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SIST EN 16185-2:2015+A1:2020

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Železniške naprave - Zavorni sistemi motornih vlakov - 2. del: Preskusne metode

Railway applications - Braking systems of multiple unit trains - Part 2: Test methods

Bahnanwendungen - Bremssysteme für Triebzüge - Teil 2: Prüfverfahren

Applications ferroviaires - Systèmes de freinage pour trains automoteurs - Partie 2 : Méthodes d'essai

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45.040	Materiali in deli za železniško tehniko	Materials and components for railway engineering

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Railway applications - Braking systems of multiple unit trains - Part 2: Test methods

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Bahnanwendungen - Bremssysteme für Triebzüge - Teil 2: Prüfverfahren

This European Standard was approved by CEN on 13 October 2014 and includes Amendment 1 approved by CEN on 9 September 2019.

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European foreword

This document (EN 16185-2:2014+A1:2019) 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of an identical text or by endorsement, at the latest by May 2020 and conflicting national standards shall be withdrawn at the latest by May 2020.

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 includes Amendment 1 approved by CEN on 9 September 2019.

This document supersedes EN 16185-2:2014.

The start and finish of text introduced or altered by amendment is indicated in the text by tags ▌A1⟩ ⟨A1▐.

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.

This series of European Standards *Railway applications — Braking systems of multiple unit trains* consists of:

— *Part 1: Requirements and definitions*;

— *Part 2: Test methods*.

According to the CEN-CENELEC Internal Regulations, the national standards organisations 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, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

1 Scope

This European Standard specifies test methods and acceptance criteria for a brake system for use in self propelling thermal and electric trains, in the following document called EMU/DMU, operating on routes of the European conventional rail system network.

This European Standard is applicable to:

— all new vehicles designs of self-propelling thermal and electric trains;

— all major overhauls of the EMU/DMU if they involve redesigning or extensive alteration to the brake system of the vehicle concerned.

This European Standard does not cover:

— locomotive hauled trains which are specified by EN 14198;

— mass transit rolling stock which is specified by EN 13452 (all parts);

— high speed trains being operated at speeds greater than 200 km/h which are specified by EN 15734-1 and tests in EN 15734-2.

The functional testing requirements set out in this European Standard assume the vehicles are fitted with brake system architecture as defined in EN 16185-1.

The braking performance obtained by applying the tests defined in this European Standard can be used to assess compliance with the required braking performance as defined in EN 16185-1.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 14478:2005, *Railway applications — Braking — Generic vocabulary*

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

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

EN 15734-2:2010[1)], *Railway applications — Braking systems of high speed trains — Part 2: Test methods*

EN 16185-1:2014, *Railway applications — Braking systems of multiple unit trains — Part 1: Requirements and definitions*

EN 16207:2014, *Railway applications — Braking — Functional and performance criteria of Magnetic Track Brake systems for use in railway rolling stock*

EN 16334, *Railway applications — Passenger Alarm System — System requirements*

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

1) This document is currently impacted by the corrigendum EN 15734-2:2010/AC:2012.

EN ISO/IEC 17025, *General requirements for the competence of testing and calibration laboratories (ISO/IEC 17025)*

〚A1〛 EN 16834:2019, *Railway applications — Braking — Brake performance* 〚A1〛

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 14478 and the following apply.

3.1
test(ing) institute
institute that conforms to EN ISO/IEC 17025

3.2
check
test performed as a discrete verification and/or visual inspection

3.3
measurement
results recorded numerically, graphically or electronically

3.4
type test
test of one or more devices, system or complete vehicle demonstrating that the design meets the required specifications and the relevant standards

3.5
routine test
vehicle test that is performed during or after manufacture to confirm conformity to specified criteria

3.6
application force
the force applied at the friction interface (e.g. the force between brake pad and brake disc, or between brake block and wheel tread, etc.)

3.7
equivalent response time
sum of delay time and half of the brake force build-up time or brake force release time if some conditions are respected

[SOURCE: EN 14478:2005]

Note 1 to entry: The term is explained in EN 14531–1.

3.8
application force release time
period of time commencing when the application force has reduced to 95 % of the stabilised application force and ending when 5 % of the stabilised application force has been achieved

3.9
response time
a) sum of the delay time and the application force build-up time during brake application, and

b) sum of the delay time and the application force release time during brake release

4 Symbols 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
DMU	Diesel Multiple Unit
EMU	Electric Multiple Unit
EP	Electro-Pneumatic Brake
ETCS	European Train Control System
MRP	Main Reservoir Pipe
MTB	Magnetic Track Brake
MU	Multiple Unit
R	Brake mode R
R+Mg	Brake mode R+Mg
SHS	Safety loop (German: Sicherheitsschleife)
Sifa	Driver's vigilance control (German: "Sicherheitsfahrschaltung")
WRMS	Wheel Rotation Monitoring System
WSP	Wheel Slide Protection System
1 bar	= 10^5 N/m^2 = 10^5 Pa = 10^{-1} MPa

5 Requirements

5.1 General

The tests defined in this European Standard shall be carried out and the results used to verify that the braking performance and functions of the MU brake system, as a minimum, comply with the requirements of EN 16185-1. This document identifies relevant data to be documented.

