



**SLOVENSKI STANDARD**  
**oSIST prEN 13452-2:2023**  
**01-april-2023**

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**Železniške naprave - Zavore - Zavorni sistemi za mestno železnico - 2.del:  
Preskusne metode**

Railway applications - Braking - Urban rail brake systems - Part 2: Test methods

Bahnanwendungen - Bremsen - Bremssysteme städtischer Schienenbahnen - Teil 2:  
Prüfverfahren

Applications ferroviaires - Freinage - Systèmes de freinage des transports publics  
urbains et suburbains - Partie 2: Méthodes d'essais

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**Ta slovenski standard je istoveten z: prEN 13452-2**

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**ICS:**

- |        |  |  |
|--------|--|--|
| 45.040 | Materiali in deli za železniško tehniko                  | Materials and components for railway engineering |
| 45.140 | Oprema za podzemne vlake, tramvaje in lahka tirna vozila | Metro, tram and light rail equipment             |

**oSIST prEN 13452-2:2023**

**en,fr,de**



EUROPEAN STANDARD  
NORME EUROPÉENNE  
EUROPÄISCHE NORM

**DRAFT**  
**prEN 13452-2**

February 2023

ICS

Will supersede EN 13452-2:2003

English Version

## Railway applications - Braking - Urban rail brake systems - Part 2: Test methods

Applications ferroviaires - Freinage - Systèmes de  
freinage des transports publics urbains et suburbains -  
Partie 2: Méthodes d'essais

Bahnanwendungen - Bremsen - Bremssysteme des  
öffentlichen Nahverkehrs - Teil 2: Prüfverfahren

This draft European Standard is submitted to CEN members for enquiry. It has been drawn up by the Technical Committee CEN/TC 256.

If this draft becomes a European Standard, 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.

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## European foreword

This document (prEN 13452-2:2023) has been prepared by Technical Committee CEN/TC 256 “Railway applications”, the secretariat of which is held by DIN.

This document is currently submitted to the CEN Enquiry.

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

This document will supersede EN 13452-2:2003.

prEN 13452-2:2022 includes the following significant technical changes with respect to EN 13452-2:2003:

- normative references have been updated;
- test requirements have been completely revised;
- wheel slide protection recommendations have been added.

This series EN 13452, *Railway applications — Braking – Urban Rail brake systems* consists of two parts:

— *Part 1: Requirements and definitions*

— *Part 2: Test methods*

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**prEN 13452-2:2023 (E)****Introduction**

The objective of this part of the EN 13452 series is to provide the test requirements to demonstrate accordance with prEN 13452-1:2023.

This document covers the static and dynamic brake type and routine testing of trains or trainsets, but it does not cover the testing of components or equipment.

Regarding “direct EP brake” and “indirect brake (UIC type)” of prEN 13452-2:2023, which can concern other urban rail vehicles in accordance with prEN 13452-1:2023, there might be borderline cases which can also fall within the scope of EN 16185-2.

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## 1 Scope

This document specifies test methods for a brake system for use in urban rail vehicles.

NOTE Urban rail vehicles are defined in EN 17343.

This document is applicable to

- tram vehicles and light rail vehicles,
- metro vehicles with steel wheels,
- metro vehicles with rubber tyred wheels,
- other urban rail vehicles.

This document 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.

## 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.

prEN 13452-1:2023, *Railway applications — Braking - Urban Rail brake systems — Part 1: Requirements and definitions*

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

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

EN 17343, *Railway applications - General terms and definitions*

EN 15734-2:2010+A1:2021, *Railway applications - Braking systems of high speed trains - Part 2: Test methods*

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

**prEN 13452-2:2023 (E)****3 Terms and definitions**

For the purposes of this document, the terms and definitions given in prEN 13452-1:2023, EN 14478, EN 14531-1, EN 17343 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

**3.1****fully established brake**

state in which all relevant brake equipment types are assumed to be generating their demanded braking effort corresponding to their nominal value, e.g. at a dedicated speed

Note 1 to entry: The term “fully established brake” should not be confused with the term “full-service brake application”.

