BRITISH STANDARD

BS EN
1366-5:2010

Fire resistance tests for service installations

Part 5: Service ducts and shafts

ICS 13.220.50; 91.060.40

BSI
British Standards

National foreword

This British Standard is the UK implementation of EN 1366-5:2010. It supersedes BS EN 1366-5:2003 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee FSH/22/9, Fire resistance tests procedures and smoke extractions and dampers.

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

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a British Standard cannot confer immunity from legal obligations.

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Foreword

This document (EN 1366-5:2010) 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of an identical text or by endorsement, at the latest by September 2010, and conflicting national standards shall be withdrawn at the latest by September 2010.

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 1366-5:2003.

This document includes a bibliography.

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Introduction

The purpose of this test is to measure the ability of a service duct or shaft to resist the spread of fire from one fire compartment to another with fire attack from inside or outside the duct or shaft. The test specimens incorporate joints and access openings as intended in practice and are suspended as they would be in practice. Test specimens of service ducts are not loaded as in practice but a standard load is included to represent a typical service load. Test specimens of service shafts are not loaded as in practice, but a standard load is included to represent a typical service load.

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 horizontal service ducts and vertical service shafts, which pass through walls or floors and enclose pipes and cables. The test examines the behaviour of ducts and shafts exposed to fire from outside and from inside the duct. This European Standard is intended to be read in conjunction with EN 1363-1.

This European Standard does not examine the risk of fire spread as a result of thermal conduction along the piping installed in service ducts or shafts, or thermal conduction through the media these pipes carry. It does not cover the risk of damage produced by thermal elongation or shortening of tubes and cables as a result of fire, or damaged pipe suspensions. This European Standard does not give guidance on how to test one, two or three sided service ducts or shafts.

NOTE Guidance on testing service ducts and shafts of less than four sides will be covered in the extended field of application rules being developed by CEN/TC 127.

This test is unsuitable for evaluating service ducts with internal barriers at walls and floors.

Whilst the walls of service ducts or shafts tested to this method may provide specified levels of integrity or insulation, testing to this European Standard does not replace the testing of the functional endurance of small electrical cables which is covered in EN 50200.

Fire resistance testing of ducts for air distribution systems is covered in EN 1366-1.

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 1366-3, *Fire resistance tests for service installations — Part 3: Penetration seals*

EN ISO 898-1:2009, *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 898-1:2009)*

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

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 1363-1:1999, EN ISO 13943:2000 and the following apply.

3.1
service duct
horizontal duct enclosing combustible or non-combustible services, such as pipes or cables

3.2
service shaft
vertical shaft enclosing combustible or non-combustible services, such as pipes or cables

3.3
shutter of access opening
openable door or panel allowing for access to the services within the duct or shaft

3.4
supporting construction
wall, partition or floor which the duct passes through in the test

4 Test equipment

4.1 General

In addition to the test equipment specified in EN 1363-1, the following are required.

4.2 Furnace

The furnace shall be capable of subjecting service ducts and shafts to the standard heating and pressure conditions specified in EN 1363-1 and be suitable for testing horizontal ducts (see Figures 1 and 2) or vertical shafts (see Figures 3 and 4).

4.3 Loading equipment

Stranded steel cables are used to apply load to the bottom internal face of the service duct to represent service loading, or any other equivalent equipment.

4.4 Gas extraction equipment (optional)

If for safety reasons a laboratory requires to extract gases away from the open end of the duct or shaft, this shall not influence the test conditions.

5 Test conditions

5.1 Furnace

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

5.2 Loading

Horizontal service ducts shall be loaded when supporting service installations. In this case, the load shall be representative of that used in practice.

Vertical service shafts shall not be loaded except in the two following situations:

— when supporting service installations. In this case, the load shall be representative of that used in practice;

— when the service installation shaft is not fixed to each floor or when the height between two supports is greater than 5 m. In this case a weight load shall be added to the shaft length of the next floor.

6 Test specimen

6.1 Size

6.1.1 General

Any size of duct or shaft may be tested as required by the sponsor. However, sizes other than those in Tables 1 and 2 may have restricted direct field of application.

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.

Table 1 — Minimum length of test specimen

Orientation	Minimum length m			
	Inside furnace		Outside furnace	
	fire outside	fire inside	fire outside	fire inside
Horizontal duct	4,0	0,25	2,0	2,5
Vertical shaft [a]	2,0	0,25	2,0	2,0
[a] See also 5.2.				

6.1.3 Cross-section

The standard sizes of duct and shaft shall be as given in Table 2.

Table 2 — Cross-section of test specimen

Exposure conditions		Width mm	Height mm
Fire inside		1 000 ± 10	500 ± 10
Fire outside	size (1)	200 ± 10 [a]	200 ± 10 [a]
	size (2)	1 000 ± 10	500 ± 10
[a] Or the smallest size intended in practice.			

6.2 Number

One test specimen shall be tested for each type of orientation, exposure conditions and cross-section (see Table 2).

6.3 Design

6.3.1 General

The test shall be made on a test specimen, representative of the complete service duct assembly, on which information is required.

6.3.2 Duct and shaft arrangement

6.3.2.1 General

Ducts shall be arranged as shown in Figures 1 and 2 and shafts shall be arranged as shown in Figures 3 and 4. Service ducts or shafts with fire exposure from outside will have no openings in the furnace (except access panels). For service ducts or shafts exposed to an internal fire, the end of the duct facing into the furnace shall be left open. No ducts or shafts shall contain anything other than the standard cables for loading. The exposure condition (fire inside or fire outside) shall be as specified by the sponsor.

Where used in practice, each service duct or shaft shall incorporate one access opening as follows:

— fire outside: inside furnace at mid-span of exposed section of duct;

— fire inside: as shown in Figure 2 (the dimensions may be applied also to vertical shafts).

For the test, the access opening shall be at the bottom of the duct. The size of the access opening shall be representative of practice.

