



BSI Standards Publication

Fire resistance tests for service installations

Part 10: Smoke control dampers

National foreword

This British Standard is the UK implementation of EN 1366-10:2022+A1:2024. It supersedes BS EN 1366-10:2022, which is withdrawn.

The start and finish of text introduced or altered by amendment is indicated in the text by tags. Tags indicating changes to CEN text carry the number of the CEN amendment. For example, text altered by CEN amendment A1 is indicated by A1 A1.

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

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- Partie 10 : Volets de désenfumage

Feuerwiderstandsprüfungen für Installationen
- Teil 10: Entrauchungsklappen

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European foreword

This document (EN 1366-10:2022+A1:2024) 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of an identical text or by endorsement, at the latest by March 2025, and conflicting national standards shall be withdrawn at the latest by March 2025.

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

This document supersedes A1 EN 1366-10:2022 A1.

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This document has been prepared under a standardization request addressed to CEN by the European Commission. The Standing Committee of the EFTA States subsequently approves these requests for its Member States.

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

- Part 1: Ventilation ducts
- Part 2: Fire dampers
- Part 3: Penetration seals
- Part 4: Linear joint seals
- Part 5: Service ducts and shafts
- Part 6: Raised access and hollow core floors
- Part 7: Conveyor systems and their closures
- Part 8: Smoke extraction ducts
- Part 9: Single compartment smoke extraction ducts
- Part 10: Smoke control dampers
- Part 11: Fire protective systems for cable systems and associated components
- Part 12: Non-mechanical fire barrier for ventilation ductwork
- Part 13: Chimneys

A1 This standard underwent a formal review process during 2016-2021. Various comments were considered, and these were only considered when they added clarity to the test procedure. No changes have been made that make historical data redundant. This was deliberately avoided where it was thought to be occurring.

The wording and figures have been clarified to show some more detail.

Changes include the fact that symmetry as a concept has been removed. This does not negate original tests but may now mean that some additional tests are needed. [A1](#)

Any feedback and questions on this document should be directed to the users' national standards body. A complete listing of these bodies can be found on the CEN website.

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Introduction

When smoke and heat exhaust ventilation is being considered, it becomes apparent that a clear path between the area where heat and smoke is being generated (source of the fire) and the outside of the building is needed.

To create this path ducts and an uninterrupted smoke extract path are needed. This means that smoke control dampers at the fire and along the path are open and will remain open. Smoke control dampers at branches, or on the surface of the duct, along the path are closed and will remain closed. In fact, if the duct crosses a compartment boundary it becomes part of the fire compartment in which the fire started.

The purpose of this document is to define test methods to evaluate the abilities of smoke control dampers to:

- a) be applicable to single compartment and/or multi compartment fire resisting applications;
- b) be applicable to automatic systems or systems with manual activation;
- c) change state from closed to open at elevated temperatures, (and vice versa);
- d) once opened maintain a defined cross-sectional area at elevated temperature or under fire conditions following the standard time/temperature curve; and
- e) maintain a satisfactory leakage performance when subjected to negative pressure at elevated temperatures or under fire conditions following the standard time/temperature curve.

The units are mounted for the tests in a manner representative of practice.

Temperature and integrity measurements are carried out on various parts of the test construction during the test. The required leakage measurements are measured by direct flow measurement at the prescribed pressure differentials. Ambient leakage of the units is also recorded.

The satisfactory passing of some, or all, of these tests will allow products to be assessed in accordance with EN 12101-8 and be classified to EN 13501-4. The required temperatures, pressure differentials etc. are stated in EN 12101-8. EN 13501-4 requires a classification report.

CAUTION:

The attention of all persons concerned with managing and carrying out this furnace testing 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 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 document specifies test methods for smoke control dampers to assess their performance under elevated temperature or fire conditions, as well as at ambient temperatures.

Smoke control damper tests are used to confirm that the furnace testing requirements of EN 12101-8 are met and EN 12101-8 is for consideration before carrying out these tests.

Smoke control dampers tested to this document are expected to be classified using EN 13501-4 and this document is expected to be considered before carrying out these tests.

NOTE Some smoke control dampers to be tested might require testing following the information given in EN 1366-2 and this needs consideration before carrying out testing.

This document is expected to be read in conjunction with EN 12101-8, EN 13501-4, EN 1366-2 and EN 1363-1, the latter giving further details for fire resistance testing.

For installation details, the requirements for smoke extraction ducts are for consideration and these are defined in EN 1366-8 and EN 1366-9.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 1363-1, *Fire resistance tests — Part 1: General requirements*

EN 1366-2, *Fire resistance tests for service installations — Part 2: Fire dampers*

EN 1366-8, *Fire resistance tests for service installations — Part 8: Smoke extraction ducts*

EN 1366-9, *Fire resistance tests for service installations — Part 9: Single compartment smoke extraction ducts*

EN 1751, *Ventilation for buildings — Air terminal devices — Aerodynamic testing of damper and valves*

EN 10095, *Heat resisting steels and nickel alloys*

EN 13501-4, *Fire classification of construction products and building elements — Part 4: Classification using data from fire resistance tests on components of smoke control systems*

EN ISO 5167-1, *Measurement of fluid flow by means of pressure differential devices inserted in circular cross-section conduits running full — Part 1: General principles and requirements (ISO 5167-1)*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

3.1

elevated temperature

temperature in excess of normal ambient air, below those necessary for fire resistance testing (i.e. the standard fire curve in accordance with EN 1363-1), to which smoke and heat exhaust ducts for single compartments are tested

3.2

HOT 400/30

additional test and classification for a smoke control damper that requires proof of opening and closing operations for 30 minutes at 400 °C

3.3

HVAC

heating, ventilating and air conditioning

Note 1 to entry: Usually used with the addition of the word “system”.

3.4

interface control unit

device which controls the operation of the actuator located at the smoke control damper or within the same fire zone as the smoke control damper and usually associated with a smoke control/fire alarm system

3.5

largest size

greatest size of smoke control damper individual unit including the maximum width and height (as opposed to an assembly/battery of units) proposed for sale/manufacture

3.6

modulating actuator

smoke control damper control mechanism which can control the smoke control damper to be in a position or number of positions between fully open and fully closed in normal day to day operation (not fire conditions)

3.7

penetration seal

fire stopping method

product(s) used between the smoke control system duct/damper and the fire compartment structure to maintain the fire resistance, and tested in accordance with EN 1366-8 (ducts) or EN 1366-10 (dampers)

3.8

safety position

position (open or closed) into which specific projects could require certain dampers to move to, or remain in, depending upon the fire location within the building

Note 1 to entry: Specific projects can require certain smoke control dampers to move to an open or closed position, depending upon the fire location within the building.

