



SLOVENSKI STANDARD
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Železniške naprave - Zavore - Zavorne obloge

Railway applications - Braking - Brake pads

Bahnanwendungen - Bremsen - Bremsbeläge

Applications ferroviaires - Freinage - Garnitures de frein

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Bahnanwendungen - Bremsen - Bremsbeläge

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European foreword

This document (prEN 15328:2019) 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 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 2008/57/EC.

For relationship with EU Directive 2008/57/EC, see informative Annex ZA, which is an integral part of this document.

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prEN 15328:2019 (E)**Introduction**

This document gives the requirements for the design, dimensions, performance and testing of a brake pad which, as part of a disc brake system, acts on one friction face of a brake disc in accordance with EN 14535-1 and EN 14535-2.

The generic test program can also be used with different program parameter figures for specific project applications. The use of project adapted programs is suspended to the involved parties agreement.

This document contains the requirements for interfacing the brake pads with the rail vehicle, the testing procedures in order to confirm that it satisfies the basic safety and technical requirements, the material control procedures to ensure product quality, reliability and conformity, as well health and environmental requirements are fulfilled.

Each manufacturer is responsible for ensuring that the quality of design, workmanship and construction is in accordance with good engineering practice.

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1 Scope

This document specifies requirements for pads for disc brakes of railway rolling stock.

This document is applicable to pads designed to be fitted to disc braked rail vehicles. The brake pad may be manufactured from any material.

The document defines requirements and generic test programs for brake pads. In order to qualify the brake pad performance in accordance with the classification the standard provides fixed parameter figures as categories defined in paragraph classification scheme.

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 14478, *Railway applications — Braking — Generic vocabulary*

EN 14535-1, *Railway applications — Brake discs for railway rolling stock — Part 1: Brake discs pressed or shrunk onto the axle or drive shaft, dimensions and quality requirements*

EN 14535-2, *Railway applications — Brake discs for railway rolling stock — Part 2: Brake discs mounted onto the wheel, dimensions and quality requirements*

EN 14535-3, *Railway applications — Brake discs for railway rolling stock — Part 3: Brake discs, performance of the disc and the friction couple, classification*

EN 16451, *Railway applications — Braking — Brake pad holder*

EN ISO 4287, *Geometrical product specifications (GPS) — Surface texture: Profile method — Terms, definitions and surface texture parameters (ISO 4287)*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 14478, EN 14535 (all parts) 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

instantaneous coefficient of friction

instantaneous value of coefficient of friction of the friction couple pad/disc at any one instant during braking

3.2

static coefficient of friction

coefficient of friction achieved by the friction couple at the point where relative movement between the pad friction surface and disc friction face begins

prEN 15328:2019 (E)**3.3****brake disc temperature**

arithmetic average value of the measured temperature of the disc friction

3.4**friction face**

radially and circumferentially extending planar surface of the disc available for frictional engagement of the brake pad

3.5**friction surface**

radially and circumferentially extending planar surface of the pad available for frictional engagement with the brake disc friction face

3.6**contact surface area**

static contact surface of the pad available for frictional engagement with the brake disc friction face

3.7**friction material**

consumable portion of the pad that acts on the friction face of the brake disc in order to provide the specified brake performance

3.8**brake pad**

assembly of friction material and an associated fixing element acting on one friction face of a brake disc

Note 1 to entry: A brake pad can be manufactured in one piece or comprise two separate parts. Where manufactured in two separate halves, the pad comprises one left-hand and one right-hand half. For a brake disc four brake pad halves or two brake pads can be used.

3.9**brake pad holder**

component for the secure mounting and positioning of the brake pad and transmitting the brake pad force

3.10**brake disc**

rotor having one or more co-planar annular friction faces for the engagement of brake pads and means of transmitting rotation between itself and the associated axle or drive shaft element

4 Symbols and abbreviations

For the purposes of this document, the symbols and abbreviations given in Table 1 apply.

