



SLOVENSKI STANDARD SIST EN 1366-9:2024

01-december-2024

Nadomešča:
SIST EN 1366-9:2008

Preskusi požarne odpornosti servisnih inštalacij - 9. del: Kanali za odvod dima iz enega požarnega sektorja

Fire resistance tests for service installations - Part 9: Single compartment smoke extraction ducts

Feuerwiderstandsprüfungen für Installationen - Teil 9: Entrauchungsleitungen für einen Einzelabschnitt

Essais de résistance au feu des installations techniques - Partie 9 : Conduits d'extraction de fumées relatifs à un seul compartiment

Ta slovenski standard je istoveten z: **EN 1366-9:2024**

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ICS:

13.220.50	Požarna odpornost gradbenih materialov in elementov	Fire-resistance of building materials and elements
91.060.40	Dimniki, jaški, kanali	Chimneys, shafts, ducts

SIST EN 1366-9:2024

en,fr,de

EUROPEAN STANDARD

EN 1366-9

NORME EUROPÉENNE

EUROPÄISCHE NORM

October 2024

ICS 13.220.50; 91.140.30

Supersedes EN 1366-9:2008

English Version

Fire resistance tests for service installations - Part 9: Single compartment smoke extraction ducts

Essais de résistance au feu des installations techniques
- Partie 9 : Conduits d'extraction de fumées relatifs à un
seul compartiment

Feuerwiderstandsprüfungen für Installationen - Teil 9:
Entrauchungsleitungen für einen Einzelabschnitt

This European Standard was approved by CEN on 2 September 2024.

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COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

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European foreword

This document (EN 1366-9:2024) has been prepared by Technical Committee CEN/TC 127 “Fire safety in buildings”, the secretariat of which is held by BSI.

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of an identical text or by endorsement, at the latest by April 2025, and conflicting national standards shall be withdrawn at the latest by April 2025.

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 supersedes EN 1366-9:2008.

In comparison with the previous edition, the following technical modifications have been made:

- method for determination of reduction in internal cross-sectional area was added;
- positions for measurement of deflection of cross-section outside furnace were defined;
- introduction of an alternative oxygen sampling probe;
- use of two separate O₂ analysers based on paramagnetic measurement method for the two sampling points is mandatory;
- direct field of application for vertical parts of duct within the smoke compartment was added, without penetrating any wall/floor where fire resistance is required;
- details of holes in perforated plate for circular ducts were included in figures;
- standard for gas temperature thermocouples were added;
- location of compensators (if used) were amended.

This document has been prepared under a standardization request addressed to CEN by the European Commission. The Standing Committee of the EFTA States subsequently approves these requests for its Member States.

EN 1366, *Fire resistance tests for service installations* consists of the following parts:

- *Part 1: Ventilation ducts*
- *Part 2: Fire dampers*
- *Part 3: Penetration seals*
- *Part 4: Linear joint seals*
- *Part 5: Service ducts and shafts*
- *Part 6: Raised access and hollow core floors*
- *Part 7: Conveyor systems and their closures*
- *Part 8: Smoke extraction ducts*

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- *Part 9: Single compartment smoke extraction ducts*
- *Part 10: Smoke control dampers*
- *Part 11: Fire protective Systems for cable systems and associated components*
- *Part 12: Non-mechanical fire barrier for ventilation ductwork*
- *Part 13: Chimneys*
- *Part 14: Partial penetration seals*

Any feedback and questions on this document should be directed to the users' national standards body. A complete listing of these bodies can be found on the CEN website.

According to the CEN-CENELEC Internal Regulations, the national standards organisations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Türkiye and the United Kingdom.

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Introduction

This part of this European Standard has been prepared because a method of test for smoke extraction ducts used in single compartment applications has become necessary. This test exposes a smoke extraction duct to conditions intended to represent the pre-flashover stage of a fire.

