BS EN 1366-1:2014

BSI Standards Publication

Fire resistance tests for service installations

Part 1: Ventilation ducts

National foreword

This British Standard is the UK implementation of EN 1366-1:2014. It supersedes BS EN 1366-1:1999 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee FSH/22/-/9, Fire resistance tests for ducts, including smoke extract ducts.

A list of organizations represented on this committee can be obtained on request to its secretary.

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Foreword

This document (EN 1366-1:2014) 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of an identical text or by endorsement, at the latest by April 2015 and conflicting national standards shall be withdrawn at the latest by April 2015.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 1366-1:1999.

This European Standard 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 Product Directive.

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;*

— *Part 7: Closures for conveyors and trackbound transportation systems;*

— *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;*

— *Part 13: 1-, -2, 3- sided ducts;*

— *Part 14: Kitchen extract ducts*;

— *Part 15*: *Mixed penetrations including pipes cables, ducts and dampers*.

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

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, in whole or in part, are normatively referenced in this document and are indispensable for its application. 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

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/m^3	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/m^3	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.

7.4 Fire stopping

The fire stopping of the penetration through the supporting construction shall be as intended in practice. The maximum width of the gap between the duct and the wall shall be accommodated as used in practice.

7.5 Unsupported vertical ducts

Where, in practice, vertical ducts are not fixed to each floor, the test specimen shall be suitably loaded to simulate the weight of the remaining height of unsupported ducting. Rules given in EN 15882-1 shall be followed.

NOTE Mechanical hazards may arise from this additional loading for the personnel.

7.6 Restraint of ducts

7.6.1 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.

7.6.2 Outside the furnace

Only horizontal duct B shall be restrained outside the furnace. The restraining point shall be located at a position (2000 ± 200) mm from the supporting construction and shall provide restraint on movement in horizontal direction but shall allow movement in vertical direction (see Figure 18). The frame used to apply the restraint shall be rigid and have sufficient strength to resist all horizontal forces.

For test purposes the horizontal movement of the top edge of the vertical ducts A and B 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 d 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 6 to 8.

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

9.1.2 Unexposed surface thermocouples

9.1.2.1 General

The temperature of the test specimens shall be measured with thermocouples as described in EN 1363-1. The position of thermocouples (for measuring maximum and / or average temperature, T_1 and T_2) at the point of penetration of the duct through the wall or floor is shown in Figures 9 to 11 for a number of different penetration details. At least one thermocouple (T_i) of each type shall be positioned on each side of a rectangular duct – circular ducts shall be measured analogously.

Thermocouples shall be located where a discontinuity in thickness of insulation or wall thickness of the duct occurs. This includes additional fillets, strips etc. (see Figures 9 to 11).

9.1.2.2 Maximum temperature rise

Additional thermocouples T_1 for determining maximum temperature rise shall be located in positions on the outer surface of the fire protection material to coincide with the first joints of each layer (see also Figure 16). Additional thermocouples shall be positioned over the first steel duct joint on the unexposed side (outer layer). None of these thermocouples shall be closer to the penetration than 25 mm.

9.1.2.3 Ducts with combustible linings

Where ducts with combustible internal linings are used, four additional thermocouples, reference T_3, shall be fixed inside duct A, at a position of approximately mid-span within the part of the duct exposed within the furnace. The thermocouples shall be fixed to the inside face of the duct at the locations shown in Figure 12. The thermocouples shall not coincide with joints or cover strips.

9.1.2.4 Compensating devices

Where compensating devices have been incorporated, thermocouples shall be located on the outer surface of the compensator in duct B. These shall be used to check compliance with the maximum temperature rise limits only.

9.1.2.5 Suspension device

Where steel suspension devices are protected, then their temperatures shall be measured. A thermocouple shall be positioned on each component of at least two suspension device systems (see 13.6.2)

9.1.2.6 Access panel

Additional thermocouples on access panels shall be arranged as shown in Figure 13.

9.2 Pressure

Furnace pressure shall be measured in accordance with Clause 5.

10 Test procedure

10.1 General

Before the test the leakage of the laboratory measuring and condensing system shall be measured, and the system leakage shall be deducted from the total measuring leakage throughout the test.

The test shall be carried out using the equipment and procedures in accordance with EN 1363-1.

10.2 Control of conditions to permit assessment of integrity

10.2.1 Duct A

Control the underpressure inside duct A (see Figure 4) to (300 ± 15) Pa (or (500 ± 15) Pa if required by the test sponsor) below the laboratory pressure at the beginning of the test and maintain it at this value throughout the test.

If used 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.

10.2.2 Duct B

Prior to the start of the test stabilise the air velocity in duct B (see Figure 5) to 3m/s. Adjust the fan during the "fan on" parts of the test to maintain the velocity of (3 ± 0,45) m/s. If the air temperature in the duct is used in the calculation of the velocity, the temperature measured after the duct (Figure 5, No. 7) shall be used for the calculation. The temperature measurement shall be taken no further than 100 mm from the end of the duct; if a larger distance is needed, the connecting pipe shall be insulated.

25 min after the commencement of the test according to EN 1363-1, open the fan by-pass vent and then shut the damper whilst leaving the fan running. Allow two minutes for the conditions to stabilise in duct B.

Make an assessment of integrity of the duct assembly outside the furnace in the simulated "fan off" situation for a period of 3 min. Then re-open the damper and close the by-pass vent. The damper shall be opened or shut in not less than 10 s and not more than 20 s. Check that velocity of the fan is within the limits defined above.

Repeat this procedure five minutes before the completion of every 30-minute period of the test. Make assessments of integrity in the damper open position (fan-on situation) at all other times.

10.3 Test measurements and observations

10.3.1 Integrity

10.3.1.1 For ducts A and B including where the ducts pass through the wall or floor:

Evaluate the test specimen for integrity as given in EN 1363-1. Table 5 summarises the evaluation required to assess integrity.

Table 5 - Summary of appropriate integrity evaluation

Duct	Within Furnace	Outside Furnace
Duct A **(Fire outside duct)**	Volume flow rate	Volume Flow Rate Cotton Pad Openings Flaming
Duct B **(Fire inside duct)**	--------	Cotton Pad Openings Flaming

10.3.1.2 For duct A only:

Record the pressure differential across the venturi, orifice plate, etc. at not more than 60 s intervals throughout the test.

Calculate the leakage from the recorded pressure differential from the venturi, orifice plate, etc. using the formulae for volume flow rates given in EN ISO 5167-1, EN ISO 5167-2 and EN ISO 5167-3. The calculation shall be related to normal temperature (20 °C) and normal pressure (1013 mbar).

10.3.2 Insulation

Measure the average and maximum temperatures of the unexposed faces of the test specimens as specified in EN 1363-1. Use a roving thermocouple to locate points of high temperature not covered by the fixed thermocouples, at locations where the duct is outside the furnace only.

10.3.3 Thermal expansion/contraction and restraint forces

10.3.3.1 For horizontal duct A only

Measure and record the thermal expansion/contraction in axial direction at the penetration point and at the unexposed end of the duct (see Figure 17).

10.3.3.2 For horizontal duct B only

If requested by the sponsor the restraint force in horizontal duct B shall be measured and recorded at the point of application of the restraint outside the furnace (see Figure 18) using the device described in 4.11.

10.3.4 Additional observations

Throughout the test, make observations of all changes and occurrences which do not affect the performance criteria but which could create hazards in a building, including, for example:

a) deflections; this shall cover the general behaviour of the duct e.g. the direction in which it is deflecting. Precise measurements are not required;

b) the emissions of smoke from the unexposed face of the duct. This may, for example, be attributable to its coverings and/or lining. Only limited observations may be possible in view of the highly subjective nature of such observations;

c) the time when the suspension or fixing devices can no longer retain the duct or its sections in its intended position.

10.4 Termination of the test

Terminate the test for the reasons given in EN 1363-1.

11 Performance criteria

11.1 Integrity

Integrity failure shall be deemed to have occurred if any of the following are observed:

a) integrity failure on the unexposed side as defined in EN 1363-1,

b) the volume flow rate measured in duct A exceeds 15 m^3 /(m^2 h), related to 20 °C and 1013 mbar, related to the internal surface area of the duct inside the furnace.

11.2 Insulation

11.2.1 General

Insulation failure shall be as defined in EN 1363-1.

Only thermocouples T_2 shall be used to determine the average temperature rise. Thermocouples T_1, T_2, T_s, and the roving thermocouple shall be used to determine the maximum temperature rise.

If applicable, thermocouples $T_{AP,1}$ on the duct around an access panel shall be used to determine the maximum temperature rise and $T_{AP,2}$ on the access panel shall be used to determine the maximum and average temperature rise of the access panel.

Insulation failure on thermocouples for the access panel (T_{AP}) shall be regarded as insulation failures for these devices only and not for the whole duct system.

For compensators, only the maximum temperature rise ($T_{CO,1}$) shall be measured on all relevant places where a discontinuity in shape of the compensator (in analogy to a penetration) occurs.

11.2.2 Duct with combustible lining

Insulation failure shall be as defined in EN 1363-1.

Thermocouples T_3 shall also be used to determine the average and maximum temperature rise. Positioning of these thermocouples is indicated in Figure 12.

11.3 Smoke Leakage

Failure of this criterion shall have occurred if the flow rate in duct A during the test exceeds 10 m^3 /(m^2 h), related to 20 °C and 1013 mbar, related to the internal surface area of the duct inside the furnace.

12 Test report

In addition to the items required by EN 1363-1, the following shall also be included in the test report.

a) a reference that the test was carried out in accordance with EN 1366-1;

b) the method of fixing, support and mounting, as appropriate for the type of test specimen;

c) a description of the method and materials used to seal the gap between the duct and opening provided in the wall or floor to accommodate the duct;

d) the details of the supporting construction and, where vertical ducts are loaded, give details of the load applied;

e) the thermal expansions / contractions measured;

f) other observations made during the test according to 10.3.3, including a complete record of the following test parameters as a function of time:

For Duct A:

1) the calculated volume flow in duct A

2) pressure difference between the inside the of the duct and the laboratory

3) gas temperature measured at measuring station (item 12 on Figure 4)

For Duct B

1) the calculated volume flow in duct B

2) the gas temperature measured at the exit point

(item 7 on Figure 5)

g) performance achieved in relation to 11.3;

h) where steel ducts are used, the thickness, leakage class to EN 1507, and whether any external stiffening or internal stiffeners were incorporated.

13 Field of direct application of test results

13.1 General

The field of direct application only covers circular and four sided rectangular ducts.

13.2 Vertical and horizontal ducts

A test result obtained for horizontal ducts A and B is applicable to horizontal ducts only.

A test result obtained for vertical ducts A and B is applicable to vertical ducts without branch.

A test on horizontal duct A, which includes a branch duct, also covers the use of branches on previously tested vertical ducts. These test results cover the forms of T-pieces, branches and direction changing pieces using the same jointing technique.

13.3 Sizes of ducts

A test result obtained for the standard sizes of duct A and duct B specified in Tables 1 and 2 is applicable to all dimensions up to the maximum nominal internal sizes given in Table 6.

Table 6 - Maximum nominal internal dimensions of ducts tested as defined in Table 2 permitted under direct application

	Rectangular width mm	**Rectangular height mm**	**Circular diameter mm**
duct size	1250	1000	1000

For ducts tested at a size other than those specified in Clause 6, no extrapolation to larger sizes is allowed. However, all smaller sizes are covered.

For ducts tested larger than the allowable upper limits for extrapolation, no extrapolation to larger sizes is allowed.

13.4 Pressure difference

13.4.1 A test result obtained for the standard underpressure of 300 Pa in duct A is applicable to a pressure difference between -300 Pa to +300 Pa providing that the integrity criteria during the duct B test was satisfied.

