BRITISH STANDARD

BS EN
14817:2006

Railway applications — Suspension components — Air-spring control elements

The European Standard EN 14817:2006 has the status of a British Standard

ICS 45.040

BSI
British Standards

National foreword

This British Standard is the official English language version of EN 14817:2006.

The UK participation in its preparation was entrusted by Technical Committee RAE/3, Railway rolling stock materials, to Subcommittee RAE/3/-/4, Suspension components, which has the responsibility to:

— aid enquirers to understand the text;

— present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep UK interests informed;

— monitor related international and European developments and promulgate them in the UK.

A list of organizations represented on this subcommittee can be obtained on request to its secretary.

Cross-references

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Railway applications - Suspension components - Air spring control elements

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Bahnanwendungen - Federungselemente - Luftfedersteuerglieder

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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. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

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Foreword

This European Standard (EN 14817:2006) 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of an identical text or by endorsement, at the latest by October 2006, and conflicting national standards shall be withdrawn at the latest by October 2006.

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Romania, Slovakia, Spain, Sweden, Switzerland and the United Kingdom.

Introduction

Designing an air spring control element initially requires knowledge of the mechanical system into which it is integrated. From this come the performance requirements specific to each case that only the customer is able to specify.

The requirements of the standard should be applied jointly to the supply conditions for the air spring control elements.

This standard puts into concrete form the studies and work carried out to improve the performance and quality of the air spring control elements in order to meet the requirements of modern rail transport equipment.

This standard is intended for the users of rail networks, manufacturers and suppliers of rail equipment and suppliers of air brake control elements.

1 Scope

This standard specifies:

- the characteristics the air brake control elements shall have and the tests to be carried out;
- the guidelines for drafting the approval procedure applied by the customer;
- the guidelines for drafting the qualification procedure for the product based on the requirements specified;
- the guidelines for drafting the quality surveillance provisions for the manufacture of the air spring control elements.

The requirements of this standard are applicable to air spring control elements having to equip rail vehicles operating on a reserved track under permanent guidance without any distinction between the nature or the route of the track.

It covers complete control elements. It is essential that the various components are defined by particular specifications.

This standard specifies:

- the differential valves;
- the filters;
- the levelling valves;
- the non-return valves;
- the minimum pressure valves;
- the pressure-reducing valves;
- the end stop valves;
- the isolating valves.

This standard does not take into account the other air suspension control elements such as the installation of pipes, pipework elements and air production elements.

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 50102, *Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts (IK code)*

EN 60529, *Degrees of protection provided by enclosures (IP code) (IEC 60529:1989)*

ISO 31-1, *Quantities and units – Part 1: Space and time*

ISO 31-3, *Quantities and units – Part 3: Mechanics*

ISO 1219-1, *Fluid power systems and components – Graphic symbols and circuit diagrams – Part 1: Graphic symbols*

ISO 8573-1, *Compressed air for general use – Part 1: Contaminants and quality classes*

ISO 9227, *Corrosion tests in artificial atmospheres – Salt spray tests*

ISO 10209-1, *Technical product documentation – Vocabulary - Part 1: Terms relating to technical drawings - General and types of drawings*

3 Terms, definitions, symbols and abbreviations

3.1 Terms and definitions

For the purposes of this European Standard, the following terms and definitions apply.

3.1.1
differential valve
appliance whose basic function is to permit a flow of air between two air springs of the same bogie when their pressure differential is greater than a specified threshold

3.1.2
filter
appliance whose basic function is to catch the pollutants in the compressed air

3.1.3
levelling valve
appliance whose basic function is to maintain the height of an air spring at a predetermined constant value whatever the static load applied whilst admitting or discharging air

3.1.4
end stop valve
appliance whose basic function is to limit the height of an air spring to a predetermined value by purging it rapidly into the atmosphere

3.1.5
minimum pressure valve
appliance whose basic function is to admit an air flow in one single direction above a given pressure

3.1.6
non-return valve
appliance whose basic function is to admit an air flow in one single direction

3.1.7
pressure drop
difference between the inlet pressure and outlet pressure of a control element at a given moment

3.1.8
pressure reducing valve
appliance that supplies a relatively constant outlet pressure regardless of the inlet pressure and outlet air flow

NOTE It is essential that the inlet pressure, however, remains higher than the regulated outlet pressure.

