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Železniške naprave - Zavorni sistemi na vlakih za velike hitrosti - 2. del: Preskusne metode

Railway applications - Braking systems of high speed trains - Part 2: Test methods

Bahnanwendungen - Bremssysteme für Hochgeschwindigkeitszüge - Teil 2:
Prüfverfahren

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Applications ferroviaires - Systèmes de freinage pour trains à grande vitesse - Partie 2 :
Méthodes d'essai

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Railway applications - Braking systems of high speed trains - Part 2: Test methods

Applications ferroviaires - Systèmes de freinage pour trains
à grande vitesse - Partie 2 : Méthodes d'essai

Bahnanwendungen - Bremsysteme für
Hochgeschwindigkeitszüge - Teil 2: Prüfverfahren

This European Standard was approved by CEN on 23 October 2010.

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EN 15734-2:2010 (E)**Foreword**

This document (EN 15734-2:2010) 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of an identical text or by endorsement, at the latest by May 2011, and conflicting national standards shall be withdrawn at the latest by May 2011.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] 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 the EU Directive, see informative Annex ZA, which is an integral part of this document.

EN 15734, *Railway applications — Brake systems of high speed trains*, consists of the following parts:

— *Part 1: Requirements and definitions*

— *Part 2: Test methods*

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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, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

1 Scope

This European Standard specifies test methods and acceptance criteria for a brake system for use in high speed trains as described in the TSI Rolling Stock, operating on routes of the trans-European high-speed rail system.

The tests defined in this document have the purpose of verifying that the braking performance and functions of the train's brake system comply at least with the respective requirements of EN 15734-1.

This European Standard is applicable to:

- new vehicles of high speed trains;
- new constructions of existing vehicle types;
- major overhauls of the above-mentioned vehicles if they involve redesigning or extensive alteration to the brake system of the vehicle concerned.

The functional testing requirements set out in this document assume the vehicles are fitted with a brake system architecture that follows the UIC air brake pipe control principles.

High Speed Rolling Stock can be fitted with alternative brake system architectures that do not employ brake pipe control. In these cases equivalent testing requirements will need to be generated to test the functional performance of brake system fitted.

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2 Normative references

The following referenced documents are indispensable for the application 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 15220-1, *Railway applications — Brake indicators — Part 1: Pneumatic operation brake indicators*

EN 15327-1, *Railway applications — Passenger alarm subsystem — Part 1: General requirements and passenger interface for the passenger emergency brake system*

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

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

EN 15611, *Railway applications — Braking — Relay valves*

EN 15663, *Railway applications — Definition of vehicle reference masses*

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

EN 50125-1, *Railway applications — Environmental conditions for equipment — Part 1: Equipment on board rolling stock*

EN 50128, *Railway applications — Communications, signalling and processing systems — Software for railway control and protection systems*

UIC 544-1:2004, *Brakes — Braking power*

EN 15734-2:2010 (E)**3 Terms and definitions**

For the purposes of this document, the following terms and definitions apply.

- 3.1 approval body**
Notified Body or National Railway Authority that conforms to EN ISO/IEC 17025
- 3.2 test(ing) institute**
test(ing) institute that conforms to EN ISO/IEC 17025
- 3.3 check**
test performed as a discrete measurement or visual inspection
- 3.4 record**
results recorded either graphically or electronically
- 3.5 type test**
test of one or more devices, system or complete vehicle demonstrating that the design meets the required specifications and the relevant standards

NOTE (Type) tests are performed by a test institute.

