SLOVENSKI STANDARD
SIST EN 15611:2009

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Železniške naprave - Zavore - Ventili za kontrolo tlaka

Railway applications - Braking - Relay valves

Bahnanwendungen - Bremse - Relaisventile

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Management Centre: rue de Stassart, 36 B-1050 Brussels

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Foreword

This document (EN 15611:2008) 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of an identical text or by endorsement, at the latest by May 2009, and conflicting national standards shall be withdrawn at the latest by May 2009.

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 European Standard has been prepared under a mandate given to CEN/CENELEC/ETSI by the European Commission and the European Free Trade Association and supports essential requirements of EU Directive 96/48 and EU Directive 2001/16, as modified by EU Directive 2004/50.

For relationship with EU Directive(s), see informative Annexes ZA and ZB, which are integral parts of this document.

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, 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 is applicable to relay valves designed 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, and in response to a change in vehicle load that is either continuously variable or in two stages i.e. empty - loaded.

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

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

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 14478:2005, *Railway applications – Braking – Generic vocabulary*

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

EN 15625, *Railway applications – Braking – Automatic variable load sensing devices*

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

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 61373:1999, *Railway applications – Rolling stock equipment – Shock and vibration tests (IEC 61373:1999)*

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

ISO 8573-1:2001, *Compressed air – Part 1: Contaminants and purity classes*

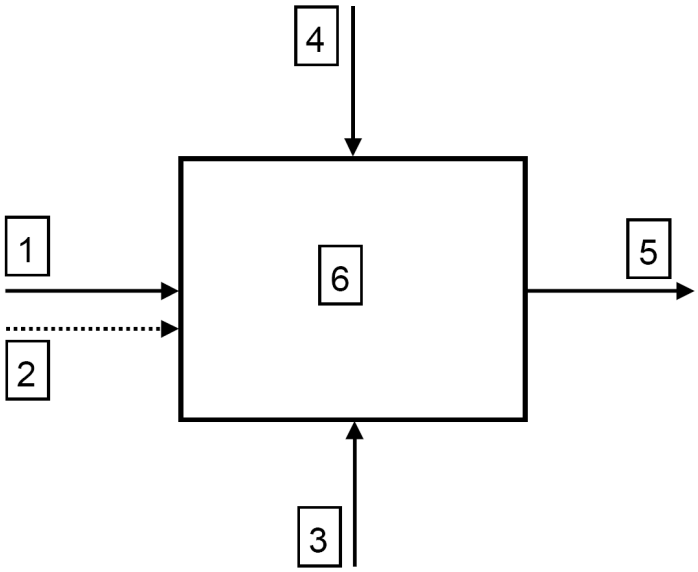
3 Terms and definitions, symbols and abbreviations

For the purposes of this document, the terms and definitions, symbols and abbreviations given in EN 14478:2005 and the following apply.

3.1 Terms and definitions

3.1.1
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

NOTE 1 See Figure 1.



Key

1 first input pressure

2 second input pressure

3 control signal - continuous load sensing pressure (Lcp), or control signal - empty/load signal pressure (Lsp), or mechanical input (lever) or electrical input

4 auxiliary reservoir pressure, supply pressure (AR)

5 output pressure

6 relay valve

Figure 1 — Relay valve, pressures and control signals

NOTE 2 The definition of “relay valve” in EN 14478 is specific to a load dependant relay valve. This EN standard considers one or more input pressures in accordance with the diagram in Figure 1.

3.1.2
input pressure
control pressure received by the relay valve

NOTE 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.

3.1.3
output pressure
pressure output from the relay valve

NOTE Pressure generally considered as being the brake cylinder pressure when the relay valve is used in a variable load braking system. This pressure can also be used as the input pressure to another relay valve. The output pressure can obtain one, two or three fixed levels or it can be changed continuously between a minimum and a maximum or vice versa.

3.1.4
relay valve ratio
ratio of the output pressure to input pressure

3.1.5
control signal
signal received from the continuous load sensing device (Lcp) or empty - loaded changeover device (Lsp) or a mechanical input (lever) or an electrical input that varies the relay valve ratio dependant on vehicle load

NOTE This can also be a speed signal or other parameter, dependant on the relay valve application.

3.1.6 Relay valve types

3.1.6.1
single stage relay valve
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

3.1.6.2
multi stage relay valve
relay valve type B
relay valve with more than one fixed relay valve ratio, where the ratios can be less (step-down), equal or greater (step-up) than 1

3.1.6.2.1
relay valve type B1
multi stage relay valve that can change relay valve ratio during a brake application

NOTE Typically used on vehicles normally operated in empty or fully loaded condition.