Vertical shafts shall be arranged as shown in Figures 3 and 4 and shall penetrate through the furnace roof slab/supporting construction. The shafts shall be fixed at the furnace roof level as they would be fixed in practice when penetrating a floor (as specified by the sponsor).

6.3.2.2 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 for every layer of fire protection material, both inside and outside the furnace and in any steel duct.

Outside the furnace, the joint in the outer layer of the fire protection material shall be no further than 700 mm from the supporting construction and no nearer than 100 mm to thermocouples T2 in accordance with 9.1. Inside the furnace, the joint in the outer layer of fire protection material shall be located at approximately mid-span. The location of joints in inner layers shall be as specified by the sponsor.

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 at mid-span lies midway between them. Centres of the suspension devices shall be specified by the sponsor and shall be representative of practice.

6.3.2.3 Joints in vertical service shafts

For the vertical shaft exposed to fire from inside, the test configuration shall include at least one joint inside the furnace and one joint outside it. There shall be at least one joint for every layer of fire protection material, both inside and outside the furnace and in any steel duct.

Outside the furnace, the joint in the outer layer of the fire protection material shall be no further than 700 mm from the supporting construction and no nearer than 100 mm to thermocouples T2 in accordance with 9.1. Inside the furnace, the joint in the outer layer of fire protection material shall be located at approximately mid-span. The location of joints in inner layers shall be as specified by the sponsor.

For the vertical shaft exposed to fire from outside, the test arrangement shall include at least one joint inside and one joint outside the furnace. There shall be at least one joint both inside and outside the furnace in every layer of fire protection material.

Outside the furnace, for both the shaft exposed to fire from inside and that exposed to fire from outside, there shall be a joint in the outer layer of the fire protection material no further away than 700 mm from the supporting construction but it shall not be within 100 mm of thermocouples T2.

Inside the furnace, the joint in the outer layer of fire protection material exposed to fire from outside shall be located at approximately mid-span. For multi-layer systems, the location of joints on the inner layer shall be specified by the sponsor.

7 Installation of test specimen

7.1 General

The fire stopping at the penetration through the supporting construction shall be as intended in practice. If the width of the gap for fire stopping around the duct at the furnace penetration point is not specified, a width of 50 mm shall be used.

Where the duct or shaft 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 from the duct/shaft or the outer edge of any fire stopping.

Parts of the ducts or shafts within the furnace shall be exposed to fire from all sides over their whole length. Where vertical shafts are not in practice to be fixed to each floor, then the mass of shafts above shall be reproduced in the test. The simulated height and the mass represented during the test shall be stated in the test report.

There shall be a clearance of (500 ± 50) mm between the top of the horizontal duct and the ceiling, and also at least 500 mm between the underside of the horizontal duct and the floor. Similarly, there shall be a clearance of at least 500 mm between the sides of ducts or shafts and furnace walls. At the furnace wall remote from the penetration point the duct shall be fully restraint in all directions.

The test specimen shall be installed in a manner representative of its use and practice. For the test the loading occurring in practice by cables, pipes and cabletrays (if not included in the test specimen) shall be taken into account by stranded steel cables as replacement.

Apply the stranded steel cables along the complete length of the bottom, inside face of each horizontal service duct to represent a uniformly distributed load. The minimum load (f) shall be:

$$f = 20 \times \frac{W}{1000}$$

where

f is the load in kilograms per metre (kg/m);

W is the width of service duct in millimetres (mm).

To ensure uniform loading, a minimum of three cables uniformly distributed across the width shall be used, but the depth of the cables shall not exceed 50 mm above the bottom inside face of the duct (a 30 mm diameter stranded steel cable has a mass of approximately 3,8 kg/m).

7.2 Standard supporting construction

Where the type of supporting construction to be used in practice is not known, the standard supporting constructions described in EN 1363-1 shall be used.

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 that supporting construction.

8 Conditioning

8.1 General

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

8.2 Sealing materials prepared with moisture

Hygroscopic materials used to seal the gap between the supporting construction and the duct where the gap is ≤ 10 mm wide shall be conditioned for one day before fire testing.

Hygroscopic materials used to seal the gap between the supporting construction and the duct assembly where the gap is > 10 mm wide shall be conditioned for seven days before fire testing.

9 Application of instrumentation

9.1 Thermocouples

9.1.1 Furnace thermocouples (plate thermometers)

Plate thermometers shall be provided in accordance with EN 1363-1.

For vertical shafts, the plate thermometers shall be orientated so that side "A" faces the walls of the furnace opposite the ducts being evaluated.

For horizontal ducts, side "A" of the plate thermometers positioned below the duct being evaluated shall face the floor of the furnace. For plate thermometers positioned above the duct being evaluated, side "A" shall face the roof of the furnace.

9.1.2 Thermocouple locations

9.1.2.1 General

The temperature of the test specimens shall be measured in accordance with EN 1363-1.

9.1.2.2 Temperature at the penetration of the service duct or shaft through the wall or floor

The position of thermocouples at the point of penetration of the duct or shaft through the wall or floor is shown in Figures 5 to 7 for a number of different penetration details. Additional thermocouples T1 shall be located in positions on the outer surface of the fire protection material to coincide with all joints (inner layer joints as well). Thermocouples T2 shall be used to determine the mean temperature rise, and thermocouples T1 and T2 shall be used for determining maximum temperature rises.

9.1.2.3 Temperature of air inside duct or shaft exposed to fire from outside

Thermocouples, reference T3, shall be located on the centre line of the end piece of the specimen, 50 mm and 100 mm below the top of the specimen at the positions shown in Figure 4. For ducts they shall be located 50 mm and 100 mm from the opening to the outside (see Figure 1).

9.1.2.4 Temperature on unexposed face of access door or panel

Surface thermocouples shall be located as shown in Figure 8. Thermocouples around the edges of the door/panel shall be located with the centres of the disc 25 mm from the closing edges. Thermocouples on the access door/panel shall be at the centre and at the centre of each quarter.

9.1.2.5 Temperature of the protected suspension device

If the suspension devices within the furnace are protected, a thermocouple shall be positioned on each component of at least two protected suspension devices.

9.2 Pressure

Furnace pressure shall be measured in accordance with EN 1363-1 and the pressure probe(s) located at a position 100 mm below the roof of the furnace.

10 Test procedure

10.1 General

The test shall be carried out using the equipment in Clause 4, and the procedures in this European Standard and EN 1363-1.

10.2 Test measurements and observations

10.2.1 General

Make the following measurements and observations to enable the criteria of integrity and insulation to be assessed.

10.2.2 Integrity

10.2.2.1 Integrity during fire exposure at the outside

a) Look for the formation of cracks and openings in the duct or shaft outside the furnace.

b) Determine the time at which the passage of flames or hot gases causes ignition of the cotton pad according to EN 1363-1, the cotton pad being applied to any crack or hole which develops in the duct or shaft assembly outside the furnace. Measure the size and determine the time at which the size of the gaps exceeds the limits specified in EN 1363-1.

c) Throughout the test, monitor for an integrity failure where the duct or shaft passes through the wall or floor.

d) Throughout the test, collapsing of parts or in full of the duct or shaft inside the furnace or the development of openings shall be observed and the time at which it occurs shall be determined.

e) The time has to be determined, when the temperature at thermocouple T3 passes a value of 300 °C.

10.2.2.2 Integrity during fire exposure at the inside

a) Look for the formation of cracks and openings in the duct or shaft outside the furnace.

b) Determine the time at which the passage of flames or hot gases causes ignition of the cotton pad according to EN 1363-1, the cotton pad being applied to any crack or hole which develops in the duct or shaft assembly outside the furnace. Measure the size and determine the time at which the size of the gaps exceeds the limits specified in EN 1363-1.

c) Throughout the test, monitor for an integrity failure where the duct or shaft passes through the wall or floor.

10.2.3 Insulation (temperature of the surfaces outside the furnace – for both exposure at the inside and exposure at the outside)

Measure the mean and maximum temperatures of the unexposed faces of the test specimens as specified in 9.1.2 and in accordance with EN 1363-1, using a roving thermocouple to locate points of high temperature not covered by the fixed thermocouples.

10.2.4 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 will cover the general behaviour of the duct or shaft, which direction it is deflecting in; precise measurements are not required;

b) the emissions of smoke from the duct or shaft outside the furnace, for example, attributable to its coverings and/or lining. Only limited observations may be possible and in view of the subjective nature of such observations; the information should be used with some degree of caution.

10.3 Termination of the test

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

11 Performance criteria

11.1 Integrity

Integrity failure shall be deemed to have occurred if any observations are made as described in EN 1363-1 (see also 10.2.2). With fire attack at the outside integrity failure is deemed to have occurred also when the duct or shaft inside the furnace is collapsing in parts or totally or when the temperature at thermocouple T3 exceeds the limit value specified in 10.2.2.1.

11.2 Insulation

Insulation failure shall be deemed to have occurred when the temperature rises above initial ambient temperature in the laboratory on the unexposed surface of the test specimen outside the furnace exceed either:

a) 140 °C as a mean value (thermocouples T2 shall be used to determine the mean temperature rise, see 9.1.2.2); and in respect of access panels located outside the furnace, thermocouples Ta (1-5) (see Figure 8); or

b) 180 °C as a maximum value read by any surface thermocouple described in 9.1.2.2, or those described in 9.1.2.4 for access panels located outside 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 1366-5;

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 or shaft and the opening provided in the wall or floor to accommodate the duct or shaft;

d) the details of the supporting construction;

e) the load of the stranded steel cables used for loading the test specimen;

f) any other observations made during the test.

13 Field of direct application of test results

13.1 Walls or floors through which the ducts or shafts lead

A test result obtained for a fire resisting duct or shaft passing through a wall or floor made of masonry, concrete or a partition (without any cavity) is applicable to the same type of wall or floor with a thickness and density equal to or greater than that of the wall or floor used for the test.

13.2 Sizes of ducts or shafts

13.2.1 Fire exposure from outside

13.2.1.1 Service ducts or shafts tested with size (i) and (ii)

The results of ducts or shafts tested with size (i) and (ii) are applicable to all the cross-section dimensions between the minimum and the maximum given in Table 3.

Table 3 — Applicability of results to other dimensions

	Width mm	**Height or depth** mm
Minimum [a]	200	200
Maximum	1 250	1 000
[a] Or the minimum size intended in practice.		

13.2.1.2 Service duct or shaft tested with size (ii) only

The results for ducts or shafts tested with size (ii) only are applicable to all the dimensions between the minimum and maximum given in Table 4.

Table 4 — Applicability of results to other dimensions (tested with size (ii) only)

	Width mm	**Height or depth** mm
Minimum [a]	1 000	500
Maximum	1 250	1 000
[a] Or the minimum size intended in practice.		

13.2.1.3 Service ducts or shafts tested with another size

The results of ducts or shafts which have been tested with another size are only applicable to that size.

13.2.2 Fire exposure from inside

The test result applies to any size smaller than that tested. If the standard size has been tested, then the result applies to a maximum cross-section of 1,25 m × 1,0 m (width × height).

13.3 Admissible services

The results of tests following this standard may be used for shafts which include all usual services. For service ducts with cable trays not included in the test specimen this applies only to a maximum mass of the stranded cables used for testing the specimen.

NOTE 1 A positive assessment of the integrity during exposure from inside supposes that the entrance and exit of installations are in accordance with EN 1366-3.

NOTE 2 It should be noted that some services in normal use and/or in case of fire have significant thermal elongation and can thus lead to a loss of integrity.

13.4 Suspension devices for ducts

13.4.1 Material and sizing

As the test configuration does not allow an assessment of the loadbearing capacity, the suspension devices shall be made of steel and be sized so that the calculated stresses do not exceed the values given in Table 5. This is valid for a maximum length of the hangers of 1,5 m.

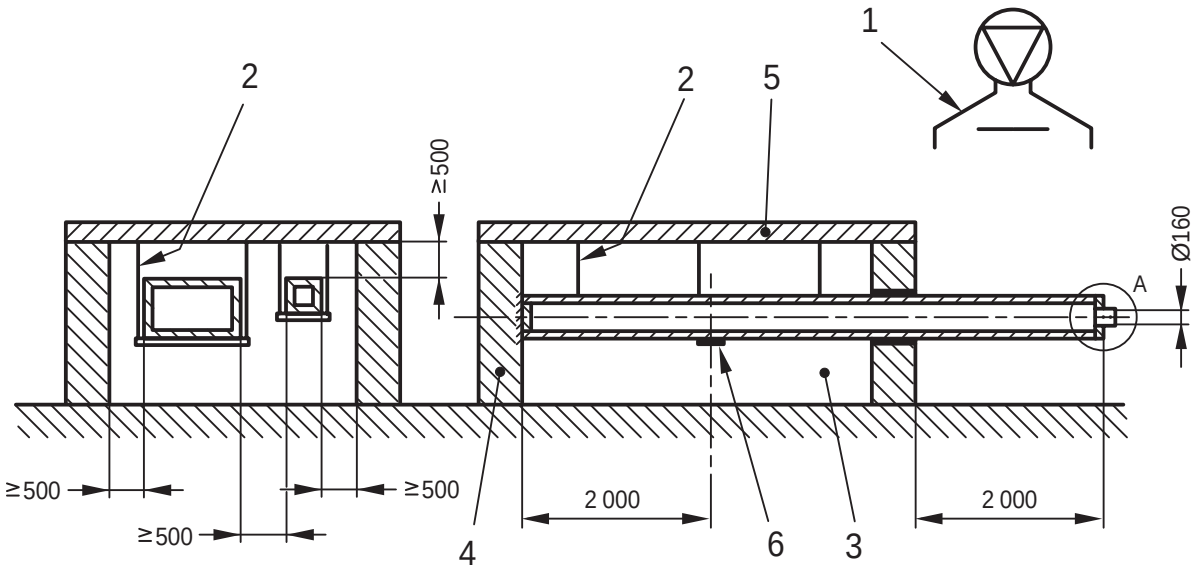
Table 5 — Maximum values of stresses in suspension devices depending on duration of fire resistance

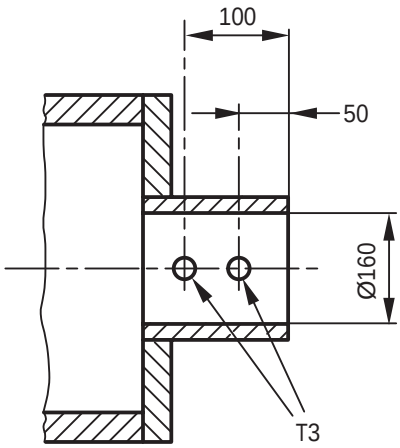
Type of load	**Maximum stresses** N/mm^2	
	Duration of fire resistance	
	≤ 60 min	**> 60 min and ≤ 120 min**
Tensile stress in all vertically orientated components	9	6
Shearing stress in screws of property Class 4.6 to EN ISO 898-1:2009	15	10

13.4.2 Elongation

The elongation in millimetres (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.

13.4.3 Dimensions in millimetres





A

Key

1 Optional fan and extract hood

2 Suspension devices

3 Furnace

4 Furnace walls

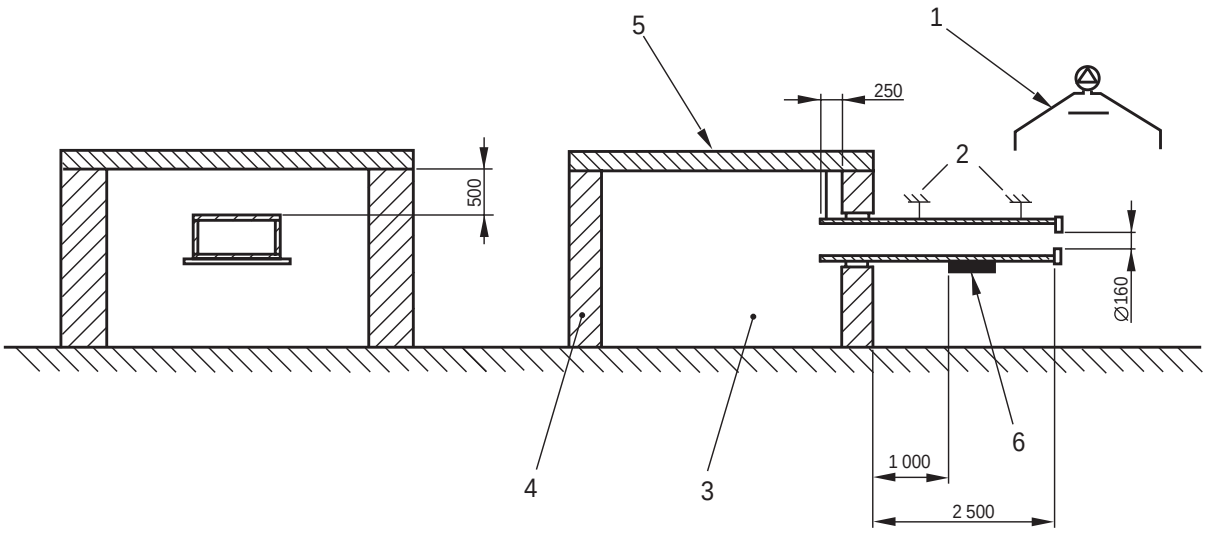
5 Furnace roof

6 Access panel

T3 Thermocouples

Figure 1 — Example of test arrangement for horizontal service ducts (fire exposure from outside)