- 3.6 routine test**
vehicle test that is performed during or after manufacture to confirm conformity to specified criteria

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4 Symbols, units and abbreviations

For the purpose of this document, the following symbols, units and abbreviations apply:

ATC	Automatic Train Control
ATP	Automatic Train Protection
BC	Brake Control
BP	Brake Pipe
DP	Data Processing
EP	Electro Pneumatic Brake
ETCS	European Train Control System
R+Mg	Brake mode R+Mg
MRP	Main Reservoir Pipe
MTB	Magnetic Track Brake
R	Brake mode R

Sifa Driver's vigilance control (German: "Sicherheitsfahrerschaltung")

WRMS Wheel Rotation Monitoring System

WSP Wheel Slide Protection System

1 bar = 1 000 mbar = 10^5 N/m² = 10^5 Pa = 10^{-1} MPa

5 Requirements

5.1 General

This document defines the content of the static and dynamic tests dedicated to the brakes, which are needed for the following phases:

- type tests which demonstrate that the brake system conforms to the requirements. They are done with a pre-serial unit or with the first unit of a serial production;
- routine tests which confirm the technical stability of the production process of the system and its subsystems. For this purpose the basic features and functions of the system and its subsystems are to be checked;
- verification that the braking performance and the functions of the train's braking system comply at least with the respective requirements of EN 15734-1;
- identification of data for the verification of the brake performance and the functions of the train's braking system.

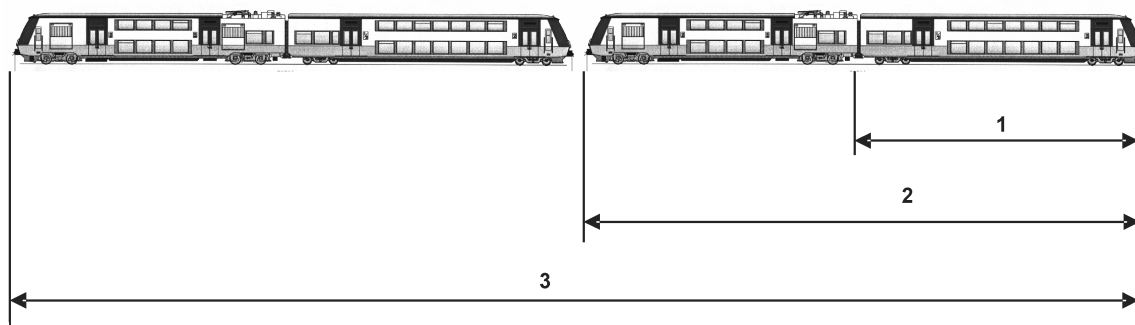
The document also identifies relevant data to be recorded.

The type and routine tests are as follows:

- tests with a single vehicle (Level 1);
- tests with one single unit (Level 2). These tests serve to check the common functions of the unit and the interfaces between the vehicles;
- tests with multiple units consisting of two to n units (Level 3) up to the maximum configuration. These tests serve to check the common functions of the train composition and the interfaces between the units.

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Figure 1 gives an example of the three levels.



Key

- 1 Level 1: vehicle
- 2 Level 2: single unit
- 3 Level 3: multiple unit

Figure 1 —Type test and routine test levels

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5.2 Test procedure

5.2.1 General

The procedures shall include the following items:

- identification of the parts to be tested;
- general conditions for the tests;
- specification of the test equipment;
- test program.

5.2.2 Identification of the parts to be tested

A list of the parts to be tested shall be made, with a description starting from the total system or subsystem down to the single parts of the brake system. It is recommended to attach pneumatic, electric or electronic schemes, graphs, etc. The test stand and the procedure shall be documented with pneumatic, electric or electronic schemes, graphs, etc.

5.2.3 General conditions for the tests

5.2.3.1 Temperature

The tests shall be run at a temperature within the range of the air temperature class in accordance with EN 50125-1, specified for the tested system.

5.2.3.2 Energy supply

a) Compressed air supply

If the system cannot be supplied with compressed air from its own supply, for instance for the tests with a single vehicle, an external air supply is to be used with air quality (solid particles, humidity and liquid water, oil) and characteristics (flow rate, minimum pressure, etc.) that shall be at least equivalent to the one of the system's normal air supply.

b) Electric supply

If the vehicle cannot be supplied with electric energy from its own supply, for instance for the tests with a single vehicle, an external supply is to be used with characteristics that shall be the same as the one of the normal vehicle's supply.

