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Fire resistance tests — Fire dampers for air distribution systems —

Part 5: Intumescent fire dampers

Essais de résistance au feu — Clapets coupe-feu pour systèmes de distribution d'air —

Partie 5: Clapets résistants au feu intumescent

Reference number
ISO 10294-5:2005(E)

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. 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.

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

ISO 10294-5 was prepared by Technical Committee ISO/TC 92, *Fire safety*, Subcommittee SC 2, *Fire containment*.

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

— *Part 1: Method of test*

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

— *Part 3: Guidance on the test method*

— *Part 4: Test of thermal release mechanism*

— *Part 5: Intumescent fire dampers*

Fire resistance tests — Fire dampers for air distribution systems —

Part 5: Intumescent fire dampers

CAUTION — The attention of all persons concerned with managing and carrying out this fire resistance test is drawn to the fact that fire testing can be hazardous and that there is a possibility that toxic and/or harmful smoke and gases can be evolved during the test. Mechanical and operational hazards can 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 shall be made and safety precautions shall be identified and provided. Written safety instructions shall be issued. Appropriate training shall be given to relevant personnel. Laboratory personnel shall ensure that they follow written safety instructions at all times.

1 Scope

This part of ISO 10294-5 describes the test requirements related to intumescent fire dampers. It identifies the minor modifications needed to adapt the test method described in ISO 10294-1 (which was intended for mechanical dampers) to suit intumescent fire dampers. Additional tests are included to give an assessment of the operational reliability of intumescent fire dampers.

This test is intended for intumescent fire dampers that are expected to be classified as EI dampers in accordance with ISO 10294-2. Without the addition of a mechanical damper, they are unable to achieve the "S" classification, which includes a leakage limit imposed at ambient temperatures.

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.

ISO 10294-1:1996, *Fire resistance tests — Fire dampers for air distribution systems — Part 1: Test method*

ISO 10294-2:1999, *Fire resistance tests — Fire dampers for air distribution systems — Part 2: Classification, criteria and field of application of test results*

ISO 10294-3:1999, *Fire resistance tests — Fire dampers for air distribution system — Part 3: Guidance on the test method*

ISO 10294-4: 2001, *Fire resistance tests — Fire dampers for air distribution systems — Part 4: Test of thermal release mechanism*

ISO 13943, *Fire safety — Vocabulary*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 13943 and the following apply.

3.1
intumescent
term describing the phenomenon of expansion in excess of normal thermal expansion under the action of heat normally generated by the fire

3.2
intumescent fire dampers
non-mechanical device, installed in a ducted system that intumesces when exposed to hot gases and acts as a barrier to fire and hot smoke

3.3
intumescent sheet
intumescent material manufactured in rigid or flexible thin sections, typically 1 mm to 4 mm thick, usually cut into strips for incorporation into the fire damper

3.4
covered intumescent
partly enclosed intumescent material to provide protection, modify the behaviour, improve the surface finish and/or enhance the aesthetics of the fire damper

3.5
skinned intumescent material
totally enclosed intumescent material on all faces and edges to provide protection, modify the behaviour and improve the surface finish and/or the aesthetics of the fire damper

3.6
specially shaped intumescent
intumescent material formed into special contours by extrusion, dipping, moulding, machining or spraying onto formers or mandrills

4 Procedure

4.1 General considerations

4.1.1 Apparatus

The apparatus for the fire test shall be as described in ISO 10294-1:1996. As intumescent dampers give off some moisture, a suitable condensing device shall be installed before the flow-measuring device. This will be deemed to be effective if the gas temperature within the flow-measuring device does not exceed 40 °C at any time during the test.

4.1.2 Test specimen

The damper with the largest dimensions to be manufactured shall be tested. Where it is intended that multiple intumescent dampers will be used in a duct having a size greater than the individual damper size, the maximum number of dampers in the maximum-sized duct including all mullions and transoms together with any other supporting structure shall be tested.

4.1.3 Test procedure

4.1.3.1 General procedure and criteria

Other than the exceptions stated below, carry out the test in accordance with ISO 10294-1. The criteria with respect to integrity and insulation shall be as specified in ISO 10294-2.

4.1.3.1.1 Opening and closing cycles

The 50 opening and closing cycles specified are not applicable to this product.

NOTE The reason for the 50-cycle test for mechanical dampers is to demonstrate the likelihood of their functioning when called upon to do so, without jamming or disintegrating. Clearly a product that is activated by an irreversible chemical activity cannot be activated more than once. There are no parts moving mechanically in an intumescent fire damper, only the swelling of the intumescent material when activated by heat.

4.1.3.1.2 Time to close

There is no requirement for the damper to close before 2 min, but it shall satisfy leakage requirements after 5 min into the test.

NOTE The 2 min limit in the test for mechanical dampers is the time beyond which it is deemed that dampers that have not closed will not do so; therefore, continuation of the test would be irrelevant. Since the time deemed necessary for the furnace to stabilize is 5 min and no sensor values are considered accurate enough to record until that time has elapsed, the 2 min period has no relevance in the case of intumescent dampers.

4.1.3.1.3 Condensing device

A suitable condensing device may be considered to be a water tank fed with water at ambient temperature with about 9 m of measuring duct immersed in the tank prior to reaching the measuring device.

4.2 Reaction to fire tests — Intumescent materials

4.2.1 General

To ensure some equivalence with a mechanical damper, the following tests are described that allow an assessment of the reliability of intumescent materials used for intumescent fire dampers. These tests can be used as an initial type test to get the performance of an intumescent material tested. The result is normally used to define the specification for the material. In this case 10 specimens shall normally be tested. For the purpose of factory control, two specimens are normally used to show compliance with the specification.

Thermal activation and faulty set-off are normally tested only in the course of the initial type test but all three alternatives for “expansion pressure” are suitable tests for factory control.

Expansion pressure is normally determined at various temperatures during the initial type test to find out the range of minimum temperature dependence. For the purposes of factory production control these tests are normally conducted at a temperature in the range of temperature independence to ensure that the effect of temperature variation on the results is minimized.

Complete components or sections of components of the damper, in sufficient quantity to complete the range of testing required by the test authority and manufacturer, shall be nominated as representative specimens for initial type testing and all subsequent production control conformity tests, as dictated by local certification/approval needs.

Sample sets shall be placed in ambient laboratory conditions consisting of a temperature of 23 °C ± 4 °C and a humidity of 50 % for a minimum of seven days.

4.2.2 Thermal activation temperature test

4.2.2.1 General

This test is used to assess the activation temperature of the intumescent material used in the damper.

4.2.2.2 Apparatus

4.2.2.2.1 Oven, with an operating temperature range of 25 °C to 350 °C to within better than ± 3 °C.

4.2.2.2.2 Temperature-measuring and display device for the oven, with an accuracy of ± 1 °C.

4.2.2.3 Test specimens

Three specimens of the smallest-sized damper in the range of critical reactive intumescent components shall be tested.

4.2.2.4 Test method

Each specimen or critical reactive component shall be placed in the oven. The oven shall be set at 30 °C below the activation temperature given by the manufacturer for the intumescent material under test. The oven temperature shall be maintained for at least 15 min and intumescent activity observed. Should no intumescent development occur, the temperature shall be increased by increments of 5 °C and maintained for a minimum of 15 min at each stage until activation does commence.

4.2.3 Faulty set-off

4.2.3.1 General

This test method is intended to cover standard operating conditions (60 °C; see ISO 10294-4). However, the test method may be adapted to cover situations where the intumescent damper is intended to be operated at either lower or higher temperatures, for example dampers used in cold climates or those installed in warm-air ducts, by using the appropriate operating temperature as the test temperature. Except for the temperatures/threshold limits, there shall be accordance with all other conditions specified in this part of ISO 10294.

4.2.3.2 Apparatus

4.2.3.2.1 Oven, with a standard temperature operating range of 25 °C to at least 80 °C or a range compatible with the chosen operating temperature to within better than ± 3 °C.

4.2.3.2.2 Temperature-measuring and display device for oven, with an accuracy of ± 1 °C.

4.2.3.2.3 Thickness-measuring device, with an accuracy of ± 0,05 mm.

4.2.3.3 Test specimens

Three specimens of the smallest-sized damper in the range or three critical reactive intumescent components shall be tested. Where the intumescent material is covered by a protective skin that may be affected by the chosen operating temperature, the critical reactive intumescent component shall be composed the intumescent material and the skin.

4.2.3.4 Test method

The thickness of each specimen shall be measured at a minimum of four different locations on the intumescent reactive components and the values recorded. The specimens shall then be placed in a

pre-heated oven that is at the chosen temperature. The specimens shall be removed from the oven after 60 min and the thickness at the previously measured locations measured and recorded.

4.2.3.5 Performance

The thickness shall not vary by more than 5 % of the measurements taken prior to placing in the oven.

4.2.4 Expansion pressure test

4.2.4.1 General

This test is used to assess the pressure, and in the case of the pipe pressure test and the die-set pressure test also the expansion factor, of an intumescent material created during expansion on heating.

For intumescent material that is employed in an uncovered state and is not subject to any further processing prior to incorporation in the damper assembly, both the “disc pressure test” and the “pipe pressure test” are suitable.

Where the original intumescent material is covered, skinned, specially shaped or processed in such a way as to

a) change the performance characteristics,

b) improve or reduce resistance to moisture,

c) increase or decrease chemical or gas resistance, and/or

d) improve or reduce durability.

The coverings of intumescent materials may cause a variation of characteristics from the material in its uncovered state. Therefore, such specimens shall be selected complete with covering to provide authentic characteristics and normally the die-set pressure test is suitable. The specimens shall be of a shape and dimensions compatible with the product design.

4.2.4.2 Expansion pressure — Disc pressure test method

4.2.4.2.1 Apparatus

The test apparatus consists of two heating plates provided with a means of adjusting the distance between them. The lower plate is connected to a strain gauge/pressure transducer capable of measuring the pressure exerted by the expansion of the specimen. The strain gauge/pressure transducer is connected to a recorder that continuously records the measured pressure relative to time; see Figure B.1.

4.2.4.2.2 Test specimens

The specimens shall be circular and die-cut to a size to suite the internal diameter of the test apparatus from the intumescent material used in the fabrication of the damper. Each specimen shall be weighed and measured after being die-cut and examined to ensure that there are no voids between the specimen and the internal face of the test apparatus.

4.2.4.2.3 Test method

For uncovered sheet material, the specimen shall be placed in a steel cylinder whose height is equal to the thickness of the specimen. The inside diameter of the cylinder shall be the same size as the specimen.

The test apparatus shall be set such that there is an initial load between 0,1 N/mm^2 and 0,5 N/mm^2, the heating plates of the apparatus are preheated to a minimum of 300 °C for standard applications or to the

appropriate temperature above the activation temperature for other applications, to within better than ± 3,0 °C. The steel cylinder with the specimen in it shall be placed between two sheets of aluminium foil and centred between the two plates of the test apparatus. As the specimen heats and expands, the pressure peaks and then declines. The test shall be discontinued after a decline in pressure for at least three consecutive minutes. The maximum expansion pressure of the specimen shall be recorded.

4.2.4.3 Expansion pressure — Pipe pressure test method

4.2.4.3.1 Apparatus

4.2.4.3.1.1 Stainless steel pipe, with an inside diameter equal to the specimen (for uncovered or non-skinned sheet material).

4.2.4.3.1.2 Cylindrical stainless steel weights, with a diameter close to the inner diameter of the pipe and having masses which can result in pressures of 0,000 49 N/mm^2, 0,000 98 N/mm^2, 0,001 47 N/mm^2, 0,001 96 N/mm^2.

NOTE Pressure is equal to the mass times the acceleration of gravity divided by the area. For the above pressures, weights with masses of 5 g, 10 g, 15 g, or 20 g are often convenient.

The mass of the stainless steel weight shall have an accuracy of 2,5 %.

The configuration of the stainless steel pipe and weights is shown in Figure B.2.

4.2.4.3.1.3 Muffle furnace, capable of maintaining the chosen temperature with an accuracy of ± 3 °C.

4.2.4.3.1.4 Test specimens

Sheet material shall be tested in a disc form with a diameter to suite the internal diameter of the pipe and a minimum thickness of 3 mm.

4.2.4.3.1.5 Test method

The thickness of specimen shall be measured to the nearest 0,1 mm at five locations. The five measurements shall be used to obtain the average thickness.

Each specimen shall be placed inside the steel pipe. The specimen shall be totally covered with the weight selected depending on the anticipated expansion pressure of the material. The pipe containing the specimen shall be placed in the preheated muffle furnace for 30 min. After 30 min, the steel pipe shall be removed from the muffle furnace and cooled to ambient temperature.

After cooling, the height of the char shall be measured to the nearest 0,1 mm.

NOTE This can be accomplished by measuring the displacement of the steel weight from its original position.

The expansion factor is the ratio of the expanded thickness to the initial measured thickness.

4.2.4.4 Die-set pressure test — for covered, skinned or shaped specimens

4.2.4.4.1 Apparatus

4.2.4.4.1.1 Oven or muffle furnace, capable of maintaining the chosen temperatures with an accuracy of ± 3 °C.

4.2.4.4.1.2 Two piece die set, produced with a minimum thermal mass using materials of good thermal conductivity to minimize thermal lag.

Both upper and lower dies shall incorporate contours that match the profile of the specimens as closely as practicable to minimize voids between the specimen and the die components; see Figures B.3 and B.4.

4.2.4.4.1.3 Weights, made of brass as shown in Figure B.3.

The combined weight of upper die and brass weight shall be evenly distributed to ensure that the point of balance is at the centre of gravity and that the total weight provides the appropriate pressure (typically 0,000 49 N/mm^2, 0,000 98 N/mm^2, 0,001 47 N/mm^2 or 0,001 96 N/mm^2). This can be adjusted by removing metal from the weight.

4.2.4.4.1.4 Height gauge

4.2.4.4.1.5 Test specimens

For components of products that are covered, specially shaped, skinned or processed materials, the specimens shall be of a shape and dimensions compatible with establishing authentic characterization performance.

4.2.4.4.1.6 Test method

The specimen shall be measured and all dimensions recorded. The thickness shall be measured at each corner of the specimen and in the centre. The measurements shall be aggregated to establish the mean thickness to ± 015 mm.

The specimen shall be placed in the lower part of the die set and the upper die placed on top of the specimen. The weight shall be placed so that the shoulders on the shouldered face fit on either side of the flanges of the upper die. Tissue paper may be used to line the die faces to minimize adhesion when heated and prevent the escape of friable intumescent materials through penetrations or gaps in the die faces. A measurement shall be made from the bottom of the lower die to the highest point of the upper die using a height gauge.

The specimen contained within the die set shall be placed in an oven pre-heated to 300 °C ± 3,0 °C.

The die-set shall be removed from the oven after 30-min and as soon as cooling will allow the measurement shall be taken from the bottom of the die set to the uppermost point of the upper die using a height gauge.

The change in height shall be added to the original mean thickness and the sum of these shall be divided by the original mean thickness to establish the expansion ratio for the specimen at the prescribed pressure.

A temperature higher than 300 °C may be selected if intumescent materials of different temperature characteristics are used.

5 Test report

The test report shall contain at least the following information:

a) name and address of the testing laboratory and the location where the test has taken place, if the latter is not the same as the address of the testing laboratory;

b) unique reference identification of the report (e.g. serial number) and of each page of the report, as well as specification of the total number of pages of the report;

c) name and address of the sponsor;

d) description and name of the tested item, including details of the intumescent component construction and material specifications;

e) date of receipt of the tested item and date(s) of the test;

f) test specification or description of the test method or testing instruction;

g) description of the sampling method if necessary;

h) all deviations, additions or limitations relative to the test specification, as well as other information that is important for the specific test;

i) data concerning all non-standard test methods or procedures used;

j) results of measurements, examinations and interpolated results; if necessary, complementary tables, graphs, sketches and photos;

k) indications concerning the accuracy of measurement (if relevant);

l) signature and title or corresponding indication of the persons responsible for the technical content of the test report, as well as the date of issue;

m) indication that the test results refer only to the tested items;

n) notice that the report may not be duplicated in extracts without permission of the testing laboratory;

o) data from the tests described in Clauses 4 and 5;

p) test temperatures;

q) mass of the weights used in the pipe pressure test or die-set pressure test.

Annex A
(normative)

Durability

A.1 General

The durability tests for intumescent dampers shall consist of an expansion pressure test before and after specimens are exposed to conditions described in A.2.1, A.2.2 and A.2.3. A sample set shall consist of a minimum of 5 specimens for each exposure condition.

A.2 Exposure conditions

A.2.1 Temperature exposure to 70 °C

Sample sets shall be placed in a circulating air oven at a temperature of 70°C ± 3 °C for a minimum of 100 days.

A.2.2 Controlled humidity exposure

Sample sets shall be placed in a chamber with a controlled humidity of 97 % to 100 % at 35°C ± 1,5 °C for a minimum of 100 days.

A.2.3 Ambient temperature exposure

Sample sets shall be placed in ambient laboratory conditions at a temperature of 23°C ± 4 °C and a humidity of 50 % for a minimum of 7 days.

A.3 Acceptance criteria after temperature and controlled humidity exposure

A.3.1 Each specimen of the sample exposed to conditions in accordance with A.2.1 and/or A.2.2 shall retain at least 80 % of the average maximum peak expansion pressure or average expansion factor of that recorded for the sample set exposed to the conditions specified A.2.3.

A.3.2 The average of the peak expansion pressures or expansion factors of the set of specimens shall be within ± 20 % of the average peak expansion pressure or expansion factor of the set of specimens exposed to the conditions specified in A.2.3.

A.3.3 The peak expansion pressure shall not occur more than 20 s after the average time of the peak expansion pressure of the sample set conditioned in the laboratory.

A.3.4 Alternatively, a fire resistance test in accordance with Clause 4 may be used to assess the product after exposure. In this case, a small damper from the range is sufficient.

Annex B
(informative)

Test apparatus

The general characteristics and operation of the expansion measuring apparatus can be described as in a) to e); the numbers in parentheses refer to keyed parts in Figure B.1.

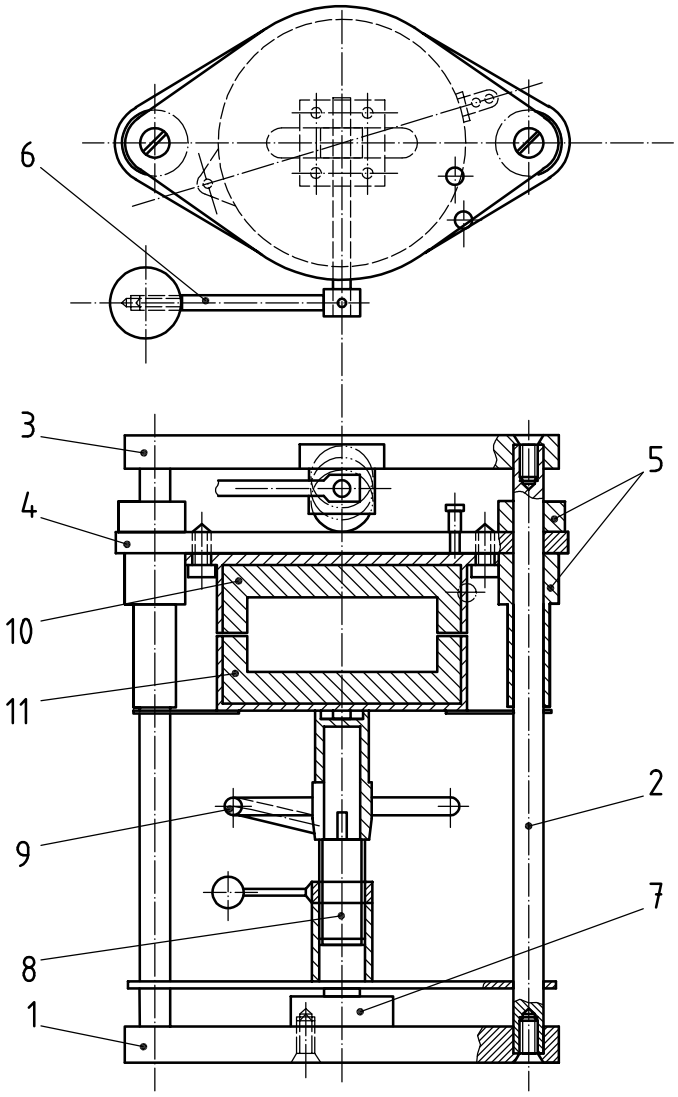
a) The measuring equipment for determining the expansion pressure, acting at given temperatures by an intumescent material, is built into a frame consisting of a base plate (1), two pillars (2) and a pressure plate (3).

b) The heated upper pressure receptor (10), which is rigid during the test but can be swung out for cleaning purposes, is connected with the frame through a guide system (5). In order to enable the specimens to be quickly inserted, the top plate can be adjusted in height by 15 mm by means of the lever (6).

c) The heated lower pressure receptor (11) transmits the force occurring during the test via a transmission device to the force transducer (7) mounted on the base plate.

d) The transmission device has a hand-wheel adjustment that accommodates specimens with a thickness of up to 32 mm. The spindle (8) serves as a locking device for the mechanism.

e) For testing specimens placed in a steel restraining ring, the heating receptors shall be spaced at a distance exceeding the height of the ring by 1 mm.

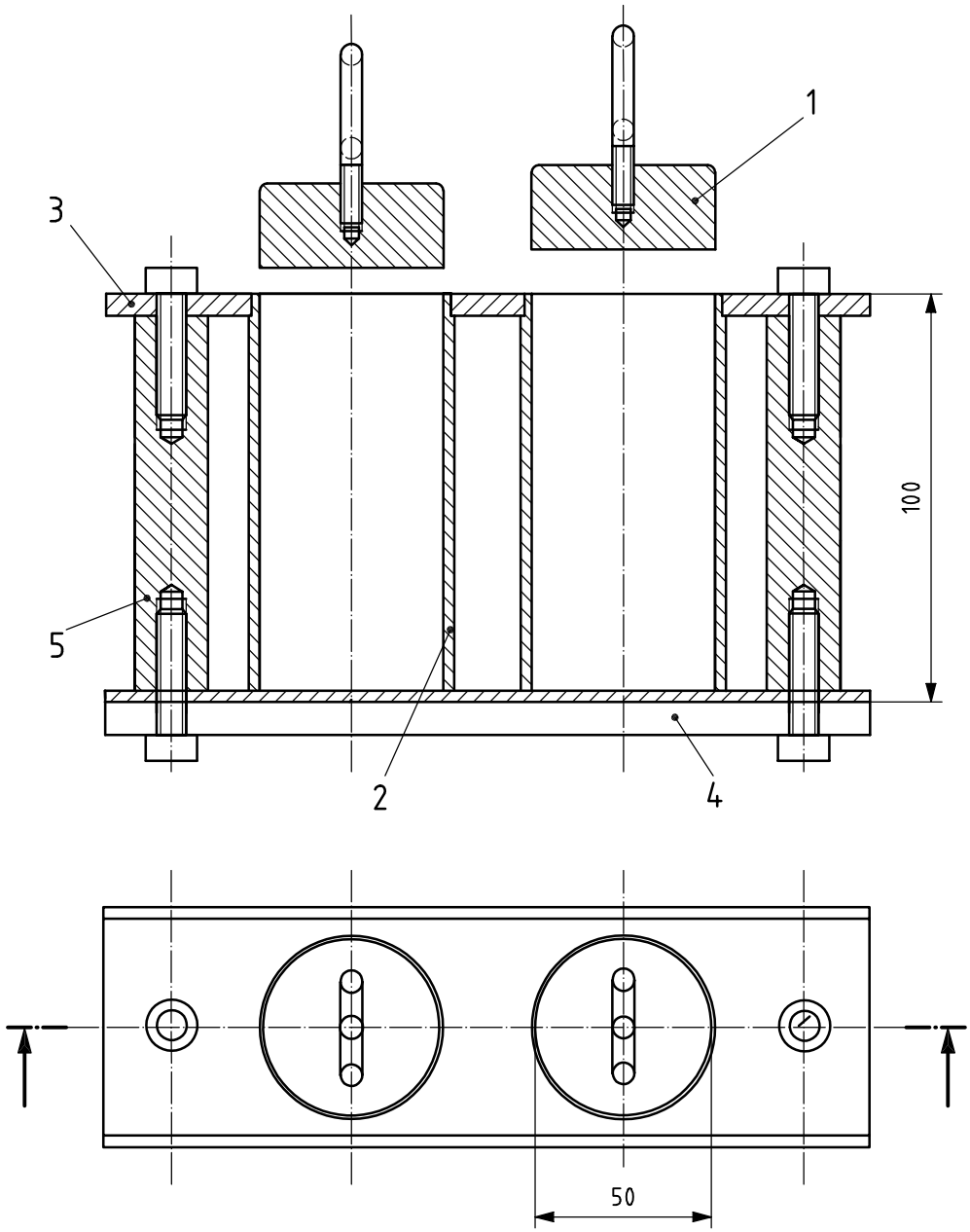


Key

1 base plate
2 pillars
3 pressure plate
4 top plate
5 guide system components
6 lever
7 force transducer
8 spindle
9 hand-wheel
10 heated upper pressure receptor
11 heated lower pressure receptor

Figure B.1 — Disc pressure test apparatus

Dimensions in millimetres



Key

1 weight
2 specimen tube
3 upper frame
4 lower frame
5 spacer bar

Figure B.2 — Pipe pressure test apparatus

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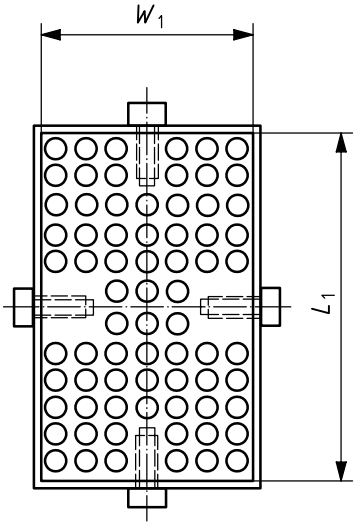
Dimensions in millimetres



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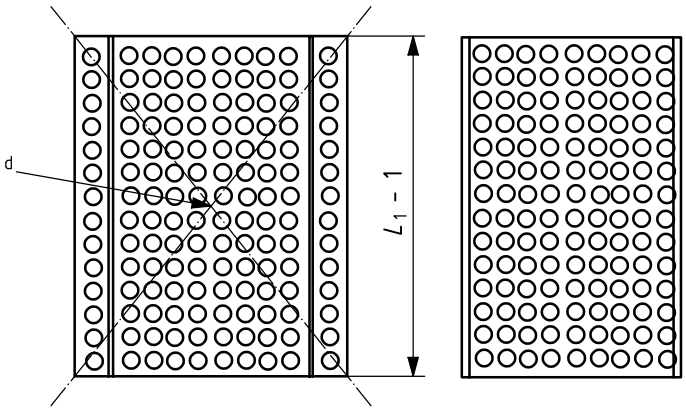

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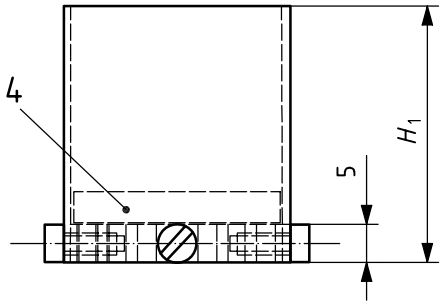
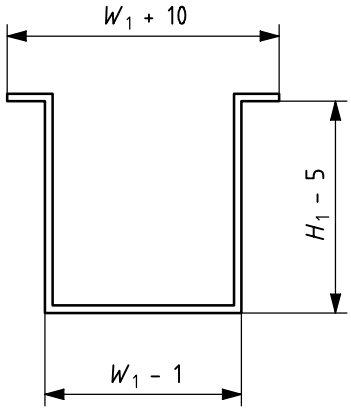
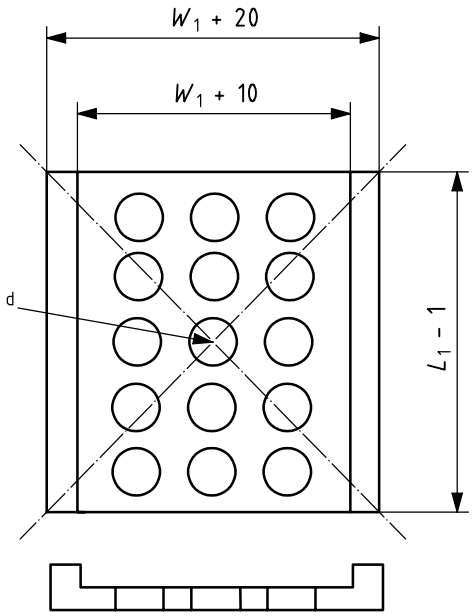






3[c]

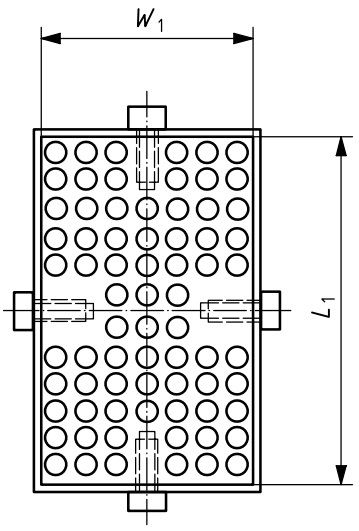
Key

1 lower die
2 upper die
3 weight
4 cross-section of specimen under test

a Dimension H_1 appropriate for the specimen expansion ratio; dimension W_1 to accommodate the width of the specimen; length L_1 to suit the specimen but typically $1{,}5 \times W_1$; materials: 5 mm brass plate and 1,0 mm brass sheet.
b Dimensions as shown: material: 1,00 mm perforated brass sheet.
c Dimensions as shown: material: brass plate.
d Centre of gravity.

Figure B.3 — Die-set for rectangular specimens

Dimensions in millimetres



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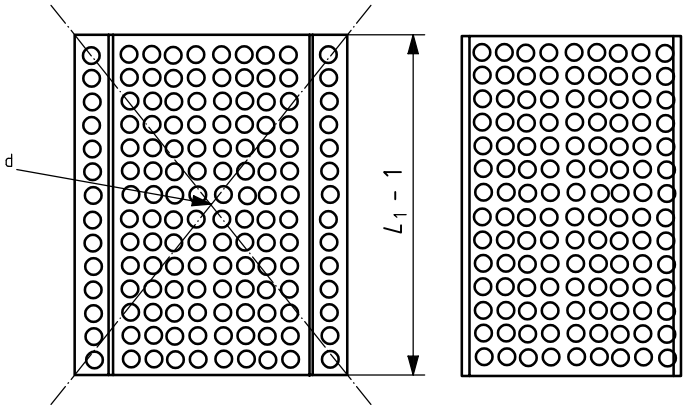

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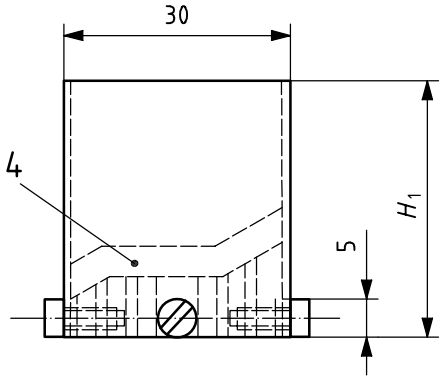
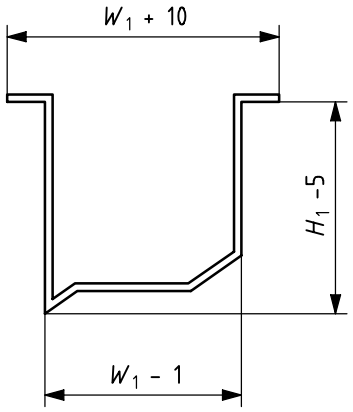
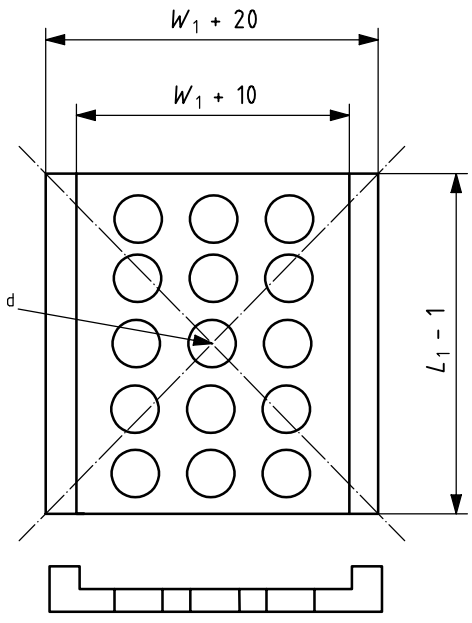






3[c]

Key

1 lower die
2 upper die
3 weight
4 cross-section of specimen under test

a Dimension H_1 appropriate for the specimen expansion ratio; dimension W_1 to accommodate the cross-section of the specimen; length L_1 to suit the specimen but typically $1{,}5 \times W_1$; materials: 5 mm brass plate and 1,0 mm brass sheet.

b Dimensions as shown: material: 1,00 mm perforated brass sheet.

c Dimensions as shown: material: brass plate.

d Centre of gravity.

