:

— conditions of application for the MTB system;

— retardation and brake forces;

— functional and design features;

— strength requirements;

— type, series and vehicle implementation tests.

For design and calculation a “reference surface” is established.

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 10025-2:2019, *Hot rolled products of structural steels — Part 2: Technical delivery conditions for non-alloy structural steels*

EN 13674-1:2011+A1:2017, *Railway applications — Track — Rail — Part 1: Vignole railway rails 46 kg/m and above*

EN 14198:2016+A2:2021, *Railway applications — Braking — Requirements for the brake system of trains hauled by locomotives*

EN 14478:2017, *Railway applications — Braking — Generic vocabulary*

EN 14531-2:2015, *Railway applications — Methods for calculation of stopping and slowing distances and immobilization braking — Part 2: Step by step calculations for train sets or single vehicles*

EN 15179:2007, *Railway applications — Braking — Requirements for the brake system of coaches*

EN 15273-1:2013+A1:2016, *Railway applications — Gauges — Part 1: General — Common rules for infrastructure and rolling stock*

EN 15734-1:2010,[1] *Railway applications — Braking systems of high speed trains — Part 1: Requirements and definitions*

[1] As impacted by EN 15734-1:2010/AC:2013 and EN 15734-1:2010/prA1:2021.

EN 15734-2:2010,[2] *Railway applications — Braking systems of high speed trains — Part 2: Test methods*

EN 16185-1:2014+A1:2020, *Railway applications — Braking systems of multiple unit trains — Part 1: Requirements and definitions*

EN 16185-2:2014+A1:2019, *Railway applications — Braking systems of multiple unit trains — Part 2: Test methods*

EN 16834:2019, *Railway applications — Braking — Brake performance*

EN 45545-2:2020, *Railway applications — Fire protection on railway vehicles — Part 2: Requirements for fire behavior of materials and components*

EN 50124-1:2017, *Railway applications — Insulation coordination — Part 1: Basic requirements — Clearances and creepage distances for all electrical and electronic equipment*

EN 50126-1:2017, *Railway Applications — The Specification and Demonstration of Reliability, Availability, Maintainability and Safety (RAMS) — Part 1: Generic RAMS Process*

EN 50129:2018,[3] *Railway applications — Communication, signalling and processing systems — Safety related electronic systems for signalling*

EN 50657:2017, *Railways Applications — Rolling stock applications — Software on Board Rolling Stock*

EN 60077-1:2017, *Railway applications — Electric equipment for rolling stock — Part 1: General service conditions and general rules (IEC 60077-1:2017)*

EN 60529:1991,[4] *Degrees of protection provided by enclosures (IP Code) (IEC 60529:1989)*

EN 61373:2010, *Railway applications — Rolling stock equipment — Shock and vibration tests (IEC 61373:2010)*

EN ISO 2409:2020, *Paints and varnishes — Cross-cut test (ISO 2409:2020)*

EN ISO 4628-3:2016, *Paints and varnishes — Evaluation of degradation of coatings — Designation of quantity and size of defects, and of intensity of uniform changes in appearance — Part 3: Assessment of degree of rusting (ISO 4628-3:2016)*

EN ISO 9227:2017, *Corrosion tests in artificial atmospheres — Salt spray tests (ISO 9227:2017)*

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[2] As impacted by EN 15734-2:2010/AC:2012 and EN 15734-2:2010/prA1:2021.
[3] As impacted by EN 50129:2018/AC:2019-04.
[4] As impacted by EN 60529:1991/A1:2000 and EN 60529:1991/A2:2013.

3 Terms, definitions and abbreviations

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 14478:2017 and the following apply.

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

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

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

3.1.1
actuator
device to lower the MTB to the rail head, commonly a pneumatic cylinder with a return spring

3.1.2
end pieces
guide the magnets on the rails

Note 1 to entry: They also contribute to the braking force.

Note 2 to entry: They are subject to wear.

