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Railway applications — Braking system — General requirements

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Contents

Page

Foreword

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This document was prepared by Technical Committee ISO/TC 269, *Railway applications*, Subcommittee SC 2, *Rolling stock*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Railway applications — Braking system — General requirements

1 Scope

This document specifies the general requirements for brake systems. This document focuses on general principles and general requirements of brake systems.

This document is applicable for all types of rolling stock during design and whole lifetime. This document does not specify the braking performance criteria.

This document can be applied to all rolling stock with metal to metal wheel/rail contact irrespective of speed classification.

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.

ISO 4975, *Railway applications — Braking system — Quality of compressed air for pneumatic apparatus and systems*

ISO 10516, *Railway application — Vehicle reference masses*[1)]

ISO 20138 (all parts), *Railway applications — Calculation of braking performance (stopping, slowing and stationary braking)*

ISO 24478:2023, *Railway applications — Braking — Generic vocabulary*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 24478, ISO 20138-1 and the following apply.

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

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
general operation
mode of operation of units intended to be coupled with other units in a train formation which is not defined at design stage

3.2
assessment
process of judging or deciding the amount, value, quality or importance of something

3.3
testing
process of using or trying something to see if it works, is suitable or obeys the rules

1) Under preparation. Stage at the time of publication: ISO/DIS 10516:2024.

3.4
verification
process of proving that something exists or is true, or of making certain that something is correct

3.5
nominal condition
given set of conditions (e.g. dry rail, straight and level track) used to determine the braking performance without safety margin or a confidence level

3.6
normal mode
operating condition with all expected brakes available and performing as specified

Note 1 to entry: Some brake units can be intentionally isolated.

3.7
degraded mode
operating condition where some of the brakes are not available and/or not performing as specified

EXAMPLE Equipment failure, leakage.

3.8
degraded condition
external factor adversely affecting the braking performance

EXAMPLE Low wheel/rail adhesion, wind, ice, snow.

3.9
maximum braking load
load condition corresponding to the maximum mass of payload for braking purposes

4 Design requirements

4.1 General requirements of the brake systems

The purpose of the main brake system is to ensure that the train can be slowed, the train speed can be maintained on a downhill gradient, the train can be stopped and the train/unit can be immobilized when it is stopped.

The main brake system shall enable service brake application, emergency brake application and stationary braking.

Rail vehicles/units designed and intended to be coupled and operated together shall be fitted with a compatible brake system to ensure the brake function in all vehicles/units of the train.

Additional brake systems may be included, e.g. safety brake, earthquake brake.

Brake systems may include functions which temporarily apply traction and brake at the same time (e.g. snow brake, hill start).

Self-propelled special vehicles in their running mode generally follow the requirements for locomotives. Special vehicles that are hauled in their running mode generally follow the requirements for freight vehicles.

NOTE ‘Special vehicles’ are machines which include infrastructure inspection machines and on-track machines (OTMs).

The brake system can incorporate the ability to adjust the braking force depending on the load of the rail vehicle/unit/train.

In brake systems using compressed air, the minimum air quality shall comply with ISO 4975.

More detailed information about automatic air brake systems is given in Annex A.

Information about certain national requirements for brake systems is given in Annex C.

4.2 General safety requirements

If a trainwide control signal for an emergency brake application is sent, no single failure in the main brake system shall result in a loss of more than 50 % of the total braking force of the train.

Any brake application signal on a service or emergency trainwide brake control line shall always cancel any traction demand.

After a control signal for a parking brake application is sent, no single failure in the brake system shall result in the complete and permanent loss of the stationary braking force of the train.

The emergency brake function of a train shall be automatic. Any inadvertent disruption of the trainwide emergency brake control line (e.g. loss of integrity resulting from an unintended train separation caused by a mechanical failure) shall immediately lead to a trainwide control signal for an emergency brake application to all vehicles from the train.

There shall be sufficient braking energy available on board the train, from the minimum stored energy distributed along the train appropriately for the design of the brake system, to ensure at least one emergency brake application capable of stopping the train from its maximum speed in any loading condition up to the maximum braking load. The local energy storage shall take into account the consumption of energy by the wheel slide protection (WSP) system under degraded conditions during emergency braking (this is sometimes referred to as inexhaustibility).

Any emergency brake demand shall lead immediately to a trainwide brake control signal for an emergency brake application and take priority over any existing brake and/or traction demand [see 4.3.2.1 a) to d)].

The cancellation of an emergency brake demand shall not lead to an automatic release of the brake. The release of an emergency brake application shall require an intentional operational demand for example by the driver or by automatic train control system.

The propagation speed of the trainwide emergency brake control signal shall be not less than 250 m/s.