3.1.9
isolating valve
appliance whose basic function is to permit air to flow or not whatever the direction

3.1.10
isolating valve with vent hole
appliance whose basic function is to permit air to flow in whatever direction or to oppose it by venting one part of the air circuit

3.2 Symbols and abbreviations

For the purposes of this European Standard, the following symbols and abbreviations apply.

Most of the symbols used in this standard and defined in this subclause conform to ISO 31-1 and ISO 31-3.

Decimal multiples and sub-multiples of the units defined in Table 1 may be used.

Table 1 — Symbols and abbreviations

Symbol Abbreviation	Unit	Explanation
p	Pa	Absolute pressure. The value zero corresponds to an absolute vacuum.
p_1	Pa	Inlet pressure.
p_2	Pa	Outlet pressure.
p_{amb}	Pa	Ambient pressure outside the control element. Unless otherwise specified, $p_{amb} = p_{at}$.
p_{at}	Pa	Normal atmospheric pressure, with p_{at} = 101325 Pa (≈1 bar)
p_e	Pa	Effective pressure. Pressure equal to the algebraic difference between the absolute pressure inside the element (p) and the ambient pressure (p_{amb}). $p_e = p - p_{amb}$
p_{mw}	Pa	Maximum working pressure. Maximum absolute pressure to which the control element is subjected in service for a given application.
p_{op}	Pa	Operating pressure.
T	°C	Ambient temperature outside the control element.
$T_E$max	°C	Upper limit of range of exceptional operating temperatures.
$T_E$min	°C	Lower limit of range of exceptional operating temperatures.

$T_N$max	°C	Upper limit of range of normal operating temperatures.
$T_N$min	°C	Lower limit of range of normal operating temperatures.
$T_S$max	°C	Upper limit of range of stationary exposure temperatures.
$T_S$min	°C	Lower limit of range of stationary exposure temperatures.
Δp	Pa	Pressure drop.
Δp_m	Pa	Maximum allowable pressure drop.

4 Documentation

4.1 Introduction

The element shall be defined in a technical specification comprising the following documents (see 4.2 and 4.3).

The types of drawings are specified in ISO 10209-1.

4.2 Documents to be provided by the customer

The customer shall prepare a technical specification comprising:

a) an interface drawing (if possible, an assembly drawing of the mechanical system or a partial drawing) showing the following points at least;

   — the space envelope;

   — the functional dimensions and tolerances.

b) technical data specifying the following points at least:

   — the working conditions (temperatures, assembly, environment, maintenance, storage, etc.);

   — the requirements (product characteristics, tolerances and desired service life);

   — the content of the approval procedure and the type testing requirements (for example: characteristics to be verified and tests to be carried out, sequence of tests and verifications).

4.3 Documents to be provided by the supplier

The supplier shall provide documentation describing the element and specifying:

a) a specification drawing including at least:

   — the overall dimensions;

   — the position of the marking.

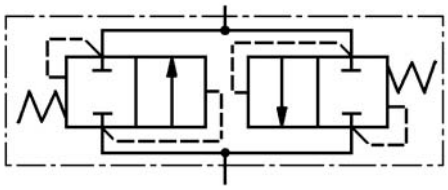
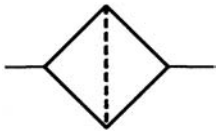
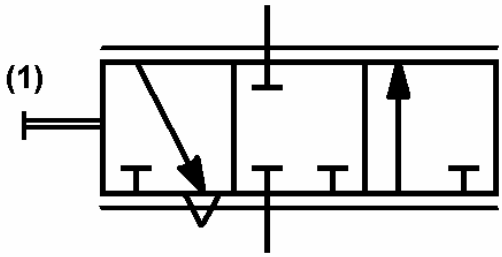
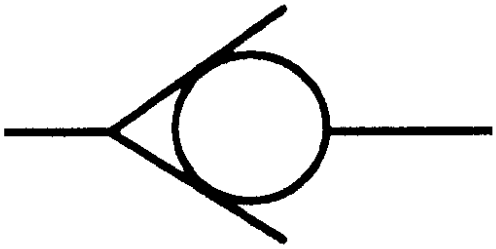
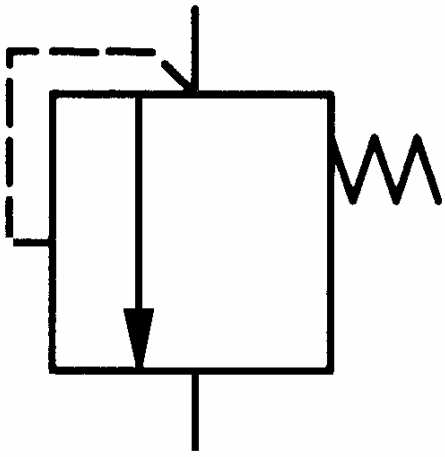
b) a specification drawing (cross-section view) with a nomenclature;