Figure B.4 — Die-set for contoured section specimens

Annex C
(informative)

The use and application of intumescent fire dampers in ducted air distribution systems

C.1 General

It should be recognized that the applications shown are indicative of general applications and are not applicable to all national regulations.

C.2 Properties

C.2.1 Intumescent fire dampers having no moving parts are unlikely to be affected in their fire performance by aggressive particles carried in the air stream.

Corrosive gases have little effect upon the performance of intumescent dampers but should the need arise to replace the dampers this can be easily and speedily accomplished.

C.2.2 A range of intumescent materials, which provide different performance characteristics in terms of activation temperatures, insulation and expansion ratios, can be used in the construction of dampers.

C.2.3 Intumescent fire dampers, in common with thermally activated mechanical dampers, are not intended to prevent the spread of cold smoke when used in isolation.

C.3 Applications

C.3.1 Intumescent fire dampers are employed to prevent the spread of flame and hot gases in ducts.

C.3.2 Intumescent fire dampers are incorporated within a duct-work installation where either there is no requirement for cold-smoke containment (see Figures C.1 and C.2) or cold-smoke damper devices are incorporated elsewhere within the system at relevant positions (see Figures C.3 and C.4).

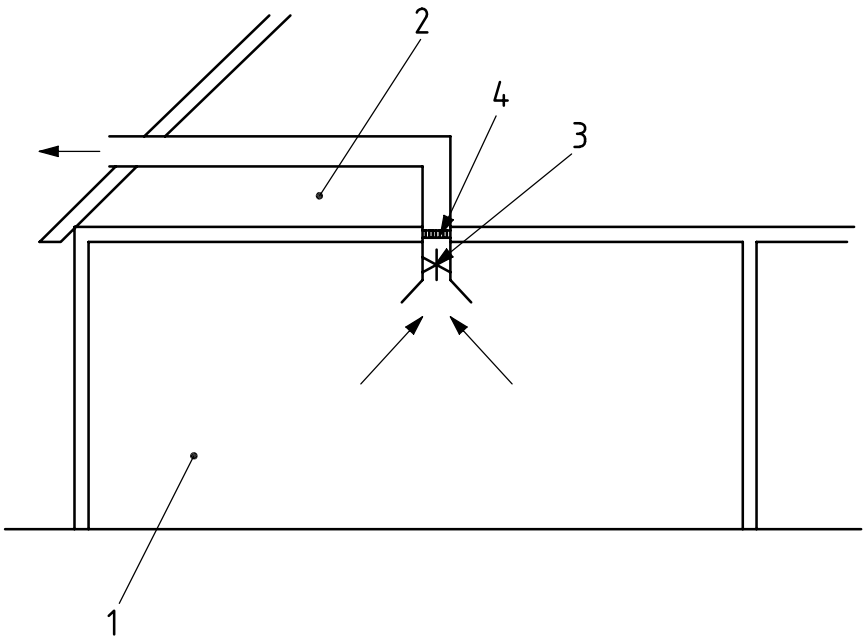
C.3.3 Intumescent fire dampers with a narrow cross-section are used in series to extend the period of integrity obtainable from a damper at any location and improve the overall insulation performance (see Figure C.5).

C.3.4 In cases where it is imperative that a fire damper be fitted but limited access or dimensional limitations preclude either the installation or subsequent maintenance of a mechanical damper, then an intumescent fire damper can provide a solution.

C.3.5 Intumescent insulating fire dampers are used in non-insulated ducts to restrict the transfer of heat via the ducting material through a fire compartment wall. Where non-fire-resisting insulation is used on the external faces of ducting, insulated fire dampers will protect such insulation downstream of the damper.

C.3.6 The incorporation of an intumescent fire damper within the spigot of a thermally activated mechanical damper (see Figure C.6) can provide insulation performance and may be fitted retrospectively to upgrade an existing installation.

C.3.7 Intumescent fire dampers combined with smoke damping devices are used in many applications requiring fire and smoke containment where their normal operating performances meet the system specifications in terms of volumetric air flow, pressure drop and noise emission (see Figure C.6).

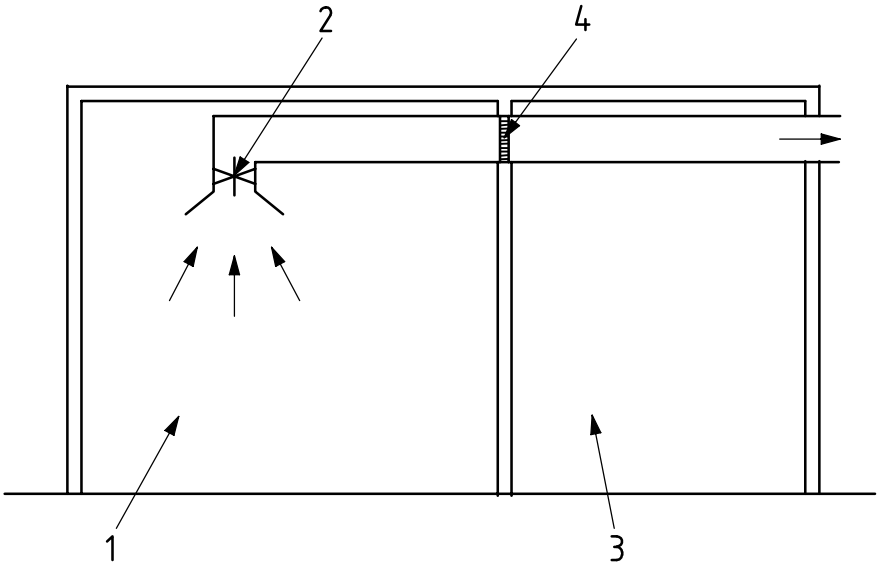


Key

1 kitchen
2 roof void
3 extraction fan
4 intumescent fire damper

NOTE In the event of a fire in the kitchen, the extraction fan will draw hot gases through the intumescent fire damper, which will seal due to the effects of heat. The fire damper will insulate the duct in the roof void and will prevent the spread of flame through the duct.

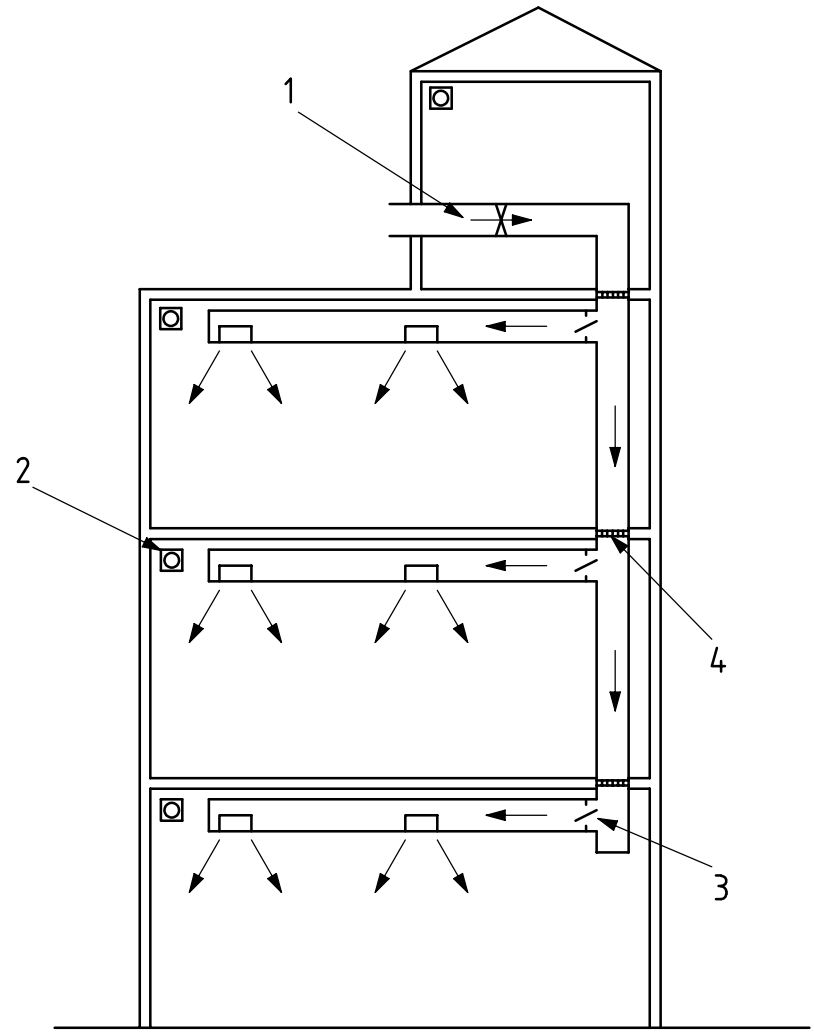
Figure C.1 — Protection from fire spreading into a roof void



Key

1 laboratory
2 extraction fan
3 corridor
4 intumescent fire damper

Figure C.2 — Protection from the spread of fire into a corridor



Key

1 air supply fan: running

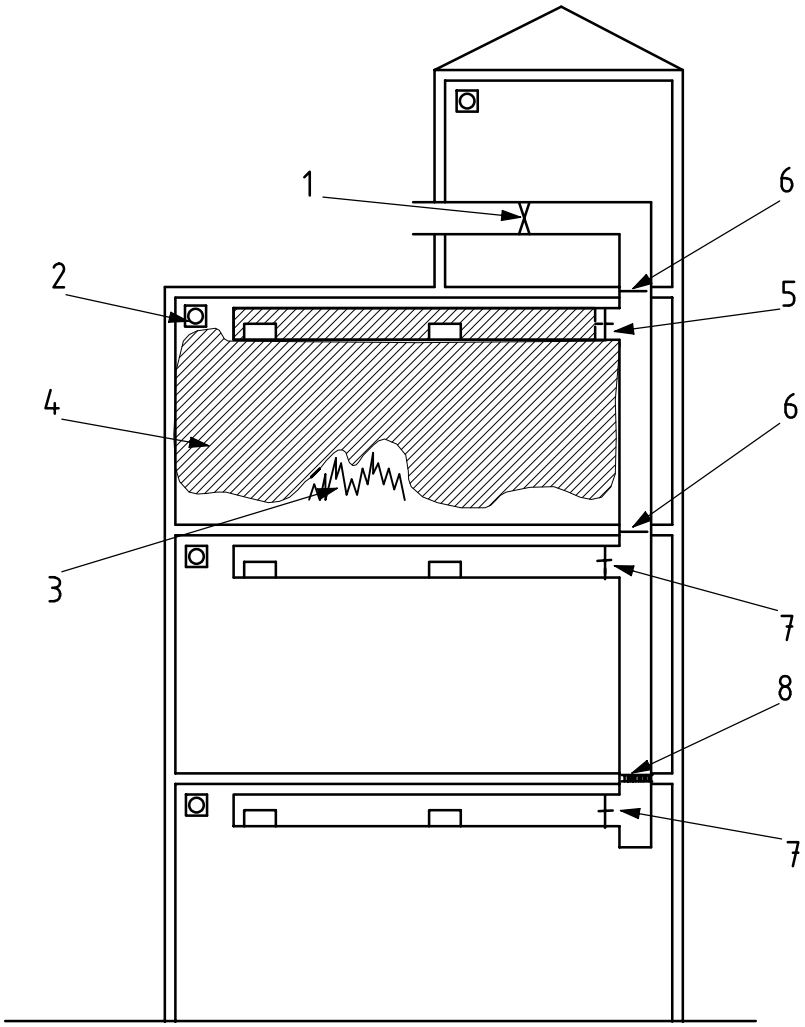
2 smoke sensor

3 electro-mechanical smoke damper: open

4 intumescent fire damper: open

NOTE A typical ventilation system is shown, where air is drawn in at a central location and is distributed by ducts throughout the building. The electro-mechanical smoke dampers and intumescent fire dampers are open under normal conditions allowing the free passage of air.