Leakage is measured at both ambient temperature and exposure at 600 °C. During the tests, air/gases are drawn through the duct at a differential pressure between the inside and outside of the duct. Leakage is determined at ambient temperature by sealing the openings in the duct located in the furnace and taking flow measurements through a flow measuring device located just before the extraction fan. With respect to determining leakage at 600 °C, oxygen-measuring techniques are used.

CAUTION — The attention of all persons concerned with managing and carrying out this fire resistance test is drawn to the fact that fire testing may be hazardous and that there is a possibility that toxic and/or harmful smoke and gases may be evolved during the test. Mechanical and operational hazards may also arise during the construction of the test elements or structures, their testing and disposal of test residues.

An assessment of all potential hazards and risks to health should be made and safety precautions should be identified and provided. Written safety instructions should be issued. Appropriate training should be given to relevant personnel. Laboratory personnel should ensure that they follow written safety instructions at all times.

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EN 1366-9:2024 (E)**1 Scope**

This part of EN 1366 specifies a test method for determining the fire resistance of smoke extraction ducts that are used for single compartment applications only. In such applications, the smoke extraction system is only intended to function up to flashover (typically 600 °C).

This method of test is only suitable for ducts constructed from non-combustible materials (class A1 and A2-s1, d0 according to EN 13501-1).

It is applicable only to four sided and circular ducts. One-, two- and three-sided ducts are not covered. This document is applicable only for the standard sizes or smaller as described.

This test method of part 9 is applicable only to smoke extraction ducts that do not pass into other fire compartments. For smoke extraction ducts that pass into other compartments, the method of test described in EN 1366-8 is used.

The smoke extraction duct is part of the smoke extraction system which also includes smoke control dampers and smoke extract fans.

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 1363-1, *Fire resistance tests — Part 1: General requirements*

EN 1366-1, *Fire resistance tests for service installations — Part 1: Ventilation ducts*

EN 1507, *Ventilation for buildings — Sheet metal air ducts with rectangular section — Requirements for strength and leakage*

EN 12237, *Ventilation for buildings — Ductwork — Strength and leakage of circular sheet metal ducts*

EN 10095, *Heat resisting steels and nickel alloys*

EN 13501-4, *Fire classification of construction products and building elements — Part 4: Classification using data from fire resistance tests on components of smoke control systems*

EN 60584-1, *Thermocouples — Part 1: EMF specifications and tolerances (IEC 60584-1)*

EN ISO 5167-1, *Measurement of fluid flow by means of pressure differential devices inserted in circular cross-section conduits running full — Part 1: General principles and requirements (ISO 5167-1)*

EN ISO 5167-2, *Measurement of fluid flow by means of pressure differential devices inserted in circular cross-section conduits running full — Part 2: Orifice plates (ISO 5167-2)*

EN ISO 5167-3, *Measurement of fluid flow by means of pressure differential devices inserted in circular cross-section conduits running full — Part 3: Nozzles and Venturi nozzles (ISO 5167-3)*

ISO 10294-3:1999, *Fire resistance tests — Fire dampers for air distribution systems — Part 3: Guidance on the test method*

EN ISO 13943, *Fire safety — Vocabulary (ISO 13943)*

ISO 5221, *Air distribution and air diffusion — Rules to methods of measuring air flow rate in an air handling duct*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 1363-1 and EN ISO 13943 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

single compartment smoke extraction ducts

ducts for use within single fire compartment application

3.2

suspension devices

components used for securing a duct to a load bearing structure

[SOURCE: EN 1366-8:2024, definition 3.4]

3.3

supporting construction

wall which the duct passes through in the test

3.4

single fire compartment

fire area of a single compartment building bounded by fire-resistant elements

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3.5

smoke zone (zone)

area into which a construction work is divided for the extraction of smoke and hot gases and served by a SHEVS (or sub-system of a SHEVS), which is initiated by a signal from a single or group of initiation devices associated with the zone