3.1.3
high suspension
variation of the MTB in which the magnets are connected with each other by means of tie bars and, in their rest position, are fastened to centring elements situated at a rest position in the running gear where they are held by spring action, and in which, so as to apply the magnets, an energy source is used for lowering them onto the rails

3.1.4
high/low suspension
variation of the MTB in which the magnets are likewise connected with each other by means of tie bars and, in their rest position, are fastened to centring elements situated at a rest position in the running gear where they are displaced to their low position by using an external energy source, whereas, in their low position, however they are situated at a height which, when the magnets are energized, causes the magnets to get self-attracted by the rails, against a spring force

3.1.5
low suspension
variation of the MTB in which the magnets are suspended above the rail surface, by the action of a spring, at a level that allows the magnets, when they are energized, to become self-attracted by the rail

3.1.6
pole shoes
friction elements of the magnet that produce the braking force

Note 1 to entry: They are subject to wear and are therefore replaceable.

3.1.7
rest position
position of the MTB in which the magnets suspended at a significant distance from the rail surface, unless a brake application command has been issued and in which position the magnet is guided and positioned by the bogie

Note 1 to entry: This position corresponds to the geometrical defined rest position in case of high suspension and high/low suspension.

3.1.8
weld-ons
accumulation of metallic wear debris that attaches to the underside of the MTB pole pieces

Note 1 to entry: The presence of this material reduces the braking performance of the MTB and thus needs to be removed during maintenance activities.

3.1.9
working position
position of the MTB in which the magnets are in contact with the rail where it centres itself, due to the action of the magnetic field and in which, when the magnet is energized, the brake force is produced by friction

3.2 Abbreviations

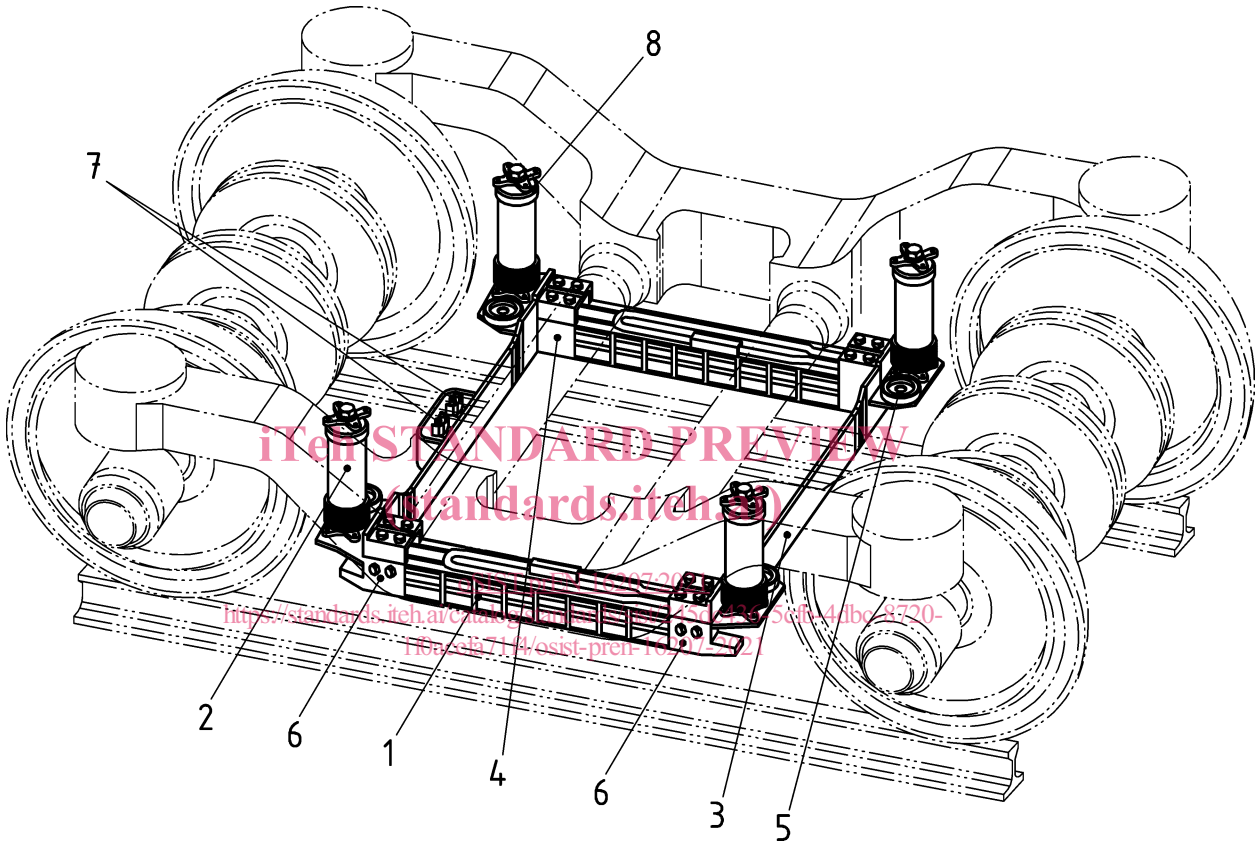
For the purposes of this document, the following abbreviations apply.

