

Fire resistance tests for service installations —

Part 8: Smoke extraction ducts

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National foreword

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Partie 8: Conduits d'extraction de fumées

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Foreword

This document (EN 1366-8:2004) 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of an identical text or by endorsement, at the latest by January 2005, and conflicting national standards shall be withdrawn at the latest by January 2005.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of the Construction Products Directive.

EN 1366 '*Fire resistance tests for service installations*' consists of the following Parts:

Part 1: Ducts

Part 2: Fire dampers

Part 3: Penetration seals

Part 4: Linear joint seals (in course of preparation)

Part 5: Service ducts and shafts

Part 6: Raised access and hollow core floors (in course of preparation)

Part 7: Conveyor systems and their closures

Part 8: Smoke extraction ducts

Part 9: Single compartment smoke extraction ducts (in course of preparation)

Part 10: Smoke control dampers (in course of preparation)

Part 11: Fire protective systems for essential services (in course of preparation).

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

Introduction

This Part of 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 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 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 shall 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 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 resisting ducts that have passed the test for the appropriate period to EN 1366-1 (ducts A and B). For duct A, it is a requirement for fire resisting smoke extraction ducts that the document under pressure of 300 Pa, as given in EN 1366-1 is increased to 500 Pa when testing to EN 1366-1. For the purposes of the test described in this document, the duct is referred to as duct C.

This test has been designed to cover both vertical and horizontal smoke extraction ducts. However, provided both horizontal and vertical tests have been carried out to EN 1366-1 on the specific system, a vertical system need not be evaluated to this method provided it has been tested in a horizontal orientation to this method. However, if the system in practice is only to be used for vertical applications in smoke extraction systems, then it will need to be tested in a vertical orientation to this method.

This method of test is only suitable for ducts constructed from non-combustible materials (Euroclass A1 and A2).

It is applicable only to four sided ducts; one, two and three sided ducts are not covered.

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 1363-1:1999, *Fire resistance tests - Part 1: General requirements*

EN 1366-1:1999, *Fire resistance tests for service installations - Part 1: Ducts*

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

EN ISO 5167, *Measurement of fluid flow by means of pressure differential devices inserted in circular cross-section conduits running full (ISO 5167-1:2003)*.

EN ISO 13943:2000, *Fire safety – Vocabulary (ISO 13943:2000)*.

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 1363-1:1999 and EN ISO 13943:2000 and the following apply.

3.1

smoke extraction duct

duct used for the extraction of smoke in case of fire and designed to provide a degree of fire resistance

3.2

suspension devices

components used for suspending and fixing a duct from a floor or supporting a duct from a wall

3.3

supporting construction

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

3.4

compensator

device that is used to prevent damage from the forces generated by expansion (see EN 1366-1 for guidance)

4 Test equipment

4.1 General

In addition to the test equipment specified in EN 1363-1, the equipment in 4.2 to 4.14 is required. The overall test arrangement is shown in Figures 1 and 2. Details of instrumentation and other details are shown in Figures 3 to 13.

4.2 Furnace

The furnace shall be capable of subjecting fire resisting 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.

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 or roof, see Figures 1 and 2.

The plates shall be made from heat resisting steel, 19 % min. Cr content and 11 % min. Ni content. The number of holes and dimensions are given in Tables 2 and 3. The thickness of the plates shall be 2,5 mm.

NOTE 1 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.

NOTE 2 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 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	Differential pressure for fire test and pre-test calibration
	Pa	Pa
1	-500	-150
2	-1 000	-300
3	-1 500	-500

Table 2 — Details of perforated plates for testing rectangular ducts (see Figure 3)

Specification for perforations	Pressure level		
	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

Table 3 — Details of perforated plate for testing circular ducts (see Figure 4)

Specification for perforations	Pressure level		
	1	2	3
Total number of holes	541	403	319
Diameter of hole (mm)	10	10	10
Distance from rim e (mm)	30	35	35
Mounting hole separation a (mm)	20,8	22,2	27,5
Mounting hole separation b (mm)	20,8	22,2	27,5

4.4 Inlet nozzles

Each nozzle shall have an internal dimension of 160 mm (suitable for the standard sizes of ducts specified in 6.1), in accordance with EN ISO 5167 and ISO 5221, 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 $\pm 5\%$.

4.5 Ambient temperature leakage measuring device

The ambient temperature leakage measuring device shall be in accordance with EN ISO 5167 and ISO 5221 or another suitable device, and suitably mounted at the end of the duct, connected to appropriate differential pressure measuring equipment. The measuring device shall be capable of measuring to an accuracy of $\pm 5\%$.

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 variable speed fan may be used. Any flow control damper shall be attached to the extraction fan connecting duct (see 4.8).

4.7 Welded connecting tube

A welded connecting tube, which is a tube designed to provide a suitable gas tight connection between the inlet nozzles and the oxygen measuring probes, shall be provided.

4.8 Extraction fan connecting duct

An extraction 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 $2 \times V_n$ where V_n 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 6.1.2 with cross section of 1 m x 0,25 m:

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

The characteristic curves of the fan shall be horizontal for the actual air flow. 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

1,5 mm sheathed thermocouples shall be provided for measuring the gas temperature adjacent to the nozzles. An alternative thermocouple may be used, provided it can be shown to have equivalent response time.

4.11 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.

4.12 Oxygen measuring equipment

Equipment for measuring the oxygen content of gases shall be provided. This system shall consist of paramagnetic cell oxygen analysers 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 equal to or better than $\pm 0,1$ %.

4.13 Restraining equipment

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

4.14 Observation window

An observation window shall be provided between the two nozzles and a suitable method of viewing from a safe distance be provided (a mirror arrangement may be found suitable).

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 (15 ± 3) Pa throughout the test at the mid-height position of the ducts 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 Figures 3 and 9).

Table 4 — Minimum length of test specimen

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