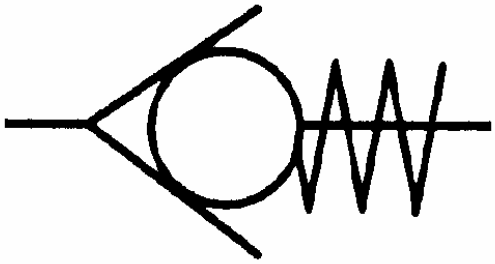
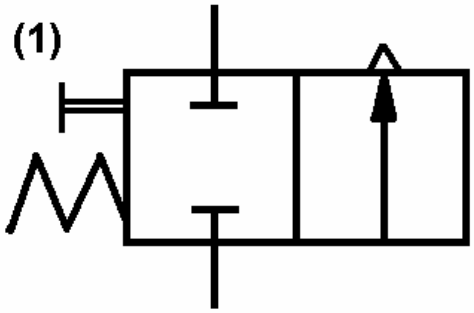
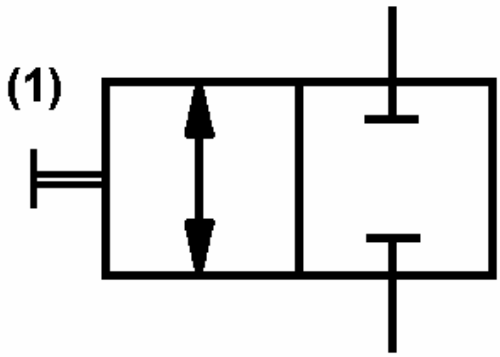
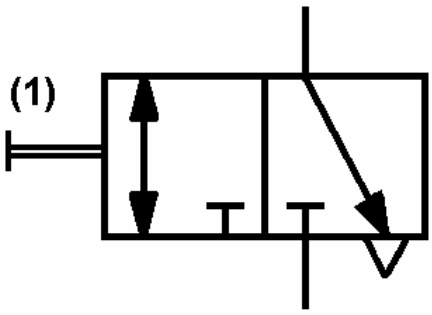
c) technical data specifying at least the necessary information on the control element (for example: assembly and maintenance instructions).

5 Graphical symbols

The control elements shall be represented in the diagrams by the symbols given in Table 2.

Table 2 — Graphical symbols

Element	Graphical symbol
Differential valve	
Filter	
Levelling valve	
Non-return valve	
Pressure reducing valve	

Minimum pressure valve	
End stop valve	
Isolating valve	
Isolating valve with vent hole	
1) The control mode shall be represented in accordance with the rules in ISO 1219-1	

6 Working conditions

6.1 General

The control element shall ensure all the functions in the working and environmental conditions to which it is subjected in operation.

These conditions shall be defined in the technical specification for the control element.

6.2 Climatic and atmospheric condition

The variation in air temperature (ambient temperature) taken into account is generally between "- 25 °C and + 50 °C".

However, a different range of temperatures may be used if the operating or geographic conditions are exceptional.

6.3 Environmental conditions

Depending on its location on the vehicle and its operating conditions, the control element may be exposed to attacks from various sources:

— chemical products (cleaning products, for example);

— organic waste;

— oil;

— ballast;

— etc.

6.4 Operation

The control element shall ensure without incident that all functions are operational when it is subjected to the maximum air circuit pressure in the specified operating conditions.

The maximum working pressure (p_{mw}) shall be defined in the technical specification.

The vehicle air circuits may contain pollutants (dust, water, oil),

The air quality shall be defined in the technical specification in accordance with ISO 8573-1.

NOTE For the tests, the air quality is defined in 8.1.2.

6.5 Mechanical conditions

Depending on its location on the vehicle and its operating conditions, the control element may be exposed to mechanical stresses (vibration, impact, etc.).

7 Product definition

7.1 General

The customer shall define in the technical specification all the necessary characteristics for defining the control element as a function of its operating and working conditions.

These characteristics shall be selected from those listed in Tables 3 and 4.

Unless specified otherwise, the control element shall meet the requirements for the characteristics marked by the symbol * in Table 3 and defined in this standard.

Table 3 — Basic characteristics

CHARACTERISTIC		Definition of the characteristic (subclause)	Verification and test method (subclause)
Resistance to operating conditions			
Extreme temperatures	*	7.2.1	8.2.1
Water penetration	*	7.2.2	8.2.2
Penetration of external solid bodies	*	7.2.3	8.2.3
Mechanical impacts	*	7.2.4	8.2.4
Projections of ballast		7.2.5	8.2.5
Corrosion	*	7.2.6	8.2.6
Reaction to fire		7.2.7	8.2.7
Other conditions		7.2.8	8.2.8
Physical characteristics			
Material	*	7.3.1	8.3.1
Mass	*	7.3.2	8.3.2
Appearance	*	7.3.3	8.3.3
Air-tightness	*	7.3.4	8.3.4
Fatigue behaviour		7.3.5	8.3.5
Geometrical and dimensional characteristics	*	7.4	8.4

Table 4 — Functional characteristics

	CHARACTERISTIC			
	Air flow	**Pressure drop**	**Filtering performance**	**Operating pressure**
Definition of the characteristic (subclause)	7.5.2	7.5.3	7.5.4	7.5.5
Verification and test method (subclause)	8.5.2	8.5.3	8.5.4	8.5.5
Differential valve	Recommended			Obligatory
Filter	Obligatory	Recommended	Obligatory	
Levelling valve	Obligatory			
Non-return valve	Obligatory	Recommended		
Pressure-reducing valve	Obligatory			Obligatory
Minimum pressure valve	Obligatory			Obligatory
End stop valve	Obligatory			
Isolating valve	Obligatory			
Isolating valve with vent hole	Obligatory			

7.2 Resistance to operating conditions

7.2.1 Extreme temperatures

The ranges of ambient temperatures the control element shall withstand shall be defined in the technical specification.

There are three conditions specified in Table 5.

Table 5 — Temperature ranges

Condition	Temperature range	Definition
A	T_N**min** to T_N**max**	Subjected to any temperature in this range, all the nominal values of the control element characteristics shall be met.
B	T_E**min** to T_N**min** and T_N**max** to T_E**max**	Subjected to any temperature in this range, the control element shall function without incident. Evolution of the characteristics is allowed as long as this does not cause any malfunction of the air suspension. Therefore, the specific requirements to ensure correct functioning of the air suspension shall be defined in the technical specification.
C	T_S**min** to T_E**min** and T_E**max** to T_S**max**	When the control element is not being used (for example: storage, prolonged immobilization of the vehicle), it shall withstand any temperature in this range without deterioration. Its characteristics shall return as soon as conditions A and B are attained.

The extreme temperatures shall be specified in the technical specification. Otherwise, the following values shall be considered:

— T_S**max** = + 70 °C;

— T_E**max** = + 50 °C;

— T_N**max** = + 35 °C;

— T_N**min** = + 5 °C;

— T_E**min** = - 15 °C;

— T_S**min** = - 25 °C.

For conditions A and B, the technical specification shall specify the characteristics to be verified and the corresponding values.

7.2.2 Water penetration

The control element shall be watertight.

Penetration of water into the control element may be allowed if it does not cause malfunction of the element itself or of the assembly of which it is a part.

In this case, the acceptance criteria shall be the subject of an agreement between the customer and the supplier.

Table 6 gives, for each protection level, the definition of the protection against water penetration of the assembled control element under operating conditions.

The level of protection against water penetration shall be defined in the technical specification by specifying the alphanumerical symbol **Hi**. Otherwise, protection level **H1** applies.

Table 6 — Protection against water penetration

Symbol Hi	Definition
H1	The control element shall be watertight when subjected to drops of water falling perpendicularly.
H2	The control element, inclined + 15 degrees - 15 degrees relative to its operating position, shall be watertight when subjected to drops of water falling perpendicularly.
H3	The control element shall be watertight when subjected to water falling as fine rain.
H4	The control element shall be watertight when subjected to water splashes.
H5	The control element shall be watertight when subjected to a water jet.
H6	The control element shall be watertight when subjected to a powerful water jet.

7.2.3 Penetration of external solid bodies

The expression "external solid bodies" applies to any body, material, particle etc. that is not part of the control element.

The presence of external solid bodies inside the control element is not allowed.

Penetration of external solid bodies into the control element may be allowed if it does not cause a malfunction of the element itself or of the assembly of which it is a part.

In this case, the acceptance criteria shall be the subject of an agreement between the customer and the supplier.

Table 7 gives, for each protection level, the definition of the protection against penetration of external solid bodies of the assembled control element under operating conditions.

The level of protection against penetration of external solid bodies shall be defined in the technical specification by specifying the alphanumerical symbol **Si**. Otherwise, protection level **S1** applies.

Table 7 — Protection against penetration of external solid bodies

Symbol Si	Definition
S3	Protection against the penetration of external solid bodies of a diameter greater than or equal to 2,5 mm
S4	Protection against the penetration of external solid bodies of a diameter greater than or equal to 1 mm
S5	Protection against the penetration of dust

7.2.4 Mechanical impacts

The control element shall withstand mechanical impacts.

Table 8 gives the value, in joules, of the impact energy corresponding to each level of protection against mechanical impacts that the control element may withstand without causing a malfunction.

The level of protection against mechanical impacts shall be defined in the technical specification by specifying the alphanumerical symbol **Mi**. Otherwise, the level of protection **M0** applies.

Table 8 — Protection against mechanical impacts

Symbol Mi	Characteristic of the level of protection (the element is protected against an impact in which the energy is:)
M0	No requirement
M1	0,15 J
M2	0,2 J
M3	0,35 J
M4	0,5 J
M5	0,7 J
M6	1 J
M7	2 J
M8	5 J
M9	10 J
M10	20 J
M11	50 J
M12	100 J

7.2.5 Projection of ballast

If required, the requirements concerning the behaviour of the control element when subjected to ballast projection shall be defined in the technical specification.

7.2.6 Corrosion

The external surfaces of the control element shall be protected against corrosion.

The technical specification shall specify the level of protection applicable to each surface to be protected.

The level of protection against corrosion shall be defined by specifying the alphanumerical symbol **Ci**. Otherwise, the level of protection **C1** applies.

Table 9 gives, for each level of protection, the definition of the protection against corrosion.

Table 9 — Protection against corrosion

Symbol Ci	Characteristic of the level of protection (corrosion resistance under the test conditions defined in 8.2.6)
C1	Protection for 96 h
C2	Protection for 168 h
C3	Protection for 240 h
C4	Protection for 480 h
C5	Protection for 1000 h

7.2.7 Reaction to fire

If required, the reaction to fire of the control element shall be defined in the technical specification.

Otherwise, the control element shall be classified as a function of its reaction to fire, the opacity of the smoke and the toxicity of the gases emitted.

7.2.8 Other conditions

Any other operating condition for the control element shall be defined in the technical specification.

7.3 Physical characteristics

7.3.1 Material

The material of the control element shall be specified in the definition drawing or an enclosed document.

7.3.2 Mass

The mass of the control element shall be specified in the definition drawing provided by the supplier.

Mass requirements may be specified in the technical specification (for example: maximum mass).

7.3.3 Appearance

The accessible parts of the control element shall not have any sharp edges.

The components of the control element shall not have any manufacturing faults likely to cause a malfunction (cracks, seams, absence of material, etc.).

7.3.4 Air-tightness

The control elements fixed in their assembly shall be air-tight.

The maximum allowable loss of pressure (Δp_m) shall be defined in the technical specification with the test conditions if they are special.

Otherwise, Δp_m is equal to 0,015 MPa (0,15 bar):

— for a new control element;

— under the experimental conditions defined in 8.3.4;

— in a 23/50 reference atmosphere (ambient temperature of 23 °C and relative humidity of 50 %).

7.3.5 Fatigue behaviour

The control elements shall withstand all stresses, forces and vibrations to which they are subjected in operation.

The fatigue behaviour of a control element may be defined by a fatigue test simulating the movements, forces and vibrations arising in operation.

If a fatigue test is required, the test programme (see 8.3.5) and the acceptance criteria shall also be defined in the technical specification.

7.4 Geometrical and dimensional characteristics

The space envelope assigned to the control element shall be defined.

The overall dimensions of the control element shall be compatible with the specified space envelope.

7.5 Functional characteristics

7.5.1 General

The main functional characteristics of a control element are defined in the following subclauses**.**

Other characteristics may be defined. In this case, they are also defined in the technical specification.

For each functional characteristic, the direction of the air flow shall be specified in the technical specification.

7.5.2 Air flow

If required, the air flow for a given inlet pressure (p_1) shall be defined with its tolerances in the technical specification.

7.5.3 Pressure drop

If required, the maximum allowable pressure drop Δp_m for a given inlet pressure p_1 shall be defined in the technical specification.

7.5.4 Filtering performance

If required, the quality class of the compressed air passing through the control element shall be specified in the technical specification in accordance with ISO 8573-1.

The nominal efficiency of the filter element shall be defined, in microns, in the technical specification.

7.5.5 Operating pressure

The operating pressure p_{op} shall be defined in the technical specification.

8 Verification and test methods

8.1 General

8.1.1 Test conditions

The measurements and tests shall be carried out under the atmospheric and air flow conditions specified in the control element technical specification.

Otherwise, the tests shall be carried out at an ambient temperature of (23 ± 5) °C and a relative humidity of (50 ± 10) %.

Tests may require a specific temperature as a function of the requirements of this standard.

For each test, the temperature shall be recorded and supplied with the results of the measurements.

The tests shall be carried out in the tolerance range of the specified parameters and their declared actual value.

Interpretation of the test results shall be the subject of an agreement between the customer and the supplier.

The accuracy of the measurements shall be determined.

The relationship between the accuracy of a measurement and the specified tolerance (on a parameter or on the measured result) shall be the subject of an agreement between the customer and the supplier.

For any amendment, the supplier shall have the agreement of the customer.

8.1.2 Test installation

The test installation shall comprise at least:

— an air supply;

— an isolating valve between the test installation and the air supply;

— a measuring apparatus (pressure gauge, flowmeter, etc.);

— the control element to be tested.

A description of the test installation shall be sent to the customer for approval.

A test installation diagram shall be included in the test report. This diagram shall be prepared according to the requirements of clause 5 of ISO 1219-1.

The test installation shall be air-tight.

Under the experimental conditions defined in 8.3.4, (without the control element to be tested), the pressure drop shall be less than or equal to 10 % of Δp_m.

The supply pressure shall be regulated to the value specified for the test. Otherwise, a tolerance of ± 0,1 MPa is applied to this value.

The quality of the compressed air used in the test installation shall be greater than or equal to purity class 4.3.5 according to ISO 8573-1.

The measuring apparatus used to record the pressure shall have an accuracy of at least 0,001 MPa.

8.1.3 Definition and preparation of test pieces

Unless otherwise specified, the test piece for all the tests shall be the complete control element**.**

8.2 Verification of resistance to the operating conditions

8.2.1 Extreme temperatures

The tests shall be carried out at the temperatures defined in the control element technical specification, with the following tolerances:

± 2°C for T_E**max**, T_N**max**, T_N**min** and T_E**min**;

± 3°C for T_S**max** and T_S**min**.

During the tests, the control element shall be kept in a climatic chamber.

The characteristics defined in the technical specification shall be verified.

8.2.2 Water penetration

The test methods for verifying resistance to water penetration are those defined in EN 60529.