13.4.2 A test result obtained for an underpressure of 500 Pa in duct A is applicable to a pressure difference between -500 Pa to +500 Pa providing that the integrity criteria during the duct B test was satisfied.

13.4.3 Where higher underpressure or overpressures are required, guidance is given in EN 15882-1. If a test is done with an underpressure higher than 500 Pa then the results are applicable for a pressure difference between the tested underpressure to +500 Pa. The result is only applicable for duct dimensions equal to or less the tested.

13.5 Height of vertical ducts

13.5.1 Ducts supported at each storey

The test results are applicable to any number of storeys provided:

a) distance between supporting constructions does not exceed 5 m

b) limitation on buckling are satisfied (see 13.5.3)

13.5.2 Ducts supporting its own self load

Test results obtained from ducts with additional load are applicable to ducts with an overall height corresponding to the load applied in the fire test. Limitations on buckling and lateral support shall also be satisfied (see 13.5.3).

13.5.3 Limitations on buckling

In order to prevent damage to the construction from buckling of vertical ducts, the test results are only applicable to situations where the ratio between the length of the duct exposed in the compartment to the smallest lateral dimension across the outside face of the duct (or outer diameter) does not exceed 8:1(distances between lateral supports: shortest duct dimension (length, width or diameter)), unless additional lateral supports are provided.

In cases where additional supports are provided, the ratio of the distance between the additional supports, or the distance between the supports and the supporting construction to the smallest lateral dimension across the outside face of the duct (or outer diameter) shall not exceed 8:1.

13.6 Suspension devices for horizontal ducts

13.6.1 As the test configuration does not allow an assessment of the load-bearing capacity, the suspension devices shall be made of steel and be sized such that the calculated stresses do not exceed the values given in Table 7.

Table 7 - Maximum values of stresses in suspension devices depending on duration of fire resistance *t*

Type of load	**Maximum stresses (N/mm²)**		
	***t* ≤ 60 min**	**60 min < *t* ≤ 120 min**	**120 min < *t* ≤ 240 min**
Tensile stress in all vertically orientated components	9	6	3
Shearing stress in screws of property class 4.6 according to EN ISO 898-1	15	10	5

NOTE Stress is calculated from supported load only (and ignores assembly stresses).

13.6.2 The elongation in mm of the suspension devices of the test ducts can be calculated on the basis of temperature increases and stress levels. For unprotected steel suspension devices, the temperature used shall be the maximum furnace temperature. For protected steel suspension devices, the maximum recorded suspension device temperature shall be used. The value calculated represents the elongation limit for suspension devices with a greater length than in the test.

NOTE For unprotected suspension devices of approximately 1,5 m length an elongation of 40 mm can be expected depending on the fire resistance period.

13.6.3 The largest distance between suspension devices used in the test construction cannot be exceeded.

13.6.4 The maximum tested distance between the suspension device and the closest innermost duct joint on the underside (inside the furnace, when testing horizontal duct A) shall not be exceeded with a tolerance of 100 mm. The maximum tested distance between the suspension device and the closest joint of the outermost layer of insulation material on the underside (outside the furnace, when testing horizontal duct B) shall not be exceeded with a tolerance of 100 mm.

13.6.5 In cases where the lateral dimension between the outer vertical surface of the duct and the centre line of the suspension device is less than 50 mm, the test result shall apply up to 50 mm. If it is tested at greater than 50 mm then it is valid up to the distance tested.

13.6.6 The horizontal load-bearing component of the suspension device shall be of the same type of profile as in the test. It shall be sized in such a way that the bending stress does not exceed that applied to the equivalent member in the test.

13.7 Supporting construction

A test result obtained for a fire-resisting duct passing through a standard supporting construction (see 7.2) is applicable to a supporting construction with a fire resistance equal to or greater than that of the standard supporting construction used for the test (thicker, denser, more layers of board, as appropriate).

Test results obtained with flexible vertical supporting constructions may be applied to rigid supporting constructions as described in 7.2 of a thickness equal to or greater than that of the element used in the tests, provided that the classified fire resistance of the rigid supporting construction is greater than or equal to the one used for the test.

13.8 Steel ducts

The test result may be applied to those ducts having higher air tightness (according to EN 1507 for rectangular steel sheet ducts and EN 12237 for circular steel sheet ducts) than the air tightness of the duct tested, on condition that the sealing materials used are of the same generic type.

If non-combustible seals are used in the duct tested, the results do not comply for a duct with higher tightness achieved by combustible seals. The vice versa can be accepted.

NOTE There are no standardized air tightness classes for ducts made of boards.

Test results on a steel duct that has been stiffened shall only apply to ducts that are also stiffened in a similar manner.

13.9 Ducts with boards

Tests on ducts with cover strips at the joints do not allow the ducts without cover strips at the joints; however covered joints can be accepted on the basis of test results with uncovered joints.

13.10 Fire stopping

The average gap between the duct and the supporting construction, which has been measured at the beginning of the test, shall be considered as the maximum distance. Smaller gaps are allowed to be used in practice.

13.11 Access panel

If identical access panels have been tested in a duct A and duct B, access panels of identical construction with equal to or less length, width or diameter to those tested are allowed.

Access panels tested at the underside of the horizontal duct are applicable at all locations in horizontal ducts and in vertical ducts.

13.12 Compensators

If the duct is tested without compensator no compensator shall be used in practice.

When testing with compensator on the exposed side of duct A and compensators on both sides (exposed and unexposed) of duct B, compensators shall be used in practice.

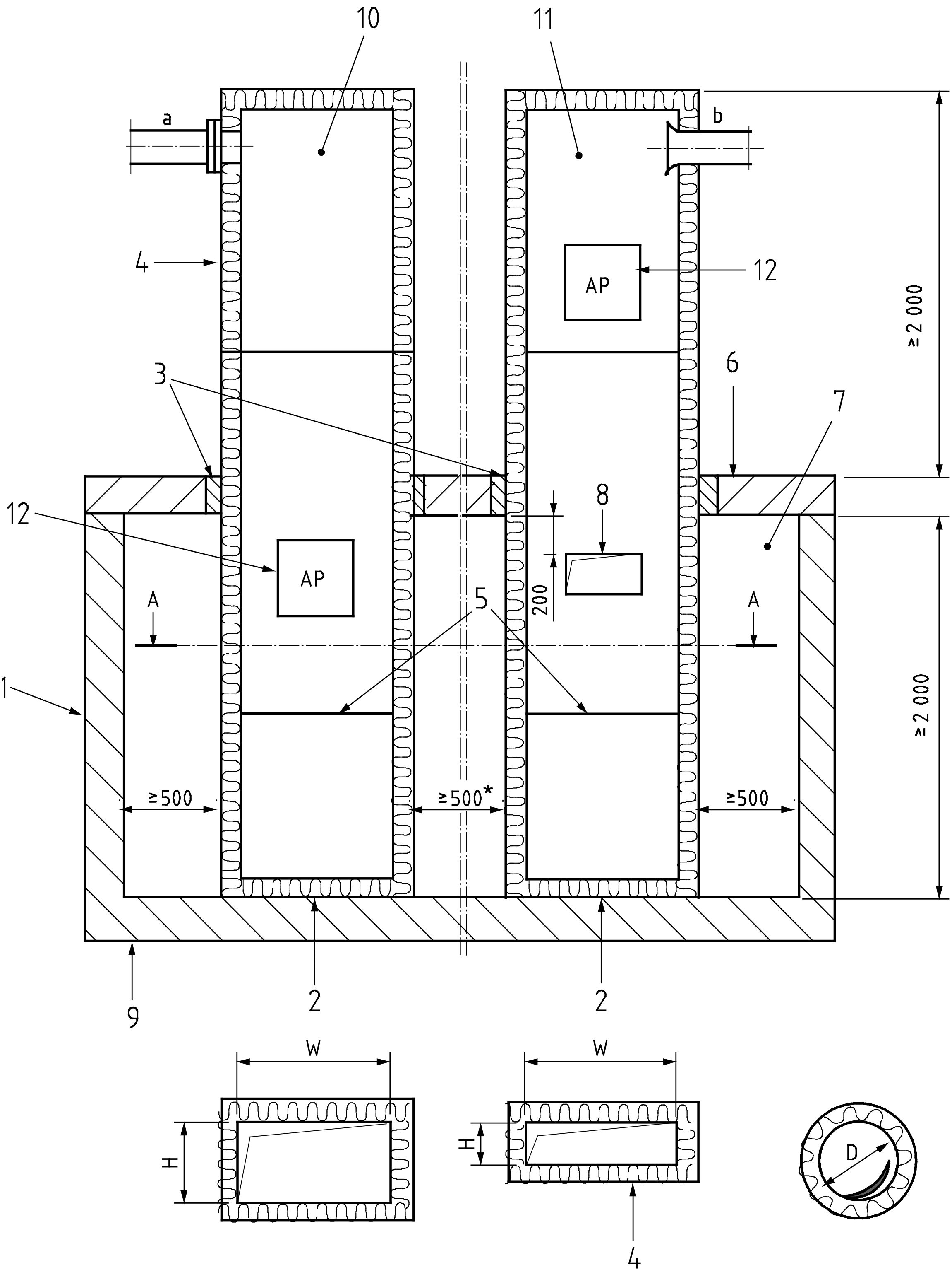
When testing with compensator on the exposed side of duct A and compensator on the unexposed side of duct B, compensators may be used in practice, but their use is not compulsory.

13.13 Ducts with combustible lining

Combustible lining shall be used only if tested in accordance with 11.2.2. The thickness of the combustible lining used in practise shall not exceed the tested thickness.