5.2.4 Specification of the test equipment

The measuring equipment shall comply with the requested accuracy.

The recording apparatus shall have enough measurement tracks, in order that a record can include all the needed information for the test. Each measurement track shall be clearly identified.

The records shall include the information listed in 5.2.6 and 8.1.3.

The quality of the records shall enable the copy of them without quality loss. If a digital recording system is used, an open format shall be used for data files.

5.2.5 Test program

The items listed in the following tables describe the minimum to be checked but do not define the testing procedure.

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Additional tests shall be proposed to suit the specific configuration of the brake system architecture (e.g. automatic air brake, direct electro-pneumatic air brake, etc.) fitted on the rolling stock, or if specific requirements are mentioned in the functional specification.

This list of tests shall be only considered as a basis for building up the dedicated test procedure for a given rolling stock.

Each test in the following tables includes a short and basic description of the function to be tested. The complete and detailed description shall be included into the test procedure to be presented to the approval body.

The type tests shall include the degraded modes tests, with special attention to the redundant functions.

The tests shall start only if the software of the brake function / brake system has been successfully validated in advance in accordance with EN 50128.

5.2.6 Reports

The tests shall be presented in a report and transmitted to the approval body that assesses the vehicle.

This report shall at least include:

- a) reference of the test (type test or routine test);
- b) date and location of the test;

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- c) identification and type of the tested vehicle;
- d) software release number, and associated checksums;
- e) description of the measurement tools, and the way they are used;
- f) test (program) specification completed with the results and the associated records. Each record shall include:
 - 1) identification and type of the tested vehicle;
 - 2) name of the test performed and reference paragraph in the test procedure;
 - 3) recording methodology;
 - 4) name and scale for all the recorded parameters;
 - 5) obtained results;
 - 6) date;
 - 7) identification of the different charts;
- g) conclusion of the tests in which a table listing all the adjustable parameter settings of the tests (choke diameters, software configuration, etc.) shall be recorded.

The format shall enable an easy access to all the information associated to the tests. An example is attached in Annex A.

NOTE If, for the routine tests, the vehicle manufacturer would like to use another way for recording the information (record, check), this will need the approval of the approval body.

5.2.7 Documentation

The parameters as follows shall be recorded irrespective from the type of testing:

- software versions of all brake-relevant components (all software-controlled systems, contributing directly or indirectly to the braking performance: drive units, anti-skid protection systems, brake modules, etc.);
- batch numbers of the friction materials (blocks, inserts, pads, etc.) and results of bench tests in dry and wet conditions;
- brake cylinder pressures in the case of an emergency brake application for at least one motor bogie and one trailer bogie;
- wheel diameter.

It is assumed that the documentation conforms to the relevant standards and that conformity with these requirements shall be established before performing the tests.

5.3 Methodology**5.3.1 Measurement of the application time at the brake cylinder**

The application time is to be measured from 0 % to 95 % of the maximum stabilized pressure at the brake cylinder. This is measured at the brake cylinder which is the furthest from of the brake panel which controls it. It is accepted to add a T-connection for the type test.

5.3.2 Measurement of the release time at the brake cylinder

The release time is to be measured from the maximum stabilized pressure at the brake cylinder down to 0,4 bar. This is measured at the brake cylinder furthest from the brake panel which controls it. It is accepted to add a T-connection for the type test. However for the routine tests of the stocks equipped with variable load relay valves, it is usual to measure at the distributor's brake cylinder pilot pressure.

In any case, the full release at the brake cylinder shall be verified.

5.3.3 Measurement of the pressure drop time in the brake pipe or the equalising reservoir of the driver's brake valve

The pressure drop time is to be measured from 5 bar to 3,5 bar, but the pressure drop to be done is to be from 5 bar to 3,2 bar.

5.3.4 Measurement of the pressure rise time in the brake pipe or the equalising reservoir of the driver brake valve

The pressure rise time is to be measured from 3,5 bar to 4,9 bar.