Table 1 — Symbols and abbreviations

Symbol	Designation	Unit
D	Diameter of wheel	mm
F_B	Nominal application force per disc	kN
F_b	Instantaneous application force per wheel	kN
m	Mass to be braked per disc (inclusive of the rotational masses)	t
R_z	Surface roughness (maximum height of profile)	μm
s_2	Stopping distance from the moment on when $F_b = 0,95 F_B$ to rest	m
v	Theoretical initial speed at the brake application initiation	km/h
v_i	Instantaneous speed	km/h
v_3	Final speed at the end of braking	km/h
v_m	Maximum service speed	km/h
$\mu_a = \frac{F_{tR}}{F_b}$	Friction coefficient (brake pad): The instantaneous friction coefficient μ_a specified at every instance of the braking time by the ratio between the total brake force F_{tR} and the total application force F_b	—
$\mu_m = \frac{1}{s_2} \cdot \int_0^{s_2} \mu_a \cdot d_s$	Mean friction coefficient: The mean friction coefficient μ_m integrated over the time from where 95 % of the nominal application force F_B is reached over the stopping distance s_2	—
$\mu_{m,nom}$	Nominal friction coefficient (brake pad)	—
θ_0	Mean initial temperature at the beginning of the brake application	$^{\circ}\text{C}$
CI	Cast iron	
SBP	Standard brake pad	
RIC	Regolamento Internazionale delle Carrozze (en: International Coach Regulations)	

5 Characteristics and test method of the brake pads

5.1 Classification of brake pads

This standard defines the characteristics required of brake pads for the categories A1 to G1 of brake pads, listed in Table 5. The characteristic requirements for the application in coaches used in general operation are, listed in Table 6.

5.2 Coefficient of friction

The coefficient of friction should be independent of the extent to which the pads are bedded-in, the specific pressure, the temperature and the environmental conditions.

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In wet conditions, or when there is snow, the coefficient of friction at any given moment should vary only slightly compared to the coefficient of friction under dry conditions.

These prescriptions shall be achieved in accordance with 5.5 to 5.9.

5.3 Environmental impact, health and safety

All raw materials used in the manufacture of the brake pads shall comply with the relevant regulations of environment, health and safety. In addition, a safety data sheet shall be presented.

5.4 Usage requirements

The composition of the material from which the brake pads are made should be chosen so that the best compromise is obtained between:

- the frictional properties,
- the wear of the pads, and
- the aggressiveness against the brake disc.

5.5 Frictional requirements for brake pads**5.5.1 General**

This chapter describes the requirements for brake pads used in locomotives, motor units, freight wagon and coaches. Optional test programs and requirements for coaches are defined in 5.6.

5.5.2 Priority levels of brake applications

In the test programs A1 to G1, the brake applications are prioritized, in accordance with a decreasing level of importance, as given in Table 2.

Table 2 — Priority levels of brake applications for test programs

Priority level	Type of brake application
1	Dry brake applications with the highest clamp force for each mass, normal conditions
2	Wet brake applications and hot brake applications with highest clamp force, for each mass
3	Brake applications with highest clamp force used for cleaning, drying, regenerating, or after continuous brake applications, for each mass
4	All other brake applications, with the exception of continuous brake applications and bedding brake applications and the examination of static coefficient of friction
—	Continuous brake applications, brake applications used for bedding in, examination of static coefficient of friction

Normal conditions refer to brake applications under dry conditions with low initial temperature and with the disc and the pad unaffected by high thermal load or residual wetness.

Brake pads of categories A1 to G1 are characterized by the velocity-dependent nominal line, $\mu_{m,nom}$.

The nominal line for the coefficient of friction is calculated for each brake pad and each test program as the linear regression line of the mean coefficients of friction (expressed in a rounding range of 0,001) versus speed of all brake applications with priority 1, extending from the lowest to the highest test speed.

The nominal line takes the form

$$\mu_{m,nom} = a \cdot v + b$$

where

a shall be given in the unit $(100 \text{ km/h})^{-1}$.

5.5.3 Criteria for the nominal line

The nominal line should lie between 0,300 and 0,450.

It shall lie between 0,280 and 0,470. The difference between the maximum value and the minimum value of the nominal line shall be less or equal to 0,150.

5.5.4 Criteria for the mean coefficient of friction

Deviations of coefficients of friction are calculated by means of a tolerance band centred around the nominal line.

The tolerance bands for the mean coefficients of friction in accordance with their priority are given in Table 3.