SIDE VIEW

All dimensions in mm



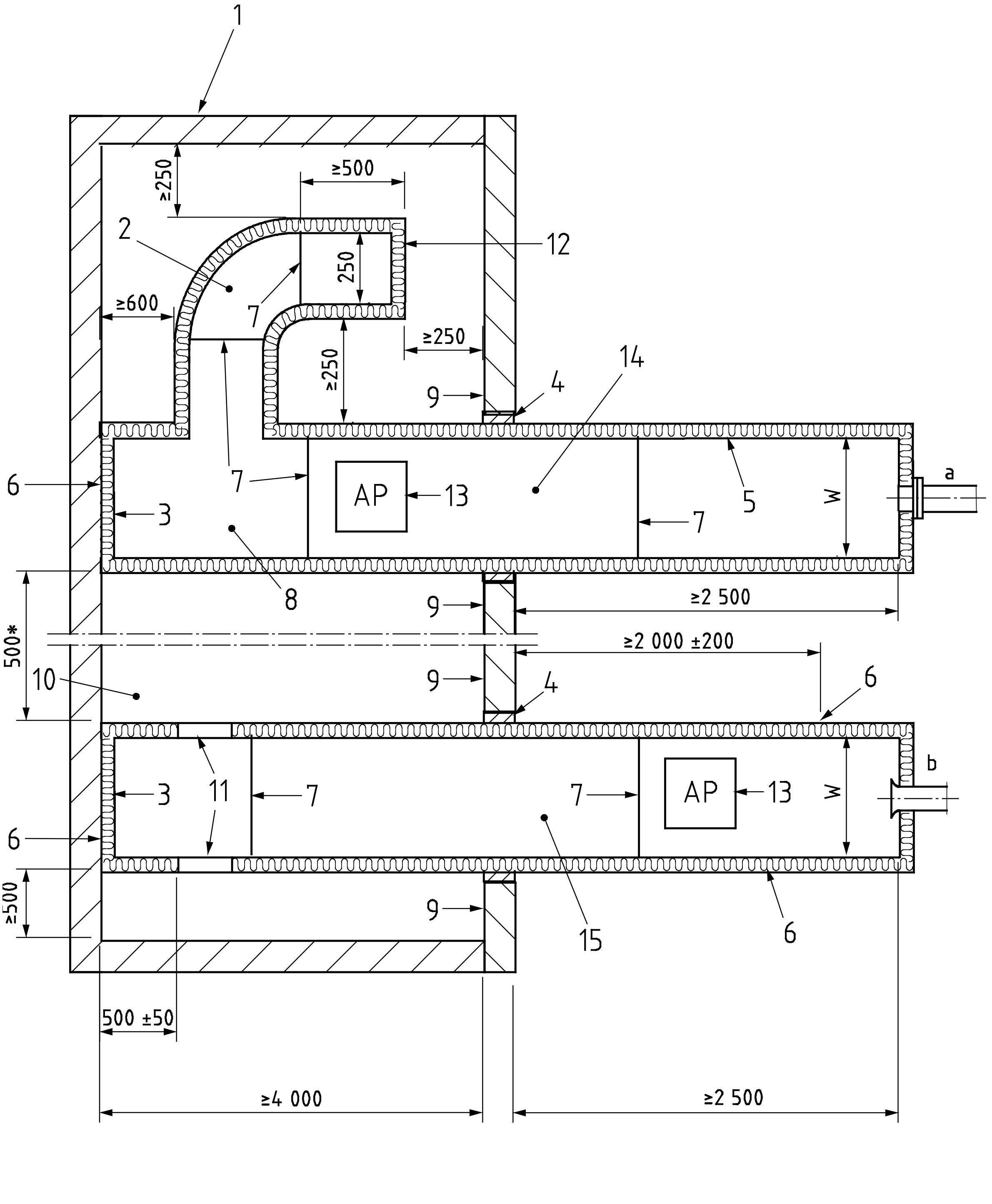
Key

a) details in Figure 4
b) details in Figure 5
1 furnace wall
2 closed end
3 fire-stopping as in practice
4 insulation
5 joints
6 supporting construction
7 furnace chamber
8 openings: total cross section 50 % of duct cross section duct B (see 6.3.4)
9 furnace floor
10 duct A
11 duct B
12 access panel see Figure 13
W width
H height
D diameter
* when duct A and duct B tested together

Figure 1 – Test arrangements for vertical ducts

PLAN VIEW

All dimensions in mm



Key

a) details in Figure 4

b) details in Figure 5

1 furnace wall

2 duct with 90° elbow, cross section (see 6.3.3) see Figure 14

3 closed end

4 fire-stopping as in practice

5 insulation

6 rigid restraint device

7 joints

8 T-piece

9 supporting construction

10 furnace chamber

11 openings: total cross section 50 % of duct cross section duct B

12 sealed end of elbow

13 access panel see Figure 13

14 duct A

15 duct B

W W width

* when duct A and duct B tested together

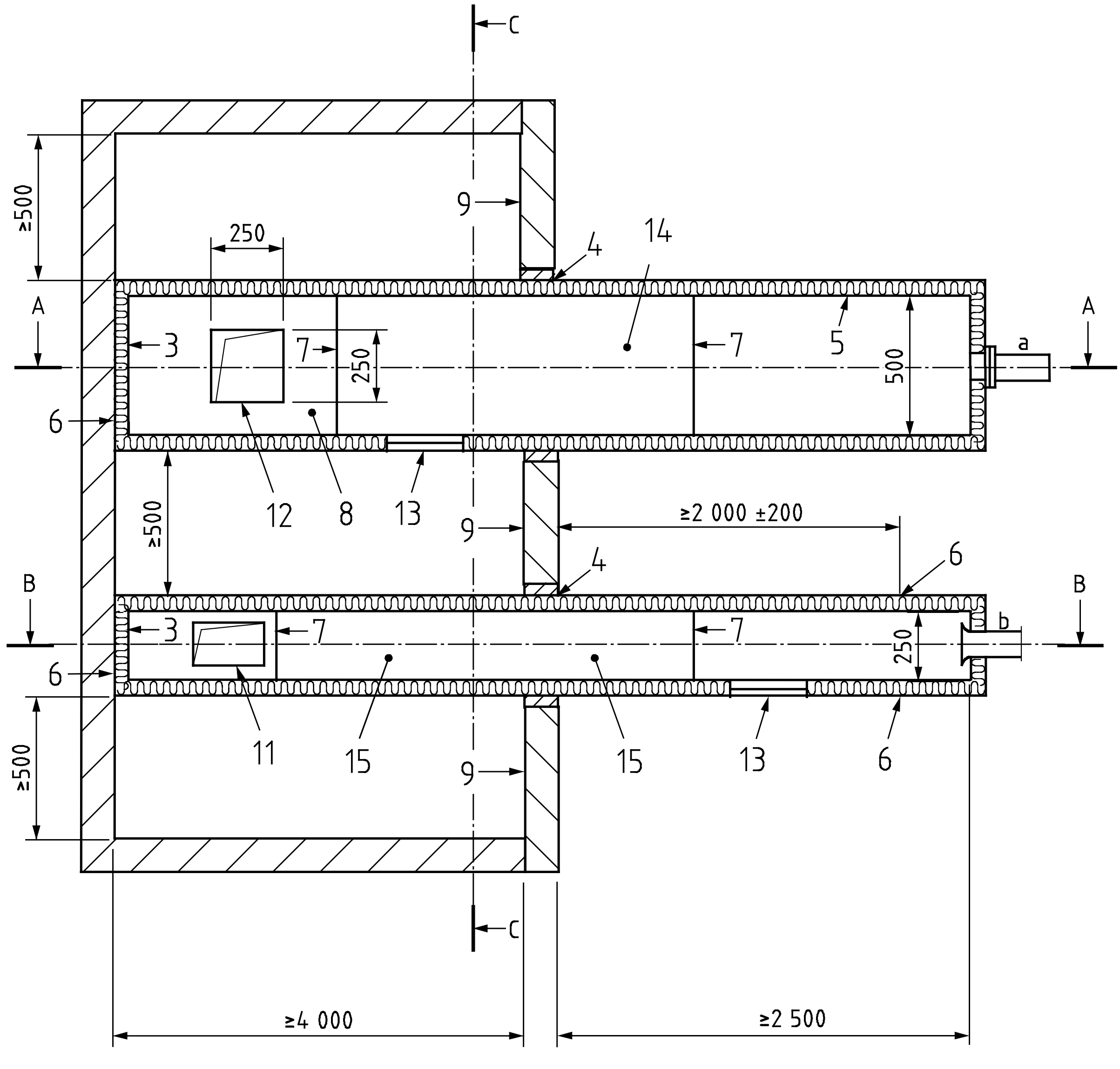
The sealed end inside the furnace shall be restrained.

NOTE The rigid restraining device can be independent from the surface wall.