3.1.6.2.2
relay valve type B2
multi stage relay valve where a change of relay valve ratio cannot take place during a brake application

NOTE Blocking the relay valve ratio during brake application is typically used to avoid frequent changeovers taking place on vehicles operated near the changeover weight.

3.1.6.2.3
empty/load relay valve
specific type of multi stage relay valve (type B1 or B2) with only two stages, giving an empty (tare) or a loaded output pressure proportional to input pressure dependant on the load signal input

3.1.6.3
variable load relay valve
relay valve type C
relay valve with a continuously changeable relay valve ratio, where a load signal is used to change the ratio

3.1.6.4
multi stage variable load relay valve
relay valve type C1
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 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.

3.1.6.5
two (multi) input relay valve
relay valve type D
relay valve (type A, B or C) with two (or more) input pressures, controlling a single output pressure

3.1.6.6
variable load relay valve with kinked characteristic
relay valve type E
variable load relay valve (Type C) with a special, non-linear characteristic, which automatically comes into operation when the vehicle has more than a certain load

NOTE 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.

3.1.7
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

3.1.8
initial sensitivity
change of input pressure, starting at 0 bar which causes the output pressure to start increasing

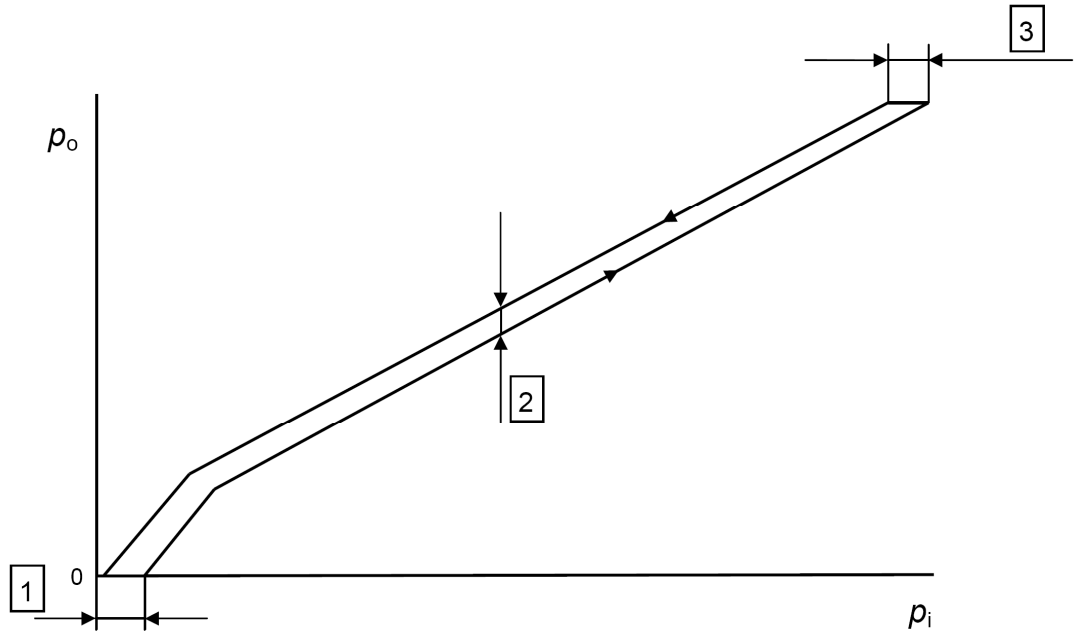
NOTE See Figure 2.

3.1.9
sensitivity at reversal
change of input pressure causing a variation of output pressure, when the change of input pressure is changing its direction from increasing to decreasing

NOTE See Figure 2.

3.1.10
hysteresis
difference in output pressure with the same input pressure, where the input pressure is first rising to a value and then, having been taken past that value, subsequently falls to the same value

NOTE 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

3.1.11
initial braking position
first braking step corresponding to a reduction of the brake pipe pressure of 0,4 bar to 0,5 bar, which results in an input pressure to the relay valve of (0,7 ± 0,1) bar

3.1.12
normal litre
Nl
unit of mass for gases equal to the mass of 1 l at a pressure of 1,013 2 bar (1 atmosphere) and at a standard temperature, often 0 °C or 20 °C

NOTE Airflow is often stated in normal litres per minute (Nl/min).

3.2 Symbols

p pressure

p_i input pressure

p_o output pressure

t time

3.3 Abbreviations

BCP brake cylinder pressure

Lcp Control signal - continuous load sensing pressure

Lsp Control signal - empty/load signal pressure

AR Auxiliary reservoir pressure, supply pressure

4 Design and manufacture

4.1 General

4.1.1 A relay valve shall enable a distributor valve to be used without any vehicle specific modification to the distributor, 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.