This document defines the static and dynamic tests required for the following phases:

— type tests which demonstrate that the brake system conforms to the requirements in all respects; these tests are carried out using a MU that is representative of the design/type of the MU being approved;

— routine tests which are carried out on each and every example of the approved design/type of MU in order to confirm the technical stability of the production processes; for this purpose only the basic features and functions of the system and its sub-systems are verified.

It is expected that tests for the purpose of vehicle acceptance are strictly selected from the list of type tests and performed by a body accredited in accordance with EN ISO/IEC 17025.

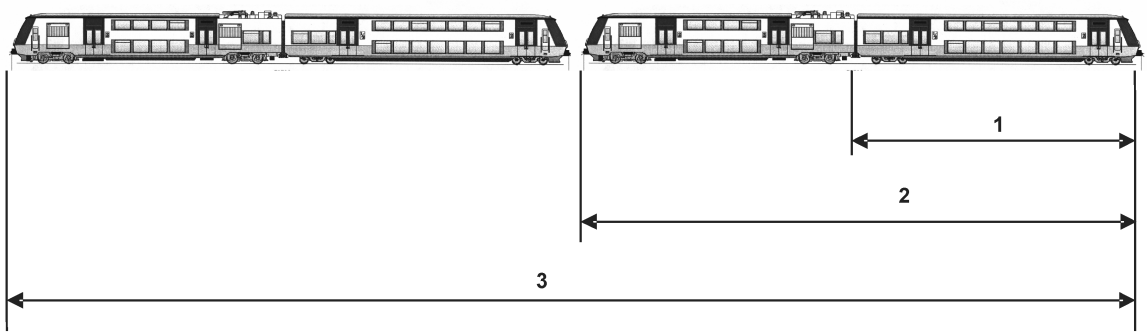
The type and routine tests are as follows:

— tests with one MU (Level 2): these tests serve to check the common functions of the MU and the interfaces between the vehicles which comprise the MU;

— tests with two or more coupled MU's (Level 3) up to the maximum MU configuration: these tests serve to check the common functions of the MU composition and the interfaces between the MUs.

It is sufficient to carry out coupled Multiple Units testing in the tare load state only but with the maximum number of coupled vehicles (unless otherwise specified).

Figure 1 gives an example of the levels.



Key

1 Level 1: Vehicle

2 Level 2: Single Multiple Unit

3 Level 3: Coupled Multiple Units

NOTE This document addresses testing requirements to Level 2 and Level 3. Testing at Level 1 is not defined and is the responsibility of the manufacturer.

Figure 1 — Type test and routine test levels

5.2 Test specification

5.2.1 General

The test specification shall be agreed and shall include the following:

— the test schedule;

— the functions to be tested;

— the conditions for the tests;

— the procedures for carrying out the tests;

— the test equipment to be used;

— the pass/fail criteria.

5.2.2 Identification of the parts to be tested

A list of the items of brake system equipment (and any associated equipment) to be tested shall be included, along with an appropriately detailed technical description of the items concerned and their intended interactions of relevance to the testing. It is recommended that pneumatic, electrical and/or

electronic schematic diagrams and graphs etc. are also included as an aid to those carrying out the tests specified.

5.2.3 General conditions for the tests

5.2.3.1 Temperature

The tests shall be conducted at a temperature included within the range specified for the brake system being tested.

Static or dynamic tests at the limits of the temperature range specified for the system being tested are not included within the scope of this document.

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 static tests at the single vehicle level, 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.) comparable to that of the system's normal air supply.

b) Electric supply:

If the system 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 comparable to that of the system's normal electric supply.

5.2.3.3 Load conditions

For the purposes of this document, the definitions given in EN 15663 for vehicle reference masses shall be applied with the following correspondence:

— tare = design mass, in working order;

— normal = design mass under normal payload;

— crush = maximum braking load, as defined in EN 16185-1.

6 Static tests program

6.1 General

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

The actual test schedule shall cover all features of the specific brake system architecture (e.g. automatic air brake, direct electro-pneumatic air brake, etc.) fitted on the MU.

This list of tests shall be only considered as a basis for building up the dedicated test specification for a given MU.

Each test shown in the following schedule includes a short and basic description of the function to be tested. The complete and detailed description for each test shall be included into the test specification.

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, as far as is practicable, and in accordance with EN 50128.

6.2 Reports

The tests shall be presented in a report.