Figure 2 – Test arrangement for horizontal ducts

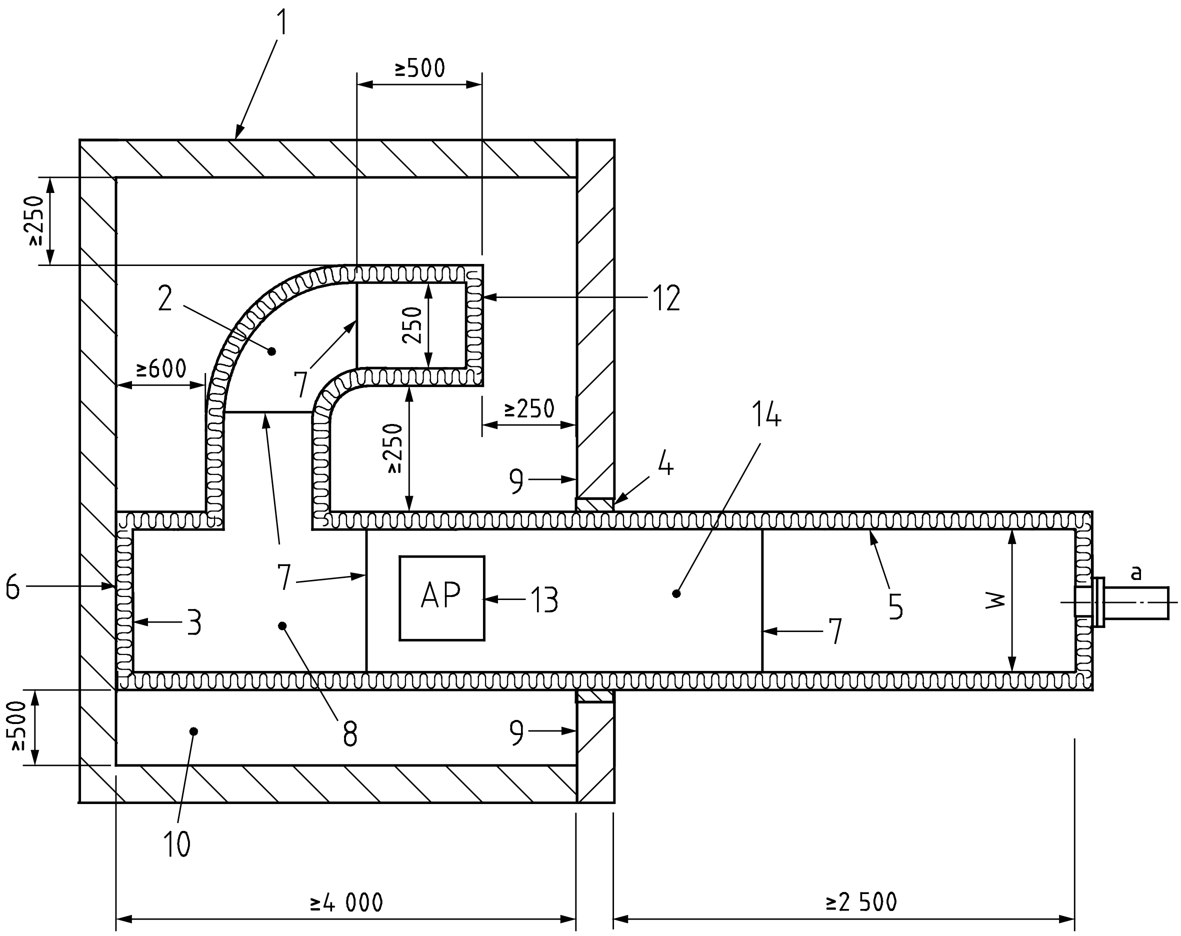
SIDE VIEW

All dimensions in mm



PLAN VIEW

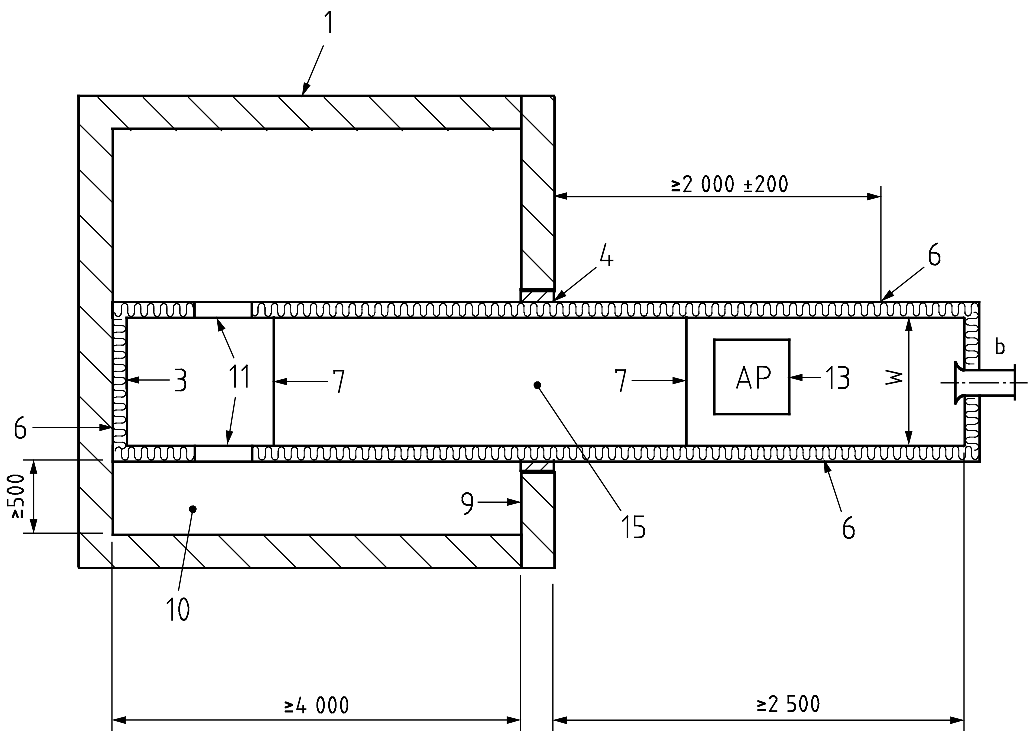
All dimensions in mm



A — A

PLAN VIEW

All dimensions in mm



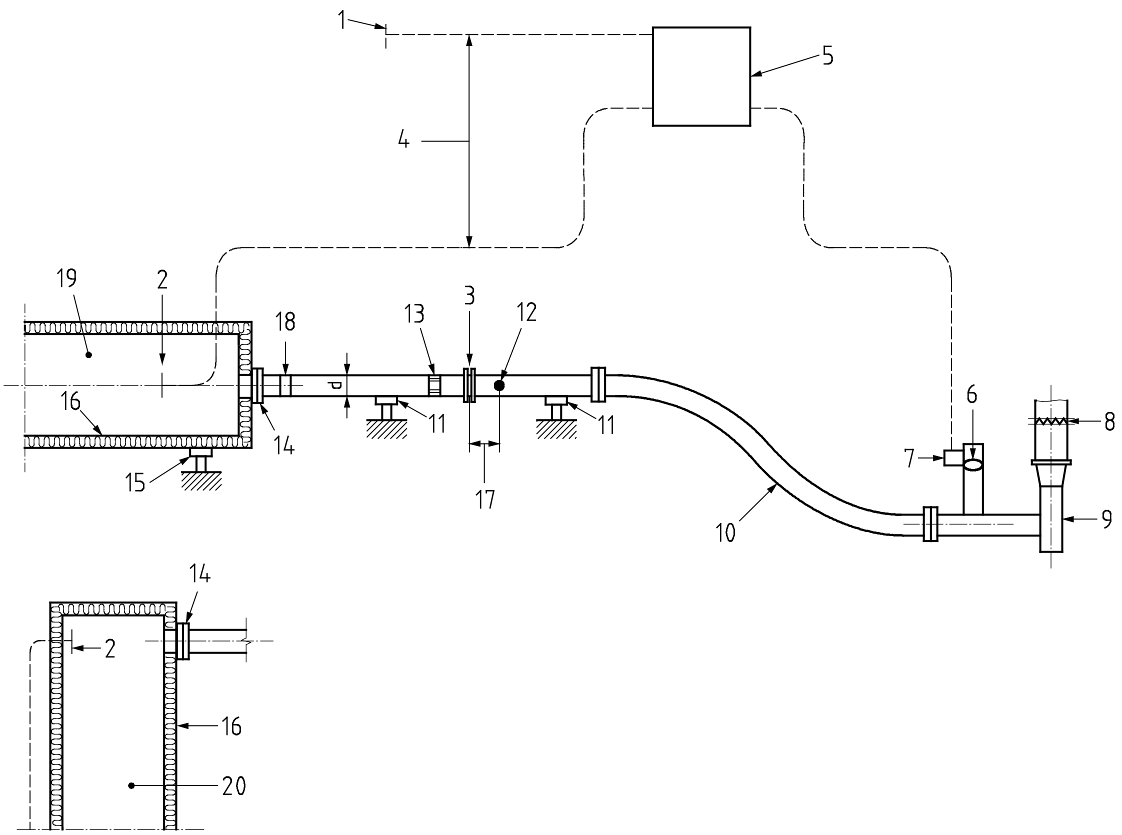
B — B

Key

a)	details in Figure 4
b)	details in Figure 5
1	furnace roof
2	duct with 90° elbow, cross section (see 6.3.3) see Figure 14
3	closed end (may pass through furnace wall)
4	fire-stopping as in practice
5	insulation
6	rigid restraint
7	joints
8	T-piece
9	supporting construction
10	furnace walls
11	openings: total cross section 50 % of duct cross section duct B
12	opening of elbow
13	access panel see Figures 2 and 13
14	duct A
15	duct B
W	width

The sealed end inside the furnace shall be restrained.

Figure 3 – Alternative test arrangement for horizontal ducts A + B superposed



Key

duct A

1 pressure sensor in laboratory

2 pressure sensor (on centre line of flange 14)

3 orifice plate venturi, or similar

4 pressure differential (300Pa)

5 pressure differential control box

6 pressure control dilution damper

7 pneumatic actuator or manual control

8 balancing damper

9 fan

10 flexible connecting duct

11 support

12 thermocouple, diameter ≤ 2 mm

13 flow straightener (where necessary)

14 flange

15 support (test duct)

16 test duct

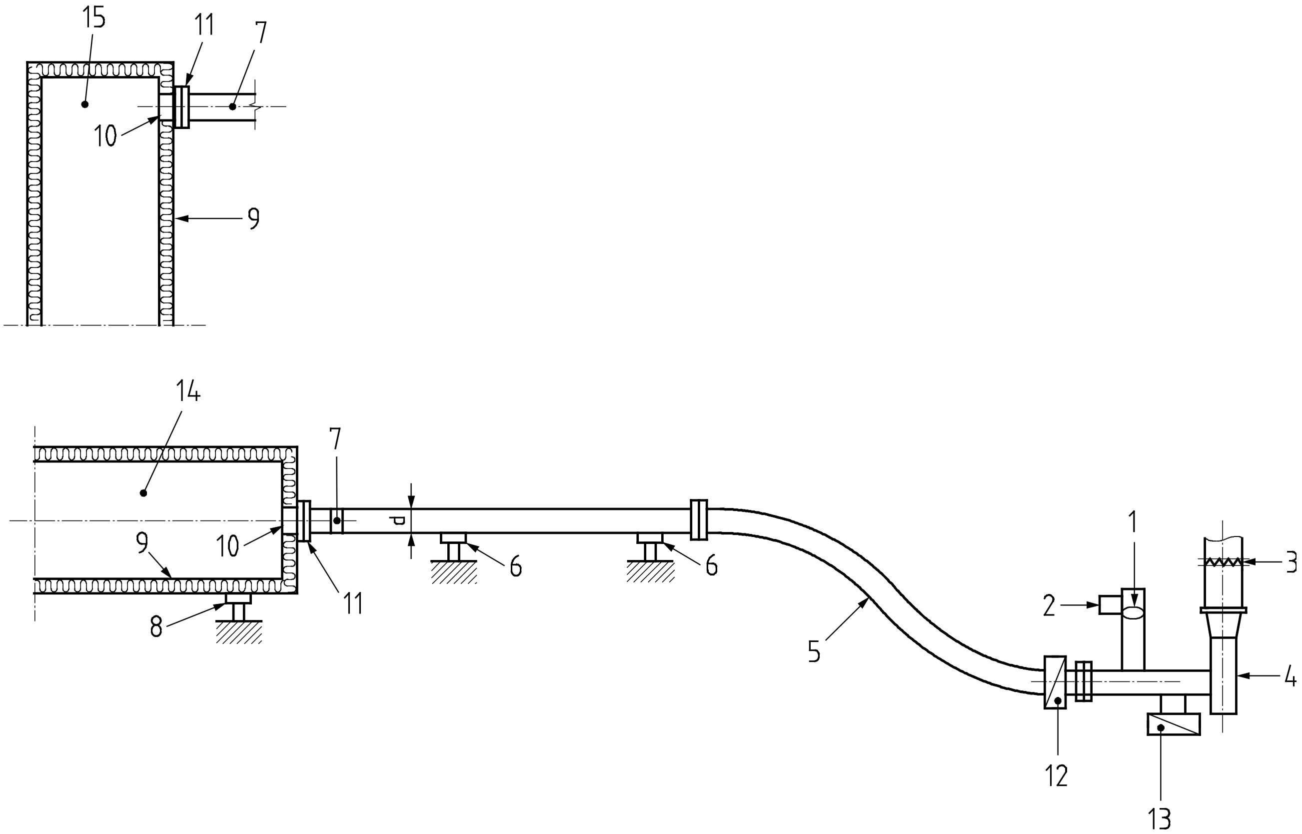
17 distance: thermocouple – orifice plate: 2d

18 condensing device

19 duct A horizontal

20 duct A vertical

Figure 4 – Leakage measuring station for duct A



Key

duct B

1 1 pressure control dilution damper

2 2 pneumatic actuator or manual control

3 3 balancing damper

4 4 fan

5 5 flexible connecting duct

6 6 support

7 7 thermocouple, 1,5 mm diameter, positioned in the centreline of the pipe with the tip pointing towards duct B

8 8 support (test duct)

9 9 test duct

10 10 inlet nozzle or other suitable measuring device

11 11 flange

12 12 damper (cF. 4.7)

13 13 bypass if necessary

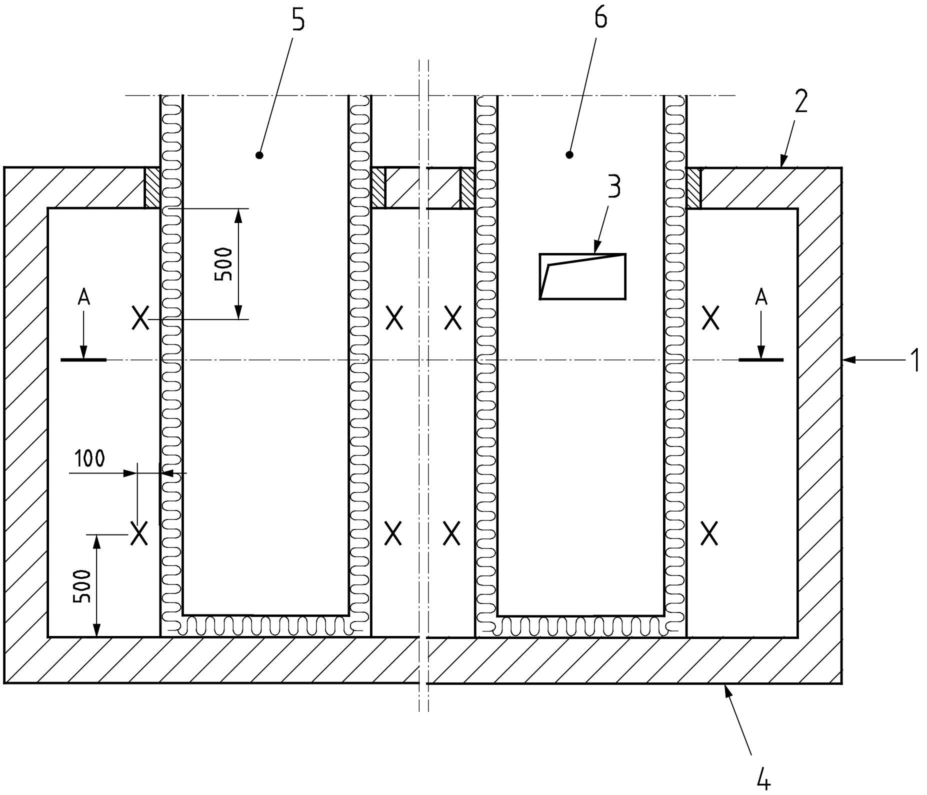
14 14 duct B horizontal

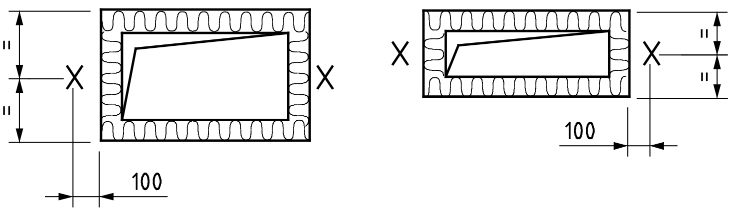
15 15 duct B vertical

Figure 5 – Gas velocity measuring station for duct B

SIDE VIEW

All dimensions in mm





A — A

Key

X furnace thermocouples

1 furnace wall

2 furnace roof

3 openings: total cross section 50 % of duct cross section duct B (see 6.3.4)

4 furnace floor

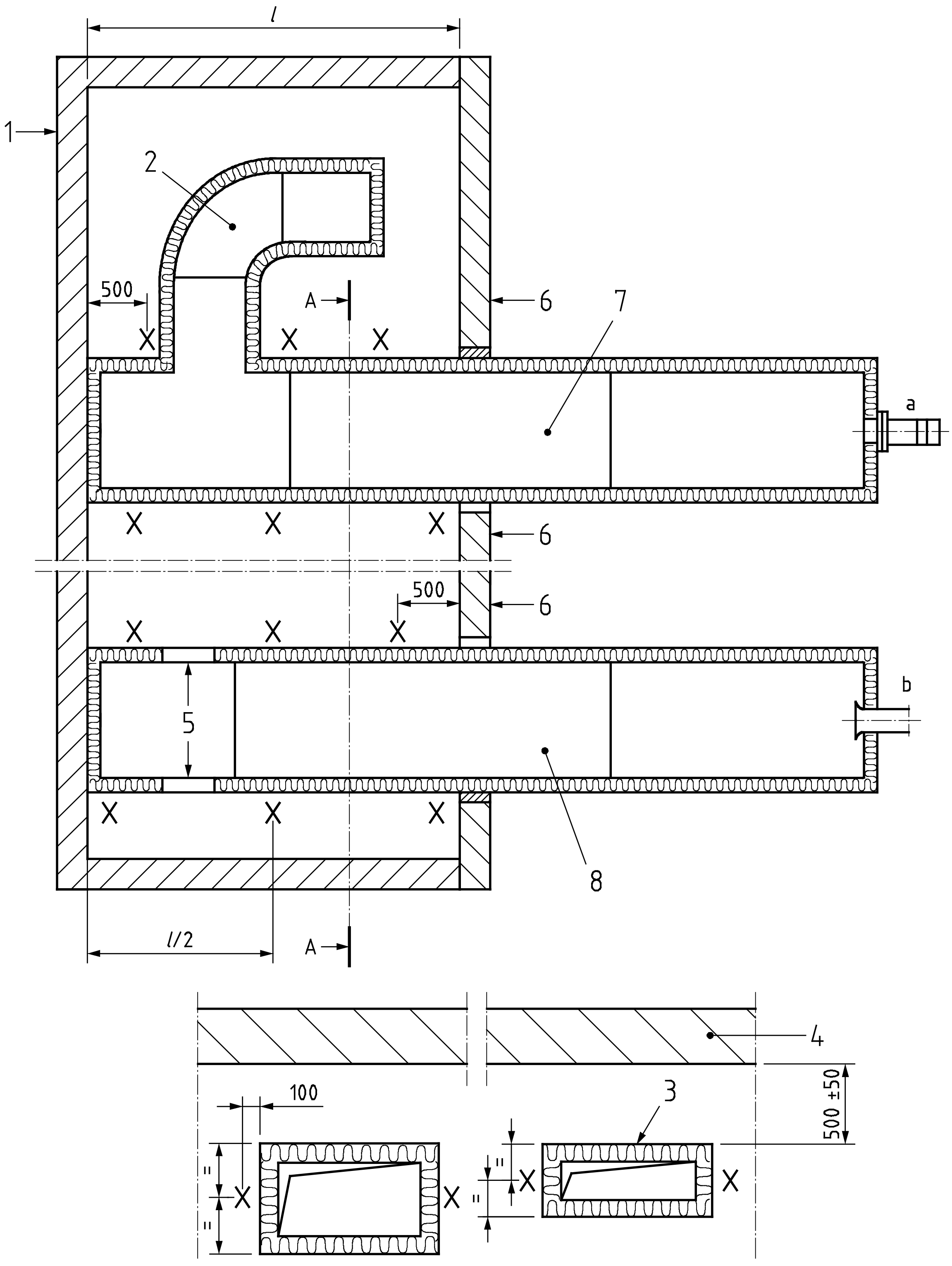
5 duct A

6 duct B

Figure 6 – Location of furnace thermocouples for ducts in vertical position

PLAN VIEW

All dimensions in mm



A — A

Key

a) details in Figure 4

b) details in Figure 5

X furnace thermocouples

1 furnace wall

2 90° elbow (see Figure 2 and 6.3.3)

3 insulation

4 cover of furnace

5 openings: total cross section 50 % of duct cross section duct B

6 supporting construction

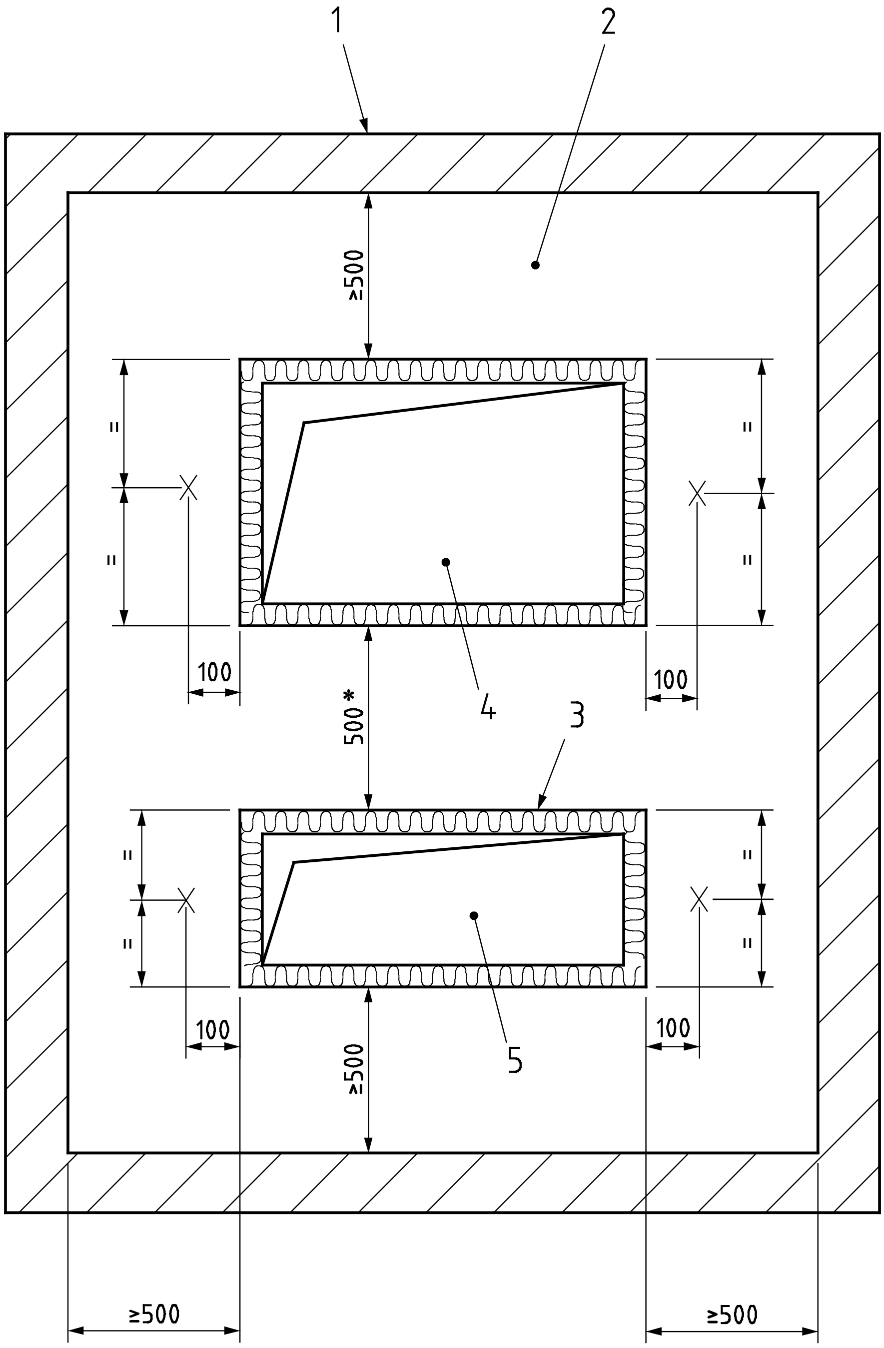
7 duct A

8 duct B

Figure 7 – Location of furnace thermocouples for ducts in horizontal position

FRONT VIEW

All dimensions in mm



C — C

Key

X furnace thermocouples

1 furnace roof

2 furnace chamber

3 insulation

4 duct A

5 duct B

duct A = b 1000 x h 500

duct B = b 1000 x h 250

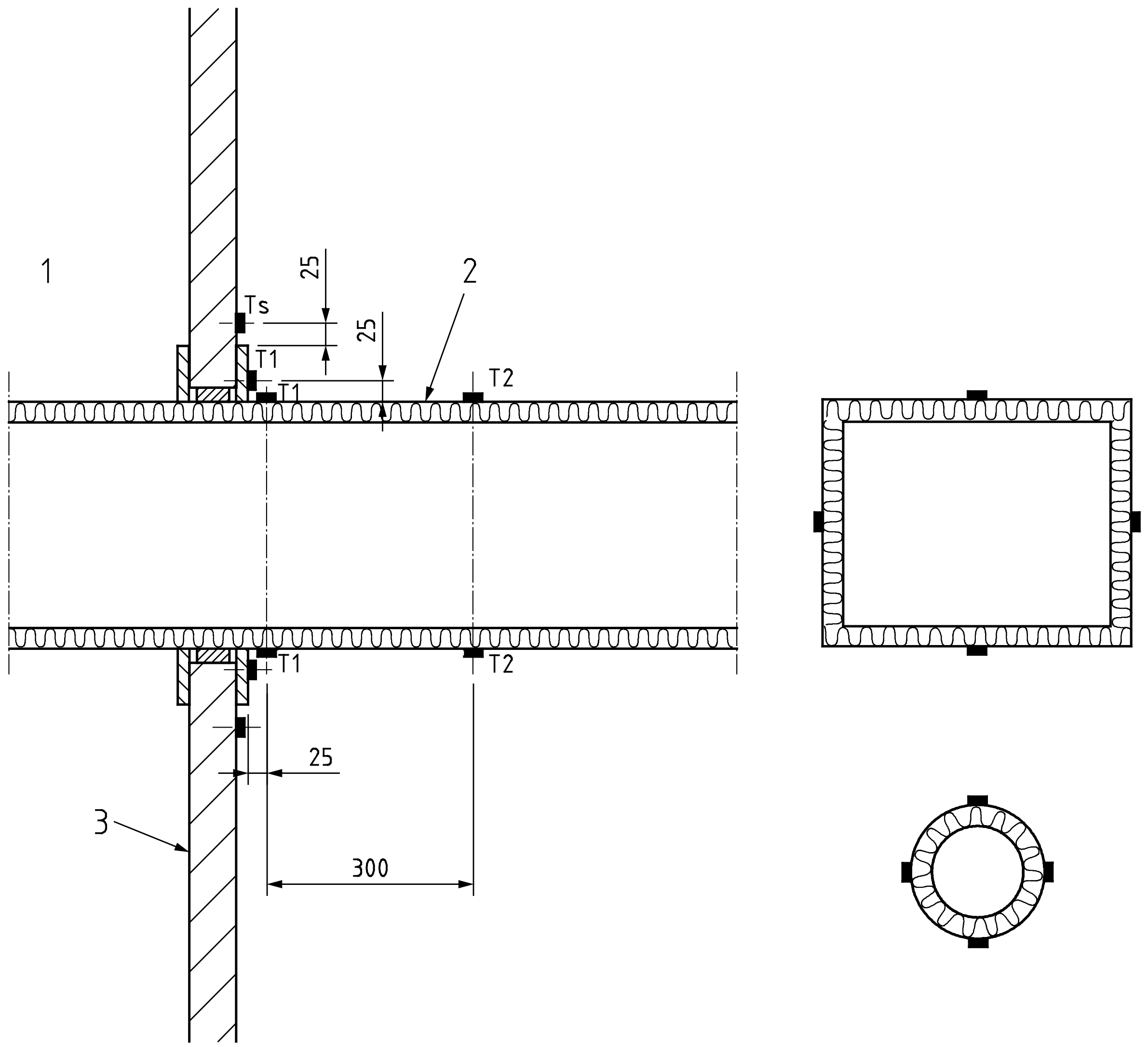
C – C see Figure 3

* when duct A and duct B tested together

The sealed end shall be independent of the furnace wall.

Figure 8 - Test arrangements for horizontal ducts, A + B superposed see Figure 3

All dimensions in mm

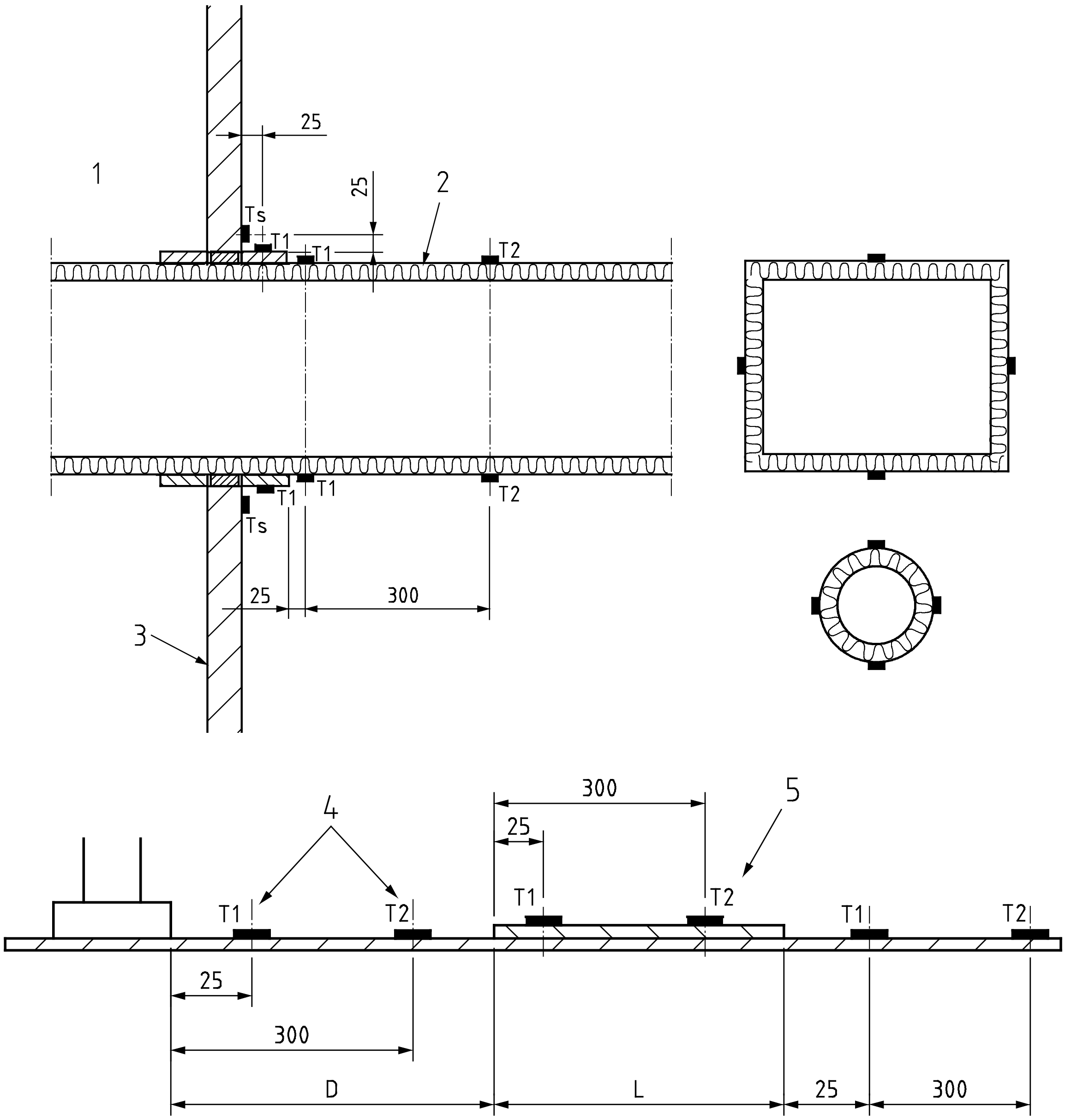


Key

1	furnace
2	fire resisting duct
3	supporting construction
Ts	maximum surface temperature on supporting construction
T1	surface thermocouples for determining the maximum temperature
T2	surface thermocouples for determining the average and maximum temperature
▬	surface thermocouples

Figure 9 – Location of surface thermocouples (penetration example 1)

All dimensions in mm

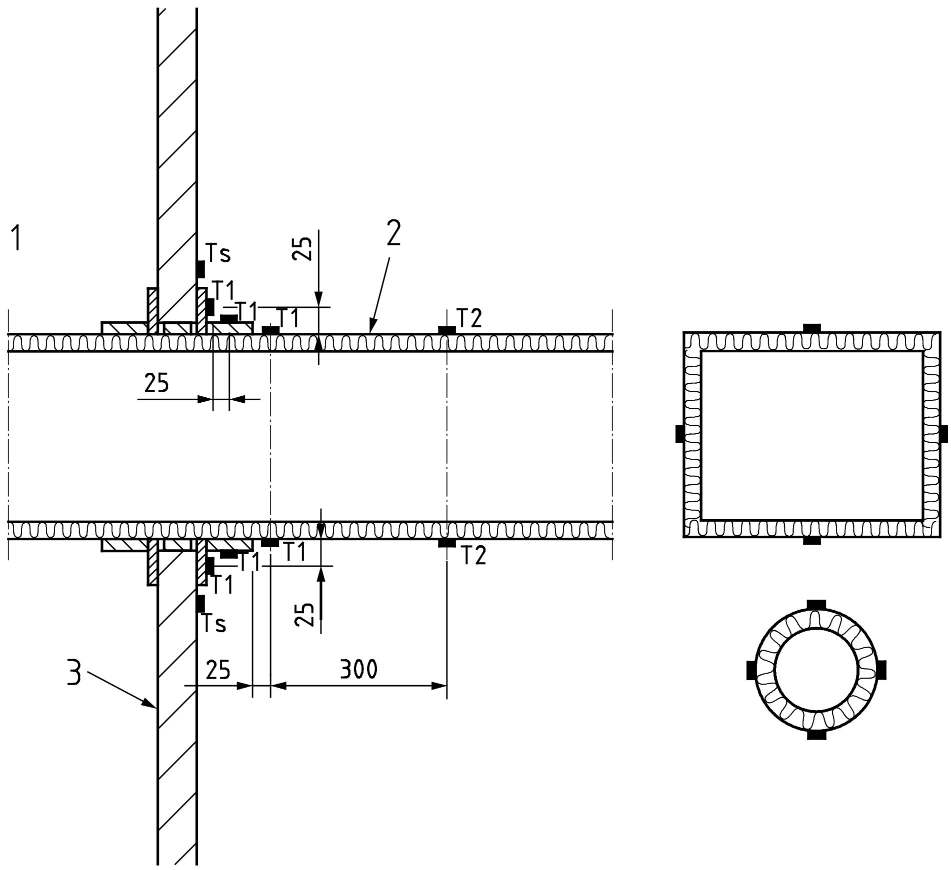


Key

1	furnace
2	fire resisting duct
3	supporting construction
4	this T1 if D ≥ 50 mm and additional T2 if D ≥ 350 mm
5	this T2 if L ≥ 350 mm
L	length of the strip
Ts	maximum surface temperature on supporting construction
T1	surface thermocouples for determining the maximum temperature
T2	surface thermocouples for determining the average and maximum temperature
▬	surface thermocouples

Figure 10 – Location of surface thermocouples (penetration example 2)

All dimensions in mm

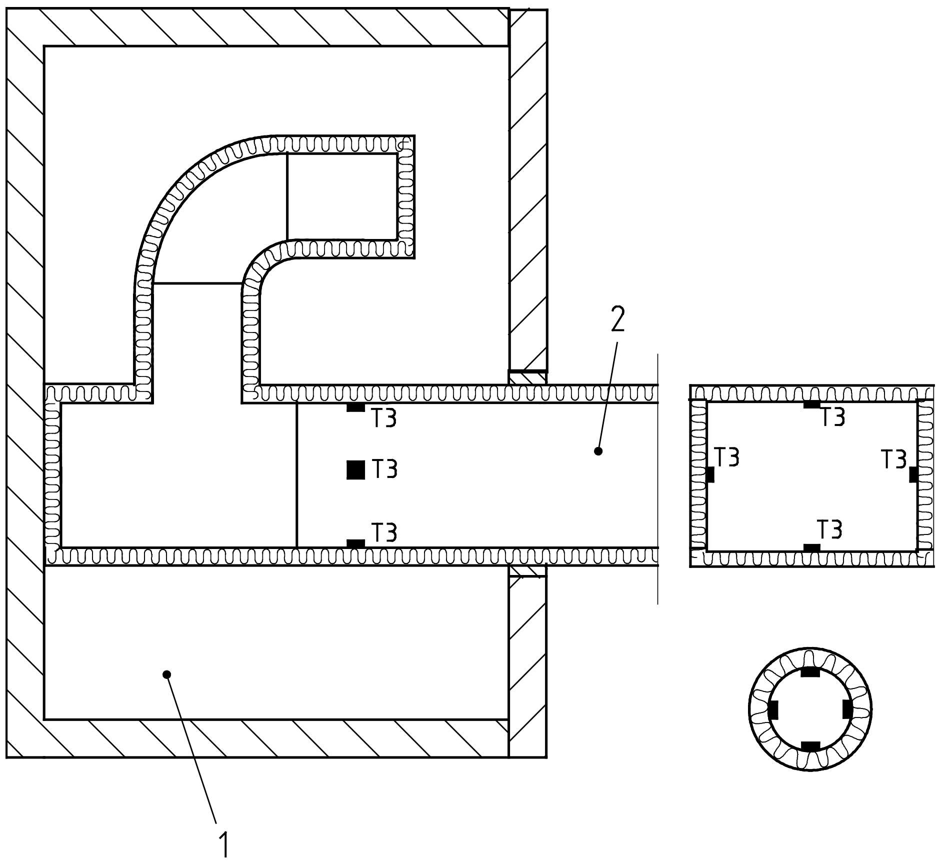


Key

1	furnace
2	fire resisting duct
3	supporting construction
Ts	maximum surface temperature on supporting construction
T1	surface thermocouples for determining maximum temperature
T2	surface thermocouples for determining the average and maximum temperature
Ts, T1, T2	minimum of one of each side of the duct
▬	surface thermocouples