**3.2****reference deceleration rate**

$a_{\text{ref}}$

vehicle/trainset deceleration achieved when all brake equipment types are assumed to be fully established

**4 Symbols and abbreviated terms**

For the purposes of this document, the following symbols and abbreviated terms apply:

|                 |   |
|-----------------|---|
| $a$             | deceleration, expressed in $\text{m/s}^2$   |
| $a_e$           | equivalent deceleration, expressed in $\text{m/s}^2$  |
| $j_{\text{av}}$ | average jerk, expressed in $\text{m/s}^3$ ;   |
| $s$             | stopping distance, expressed in m   |
| $t$             | time, expressed in s  |
| $t_e$           | equivalent response time, expressed in s  |
| $t_a$           | delay time, from brake demand to achieving $a$ % of the established deceleration, expressed in s, in accordance with EN 14478       |
| $t_b$           | response time, from brake demand to achieving $b$ % of the established deceleration, expressed in s, in accordance with EN 14478    |
| $t_{\text{ab}}$ | build-up time, from achieving $a$ % to achieving $b$ % of the established deceleration, expressed in s, in accordance with EN 14478 |
| $v$             | speed, expressed in m/s   |
| $v_0$           | initial speed, expressed in m/s   |
| MTB             | magnetic track brake  |
| MU              | multiple unit   |
| WSP             | wheel slide protection  |



## 5 Test requirements

### 5.1 General

The tests defined in this document shall be carried out and the results used to verify that the braking performance and functions of the brake system, as a minimum, correspond to the requirements of prEN 13452-1:2023. 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 tram vehicle/MU that is representative of the design/type being approved;
- routine tests which are carried out on each example of the approved design/type of tram vehicle/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.

All routine tests shall be completed successfully prior to the introduction of that train into service.

It is expected that tests for the purpose of vehicle acceptance are strictly selected from the list of type tests of Annex A.

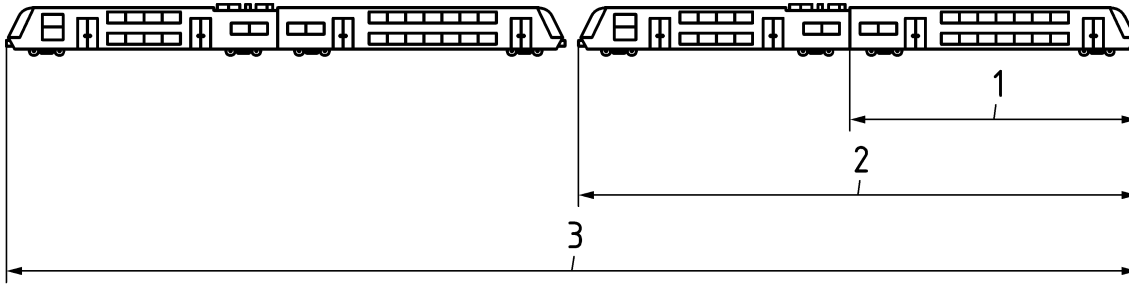
The type and routine tests shall be performed at different levels as explained below:

- tests with one tram vehicle/MU (train formation level 2):
  - these tests serve to check the common functions of the vehicle/trainset and the interfaces between the vehicles which comprise the tram vehicle/MU;
- tests with two or more coupled tram vehicles/MUs (train formation level 3) up to the maximum tram vehicles/MUs configuration:
  - these tests serve to check the common functions of the tram vehicle/MU composition and the interfaces between the tram vehicles/MUs.

It is sufficient to carry out train formation level 3 testing in the tare load state only but with the maximum number of coupled vehicles (unless otherwise specified).

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Figure 1 gives an example of the levels.

**Key**

- 1 train formation level 1: vehicle not self-operating
- 2 train formation level 2: minimum self-operating unit
- 3 train formation level 3: coupled level 2

NOTE 1 Train formation level 3 may not be applicable if coupling of self-operating units is not foreseen.

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

**Figure 1 — Train formation level definitions for type and routine test**

Type testing of refurbished rolling stock shall be undertaken if the brake system has been modified or if the train mass and/or passenger load has been significantly changed.

The content of the type testing for refurbished rolling stock shall be consistent with the modifications implemented. Routine tests shall be performed on every refurbished unit or train prior to that train entering service.

## 5.2 Type and routine test requirements

### 5.2.1 Static type and routine tests

Prior to any static testing, all necessary system integration and constructional tests shall have been successfully completed.

