

DIN EN 16834:2019-07 (E)

Railway applications - Braking - Brake performance

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
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 max,	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 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