3.9

smallest size

least size of smoke control damper individual unit including the minimum width and height proposed for sale/manufacture

3.10**multi-compartment smoke control damper**
multi-compartment SCD

device which can be open or closed to control the flow of smoke and hot gases into, from or within a duct for use in multi-compartment applications which is required to maintain compartmentation when closed

3.11**single compartment smoke control damper**
single compartment SCD

device which can be open or closed to control the flow of smoke and hot gases into, from or within a duct for use in single compartment applications at elevated temperatures (600 °C)

3.12**builders work**

any construction formed from concrete, blockwork, light wall or other materials as part of general construction, such as used to construct shafts, walls and floors

3.13**duct mounted smoke control damper**
duct mounted SCD

A_1 smoke control damper mounted on the surface of, or in line (perpendicular to the duct axis) with a smoke control duct A_1

3.14**compartment mounted smoke control damper**
compartment mounted SCD

smoke control damper mounted at a compartment boundary formed from builders' work A_1 *deleted text* A_1

3.15**smoke control damper for systems with automatic activation**

smoke control damper that is applicable to the smoke control systems that operate automatically on receipt of a smoke or fire alarm without any manual action/intervention and allow no firefighter overrides

Note 1 to entry: A smoke control system with an attended control room can also be accepted as an automatic system, provided that once initiated, the system does not cause the smoke control damper position to be changed.

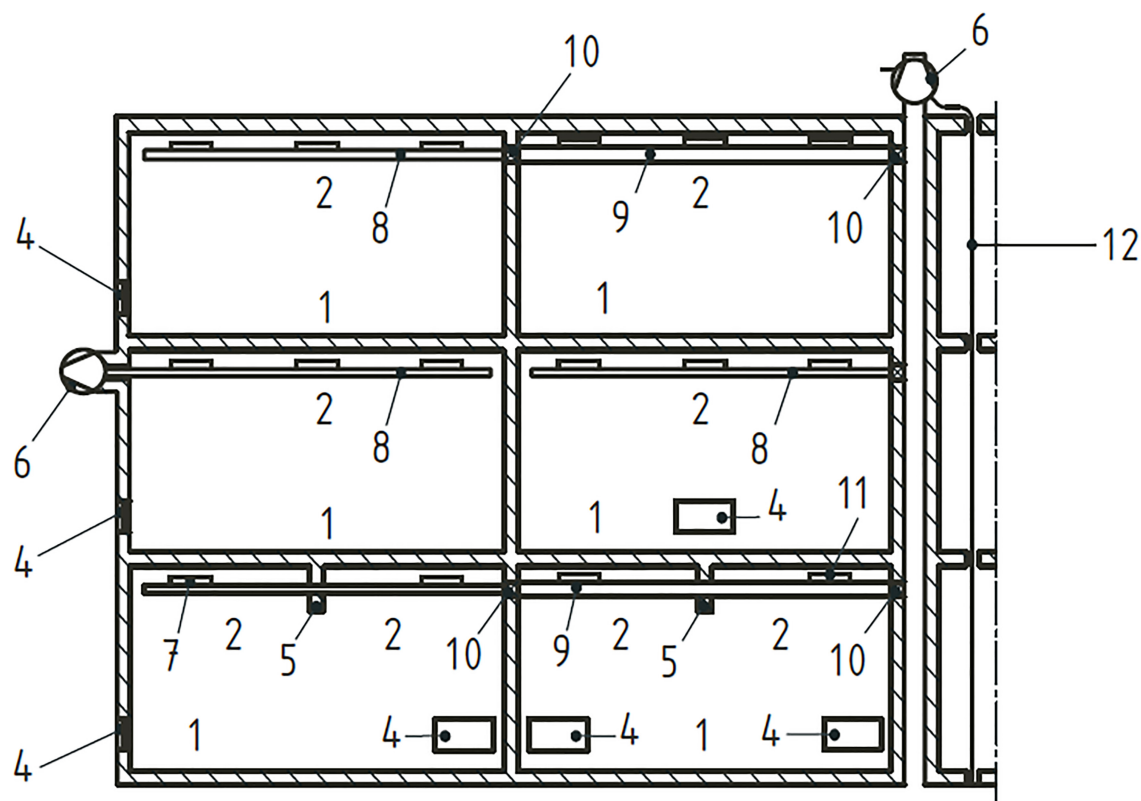
3.16**smoke control damper for systems with manual activation**

smoke control damper that is applicable to the smoke control systems (smoke and heat exhaust ventilation type or pressurization type), that will be put into operation, on detection smoke or fire, by human intervention (e.g. by pressing a button or pulling a handle) leading to a sequence of automatic actions in the operation of the smoke control system or a system that allows firefighter overrides

3.17**thermal operating device**

temperature sensitive device such as a fusible element which responds to temperature to initiate a subsequent action such as causes the damper to change position

Note 1 to entry: Further information is given in Figure 1.



Key

- 1 fire compartments
- 2 smoke reservoirs
- 4 air inlets
- 5 smoke barriers
- 6 powered smoke and heat exhaust ventilator (fan)
- 7 smoke control dampers for single compartments (EN 12101-8 and EN 1366-10)
- 8 smoke control ducts for single compartments (EN 12101-7 and EN 1366-9)
- 9 smoke control ducts for multi compartments (EN 12101-7 and EN 1366-8)
- 10 smoke control dampers for multi compartments (EN 12101-8 and EN 1366-10) mounted inside or outside of wall or floor (compartmentation tests)
- 11 smoke control dampers for multi compartments (EN 12101-8 and EN 1366-10) mounted on the surface of the duct (surface of duct tests)
- 12 electrical equipment

Figure 1 — Example of powered smoke and heat exhaust ventilation system in cross-section

4 Test equipment

4.1 General

In addition to the test equipment specified in EN 1363-1, the equipment in the following clauses is required (examples of test arrangements are given in Figure 4, Figure 5, Figure 8 and Figure 9).

4.2 Test duct for surface mounted SCDs

See 5.2.2.2 and 5.2.2.3.