BP	Brake Pipe
CCS	Control Command and Signalling
DC	Direct Current
EMC	Electromagnetic Compatibility
FME(C)A	Failure Mode Effect (criticality) Analysis
g	acceleration by gravitation (9,81 m/s^2)
IP67	IP-Code: a coding system to indicate the degrees of protection by an enclosure against access to hazardous parts, ingress of solid foreign objects, ingress of water and to give additional information in connection with such protection, according to EN 60529
MTB	Magnetic Track Brake, equipment for one bogie/running gear
PD2	degrees of pollution for the purpose of evaluating creepage distances and clearances, according to EN 50124-1
q	clearance in mm between wheel set and lower part of the bogie frame in accordance with EN 15273-1:2013+A1:2016
R+Mg	brake mode with the MTB function active in accordance with EN 14198
TSI	Technical Specification for Interoperability
U_N	nominal battery voltage
WSP	Wheel Slide Protection

4 Task and purpose of the MTB

The MTB is an additional braking device that directly acts on the rails and is therefore independent of wheel/rail adhesion. Its action is obtained by friction due to the magnetic attractive force. The magnetic attractive force can be generated electrically or by permanent magnets. The MTB is installed into the bogie or running gear, if required, to complement the brake depending on the wheel/rail adhesion. In the bogie the magnets are installed between the wheels.

Figure 1 shows an example of an MTB with high suspension fitted to a bogie, which is represented in a simplified version.



Key

1 magnet with segmented or rigid pole shoes
2 actuator
3 tie bar
4 brake reaction bracket, non-magnetic
5 centring device to restrict lateral movement in the rest position
6 special end pieces for negotiating point work
7 electrical interface
8 pneumatical interface

Figure 1 — Installation of an MTB into a bogie (example)

The MTB is generally used in the following cases:

a) Emergency brake applications:

The MTB is activated automatically in case of an emergency brake application. If the MTB is part of the emergency braking performance then it is subject to specific safety and reliability requirements with respect to its availability to be applied. In this situation the retardation rate can be included in the braked weight value/overall retardation of the vehicle.

b) Brake application under low adhesion conditions or steep slopes:

The MTB may be actuated at the driver's discretion independently of the wheel/rail adhesion dependent brake.

If MTB is on vehicles that are to be run through shunting areas, the system shall allow the inhibition of MTB and the clearance restrictions in accordance with EN 15273-1:2013+A1:2016, Figure C.4 shall be observed.

NOTE 1 There is a risk that roll down humps, rail brakes and other shunting and retarding devices may contact MTBs particularly on track curves having a radius of $R < 150$ m.

NOTE 2 Vehicles which by reason of their design are liable to sustain damage when crossing shunting humps will be marked with EN 15877-2:2013, Figure 76. Vehicles which are not designed for passing rail brakes will be marked with EN 15877-2:2013, Figure 58.

