BS EN 15611:2020+A1:2022

BSI Standards Publication

Railway applications — Braking — Relay valves

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National foreword

This British Standard is the UK implementation of EN 15611:2020+A1:2022. It supersedes BS EN 15611:2020, which is withdrawn.

The start and finish of text introduced or altered by amendment is indicated in the text by tags. Tags indicating changes to CEN text carry the number of the CEN amendment. For example, text altered by CEN amendment A1 is indicated by ▌A1⟩ ⟨A1▌.

The UK participation in its preparation was entrusted to Technical Committee RAE/4/-/1, Railway applications - Braking.

A list of organizations represented on this committee can be obtained on request to its committee manager.

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EUROPEAN STANDARD

NORME EUROPÉENNE

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European foreword

This document (EN 15611:2020+A1:2022) 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of an identical text or by endorsement, at the latest by May 2023, and conflicting national standards shall be withdrawn at the latest by May 2023.

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 2 October 2022.

This document supersedes [A1⟩ EN 15611:2020 ⟨A1].

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

Compared to EN 15611:2008+A1:2010, the following changes have been made:

a) normative references have been updated;

b) terms and definitions have been revised;

c) requirements on design have been revised;

d) requirements on materials have been revised;

e) requirements on type testing have been revised;

f) requirements on in-service assessment have been revised

g) requirements on markings have been revised;

h) annexes have been revised.

This document has been prepared under a Standardization Request given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s) / Regulation(s).

For relationship with EU Directive(s) / Regulation(s), see informative Annex ZA, which is an integral part of this document.

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1 Scope

This document is applicable to relay valves designated to control the brake cylinder pressure of compressed air brakes fitted to railway vehicles, in association with an air brake distributor valve or other control device. It covers one stage relay valves and relay valves adjusting the brake cylinder pressure in response to a change in vehicle speed or load that is either continuously variable or in two or more stages, i.e. empty – loaded.

Relay valves operating with other pressures, in particular the brake pipe pressure, are not included.

This document specifies the requirements for the design, manufacture and testing of relay valves.

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.

EN 14478:2017, *Railway applications — Braking — Generic vocabulary*

EN 15355:2019, *Railway applications — Braking — Distributor valves and distributor-isolating devices*

[A1] EN 15625:2021 [A1], *Railway applications — Braking — Automatic variable load sensing devices*

EN 45545-1:2013, *Railway applications — Fire protection on railway vehicles — Part 1: General*

[A1] EN 45545-2:2020 [A1], *Railway applications — Fire protection on railway vehicles — Part 2: Requirements for fire behaviour of materials and components*

EN 50125-1:2014, *Railway applications — Environmental conditions for equipment — Part 1: Rolling stock and on-board equipment*

EN 60721-3-5:1997, *Classification of environmental conditions — Part 3: Classification of groups of environmental parameters and their severities — Section 5: Ground vehicle installations (IEC 60721-3-5:1997)*

EN 61373:2010, *Railway applications — Rolling stock equipment — Shock and vibration tests (IEC 61373:2010)*

EN ISO 228-1:2003, *Pipe threads where pressure-tight joints are not made on the threads —Part 1: Dimensions, tolerances and designation (ISO 228-1:2000)*

ISO 8573-1:2010, *Compressed air —Part 1: Contaminants and purity classes*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 14478:2017, EN 15355:2019 and the following apply.

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

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

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

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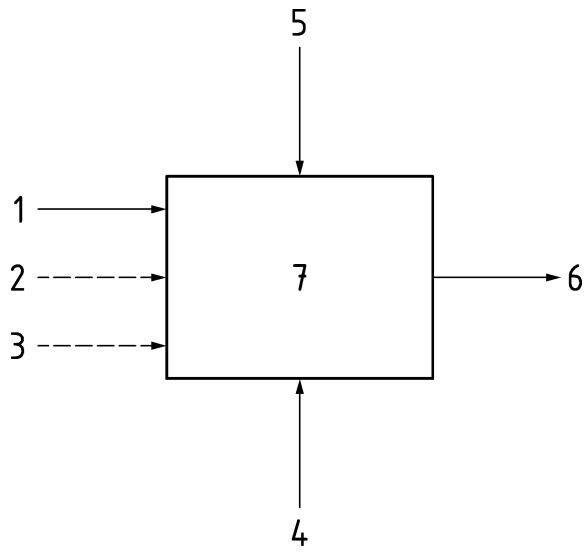
3.1
relay valve
device, the main function of which is to control a pneumatic output pressure as a function of the variation of one or more input pressures (see Figure 1)



Key

1 first input pressure

2 second input pressure

3 third input pressure

4 control signal – continuous load sensing pressure (LCP), or control signal – empty/load signal pressure (LSP), or mechanical input (lever) or electrical input

5 auxiliary reservoir pressure, supply pressure (AR)

6 output pressure

7 relay valve

Figure 1 — Relay valve, pressures and signals

3.2
input pressure
control pressure received by the relay valve

Note 1 to entry: Pressure generally considered as being the output pressure from a distributor or a brake control unit; sometimes referred to as pilot pressure or dummy brake cylinder pressure.

