SLOVENSKI STANDARD
oSIST prEN 1366-8:2023

01-julij-2023

Preskusi požarne odpornosti servisnih inštalacij – 8. del: Kanali za odvod dima

Fire resistance tests for service installations - Part 8: Smoke extraction ducts

Feuerwiderstandsprüfungen für Installationen - Teil 8: Entrauchungsleitungen

Essais de résistance au feu des installations techniques - Partie 8: Conduits d'extraction de fumées

Ta slovenski standard je istoveten z: **prEN 1366-8**

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 1366-8:2023 **en,fr,de**

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

DRAFT
prEN 1366-8

April 2023

ICS 13.220.50

Will supersede EN 1366-8:2004

English Version

Fire resistance tests for service installations - Part 8: Smoke extraction ducts

Essai de résistance au feu des installations de service - Partie 8: Conduits d'extraction de fumées

Feuerwiderstandsprüfungen für Installationen - Teil 8: Entrauchungsleitungen

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

If this draft becomes a European Standard, 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.

This draft European Standard was established by CEN 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 CEN-CENELEC Management Centre has the same status as the official versions.

CEN members are the national standards bodies of 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 United Kingdom.

Recipients of this draft are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

Warning : This document is not a European Standard. It is distributed for review and comments. It is subject to change without notice and shall not be referred to as a European Standard.

EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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

Ref. No. prEN 1366-8:2023 E

Contents

Page

European foreword

This document (prEN 1366-8:2023) 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 1366-8:2004.

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;

— failure criteria for mechanical stability of duct inside furnace defined.

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 document has been prepared because a method of test for fire resisting smoke extraction ducts has become necessary to evaluate the ability of fire resisting ducts already tested to EN 1366-1 to function adequately as smoke extraction ducts.

Leakage is measured at both ambient and elevated temperatures. 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 elevated temperatures, oxygen concentration measuring techniques are used.

The method described in this test is complex and requires sophisticated instrumentation. It is not recommended therefore to try to test multiple assemblies in this test.

The attention of all persons concerned with managing and carrying out this fire resistance test is drawn to the fact that fire testing can be hazardous and that there is a possibility that toxic and/or harmful smoke and gases might be evolved during the test. Mechanical and operational hazards might 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 document specifies a test method for determining the fire resistance of smoke extraction ducts. It is applicable only to smoke extraction ducts that pass through another fire compartment from the fire compartment to be extracted in case of fire. It represents fire exposure of a fully developed fire.

This method of test is only applicable to fire resistant ventilation ducts (same construction) with the following classification according to EN 13501-3:

— fire from inside and outside i ↔ o;

— applicable to a pressure difference up to 500 Pa;

NOTE 1 It is assumed that the duct A test(s) in accordance with EN 1366-1 has been performed with an under-pressure of minimum 500 Pa.

— with integrity (E) and insulation (I) criteria equal to or higher than the intended classification for the smoke extraction duct.

For the purposes of the test described in this document, the duct is referred to as duct C.

This test method has been designed to cover both vertical and horizontal smoke extraction ducts. A vertical system need not be evaluated to this method provided that:

— both horizontal (ho) and vertical (ve) classification according to EN 13501-3 has been obtained for the ventilation duct, and

— it has been tested in a horizontal orientation to this method.

If the ventilation duct in practice is only used for vertical applications in smoke extraction systems, only vertical (ve) classification is bound to be used and tested in a vertical orientation to this method according to EN 13501-3.

This test method is suitable for ducts constructed from non-combustible materials (Euroclass A1 and A2 according to EN 13501-1).

NOTE 2 Reaction with components of the duct can reduce the oxygen concentration and lead to misinterpretation of the calculated leakage rate.

This standard applies to four sided ducts only (with fire exposure on all four sides). Ducts that utilize elements of construction for one, two or three sides are not covered. An alternative test method for one, two and three sided ducts will be developed separately.

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 10095, *Heat resisting steels and nickel alloys*

EN 13501-3, *Fire classification of construction products and building elements - Part 3: Classification using data from fire resistance tests on products and elements used in building service installations: fire resisting ducts and fire dampers*

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 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.

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

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

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

3.1
smoke extraction duct
fire resistant duct used for the extraction of smoke in case of fire

3.2
fire-resistant ventilation duct
duct used for the distribution or extraction of air and designed to provide a degree of fire resistance

[SOURCE: EN 1366-1:2014+A1:2020, definition 3.1]

3.3
self-supporting duct
duct constructed from fire-protective boards, without encasing a steel duct

[SOURCE: EN 1366-1:2014+A1:2020, definition 3.3]

3.4
suspension devices
components used for securing a duct to a load bearing structure

3.5
supporting construction
wall, partition or floor through which the duct passes in the test

[SOURCE: EN 1366-1:2014+A1:2020, definition 3.5]

3.6
compensator
device used to prevent damage to the duct, the penetration seal 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
access panel
cover for an inspection opening within the duct

[SOURCE: EN 1366-1:2014+A1:2020, definition 3.7]

3.8
fire protected steel duct
steel duct with an external insulation to provide fire resistance

[SOURCE: EN 1366-1:2014+A1:2020, definition 3.8]

3.9
internal surface area with under-pressure
surface area of the duct from the perforated plate to the end of the duct by the inlet nozzles including the endplate where the nozzles are positioned and excluding the surface of the perforated plate

3.10
total internal surface area
full internal area of the duct including both end plates

4 Test equipment

4.1 General

In addition to the test equipment specified in EN 1363-1, the following is required:

4.2 Furnace

This 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 (see Figure 1) or vertical (see Figure 2) orientation.

It is required that the construction of furnace shall allow observation of at least 75 % of the test specimen.

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 3 or Figure 4 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 or roof, 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 Figures 3 and 4. The thickness of the plates shall be 2,5 ± 0,5 mm.

NOTE 1 The table in Figure 3 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.

NOTE 2 The table in Figure 4 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 6.1.3 and Table 3).

Further details of the plate are shown in Figures 3, 4 and 5.

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

Pressure level	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

4.4 Inlet nozzles

The measuring device shall be capable of measuring to an accuracy of + 5 % when used in cold conditions and shall be suitably mounted to the end of the duct with its piezometric ring connected to appropriate differential pressure measuring equipment

NOTE 1 For the standard sizes of ducts specified in 7.1, an internal dimension of diameter = 160 mm of each nozzle is suitable (cf. Figure 7). 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 6 and 7. 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 ±2,5 % and suitably mounted at the end of the duct, connected to appropriate differential pressure measuring equipment.

NOTE Descriptions of possible measuring devices are given in the EN ISO 5167 series 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. As an alternative to this tube sensor, a piezometric ring can be used. An example for the piezometric ring is shown in Figure 7, item 4.

A second sensor (e.g. an open end of a measuring tube) shall be located on the same level outside the duct. This is shown in Figures 6 and 7 as pressure sensor D1.

4.7 Welded connecting duct

A duct tightly welded, which is designed to provide a suitable 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 7, item 7.

4.8 Extraction fan

A fan for extracting gas under the fire test with a suggested capacity of at least 2 x Vn where Vn is the required capacity calculated by multiplying the air speed (2 m/s) by the height and width of the duct, e.g. for the rectangular duct described in 6.1.3 with cross section of 1 m x 0,25 m:

Vn = 2 m/s x 1,0 m x 0,25 m = 0,5 m^3/s

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

4.9 Thermocouples

Sheathed thermocouples shall be provided 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 6 and 7, item 6.

4.10 Surface thermocouples

Surface thermocouples for measuring surface temperature of the type specified in EN 1363-1 and at the locations specified in EN 1366-1 shall be used.

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 ± 0,1 Vol-%.

4.12 Oxygen measurement probes

Gas probes made of stainless steel shall be provided for extracting the furnace gas from the inside of the duct at the locations G1 and G2 in Figure 6. The end of the probe shall be located in the centre point of the duct cross section.

An alternative gas probe according to Figure 14 can be used.

Both types of gas probes are described in 9.3.

4.13 Restraining 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 ± 1mm.

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

5 Test conditions

The heating conditions and the furnace atmosphere shall conform to those given in EN 1363-1.