4.1.2 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.

4.1.3 The use of a relay valve shall enable the vehicle to maintain a nominally constant brake application or release time.

4.1.4 The use of a relay valve shall enable the brake cylinder pressure to be maintained between prescribed limits (e.g. interoperable or national). 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 mass percentage irrespective of load.

4.1.5 Table 1 below provides a description of relay valve types described in this standard with the relevant clause references.

Table 1 — Relay valve types and corresponding clauses

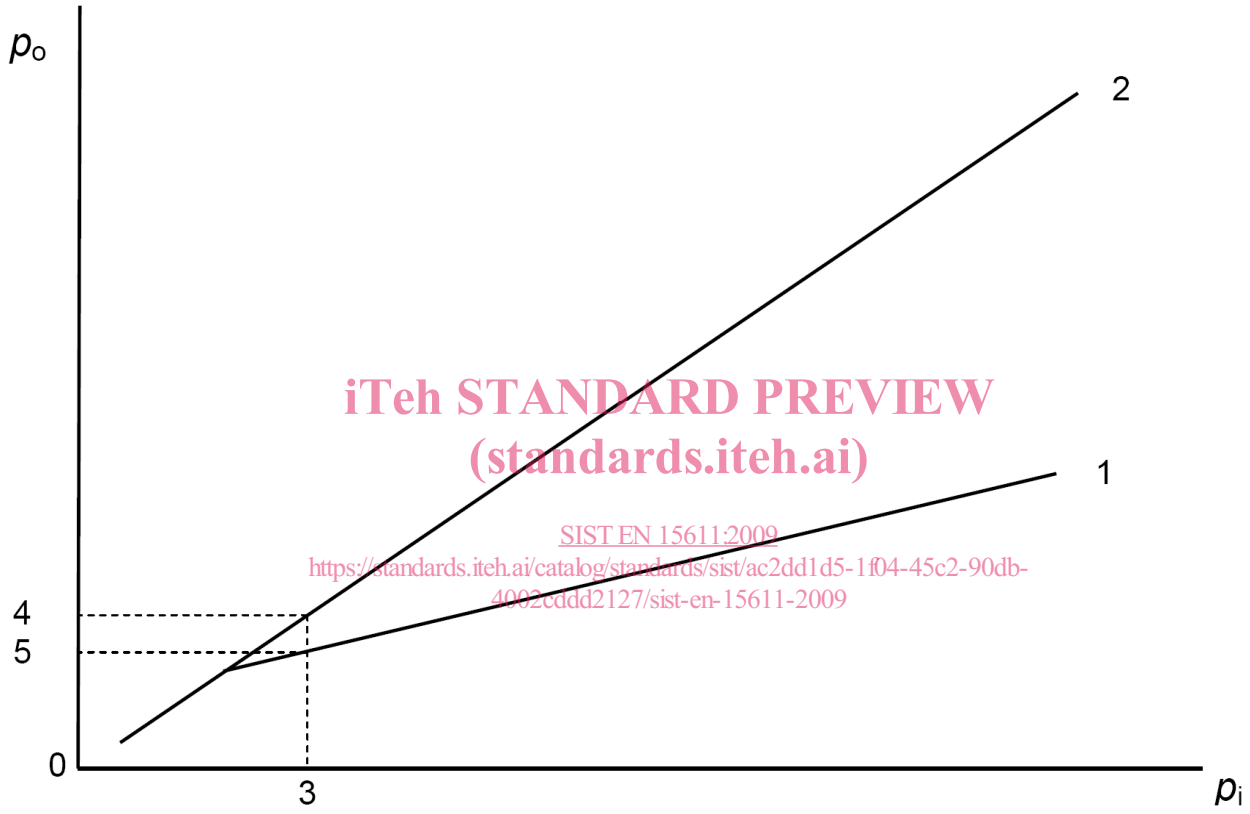
Type Symbol	Description	Comment	Definitions Clause Reference	Functional Requirement Clauses	Testing Clauses
A	One fixed relay valve ratio		3.1.6.1 Single stage relay valve	4.2.1 4.2.2.1 4.2.3 4.2.7 4.2.8 4.2.9 4.2.10 4.2.11 4.3 4.4 4.5 4.6 4.7 4.8 4.9 4.10 5	6.2.4.2 6.2.4.3 6.2.4.11 6.2.4.12 6.2.4.14 6.2.4.15 6.2.4.16 6.2.4.17
B – Basis of either B1 or B2 Types below	Two or more fixed relay valve ratios	Empty/loaded or low/high	3.1.6.2 Multi stage relay valve	4.2.1 4.2.2.1 4.2.2.2 4.2.3 4.2.7 4.2.8 4.2.9 4.2.10 4.2.11 4.3 4.4 4.5 4.6 4.7 4.8 4.9 4.10 5	6.2.4.2 6.2.4.3 6.2.4.4 6.2.4.11 6.2.4.12 6.2.4.14 6.2.4.15 6.2.4.16 6.2.4.17
B1		Change of relay valve ratios required/allowed during brake application	3.1.6.2.1	As for Type B plus 4.2.4	As for type B plus 6.2.4.5
B2		Change of relay valve ratio not allowed during brake application	3.1.6.2.2	As for Type B plus 4.2.5	As for Type B plus 6.2.4.6
C	Continuously changing relay valve ratio		3.1.6.3 Variable load relay valve	4.2.1 4.2.2.1 4.2.3 4.2.5 4.2.7 4.2.8 4.2.9 4.2.10 4.2.11 4.3 4.4 4.5 4.6 4.7 4.8 4.9 4.10 5	6.2.4.2 6.2.4.3 6.2.4.6 6.2.4.7 6.2.4.8 6.2.4.12 6.2.4.14 6.2.4.15 6.2.4.16 6.2.4.17
C1		Continuously changing relay valve ratio, with a multi stage feature added	3.1.6.4 Multi stage variable load relay valve	As for Type C plus 4.2.2.3	As for Type C plus 6.2.4.10
D	Two or more input pressures with „select high“ feature	overlay function to type A – C	3.1.6.5 Two (multi) input relay valve	As for Type A, B or C plus 4.2.2.4	As for Type A, B or C plus 6.2.4.13
E	Kinked characteristic	additional overlay function to type C	3.1.6.6 Variable load relay valve with kinked characteristic	As for Type C plus 4.2.6	As for Type C plus 6.2.4.9