3.3
output pressure
pressure output from the relay valve, generally considered as being the brake cylinder pressure

Note 1 to entry: This pressure can also be used as the input pressure to another relay valve. The output pressure can obtain one or more fixed levels or it can be changed continuously between a minimum and a maximum or vice versa.

3.4
relay valve ratio
ratio of the output pressure value to input pressure value

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3.5
control signal
signal used to change the relay valve ratio:

— received from the continuous load sensing device (LCP),

— received from empty-loaded changeover device (LSP),

— generated by the position of mechanical changeover,

— generated by other means, e.g. speed dependent

3.6
relay valve type A
relay valve with one fixed relay valve ratio, where the ratio can be less (step-down), equal or greater (step-up) than 1

3.7
relay valve type B1
relay valve with two or more fixed relay valve ratios that can change during a brake application, where the ratio can be less (step-down), equal or greater (step-up) than 1

Note 1 to entry: Typically, two stages "empty/load" relay valve, giving an empty (tare) or a loaded output pressure proportional to input pressure dependant on the load signal input and used on vehicles operated in empty or fully loaded condition. Alternatively, the ratio can be changed in function of speed.

3.8
relay valve type B2
relay valve with two or more fixed relay valve ratios that cannot change during a brake application, where the ratio can be less (step-down), equal or greater (step-up) than 1

Note 1 to entry: Typically, two stage "empty/load" relay valve, giving an empty (tare) or a loaded output pressure proportional to input pressure dependant on the load signal input. Blocking the relay valve ratio during brake application is typically used to avoid frequent changeovers taking place on vehicles operated near the changeover weight.

3.9
relay valve type C1
one stage relay valve with a continuously changeable relay valve ratio, where a load signal is used to change the ratio

3.10
relay valve type C2
relay valve with a continuously changeable relay valve ratio, where a load signal is used to change the ratio and with a multi-stage feature added

Note 1 to entry: Typically, a load signal is used to change the relay valve ratio and a control signal (automatic or manual) is used to change the stage(s). The typical result is that at the same load and input pressure, in the lower stage (e.g. P-mode, passenger train) results a lower output pressure and in a higher stage (e.g. R-mode, rapid passenger train) this results in a higher output pressure.

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3.11
function D for a relay valve
overlay function to relay valve type A, C1, C2 with two or more input pressures

Note 1 to entry: In this case the type of the relay valve is respectively AD, C1D and C2D.

3.12
relay valve type E
variable load relay valve with a special, non-linear characteristic, which automatically comes into operation when the vehicle has more than a certain load

Note 1 to entry: The E type may be a combination of a C1 or C2 type and an additional functional block, or may be a specific generic design. This function reduces (in comparison with a linear characteristic) the output pressure for low input pressures to a certain level to limit the heat impact to the wheels during continuous braking.

3.13
sensitivity
change of input pressure causing a variation of output pressure, when the change of input pressure is in the same direction, with no overshoot or reversal

3.14
initial sensitivity
change of input pressure, starting at 0 bar, which causes the output pressure to start increasing (see Figure 2)

3.15
sensitivity at reversal
change of input pressure causing a variation of output pressure, when the input pressure is changing from increasing to decreasing (see Figure 2)

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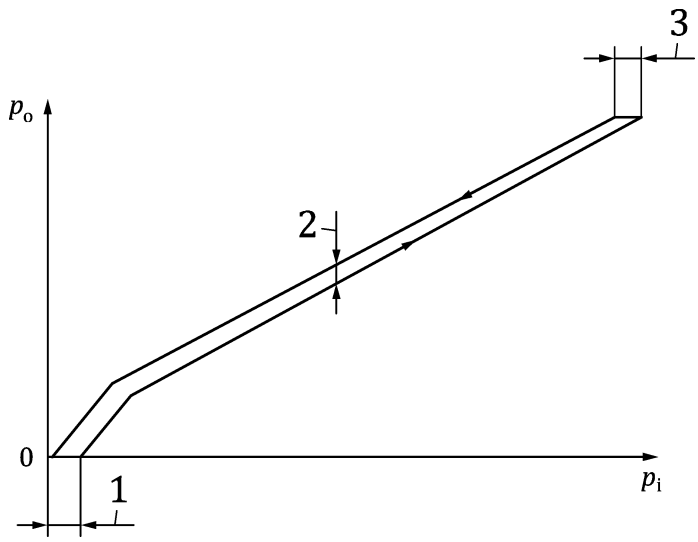
3.16
hysteresis
difference in output pressure with the same input pressure, first rising to a value and then, having been taken past that value, subsequently falls to the same value (see Figure 2)



Key

1 initial sensitivity

2 hysteresis

3 sensitivity at reversal

NOTE The figure is simplified for illustrative purposes, e.g. the real pressure development is not shown.

