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Fire resistance tests for service installations - Part 10: Smoke control dampers

Feuerwiderstandsprüfungen für Installationen - Teil 10: Entrauchungsklappen

Essais de résistance au feu des installations techniques - Partie 10: Volets de désenfumage

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Foreword

This document (EN 1366-10:2011) 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of an identical text or by endorsement, at the latest by October 2011, and conflicting national standards shall be withdrawn at the latest by October 2011.

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EN 1366 ‘Fire resistance tests for service installations’ consists of the following

Part 1: 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 (in course of preparation)

Part 12: Fire resistance tests for service installations - Part 12: Non-mechanical fire dampers (in course of preparation)

Part 13: Fire resistance tests for service installations - Part 13: 1-, -2, 3- sided ducts (in course of preparation)

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Introduction

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

To create this path there need to be ducts and the smoke extract path needs to remain uninterrupted. This means that smoke control dampers at the fire and along the path have to be open and remain open. Smoke control dampers at branches, or on the surface of the duct, along the path need to be closed and 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 European Standard is to define test methods to evaluate the abilities of smoke control dampers to

1) be applicable to single compartment and/or multi compartment fire resisting applications;

2) be applicable to automatic systems or systems with manual intervention;

3) change state from closed to open at elevated temperatures, and vice versa;

4) once opened maintain a defined cross sectional area at elevated temperature;

5) maintain a satisfactory leakage performance when subjected to negative pressure at elevated temperatures.

The units need to be mounted for the tests in a manner representative of practice.

Temperature and integrity measurements need to be carried out on various parts of the test construction during the test. Leakage measurements required need to be measured by direct flow measurement at the prescribed pressure differentials. Ambient leakage of the units needs also to be recorded.

Performance of these tests need to allow products to comply with EN 12101-8 and be classified to EN 13501-4. The required temperatures, pressure differentials etc. are stated in EN 12101-8.

Completing the tests within this European Standard does not ensure full compliance with EN 12101-8, as other, additional, requirements are defined in EN 12101-8. Some of these may be required to meet the classification requirements of EN 13501-4 as well.

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 shall be made and safety precautions need to be identified and provided. Written safety instructions need to be issued. Appropriate training needs to be given to relevant personnel. Laboratory personnel need to ensure that they follow written safety instructions at all times.

1 Scope

This European Standard specifies test methods for smoke control dampers to assess their performance under elevated temperature or fire conditions.

It needs to be noted that the smoke control damper to be tested may require testing to EN 1366-2 and that this needs to be considered before carrying out these tests.

Smoke control damper tests are required to confirm that the furnace testing requirements of EN 12101-8 are met and EN 12101-8 needs to be considered before carrying out these tests.

Smoke control dampers tested to this European Standard should be classified using EN 13501-4 and this European Standard needs to be considered before carrying out these tests.

To this end this European Standard needs 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 need to be considered and these are defined in EN 1366-8 and EN 1366-9.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 1363-1, *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 1507, *Ventilation for buildings — Sheet metal air ducts with rectangular section — Requirements for strength and leakage*

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

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 5167-1:2003)*

EN ISO 13943:2010, *Fire safety — Vocabulary (ISO 13943:2008)*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN ISO 13943:2010 and the following apply.

3.1
air inlet
device connected to outside air to allow the inlet of air from outside the construction works

3.2
attended control room
room with people, who have the duty to control the smoke exhaust system, permanently (24 h, seven days per week) monitor the incoming signals from the smoke control system and put the smoke control system into operation in case of smoke alarm

NOTE This ensures that the smoke control system is running and items such as the smoke control dampers are in position within the system response time.

3.3
back-up power supply
power supply to operate the system when the normal power supply has failed

3.4
commissioning
act of ensuring that all components and the system are installed and operating in accordance with this European Standard

3.5
elevated temperature
temperature in excess of normal ambient air, below those necessary for fire resistance testing, to which smoke and heat exhaust ducts for single compartments are tested

3.6
fire compartment
enclosed space, comprising one or more separate spaces, bounded by elements of construction having a specified fire resistance and intended to prevent the spread of fire (in either direction) for a given period of time

NOTE Fire compartment often has regulatory connotations. The term should not be confused with "room of origin" or "fire cell".

3.7
HVAC
heating, ventilating and air conditioning (usually used in association with the word system)

3.8
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 – usually associated with a smoke control/fire alarm system

3.9
largest size
this refers to the largest size of damper individual unit (as opposed to an assembly of units) proposed for sale/manufacture

3.10
modulating actuators
smoke control damper or fire damper control mechanism which can control the smoke control damper or fire damper to be in a position or number of positions between fully open and fully closed

3.11
multi compartment fire resisting smoke control dampers
smoke control dampers for use in multi compartment areas, which may be associated with smoke control duct tested according to EN 1366-8 and/or may be installed within or on the face of a fire compartment structure

3.12
multi compartment fire resisting smoke control system ducts
fire resisting ducts for use in multi compartment application and that have been tested and met the requirements of EN 1366-8

3.13
natural smoke and heat control system
smoke and heat ventilation system which uses natural ventilation

NOTE Natural ventilation is caused by buoyancy forces due to differences in density of the gases because of temperature differences.

3.14
penetration seal
product used between the smoke control system duct/damper and the fire compartment structure to maintain the fire resistance, when tested and having met the requirements of EN 1366-8, at the position where a smoke control system duct passes through the element, or a smoke control damper or fire damper is mounted in the element

3.15
powered smoke and heat exhaust system
smoke and heat ventilation system which utilises a number of smoke control fans having met the requirements of EN 12101-3 for a defined period of time which causes the positive displacement of gases

3.16
pressure differential systems
system of fans, ducts, vents, and other features provided for the purposes of creating a lower pressure in the fire zone than in the protected space (see prEN 12101-13)

3.17
remote signalling device
device located away from the smoke control damper or fire damper which indicates the damper position, open or closed

3.18
safety position
position (open or closed) into which specific projects may require certain dampers to move, depending upon the fire location within the building

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

3.19
single compartment smoke control dampers
smoke control dampers for use in single compartment areas, which may be associated with smoke control ducts tested to EN 1366-9, and/or may be installed in an external wall, floor or roof

3.20
single compartment smoke control system ducts
ducts for use within single fire compartment application and that have been tested and met the requirements of EN 1366-9

3.21
smallest size
this refers to the smallest size of damper individual unit including the minimum width and length proposed for sale/manufacture

3.22
smoke and heat exhaust ventilation system (SHEVS)
system consisting of components jointly selected to exhaust smoke and heat

NOTE The components form a system which complies with the requirements of CEN/TR 12101-4 in order to establish a buoyant layer of warm gases above cooler cleaner air.

3.23
smoke and heat exhaust ventilator (SHEV)
device specially designed to move smoke and hot gases out of construction works under conditions of fire

3.24
smoke barrier
barrier to restrict the spread of smoke and hot gases from a fire, forming part of the boundary of a smoke reservoir or used as a channelling screen, or used as a void edge boundary

3.25
smoke control damper for systems with automatic activation
smoke control damper that is applicable to the systems defined in 3.29

3.26
smoke control damper for systems with manual intervention
smoke control damper that is applicable to the systems defined in 3.30 and 3.31

3.27

smoke control damper
device automatically or manually activated, which can be open or closed in its operational position, to control the flow of smoke and hot gases into, from or within a duct

3.28
smoke control duct
duct used in a system to control the movement and /or containment of smoke and heat

3.29
smoke control system with automatic activation
smoke control system (smoke and heat exhaust ventilation type or pressure differential type), that operates automatically on receipt of a smoke or fire alarm without any manual action/intervention

NOTE A system with an attended control room can also be accepted as an automatic system. Once initiated, the system does not cause the smoke control damper position to be changed.

3.30
smoke control system with automatic activation and with manual override
smoke control system (smoke and heat exhaust ventilation type or pressure differential type), that can be put into operation as 3.29 on receipt of a smoke or fire alarm, but once initiated the system allows the smoke control damper position to be changed by external input/firemen's' override

3.31
smoke control system with manual intervention
smoke control system (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

NOTE Once initiated, the system allows the smoke control damper position to be changed by external input/firemen's' override.