Figure 11 – Location of surface thermocouples (penetration example 3)

All dimensions in mm



Key

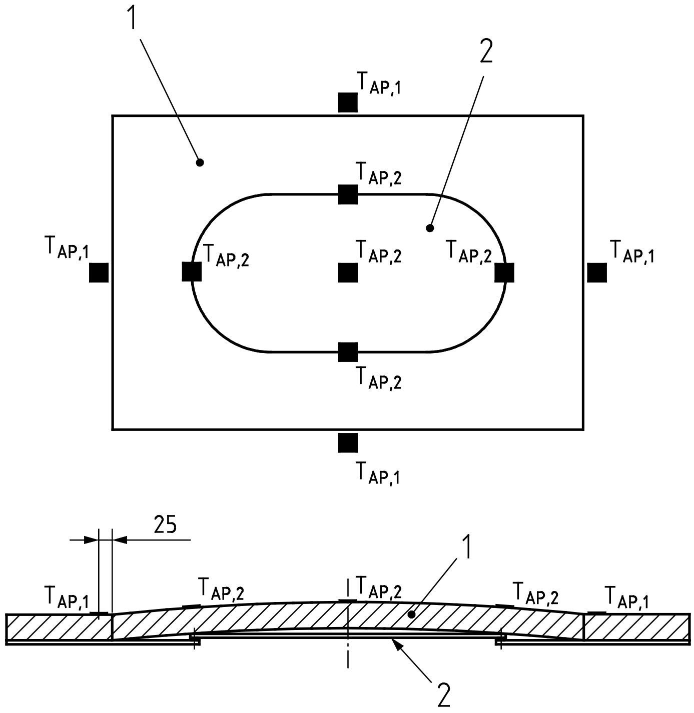
1 furnace

2 duct A

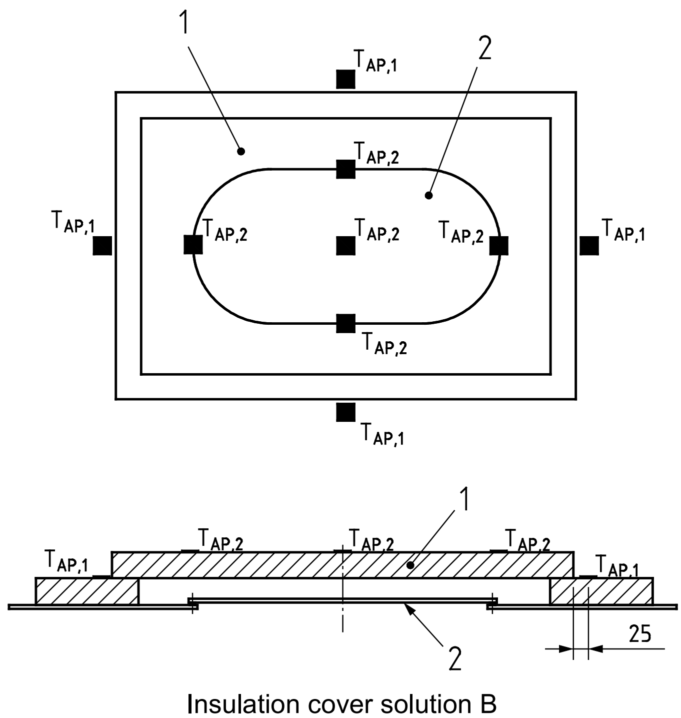
T3 surface thermocouples for determining the average and maximum temperature

Figure 12 – Interior surface thermocouples for the use of combustible internal linings

All dimensions in mm



Insulation cover solution A



Insulation cover solution B

Key

1 insulation cover

2 access panel

Figure 13 – Location of surface thermocouples on access panel (duct B)

All dimensions in mm

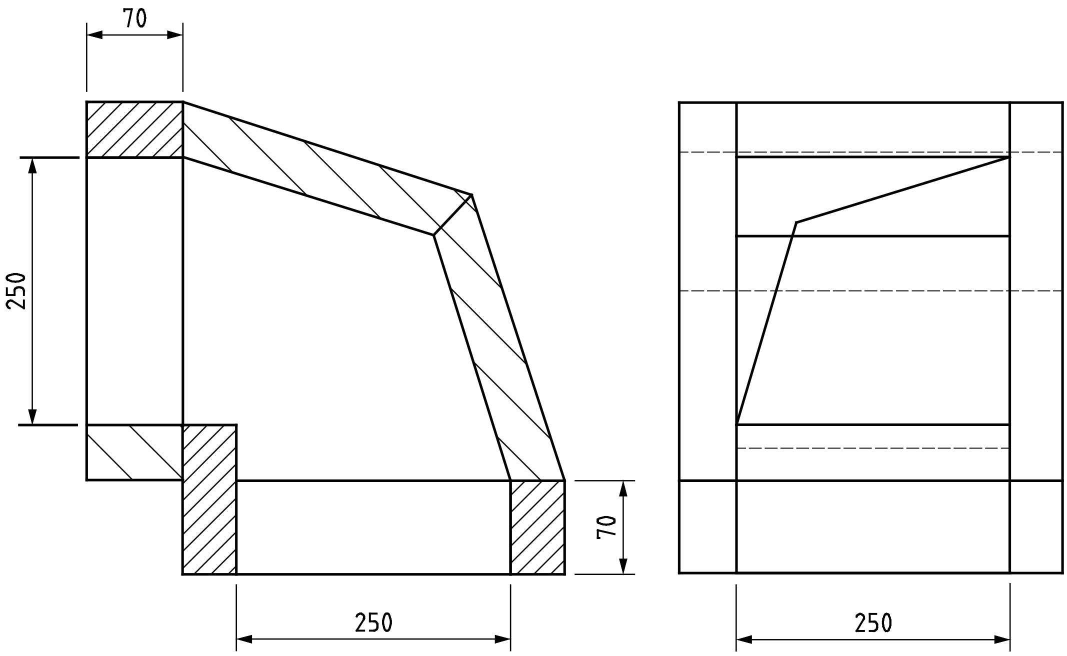
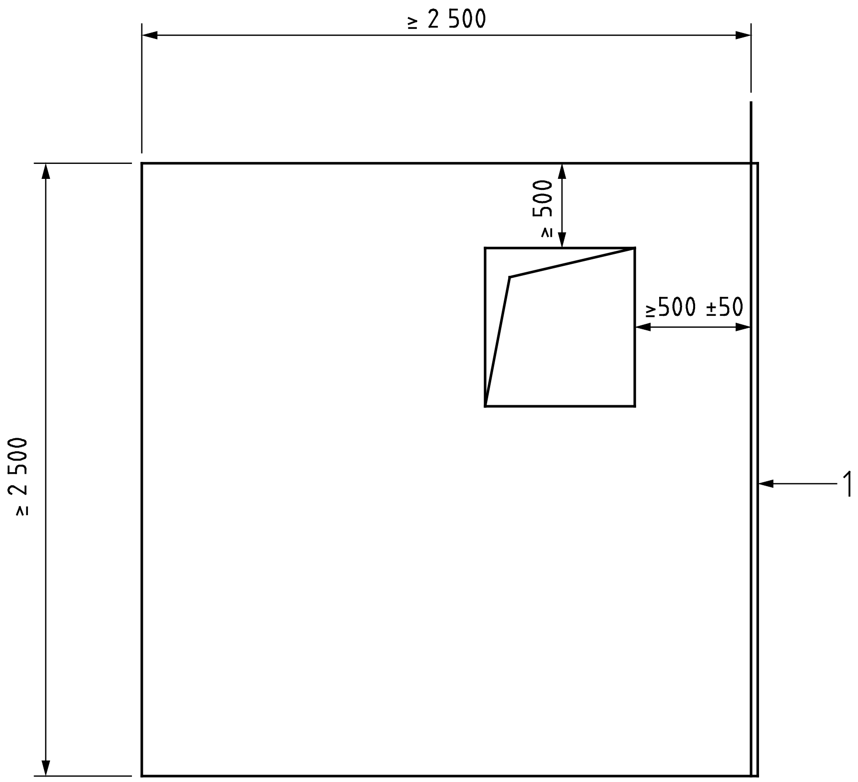


Figure 14 – Detail segmented bend – example – see Figure 2 and 3 for duct A

All dimensions in mm

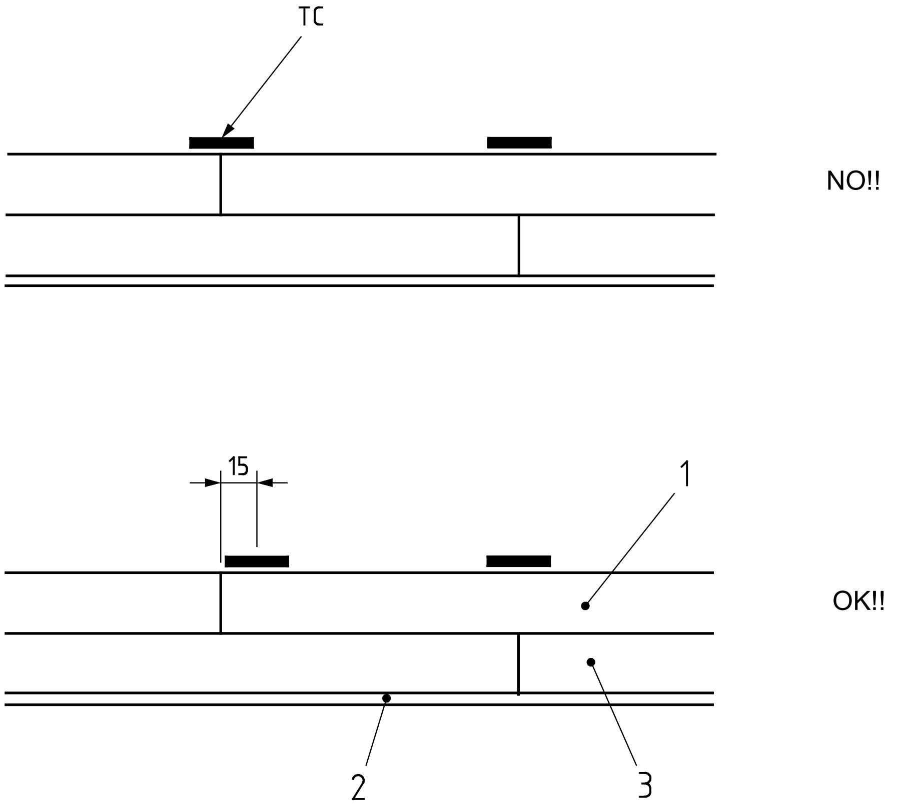


Key

1 free edge

Figure 15 – Clear spacing between outer edge of penetration to edges of flexible supporting walls