Figure C.3 — Air distribution system — Normal conditions

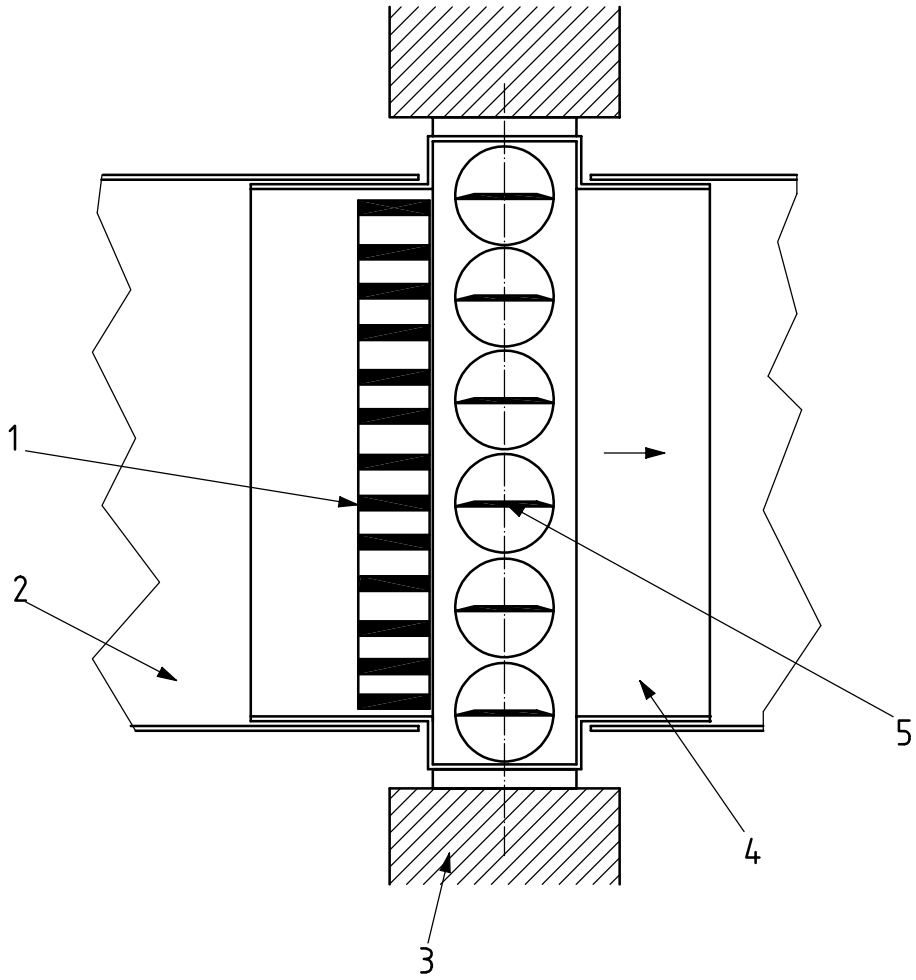


Key

1 ventilation fan: stopped
2 smoke sensor
3 fire
4 smoke
5 electro-mechanical smoke damper
6 intumescent fire dampers: closed
7 electro-mechanical smoke dampers: closed
8 intumescent fire damper: open

NOTE In fire conditions, the ventilation fan is stopped. Smoke sensors trigger the electro-mechanical smoke dampers (5) and (7) to close and the intumescent fire dampers (6) to seal off as they rise in temperature. Therefore, smoke is prevented from spreading around the building and fire is contained within the compartment in which the fire originated.

Figure C.4 — Air distribution — In fire conditions

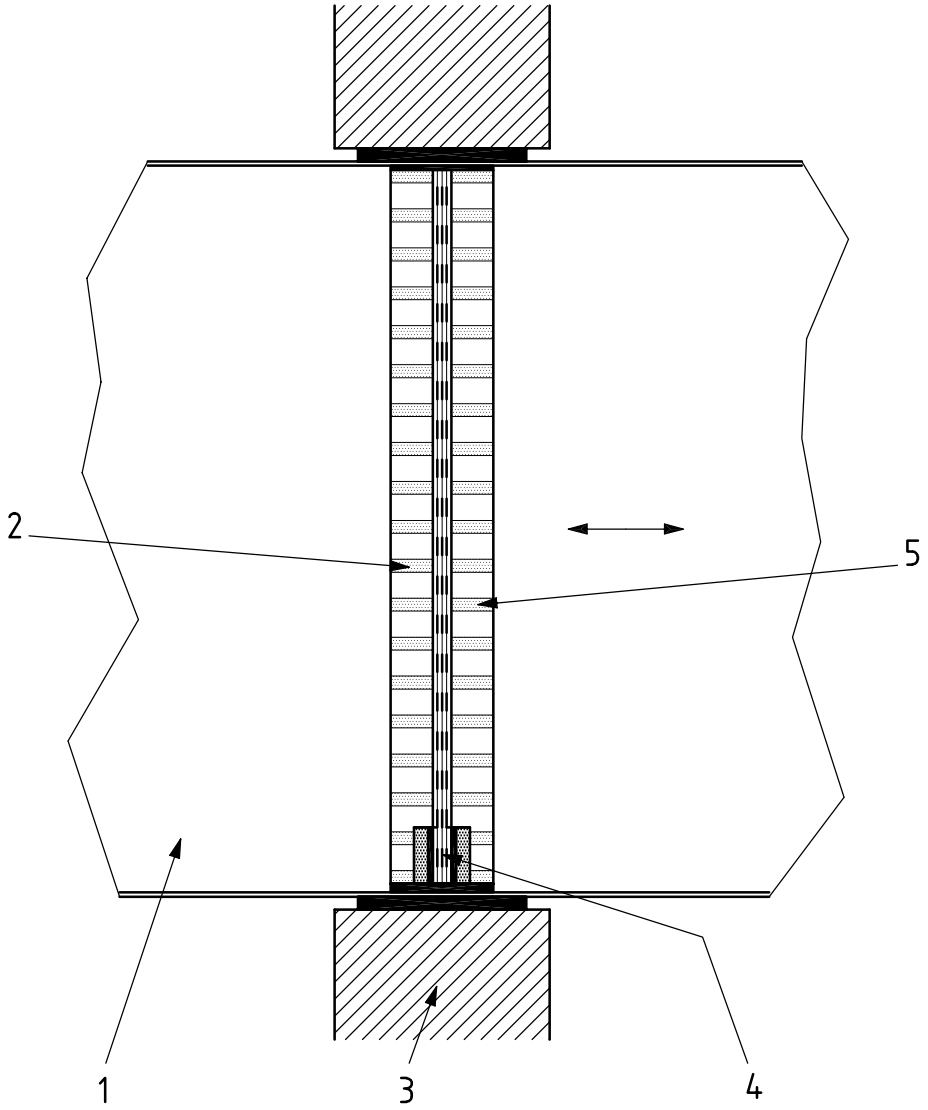


Key

1 duct
2 intumescent fire damper
3 compartment wall
4 mechanical fire dumper
5 damper blades

NOTE As shown, fitting an intumescent fire damper within the housing can enhance the insulation performance of a mechanical fire damper. This will give E (integrity) plus I (insulation) performance criteria.

Figure C.5 — Dampers in series



Key

1 duct
2 slotted smoke control shutter plates
3 compartment wall
4 shutter plate actuator
5 intumescent fire damper module

NOTE A motorised actuator initiated by a smoke sensor drives a central slotted central plate between two slotted fixed plates. Under normal conditions when the slots of the three plates are aligned, air is able to pass through the assembly. When activated by signal from a smoke sensor, the central plate is moved and the slots will be displaced from alignment creating an effective gas seal through the assembly. This provides cold and warm smoke containment. Twin intumescent fire damper modules prevent penetration by fire or hot smoke. The combined damper will give E (integrity) plus I (insulation) plus S (leakage) performance criteria.

Figure C.6 — Combined intumescent fire and smoke damper

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