3.32
smoke layer
layer of smoke that stabilises underneath the ceiling due to the affect of temperature gradient

3.33
smoke logging
condition within a building when the hot gases from a fire descend to a level whereby the safe escape of the occupants is hampered and the ingress of firefighters is prevented

3.34
smoke reservoir
region within a building limited or bordered by smoke barriers or structural elements and which in the event of a fire retains a thermally buoyant smoke layer

3.35
smoke zone (zones)
areas into which construction works are divided for the extraction of smoke and hot gases

NOTE Each zone is served by a SHEV (or sub system of a SHEV), which is initiated by a signal from a single or group of initiation devices associated with the zone.

3.36
structural supports
means of retaining the smoke control system duct to the building structure

3.37
system response time
time from the initiation of the smoke control system to it being fully operational

3.38
thermal operating device
temperature sensitive device which responds to initiate a subsequent action

3.39
triggering device
device such as a fire detector system, smoke detector or pushbutton which sends an activating signal to the initiation device(s)

4 Test equipment

4.1 General

In addition to the test equipment specified in EN 1363-1, the following is required (examples of test arrangements are given in Figures 3, 5, 8 and 9):

4.2 Connecting duct for multi compartment fire resisting smoke control damper: maintenance of opening test and EN 1366-2 test

The connecting duct shall be of all welded construction fabricated from (1,5 ± 0,1) mm thick steel with a width and height appropriate to the size of smoke control damper or fire damper being tested. The duct shall have a length of two times the diagonal dimension of the smoke control damper or fire damper up to a maximum of 2 m (See Figure 6). The connecting duct shall be provided with a gas tight observation window. The general test arrangement showing flow measuring equipment is shown in Figure 6.

4.3 Volume flow measuring station for multi compartment fire resisting smoke control damper: maintenance of opening test and EN 1366-2 test

This shall consist of a Venturi, orifice plate, or other suitable device and (where necessary) an air flow straightener, installed in straight lengths of pipe, all sized in accordance with EN ISO 5167-1. It shall be installed between the connecting duct and the exhaust fan to determine the volume flow rate of gases passing through the smoke control damper or fire damper under test. This shall be done at elevated temperature, unless a condenser is used. The volume flow results shall be expressed at 20 °C. The measuring device shall be capable of measuring to an accuracy of ± 5 %. Regardless of whether vertical or horizontal smoke control damper or fire dampers are being tested, the volume flow measuring station shall always be used in a horizontal direction.

4.4 Plenum for High Operating Temperature (HOT) test

A steel plenum box shall be mounted on the non fire side of the smoke control damper over the whole face area. This is shown in Figure 18. It shall extend out from the standard supporting construction (wall) by 50 mm or past the edge of any blades that will pass beyond the supporting construction when opening by 50 mm. The box shall have an observation hole in the face opposite the damper blades of 50 mm diameter.

4.5 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 power/supply 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 loading the smoke control damper shall be 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, so that a test could be set to run without attendance, noting that each cycle could potentially take 120 s.

4.6 Condensing unit

Where materials used in the construction of the test duct or the smoke control damper may generate quantities of steam during the fire test, a condensing unit having provisions for drainage shall be installed between the smoke control damper or fire damper and the flow measuring device. When using the condensing device, the temperature recorded by the thermocouple positioned downstream of the flow measuring device described in 4.3 shall not exceed 40 °C.

NOTE A suitable condensing device may be considered to be a water tank fed with water at ambient temperature with (approximately 9 m) of measuring duct immersed in the tank prior to reaching the measuring device providing that there is a means for removal of the condensate. Custom devices designed by individual laboratories that meet the 40 °C condition and allow condensate removal are allowable.

4.7 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 Figures 6, 14 and 15).

4.8 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 or fire 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 ± 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 or fire damper under test. A variable speed fan may be used instead of the dilution damper.

4.9 Perforated plate

The perforated plate controls 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 plate shall be positioned (250 ± 50) mm from where the duct passes through the furnace wall (see Figures 3, 8, 9 and 14).

These plates shall be made from heat resisting steel, 19 % min. Cr content and 11 % min. Ni content (Euronorm (X2Cr-Ni19-11). Full details of the number of holes and dimensions are given in Figures 12a and 12b. The thickness of the plates shall be 2,5 mm.

Figure 13 shows details for the mounting of the perforated plate in different duct types.