The principal objectives of these static type tests are to verify that the train's brake corresponds to the specification and to establish the values of all the relevant parameters as a reference for assessing the dynamic performance.

A full functional test, including all safety devices, shall have been satisfactorily completed before the beginning the dynamic tests.

Static type testing for the brake system may combine both bench tests and on-train tests. The scope of static type testing shall include, but not be limited to, the following (where applicable or equivalents depending on the type of brake equipment):

- brake cylinder pressures (or equivalent);
- load-weigh signals (e.g. pressures);
- brake application times for all braking modes and all brake equipment types (when possible, in static condition) in order to determine the actual equivalent reaction time  $t_e$ , as defined in 5.2.1, to be equal or less than the values required in prEN 13452-1:2023, Table 4, Table 8, Table 12 or Table 16;
- functionality, e.g. correct operation of all components of the brake system installed in the vehicle;

- functionality of emergency and safety loop;
- interlock operation (e.g. traction inhibition in emergency braking and safety braking);
- brake stored energy capacity (e.g. brake reservoir volume);
- leakage tests;
- protection devices fitted to minimize the effects of failures (e.g. chokes, check valves);
- WSP application/release times;
- sanding system operation.

These tests shall be conducted as defined in Annex A, Table A.1 and Table A.2.

## 5.2.2 Dynamic type tests

### 5.2.2.1 General

Prior to any dynamic testing, the static testing specified in 5.2.1 shall have been completed.

Before starting the dynamic brake testing, the test engineer should check that the relevant brake equipment is operating correctly and that adequate wheel to rail adhesion is present, i.e. no wheel slide protection activity is present.

When loading the vehicles to simulate laden conditions, the weights should be distributed within the vehicles in accordance with a defined loading plan for the test weights.

It is recommended that the braking is initiated by an automatic triggering device. If this is not done, the effect of the tolerances in the initiation method on the results should be assessed.

Unless otherwise specified in the technical specification, the dynamic tests shall be performed on dry, level and straight track.

In order to achieve full functionality under dynamic conditions, friction brake components as well as track brakes shall be bedded in sufficiently:

- for MTB: minimum 60 % of the contact area;
- for pads/blocks: minimum 80 % of the contact area.

The dynamic type testing aims to demonstrate that the train performance corresponds to the relevant requirements of prEN 13452-1:2023, Clause 6, Clause 7, Clause 8 or Clause 9.

For any initial speed, in accordance with prEN 13452-1:2023, 5.6.2, the stopping distance for each test shall be measured and corrected in accordance with B.1.3.

- For **CASE A** as defined in prEN 13452-1:2023, 5.6.3, the corrected stopping distance according to B.1.3 for each test shall be less than or equal to the required stopping distance.
- For **CASE B** as defined in prEN 13452-1:2023, 5.6.3, the corrected stopping distance in accordance with B.1.3 for each test shall be used to calculate  $a_e$  in accordance with B.1.4 ( $t_e$  already measured in accordance with B.1.2). This  $a_e$  shall be greater than or equal to the values specified in prEN 13452-1:2023, Clause 6, Clause 7, Clause 8 or Clause 9.

In addition, during any of the tests, compliance with the comfort limits defined in prEN 13452-1:2023, Clause 6, Clause 7, Clause 8 or Clause 9 shall be verified. The jerk shall be extracted from the tests in accordance with B.1.5.

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Additional tests should be performed to demonstrate accordance with the brake performance specified by the technical specification to be achieved under defined brake failure conditions (refer to prEN 13452-1:2023, 15.7).

The stopping distance (**CASE A**) or the  $a_e$  (**CASE B**) in dry rail condition obtained from different tests should not diverge by more than  $\pm 10\%$  from their average of all those tests, done under defined identical conditions (e.g. same speed, load, location).

The tests shall be conducted to avoid the risk of excessive temperatures caused by too frequent braking. The relevant cooling time between 2 tests or test batches shall be agreed.

**5.2.2.2 Emergency, safety and service braking**

The emergency, safety and service braking tests shall be conducted with load and speed combinations in accordance with Annex A.

