

STN	Železnice Brzdenie Výkonnosť brzd	STN EN 16834 28 4009
------------	--	--

Railway applications - Braking - Brake performance

Táto norma obsahuje anglickú verziu európskej normy.
This standard includes the English version of the European Standard.

Táto norma bola oznámená vo Vestníku ÚNMS SR č. 09/19

Obsahuje: EN 16834:2019

129035

EUROPEAN STANDARD

EN 16834

NORME EUROPÉENNE

EUROPÄISCHE NORM

April 2019

ICS 45.040

English Version

Railway applications - Braking - Brake performance

Applications ferroviaires - Freins - Performance de freinage

Bahnanwendungen - Bremse - Bremsvermögen

This European Standard was approved by CEN on 12 November 2018.

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, 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 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**

Contents	Page
European foreword.....	5
1 Scope	6
2 Normative references	6
3 Terms and definitions	7
4 Symbols and abbreviations	8
5 Principles of determining the brake performance	9
5.1 General.....	9
5.2 Brake assessment with braked weights.....	10
5.3 Brake assessment with deceleration's method.....	11
6 Execution of tests	11
6.1 Test methods.....	11
6.1.1 General.....	11
6.1.2 Freight wagons and coaches.....	11
6.1.3 Locomotives.....	12
6.1.4 EMU/DMU and high speed trainsets.....	12
6.1.5 Testing of vehicles/trains with additional brake equipment.....	12
6.2 Load conditions for tests.....	12
6.2.1 Freight wagons.....	12
6.2.2 Locomotives.....	13
6.2.3 Passenger vehicles.....	13
6.3 Speeds to be used for testing.....	14
6.4 Method of execution of the test.....	15
6.4.1 General.....	15
6.4.2 Atmospheric conditions.....	16
6.4.3 Condition of brake equipment.....	16
6.4.4 Number and validity of individual tests.....	16
6.5 Test in degraded mode and degraded conditions.....	17
6.6 Determination of brake performance for the ETCS system.....	17
6.7 Evaluating the test results for stopping distance.....	18
6.7.1 Correcting the stopping distances for each test.....	18
6.7.2 Determining the mean stopping distance.....	19
6.7.3 Correction of the mean stopping distance.....	22
6.8 Parking and holding brake testing.....	25
7 Assessment for deceleration method	25
7.1 General.....	25
7.2 Physical principles.....	25
7.3 Determining the parameters required for brake performance.....	26
7.3.1 General.....	26
7.3.2 Method for determining decelerations.....	27
7.4 Assessment of performance under degraded conditions.....	30
7.4.1 Coefficient of friction reduced due to moisture.....	30
7.4.2 Effect of reduced adhesion.....	30
7.4.3 Determining degraded deceleration.....	31
8 Assessment of the braked weight	31

8.1	General	31
8.1.1	Determining braked weight percentage	31
8.1.2	Determining braked weight.....	32
8.2	Coaches and EMU/DMU's	33
8.3	Additional assessment for Coaches operating with a speed above 160 km/h from vehicles test	33
8.4	Freight wagons in P.....	34
8.5	Freight wagons in G.....	34
8.6	Locomotives.....	34
8.7	Magnetic track brake and eddy current brake	35
8.7.1	General	35
8.7.2	Assessment using train test	35
8.7.3	Assessment using single vehicle test.....	35
8.8	ep brake (ep-direct and ep-assist)	35
8.9	Brake pipe accelerators valves.....	35
9	Recommendations for the use of braked weight percentage in operation	36
9.1	General	36
9.2	Principles of use for trains operating in P mode.....	36
9.3	Adjustment for trains comprising a locomotive and coaches	37
9.3.1	Variation in braked weight taking into account the length of the train	37
9.3.2	Braked weight of trains fitted with brake accelerators.....	37
9.3.3	Rules of use for train operation: Braked weight of trains fitted with ep assist	38
9.3.4	Variation in braked weight taking into account supplementary dynamic brake	38
9.4	Adjustments for Freight trains braked in the P mode.....	38
9.4.1	Variation in braked weight taking into account the length of the train	38
9.4.2	Reduction in the braked weight of a G-braked vehicle in a P-braked train	39
9.4.3	Variation in braked weight taking into account Brake accelerators and ep assist.....	39
9.5	Principles of use for trains operating in G mode.....	39
9.5.1	General	39
9.5.2	Freight trains.....	39
10	Operation with the ETCS system	40
11	Assessment of maximum utilization of adhesion.....	40
12	Assessment of gradient capability of parking/holding brake.....	41
Annex A	(normative) Brake assessment for trains	42
A.1	Assessment sheet for trains using brake positions P, R, R+Mg.....	42
A.2	Overview of the mathematical formulae for the assessment curves for trains using brake positions P, R, R+Mg.....	44
Annex B	(normative) Brake assessment for single vehicles	45
B.1	Assessment sheet for single vehicles.....	45
B.2	Overview of the mathematical formulae for the assessment curves for single vehicles....	47
Annex C	(normative) Checking of the friction pairing of disc-braked single vehicles.....	48
C.1	Diagram for checking the friction pairing of disc-braked single vehicles	48
C.2	Overview of the mathematical formulae for the assessment curves for checking the friction pairing of disc-braked single vehicles.....	50
Annex D	(normative) Determining the brake performance of freight wagons fitted with cast iron brake blocks (P10) or fully certified and exchangeable LL-blocks.....	51
Annex E	(normative) Determining the equivalent brake response time	54
E.1	General	54
E.2	Determining the equivalent brake response time based on train deceleration	54