Dimensions in millimetres



Key

1 Optional fan and extract hood

2 Suspension devices

3 Furnace

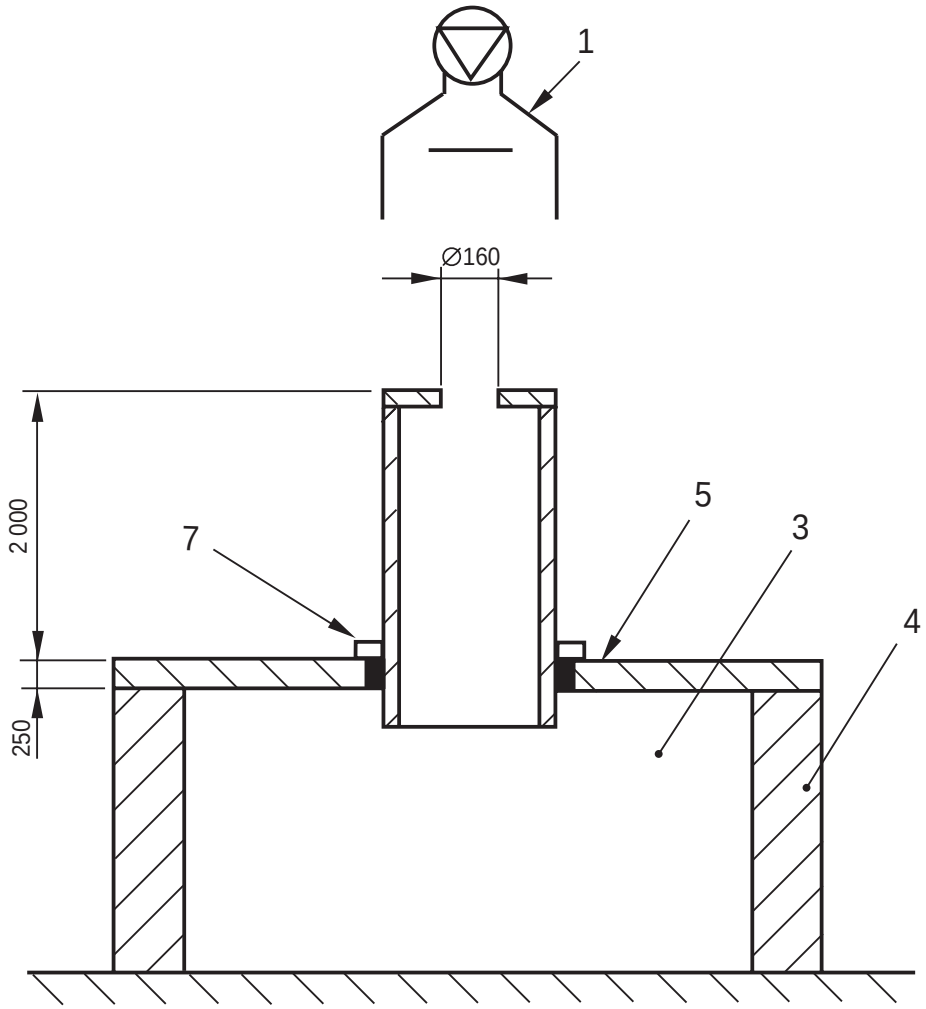
4 Furnace walls

5 Furnace roof

6 Access panel

Figure 2 — Example of test arrangement for horizontal service ducts (fire exposure from inside)

