SLOVENSKI STANDARD
SIST EN 13452-1:2004

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Railway applications - Braking - Mass transit brake systems - Part 1: Performance requirements

Bahnanwendungen - Bremsen - Bremssysteme des öffentlichen Nahverkehrs - Teil 1: Anforderungen an das Leistungsvermögen

Applications Ferroviaires - Freinage - Systèmes de freinage des transports publics urbains et suburbains - Partie 1: Exigences de performances

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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 Management Centre has the same status as the official versions.

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Contents

Foreword

This document (EN 13452-1:2003) 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of an identical text or by endorsement, at the latest by September 2003, and conflicting national standards shall be withdrawn at the latest by September 2003.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association.

CEN/TC 256/SC3/WG 23 "Braking/Urban traffic" has been assisted with the preparation of this European Standard by CEN/TC 256/SC3/ WG 25 "Braking/Terminology, calculations and acceptance procedures".

This series EN 13452 *Railway applications – Braking – Mass transit brake systems* consists of two parts:

— Part 1: Performance requirements

— Part 2: Methods of test.

With regard to clause 9, which concerns Commuter/Regional trains, it should be noted that there might be borderline cases which can also come under the scope of CEN/TC 256/SC3/WG 22, “Braking Operation - Mainline Trains”.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Slovak Republic, Spain, Sweden, Switzerland and the United Kingdom.

Introduction

At this time, no European rules/regulations exist giving requirements and performances for braking of guided vehicles for urban transport systems. There are some national rules which cover certain types of rolling stock.

With regard to the Europe-wide competition required now, this European Standard will allow all prospective bidders to propose or offer rolling stock meeting specified minimum requirements for braking performances.

There is an equivalent European Standard (prEN 14198) covering the braking requirements for Main Line (Inter City) Trains. For any trains whose service operation could be considered to be either Main Line or (long distance) Commuter or Regional, the Transport Authority should define whether the brake performance is to be in accordance with the Main Line or the Commuter/Regional Section of this European Standard.

1 Scope

This European Standard specifies minimum and maximum limiting requirements for braking systems and performance. The Transport Authority defines the particular parameters where required in this European Standard and specifies any additional braking requirements to the vehicle builder/braking system supplier.

This European Standard specifies requirements and performances for the braking of vehicles for urban transport systems, running on steel or rubber tyred wheels and guided by steel rails or other equivalent means.

This European Standard applies to vehicles operating on:

— tramways;

— light railways;

— metros on steel wheels;

— metros on rubber tyred wheels;

— Commuter/Regional railways;

and is applicable to:

— all newly designed vehicles;

— all major refurbishments, if these include either redesign or extensive modifications to the brake system;

— any new builds of existing designs of vehicles. For this type of vehicle, the Transport Authority may specify performance values different from those defined in this European Standard.

This European Standard does not apply to special transport systems, e.g. suspended monorail, rack and pinion lines, isolated operations such as scenic railways, special duty vehicles, etc.

Transport Authorities shall ensure that specifications include this European Standard as part of the brake system requirements. Suppliers shall identify, at the time of tendering, any non-compliances against this European Standard.

Compliance with the functional and performance requirements defined in this European Standard is verified by testing in accordance with EN 13452-2.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text, and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

EN 13452-2 *Railway applications - Braking - Mass transit brake systems - Part 2: Methods of test.*

3 Terms and definitions

For the purposes of this European Standard, the following terms and definitions apply:

3.1 Basic terms and definitions

3.1.1
train
single vehicle or a number of coupled vehicles/units operating on a guided ground transport system (see Table 1)

Table 1 — Definitions of rolling stock formations

Articulated	Non-articulated
Vehicle - see Unit Unit - minimum operational formation of articulated cars	Vehicle - Any single car on its running gear Unit - Minimum operational formation comprising one or more vehicles coupled together
Train - refers to any formation which may operate in service, it may comprise one or more units coupled together	Train - Refers to any formation which may operate in service, may be either a single vehicle or one or more units coupled together

3.1.2
driver
person in manual control of train motion

3.1.3
retardation
result of a force acting contrary to the direction of the movement

3.1.4
retarding force
sum of all the forces contributing to the retardation of the train, including train resistance

3.1.5
braking
process by which a force is produced so as to resist train movement which is taking place or to prevent movement of a stationary train

3.1.6
brake
equipment the principal function of which is to cause braking

3.1.7
brake system
a combination of means (hardware and software) to achieve, with a chosen level of safety, the braking requirements of the train

NOTE Brake system includes control, actuation and energy dissipation equipment.

3.2 Braking functions

3.2.1
service braking
braking used normally either under control of the train driver and/or automatic driving equipment so as to control the train's speed

3.2.2
full service braking
maximum available level of service braking

3.2.3
emergency braking
braking provided with the principal objective of maximising the safety of passengers, staff and non-users of the railway

NOTE 1: The emergency brake system is capable of bringing the train to rest within a defined speed distance relationship at defined levels of deceleration and jerk commensurate with the safety of public and staff.

The various emergency brake modes are defined with regard to initiation as follows. The braking performance achieved for each of these emergency brake modes does not necessarily need to be different. It is acceptable to group two or more modes together when specifying the emergency brake system for a particular train:

	Principal Means of Initiation
Emergency 1:	Driver vigilance, or ATO
Emergency 2:	Passenger alarm
Emergency 3:	Driver, via dedicated position on brake controller, or ATP system
Emergency 4:	Authorised person via control separate from brake controller

NOTE 2: It is possible for the different levels of emergency braking to be initiated by means other than those indicated above.