5.3.5 Measurement of the dead time of the WSP dump valves

The dead time for exhaust and fill is to be measured from the command to fill or release to the start of the pressure variation at the brake cylinder. This is measured at the brake cylinder which is furthest away from the dump valve which controls it. It is accepted to add a T-connection for the type test.

5.3.6 Measurement of the exhaust time of the WSP dump valves

The exhaust time is to be measured from the maximum stabilized pressure at the brake cylinder down to 0,4 bar. This is measured at the brake cylinder of the vehicle which is furthest away from the dump valve which controls it. It is accepted to add a T-connection for the type test.

5.3.7 Measurement of the fill time of the WSP dump valves

The fill time is to be measured from 0 % to 95 % of the maximum stabilized pressure at the brake cylinder. This is measured at the brake cylinder of the vehicle which is furthest away from the dump valve which controls it.

5.3.8 Measurement of air tightness

When carrying out pressure leakage tests, waiting time shall be at least 1 min for pressure stabilisation before starting timing measurements.

5.3.9 Measurement of lowering time of the MTB

The lowering time of the MTB shall be measured between the activation command and the impact of the magnets on the rail.

5.3.10 Measurement of rising time of the MTB

The rising time of the MTB shall be measured between the deactivation command and reaching their upper position.

EN 15734-2:2010 (E)**5.3.11 Measurement of application and release times of EP assist brake**

The times shall be checked on an individual vehicle with the compressed air brakes applied, with the BP first being pressurized to 5 bar and then shut off. The times shall be calculated when the electrical signal is established to the braking or release solenoid valve.

During ep braking, the application time shall be measured decreasing the BP pressure from 5 bar to 3,5 bar. During ep release, the release time shall be measured increasing the BP pressure from 3,5 bar to 4,9 bar with an auxiliary air reservoir pressure of 5,3 bar to 5,5 bar.

5.3.12 Measurement of the contribution of the different brakes

During dynamic tests the contribution of the different brakes installed on the rolling stock shall be measured as follows:

- for the friction brake by recording the pressure in the brake cylinders;
- for the dynamic brake by recording the brake force information provided by the traction equipment;
- for the eddy current brake by recording the brake force information provided by the control equipment;
- for the magnetic track brake by recording their state and using design data.

5.3.13 Evaluation of the longitudinal brake force applied to the track by Magnetic Track Brake or Eddy Current Brake

The longitudinal force shall be evaluated for emergency brake application and if applicable also for full service brake application from maximum speed under operational mass in working order. If there a load dependent brake force is applied for the Eddy Current Brake, then the design mass under exceptional payload shall also be considered.

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The longitudinal force for the magnetic track brake shall be calculated from the deceleration which is raised by the Magnetic track brake. These deceleration shall be calculated as the difference between the deceleration which is measured for brake applications with and without acting Magnetic Track Brake.

For the Eddy Current Brake the recorded brake force information provided by the control equipment shall be evaluated.

6 Static tests programme

6.1 Test on vehicle (Level 1)

Table 1 — Test on vehicle (Level 1)

Name of the test	Type test		Routine Test	
	Record	Check	Record	Check
6.1.1 Basic visual inspection				
6.1.1.1 The conformity of the vehicle data shall be checked concerning — vehicle type and number; — vehicle inscriptions.		✓		✓
6.1.1.2 The conformity of the pneumatic, mechanical, electric and electronic brake equipment regarding types, quantity and marking with the documentation shall be checked.		✓		✓
6.1.2 General safety related assessment of the installation				
6.1.2.1 The installation of the brake system parts in the vehicle (e.g. installation position, clearances and safety features as defined in the installation documentation) shall be checked.		✓		✓
6.1.2.2 The correct installation of piping and flexible connections shall be checked.		✓		✓
6.1.2.3 The clearance of the friction brake components as defined in the installation documentation shall be checked.		✓		✓
6.1.2.4 The accessibility, by maintenance staff, to the wear conditions of the friction partners, especially brake discs, brake blocks or pads and running surface of the wheels shall be checked.		✓		✓