4.3 Connecting duct for compartment boundary mounted SCDs

4.3.1 Compartmentation test

See EN 1366-2.

4.3.2 Maintenance of opening test

The duct connector (Figure 9, item 9) shall be classified in accordance with EN 13501-4 and match the damper cross section.

A normal steel fabricated duct may be used for the mounting of the perforated plate (Figure 9, item 5). The perforated plate mounting duct shall have a cross section 1 000 mm × 250 mm and have a minimum length of 2 m. The perforated plate mounting duct may be provided with a gas tight observation window.

4.4 Cycling equipment

Full information on the equipment needed to perform the cycling tests is shown in Annex A. In addition, the following shall be considered:

Equipment shall be required to control a supply to allow the smoke control damper actuator to be cycled. This equipment shall be able to provide the nominal operating motive force less 10 %, plus 15 %, and be variable between these values to confirm that the smoke control damper shall operate at the extremes. If the unit to be tested requires a control signal of any type this shall be provided in addition and shall be able to give the device a signal at each extreme and any in between these.

Methods of adding a load to the smoke control damper are required (see Annex A).

NOTE A device that allows the smoke control damper to be cycled automatically, together with a method of recording completed cycles, would be useful. A test could thereby be set to run without attendance, noting that each cycle could potentially take 120 s.

4.5 Condensing unit

When performing the compartmentation test, there could be a requirement for a condensing unit, because the smoke control damper could generate some steam; refer to EN 1366-2.

4.6 Gas temperature measuring devices

These shall be positioned adjacent to the flow measuring device. A suitable device is a 1,5 mm diameter sheathed thermocouple (Type K) orientated vertically with its measuring junction located at the centre line 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 Figure 8, Figure 19, Figure 20).

4.7 Exhaust fan system

This shall be capable of controlling the flow rates and maintaining the specified pressure differential between the connecting duct and the furnace when the smoke control damper is closed.

The pressure differential shall be regulated by means of a dilution damper installed just before the fan inlet. The pressure shall be controlled to within $\pm 5\%$ of the specified value. A balancing damper shall be fitted at the outlet of the fan to adjust the pressure range of the systems to suit the smoke control damper under test. A variable speed fan may be used instead of the dilution damper.

4.8 Perforated plate

The perforated plate limits the flow through the duct so that the required differential pressure, see Table 1, can be achieved. Depending on the end-use conditions, a pressure level from Table 1 shall be selected: These levels correspond to typical values used in smoke extraction design. The pressure will be measured as shown in 4.12.

The plate shall be made from austenitic heat-resisting steel (grade number 1.4835) in accordance with EN 10095. The plates shall be manufactured in accordance with the details shown in Figure 16 (rectangular) and Figure 17 (Circular) which show the number of holes and dimensions etc. The thickness of the plates shall be $2,5 \text{ mm} \pm 0,5 \text{ mm}$.

NOTE Perforated plates made to the old specification: heat resisting steel, 19 % min. Cr content and 11 % min. Ni content (Euronorm (X2Cr-Ni19-11); thickness between 2,5 mm and 3,0 mm are acceptable (to use up materials) and tests made using the old specification plates are still valid tests.

The plate shall be positioned (250 ± 50) mm from where the duct passes through the furnace wall (see Figure 4, Figure 5, Figure 9).

Figure 18 shows details for the mounting of the perforated plate in different duct types.

Table 1 — Differential pressures between inside and outside the duct for smoke extraction ductwork

Pressure level	Operating differential pressure at ambient temperature Pa	Differential pressure for the fire test Pa
1	-500	-150
2	-1 000	-300
3	-1 500	-500

4.9 Volume and flow measurement for duct mounted SCDs

For measurement of the volume flow during the fire resistance or elevated temperature test, flow nozzles shall be used. Each nozzle shall have an internal dimension of 160 mm and conform with the details shown in Figure 20 and Figure 21. These shall be suitable for the standard size of duct specified in 5.2.1 in accordance with EN ISO 5167-1 and shall be suitably mounted to the end of the duct with its piezometric ring connected to appropriate differential pressure measuring equipment.

Alternatively measurement may be made by other suitable devices, providing the equipment used is in accordance with EN ISO 5167-1 (general principles), EN ISO 5167-3 or EN ISO 5167-4 as necessary.

Calculations shall be in accordance with the chosen measurement standard.

The measuring device shall be capable of measuring to an accuracy of $\pm 5 \%$.

4.10 Volume flow measurement for compartment boundary mounted SCDs

4.10.1 Compartmentation test

Generally, as EN 1366-2. The general test arrangement showing flow measuring equipment is shown in Figure 8.

4.10.2 Maintenance of opening test

See 4.9.

4.11 Ambient leakage measurement equipment

If the equipment noted in 4.9 and 4.10 can measure the ambient leakage of the dampers mounted in the test set up, then this may be used.

Alternatively, the ambient leakage measuring equipment described in EN 1751 may be used.

In either case, the measuring device shall be capable of measuring to an accuracy of $\pm 5\%$.

Calculations shall be in accordance with the chosen measurement standard.

4.12 Pressure sensors for differential pressure control

4.12.1 Duct mounted smoke control dampers

A tube sensor as specified in EN 1363-1 shall be located at the end of the duct, inside the duct, at the level of its centre line. A second sensor (e.g. an open end of a measuring tube) shall be located on the same level outside the duct differential pressure fine control device.

4.12.2 Compartment boundary mounted smoke control dampers

A pressure tapping shall be located on the centre line, at mid height, of one vertical side wall of the connecting duct. Instrumentation to determine the pressure differential between the furnace and the connecting duct shall be provided.

A flow control damper shall be provided for a fine control for maintaining the required differential pressure. Alternatively, another suitable device such as a variable speed fan may be used. Any flow control damper shall be attached to the extract fan connecting duct (see 4.14).

4.13 Welded connecting tube

A welded connecting tube is a tube that shall provide a suitable gas tight connection between the inlet nozzles and the oxygen measuring probes.

4.14 Extract fan connecting duct

An extract fan connecting duct shall be used to connect between the test specimen and the extraction fan. An inlet opening may be provided if a flow control damper is used for fine control of the differential pressure (see 4.12).

4.15 Extraction fan

The extraction fan provided by the laboratory shall be capable of exceeding the test requirements stated in this document.

4.16 Thermocouples

1,5 mm sheathed thermocouples shall be provided for measuring the gas temperature adjacent to the nozzles. An alternative thermocouple may be used, provided it can be shown to have equivalent response time.