3.6

compensator

device used to prevent damage to the duct and/or the structural elements (horizontal or vertical) from the forces that are generated by the thermal expansion of the duct and/or its suspension devices

3.7

smoke and heat exhaust ventilation system

SHEVS

system consisting of products and/or components jointly selected to exhaust smoke and heat

Note 1 to entry: The products and/or components form a system in order to establish a buoyant layer of warm gases above cooler cleaner air

[SOURCE: EN 12101-7:2011, definition 3.8]

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4 Test equipment

4.1 General

In addition to the test equipment specified in EN 1363-1, the equipment in 4.2 to 4.4 is required. The overall test arrangement is shown in Figure 1. Details of instrumentation and other details are shown in Figures 2 to 10.

4.2 Furnace

The furnace shall be capable of subjecting smoke extraction ducts to the standard heating and pressure conditions specified in EN 1363-1 and be suitable for testing ducts in the horizontal orientation (see Figure 1).

4.3 Perforated plate

The perforated plate defines the under-pressure inside the duct by the air flow speed of 2 m/s in ambient conditions. Choose the perforated plate from Figure 2 or Figure 3 to suit the required pressure level according to Table 1. The plate shall be positioned (250 ± 50) mm from where the duct passes through the furnace wall, see Figure 1.

The plate shall be positioned (250 ± 50) mm from where the duct passes through the furnace wall (see Figures 1 and 2).

The plate shall be made from austenitic heat-resisting steel (grade number 1.4835 or 1.4828) in accordance with EN 10095 *Heat resisting steels and nickel alloys*. The number of holes and dimensions are given in the tables of Figure 2 and Figure 3. The thickness of the plates shall be $(2,5 \pm 0,5)$ mm.

The table in Figure 2 gives details of perforated plates for standard rectangular ducts of size 1 000 mm \times 250 mm. For smaller sizes, the number of holes will be reduced proportional to the smaller cross-section (a change to larger sizes is not permitted; see 6.1.2 and Table 3).

The table in Figure 3 gives details of perforated plates for standard circular ducts of diameter 560 mm. For smaller sizes, the number of holes will be reduced proportional to the cross-section (a change to larger sizes is not permitted; see 6.1.2 and Table 3).

Further details of the plate are shown in Figures 2, 3 and 4.

Table 1 — Differential pressures between inside and outside the duct for smoke extraction ductwork

Pressure level ^a	Operating differential pressure at ambient temperature Pa	Differential pressure for fire test and pre-test calibration Pa
1	-500	-150
2	-1 000	-300
3	-1 500	-500

^a See Clause 5.

4.4 Air velocity measuring station

The measuring station shall consist of one or two inlet nozzle(s), or other suitable device, installed in a straight length of pipe sized to EN ISO 5167-1. The temperature of the extracted hot gas shall be measured with a sheathed thermocouple type K according EN 60584-1, max. 3 mm in diameter. Its measuring junction shall be located no more than 1/4 of the pipe diameter away from the centre line of the pipe and at a maximum distance of $2 \times d$ of the pipe diameter downstream from the nozzle / device. The pipe between the nozzle(s)/device shall be insulated.

The measuring device shall be capable of measuring to an accuracy of 5 % when used in ambient conditions.

The measuring device shall be capable of measuring to an accuracy of 5 % when used in ambient conditions and shall be suitably connected to the end of the duct.

If the measuring device consist of a venturi, orifice plate and (where necessary) an airflow straightener, this shall be installed in straight lengths of pipe, all sized to EN ISO 5167-1, EN ISO 5167-2 and EN ISO 5167-3.

NOTE 1 For the standard sizes of ducts specified in 6.1, an internal dimension of diameter = 160 mm of each nozzle is suitable (Figure 10). Descriptions of similar nozzles are given in EN ISO 5167-3, EN ISO 5167-4 and ISO 5221.

NOTE 2 Suggestion to an inlet nozzles system for standard size ducts is shown in Figures 9 and 10. The calculation procedure is given in Annex A.

