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Fire resistance tests for service installations - Part 1: Ventilation ducts

Feuerwiderstandsprüfungen für Installationen - Teil 1: Lüftungsleitungen

Essais de résistance au feu des installations techniques - Partie 1: Conduits de ventilation

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91.060.40	Dimniki, jaški, kanali	Chimneys, shafts, ducts

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Fire resistance tests for service installations - Part 1: Ventilation ducts

Essais de résistance au feu des installations techniques - Partie 1: Conduits de ventilation

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This European Standard was approved by CEN on 13 June 2014 and includes Amendment approved by CEN on 1 June 2020.

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European foreword

This document (EN 1366-1:2014+A1:2020) 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of an identical text or by endorsement, at the latest by February 2021 and conflicting national standards shall be withdrawn at the latest by February 2021.

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 includes Amendment 1 approved by CEN on 1 June 2020.

This document supersedes ▌A1⟩ EN 1366-1:2014 ⟨A1▌.

The start and finish of text introduced or altered by amendment is indicated in the text by tags ▌A1⟩ ⟨A1▌.

▌A1⟩ This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association. ⟨A1▌

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

— *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 floors;*

— ▌A1⟩ *Part 7: Conveyor systems and their closures;* ⟨A1▌

— *Part 8: Smoke extraction ducts;*

— *Part 9: Single compartment smoke extraction ducts;*

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

— *Part 11: Protective Systems for Essential Services (in course of preparation);*

— *Part 12: Non-mechanical fire barrier for ventilation ductwork;*

— ▌A1⟩ *Part 13: Chimneys.* ⟨A1▌

▌A1⟩ *deleted text* ⟨A1▌

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Introduction

The purpose of this test is to measure the ability of a representative ventilation duct assembly / system that is part of an air distribution system to resist the spread of fire from one fire compartment to another with fire attack from inside or outside the duct. It is applicable to vertical and horizontal ducts, with or without branches, taking into account joints and openings, as well as suspension devices and penetration points.

The test measures the length of time for which ducts, of specified dimensions, suspended as they would be in practice, satisfy defined criteria when exposed to fire from (separately) both inside and outside the duct.

The closed end of each horizontal duct at the back of the furnace is fully restraint. Outside the furnace, ducts exposed to fire from the outside are tested unrestrained, while ducts exposed to fire from the inside (horizontal only) are tested restrained.

The force measurement at horizontal duct B is not mandatory but can be done on the request of the sponsor.

The test takes into account the effect of fire exposure from the outside where a pressure differential is maintained in the duct as well as the effect of fire entering the ducts in conditions where forced air movement may or may not be present.

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 European Standard specifies a method for determining the fire resistance of vertical and horizontal ventilation ducts including those access panels, which are integral part of the tested ducts. The test examines the behaviour of ducts exposed to fire from the outside (duct A) and fire inside the duct (duct B). This European Standard is used in conjunction with EN 1363-1.

Annex A provides general guidance and gives background information.

This European Standard is not applicable to:

a) ducts whose fire resistance depends on the fire resistance performance of a ceiling or wall (where ducts are located in cavities enclosed by fire-resistant shafts or ceilings);

b) ducts containing fire dampers at points where they pass through fire separations;

c) one, two or three sided ducts;

d) fixing of suspension devices (e.g. anchors) to floors or walls.

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 1364-1:1999, *Fire resistance tests for non-loadbearing elements - Part 1: Walls*

EN 1366-8, *Fire resistance tests for service installations - Part 8: Smoke extraction 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 15882-1, *Extended application of results from fire resistance tests for service installations - Part 1: Ducts*

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

EN ISO 898-1, *Mechanical properties of fasteners made of carbon steel and alloy steel - Part 1: Bolts, screws and studs with specified property classes - Coarse thread and fine pitch thread (ISO 898-1)*

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)*

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

3 Terms and definitions

For the purposes of document, the terms and definitions given in EN 1363-1 and EN ISO 13943, together with the following, apply.

3.1
fire-resistant ventilation duct
duct used for the distribution or extraction of air and designed to provide a degree of fire resistance

3.2
combustible lining
lining / coating on the inner surface of the duct; reaction to fire classification of the lining material (tested in end use condition, treated as an external, non-substantial component) worse than class A2-s1,d0 according to EN 13501-1

3.3
self-supporting duct
duct constructed e.g. from fire-protective boards without encasing a steel duct

3.4
suspension devices
components used for suspending and fixing a duct from a floor or supporting a duct from a wall

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

3.6
compensator
device used to prevent damage from the forces generated by expansion

3.7
access panel
cover for an inspection opening within the duct

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

〚A1〛 **3.9**
kitchen extract duct
ductwork where combustible deposits, such as grease are likely to accumulate on its internal surfaces 〚A1〛

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 ventilation ducts to the standard heating and pressure conditions specified in EN 1363-1 and be suitable for testing ducts in the vertical (see Figure 1) or horizontal (see Figure 2) orientation.