4.3 Requirements for the main brake system

4.3.1 General requirements

A main brake system shall provide, as a minimum, the following functions:

— emergency brake application and release;

— service brake application and release;

— stationary brake application and release.

A brake demand for a brake application shall always have priority over a brake demand for a brake release that can have already been initiated.

To achieve these functions, a main brake system generally incorporates the following features:

— trainwide brake control device(s);

— brake demand devices (driver's cab equipment, control command signalling equipment, etc.);

— trainwide brake control line(s);

— local brake control device(s);

— brake units;

— monitoring and display of the brake status;

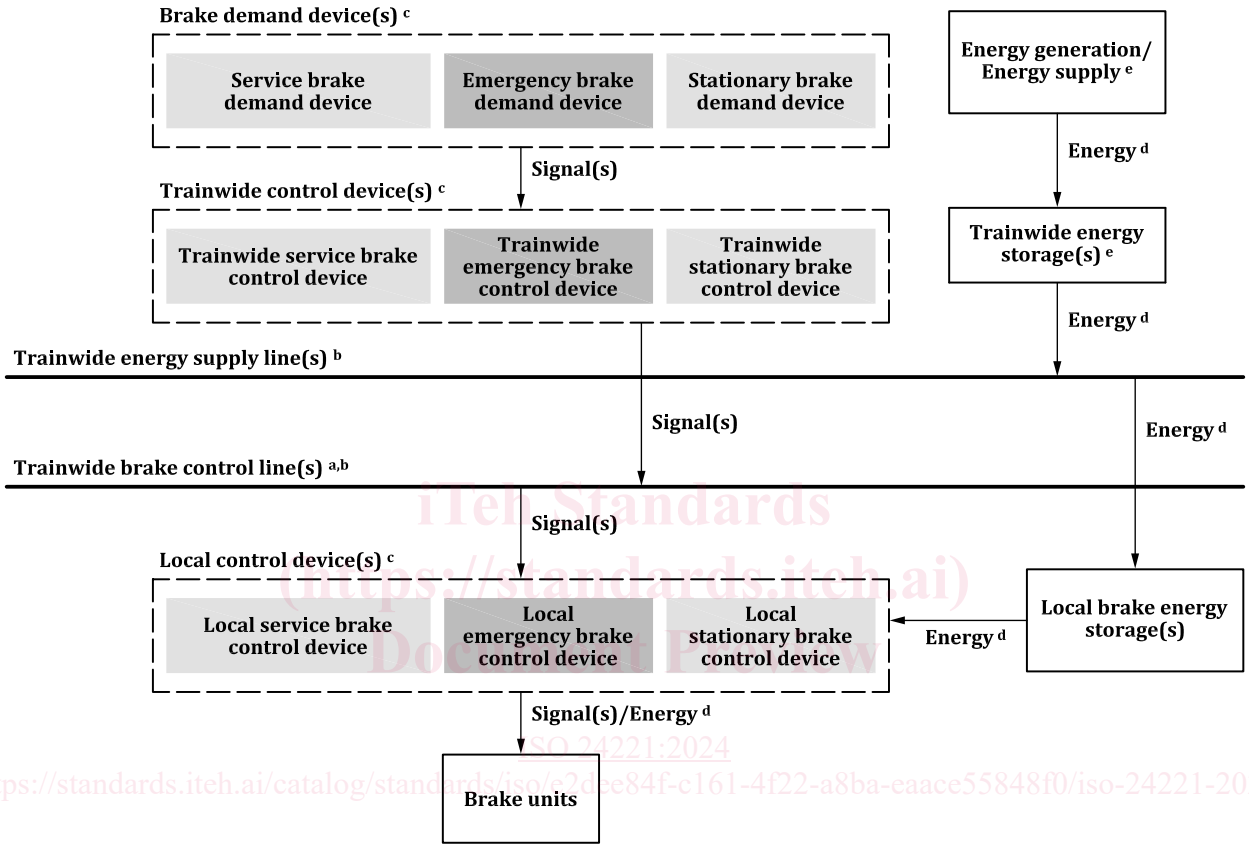
— distributed energy storage for braking force generation.

For further explanations on devices and signals, see ISO 24478:2023, Annex D.

When a trainwide energy supply line is used that is separate from any trainwide brake control lines, it is permitted for this energy supply line also to supply energy to other systems.

The energy in a trainwide brake control line and local brake energy storage shall not be used for other purposes than for the brake.