4.17 Oxygen measuring equipment

Equipment for measuring the oxygen content of gases shall be provided. This system shall consist of paramagnetic cell oxygen analysers together with appropriate equipment for cooling, filtering and drying the gases. The accuracy of the oxygen volume measurement shall be better than $\pm 0,1\%$. Appropriate connecting tubes and probes shall be provided. Where a single paramagnetic cell oxygen gas analyser is used, the 90 % response time of the complete system shall be 20 s maximum. Where two paramagnetic cell oxygen gas analysers are used, the 90 % response time of the complete system shall be 40 s maximum. Just prior to starting the fire test the gas analysers shall be calibrated. This shall be done using

reference gases, such as oxygen free nitrogen to set zero and another gas of known oxygen content to set the equipment span.

4.18 Observation windows

Provision may be made to provide suitable observation windows to allow the test observations to be made safely.

5 Test specimens

5.1 Cross-section

The size of smoke control damper subjected to the fire resisting and elevated temperature tests shall be the largest size. The fire resisting and elevated temperature tests require ambient leakage tests prior to those tests. Ambient leakage shall be required to be determined also on the smallest size.

Suitable transition pieces shall be constructed to allow transition of the smoke control dampers to the selected test duct.

5.2 Design

5.2.1 General

The test shall be made on test specimens representative of the smoke control damper (SCD) range.

The smoke control damper shall include all ancillaries such as actuators, end switches, etc.

Any interface control unit that governs the movement of the actuator shall be tested and operate to the same time/temperature criteria as the actuator it controls.

5.2.2 Supporting constructions

5.2.2.1 General

The installation shall be representative of that intended to be used in practice, reproducing the method of fixing the damper to the duct, the supporting constructions and the penetration seals/fire stopping.

The tested installation shall be fully described in the test report.

5.2.2.2 Duct for single compartment smoke control dampers

This shall be a duct previously tested to EN 1366-9 as a single compartment smoke control duct and shall have, as a minimum, the standard tested cross section of 1 000 mm and 250 mm (see Figure 4, Figure 5, Figure 6 and Figure 9) or diameter 560 mm (circular ducts).

The duct shall be installed in the compartment boundary as it was tested and use the same penetration seal/fire stopping method.

Ducts may be rectangular or circular. Transitions may be made to circular ducts as shown in Figure 15.

5.2.2.3 Duct for multi compartment smoke control dampers

This shall be a duct previously tested to EN 1366-8 as a multi-compartment smoke control duct and shall have, as a minimum, the standard tested cross section of 1 000 mm and 250 mm (see Figure 4, Figure 5, Figure 6, Figure 9 and Figures 10 and 11) or diameter 560 mm (circular ducts).

The duct shall be installed in the compartment boundary as it was tested and use the same penetration seal/fire stopping method.

If required, the duct may be supported in the way it was tested in order to prevent the horizontal movement of the top edge of the vertical duct.

Ducts may be rectangular or circular. Transitions may be made to circular ducts as shown in Figure 15.

5.2.2.4 Smoke control dampers mounted in a compartment boundary

A standard supporting construction may be selected as detailed in EN 1366-2. Where an alternative is proposed, this shall be fully documented. The smoke control damper shall be installed using any method of penetration seal/fire stopping, but this method shall be fully described in the test report.

The same methods of penetration seal/fire stopping shall be used for both the compartmentation test and the maintenance of opening test and shall be fully described in the test report.

5.2.3 Inclusion of grilles

Where grilles are to be supplied with the smoke control damper and the distance between the grille and the centre line of blade pivot axis of the smoke control damper is less than 200 mm, testing of the smoke control damper shall also include the grilles as part of the assembly.

In this case, the surface thermocouples which are taken into account for the insulation criteria are the ones which are fixed onto the grill.

Where a smoke control damper and grilles are to be supplied as separate entities and they are to be installed greater than a distance of 200 mm, this arrangement shall not require testing as an assembly, only the smoke control damper on its own.

In this case, the surface thermocouples which are taken into account for the insulation criteria are the ones which are fixed onto the damper.

6 Test methods

6.1 General

Smoke control dampers shall be tested according to their proposed end use application to enable classification to be made. The different SCDs are characterized and broadly split into:

- duct mounted or compartment boundary mounted with both horizontal and vertical orientation, according mounting conditions;
- Manual Activation (MA) or Automatic Activation (AA);
- standard time/temperature (EN 1363-1) curve or the elevated temperature (600 °C) curve;
- multi or single compartment according to applications.

6.2 Test sequence

The test sequence for a smoke control damper shall be as follows:

- a) Two/three/five samples of the largest size of SCD and one of the smallest size shall be selected.

If only the duct mounted tests are to be performed, this requires two dampers of the largest size. If only the compartment boundary tests are to be performed, this requires three dampers of the largest size.

Five dampers of the largest size will be required if performing the whole suite of tests for both applications.

These tests shall be repeated for both horizontal and vertical applications if both applications are required.

The orientation of the blade axis shall be the same as it is intended for the fire resistance test.

- b) Each unit shall be tested for ambient leakage (6.3).
- c) Each unit of the largest size shall then be subjected to a cycling test (6.4), the number of cycles dependent upon the final proposed application. The orientation of the blade axis shall be the same as it is intended for the fire resistance test.
- d) Each unit of the largest size shall then again be subjected to ambient leakage test (6.3).
- e) The type of elevated and fire resistance tests to be undertaken shall be selected following 6.5.
- f) The same units of the largest size shall be fitted to the selected test construction.
 - 1) Duct mounted SCD – one for inside the furnace and one for outside the furnace.
 - 2) Compartment boundary mounted SCD – two for the maintenance of compartmentation test and one for the maintenance of opening test.
- g) Smoke control dampers shall undergo elevated temperature (single compartment) or fire resistance tests (multi compartment) to 6.6 using the AA initiation regime from 6.7. If required to meet the maintenance of opening test for MA, then the same product (protected actuator etc) shall be used here.
- h) Compartment mounted SCDs shall undergo a maintenance of opening test to 6.6 using an initiation regime chosen from 6.7 (AA or MA).
- i) An optional HOT400/30 operational test at 400 °C for 30 min may be undertaken.

Fire compartmentation takes precedence over smoke control and unless it is done as a part of a smoke control system, compartmentation should not be put at risk, if for instance the smoke control system would fail to work or work correctly.