3.2.4
security braking
braking intended to achieve a higher level of system integrity than the service and emergency brake (to further assure a brake application); the braking performance can be at a lower level than that achieved in emergency or service braking

NOTE Can be required by particular Transport Authority.

3.2.5
drag braking
braking used to control the train speed on a gradient to a substantially constant value

3.2.6
irrevocable braking
braking maintained until the train is stopped

3.2.7
immobilisation braking
braking used to prevent a stationary train from moving, under the specified conditions

3.2.7.1
holding brake
brake which holds a train stationary with passengers for a defined time and load

3.2.7.2
parking brake
brake which can permanently hold a train with a defined load on a defined gradient

3.3 Braking techniques

The following techniques are ways by which the required braking functions (as defined in section 3.2) may be achieved.

3.3.1
dynamic braking
generic term covering a number of braking methods only effective when the train is moving

3.3.1.1
electro-dynamic brake
dynamic braking with traction motors used as generators:

— when braking current is fed into a resistor, it is called rheostatic braking;

— when braking current is returned into the power supply, it is called regenerative braking

3.3.1.2
hydro-dynamic brake
dynamic braking where the kinetic energy of the vehicle is converted into heat using a hydraulic medium, e.g. the vehicle hydraulic transmission

3.3.2
friction braking
braking achieved by means of the application of either brake blocks (or shoes) to the wheel treads or brake drums or by means of brake pads to discs

NOTE In all these cases, the friction brake clamping force can be provided by spring force application of the brake blocks or pads. Release of the brakes is then achieved by compressed air, electrically or hydraulically.

3.3.2.1
pneumatic brake
the friction brake clamping force and the control are achieved pneumatically

3.3.2.2
electropneumatic brake
the friction brake clamping force is provided by compressed air and the control is achieved electrically

3.3.2.3
electromechanical brake
the friction brake clamping force and the control are provided electrically

3.3.2.4
air over hydraulic brake
the friction brake clamping force is provided hydraulically and the control is by compressed air

3.3.2.5
electrohydraulic brake
the friction brake clamping force is provided hydraulically and the control is achieved electrically

3.3.3
magnetic track brake
brake using the friction between magnetic shoes and rails

NOTE This covers both electromagnetic and permanent magnet track brakes.

3.3.4
eddy current brake
brake using the Foucault currents for providing braking efforts without contact within discs, wheels or rails

3.3.5
wheelslide protection (WSP)
system to optimise braking performance, and to provide protection against wheel set damage, during braking in poor wheel/rail adhesion conditions

3.3.6
brake blending
interaction between two (or more) methods of braking to attain a required level of retardation

NOTE Most often used in service braking with the dynamic and friction brakes being blended together.

3.4 Load control

The adjustment of the braking force on a brake system in accordance with the load, with the objective of maintaining the deceleration constant irrespective of load.

3.5 Mechanics of braking

3.5.1
brake force
applied force provided by any one brake (friction, dynamic, track) to retard the train

3.5.2
static mass
mass of a stationary train

3.5.3
rotational mass
equivalent mass of the moment of inertia of the wheelsets and coupled rotating parts of the train

3.5.4
dynamic mass
sum of the static mass and the rotational mass

3.5.5
operating mass
static mass of the train when fully equipped for passenger service operation, but with no passengers on board (equal to “EL E”)

NOTE In practice the term operating load is often used instead of operating mass.

3.5.6
pay load
mass of passengers and luggage carried by the train

3.5.7
adhesion
physical interface phenomenon used to transmit the tangential force at the wheel/rail or wheel/track contact

3.5.8
coefficient of adhesion
value of the relationship between the tangential force and the normal force at the wheel/rail or wheel/track contact

3.5.9
adhesion dependent braking
braking in which the retarding force is supported by adhesion

3.5.10
adhesion independent braking
braking in which the retarding force is supported other than by adhesion

3.6 Dynamics of braking

The following timing terms and definitions assume that the timing starts at the change in the brake demand signal. This will be from a fully released state.

NOTE Refer to EN 13452-2 for methods of measuring or approximating these values.

3.6.1
delay time
period of time commencing when a change (positive or negative) in brake demand is initiated and ending when achieving 10 % of the established deceleration

3.6.2
build-up time
period of time commencing at the end of the delay time and ending when achieving 90 % of the established deceleration

3.6.3
response time
period of time commencing when a change (positive or negative) in brake demand is initiated and ending when achieving 90 % of the established deceleration. The response time corresponds to the addition of the delay time and the build up time

3.6.4
equivalent response time
theoretical response time used to calculate stopping distances; during this time, the theoretical deceleration is equal to zero; after this time, it is equal to a_e. This time is called t_e.

NOTE In practice, this time can be calculated from the actual braking performance as described in Figure 2.

3.6.5
stopping distance
distance covered from the initiation of a brake demand until stop

3.6.6
braking distance
theoretical distance covered, after the time t_e calculated using the method described in 5.5.1

3.6.7
jerk

3.6.7.1
instantaneous jerk
first derivative of the deceleration with the time

3.6.7.2
average jerk
change of acceleration or deceleration with respect to a defined period of time

3.7 Decelerations

The graphics illustrate the terms and definitions and show details (see Figures 1 and 2).

3.7.1
instantaneous deceleration
absolute value of the first derivative of the speed with respect to time (during braking)

3.7.2
equivalent deceleration
theoretical constant value used to calculate stopping distances. This is called a_e