The general structure of a main brake system is shown in Figure 1.



a Discrete trainwide brake control lines for service brake control, emergency brake control and stationary brake control are also possible.

b For some applications, the trainwide energy supply line and the trainwide brake control line can be combined (e.g. brake pipe).

c Depending on technological implementation, one or more boxes can be combined and correspond to a single device.

d Different types of energy can be used simultaneously, e.g. pneumatic, electric, hydraulic.

e Energy generation / energy supply and trainwide energy storages are not dedicated to braking purpose only and are not considered as part of the brake system.

Figure 1 — General structure of the main brake system

4.3.2 General functions on train level

4.3.2.1 Brake control functions

The brake control functions on train level are as follows.

a) The train shall be equipped at least with one trainwide emergency brake control line (e.g. pneumatic brake pipe, electrical emergency brake loop).

b) The train shall be equipped with local brake control devices which are connected to the trainwide brake control line.

c) All brake units intended to be used for emergency braking shall be controlled by each trainwide emergency brake control line.

d) Brake units intended to be used for service braking shall be controlled at least by a trainwide service brake control line (e.g. hard wired, data bus). A trainwide service brake control line can be combined with a trainwide emergency brake control line.

It is permitted to use brake units for both emergency and service braking.

4.3.2.2 Automatic brake application

In order to achieve the automatic brake function, the main brake system shall be designed using a "fail-safe" principle for an emergency brake application. This is generally achieved by de-energizing the trainwide emergency brake control line to command the emergency brake application.

If a separate trainwide brake control line is used for service brake control only, this does not need to achieve the automatic brake function.

4.3.2.3 Graduable brake application and release

The main brake system shall be capable of transmitting a graduable trainwide service brake control signal.

If the train is equipped with several service brake demand devices (e.g. several driving cabs, ATO system), no more than one service brake demand device shall be able to transmit a demand on the trainwide brake control device at any time in operation.

The main brake system shall be capable of achieving at least seven levels of increasing service brake application (from brakes released up to and including full service brake application).

The provision of direct release or graduable release of the service brake applications depends on local applicable regulations.

NOTE The graduability can be realized by a time- or position-dependent service brake demand device.

4.3.2.4 Emergency brake demand devices

The main brake system can include different emergency brake demand devices dedicated to specific purposes, for example, derailment detection system, on-board temperature monitoring of axle bearings, "dead man" system.

The emergency braking performance shall be assessed with the emergency brake demand device that is the slowest to generate the trainwide emergency brake control signal(s). It applies to all emergency brake demand devices that can be used by the driver and to train control systems or to train protection systems but not to passenger activated systems.

If a type of emergency brake demand is realized by the action of multiple trainwide emergency brake control devices, then the emergency braking performance shall be assessed in the least favourable configuration allowed in operation without restriction. For example, with a train equipped with a pneumatic trainwide emergency brake control line and an emergency brake demand is done by opening two valves and if the

train is allowed to operate with one of these two valves isolated without restrictions, the emergency braking performance is assessed with only one valve opening.

NOTE The slowest device to generate the trainwide emergency brake control signal is the one for which the stopping distance is the longest.

4.3.2.5 Stationary braking

4.3.2.5.1 General

Stationary braking shall provide the functions to keep a train stationary either for a certain period of time or permanently when it is not in operation, with or without any energy replenishment.

Stationary braking is used for the following functions:

— holding (see ISO 24478:2023, 3.4.5);

— immobilizing (see ISO 24478:2023, 3.4.6);

— parking (see ISO 24478:2023, 3.4.7).

4.3.2.5.2 Holding

The holding function shall be able to:

— secure the train at standstill during a temporary stop (e.g. in a station, in front of a signal),

— secure the train on a gradient during a hill start (anti-roll back brake).

NOTE 1 The holding function is only intended to be active when the train is at standstill following an application of the service brake or emergency brake.

NOTE 2 The holding function can be provided by either the leading rail vehicle or the locomotive alone, or both, or multiple vehicles along the train.

NOTE 3 The holding function can be simultaneously applied with a traction demand (anti-roll back brake, hill start).

NOTE 4 The brake system energy used can be replenished while the holding function is in use.

4.3.2.5.3 Immobilizing

The immobilizing function shall be able to hold a train stationary under specified load conditions for a defined period of time and on a defined gradient using just the brake system energy stored on the train without replenishment.

NOTE 1 The immobilizing function is active when the train is at standstill following an application of the service brake or emergency brake.

NOTE 2 The immobilizing function is normally considered with a train at its maximum load, on the maximum gradient of the line and for at least two hours for trains carrying passengers, at least 30 min for other types of trains.

NOTE 3 It is permitted to substitute the immobilization brake function by the parking brake, if this can achieve the required performance.

4.3.2.5.4 Parking

The parking function shall be able to hold a rail vehicle/unit/train stationary under specified load conditions for an indefinite period of time until intentionally released and on a defined gradient without replenishment of the brake system energy.