Dimensions in millimetres



Key

1 Optional fan and extraction hood

3 Furnace

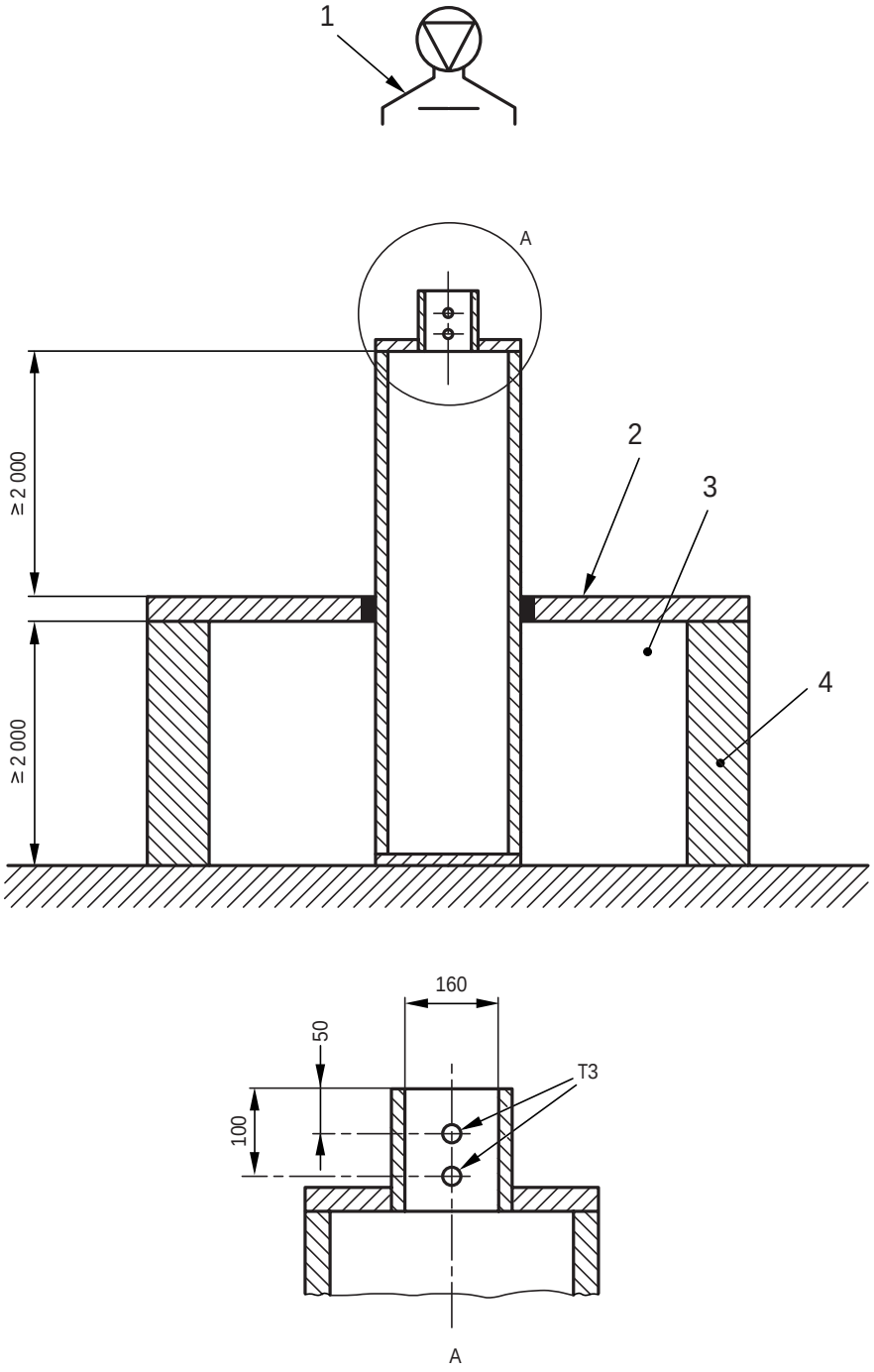
4 Furnace walls

5 Furnace roof

7 Collar to support the load of the shaft by the floor (if intended in practice – see 5.2 and 7.1)

Figure 3 — Example of test arrangement for vertical service shafts (fire from inside)

Dimensions in millimetres



Key

1 Optional fan and extraction hood

2 Furnace roof

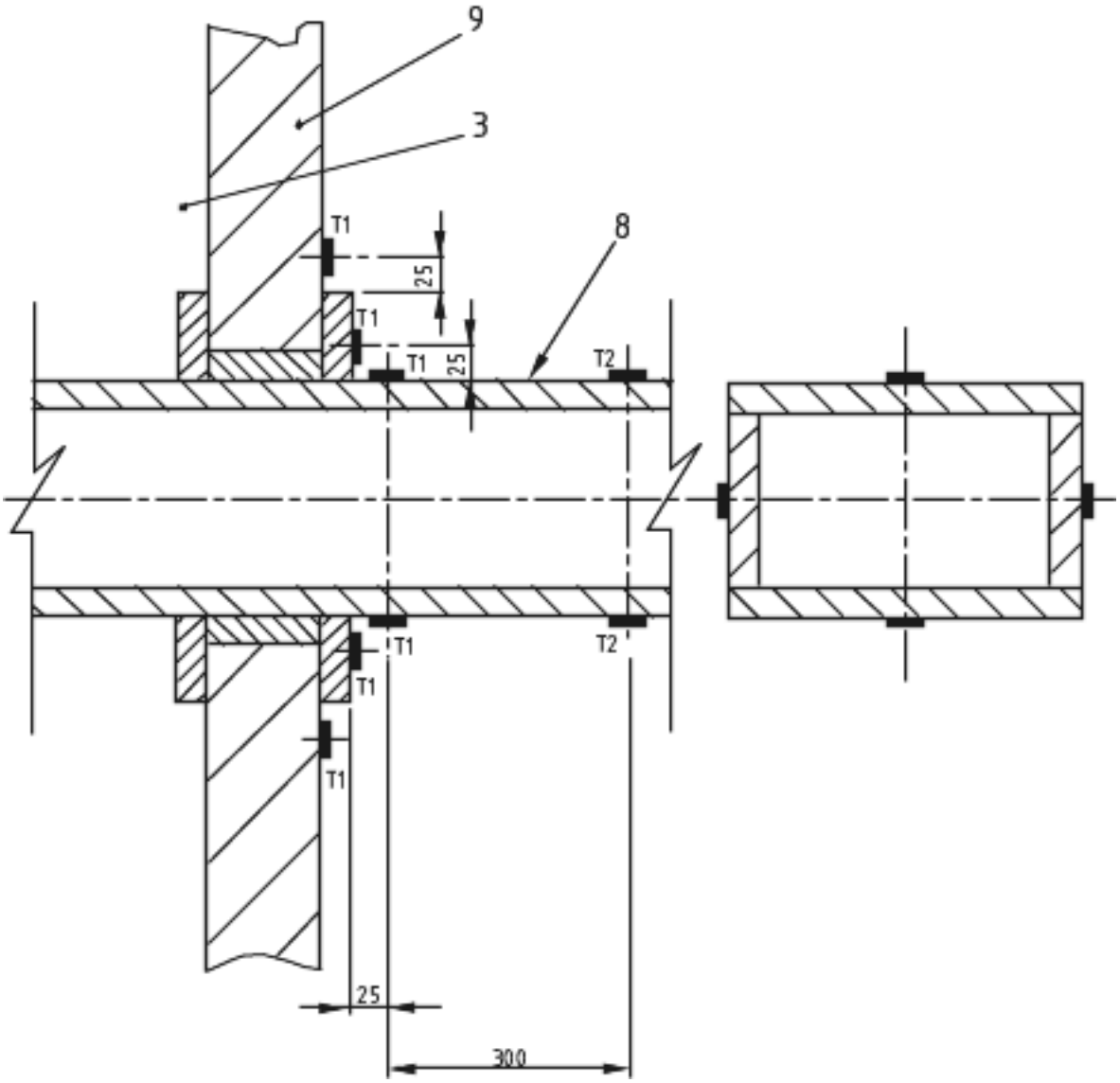
3 Furnace

4 Furnace walls

T3 Thermocouples

Figure 4 — Example of test arrangement for vertical service shafts (fire from outside)