EN 16834:2019 (E)

E.3	Determining the equivalent brake response time based on brake cylinder filling times	55
E.3.1	General.....	55
E.3.2	Assessment.....	55
Annex F	(normative) Conversion model for ERTMS/ETCS.....	57
F.1	Introduction.....	57
F.2	Symbols for this Annex.....	57
F.3	Scope of validity of model	59
F.4	Brake model.....	60
F.4.1	General principles.....	60
F.4.2	Calculating the equivalent emergency brake development time.....	62
F.4.3	Calculating the equivalent full brake development time	63
F.4.4	Calculating the basic decelerations.....	64
F.4.5	Calculating the decelerations during emergency braking.....	66
F.5	Example of calculation of the stopping or slowing distance.....	67
Annex G	(normative) Assessment sheet for individual vehicles running at speeds of less than 100 km/h using brake positions P and R	68
G.1	Assessment sheet for individual vehicles fitted with cast iron blocks (P10) at speeds below 100 km/h	68
G.2	Overview of the mathematical formulae used in assessment curves for individual vehicles fitted with cast iron blocks (P10) at speeds below 100 km/h.....	70
G.3	Assessment sheet for individual vehicles fitted with EN-UIC brake system and disc brakes or K blocks at speeds below 100 km/h.....	71
G.4	Overview of the mathematical formulae used in assessment curves for individual vehicles fitted with EN-UIC disc brakes or composite brake blocks at speeds below 100 km/h.....	73
Annex H	(normative) Procedure for verifying the maximum utilization of adhesion between wheel and rail.....	74
H.1	Symbols and abbreviations for this Annex.....	74
H.2	General.....	74
H.3	Prerequisites	74
H.4	Determination of the maximum equivalent mean deceleration based on distance relevant for adhesion $\bar{a}_{\max,\tau}$.....	75
H.5	Calculation of the mean friction coefficient for the friction brake μ_m of the test.....	75
H.6	Calculation of the maximum utilization of adhesion between wheel and rail τ_{\max}.....	75
Annex I	(informative) Example for verifying the maximum utilization of adhesion between wheel and rail for non-homogenous friction brake equipment.....	77
I.1	Non-homogenous friction brake equipment.....	77
I.2	Variation of brake cylinder pressure during brake application.....	77
Annex J	(informative) Example for correction and validation of test results exceeding mandatory test conditions — Treatment of curve radii lower than 1 000 m	80
Annex ZA	(informative) Relationship between this European Standard and the essential requirements of EU Directive 2008/57/EC aimed to be covered.....	82
Bibliography	84

European foreword

This document (EN 16834:2019) 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 2019, and conflicting national standards shall be withdrawn at the latest by October 2019.

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 has been prepared under a mandate 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.

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, 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.

EN 16834:2019 (E)**1 Scope**

This document defines a harmonized way to assess the braking performance by test of locomotives, passenger coaches, freight wagons and self-propelled passenger trains (EMU/DMU).

The document sets out the standardized method for undertaking brake performance tests and the correction factors to be applied to the data obtained for all types of rolling stock.

This document also defines the methods to assess the brake performance in terms of stopping distance, and from this the process to determine vehicle(s) deceleration and braked weight.

It then deals with conversion of the braked weight to the braked weight percentage of a vehicle or train for operating purposes. It also sets out additional factors when determining the braked weight percentage of a train calculated from specified braked weight, depending on the formation of the train.

In Annex D there is a method for determining brake performance of freight wagons fitted with P10 cast iron or LL-blocks using limited testing (force measurement).

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 14198, *Railway applications — Braking — Requirements for the brake system of trains hauled by locomotives*

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

EN 14531-1, *Railway applications — Methods for calculation of stopping and slowing distances and immobilization braking — Part 1: General algorithms utilizing mean value calculation for train sets or single vehicles*

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 15355, *Railway applications — Braking — Distributor valves and distributor-isolating devices*

EN 15595, *Railway applications — Braking — Wheel slide protection*

EN 15663, *Railway applications — Vehicle reference masses*

EN 15877-1, *Railway applications — Marking on railway vehicles — Part 1: Freight wagons*

EN 15877-2, *Railway applications — Markings of railway vehicles — Part 2: External markings on coaches, motive power units, locomotives and on track machines*

EN 16207, *Railway applications — Braking — Functional and performance criteria of Magnetic Track Brake systems for use in railway rolling stock*

EN 16452, *Railway applications — Braking — Brake blocks*

koniec náhľadu – text ďalej pokračuje v platenej verzii STN