Figure 2 — Hysteresis and sensitivity

3.17
normal litre
unit of amount of a gas equal to the amount of 1 l at a pressure of 1,00 bar and at a standard temperature, at 20 °C

Note 1 to entry: Air flow is often stated in normal litres per minute (Nl/min).

3.18
matched pair
combination of a distributor valve and one or more relay valves to achieve specific tolerances of brake cylinder pressure and timings

Note 1 to entry: The combination is usually kept together throughout the lifetime of the components.

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4 Symbols and abbreviations

For the purposes of this document, the symbols and abbreviations given in Table 1 apply.

Table 1 — Symbols and abbreviations

Symbol	Designation	Unit
p	pressure	bar
p_i	input pressure	bar
p_o	output pressure	bar
t	time	s
AR	auxiliary reservoir pressure, supply pressure	bar
BCP	brake cylinder pressure	bar
LCP	control signal – continuous load sensing pressure	bar
LSP	control signal – empty/load signal pressure	bar

5 Design and manufacture

5.1 General

A relay valve shall enable a distributor valve or a brake control unit to be used without any vehicle specific modification to the distributor or the brake control unit, related to the brake cylinder volume. This includes the independence of the brake application and release times, the inshot feature and the output pressure development for any output (brake cylinder and piping) volume.

The use of a relay valve shall not alter any of the characteristics of the distributor and/or a brake control unit that are not specified in this standard.

The use of a relay valve shall enable the brake cylinder pressure to be maintained between prescribed limits. These limits may be defined by different brake modes or speed-dependent requirements or where there is a requirement to maintain a nominal constant brake performance irrespective of load.

Table 2 below provides a description of relay valve types described in this standard in comparison to EN 15611:2010.

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Table 2 — Relay valve types

Basic type	Design variants	Optional additional function	Type (EN 15611:2010)	Type (new)
one fixed ratio of output/input pressures	adaptable by diameters of pistons or adjustable by screw	none	A	A
		multi input for "select high"	—	AD
more than one fixed ratio of output/ input pressures[a]	adaptable by diameters of pistons or adjustable by screw	ratio can change during brake application	B1	B1
		ratio cannot change during brake application	B2	B2
variable load relay valve		none	C	C1
		with a multi stage feature added	C1	C2
		two input pressures for "select high"	D	C1D
		two input pressures for "select high" with a multi stage feature added	D	C2D
variable load relay valve with kinked characteristics[b]		special nonlinear characteristic (kink valve)	E	E

[a] A multi stage relay valve with only two stages giving output pressures corresponding to empty or laden vehicle can be named empty/load relay valve.

[b] The E type may be a combination of a C1 or C2 type and additional functional block, or may be a specific generic design.

The adjustment range of the output pressure for adjustable by screw, adaptable by the diameter of the piston and variable load relay valves should be from 0,50 bar to 6,00 bar.

Adjustment of the maximum output pressure of a relay valve adjustable by screw should be achieved without changing internal parts and be accessible without dismantling the device. However, an easily removable protective device should be installed.

For a defined adjustment of a certain spring, the setting of the stops for low and high output pressures of a variable load relay valve should be achieved without changing internal parts and be accessible without dismantling the device. However, an easily removable protective device should be installed.

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5.2 Functional requirements

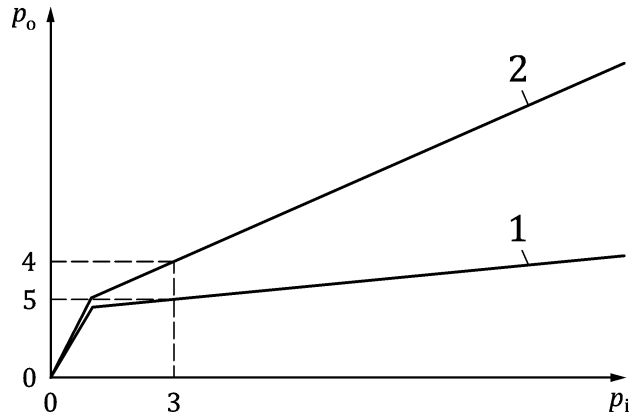
5.2.1 General

The requirements shall be tested as given by Table 5.

5.2.2 Minimum output pressure

The specific minimum output pressure of a relay valve as response to a first brake step with an input pressure of (0,75 ± 0,02) bar shall have a fixed value, defined by its documentation.