4.2 Functional requirements

4.2.1 Minimum output pressure

The minimum output pressure of the relay valve (brake cylinder pressure) shall be such that a minimum brake force of 10 % of the maximum brake force in all conditions of vehicle load, is achieved in response to a nominal input pressure of 0,7 bar (Initial braking position). Figure 3 gives an example of the output pressure of a relay valve for different conditions of vehicle load.

NOTE The relay valve design may provide means to make the minimum output pressure changeable according to the requirements of different applications.



Key

1 empty condition

2 loaded condition

3 initial input pressure (0,7 ± 0,1) bar

4 initial output pressure loaded

5 initial output pressure unloaded

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

4.2.2 Accuracy of the output pressure and changeover

4.2.2.1 General (type A, B1, B2, C, C1, E)

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:

— ± 0,1 bar for nominal output pressures ≤ 3,8 bar at an input pressure of (3,8 ± 0,02) bar;

— ± 0,15 bar for nominal output pressures > 3,8 bar at an input pressure of (3,8 ± 0,02) bar.

This requirement shall be tested in accordance with 6.2.4.4 (type B1 and B2), 6.2.4.7 (type C and C1), 6.2.4.9 (type E) and 6.2.4.11 (type A, B1 and B2).

4.2.2.2 Accuracy of the changeover of a two, or more, stage relay valve (type B, 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 4.2.3, at nominal values of the load signal pressures (Lsp).

The accuracy of the changeover shall be tested in accordance with 6.2.4.4.

4.2.2.3 Accuracy of the change of a variable load relay valve with a two stage function overlaid to the variable load brake function (type C1)

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 initial and full service and within a tolerance of ± 10 % for any load condition; this condition is related to a nominal input pressure of 3,8 bar and shall be initiated by a pneumatic or electric control signal.

This requirement shall be tested in accordance with 6.2.4.10.

4.2.2.4 Accuracy of the output pressure of a relay valve designed for two or more input pressures (type D)

The output pressure of the relay valve shall correspond to the highest of the input pressures. The tolerance of the maximum output pressure nominal values shall be ± 0,1 bar, if the nominal value is ≤ 3,8 bar and ± 0,15 bar, if the nominal value is > 3,8 bar. In the case where two or more input pressures are acting simultaneously, the output pressure tolerance shall be a maximum of ± 0,20 bar, if the nominal value is ≤ 3,8 bar and ± 0,30 bar, if the nominal value is > 3,8 bar.

This requirement shall be tested in accordance with 6.2.4.13.

4.2.3 Load signal characteristics

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

a) manual empty-loaded 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 dependant on the brake system design, as follows: