INTERNATIONAL STANDARD

ISO 10294-1

First edition
1996-12-15

Fire resistance tests — Fire dampers for air distribution systems —

Part 1:
Test method

Essais de résistance au feu — Clapets résistant au feu pour des systèmes de distribution d'air —

Partie 1: Méthode d'essai

Reference number
ISO 10294-1:1996(E)

Contents

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 10294-1 was prepared by Technical Committee ISO/TC 92, *Fire safety*, Subcommittee SC 2, *Fire resistance*.

Preparation of this test was necessary because of problems arising from the spread of fire and smoke in buildings through ventilation ducts and other openings in fire-separating walls and floors.

This test should be read in conjunction with ISO 834-1.

ISO 10294 consists of the following parts, under the general title *Fire resistance tests — Fire dampers for air distribution systems*:

— *Part 1: Test method*

— *Part 2: Classification, criteria and field of application of test results*

— *Part 3: Explanatory document*

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Fire resistance tests — Fire dampers for air distribution systems —

Part 1:
Test method

SAFETY WARNING — In order that suitable precautions may be taken to safeguard health, the attention of all concerned in fire testing is drawn to the possibility that toxic or harmful gases may be evolved during the conduct of this test.

1 Scope

This part of ISO 10294 specifies a test method for the determination of the resistance of a fire damper to heat and the passage of smoke and gases at high temperatures.

The general purpose of the test is to evaluate the ability of a damper to prevent fire and smoke spreading from one fire compartment to another through an air distribution system.

NOTE — For classification, criteria and field of application of test results, see ISO 10294-2. For an explanatory document, see ISO 10294-3.

The test method described in this part of ISO 10294 is applicable to fire dampers. It is not intended to be used for dampers used only in smoke control systems.

The method is primarily intended for tests of mechanical devices.

Without modification it is not suitable for testing dampers in suspended ceilings.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO 10294. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this part of ISO 10294 are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 834-1:— [1], *Fire resistance tests — Elements of building construction — Part 1: General requirements.*

ISO 5167-1:1991, *Measurement of fluid flow by means of pressure differential devices — Part 1: Orifice plates, nozzles and Venturi tubes inserted in circular cross-section conduits running full.*

1) To be published.

ISO 5221:1984, *Air distribution and air diffusion — Rules to methods of measuring airflow rate in an air handling duct.*

ISO 10294-2:— [1], *Fire resistance tests — Fire dampers for air distribution systems — Part 2: Classification, criteria and field of application of test results.*

ISO 10294-3:— [1], *Fire resistance tests — Fire dampers for air distribution systems — Part 3: Explanatory document.*

3 Definitions

For the purposes of this part of ISO 10294, the following definitions apply:

3.1 test construction: The complete assembly, consisting of the separating element, damper and duct sections and penetration seals (if any).

3.2 supporting construction: The wall, partition or floor into which the damper and duct section is installed for the test.

3.3 separating element: The wall, partition or floor into which the damper and duct is installed in the building.

3.4 connecting duct: The duct section between the damper or separating element and the measuring station.

3.5 measuring station: The equipment consisting of pipe system with an orifice plate or venturi and an air flow straightener (if any), installed between the connecting duct and the exhaust equipment to determine the volume flow rate of gases passing through the damper under test.

3.6 exhaust equipment: The equipment consisting of a fan and balancing or dilution dampers (if any), to apply and maintain the underpressure in the connecting duct.

3.7 fire damper: A mobile closure within a duct which is operated automatically or manually and is designed to prevent the passage of fire.

3.8 damper actuating mechanism: Mechanism, integral or directly associated with the damper which, when initiated by the damper triggering device, causes the movable component of the damper to change from the "open" to the "closed" position.

3.9 insulated damper: A damper which satisfies the integrity, leakage and insulation requirements of ISO 10294-2.

3.10 uninsulated damper: A damper which satisfies the integrity and leakage requirements of ISO 10294-2.

4 Principles of the test

The damper with its fixing device is built into, or attached directly to, or remotely via a section of ducting to, a fire-separating building element in a manner representative of practice. Tests are performed starting with the damper in the open position so as to expose the actuating mechanism of the damper to furnace conditions. Temperature and integrity measurements are carried out in various parts of the test construction during the test. The tightness of the damper system is measured by direct flow measurements whilst maintaining a constant pressure differential across the closed damper of 300 Pa. For special applications, higher underpressures may be employed. The tightness of the damper in the closed position is also measured at ambient temperature prior to the start of the furnace test.

1) To be published.

As the test conditions and tolerances for the beginning of the fire test are not specified in detail, the fire test enables only a limited assessment of the actuating mechanism to be carried out.

5 Apparatus

The test apparatus specified in 5.1 to 5.8, including the instrumentation, shall be in accordance with ISO 834-1 except where specifically stated otherwise.

An example of a test arrangement is shown in figure 1.

5.1 Furnace, capable of achieving the heating and pressure conditions specified in ISO 834-1.

The damper being tested shall be attached to the connecting duct in accordance with the manufacturers instructions. The connecting duct shall be of all welded construction fabricated from (1,5 ± 0,1) mm thick steel with a width and height appropriate to the size of the damper being tested. The duct shall have a length of 2 × the diagonal dimension of the damper up to a maximum of 2 m. The connecting duct shall be provided with a gas-tight observation port.

5.2 Measuring station, consisting of an orifice plate, venturi, or other suitable device, an air flow straightener (if required) and straight lengths of pipe sized in accordance with ISO 5167-1 and ISO 5221 installed between the connecting duct and the exhaust fan to determine the volume flow rate of gases passing through the damper under test. When testing dampers installed in floors it is still possible to use the measuring station horizontally and a suitable mounting detail is shown in figure 2.

5.3 Exhaust fan system, capable of controlling flow rates and maintaining a pressure difference between the connecting duct and the furnace of the required pressure when the damper is closed.

Regardless of what test pressure is chosen the fan should be capable of achieving a 200 Pa pressure difference higher than the test pressure difference chosen for the test.

Regulation of the 300 Pa (or higher pressure differential) may be by means of a dilution damper installed just before the fan inlet. The pressure must be controlled to within ± 5 % of the required pressure. A balancing damper shall be fitted at the outlet of the fan to adjust the pressure range of the systems to suit the damper under test. A variable speed fan may be used instead of the dilution damper.

5.4 Instrumentation for measuring and recording the furnace temperature, in accordance with ISO 834-1. Locations of the furnace thermocouples for a number of different test arrangements are shown in figures 3, 4, 5, 6, 7 and 8.

The gas temperature adjacent to the flow measuring device shall be measured by a 0,25 mm bare wire thermocouple enclosed in a 6 mm diameter porcelain twin wall tube with its measuring junction located at the centreline of the measuring duct and at a distance equal to twice the diameter of the measuring duct downstream from the flow measuring device. A similar thermocouple shall be located at the exit from the connecting duct plenum (see figures 1 and 2). Alternative thermocouples may be used provided it can be shown that they have equivalent response time.

5.5 Instrumentation for measuring and recording surface temperature, in accordance with ISO 834-1.

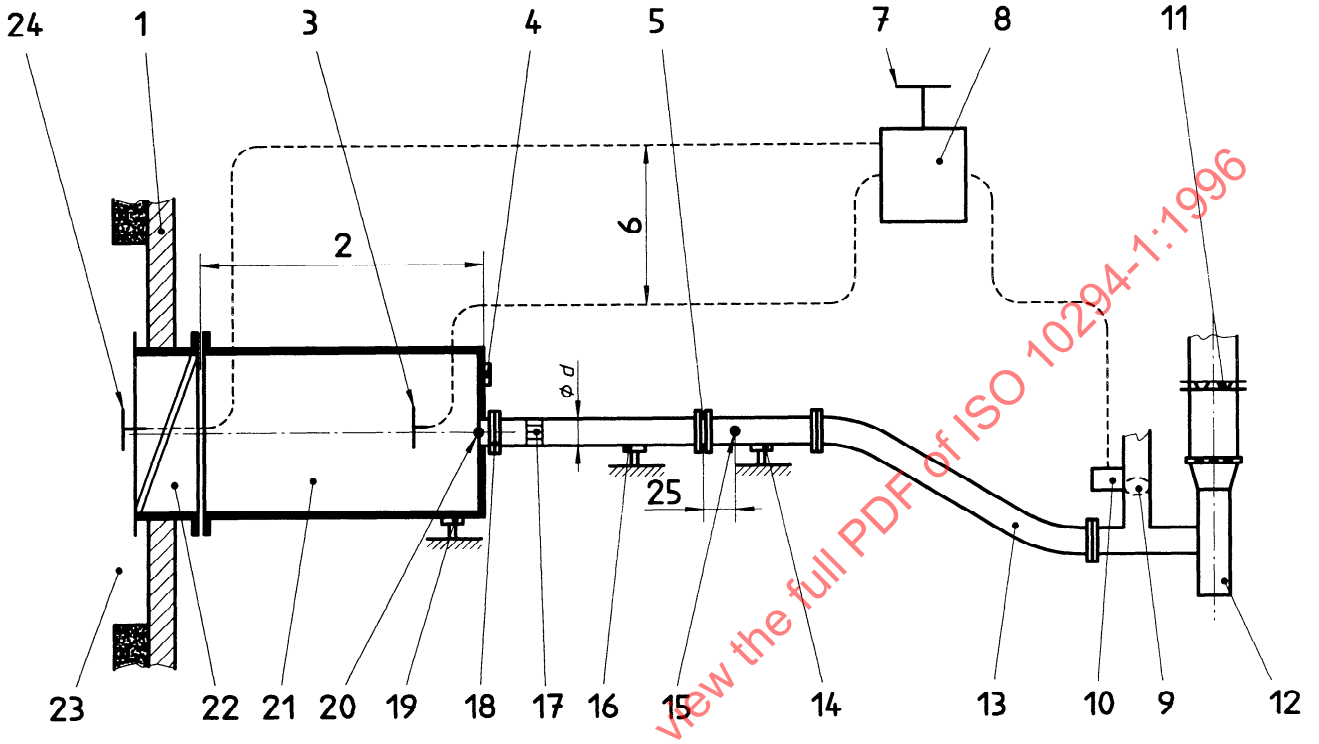
It shall be located, depending on the method of mounting the damper selected, in the positions shown in either figures 3, 4, 5, 6, 7 or 8.

5.6 Instrumentation for measuring pressure differential between the furnace and the connecting duct.

A pressure tapping shall be located on the centreline of one vertical side wall of the connecting duct. Instrumentation shall have a 300 Pa measurement capacity higher than the test pressure chosen for the test. Instrumentation shall also be provided for measuring the pressure difference between inside and outside (ambient) of the furnace.

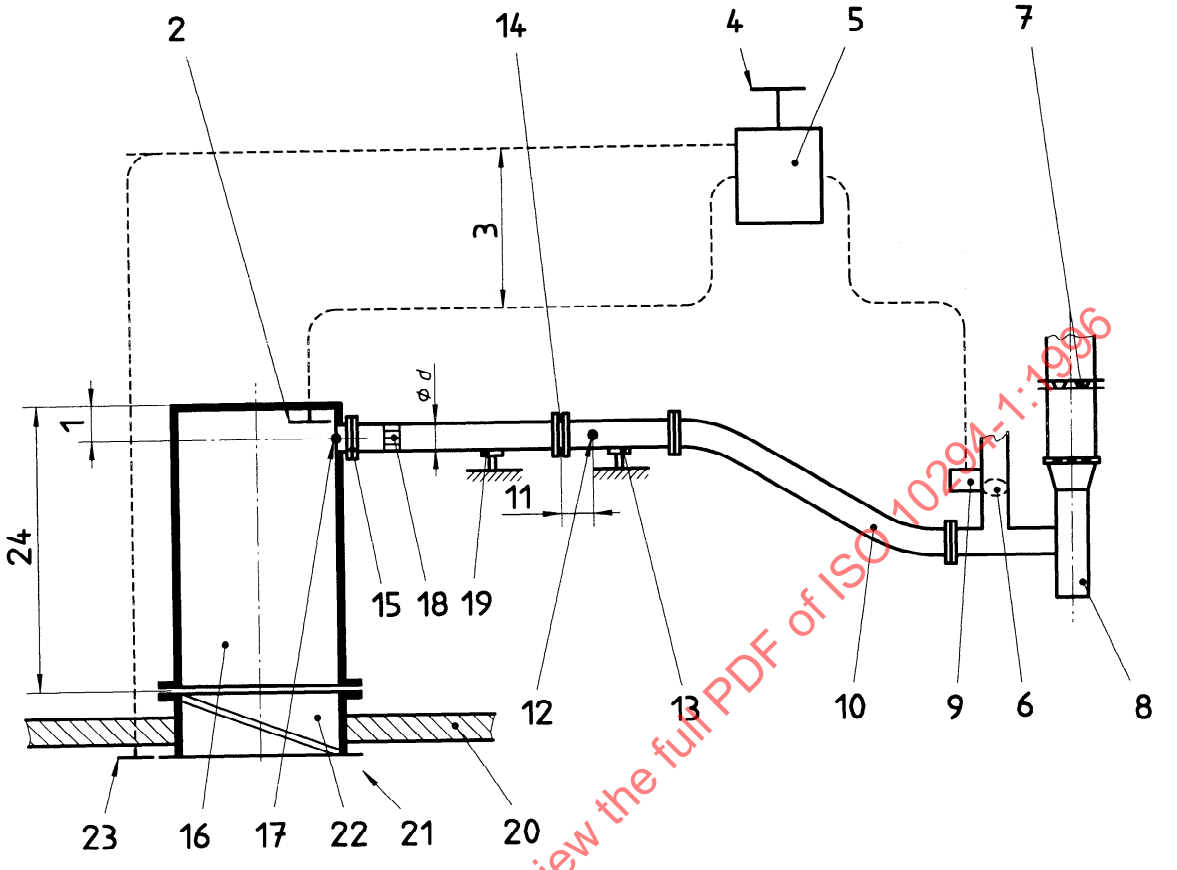
5.7 **Timing device,** capable of running throughout the test period.

5.8 **Gap gauges and cotton pad,** according to ISO 834-1, to judge the integrity of the joints between the damper and its connecting duct and the damper assembly and the supporting construction of the test arrangement.



1 Supporting construction (wall)
2 2 × diagonal (to a maximum of 2 m)
3 Pressure sensor (on centreline)
4 Observation port
5 Orifice plate or venturi
6 Pressure differential (300 Pa)
7 Pressure sensor in laboratory
8 Pressure differential control box
9 Pressure control dilution damper
10 Pneumatic actuator or manual control
11 Balancing damper
12 Fan
13 Flexible connecting duct
14 Support
15 Thermocouple
16 Support
17 Flow straightener
18 Flange
19 Support
20 Thermocouple at exit from plenum
21 Connecting duct
22 Test damper
23 Furnace chamber
24 Pressure sensor (on centreline of damper)
25 Distance: thermocouple to orifice plate = 2 d

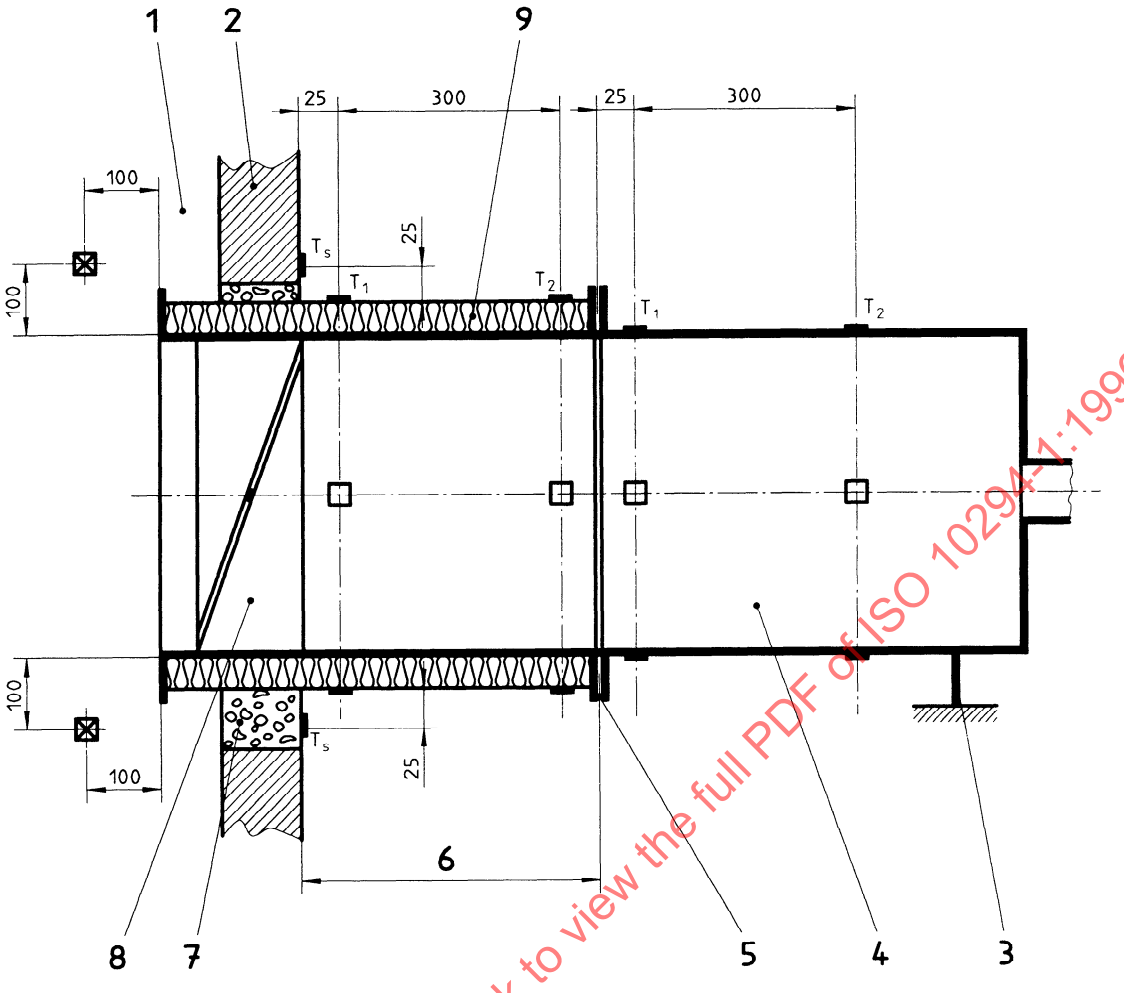
Figure 1 — Example of general test arrangement



1 Dimension equal to the diameter of the measuring station
2 Pressure sensor
3 Pressure differential (300 Pa)
4 Pressure sensor in laboratory
5 Pressure differential control box
6 Pressure control dilution damper
7 Balancing damper
8 Fan
9 Pneumatic actuator or manual control
10 Flexible connecting duct
11 Distance: thermocouple to orifice plate = 2 d
12 Thermocouple
13 Support
14 Orifice plate or venturi
15 Flange
16 Connecting duct
17 Thermocouple at exit from plenum
18 Flow straightener
19 Support
20 Supporting construction (floor)
21 Furnace chamber
22 Test damper
23 Pressure sensor
24 2 × diagonal (to a maximum of 2 m)

Figure 2 — Example of an alternative arrangement when testing dampers in floors

Dimensions in millimetres



1	Furnace
2	Supporting construction
3	Support
4	Connecting duct
5	Connecting angle
6	Length L to be specified by damper manufacturer
7	Infill material, provided it is necessary
8	Damper
9	Insulated ductwork
T_s, T_1, T_2	Thermocouples (Minimum of one each side)
T_s	Maximum temperature at supporting construction
T_1	Maximum temperature at the • damper (if $L \geqslant 50$ mm) • connecting duct
T_2	Average temperature at the • damper (if $L \geqslant 350$ mm) • connecting duct

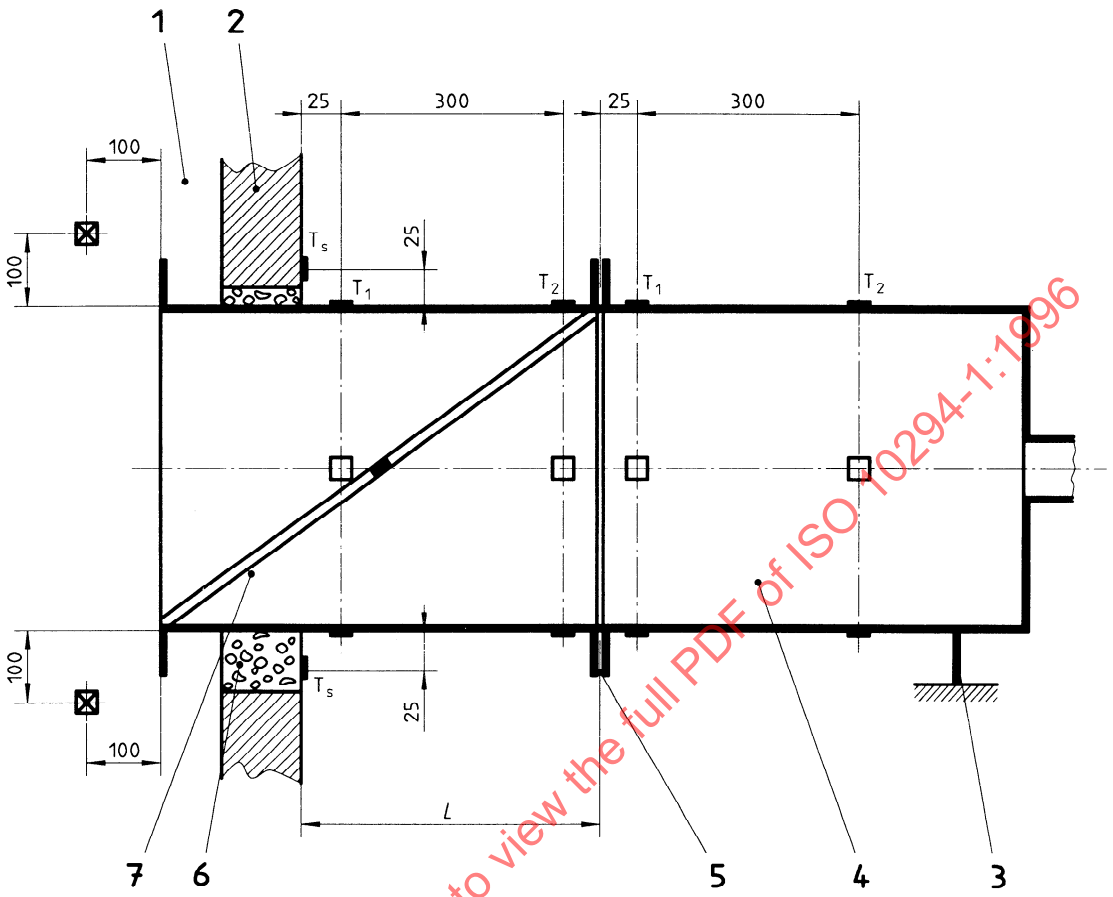
⊠ Furnace thermocouples, 4 pieces

Damper symbol

Infill material (for example: concrete, fibrous material)

Figure 3 — Position of surface thermocouples, when damper is installed in an insulated duct

Dimensions in millimetres



1	Furnace	
2	Supporting construction	
3	Support	
4	Connecting duct	
5	Connecting angle	
6	Infill material, provided it is necessary	
7	Damper	
L	Length to be specified by damper manufacturer	
T_s, T_1, T_2	Thermocouples (Minimum of one each side)	
T_s	Maximum temperature at supporting construction	
T_1	Maximum temperature at the	● damper (if $L \geqslant 50$ mm) ● connecting duct
T_2	Average temperature at the	● damper (if $L \geqslant 350$ mm) ● connecting duct

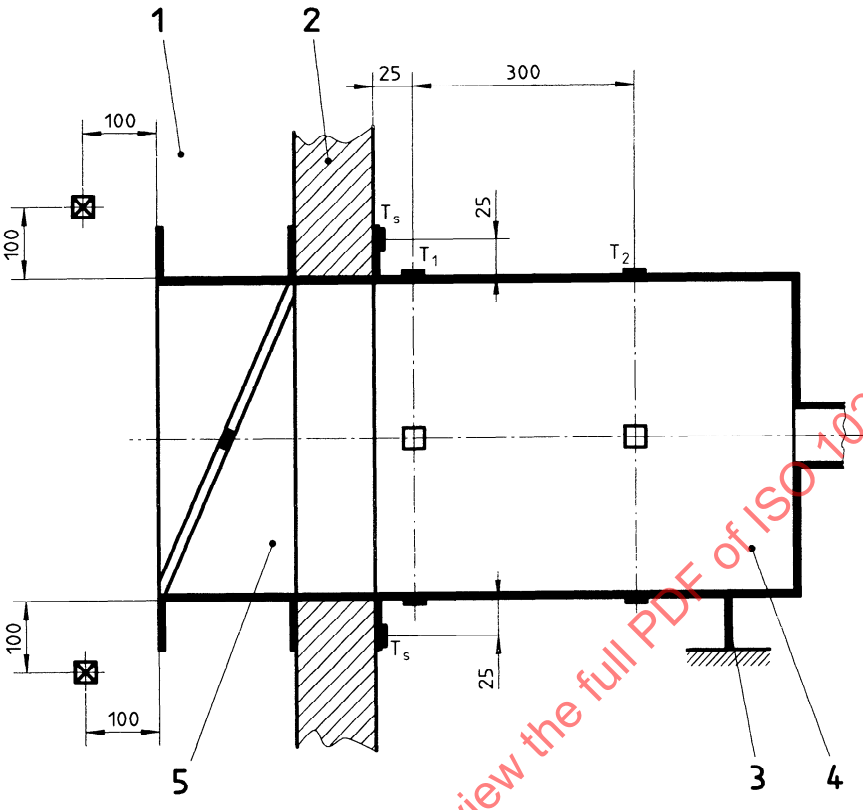
⊠ Furnace thermocouples, 4 pieces

Damper symbol

Infill material (for example: concrete, fibrous material)

Figure 4 — Standard position for furnace thermocouples

Dimensions in millimetres



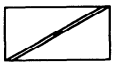
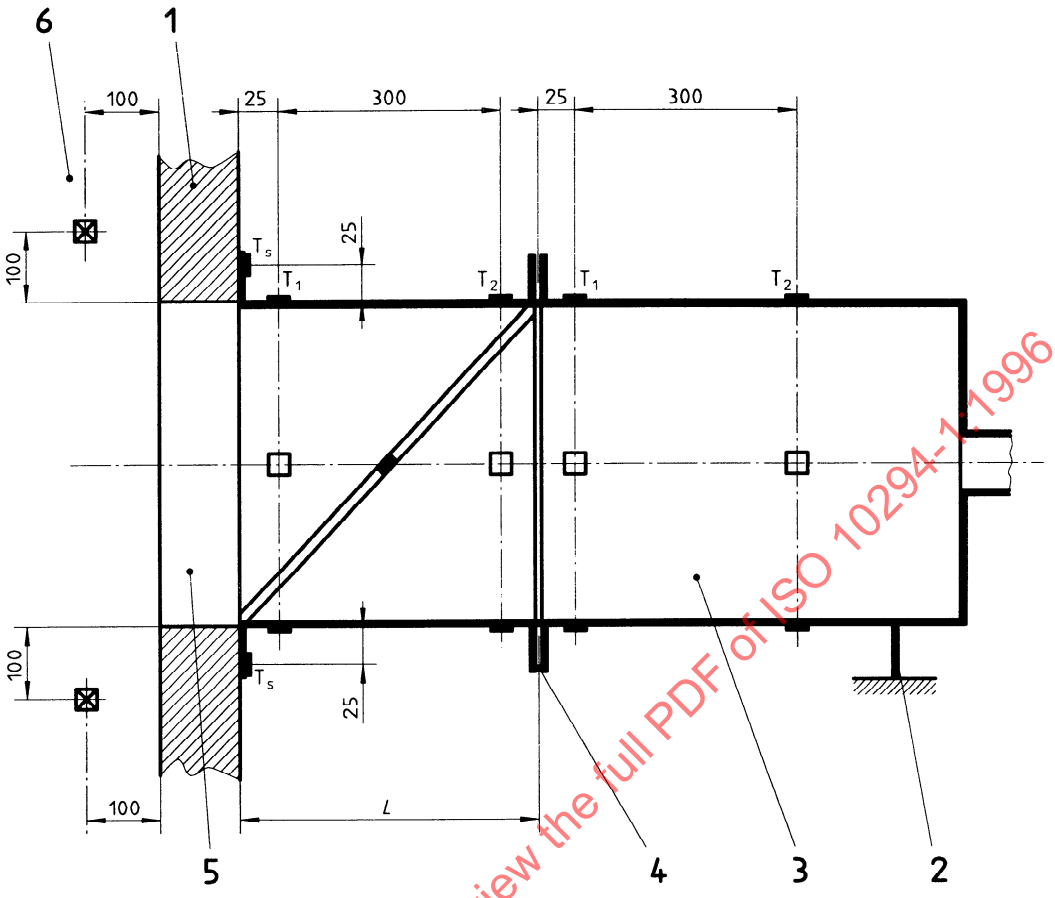
1	Furnace
2	Supporting construction
3	Support
4	Connecting duct
5	Damper
T_s, T_1, T_2	Thermocouples (Minimum of one each side)
T_s	Maximum temperature at supporting construction
T_1	Maximum temperature at the connecting duct
T_2	Average temperature at the connecting duct
⊠	Furnace thermocouples, 4 pieces
	Damper symbol

Figure 5 — Damper mounted onto face of supporting construction within the furnace

Dimensions in millimetres



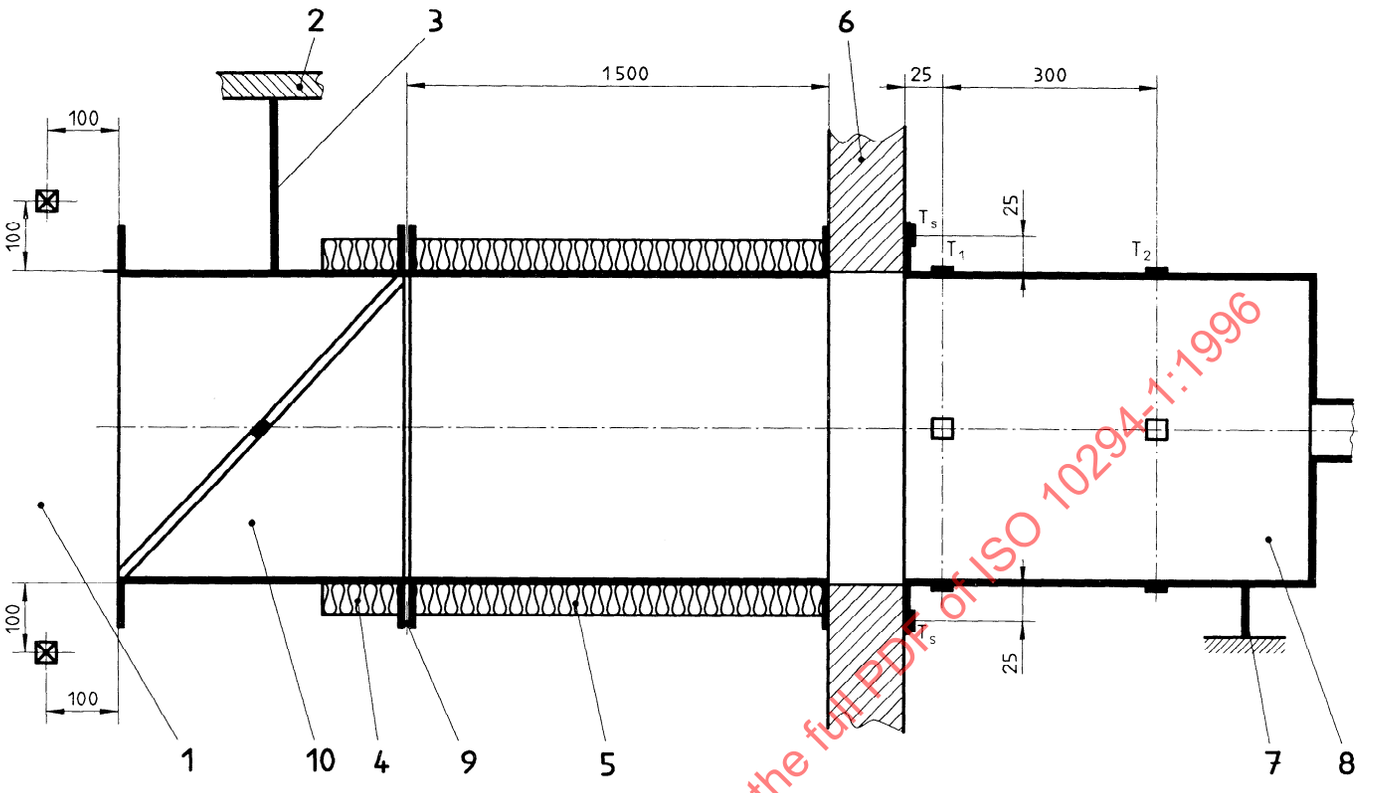
1	Supporting construction	
2	Support	
3	Connecting duct	
4	Connecting angle	
5	Damper	
6	Furnace	
L	Length to be specified by damper manufacturer	
T_s, T_1, T_2	Thermocouples (Minimum of one each side)	
T_s	Maximum temperature at supporting construction	
T_1	Maximum temperature at the	● damper (if $L \geqslant 50$ mm) ● connecting duct
T_2	Average temperature at the	● damper (if $L \geqslant 350$ mm) ● connecting duct

⊠ Furnace thermocouples, 4 pieces

Damper symbol

Figure 6 — Damper mounted onto face of supporting construction outside the furnace

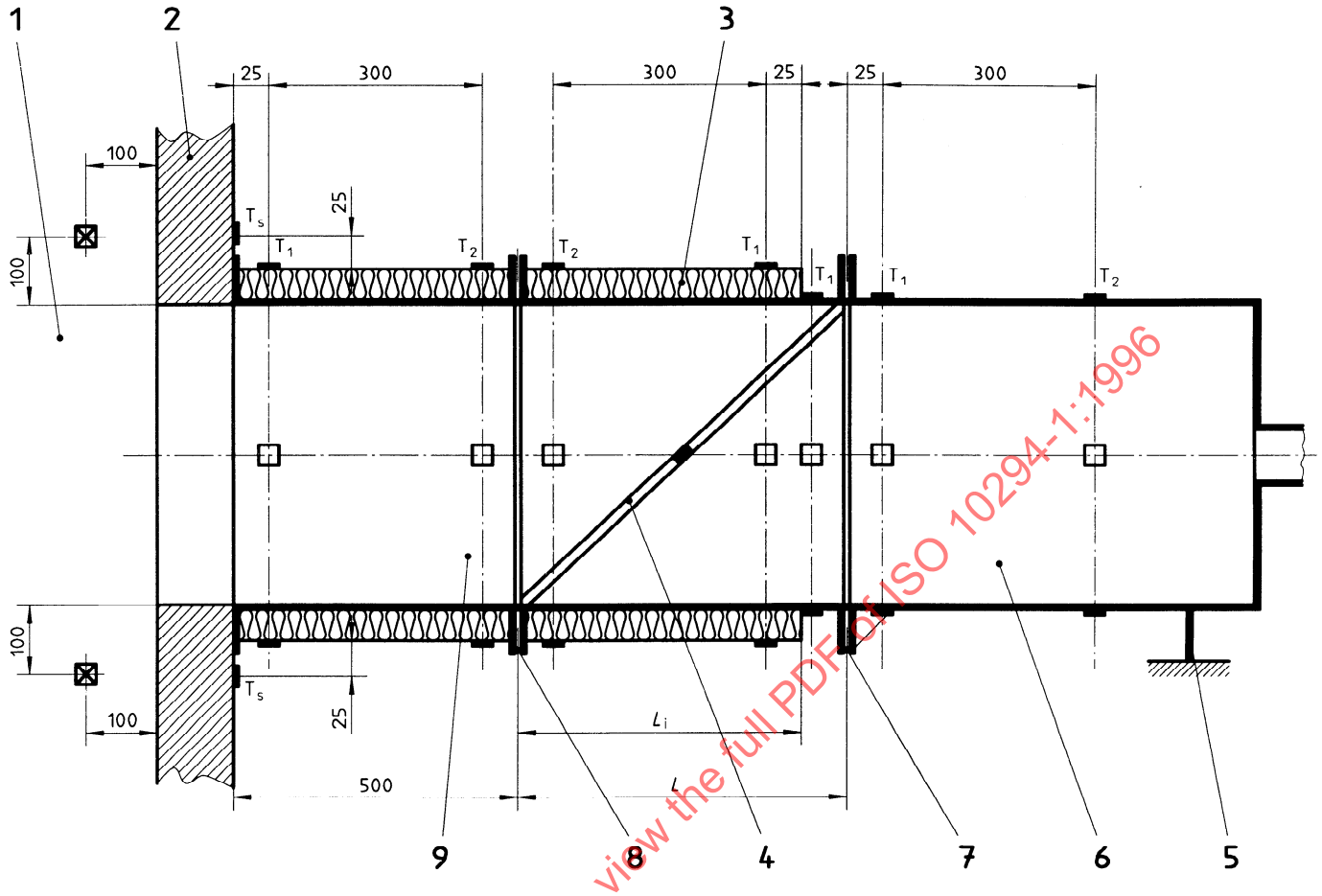
Dimensions in millimetres



1	Furnace
2	Floor for example
3	Suitable attachment as in practice
4	Insulation, provided it is necessary
5	Insulated duct
6	Supporting construction
7	Support
8	Connecting duct
9	Connecting angle
10	Damper
T_s, T_1, T_2	Thermocouples (Minimum of one each side)
T_s	Maximum temperature at supporting construction
T_1	Maximum temperature at the connecting duct
T_2	Average temperature at the connecting duct
⊠	Furnace thermocouples, 4 pieces
	Damper symbol

Figure 7 — Damper mounted remote from the supporting construction and within the furnace chamber

Dimensions in millimetres



1	Furnace	
2	Supporting construction	
3	Damper insulation, provided it is necessary	
4	Damper	
5	Support	
6	Connecting duct	
7	Connecting angle	
8	Connecting angle	
9	Insulated duct	
L	Length L to be specified by damper manufacturer	
L_i	Length of insulation where insulation is necessary	
T_s, T_1, T_2	Thermocouples (Minimum of one each side)	
T_s	Maximum temperature at supporting construction	
T_1	Maximum temperature at the	● insulated duct ● insulated part of damper ● uninsulated part of damper (if $L_i < L$)
T_2	Average temperature at the	● insulated duct ● damper ● connecting duct

⊠ Furnace thermocouples, 4 pieces

Damper symbol

Figure 8 — Damper mounted remote from the supporting construction and outside the furnace chamber

6 Test construction

6.1 General

The test construction shall contain all construction details relevant for test results. Only a maximum of two dampers may be tested at one time.

6.1.1 Side to be tested

Dampers shall be tested from both sides (i.e. two specimens) unless the assembly, including the hardware, is entirely symmetrical, or unless by its construction it can only be installed in such a way that it can only be exposed to fire from one side.

If testing is carried out from one side only (i.e one specimen) the reason for this shall be clearly stated in the report.

6.1.2 Dampers installed in both walls and floors

Dampers which are to be employed in both walls and floors shall be tested in both orientations.

6.1.3 Dampers installed within a structural opening

Dampers to be positioned within a structural opening shall be tested as shown in figure 1 when installed in a wall and as shown in figure 2 when installed in a floor.

6.1.4 Dampers mounted onto face of wall or floor

Uninsulated dampers mounted on a wall or floor and attached to the face of a structure shall be tested with the damper positioned within the furnace as shown in figure 5. Insulated dampers shall be tested from both sides so that the insulation properties of the damper body and where appropriate the duct can be evaluated. An example of a damper mounted to the wall/floor outside the furnace is shown in figure 6.

6.1.5 Dampers remote from wall or floor

6.1.5.1 Within the furnace

Dampers mounted remote from the wall or floor and separate from the structure shall be attached to a length of ductwork. For test purposes, the duct shall be attached to the supporting construction with the damper installed at the duct end within the furnace, as shown in figure 7. This length of ductwork shall be (150 ± 50) mm long and insulated to the extent necessary to ensure that it remains intact throughout the test. The distance between the outer surface of the duct and the furnace wall or floor shall not be less than 500 mm.

6.1.5.2 Outside the furnace

For dampers that are to be mounted onto a section of duct outside the furnace, as shown in figure 8, the length of duct shall be (500 ± 50) mm.

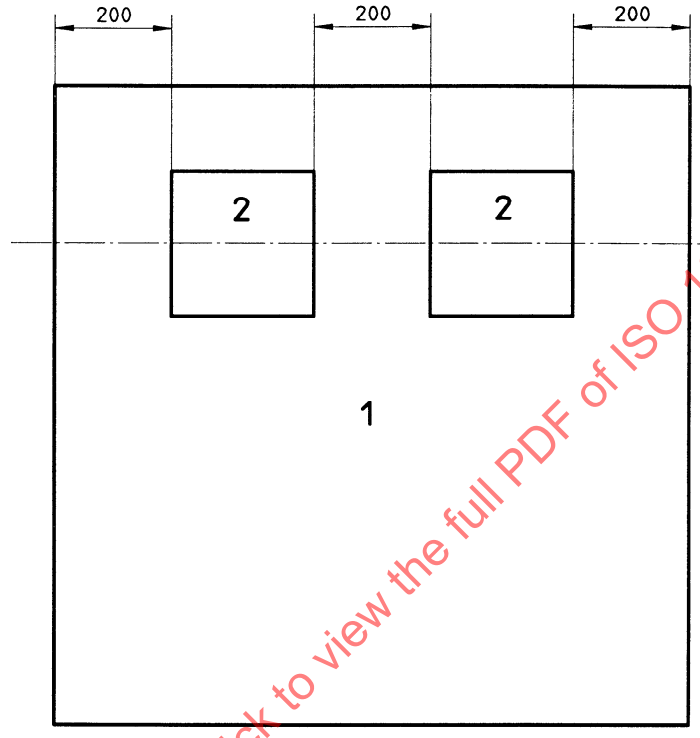
6.1.6 Minimum separation between dampers

Where two dampers are to be tested at the same time, the distance between the dampers must not be less than 200 mm, as shown in figure 9. Where the dampers are mounted in a wall or partition, but are not located in the same horizontal plane, the required furnace pressure will be determined at the horizontal plane of the lower damper [see 9.8 a) and figure 10].

