Information Sheet 08

The role and guidance for the appropriate use of fire resistant and smoke containment dampers in ducted building ventilation systems

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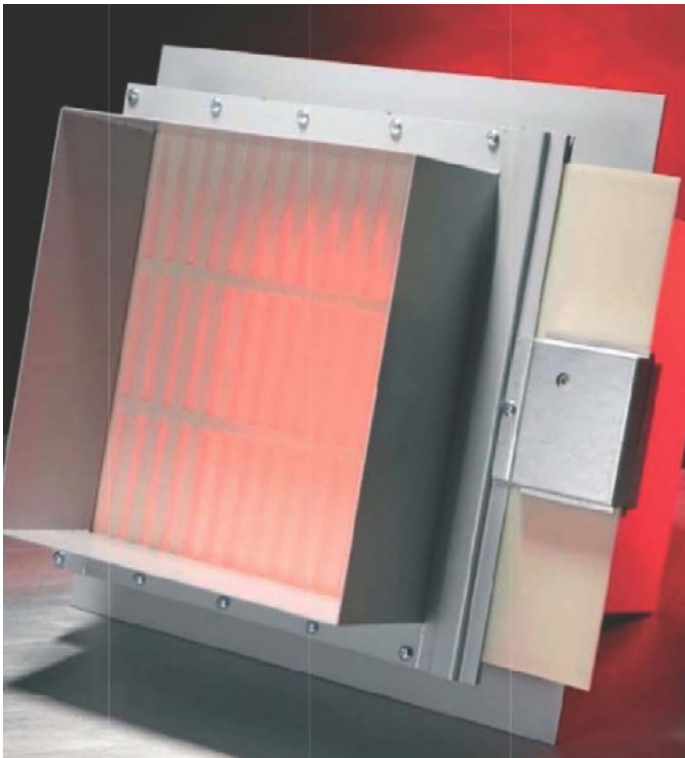
Intumescent Fire Seals Association
The home of reactive fire protection systems



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1.0 Introduction

This IFSA Information Sheet is intended to give guidance to ventilation system designers, product specifiers, building control authorities, fire prevention officers, builders and installers on the correct use of fire and smoke containment dampers. It describes their role, varieties, and limitations together with the performance requirements and relevant test standards.

2.0 The role of 'fire' and 'Fire and smoke' dampers

Ventilation systems by their very nature provide an easy route for the passage of fire and smoke through a building in fire conditions unless containment devices are incorporated into their design.

There are two principal ventilation systems:

1. **Those based upon fire resistant ductwork**

   In the case of fire resistant ductwork systems the whole duct is designed to perform as a fire compartment, air ingress to the duct is confined to one fire compartment and follows a direct route to egress externally from the building. Such systems do not need any additional internal protection devices but are usually the most costly option.

2. **Those based upon steel non-fire resistant ductwork**

   Steel non-fire resistant ductwork is the most popular option and often travels throughout a building passing through many fire compartment boundaries both horizontally and vertically. Consequently 'fire' or 'fire and smoke' dampers are necessary at each fire boundary to prevent fire and smoke passing unchecked from one fire compartment to another.

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3.0 Definitions and functions

3.1 Fire damper

A device that when activated by a rise in temperature of the air stream in a ventilation duct will close, thus preventing the spread of flame and hot smoke beyond the fire compartment boundary through which the duct is passing.

3.2 Fire and smoke damper

A device that when activated either by interface with smoke sensors or by a rise in temperature of the air stream in a ventilation duct will close, thus preventing the spread of cold smoke, flame and hot smoke beyond the fire compartment boundary through which a ventilation duct is passing.

3.3 Smoke control damper

A device that may be normally open or closed and is designed to allow smoke to be extracted or constrained through a range of temperatures up to 600°C. This product is usually fitted into custom built smoke extraction ducts. **This definition is included for clarification but products of this type are outside of the scope of this document.**

4.0 Variety of damper types

4.1 Fire rated (hot smoke and flame containment):

Mechanical heat activated fire dampers

Mechanical fire dampers are generally of steel construction, the air path being sealed off in fire conditions by the spring driven rotation through 90° of one or more blades when released by a thermally activated mechanism such as a fusible link. Such dampers are not designed to contain cold smoke since their activation temperature is in excess of 74°C and are therefore not an acceptable option for all applications.

Intumescent heat activated fire dampers

React to heat in fire conditions when the major intumescent components swell up to many times their original size, sealing the gaps between them and thereby closing the air path. Intumescent dampers are now in common use and are available in several forms providing different performance characteristics often using different types of intumescent material. Such dampers are not designed to contain cold smoke since their activation temperature is in excess of 74°C and are therefore not an acceptable option for all applications.

When intumescent materials are activated by heat, they expand in volume and create a relatively impermeable mass of char which restricts the spread of flames and combustion gases including smoke. Generally, the impermeability is increased if the expanded intumescent is contained and compressed within an encapsulation. Intumescent materials require little or no maintenance and cannot malfunction when heated, thereby providing a very effective and reliable seal compared to mechanical devices.

For a detailed explanation of various intumescent materials, their function and behaviour in fire conditions please refer to IFSA Information Sheets 1 or 2.

4.2 Fire and smoke rated (cold smoke, hot smoke and flame containment):

Electro-mechanical and heat activated fire and smoke dampers

These dampers have the same basic structure as the fire rated mechanical dampers and are activated by heat, but they also incorporate an electrical system that interacts with smoke detectors via the building fire alarm panel to close the blades electrically.

Electro-mechanical and heat activated intumescent fire and smoke dampers

Intumescent/electro-mechanical dampers are usually manufactured by combining an intumescent fire rated damper with a set of 'hit & miss' plates or rotating blades that are driven by an electro-mechanical system which interacts with smoke detectors via the building fire alarm panel. This means that the damper can close off the duct in two entirely separate ways, firstly by smoke detection, which operates the closing plates and later by a rise in temperature, which causes the intumescent to activate, i.e. expand and close off the duct.

5.0 Cautionary notes

Damper specifications are frequently determined by habit with little consideration of new products and scant allowance made for the operating conditions to be encountered. Though maintenance and servicing schedules are recommended by the manufacturers of dampers, there is evidence that in the past such schedules were often not carried out. The advent of the 'Regulatory Reform (Fire Safety) Order:2005' makes it clear that such omission cannot be tolerated in the future. It is therefore important to ensure that fire protected ventilation systems incorporate minimum maintenance products that can be readily accessed and serviced.

Fire resistance tests are always conducted with new specimens and clean installations. There are no current test requirements that take into account the effects of builder's debris, grease and dust accumulations whereas in the real world deposits on the mechanisms and thermal release devices can within a relatively short period of time have a significant influence on performance. Consequently the evidence of a successful fire test for a damper does not necessarily mean that the product will perform reliably in all operating conditions.

The tighter confines of modern buildings often makes installation of fire dampers in the correct location difficult to achieve. This results in either the damper being incorrectly located or inaccessible for servicing or in worse cases, impossible to inspect. Also bulky damper design often makes installation in the correct location very difficult. Consequently dampers on occasion may be located in wholly inappropriate positions for the fire protection needed. Accessibility problems during installation may also result in distortion or loading on the device which may be detrimental to its reliability.

It is therefore essential to select dampers that are appropriate to the required application in terms of: fire resistance, smoke leakage, volumetric flow, pressure drop, reliability, minimal maintenance and dimensional compatibility with the supporting construction. In the UK dampers are not generally required to satisfy the insulation criteria but many European states do require insulation performance to be provided to protect against secondary ignition downstream of a damper. If therefore insulation performance is intrinsic in the design of a damper at no extra cost then the added protection should be welcome.

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6.0 The advantages of intumescent based dampers

Good quality intumescent based dampers have several advantages over their mechanical counterparts:

6.1 'Fire' rated intumescent dampers (See figure 1)

1. Fire rated dampers have no moving parts that can jam open.
2. Intumescent material will always react to heat thereby ensuring failsafe closure when subject to fire conditions.
3. Light in weight and slim in section allowing easier correct installation.
4. Most intumescent dampers provide a level of insulation performance.
5. Distortion during installation should not affect their fire performance or reliability
6. They require minimum maintenance, probably only an occasional clean in particularly hostile conditions.

6.2 'Fire and smoke' rated intumescent based dampers (see figure 2)

'Fire and smoke' rated intumescent based dampers use low dc voltage, low power, control and operating systems that are cost effective and safe to maintain.

If the cold smoke containment element of the damper should fail for any reason the intumescent element will seal the damper as soon as the activation temperature is reached.

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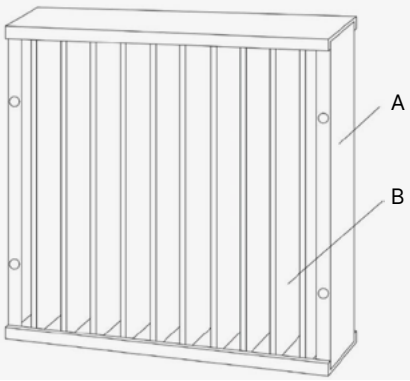

Figure 1: Typical Fire Rated Damper

A – Steel outer frame

B – Metal encapsulated intumescent slats

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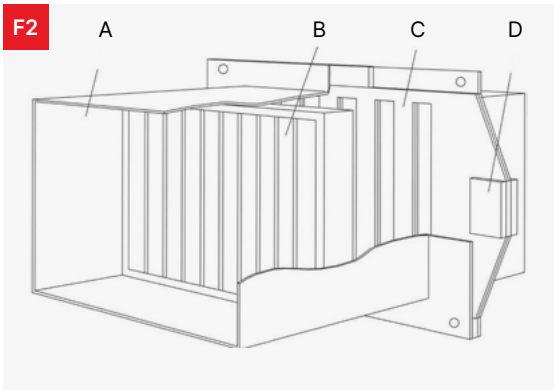

Figure 2: Typical Electro-mechanical Intumescent Damper

A – Steel damper casing

B – Fire Rated Damper as shown in Figure 1

C – Smoke 'Hit & Miss' sliding shutter plates

D – Electronic actuator interfaced with smoke sensors via fire alarm panel or BMS

NOTE: Shutter plates and actuator assembly can be slid from casing for ease of maintenance.

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7.0 Fire performance requirements

7.1 'Fire' rated intumescent dampers (See figure 1)

Fire rated dampers are usually required to provide fire integrity for a period of at least 120 minutes but other periods can on occasion be required e.g. 60, 90, and rarely 240 minutes.

Care should be taken to ensure that the fire test evidence provided by the damper manufacturer is appropriate to the intended application. For example a fire damper tested in accordance with BS476 part 20 or 22 may not be sufficiently durable in high air velocities often encountered in new installations. The pressure differential required during BS476 part 20 or 22 tests is usually no greater than 25Pa which presumes a low air velocity impinging on the damper in normal operating conditions. If possible, dampers should be selected that have been successfully tested in accordance with EN1366-2, in which the pressure differential from one side of the test specimen to the other is 300Pa.

7.2 Insulation

In the UK insulation performance is not currently a requirement for dampers installed in non-fire resistant ducts but several countries in Europe insist upon it. Where insulation performance is required it should be noted that this requirement will also apply to the ductwork emerging from the fire compartment boundary.

7.3 Smoke leakage

Air leakage through a fire rated damper is measured constantly throughout the duration of a fire test and shall not exceed 360m^3 per hour per square metre, but since the fire test starts with the damper in the open position, as it would be in normal operation, there will be uncontrolled leakage before the air temperature has risen sufficiently to activate the thermal release or intumescent elements. If therefore, in a real fire the temperature increases gradually, a large volume of smoke could be allowed to pass through the building before the damper becomes hot enough to activate.

For this reason fire rated dampers are only permitted where cool smoke is not perceived as a threat to the occupants of the building.

Fire and smoke rated dampers are initially tested for reliability and durability of electro-mechanical operation for a period equivalent to the anticipated working life of the damper. Then in accordance with EN1366-2 the air leakage rate is measured at ambient temperature before the fire test begins and then continuously throughout the fire test. The maximum allowable leakage rate is 200m^3 per square metre per hour.

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8.0 Recommended installation methods

Though general guidance can be found in the ASFP Grey book on generic damper and duct installations, it is strongly recommended that the installation instructions as supplied by the damper manufacturer should be followed in detail.

The instructions should provide essential information concerning the correct installation methods for all applications and supporting constructions including masonry walls, stud walls, fire resistant partitioning ceilings and floors. The manufacturer should also supply test reports indicating successful test results relevant to the application required.

In the case of 'Fire and Smoke' rated dampers the damper manufacturer should supply detailed wiring and commissioning instructions for the correct installation and interface with the fire alarm panel or building management system of the relevant building.

The installation, wiring and commissioning should only be undertaken by competent persons qualified in the relevant skills.

9.0 Dimensional and positional limitations

The damper selected should not exceed the dimensions (on any axis) from that which was tested or has otherwise been assessed as part of a field of application report. Most dampers are installed vertically but if they are required for a horizontal application, successful test evidence in that orientation should be requested from the damper manufacturer.

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10.0 Non-fire performance Requirements

10.1 Volumetric flow

Ventilation system designers will have established the rate of air change required for each compartment of a building and should determine the pressure differentials that will ensue from the supply air and make up air arrangement. Fire engineers should also provide information concerning the pressure variables necessary in the building to conform to their fire protection strategy. Once the two inputs are reconciled dampers can be selected which are compatible with the aerodynamic performance required in terms of volumetric flow, air velocity, pressure drop and air generated sound levels.

10.2 Acoustic considerations

There are two aspects of acoustic performance which should be considered, generated sound and transferred sound.

1. Generated sound is the result of air passing through a damper causing rattling or reed type noise, particularly at higher velocities of air through the duct. This can be exacerbated by the design of the damper type. Also in the case of fire and smoke rated dampers, sound can be generated by electro-mechanical actuation or some solenoid driven systems. Where these issues are likely to be of some consequence performance data should be sought from the manufacturer.
2. Transferred sound is that which is carried from its source in the air passing through the damper. Attenuation can be achieved if deemed necessary but this is rarely an important consideration.

10.3 Durability & reliability

The environment in which the product will be located should be taken into account. Ensure that the product selected has evidence of its compatibility to the anticipated conditions such as humidity, moisture, high or low ambient temperatures, acidic or alkaline atmospheres, air velocities and pressure differentials.

Ensure that the product is sufficiently protected to remain functional when subjected to the environmental abuse that may be encountered.

Establish what maintenance or cleaning regime will be necessary to ensure reliable performance both as an air transfer device and a fire/smoke containment system.

There are but a few manufacturers of genuine intumescent fire dampers but intumescent dampers can appear very similar to intumescent air transfer grilles. It is therefore essential to confirm the product selected for fire protection in ductwork has been appropriately tested since a product designed for operation at a differential pressure of 25Pa will not last very long when subjected to the rigours of differential pressure that may be encountered in a ducted ventilation system.

11.0 Test standards

11.1 Fire resistance & smoke leakage test standards

BS476-22:1987
Fire tests on building materials and structures. Methods for determination of the fire resistance of non-load bearing elements of construction.

BS EN 1363-1:2020
Fire resistance tests: general requirements.

BS EN 13501-2:2016
Fire Classification of Construction Products and Building Elements Part 2: Classification using data from fire resistance tests, excluding ventilation services.

BS EN 1366-2:2015
Fire resistance tests for service installations. Fire dampers.