Dimensions in millimetres



Key

3 Furnace

8 Service duct or shaft

9 Supporting construction

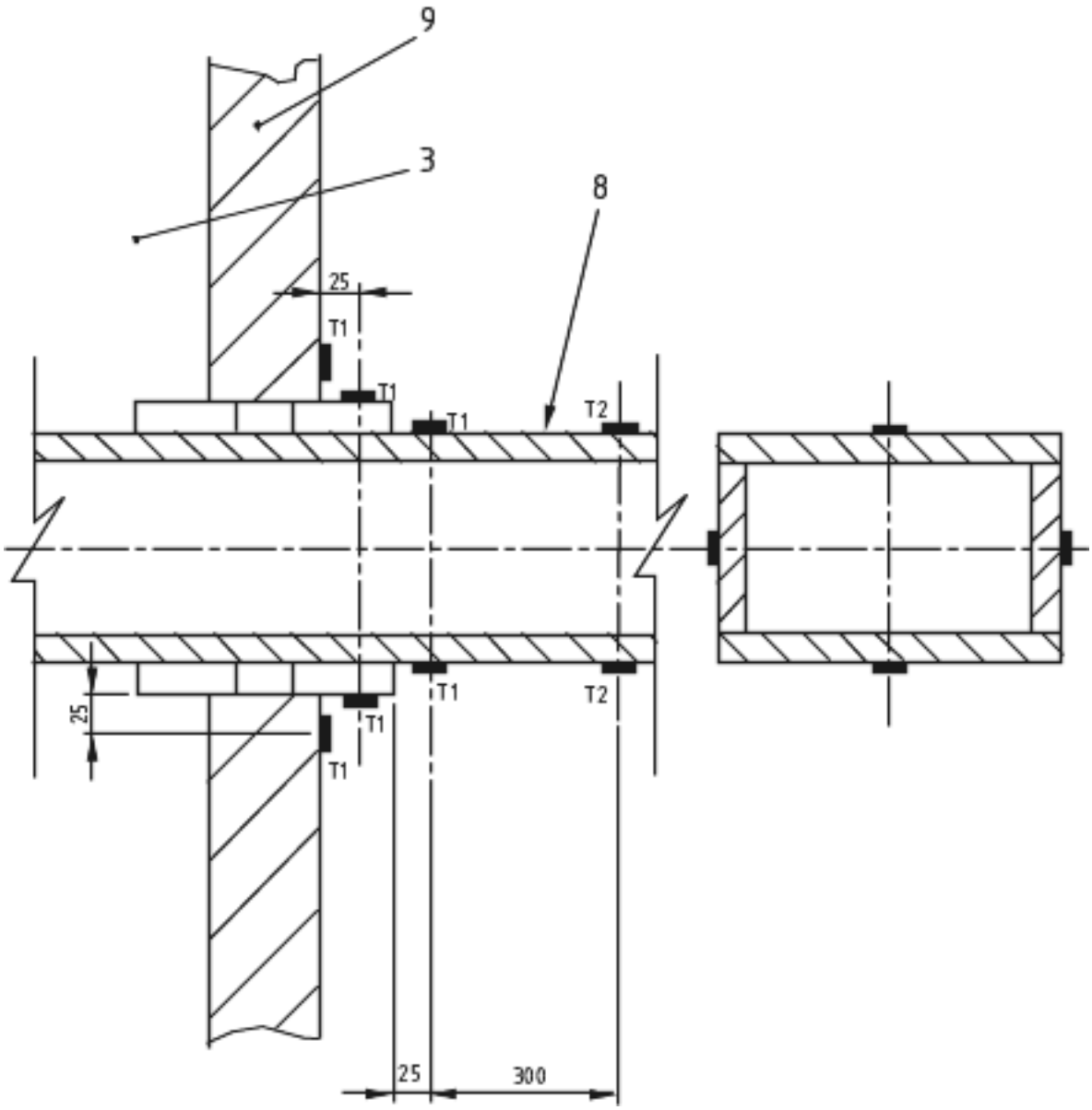
T1 – Surface thermocouple for determining maximum temperature