5 Design requirements

5.1 Space envelope to be observed by the MTB

The position of the brake magnets above rail shall ensure a clearance which is sufficient under all operating configurations/conditions to prevent the magnets making contact with the rail if not activated (due to vibrations or suspension movements, independent of speed, even under extreme conditions with wheel wear and new brake magnets.

The clearances shall take into account the lateral excursion and the vertical height position of the MTB when the vehicle is in the operating condition. The clearances of the vehicles to be observed are generally guided by the following provisions:

a) The permissible clearances in accordance with EN 15273-1:2013+A1:2016, Figure C.4, including space "*e*", for the lower limitation of the vehicles shall not be exceeded by any parts of the MTB, neither in its rest nor in its working position. When the brake is in its working position, the magnets are centred on the rail, due to their magnetic force, as a consequence of which their gauge clearance only needs to be provided for the rest position of the brake.

b) For the short time during the transition from its rest to its working position and vice versa gauge clearance shall be equated with its working position.

c) In case space "*e*" should be used in working position and the magnets should contact with the track, e.g. when passing over switches, track or road crossings, their safe return to space "*d*" shall be ensured, without any functional impediment.

d) When performing the clearance check, the following criteria shall be taken into account:

1) the wear condition of the wheels;

2) the condition of the pole shoes;

3) the suspension movements of the bogie.

5.2 Retardation force

The retardation of the MTB depends on its magnetic attractive force on the rail, the magnet length applied, the material of its magnets and their condition during the braking process. The braking force produced by friction between the magnets and the rail results from the combined effect of the magnetic force applied and the coefficient of friction element/rail.

For dimension and design purposes calculations shall be carried out in accordance with EN 14531-2:2015. The performance shall be verified by testing.

The MTB shall, whenever possible, reach its specified retardation rate under all environmental conditions that are typical for railway operation. It is permitted during winter control to use heating elements to reduce the build-up of ice on the pole shoes.

The magnetic attractive force of the MTB on to the rail head shall be defined in the technical documents of the manufacturer and is expressed and measured in accordance with the methods described in 9.1.2.

5.3 Guidance of the activated magnet when applied to the rails

As a rule, each magnet or both magnets jointly, arranged opposite each other, shall have an optimum contact with the rail head when activated. For this purpose, the MTB shall be provided with sufficient lateral freedom in the bogie in the working position. The MTB shall have an adequate lateral clearance. In EN 15273-1:2013+A1:2016 the clearance between axle and bogie underframe is defined by q:

x = lateral distance + q

The distance between the centre lines of the magnets shall be (1 510 ± 10) mm for standard gauge (1 435 mm), see Annex C. When intended for use on different gauges the distance between the centre lines shall be adjusted accordingly.

A bogie shall always comprise two magnets with pole shoes of identical construction. Appropriate devices (e. g. tie bars) shall be provided to maintain the pole shoes in a parallel position to each other.

When the rail head is interrupted (switches, crossings), guidance of the magnet along the longitudinal axis of the rail head and its geometrical position, in relation to the vertical axis, shall be ensured in an optimum way to achieve a retardation rate that is as uniform as possible and to make sure that the MTB guiding elements in the running gear be subjected to the least possible mechanical load. The working MTB shall be capable of passing over switches and crossings (incorporating fixed crossings). A reference switch where the tangent of the crossing angle is tg $\alpha \geq 0{,}034$ is able to verify the capable function.

5.4 Rest position of the magnet above the rail surface

The MTB when in its rest position with the vehicle in working order, with fully worn wheels and taking into account static deflection of the running gear shall:

— remain within the space "*b*", as defined in EN 15273-1:2013+A1:2016, Figure C.4;

— be 40 mm to 100 mm above the rail surface.

It may be assumed that the stationary parts in the switch and crossing environment do not exceed a height of 80 mm above the rail surface.