The furnace pressure shall be controlled to Δp = 15 Pa throughout the test at the mid-height position of the horizontal ducts. For vertical ducts the furnace pressure shall be controlled to Δp = 20 Pa at a distance of 100 mm below the ceiling. The tolerance of the pressure differential is given in EN 1363-1.

Details of test conditions within the ducts during the test are given in Clause 11.

6 Test specimen

6.1 Size

6.1.1 General

For duct specimens of sizes other than those given in Table 3, the field of direct application is restricted (see Clause 13).

6.1.2 Length

The minimum lengths of the parts of the test specimen inside and outside the furnace shall be as given in Table 2 (see also Figures 3 and 9).

Table 2 — Minimum length of test specimen

Orientation	Minimum length (m)	
	Inside furnace	Outside furnace
Horizontal	3,0	4,2
Vertical	2,0	4,25

6.1.3 Cross-section

The standard sizes of ducts given in Table 3 shall be tested unless only smaller cross-sections are used:

Table 3 — Internal cross-section of test specimen (dimension of the open cross-section)

Rectangular		Circular
Width (mm)	Height (mm)	Diameter (mm)
1 000 ± 10	250 ± 10	560 ± 10

6.2 Number

A minimum of one test specimen shall be tested. For horizontal and vertical installation, see 13.2.

6.3 Design

6.3.1 General

The test shall be made on a test specimen representative of the complete duct assembly, including integral or intended insulation on which information is required. Each type of duct requires a different approach and the laboratory shall as far as practical reproduce the edge conditions and the method of fixing or support inside and outside the furnace to that representative of that used in practice. The distance between the suspension devices and the distance between suspension devices and the separating element shall be representative of the intended application as they are an integral part of the tested system. It should be as far as is reasonably practicable the same arrangement as (or within DIAP and/or EXAP rules) complimentary to the system tested in EN 1366-1 for the same duct.

6.3.2 Openings in duct

Two openings equal in size shall be provided, one on each vertical side of the duct inside the furnace. For horizontal ducts the openings shall be positioned (500 ± 25) mm from the end of the duct inside the furnace (see Figure 1). For vertical ducts the openings shall be positioned (200 ± 10) mm below the furnace roof (see Figure 2).

In both vertical and horizontal ducts, clear openings shall have the same width/height ratio as the cross-section 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. Framing of the openings shall be as in practise (to avoid weakening the duct walls in the area around the openings).

6.3.3 Joints in horizontal ducts

The test configuration shall include at least one joint inside the furnace and at least one joint outside it. There shall be at least one joint in every layer of fire protection material (if applicable), both inside and outside the furnace and in any steel duct.

Outside the furnace, the joint in the outer layer of the fire protection material shall be no further than 700 mm from the supporting construction and no nearer than 100 mm to thermocouples T2. Inside the furnace, the joint in the outer layer of fire protection material shall be located at approximately mid-span.

The distance between joints and suspension devices shall not be less than that used in practice. If the minimum distance has not been specified, suspension devices shall be arranged so that the joint of the outermost layer at the bottom of the insulation material (if no insulation material is present: joint of the steel duct) lies midway between them. Centres of the suspension devices shall be specified by the manufacturer and shall be representative of practice.

6.3.4 Joints in vertical ducts

The test configuration shall include at least one joint inside and one joint outside it.

There shall be at least one joint for every layer of fire protection material, both inside and outside the furnace and in any steel duct.

Outside the furnace, the joint in the outer layer of the fire protection material shall be no further than 700 mm from the supporting construction and no nearer than 100 mm to thermocouples T2. Inside the furnace, the joint in the outer layer of fire protection material shall be located at approximately mid-span.

6.3.5 Support for vertical ducts

Vertical ducts shall be supported on the furnace floor and penetrate through the supporting construction (see Figure 2); the ducts shall be fixed at the level of the supporting construction as they would be fixed in practice when penetrating a floor. This shall be as specified by the sponsor.

6.3.6 Compensators

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 500 mm from the perforated plate.

6.3.7 Access panels

Where access panels are used in practice then they shall be incorporated in the test specimen. In this case the access panels shall be located outside the furnace approximately 500 mm downstream from the perforated plate. In cases where compensator and access panel are included in one test specimen, the placement of the compensator takes precedence (access panel shall be located (300 ± 50) mm from the end of the compensator or in the next section downstream).