Table 2 — Overview of test sequences

	Largest sizes	Smallest size
1	Ambient leakage	Ambient leakage
2	Cycle test	Not required
3	Ambient leakage	Not required
4	Duct mounted fire/elevated temperature test, or Compartment boundary mounted test (from side 1), and Compartment boundary mounted test (from side 2), and Compartment boundary maintenance of opening test	None
5	HOT 400/30 test (optional)	None

6.3 Ambient leakage

6.3.1 Units of the largest size

Each sample of the largest size shall be tested for ambient leakage using the method shown in EN 1751, at ambient temperature and the results recorded.

Each sample shall then be cycle tested, the number of cycles being selected from 6.4.

Each sample shall then be tested again for ambient leakage.

NOTE The above do not need to be done in the fire test construction.

The samples of the largest size shall be fitted in the proposed (fire) test construction and the whole system shall be tested for ambient leakage with all SCDs in their closed position.

6.3.2 Units of smallest size

In addition, a sample of the smallest size shall be tested for ambient leakage using the method shown in EN 1751, at ambient temperature and the results recorded.

6.4 Cycling requirements

6.4.1 General

Full details of the test and the loading to be used is given in Annex A. A.3.5 gives the requirements for horizontal blade axis dampers and A.3.6 for vertical blade axis dampers.

If smoke control dampers (SCDs) for systems are operated before a pressure or flow is added, the fan is only activated once the dampers are in their final position. Therefore, cycle testing can be done without any application of a load. If the SCDs are operated after the pressure or flow is added, they shall be tested with the application of a load.

It shall be clearly stated in the test report whether loading has been used or not.

It is recommended that “loaded” or “with no load” is stated in the classification report, the certificate of constancy of performance (CoCoP) and in the Declaration of Performance (DoP).

6.4.2 Smoke control damper to be used in dedicated smoke control systems, operated only in the case of emergency

- 1) 100 cycles at nominal operating motive force (e.g. the voltage), followed by
- 2) 100 cycles at nominal operating motive force less 10 %, followed by
- 3) 100 cycles at nominal operating motive force plus 15 %.

The results shall record that the cycles were fully completed and that each travel took no longer than 60 s. The time for the first and last operations shall be recorded.

6.4.3 Smoke control damper to be used as part of a general HVAC system as well as a smoke control system, or as part of a smoke control systems that is cycled every day to check operation

- 1) 10 000 cycles at nominal operating motive force (e.g. the voltage), followed by
- 2) 100 cycles at nominal operating motive force less 10 %, followed by
- 3) 100 cycles at nominal operating motive force plus 15 %.

The results shall record that the cycles were fully completed and that each travel took no longer than 60 s. The time for the first and last operations shall be recorded.

6.4.4 Smoke control damper to be used as part of a general HVAC system as well as a smoke control system, that uses a modulating actuator

- 1) 10 000 cycles at nominal operating motive force (e.g. the voltage) fully open to fully closed (0° to 90°), followed by
- 2) 10 000 cycles at nominal operating motive force (e.g. the voltage) half open to two thirds open (45° to 60°).

The results shall record that the cycles were fully completed and that each travel took no longer than 60 s. The time for the first and last operations shall be recorded.

6.5 Selection of elevated temperature and fire resistance tests

There is a range of alternative types of tests to evaluate a smoke control damper. Depending upon:

- mounting conditions;
- initiation regimes (AA, MA);
- heating conditions [applications multi or single compartment(s)].

Smoke control dampers for applications requiring duct mounting complete a maintenance of closure test and a maintenance of opening test during the same test.

Smoke control dampers for application in a compartment boundary shall complete both a maintenance of compartmentation test from both sides and a single maintenance of opening test before being deemed to have completed the testing.

Tests or a combination of tests with sequences given in Table 3 shall be performed.

The required ambient leakage tests and cycling tests shall be made on the units before the fire/elevated temperature tests.

Table 3 — Fire/elevated temperature tests required for different types of smoke control damper

Mounting conditions		Automatic Activation (AA) SCD		Manual Activation (MA) SCD	
Duct mounted SCD (Figure 4 and Figure 5)					
Horizontal damper	6.6.1.1.1	Fire resistance test/Initiation regime:	6.6.1.2 and 6.7.1	Fire resistance test/Initiation regime:	6.6.1.2 and 6.7.2
Vertical damper	6.6.1.1.2	Maintenance of opening/Initiation regime:	Part of above	Maintenance of opening/Initiation regime:	Part of above
Blade axis for vertical SCDs	6.6.1.1.3				
Additional test information:		6.6.3.1			
Compartment boundary mounted SCD (Figure 9)					
Horizontal damper	6.6.2.1.1	Fire resistance test/Initiation regime:	6.6.2.2 and 6.7.1	Fire resistance test/Initiation regime:	6.6.2.2 and 6.7.1
Vertical damper	6.6.2.1.2	Maintenance of opening/Initiation regime:	6.6.2.3 and 6.7.1	Maintenance of opening/Initiation regime:	6.6.2.3 and 6.7.2
Blade axis for vertical SCDs	6.6.2.1.3	Required for compartmentation test only		Required for compartmentation test only	
Test both sides					
Additional test information		6.6.3.1			

6.6 Fire resistance tests and elevated temperature tests

6.6.1 Duct mounted smoke control dampers

6.6.1.1 Mounting conditions

6.6.1.1.1 Duct mounted smoke control damper in horizontal position

To test the horizontal duct mounted condition for smoke control dampers, the duct shall be built in a horizontal orientation passing through the wall of the furnace as shown in Figure 4. Two smoke control dampers of the same type and size shall be tested.

The two SCDs shall be mounted on the top surface of the duct or on the bottom surface of the duct depending upon the end use of the SCD – see Figure 7.

Installation on the top surface of the duct does not allow installation on the bottom surface of the duct and vice versa. For the requirement for both installations, two different tests shall be performed.

6.6.1.1.2 Duct mounted smoke control damper in vertical position

To test the vertical duct mounted condition for smoke control dampers, the duct shall be built in a vertical orientation passing through the roof of the furnace as shown in Figure 5 or in a horizontal orientation passing through the wall of the furnace as shown in Figure 4 and Figure 7. Two smoke control dampers

of the same type and size shall be tested. The SCDs shall be mounted on the side surface of the duct (vertical orientation) or on the vertical side surface of the duct (horizontal orientation).