The test method to be used (**IP** code according to EN 60529) is the one corresponding to the specified **Hi** level of protection against water penetration.

During the test:

— the orifices shall be plugged;

— the control element shall not be pressurized (atmospheric pressure).

Table 10 — Correspondence between "Hi symbol and IP code"

Symbol Hi	Test method (IP code according to EN 60529)
H1	IPX1
H2	IPX2
H3	IPX3
H4	IPX4
H5	IPX5
H6	IPX6

After the test, the control element shall be dismantled and examined.

8.2.3 Penetration of external solid bodies

The test methods for verifying the resistance to penetration by external solid bodies are those defined in EN 60529.

The method to be used (**IP** code according to EN 60529) is the one corresponding to the specified **Si** level of protection against penetration of external solid bodies without a vacuum inside the control element (category 2 enclosures).

During the test:

— the orifices shall be plugged;

— the control element shall not be pressurized (atmospheric pressure).

Table 11 — Correspondence between "Si symbol and IP code"

Symbol Si	Test method (IP code according to EN 60529)
S3	IP3X
S4	IP4X
S5	IP5X

After the test, the control element shall be dismantled and examined.

8.2.4 Mechanical impacts

The test methods for verifying the resistance to mechanical impacts are those defined in EN 50102.

The test method to be used (**IK** code according to EN 50102) is the one corresponding to the specified **Mi** level of protection against mechanical impacts.

For levels **M11** and **M12**, it is permitted to extrapolate the test method applied to level **M10** (corresponding to **IK10**).

The adjustments to be taken into account are:

— for level **M11** (50 joules)

  — the mass of the material shall be (4000 ± 200) g. Its striking zone shall have a radius of curvature **R** of approximately 50 mm;

  — the drop height shall be (1275 ± 10) mm.

— for level **M12** (100 joules)

  — the mass of the material shall be (4000 ± 200) g. Its striking zone shall have a radius of curvature **R** of approximately 50 mm.

  — the drop height shall be (2550 ± 10) mm.

Table 12 — Correspondence between "Mi symbol and IK code"

Symbol Mi	Test method (IK code according to EN 50102)
M0	IK 00
M1	IK 01
M2	IK 02
M3	IK 03
M4	IK 04
M5	IK 05
M6	IK 06
M7	IK 07
M8	IK 08
M9	IK 09
M10	IK 10
M11	-
M12	-

After the test, the control element shall be examined and the characteristics required in the technical specification shall be verified.

8.2.5 Projection of ballast

The test method shall be defined in the technical specification.

8.2.6 Corrosion

The corrosion resistance shall be tested by means of a salt spray test as described in ISO 9227.

8.2.7 Reaction to fire

If this characteristic is required, the test method shall be defined in the technical specification.

8.2.8 Other conditions

For each characteristic specified, the test method shall be defined in the technical specification.

8.3 Verification of physical characteristics

8.3.1 Material

The characteristics of the material shall be measured by means of suitable tests as a function of the type of material.

8.3.2 Mass

The mass shall be measured with instruments suitable for the level of accuracy required.

8.3.3 Appearance

The control elements shall be the subject of a visual examination.

8.3.4 Air-tightness

Unless otherwise specified in the technical specification, the air-tightness test shall be carried out as follows:

The test installation (including the control element to be tested) shall be subjected for at least 10 min to a pressure $\boldsymbol{p} = \boldsymbol{p}_{mw}$ (0, + 20 %), with the air supply and the venting devices isolated.

The pressure change ($\Delta \boldsymbol{p}$) shall be measured.

The control element shall be the subject of a visual examination.

8.3.5 Fatigue behaviour

If this characteristic is required, the fatigue behaviour test shall also be defined in the technical specification.

8.4 Verification of geometrical and dimensional characteristics

The geometrical and dimensional characteristics shall be measured with instruments suitable for the size of the control element and the level of accuracy required.

8.5 Verification of functional characteristics

8.5.1 General

The test methods to be used for measuring the characteristics defined in 7.5 are described in the following subclauses.

For any other characteristic, the test method shall also be given in the technical specification.

8.5.2 Air flow

The inlet pressure p_1 shall be regulated to ± 2 % by applying increasing pressure.