In cases where access panel are included in the test specimen causing conflicts with the joints in the different layers of the duct, the placement of the joints takes precedence. In that case move the access panel further downstream.

7 Installation of test specimen

7.1 General

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

The supporting construction selected shall be a wall, partition or floor either selected from the standard supporting constructions in 8.2 or of the type to be used in practice which shall have a classified fire resistance equal or greater than the intended fire resistance of the duct being tested.

Where the duct passes through an opening in the furnace wall or roof, then the opening shall be of sufficient dimensions to allow for the supporting construction to surround all faces of the duct by at least 200 mm in case of rigid supporting constructions.

In case of flexible supporting walls, the flexible walls shall have minimum dimensions of 2 500 mm x 2 500 mm and have one fixed and one free vertical edge (for free edge cf. EN 1364-1:2015, 6.3.2). The horizontal clear spacing between the outer edge of the penetration and the free edge of the flexible supporting construction shall be (500 ± 50) mm. The clear vertical spacing between the top of the flexible supporting construction and the top of the outer edge of the penetration shall be at least 500 mm.

Ducts shall be arranged as shown in Figures 1 and 2. The end of the duct within the furnace shall be closed independently of any furnace enclosure by materials and construction similar to the remainder of the duct.

7.2 Standard supporting construction

A standard supporting construction shall be selected from the specifications detailed in EN 1366-1. Where the duct passes through an opening in the furnace wall, then the opening shall be of sufficient dimensions to allow for the supporting construction to surround all faces of the duct by at least 200 mm from the duct or the outside edge of any fire stopping.

To ensure that leaking furnace gas does not affect the duct leakage measurement it is important that the all gaps between test specimen, supporting construction and all parts of the furnace are well sealed.

7.3 Restraint of ducts

7.3.1 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.

7.3.2 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 8). The frame used to apply the restraint shall be rigid and have sufficient strength to resist all horizontal forces.

Vertical ducts shall be unrestrained outside the furnace. For test purposes the horizontal movement of the top edge of the vertical duct shall be prevented.

8 Conditioning

8.1 General

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

8.2 Water-based sealing materials

Water-based materials (e.g. mortar, concrete …) used to seal the gap between the supporting construction and the duct where the gap is ≤ 25 mm wide shall be conditioned for at least seven days before fire testing.

Water-based materials used to seal the gap between the supporting construction and the duct assembly where the gap is > 25 mm wide shall be conditioned for at least 28 days before fire testing.

9 Application of instrumentation

9.1 Thermocouples

9.1.1 Furnace thermocouples (plate thermometers)

Plate thermometers shall be provided in accordance with EN 1363-1 and shall be positioned as shown in Figures 9 (horizontal ducts) and 10 (vertical ducts).

For all ducts the plate thermometers shall be oriented so that side A faces the walls of the furnace opposite the duct being evaluated.

9.1.2 Unexposed surface thermocouples

Guidance on thermocouples at the point of penetration of the duct through the wall or floor is shown in EN 1366-1 for typical penetration details. Examples are given in Figures 11 to 13.

The application of the thermocouples is optional for the manufacturer to request them. They will not be used for classification.

9.1.3 Measurement of gas temperature adjacent to nozzles

The gas temperature adjacent to the nozzles shall be measured with the thermocouples arranged pointing downwards to allow for draining moisture. The thermocouple measuring junction shall be located at the centre line of each nozzle and at a distance equal to twice the diameter of the measuring duct downstream from the entrance to the flow measuring device shown on Figure 6 and item 6 in Figure 7.

9.2 Pressure

9.2.1 Furnace pressure

Furnace pressure shall be measured in accordance with Clause 6.

9.2.2 Under-pressure in duct

For measurement of the differential pressure between the inside and outside of the of duct, the pressure sensor shall be located horizontally 50 mm from the end of the duct in level with the centre line of the inlet nozzles as shown in Figures 6 and 7 as item no. D1 (pressure sensor in accordance with 4.6 or alternatively a four-point-measurement –piezometric-ring).