6.2 Size of specimen

The test specimen shall be the largest size relative to width and height to be supplied (see ISO 10294-2) and representative of equipment used in practice.

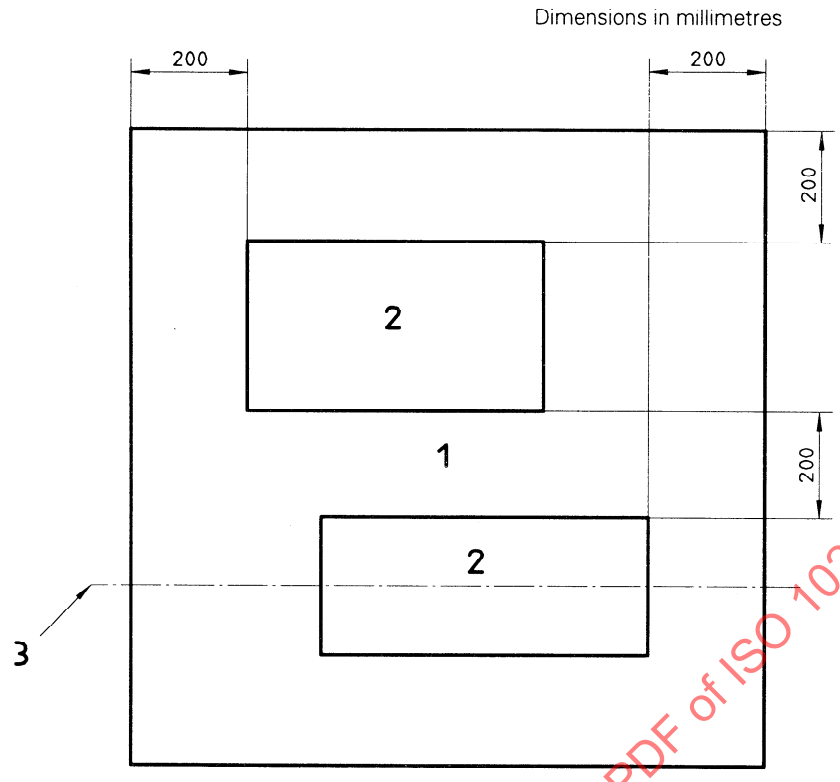
Dimensions in millimetres



1 Supporting construction

2 Damper

Figure 9 — Minimum separation between two dampers



1 Supporting construction (wall)

2 Damper

3 Pressure of 15 Pa maintained on this plane

Figure 10 — Dampers mounted in different horizontal planes

6.3 Thermal release mechanism

The thermal release mechanism shall be included in the specimen construction. If there are alternative release mechanisms where these are in series with the basic thermal release and can be shown to not inhibit the basic release then only the one thermal release mechanism is required to be tested.

NOTE — Where a damper design is modified solely with respect to the thermal release mechanism, it is not necessary to continue the test after closure provided that the release mechanism does not affect the maintenance of the closed state of damper.

6.4 Specimen installation

The dampers shall be installed as in practice in a supporting construction using methods which are in accordance with the manufacturer's instructions. Where the manufacturer of the damper requires the damper to be tested in a length of insulated ductwork he must specify the length over which the duct is to be insulated as shown in figure 3.

6.5 Supporting construction

6.5.1 Principles

The supporting construction shall be a wall, floor or partition selected in consideration of the following principles.

6.5.1.1 The supporting construction shall be a wall, partition or floor of the type to be used in practice.

6.5.1.2 A test result obtained for a fire damper mounted in a supporting construction made of masonry, concrete or solid partition (without any cavity) is applicable for the same type of supporting construction with a thickness and density equal to or greater than those of the supporting construction used for the test.

6.5.1.3 The supporting construction selected shall have fire resistance slightly greater than the required fire resistance of the damper being tested.

6.5.1.4 If a specific supporting construction different than those described above is selected, the test results obtained are applicable only to that specific wall, partition or floor.

6.5.2 Recommended supporting constructions

Following the above principles, it is possible to choose one of the following recommended supporting constructions.

6.5.2.1 Standard wall constructions

6.5.2.1.1 Normal concrete/masonry

Thickness:	(110 ± 10) mm	up to 2 h fire resistance
	(150 ± 10) mm	2 h to 3 h fire resistance
	(175 ± 10) mm	4 h fire resistance
Density:	(2 200 ± 200) kg/m^3	

6.5.2.1.2 Aerated concrete

This supporting construction is made from blocks, joined together with mortar, or panels, joined together with tongue and groove type joints.

Thickness:	(110 ± 10) mm	up to 2 h fire resistance
	(150 ± 10) mm	2 h to 4 h fire resistance
Density:	(650 ± 200) kg/m^3	

6.5.2.2 Standard floor constructions

6.5.2.2.1 Normal concrete

Thickness:	(110 ± 10) mm	up to 1 1/2 h fire resistance
	(150 ± 10) mm	2 h to 3 h fire resistance
	(175 ± 10) mm	4 h fire resistance
Density:	(2 200 ± 200) kg/m^3	

6.5.2.2.2 Aerated concrete

This supporting construction is made from floor panels, joined together with tongue and groove joints.

Thickness:	(110 ± 10) mm	up to 2 h fire resistance
	(150 ± 10) mm	2 h to 4 h fire resistance
Density:	(650 ± 200) kg/m^3	