If more than one brake equipment type (e.g. friction brakes and track brakes) is used in emergency, safety and service braking, the tests shall be performed

- for all brake equipment active (normal mode),
- in degraded mode as defined in prEN 13452-1:2023, 5.7.1.

**5.2.2.3 Testing under degraded adhesion conditions**

These tests shall be conducted as defined in Annex A.

**5.2.2.4 Parking and holding brake**

These tests shall be conducted as defined in Annex A.

**5.2.2.5 Data measurements**

The wheel diameters on the train undergoing type testing shall be recorded so that the effect of this on the results can be assessed.

During dynamic testing, at least the following parameters shall be recorded/determined in order to demonstrate accordance with prEN 13452-1:2023:

- speed - initial;
- speed - continuous;
- deceleration;
- time;
- stopping distance;
- brake initiation trigger signal;
- wheelset or wheel speeds to determine if wheel slide occurs.

In addition, the following parameters should be recorded:

- effort of electro dynamic brake;
- voltage supplied at MTB (after power switch);
- pressures or equivalent for the friction brake;

- temperature (equipment) to check maximum temperature achieved;
- line voltage if electro dynamic brake is used in regenerative mode.

### 5.2.3 Dynamic routine tests

#### 5.2.3.1 General

The purpose of the dynamic routine tests which are carried out on each example of the approved design/type of the train is to confirm the technical stability of the production processes versus braking performances through simplified test sequence.

These tests shall be conducted in accordance with Annex A.

#### 5.2.3.2 Emergency, safety and service braking

The emergency, safety and service braking tests shall be conducted with load and speed combinations in accordance with Annex A.

#### 5.2.3.3 Testing under degraded adhesion conditions

No testing is required.

#### 5.2.3.4 Parking and holding brake

No testing is required.

#### 5.2.3.5 Data measurements

During dynamic testing, at least the following parameters shall be recorded:

- initial speed;
- stopping distance or time;
- brake initiation trigger signal.

## 5.3 Documentation

### 5.3.1 General

The verification of the brake performance against the specified requirements shall be documented.

The documentation shall at least consist of

- test procedure(s),
- test report(s).

### 5.3.2 Test procedure

The test procedure shall define the method of undertaking the tests including the acceptance criteria and the information to be recorded in the associated test report.

The structure of the procedure shall be as follows:

- purpose of the testing;
- reference and issue of the associated performance calculation;

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- type and routine testing to be performed upon the vehicle prior to these tests;
- reference to any associated test procedures;

NOTE There can be several procedures to cover the total level of testing required.

- train configuration, i.e. the arrangement and vehicle types in the test formation;
- loading condition(s) under which the tests shall be performed;
- environmental conditions under which the test shall be performed;
- site conditions under which the test shall be performed, e.g. the track (minimum curve radius and maximum gradient), tunnel or open air;
- testing equipment:
  - the test equipment required to perform the test shall be defined, e.g. the measurement devices, brake triggering;
  - the instrument setting parameters, e.g. response time, filtering, scales shall be defined;
- test personnel skills:
  - the skills of personnel required to perform the test shall be defined, if necessary;
- test description:
  - the test process shall be detailed including those parameters which shall be recorded as defined in 5.2.2.5 and 5.2.3.5;
- acceptance criteria in accordance with the requirements shall be defined;
- test procedure document identity, i.e. number, revision, date, approved by etc.

**5.3.3 Test report**

The test report shall include all the information required by the test procedure and the results of the tests. Any deviations from the test procedure shall be identified. The report shall contain a clear statement of whether the tests have been successfully passed.

The structure of the test report shall be the same as the structure of the test procedure stated in 5.3.2. The report shall content sufficient information so that it is not necessary to constantly refer to the test procedure. The test procedure and the test report may be one document.

In addition, the report shall include specific reference to the vehicles used in the test and the status of components and software which influence the braking performance of the train, e.g. software version, component modification level.

The test report document identity shall be stated, i.e. number, revision, date, approved by, etc.

For each test or series of tests, the report shall record the following as a minimum:

- vehicle number;
- reference to EN 13452-1 and EN 13452-2;

- date (of test);
- location (test site);
- weather conditions;
- results;
- all related graphics required to demonstrate accordance with the requirements;
- acceptance criteria;
- names and functions of personnel present during the test.

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