This report shall at least include:

a) reference of the test (type test or routine test);

b) date and location of the test;

c) identification and type of the tested vehicle;

d) software release numbers for all the electronic control units involved in brake control;

e) description of the measurement tools, and the way they are used;

f) reference to the test specification completed with the results and the associated records. Each record shall include:

   1) date;

   2) identification and type of the tested vehicle;

   3) name of the test performed and reference paragraph in the test specification;

   4) recording methodology;

   5) name and scale for all the recorded parameters;

   6) obtained results;

   7) identification of the different charts;

   8) signature of the responsible person for the test body.

g) table listing all the adjustable parameter settings of the tests (choke diameters, software configuration, etc.);

h) conclusion for the tests.

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

6.3 Documentation

As a minimum, it shall be possible, while using the documentation, to determine the relationship with the following when considering any particular measurement or check:

— braking mode and method of control;

— software versions of all brake-relevant components (all software-controlled systems, contributing directly or indirectly to the braking performance: drive units, Wheel Slide Protection systems, brake modules, etc.);

— load cases;

— batch numbers of the friction materials (blocks, inserts, pads, etc.) and results of bench tests in dry and wet conditions;

— application forces and brake application time on sufficient vehicles and in sufficient locations to be able to assess the impact that variables in these parameters have on the overall brake performances (for type tests only);

— wheels diameter.

6.4 Methodology (for type tests only)

6.4.1 Measurement of the friction application force

The friction application force may be determined using either of the following methods:

— direct measurement of the application force on sufficient vehicles and in sufficient locations on each actuator;

— measurement of the brake cylinders pressure, on sufficient vehicles and in sufficient locations on each actuator, providing the relationship between brake cylinder pressure and application force is known.

6.4.2 Measurement of the delay time

The brake application and release delay time can be directly measured either obtained as a difference between response time and application force build-up or application force release time.

In case of direct measurement an electrical signal shall be recorded as initiating event e.g. a switch confirming that the brake handle reached the specified position.

6.4.3 Measurement of the application force build-up time

In a pneumatic brake system the application force build-up time shall be 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.

For the routine tests of the MU equipped with variable load relay valves, measurement may be taken of the automatic or indirect brake pilot pressure providing suitable allowances are incorporated to account for any time differences.

6.4.4 Measurement of the application force release time

In a pneumatic brake system the application force release time shall be 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.

For the routine tests of the MU equipped with variable load relay valves, measurement may be taken of the automatic or indirect brake pilot pressure providing suitable allowances are incorporated to account for any time differences.

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

6.4.5 Measurement of the brake response time

The brake response time can be directly measured or calculated

a) by adding together the delay time and application force build-up time during brake application or

b) by adding together the delay time and application force release time during brake release.

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

The pressure drop time shall be measured from 5 bar to 3,5 bar, but the pressure drop actually created during the test is to be from 5 bar to 3,2 bar.

6.4.7 Measurement of the pressure rise time in the brake pipe or the equalising reservoir of the driver's brake valve

The pressure rise time shall be measured from 1,5 bar below the set value to 0,1 bar below the set value (normally from 3,5 bar to 4,9 bar).

6.4.8 Measurement of the dead time of the WSP dump valves

The dead time for exhaust and fill shall be measured from the command to fill or release to 5 % pressure variation at the brake cylinder. This is measured:

— with emergency brake applied (in order to have the maximum brake cylinder pressure);

— fully venting the brake cylinder while measuring the exhaust dead time;

— fully re-filling the brake cylinder while measuring the fill dead time;

at the brake cylinder which is furthest away from the dump valve which controls it.

6.4.9 Measurement of the exhaust time of the WSP dump valves

The exhaust time shall 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.

6.4.10 Measurement of the fill time of the WSP dump valves

The fill time shall 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.

6.4.11 Measurement of air tightness

When carrying out pressure leakage tests, sufficient time shall be allowed for pressure stabilization before starting timing measurements.

6.4.12 Measurement of braking and release times of EP assist brake

The time taken to achieve a local brake pipe pressure change shall be verified on each vehicle with the BP first being pressurized and then shut-off and with normal main reservoir pipe pressure.

The braking solenoid valves shall be energised and the time taken for the brake pipe pressure to reduce over 1,5 bar from the Set Value (normally from 5 bar to 3,5 bar) shall be measured and recorded.

The release solenoid valve shall be energised and the time taken for the brake pipe pressure to increase from 1,5 bar below the set value to 0,1 bar below the set value (normally from 3,5 bar to 4,9 bar) shall be measured and recorded.

6.4.13 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 tare and load conditions.

The longitudinal force for the Magnetic Track Brake or Eddy Current Brake shall be calculated from the deceleration achieved using these brakes. This deceleration shall be calculated as the difference

between the decelerations which are measured for brake applications with and without the Magnetic Track Brake or Eddy Current Brake applied.

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