4.3 Fan for duct A

This shall be able to produce at the start and throughout the test an underpressure of (300 ± 15) Pa within duct A (see Figure 4) and shall be connected either directly, or by a suitable length of flexible ducting, to the measuring station described in 4.5.

If the duct is used in practise as a smoke extraction duct, the duct shall be tested in accordance with EN 1366-8. In this case, fan A shall be adjusted to (500 ± 15) Pa for testing duct a according to this standard.

4.4 Fan for duct B

This shall be able to produce an air velocity when extracting gas from duct B (see Figure 5), of at least 3m/s measured at ambient temperature in the duct before the test. It shall be connected either directly, or by a suitable length of flexible ducting, to the air velocity measuring station described in 4.8. The fan shall be provided with a by-pass vent that can be opened prior to the damper described in 4.7 being shut.

4.5 Volume flow measuring station

This shall consist of a venturi, orifice plate, or other suitable device and (where necessary) an airflow straightener, installed in straight lengths of pipe, all sized to EN ISO 5167-1, EN ISO 5167-2 and EN ISO 5167-3. It shall be connected to the end of the condensing unit to determine the volume flow rate of gas passing through duct A during the test. The measuring device shall be capable of measuring to an accuracy of ± 5 %. Regardless of whether vertical or horizontal ducts are being tested, the volume flow measuring station shall always be used in a horizontal orientation.

4.6 Condensing unit

This shall be installed between the end of duct A and the flow-measuring device and shall allow for sufficient drainage. The gas temperature adjacent to the flow-measuring device shall be measured by sheathed thermocouple, type K according to EN 60584-1, max. 2 mm in diameter, with an insulated hot junction, arranged pointing upwards to allow for draining moisture. Its measuring junction shall be located at the centre line of the measuring tube and at a distance equal to twice the diameter of the measuring tube downstream from the flow-measuring device. The temperature measured by this thermocouple shall not exceed 40 °C.

4.7 Damper

This shall be installed between the fan and the air velocity measuring station to shut off the airflow in duct B during evaluation of integrity in the "fan-off" condition.

4.8 Air velocity measuring station

This shall determine air velocity in duct B and 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, EN ISO 5167-2 and EN ISO 5167-3, connected to the end of both the vertical and horizontal duct B outside the furnace. The temperature of the extracted hot gas shall be measured with a sheathed thermocouple type K according to EN 60584-1, max. 2 mm in diameter, with an insulated hot junction, arranged pointing upwards to allow for draining moisture. Its measuring junction shall be located at the centre line of the pipe and at a

maximum distance of 100 mm downstream from the flange. If larger distance is necessary, the pipe between flange and measuring point shall be insulated.

4.9 Equipment for measuring gas pressure

This shall be provided in the laboratory, in the furnace and inside duct A. The measuring equipment for measuring pressures differentials between duct A and the laboratory shall be provided with an accuracy of ± 5 % relative to the intended pressure difference, i.e. 300 or 500 Pa.

4.10 Thermal expansion/contraction measuring device

This shall be provided for measuring longitudinal expansion/contraction of duct A and shall have an accuracy of ± 1 mm.

This measurement shall be at (400 ± 50) mm from the unexposed surface of the supporting construction (knowing that elongation outside the furnace will not be taken into account).

Any interference between thermocouples and the measurement of expansion/contraction should be avoided; in case of any such interference, placement of thermocouples takes precedence. The result of the expansion/contraction is not taken into account for classification, but for information of the test sponsor.

4.11 Force measuring device

If the sponsor requests the force measurement, the appropriate measuring device shall be installed at the point of applying restraint in duct B according to Figure 18.

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

If horizontal ducts A and B are tested one above the other, duct B should be at the lowest position (see Figure 8) and the furnace pressure shall be controlled to (15 ± 3) Pa at the mid height of duct B.

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

6 Test specimen

6.1 Size

6.1.1 General

For duct specimens of sizes other than those given in Table 2, 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 1 (see also Figures 1 and 2):

Table 1 — Minimum length of test specimen

Orientation	Minimum length (m)	
	Inside furnace	Outside furnace
Horizontal	4,0	2,5
Vertical	2,0	2,0

6.1.3 Cross-section

The standard sizes of ducts given in Table 2 shall be tested unless only smaller cross-sections are used:

Table 2 — Internal cross-section of test specimen (dimension of the open cross-section)

Duct	Rectangular		Circular
	Width (mm)	Height (mm)	Diameter (mm)
A	1000 ± 10	500 ± 10	800 ± 10
B	1000 ± 10	250 ± 10	630 ± 10

6.2 Number of tests

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

6.3 Design

6.3.1 General

The test shall be made on a test specimen representative of the complete duct assembly on which information is required. The method of duct construction, support and penetration shall be representative of that used in practice.