All dimensions in mm



Key

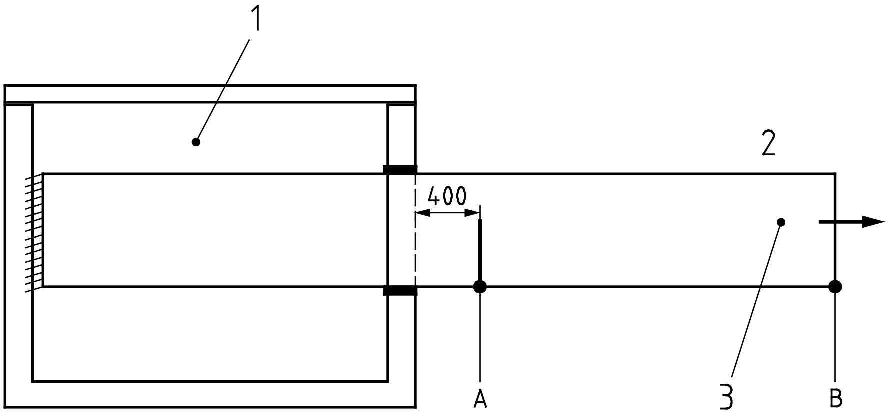
1 outer insulation layer

2 steel duct

3 inner insulation layer

Figure 16 – Additional thermocouples on the outer Insulation layer

All dimensions in mm



Key

1 inside furnace

2 outside furnace

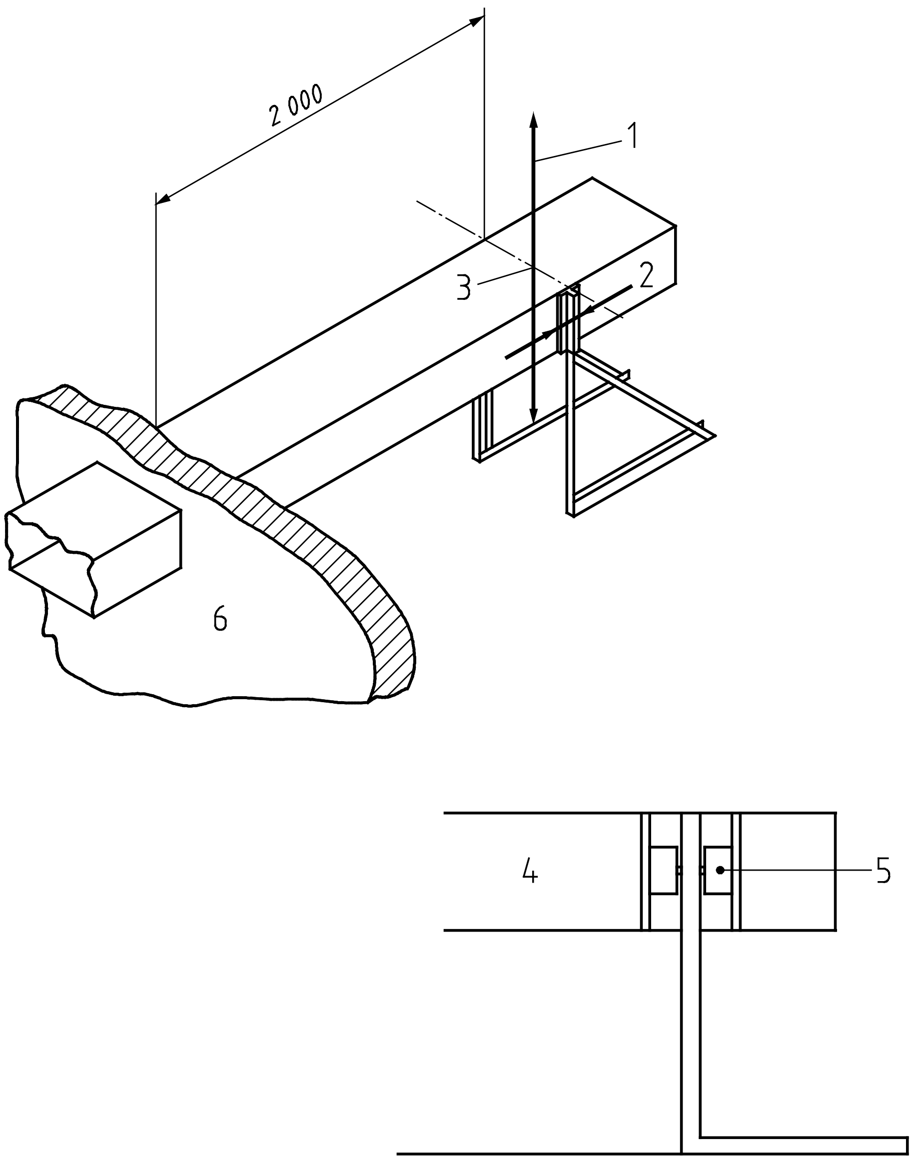
3 duct A

A expansion/contraction measurement at the penetration point – underside of the duct

B expansion/contraction measurement at the end of the duct

Figure 17 – Placement of expansion / contraction measurement

All dimensions in mm



Key

1 allow movement in both directions

2 resist movement in both directions

3 location of measuring device for restraint forces

4 duct

5 stiff load cells (method for applying and measuring restraint)

6 furnace

Figure 18 – Restraint of duct B outside the furnace

Annex A
(informative)

General guidance

A.1 General

The following explanatory notes are intended to serve as guidance for the planning, performance and reporting of a fire resistance test carried out in conformity with this European Standard.

A.2 Notes on apparatus

A.2.1 Volume flow measuring station

The condensing device is used to remove water vapour, produced by the combustion process and / or emerging from the duct materials, that may affect the gas flow measurement. The content of steam is dependent on the material used in the test specimen. The use of a condensing device should exclude the influence of steam.

To ensure that the condensing device meets this objective a requirement has been introduced that the temperature at the measuring device should not exceed 40 °C. It is for the test laboratory to provide a condensing device of adequate capacity to meet this requirement.

A.2.2 Extraction fan

A fan which can provide up to 600 m^3/h air flow, at up to 500 °C, and 1000 Pa pressure should be adequate for testing the standard sizes of ducts given in Clause 6.

A fan for extracting gas from duct B, with a suction capacity of at least twice the velocity in the cross-section of the duct (required capacity : V_n = 3 m/s x 1 m x 0,25 m = 0,75 m^3/s), is sufficient to produce the required air velocity in the ducts of 3m/s.

It may be necessary to provide a supply of fresh air (dilution air) into the extract fan to enable the hot gases to be cooled before passing through the fan. Irrespective of this, the fan shall be capable of extracting gases up to 300 °C.

The fan shall be able to provide sufficient gas flow even when deformation of the duct reduces its cross-sectional area by up to 25 %. Any larger decreases in cross-sectional area will almost inevitably be accompanied by an integrity failure and therefore this can be disregarded for determining the fan capacity.

The regulation of the gas flow can be achieved by installing a flow rate controller just before the fan.

A.3 Notes on test specimens

A.3.1 Design

The test specimen should be representative of duct installations in practice.

The cross-section sizes have been selected to cover the most common sizes of ducts used in air distribution systems.

It is recommended that ducts should be tested with compensators where expansion or contraction is likely to be significant. This means that joints, suspension and fixing devices, bolts etc., should be included and mounted in accordance with the manufacturer's instructions. The distance separating joints and the span between supports should be sufficient to enable interpolation within a range of other smaller dimensions to be made.

In most cases the largest ducts that are likely to be tested are those which can be accommodated in the furnace whilst maintaining the specific velocity in the duct of 3 m/s. Unjustifiable extrapolation to ducts restrained in a different manner, supported at greater intervals or of a larger size, should not be made. Care should be taken when making any assessment of the performance of ducts, which do not entirely conform in practice with the conditions represented in the test. Larger cross-sections of ducts may be tested provided any surface of the duct is not closer than 500 mm to the furnace walls, floor or roof.

Distortion of rectangular ducts is generally more severe than distortion of square or round ducts. The longest side of the horizontal specimen should normally be orientated horizontally in the furnace.

This European Standard requires the testing of a minimum length of 4,0 m for horizontal ducts and 2,0 m for vertical ducts inside the furnace and 2,5 m and 2,0 m respectively outside the furnace. These lengths have been chosen in order to use the fire test furnaces available in most countries.

A.3.2 Thermal expansion and contraction

A.3.2.1 Effect on supporting constructions

During fire exposure the ducts can expand or shrink due to high temperatures. This may cause premature failure of a non-load-bearing lightweight partition if the duct is fixed to it or butts against it. The expansion or contraction of the duct will apply a force to the supporting construction.

A.3.2.2 Effect on joints, attachments, etc.

During a fire test, joints, attachment devices and a representative wall or floor with fire stopping are considered as being parts of the duct system being evaluated. Alternative joints, attachment devices, fire-stopping etc., should not be used unless it can be shown that the performance in respect to integrity will not be worse and that the force on the wall or floor resulting from expansion or contraction will not be greater.

A.3.2.3 Restraint

In some end use situations horizontal ducts, with or without applied fire protection outside the fire compartment, are subject to rigid constraint against elongation. This may result from building works e.g. a wall against which the duct abuts, or because the rest of the duct assembly outside the fire compartment will itself provide restraint e.g. ducts with short, rigid supports. In these situations full restraint is reproduced in duct B. This is provided (2000 ± 200) mm from outside the furnace and also at the end of the duct inside the furnace. The restraint in the furnace is provided by either by the furnace wall or by an independent structure.

A.4 Notes on test conditions

A.4.1 Temperature-time development

If the ventilation ducts are assumed to be subject to a fully developed fire, the temperature-time curve according to EN 1363-1 is chosen. For information on other temperature regimes see EN 1363-2.

A.4.2 Anticipated pressure ranges

The movement of air in a duct passing through a compartment on fire, and which has no openings to that compartment, may create an underpressure on the duct walls which may encourage the fire to exploit any cracks which develop in the duct. An underpressure of (300 ± 15) Pa in horizontal duct A has been chosen as the underpressure at which any integrity failure of the specimen within the furnace should be measured. Applications for higher pressure levels should be assessed on an individual basis. Guidance for applications for higher pressure levels are given in EN 15882-1.

A.5 Notes on procedure

A.5.1 Air velocity in duct B

The velocity in the duct will be determined by multiplying the velocity recorded in the velocity measuring station by the ratio between the cross sectional area of the measuring station and the duct.

A.5.2 Evaluation of duct in overpressure conditions

The method of test does not describe a procedure for evaluating ducts in overpressure conditions. The field of direct application allows the result of a test to apply up to an overpressure condition of 300 Pa. If in practice, part of a duct system is to be subjected to higher overpressure, then an additional evaluation may be carried out. This may be undertaken by reversing the fan and subjecting an additional duct A specimen to the specified overpressure. All other procedures and requirements for duct A should be followed. Guidance for applications for higher pressure levels are given in EN 15882-1.

A.5.3 Insulation and integrity

The procedure includes periods during which the fans are running, interrupted by periods when the "fan off" situation is simulated (duct B). The regime is used to enable a check of the insulation and integrity properties to be made in various typical circumstances, but it is not representative of conditions in practice as far as any one duct is concerned.

Assuming failure of the ventilation fan in the event of a fire, the temperature of the gases within an insulated duct exposed on the exterior to fire conditions, will rise due both to heat transfer through the duct wall and to any failure in integrity.

In the event of a fan continuing to operate, the overpressure from a supply fan will normally exceed the buoyancy pressure of the fire, preventing fire gases entering the system; any negative pressure differential maintained by an extraction fan will only serve to assist the evacuation of hot gases to the atmosphere.

A.6 Notes on performance criteria

The importance of the various failure criteria of integrity, insulation and leakage may vary according to whether the duct is a normal ventilation duct or with internal lining as described above. Where internal combustible linings are used, additional temperature measuring points have been specified, together with a criteria of 140 °C/180 °C, to reduce the possibility of ignition of combustible materials inside the duct igniting when the duct is exposed to an external fire.

Bibliography

[1] EN 520 *Gypsum plasterboards — Definitions, requirements and test methods*

[2] EN 1363-2, *Fire resistance tests - Part 2: Alternative and additional procedures*

[3] EN 13501-1, *Fire classification of construction products and building elements — Part 1: Classification using data from reaction to fire tests*

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