SLOVENSKI STANDARD
oSIST prEN 1366-9:2023

01-julij-2023

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: **prEN 1366-9**

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

oSIST prEN 1366-9:2023 **en,fr,de**

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

DRAFT
prEN 1366-9

April 2023

ICS 13.220.50

Will supersede EN 1366-9:2008

English Version

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

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

Feuerwiderstandsprüfungen für Installationen - Teil 9: Entrauchungsleitungen für einen Einzelabschnitt

This draft European Standard is submitted to CEN members for enquiry. It has been drawn up by the Technical Committee CEN/TC 127.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
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Ref. No. prEN 1366-9:2023 E

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European foreword

This document (prEN 1366-9:2023) has been prepared by Technical Committee CEN/TC 127 “Fire safety in buildings”, the secretariat of which is held by BSI.

This document is currently submitted to the CEN Enquiry.

This document will supersede 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-section area is added;

— Positions for measurement of deflection of cross-section outside furnace are defined;

— Introduction of an alternative oxygen sampling probe;

— Use of two separate O_2 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, without penetrating any wall/floor where fire resistance is required.

This document has been prepared under a Standardization Request given to CEN by the European Commission and the European Free Trade Association.

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*

— *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*

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.

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 (euro class A1 and A2-s1, d0).

It is applicable only to four sided and circular ducts. One-, two- and three-sided ducts are not covered. This standard 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 1363-2, *Fire resistance tests - Part 2: Alternative and additional procedures*

EN 1366-1, *Fire resistance tests for service installations - Part 1: 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 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 13943, *Fire safety - Vocabulary (ISO 13943)*

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.

3.1
single compartment smoke control system ducts
ducts for use within single fire compartment application

3.2
suspension devices
components used for suspending and fixing a duct from a floor soffit or supporting a duct from a wall

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

3.5
smoke zone (zones)
areas into which a construction work is divided for the extraction of smoke and hot gases and served by a SHEV (or sub-system of a SHEV), which is initiated by a signal from a single or group of initiation devices associated with the zone

3.6
compensator
device that is used within ducts to prevent damage from the forces generated by expansion

3.7
smoke and heat exhaust ventilation system
SHEVS
products and/or components jointly selected to exhaust smoke and heat in order to establish a buoyant layer of warm gases above cooler and cleaner air

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 controls the flow through the duct so that the required differential pressure, see Table 1, can be achieved. 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.

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) in accordance with EN 10095 *Heat resisting steels and nickel alloys*. The number of holes and dimensions are given in Tables 2 and 3. The thickness of the plates shall be (2,5 ± 0,5) mm.

Table 2 gives details of perforated plates for standard rectangular ducts of size 1 000 mm x 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 5).

Table 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 5).

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.		

Table 2 — Details of perforated plates for testing rectangular ducts (see Figure 2)

Specification for perforations	Pressure level [a]		
	1	2	3
Total number of holes	550	407	324
Number of holes - horizontally	50	37	36
Number of holes - vertically	11	11	9
Diameter of hole (mm)	10	10	10
Horizontal distance from rim e (mm)	15	15	20
Vertical distance from rim c (mm)	15	15	20
Mounting hole separation a (mm)	19,8	26,9	27,4
Mounting hole separation b (mm)	21,8	22	26,3
[a] See Clause 5.			

Table 3 — Details of perforated plate for testing circular ducts (see Figure 3)

Specification for perforations	Pressure level [a]		
	1	2	3
Total number of holes	541	403	319
Diameter of hole (mm)	10	10	10
Horizontal distance from rim e (mm)	20,8	22,2	27,5
Mounting hole separation a (mm)	20,8	22,2	27,5
[a] See Clause 5.			

4.4 Inlet nozzles (fire test)

Each nozzle shall have an internal dimension of 160 mm (see Figure 10, suitable for the standard sizes of ducts specified in 6.1) in accordance with EN ISO 5167-1 and shall be suitably mounted to the end of the duct with its piezometric ring connected to appropriate differential pressure measuring equipment. The measuring device shall be capable of measuring to an accuracy of ± 5 %.

NOTE Nozzles according to ISO 5221 are also suitable.

4.5 Ambient temperature leakage measuring device

The measuring device shall be capable of measuring to an accuracy of + 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 a 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 welded connecting tube is a tube designed to provide a suitable gas tight connection between the inlet nozzles and the oxygen measuring probes shall be provided (for details see Figure 6).

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).

4.9 Extraction fan

An extraction fan is a fan for extracting gas under test with a suction capacity of at least 2 x V_n where V_n is the required capacity, e.g. for a stated cross-section of V_n = 0,25 m x 1 m, 2 x V_n = 0,5 m³/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 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 ± 15 K. The position is shown in Figures 5 and 6, item 15.