T2 – Surface thermocouples for determining average and maximum temperature

T1, T2 Minimum of one on each side of the duct or shaft

Figure 5 — Location of surface thermocouples with various penetrations

Dimensions in millimetres



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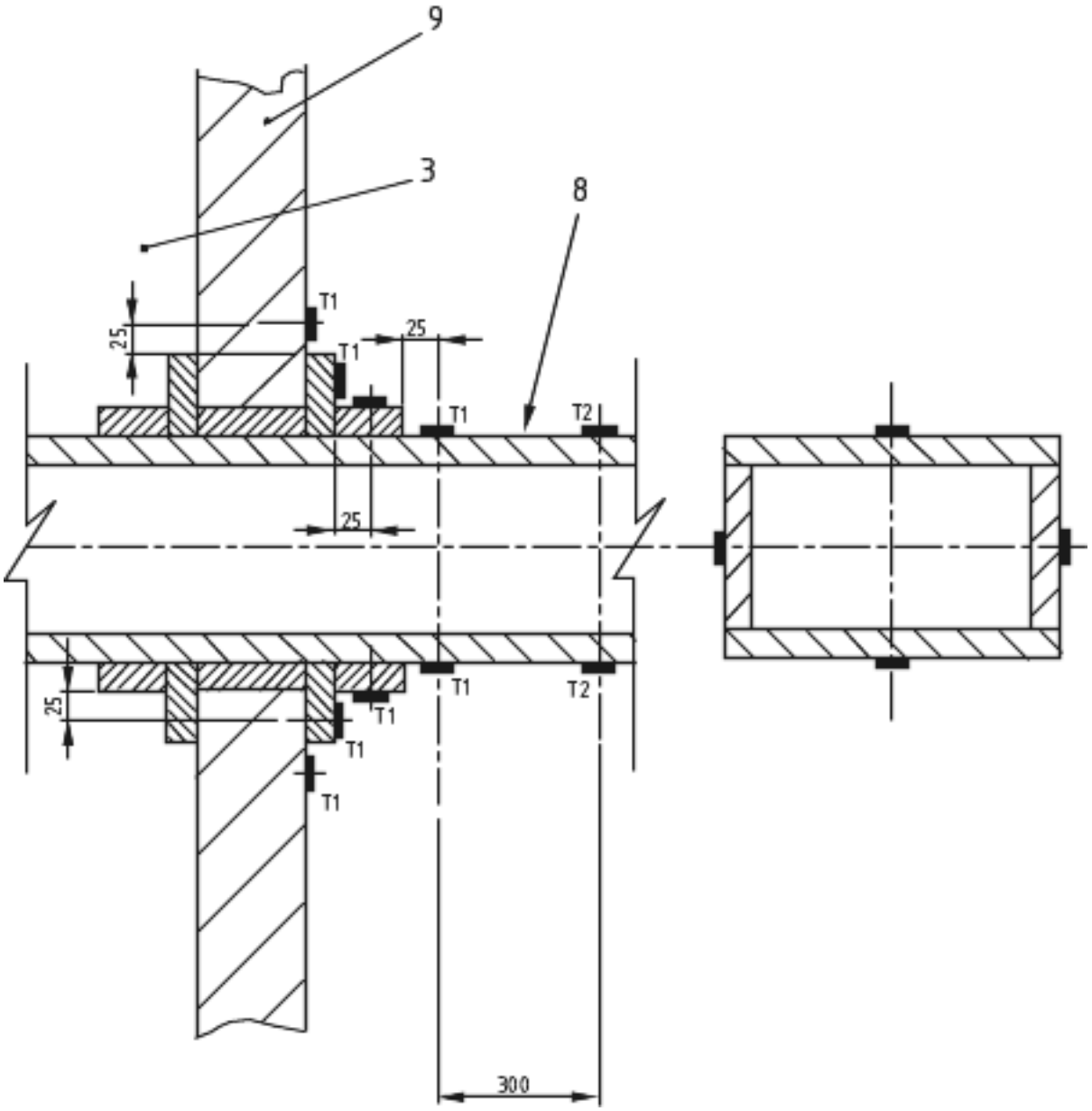
T1, T2 – Minimum of one on each side of the duct or shaft

Figure 6 — Location of surface thermocouples with various penetrations

Dimensions in millimetres



Key

3 Furnace

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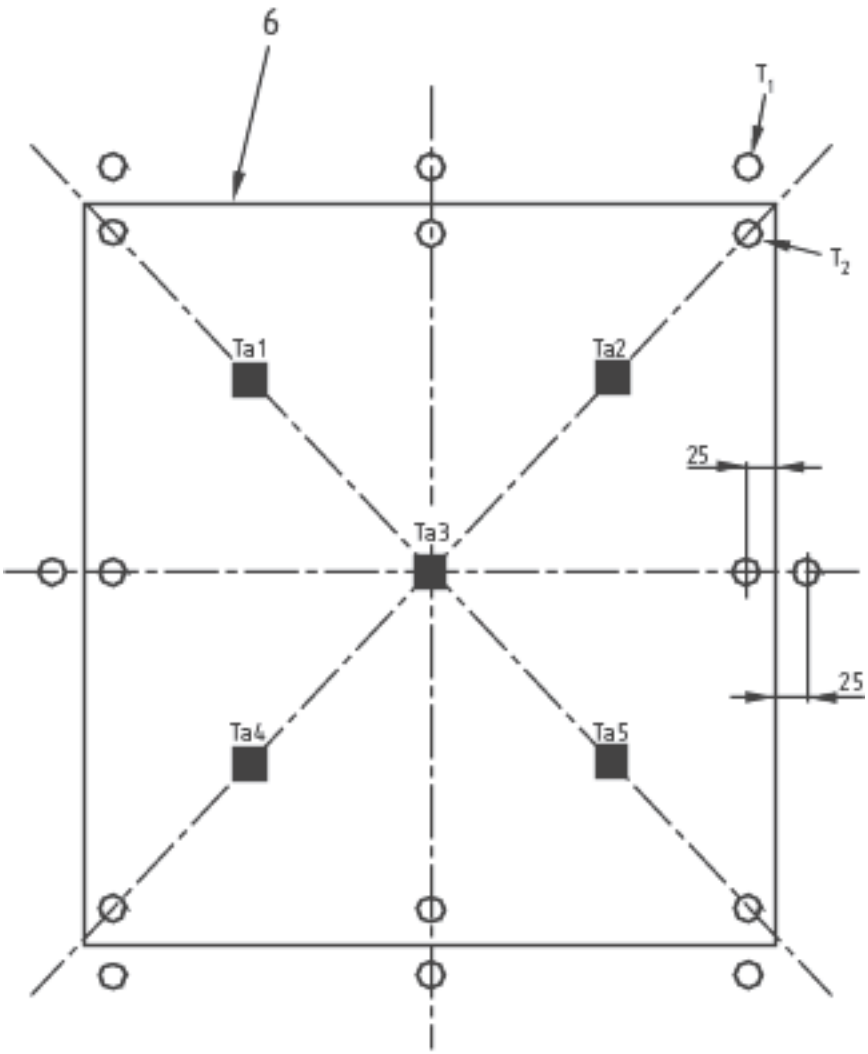
T1 – Surface thermocouple for determining maximum temperature

T2 – Surface thermocouples for determining average and maximum temperature

T1, T2 – Minimum of one on each side of the duct or shaft

Figure 7 — Location of surface thermocouples with various penetrations

Dimensions in millimetres



Key

T_1 Surface thermocouples around perimeter of access panel

Ta Surface thermocouples on access panel

6 Access panel

Figure 8 — Shutters for access openings − Location of thermocouples

Bibliography

[1] EN 1366-1, *Fire resistance tests for service installations — Part 1: Ducts*

[2] EN 520:2004, *Gypsum plasterboards — Definitions, requirements and test methods*

[3] EN 50200, *Method of test for resistance to fire of unprotected small cables for use in emergency circuits*

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