6.6.1.1.3 Blade axes

The blade pivot axis, if any, shall be considered as follows:

If a smoke control damper installation method is proposed and it is required that the damper be installed with the blade pivots horizontal and vertical, then the test shall be repeated for both horizontal and vertical blade pivots – this will be the case for vertically mounted smoke control dampers.

6.6.1.2 Elevated temperature tests and fire resistance tests for duct mounted smoke control dampers (single and multi-compartment respectively)

Samples of the largest size shall be tested in the orientation of proposed installation (i.e. vertically or horizontally).

No thermal operating device (e.g. fusible element) is required or allowed and shall not form part of the smoke control damper assembly.

The samples shall undergo the sequence of ambient leakage testing and cycling (see 6.2) before being subjected to this test.

The test sample shall be generally installed with the test equipment shown in Figure 4 or Figure 5.

The test shall be undertaken using a pressure selected from Table 1.

The initiation regime shall be selected from 6.7 – SCD with automatic activation (AA – 6.7.1) or SCD with manual activation (MA – 6.7.2).

The heating conditions and the furnace atmosphere shall conform to those specified in EN 1363-1 following:

- for multi compartment smoke control dampers: the standard curve and tolerances; and
- for single compartment smoke control dampers: the standard curve until the selected elevated temperature is reached. The selected elevated temperature shall then be maintained with a tolerance of +25 °C and –0 °C for the rest of the test.

The furnace pressure shall be controlled to (15 ± 3) Pa throughout the test at the mid-height position of the horizontal ducts. For vertical ducts the furnace pressure shall be controlled to (20 ± 3) Pa 100 mm below the ceiling. The tolerance of the pressure differential is given in EN 1363-1.

6.6.1.3 Maintenance of opening for duct mounted smoke control dampers

The maintenance of opening requirement is demonstrated as part of the elevated temperature or fire resistance test as described in this section.

6.6.2 Compartment boundary mounted smoke control dampers

6.6.2.1 Mounting conditions

6.6.2.1.1 Compartment boundary mounted smoke control damper in vertical position

To test the SCD for an application in a vertical compartment boundary, three dampers shall be selected, one for testing from one side, one for testing from the reverse side and one for the maintenance of opening test.

- Compartmentation test – Each sample shall be installed in the front wall of the furnace in a vertical position and mounted in the arrangement shown in Figure 8.

- Maintenance of opening test – The sample shall be installed in the front wall of the furnace in a vertical position and mounted in the arrangement shown in Figure 9 with the actuating mechanism positioned inside the furnace or on the centre line of the supporting construction.

The maintenance of opening test essentially only needs to be done from one side as shown, as it does not maintain compartmentation

6.6.2.1.2 Compartment boundary mounted smoke control damper in horizontal position

To test the SCD for application in a horizontal compartment boundary, three dampers shall be selected, one for testing from one side, one for testing from the reverse side and one for the maintenance of opening test.

- Compartmentation test – Each sample shall be installed in the top surface of the furnace in a horizontal position and generally mounted in the arrangement shown in Figure 8 with the various other measuring and control equipment as shown – see also EN 1366-2 for a damper mounted horizontally in the top surface of the furnace.
- Maintenance of opening test – The sample shall be installed in the top surface of the furnace in a horizontal position and mounted in the arrangement shown in Figure 9 with the actuating mechanism positioned inside the furnace or on the centre line of the supporting construction. (This test is not required in the top surface of the furnace, providing that an identical sample has passed the test following the maintenance of opening requirements for a vertical damper as defined in 6.6.2.1.1).

6.6.2.1.3 Blade axes

The blade pivot axis, if any, shall be considered as follows:

If a smoke control damper installation method is proposed with the smoke control damper mounted in a vertical application and it is required that the damper be installed with the blade pivots horizontal and vertical, then the test shall be repeated for both horizontal and vertical blade pivots.

6.6.2.2 Fire resistance test for compartment boundary mounted smoke control dampers

Samples of the largest size shall be tested in the orientation of proposed installation (i.e. vertically or horizontally).

No thermal operating device (e.g. fusible element) is required or allowed and shall not form part of the smoke control damper assembly.

The samples shall undergo the sequence of ambient leakage testing and cycling (see 6.2) before being subjected to this test.

A test shall be performed from both sides of the smoke control damper.

NOTE 1 As these smoke control dampers are mounted in a compartment boundary, they are, by definition, multi compartment and a single compartment option is not available.

NOTE 2 There were many discussions on symmetry in the revision and development of this document. It proved impossible to define symmetry in an objective way to allow all test or authorizing bodies to apply rules in a similar way, particularly in the case of installation in the supporting construction. Also, to be considered was where the smoke control damper was installed in the depth of the wall and so on. The concept of symmetry has been removed from the standard.

The test sample shall be generally installed with the test equipment shown in Figure 8; see also EN 1366-2.

The test shall be undertaken using a pressure selected from Table 1.

The AA initiation regime shall be selected from 6.7.

NOTE 3 The reason for this test (and the fact that it needs to be done both ways round) is that it is to prove compartmentation when closed. With further reference to the example of the two duct mounted dampers, the damper outside the furnace is the one that closes, and this has been protected and surrounded by ambient air until the damper inside the furnace has been opened. Consequently, there is no requirement that the smoke control damper prove closure at high temperature in the compartment boundary test so this is not a requirement to achieve MA; the AA in this test is sufficient to prove both. It is too late to close a damper after 25 min to maintain compartmentation.

The heating conditions and the furnace atmosphere shall conform to those specified in EN 1363-1 following the standard curve and tolerances (multi-compartment SCD).

The furnace pressure shall be controlled to (15 ± 3) Pa in accordance with EN 1366-2 throughout the test at mid-height of the smoke control damper (vertical compartment boundary mounted). For smoke control dampers installed in a horizontal compartment boundary, the pressure shall be controlled to (20 ± 3) Pa at 100 mm below the underside of the compartment boundary.

Where an insulation classification is required, the thermocouples shall be installed as Figures 10 and 11.

If in practice, an insulated duct is used the thermocouples T3 and T4 are informative and not part of the performance criteria.

The smoke control damper shall be open at the start of the test, except if it will never be open in practice (e.g. opened for environmental ventilation) – i.e. it remains closed until required by a system to open to allow smoke movement.

6.6.2.3 Maintenance of opening test for compartment boundary mounted smoke control dampers

A sample of the largest size shall be tested in the orientation of proposed installation (i.e. vertically or horizontally – see also 6.6.1.2).

No thermal operating device (e.g. fusible element) is required or allowed and shall not form part of the smoke control damper assembly.

The samples shall undergo the sequence of ambient leakage testing and cycling (see 6.2) before being subjected to this test.

The sample shall be installed with the actuating mechanism positioned inside the furnace or on the centre line of the supporting construction.

The test sample shall be installed in the selected supporting construction with an associated smoke extraction duct and the associated perforated plate to control the pressure and volume flow as shown in Figure 9.

The smoke extraction duct shall be attached to the damper with a transition to allow a standard tested smoke control duct 1000 mm × 250 mm with the correct perforated plate of the same relative dimensions to be used. Alternatively, a larger duct may be used, but this size shall have been tested to EN 1366-8 and then a corresponding perforated plate may also be used.

The test shall be undertaken using a pressure selected from Table 1.

Initiation regime is selected from 6.7 – SCD with automatic activation (AA) or SCD with manual activation (MA).

The heating conditions and the furnace atmosphere shall conform to those specified in EN 1363-1 following the standard curve and tolerances (multi-compartment SCD).

The furnace pressure shall be controlled to (15 ± 3) Pa in accordance with EN 1366-2 throughout the test at the mid-height position of the ducts in the furnace (duct mounted) and at mid-height of the smoke control damper (vertical compartment boundary mounted). For smoke control dampers installed in a

horizontal compartment boundary, the pressure shall be controlled to (20 ± 3) Pa at 100 mm below the underside of the compartment boundary.

Where an insulation classification is required, the thermocouples shall be installed as Figure 11.

The SCD shall be closed at the start of the test and then shall be opened at the correct time given by the chosen initiation regime defined in 6.7.

6.6.3 Additional test information

6.6.3.1 Smoke control dampers mounted on a duct

The equipment for test shown in Figure 4 and Figure 5 for SCDs mounted on a duct shall be supported by the following:

- a) Arrangement of furnace thermocouples – see Figure 6:
 - 1) they shall be positioned 100 mm from the duct side, at opposite sides of the duct where no damper is mounted;
 - 2) 2 Thermocouples at 100 mm from the supporting construction (e.g. wall, floor, underside of the furnace roof);
 - 3) 2 Thermocouples at 100 mm from the end of the duct;
 - 4) 2 Thermocouples equally spaced between the above thermocouples.
- b) Arrangement of thermocouples on damper outside of the furnace – see Figures 12, 13 and 14.
- c) Damper leakage/mass flow measurement:
 - rectangular perforated plate details – see Figure 16;
 - circular perforated plate details – see Figure 17;
 - mounting of perforated plate – see Figure 18;
 - arrangement of gas testing probes – see Figure 19;
 - flow measurement equipment detail – see Figure 20;
 - nozzle design – see Figure 21 (where used);
 - mounting of nozzles to duct end (where used) – see Figure 22;
 - if nozzles are not used, then the alternative method used shall be fully described.

6.6.3.2 Smoke control dampers mounted in a compartment boundary

The equipment for test shown in Figure 8 and Figure 9 for SCDs mounted in a compartment boundary shall be supported by the following:

- a) Arrangement of furnace thermocouples – see EN 1366-2.
- b) Arrangement of thermocouples at the compartment boundary outside of the furnace – see Figures 10 and 11.

- c) Damper leakage measurement – compartmentation – see Figure 8 and EN 1366-2.
- d) Damper leakage/mass flow measurement – maintenance of opening:
 - rectangular perforated plate details – see Figure 16;
 - circular perforated plate details – see Figure 17;
 - mounting of perforated plate – see Figure 18;
 - arrangement of gas testing probes – generally as Figure 19;
 - flow measurement equipment detail – see Figure 20;
 - nozzle design (where used) – see Figure 21;
 - mounting of nozzles to duct end (where used) – see Figure 22;
 - if nozzles are not used, then an alternative method in accordance with EN ISO 5167 and /or EN ISO 5221 may be used and the correct constants used to ensure that the calculations are correct. This shall all be fully described in the test report.

6.7 Initiation regime

6.7.1 Smoke control dampers for systems with automatic activation (AA)

This clause describes the timing criteria to be used when testing SCDs with an automatic activation (see Figure 2).

6.7.1.1 Duct mounted smoke control dampers

$T = 0$ s – furnace ignition and starting of the fan if the SCD has to open against flow and pressure or opens with the help of flow and pressure

The smoke control damper mounted in the furnace shall be closed.

The smoke control damper mounted outside the furnace shall be open at the start of the test, except if it will never be open in practice (e.g. opened for environmental ventilation) – i.e. it remains closed until required by a system to open to allow smoke movement.

$T = 30$ s

Signal the smoke control damper mounted in the furnace to move to the open position.

Signal the smoke control damper mounted outside the furnace to close (or it remains closed if it will never be open in practice (e.g. opened for environmental ventilation) – i.e. it remains closed until required by a system to open to allow smoke movement.

$T = 90$ s – smoke control dampers shall have reached their end positions (otherwise failure results) and starting of the fan if the SCD has to open without flow and pressure

6.7.1.2 Compartment boundary mounted smoke control dampers fire resistance test

$T = 0$ s – furnace ignition and starting of the fan if the SCD has to open against flow and pressure or opens with the help of flow and pressure

The smoke control damper shall be open at the start of the test, except if it will never be open in practice (e.g. opened for environmental ventilation) – i.e. it remains closed until required by a system to open to allow smoke movement.

T = 30 s

Signal the smoke control damper to close (or it remains closed if it will never be open in practice (e.g. opened for environmental ventilation)) – i.e. it remains closed until required by a system to open to allow smoke movement.

T = 90 s – the smoke control damper shall have reached its end position (otherwise other criteria may not be achieved) and starting of the fan if the SCD has to open without flow and pressure.

6.7.1.3 Compartment boundary mounted smoke control dampers maintenance of opening test

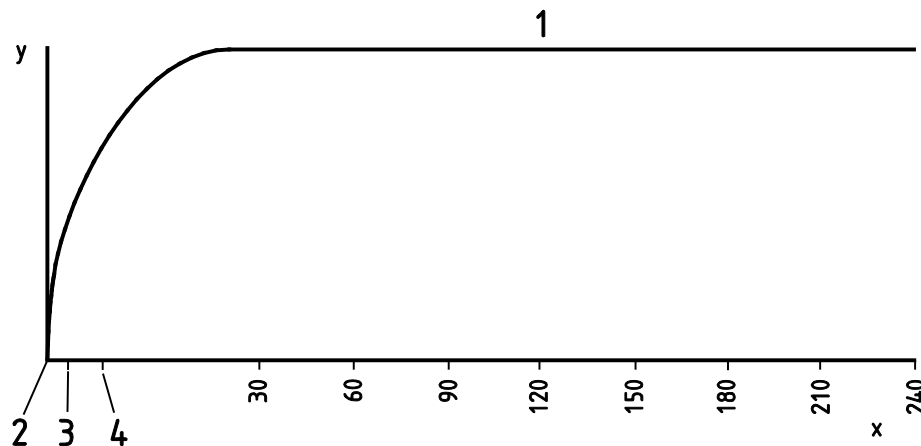
T = 0 s – furnace ignition and starting of the fan if the SCD has to open against flow and pressure or opens with the help of flow and pressure

The smoke control damper shall be closed at the start of the test

T = 30 s

Signal the smoke control damper to open

T = 90 s – the smoke control damper shall have reached its end position (otherwise other criteria may not be achieved) and starting of the fan if the SCD has to open without flow and pressure



Key

- x classification time in minutes
- y temperature
- 1 fire test curve or single compartment temperature (600 °C)
- 2 classification T = 0: furnace ignition
- 3 T = 30 s (ignition + 30 s) – command actuators to operate (open and close)
- 4 T = 90 s (ignition + 90 s) – actuators to have completed movement

Figure 2 — Curve and classification details for smoke control dampers suitable for systems with automatic activation

6.7.2 Smoke control damper for systems with manual activation (MA)

This section describes the timing criteria to be used when testing SCD with a manual activation (see Figure 3).

6.7.2.1 Duct mounted smoke control dampers

T = 0 min – furnace ignition and starting of the fan

The smoke control damper mounted in the furnace shall be closed.

The smoke control damper mounted outside the furnace shall be open at the start of the test, except if it will never be open in practice (e.g. opened for environmental ventilation) – i.e. it remains closed until required by a system to open to allow smoke movement.

T = 25 min

Signal the smoke control damper mounted in the furnace to move to the open position.

If the SCD will never move to the opposite position in its specific application, the actual movement of the SCD can differ from this general description.

Signal the smoke control damper mounted outside the furnace to close (or it remains closed if it will never be open in practice (e.g. opened for environmental ventilation) – i.e. it remains closed until required by a system to open to allow smoke movement.

T = 26 min – Smoke control dampers shall have reached their end positions (otherwise other criteria may not be achieved).

6.7.2.2 Compartment boundary mounted smoke control dampers fire resistance test

T = 0 s – furnace ignition and starting of the fan

The smoke control damper shall be open at the start of the test, except if it will never be open in practice (e.g. opened for environmental ventilation) – i.e. it remains closed until required by a system to open to allow smoke movement.

$\boxed{A_1}$ T = 30 s $\boxed{A_1}$

Signal the smoke control damper to close (or it remains closed if it will never be open in practice (e.g. opened for environmental ventilation)) – i.e. it remains closed until required by a system to open to allow smoke movement.

$\boxed{A_1}$ T = 90 s $\boxed{A_1}$ – the smoke control damper shall have reached its end position (otherwise other criteria may not be achieved) and starting of the fan if the SCD has to open without flow and pressure.

6.7.2.3 Compartment boundary mounted smoke control dampers maintenance of opening test

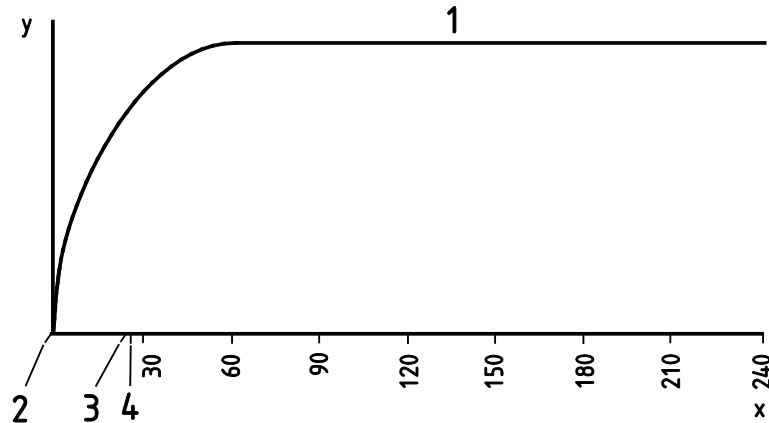
T = 0 s – furnace ignition and starting of the fan if the SCD has to open against flow and pressure or opens with the help of flow and pressure

The smoke control damper shall be closed at the start of the test.

T = 25 min

Signal the smoke control damper to open.

T = 26 min – the smoke control damper shall have reached its end position (otherwise other criteria may not be achieved) and starting of the fan if the SCD has to open without flow and pressure



Key

- x classification time in minutes
- y temperature
- 1 standard time-temperature curve (multi-compartment) or 600 °C (single compartment)
- 2 classification T = 0: furnace ignition
- 3 T = 25 min – command actuators to operate (open and close)
- 4 T = 26 min – actuators to have completed movement

Figure 3 — Curve and classification details for smoke control dampers suitable for systems with manual activation

6.8 HOT400/30 extension test

An additional test may be undertaken to support either AA or MA by performing the HOT 400 °C/30 test. Refer to Annex D.

6.9 Special constructions

The tests described above are valid to validate a single damper. If an assembly of smoke control damper units is made to form one larger unit, then this can be considered as one unit and tested accordingly. However, this does not qualify the smaller units used to make up the assembly and these must be tested separately, if to be used on their own.

Installations may be tested using less than the dimensions described in 10.4, but this should be recorded.

7 Test procedure

7.1 Fire resistance or elevated temperature and maintenance of opening test for duct mounted smoke control dampers

7.1.1 General

The necessary ambient leakage and selected cycling tests for the smoke control damper(s) shall be completed on the proposed specimens before the fire resistance test on those same specimens.

7.1.2 Pre-test calibration

7.1.2.1 Oxygen-measuring instrument

Calibrate the measuring instrument prior to the fire test.