4.11 Oxygen measuring equipment

Equipment for measuring the oxygen content of gases shall be provided. This system shall consist of two separate systems consisting of O_2 analysers based on paramagnetic cell measurement method together with appropriate 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 better than ± 0,1 vol %.

4.12 Oxygene 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-section area at ambient temperature and during the fire test. The measurement shall be done with an accuracy of ± 1 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 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 °C is reached. The mean temperature of the six furnace thermocouples shall reach 600 °C between 5 min to 10 min from igniting the first furnace burner. After 10 min this temperature shall be maintained with a tolerance of +70 °C and -0 °C for the rest of the test.

The furnace pressure shall be controlled to (15 ± 3) Pa throughout the test at the mid-height position of the duct in the furnace.

Details of test conditions within the duct during the test are given in Clause 10.

6 Test specimen

6.1 Size

6.1.1 Length

The minimum lengths of the parts of the test specimen inside and outside the furnace shall be as given in Table 4 (see also Figure 1).

Table 4 — Minimum length of test specimen

Orientation	Minimum length (m)	
	Inside furnace	Outside furnace
Horizontal	3,0	4,2

6.1.2 Cross-section

The sizes of duct given in Table 5 shall be tested unless smaller cross-sections are required for specific applications.

Table 5 — Cross-section of test specimen (standard size)

Rectangular		Circular
Width (mm)	Height (mm)	Diameter (mm)
1 000	250	560

6.2 Number

One test specimen shall be tested for each type of installation to be evaluated.

6.3 Design

The test shall be made on a test specimen representative of the complete duct. Each type of duct requires a different approach, and an attempt shall be made to reproduce the edge conditions and the method of fixing or support inside and outside the furnace representative of that used in practice. The distance between hangers or supports shall be representative. Where compensators are used in practice, then they shall be incorporated in the test specimen. In this case, the compensator shall be located outside the furnace, approximately 250 mm downstream from the perforated plate (see Figure 5).

7 Installation of test specimen

7.1 General

The test specimen shall be installed, as far as practicable, in a manner representative of its use in practice.

The fire-stopping at the penetration through the supporting construction shall be sufficient to prevent leakage of furnace gases.

Parts of the ducts within the furnace shall be exposed to fire from all sides over their whole length.

7.2 Supporting construction

As supporting construction to close the furnace shall be built from aerated concrete with a thickness of 150 mm.

7.3 Duct arrangement

7.3.1 A single duct may be tested in the furnace, or alternatively, two or more ducts may be tested in the same furnace, provided that there is sufficient furnace power and space to do so, in accordance with the dimensions shown in Figure 1.

7.3.2 Ducts shall be arranged as shown in Figure 1. The end of the ducts within the furnace shall be closed by materials and construction same as the duct itself.

7.3.3 The test arrangement shall include at least one joint inside the furnace and at least one joint outside it (see Figure 1). Any stiffeners used to maintain the cross-section of the duct shall be arranged at the positions and centres specified by the sponsor. The distance between joint and hangers shall not be less than intended in practice. If the minimum distance has not been specified, hangers shall be arranged so that the joint at mid-span lies midway between them. Centres of the hangers should be specified by the manufacturer and shall be representative of practice.

7.3.4 Two openings shall be provided, one on each vertical side of the duct inside the furnace. The openings shall be positioned (500 ± 25) mm from the end of the duct. Each opening shall have the same width/height ratio as the cross-section of the duct and have a total opening area of (50 ± 5) % of the cross-sectional area of the duct. For circular ducts, the openings shall be rectangular with a width/height ration of 4:1. The total area of the openings shall be 50 % ± 10 % of the internal cross-sectional area of the duct.

7.3.5 There shall be a clearance of (500 ± 50) mm between the top of the duct and the ceiling and at least 500 mm between the underside of the duct and the floor. Similarly, there shall be a clearance of at least 500 mm between the sides of the duct and furnace walls.

7.4 Restraint of ducts

7.4.1 Inside the furnace

All ducts shall be fully restrained in all directions at the furnace wall or floor remote from the penetration point. Where there is the possibility of the furnace wall moving then the fixings shall be made independently of the furnace structure.

7.4.2 Outside the furnace

The horizontal duct shall be restrained outside the furnace. The restraining point shall be located at a position (500 ± 50) mm from the end of the duct and shall provide restraint on movement in horizontal directions but shall allow movement in vertical directions (see Figure 7). The frame used to apply the restraint shall be rigid and have sufficient strength to resist all horizontal forces.

7.5 Perforated plate

The perforated plate shall be located (250 ± 50) mm from the external face of the supporting construction. Provision shall be made for the plate to be removed, if necessary during the pre-test calibration described in 10.1.

8 Conditioning

8.1 General

Conditioning of the test construction shall be in accordance with EN 1363-1.