Then, the air flow at the outlet of the control element shall be recorded.

8.5.3 Pressure drop

The inlet pressure p_1 shall be regulated to ± 2 % by applying increasing pressure.

Then, the outlet pressure p_2 of the control element shall be recorded.

The pressure drop shall be calculated as follows:

$$\Delta p = p_1 - p_2$$

8.5.4 Filtering performance

The quality class of the compressed air upstream of the control element under test shall be lower than that specified in the technical specification.

Unless otherwise specified, the test methods for determining pollutants shall be those defined in ISO 8573-1.

8.5.5 Operating pressure

An inlet pressure of 0 to p_{mw} shall be applied at constant speed.

The speed of application and the pressure p_{mw} shall be defined in the technical specification.

The operating pressure p_{op} shall be recorded.

9 Marking

Each control element shall have marked permanently on its external surface the following information:

— identification of the supplier;

— code of the production site, if there are more than one;

— product reference;

— date of manufacture (month and year);

— additional information if required by the customer.

The position of the above markings shall be clearly indicated on the definition drawing of the control element prepared by the supplier.

In order to ensure traceability (see Annex A), these markings shall remain legible throughout the service life of the control element.

Annex A
(informative)

Traceability, qualification and quality surveillance

A.1 Traceability

It is recommended that suppliers should establish a product identification and traceability system conforming to the recommendations of EN ISO 9000.

The traceability is the subject of a contractual document between the customer and the supplier.

A.2 Qualification of the supplier's production factory

It is recommended that the different stages of production of the control element, including the manufacture of the constituent elements, should be carried out only by qualified suppliers in conformity to the definition of EN ISO 9000, having a quality assurance system certified according to EN ISO 9001.

A.3 Product approval and qualification

A.3.1 Approval

Before being fitted to a vehicle, a control element may be submitted for approval (according to the definition in EN 45020) by the customer.

When this approval is required, all the approval conditions and procedures shall be the subject of an agreement between the customer and the supplier.

A.3.2 Qualification

A.3.2.1 General

The definitions of EN ISO 9000 apply.

Before being used on a vehicle, any new control element (whether the supplier is new or known) or any existing control element used for a new application (new technical specification) is qualified. The characteristics and properties of the control element are verified (type test) in compliance with the requirements of the customer

The scope of the tests is defined in the technical specification and is the subject of an agreement between the customer and the supplier.

A.3.2.2 Test pieces

The definition and preparation of the test pieces are specified in 8.1.3.

All the control elements used as test pieces for the qualification tests come from the same manufacturing batch and are supplied in one single consignment.

The test pieces are representative of the manufacturing technology, of the materials used and of all the characteristics for which qualification is required.

The number of test pieces and the sequence of the tests and verifications of the test pieces are defined in the technical specification.

A.3.2.3 Qualification procedure

The qualification procedure consists of verifying conformity of the product to the specified requirements.

All the characteristics defined in the technical specification are verified on the product submitted for qualification.

The qualification procedure of the control elements, except for those products from a new supplier, may be simplified in compliance with the quality assurance system of the supplier.

The verifications are carried out in conformity to the requirements of the technical specification.

The laboratory or laboratories charged with carrying out the qualification tests are designated following agreement by the customer.

A.3.2.4 Validity of the product qualification

After the product qualification, any modification to the design, technology, composition, manufacturing processes or manufacturing plant is reported to the customer for approval before implementation.

In this case, the customer may call into question the validity of the product qualification.

The qualification may also be reassessed:

— after an interruption of the manufacturing process for more than two years;

— after any operating incidents that indicate inadequate quality of the control element.

A.4 Inspection and quality surveillance

For the requirements of this clause, the definitions in EN ISO 9000 apply.

The supplier proposes the methods for checking the manufacturing quality of his products within a quality plan submitted for the approval of the customer.

Bibliography

[1] EN ISO 9000, *Quality management systems – Fundamentals and vocabulary (ISO 9000:2000)*

[2] EN ISO 9001, *Quality management systems – Requirements (ISO 9001:2001)*

[3] EN 45020, *Standardization and related activities – General vocabulary (ISO/IEC Guide 2:1996)*

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