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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

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

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

Feuerwiderstandsprüfungen für Installationen - Teil 8: Entrauchungsleitungen

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

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COMITÉ EUROPÉEN DE NORMALISATION
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European foreword

This document (EN 1366-8:2024) 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of an identical text or by endorsement, at the latest by April 2025, and conflicting national standards shall be withdrawn at the latest by April 2025.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 1366-8:2004.

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

— method for determination of reduction in internal cross-sectional 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;

— accuracy of ambient leakage measuring device revised from ±5 % to ±2,5 %;

— standard for gas temperature thermocouples added;

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

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;*

— *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.*

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.

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.

CAUTION — 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 apart from the compartment from where smoke needs 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 in fire conditions;

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;

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

If the ventilation duct in practise is only used for vertical applications in smoke extraction systems, only vertical (ve) classification is obtained in accordance with EN 13501-3 and tested only in a vertical orientation to this test method.

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

NOTE 2 Reaction with components of the duct can affect the oxygen concentration inside the duct leading to inaccurate calculation of the leakage rate. If it is determined this has happened refer to Annex D.

This document applies to four sided rectangular and circular ducts only (with fire exposure on all 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 60584-1, *Thermocouples — Part 1: EMF specifications and tolerances (IEC 60584-1)*

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

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)*

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
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 e.g. 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 × 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 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 × 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 7.1, an internal dimension of diameter = 160 mm of each nozzle is suitable (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 (D1, see Figures 6 and 7). 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 as pressure probe in laboratory D2.

4.7 Welded connecting duct

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 7, item 7.

4.8 Extraction fan

A fan for extracting gas under the fire test with a suggested capacity of at least 2 × 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 × 0,25 m:

$$Vn = 2\ m/s \times 1{,}0\ m \times 0{,}25\ m = 0{,}5\ m^3/s$$

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.