Ducts shall be arranged as shown in Figures 1, 2 and 3.

6.3.2 Minimum distance between the ducts and between ducts and furnace walls

There is no limit to the number of ducts that may be tested simultaneously in the same furnace, provided that there is sufficient space to do so, in accordance with the dimensions shown in Figures 1, 2 and 3.

There shall be a minimum clear spacing of 500 mm between the top of a horizontal duct and the ceiling. A minimum clear spacing of 500 mm shall be provided between the underside of a horizontal duct and the floor. Similarly, there shall be a minimum clear spacing of at least 500 mm between either the adjacent duct or furnace wall. The minimum clear spacing between the branch of duct A and either the adjacent duct or furnace wall shall be 250 mm.

6.3.3 Configuration of duct A (horizontal only)

The horizontal duct A shall include one bend, a T-piece and a 500 mm long length of duct to form a short branch duct having a cross-section of 250 mm x 250 mm for rectangular ducts (Ø 250 mm for circular ducts), and shall be arranged as shown in Figures 2 and 3. All specimens including this branch shall be mounted with the suspension or fixing devices as used in practice.

NOTE Figure 14 is an example for a sectional bend.

6.3.4 Openings in duct B

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 Figures 2 and 3). For vertical ducts the openings shall be positioned (200 ± 10) mm below the furnace roof (see Figure 1).

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).

6.3.5 Access panel

If an access panel is to be tested in a horizontal duct, it shall be mounted in the first straight duct piece after the T-piece (duct A) resp. the first straight duct piece after the penetration of the supporting construction (duct B) (see Figures 1 to 3). The access panel shall be located in the underside of the duct.

If an access panel is to be tested in a vertical duct, the nearest edge shall be positioned (200 ± 10) mm below the supporting construction (duct A), resp. in the first duct piece after the penetration of the supporting construction (duct B). The access panel shall be located in the widest side of the duct.

Any interference between thermocouples and the access panel should be avoided; in case of any such interference, placement of thermocouples takes precedence.

6.3.6 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 T_2. 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.

6.3.7 Joints in vertical ducts

The test configuration shall include at least one joint inside and one joint outside it (see Figure 1).

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 T_2. Inside the furnace, the joint in the outer layer of fire protection material shall be located at approximately mid-span.

6.3.8 Support for vertical ducts

Vertical ducts shall be supported on the furnace floor and penetrate through the supporting construction (see Figure 1); 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.

6.3.9 Compensators

If compensators are required in practice, they shall be incorporated in the test specimen. The compensator shall be located within the furnace for duct A, and for duct B outside the furnace approximately 1000 mm from the wall or floor. 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).

On request of the sponsor, an additional compensator may be located in duct B inside the furnace (1000 mm away from the supporting construction).

6.3.10 Steel ducts

Where steel ducts are used, the sponsor of the test shall provide the laboratory with evidence of the leakage class in accordance with EN 1507 or EN 12237.

6.3.11 Hangers

When protected hangers are used for the test, they shall be insulated over their complete length.

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 7.2 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 2500 mm x 2500 mm and have one fixed and one free vertical edge (for free edge see EN 1364-1:1999, 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 (see also Figure 15)

7.2 Standard supporting construction

Where the type of supporting construction to be used in practice is not known then one of the standard supporting constructions in Tables 3 and 4 or as described in the text below shall be used.

Table 3 — Standard rigid wall constructions

Type of construction	Thickness mm	Density kg/m³	Test duration *t* h
Normal concrete/ masonry	110 ± 10 150 ± 10 175 ± 10	2200 ± 200 2200 ± 200 2200 ± 200	$t \leq 2$ $2 < t \leq 3$ $3 < t \leq 4$
Aerated concrete[a)]	110 ± 10 150 ± 10	650 ± 200 650 ± 200	$t \leq 2$ $2 < t \leq 4$
[a)] This supporting construction may be made from blocks, bonded together with mortar or adhesive.			

A standard flexible wall construction shall be selected from the specifications as described in detail in EN 1363-1.

Table 4 — Standard floor constructions

Type of construction	Thickness mm	Density kg/m³	Test duration *t* h
Normal concrete	110 ± 10 150 ± 10 175 ± 10	2200 ± 200 2200 ± 200 2200 ± 200	$t \leq 1{,}5$ $1{,}5 < t \leq 3$ $3 < t \leq 4$
Aerated concrete	125 ± 10 150 ± 10	650 ± 200 650 ± 200	$t \leq 2$ $2 < t \leq 4$

For testing purposes: The deflection of the floor construction may be reduced, i.g. by supporting it by I-beams. If a vertical duct passes the top floor the floor construction may be reinforced except 200 mm around the opening.

7.3 Non-standard supporting constructions

When the test specimen is intended to be used in a form of construction not covered by the standard supporting constructions, it shall be tested in the supporting construction in which it is intended to be used.