Table 3 — Tolerance bands for the mean coefficients of friction vs. priorities

Priority level of brake application	1	2	3	4
Tolerance band 1	±10 %	±15 %	±20 %	±25 %
Tolerance band 2	±15 %	±20 %	±25 %	±30 %

The mean coefficient of friction for each brake application shall lie within the bounds of the tolerance band 1 in accordance with its priority, while the following exceptions are tolerated.

- A total of 6 % of all brake applications (rounded to the closest integer) of priority 1 may deviate from tolerance band 1 towards the negative side.
- A total of 12 % of all brake applications (rounded to the closest integer) of priority 1 may deviate from tolerance band 1.
- A total of 5 % of all brake applications (rounded to the closest integer) of priorities 2 to 4 may deviate from tolerance band 1 towards the negative side.
- A total of 10 % of all brake applications (rounded to the closest integer) of priorities 2 to 4 may deviate from tolerance band 1.

No mean coefficient of friction shall lie outside of tolerance band 2.

5.5.5 Criteria for continuous brake applications

During continuous brake applications, after 10 seconds the instantaneous coefficient of friction shall stay inside the band defined by $\mu_{min} = 0,250$ and $\mu_{max} = 0,500$.

After 2 minutes the instantaneous coefficient of friction shall not vary more than 0,05 during any minute and the coefficient of friction shall stay inside the band defined by $\mu_{min} = 0,250$ and $\mu_{max} = 0,500$.

The pad wear during any continuous brake application, including the stop brake application thereafter, shall not exceed 1 mm. The wear in mm can be calculated from the weight differences before and after the continuous brake application.

prEN 15328:2019 (E)**5.5.6 Criteria for bedding brake applications**

The nominal coefficient of friction of the bedded state shall be defined as the average of measured mean coefficients of friction μ_m of the last 5 braking stops carried out during the bedding section.

During the bedding-in phase, the mean coefficients of friction shall not exceed the following variations from the nominal value of the bedded state:

- $\pm 30\%$ from the 11th bedding-in brake application until 30 % of the bedding-in is finished;
- $\pm 15\%$ during the rest of the bedding-in process.

5.6 Requirements and optional test programs for brake pads for coaches**5.6.1 General**

The frictional requirements for brake pads in coaches used in generic operation (RIC traffic) are described below. The optional test programs are defined in S1.1, S2.1, T1 and T2.

5.6.2 Tolerance ranges

The tolerance ranges for the instantaneous and mean coefficients of friction on a dry disc are given for the respective applications in the diagrams of the corresponding annexes. The instantaneous and the mean coefficients of friction measured in the test bench tests shall be documented in the appropriate tolerance diagrams. For the highest clamp forces of the test program the mean coefficients of friction are summarized in a separate tolerance diagram and documented in tabular form. The average value of these mean coefficients of friction at a speed of 120 km/h at the highest contact force (excluding brake application with high initial temperatures) shall not vary more than 10 % upwards or 5 % downwards from the nominal coefficient of friction given in the tolerance diagram of the respective test program in. At speeds above 120 km/h, the average values of these mean coefficients of friction shall not vary more than 10 % upwards or 10 % downwards from the nominal coefficients of friction.

5.6.3 Criteria for continuous brake applications

During continuous brake applications, after 10 seconds the coefficient of friction shall stay inside the band defined by $\mu_{\min} = 0,250$ and $\mu_{\max} = 0,500$.

After 2 minutes the coefficient of friction shall not vary more than 0,05 during any minute and the coefficient of friction shall stay inside the band defined by $\mu_{\min} = 0,250$ and $\mu_{\max} = 0,500$.

5.6.4 Criteria for bedding brake applications

The mean coefficient of friction of the bedded state shall be defined as the average of measured mean coefficient of friction of the last 5 braking stops carried out during the bedding section.

During the bedding-in phase, the mean coefficients of friction shall not exceed the following variations from the nominal value of the bedded state:

- $\pm 30\%$ from the 11th bedding-in brake application until 30 % of the bedding-in is finished;
- $\pm 15\%$ during the rest of the bedding-in process.

5.6.5 Coefficient of friction under high thermal load

For brake applications to a stand, which are done from a high initial temperature (approximately 140 °C), the mean coefficient of friction under otherwise similar conditions shall not vary by more than $\pm 15\%$