Figure 3 gives an example of the output pressure of a relay valve for different conditions of vehicle load.



Key

1 empty condition

2 loaded condition

3 input pressure (0,75 ± 0,02) bar

4 minimum output pressure loaded

5 minimum output pressure empty

NOTE The shown characteristic is an option.

Figure 3 — Example of the output pressure p_o of a relay valve (brake cylinder pressure) in relation to the input pressure p_i for different conditions of vehicle load

5.2.3 Accuracy of the output pressure and changeover

5.2.3.1 General (all types)

The output pressure of the relay valve shall be within the following tolerances, related to the minimum (empty)/maximum (loaded) figures, given by the type plate and the installation drawing of the relay valve:

— ± 0,10 bar for nominal output pressures ≤ 3,80 bar at an input pressure of (3,80 ± 0,02) bar (ratios ≤ 1);

— ± 0,15 bar for nominal output pressures > 3,80 bar at an input pressure of (3,80 ± 0,02) bar (ratios > 1).

A relay valve may change from a ratio < 1 in empty to > 1 in loaded status.

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5.2.3.2 Accuracy of the changeover of a multi-stage relay valve (types B1 and B2)

The relay valve shall be designed to changeover from the empty (low), to intermediate (if applicable), and to the loaded (high) condition and reverse, as defined in 5.2.4, at specified values of the control signal such as load signal pressure or load sensing pressure (LSP/LCP) or with a mechanical changeover. The accuracy of the changeover shall be tested in accordance with 7.2.4.4 (types B1 and B2).

5.2.3.3 Accuracy of the changeover of a variable load relay valve with a multi-stage function overlaid to the variable load brake function (types C2 and C2D)

It shall be possible at any input pressure and any load control pressure (LCP) to change from a lower to a higher level of the output pressure or vice versa.

The ratio of the gradient of the output to the input pressures between the higher value of the output pressure to the lower value shall be constant between first brake step and full service and within a tolerance of ± 10 % for any load condition; this condition is related to a nominal input pressure of 3,80 bar and shall be initiated by a pneumatic or electric control signal.

The accuracy of the changeover shall be tested in accordance with 7.2.4.10 (types C2 and C2D).

5.2.3.4 Accuracy of the output pressure of a relay valve designed for two or more input pressures (types AD, C1D and C2D)

The output pressure of the relay valve shall correspond to the highest of the input pressures. The tolerance of the maximum output pressure values shall be ± 0,10 bar, if the nominal value is ≤ 3,80 bar and ± 0,15 bar, if the nominal value is > 3,80 bar. In the case where two or more input pressures are acting simultaneously, the output pressure tolerance shall be ± 0,20 bar, if the nominal value is ≤ 3,80 bar and ± 0,30 bar, if the nominal value is > 3,80 bar.

The accuracy of the output pressure shall be tested in accordance with 7.2.4.13 (types AD, C1D and C2D).

5.2.3.5 Hysteresis of the output pressure in relation to the load control pressure (types C1, C2, C1D, C2D)

For relay valves C1, C2 the differences of the output pressure, when load control pressure (LCP) has been increased or decreased, shall not exceed 0,20 bar if the ratio is ≤ 1 and 0,30 bar if the ratio is > 1.

For a relay valve type C1D, C2D, the differences of the output pressure when load control pressure (LCP) has been increased or decreased shall not exceed 0,25 bar if the ratio is ≤ 1 and 0,30 bar if the ratio is > 1.

For relay valves C1, C2, C1D, C2D in case that the quotient Delta-BCP/Delta-LCP is greater than 1, the differences of the output pressure when load control pressure (LCP) has been increased or decreased shall not exceed 0,30 bar if the quotient is ≤ 1 and 0,40 bar if the ratio is > 1.

The accuracy of the output pressure shall be tested in accordance with 7.2.4.7 (types C1, C2, C1D and C2D).

5.2.4 Control signal characteristics (types B1, B2, C1, C2, C1D, C2D, E)

The design of the relay valve shall allow interaction with at least one of the following load signal types:

a) manual empty-load signal, where this signal is provided by a lever, either mounted directly on the relay valve, or remotely operated on the vehicle to manually change from the low to the high output pressure, or vice versa;

b) pneumatic empty/load signal, where the relay valve shall be designed to operate on receipt of the relevant signal pressure dependent on the brake system design, as follows:

   1) Where the control pressure LSP/LCP is ≤ 0,50 bar this indicates a load that is less than the switching point and shall cause the relay valve to output its lower ratio. If LSP/LCP pressure is ≥ 3,00 bar this indicates a load greater than the switching point and shall cause the relay valve to output its higher ratio. Other switching points may be defined by the design documentation.

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