BS EN 1366-12:2014+A1:2019
Fire resistance tests for service installations. Non-mechanical fire barrier for ventilation ductwork.

11.2 Other related standards and guidance documents

EN 1751:2014
Ventilation for buildings; air terminal devices; aerodynamic testing of damper and valves.

EN ISO 5135:2020
Acoustics; determination of sound power levels of noise from air terminal devices, air terminal units, dampers and valves by measurement in a reverberation test room.

EOTA TR001:2003
Determination of impact resistance of panels and panel assemblies.

EOTA TR024:2019
Technical description and assessment of reactive products effective in case of fire.

12.0 Conclusions

It can be appreciated that fire and smoke rated dampers can provide a safe means of allowing the movement of air around buildings without the risk of fire and smoke spread but sadly there are many cases where products have been selected and installed that are wholly inappropriate for the application.

The correct specification of product is of paramount importance and whereas this document provides some guidance it is highly recommended that further guidance specific to the application should be sought from those IFSA members who specialise in the manufacture of 'fire' and 'fire and smoke' rated dampers and who have relevant up to date test evidence. Links to members can be accessed from the IFSA web site:

www.ifsa.org.uk

Finally fire dampers like any other technical product will only perform adequately if their installation is conducted in accordance with the manufacturer's instructions by competent operators. It is therefore recommended that the guidance in Approved Document B to the Building Regulations (England and Wales) should be followed and that only third party accredited installers should be used.

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13.0 Information about IFSA

The Intumescent Fire Seals Association (IFSA) is a trade association established in 1982 with the following objectives:

1. To promote the life safety benefit associated with the use of intumescent and smoke seals

2. To promote research and development into extending the areas where these benefits can be utilised

3. To participate in the development of test procedures for fire protection products in BSI, CEN and ISO which are fair, repeatable and reproducible.

At the time of its formation, IFSA recognised the need for a simple standard test to compare the performance of intumescent fire seals for use in fire door assemblies, which was free from the influence of other materials and constructional variations and yet subjected the intumescent material to the conditions which prevail in a full scale test.

It, therefore, sponsored the development of such a test and this is now embodied in BS476: Part 23 (1987). Whilst the results of the test have a limited field of application, only being usable on single leaf, single action, latched doors of limited size and distortion characteristics, it does allow the sealing capability of intumescent seals to be compared without any influence from the leaf.

There is now an ISO equivalent test, i.e. BS ISO 12472: 2003.

Due to its repeatability, the test method is being used successfully to evaluate the influence that real time ageing may have on the properties of intumescent fire seals produced by IFSA member companies. The programme planned to investigate 25 years exposure to a variety of controlled and uncontrolled environments. Findings showed no detectable visual decline.

A test programme undertaken in conjunction initially with DOE/BRE to produce standardise conditions for evaluating penetration seals formed the basis of the standard configuration incorporated in the CEN test procedure EN 1366-3 for evaluating seals for use with metal pipes. This configuration has been refined and incorporated in ISO/TR 10295-3: 2012 where a method of extrapolating the results of penetration sealing tests, using simple solid conductors, can be used to establish the field of application of intumescent sealants.

Fire stopping, service penetration sealing, fire doors and fire glass are all critical aspects of fire safe premises and under the new Regulatory Reform (Fire Safety) Order and the ongoing reliance on fire risk assessments, it is vital that risk assessors understand the role and function of these products. IFSA has produced a number of downloadable Good Practice Guides to help risk assessors know and understand when a particular intumescent application is right or wrong, or how a risk may be controlled by the use of the correctly specified sealing product.

Get in touch

Visit ifsa.org.uk for more information and expert technical guidance on fire door seals, smoke seals, glazing seals, and solutions for penetration and gap sealing.

Together, we're raising standards in fire safety - working to maximum safety and compliance across the fire protection industry.

Scan to meet our members

Visit the member showcase to discover how our community is shaping a fire-safe future.