4.5 Ambient temperature leakage measuring device

The measuring device shall be capable of measuring to an accuracy of $\pm 2,5$ % and suitably mounted at the end of the duct, connected to appropriate differential pressure measuring equipment. Descriptions of possible measuring device are given in EN ISO 5167-1 and ISO 5221.

4.6 Pressure sensors for differential pressure control

A tube sensor as specified in EN 1363-1 shall be located at the end of the duct, inside the duct, at the level of its centre line. A second sensor (e.g. an open end of a measuring tube) shall be located on the same level outside the duct.

A flow control damper shall be provided for fine control for maintaining the required differential pressure. Alternatively, another suitable device such as a variable speed fan may be used. Any flow control damper shall be attached to the extract fan connecting duct (see 4.8).

4.7 Welded connecting tube

A fully welded duct designed to provide a gas tight connection between the inlet nozzles and the oxygen measuring probes, shall be provided.

One end of the duct is designed to connect between the test specimen and the extraction fan. An inlet opening may be provided if a flow control damper is used for fine control of the differential pressure. This is shown in Figure 6, item 13.

4.8 Extract fan connecting duct

An extract fan connecting duct is a duct designed to connect between the test specimen and the extraction fan. An inlet opening may be provided if a flow control damper is used for fine control of the differential pressure (see 4.6).

EN 1366-9:2024 (E)**4.9 Extraction fan**

An extraction fan is a fan for extracting gas under test with a suction capacity of at least $2 \times V_n$ where V_n is the required capacity, e.g. for a stated cross-section of $V_n = 0,25 \text{ m} \times 1 \text{ m}$, $2 \times V_n = 0,5 \text{ m}^3/\text{s}$.

The characteristic curves of the fan shall be horizontal for the actual airflow. The capacity of the fan shall not change by more than 10 % in the event of a drop in the pressure of up to 50 Pa.

4.10 Thermocouples

Sheathed thermocouples shall be used for measuring the gas temperature adjacent to the nozzles of nickel chromium/nickel aluminium type K wire as defined in EN 60584-1, with a nominal diameter of 1,5 mm to 3 mm. The thermocouples shall measure with an accuracy of $\pm 15 \text{ K}$. The position is shown in Figures 5 and 6, item 15.

4.11 Oxygen measuring equipment

The oxygen concentration at points G1 and G2 shall be measured using two separate systems consisting of O_2 analysers based on the paramagnetic measurement method and suitable equipment for cooling, filtering and drying the gases. Appropriate connecting tubes and probes shall be provided. The 90 % response time of the complete system shall be 20 s maximum. The accuracy shall be equal to or better than $\pm 0,1 \text{ Vol-\%}$.

4.12 Oxygen measurement probes

Steel probes for extracting the furnace gas from the inside of the duct at the locations G1 and G2 on Figure 5. The end of the probe shall be located in the centre point of the duct cross-section.

An alternative gas probe according to Figure 11 can be used.

Both types of gas probes are described in 9.3.

4.13 Restraint equipment

Restraining equipment shall be applied as for duct B in EN 1366-1.

4.14 Deflection measurements

Deflection measurements shall be taken for determining the reduction of internal cross-sectional area at ambient temperature and during the fire test. The measurement shall be done with an accuracy of $\pm 1 \text{ mm}$.

The interval between a complete set of measurements shall not exceed 15 min, in any case near prior to any classification time period.

NOTE Even if the deflection is measured outside the furnace, it reflects the behaviour of the cross-section of the duct.

5 Test conditions**5.1 Differential pressure conditions**

Depending on the end-use conditions, a pressure level from Table 1 shall be selected. These levels correspond to typical values used in smoke extraction design.

5.2 Heating and pressure conditions

The heating conditions and the furnace atmosphere shall conform to those specified in EN 1363-1 (or, if applicable, EN 1363-2) until $600 \text{ }^\circ\text{C}$ is reached. The mean temperature of the six furnace thermocouples