Information Sheet 7

The Role and Guidance for the Appropriate Use of Fire Resistance and Smoke Containment Air Transfer Grilles in Non-ducted Building Ventilation Systems

Intumescent Fire Seals Association

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1. INTRODUCTION

This IFSA Information Sheet is intended to give guidance to ventilation system designers, product specifiers, building control authorities, fire prevention officers, enforcement officers and installers on the correct use of fire and smoke containment air transfer grilles in fire resisting door assemblies. It describes their role, variations and their function together with the performance requirements and relevant test standards.

2. THE ROLE OF AIR TRANSFER GRILLES

Air transfer grilles are increasingly used as part of a system design to improve the air quality and temperature control in buildings by allowing greater controlled air circulation.

Fire protection is often provided by creating pressure variations within a building to inhibit the rapid spread of fire, smoke and hot gases within. This is made possible by the use of fire and smoke sealed doors that allow the ventilation system to create a differential pressure from one side of a door to the other. Any hot gases egressing past the door seals will flow from the higher pressure side of the door to the lower pressure side. Selecting appropriate pressure differentials for different parts of the building therefore, will greatly improve the containment of fire spread and keep escape routes tenable for a longer period of time. For example hotel corridors are usually maintained at higher pressure than the adjoining rooms or fire compartments. Since most hotel fires originate in the kitchen or guest rooms the pressure differential will inhibit the spread of fire into the corridors.

A ventilation system designer having decided on the appropriate pressure differentials required in a building will need to calculate the necessary volumetric air flow to achieve the differentials allowing for ambient air leakage inherent in each part of the building.

If this air flow is to circulate through air transfer grilles fitted within a fire resisting door assembly, such grilles must be carefully selected to allow the appropriate volume of air whilst creating the specified pressure differentials. Occasionally the necessary pressure

differential is so critical that an air transfer grille which incorporates a pressure control device may be needed. This will compensate for fluctuations in general air movement in the rest of the building caused by opening doors or windows etc. A typical example is between a hospital operating theatre and corridors or adjoining rooms.

Until comparatively recently the use of air transfer grilles has been limited by the potential compromise they posed to controlling the spread of fire and smoke in the event of fire in a building. However, the creation of effective fire and smoke containment air transfer grilles with good aerodynamic performance has greatly enhanced their versatility.

It is essential however to select grilles that are appropriate to the required application in terms of: fire resistance, smoke leakage, volumetric flow, pressure drop, reliability and dimensional compatibility with the supporting construction. In the UK air transfer grilles are not generally required to satisfy the insulation criteria, especially when fitted in doors, but many European states do require the insulation criteria of the fire resistance test to be satisfied.

3. DEFINITIONS AND FUNCTIONS

3.1 Air transfer grille

A non-fire rated device which provides a security and privacy screen for an aperture through which air is passed as part of a ventilation system. The device may incorporate a means of diffusing the air stream.

Applications are restricted to their installation in those elements of building construction that are **not part of the boundary of a fire compartment or fire protected route** and includes: walls, ceilings, doors and low velocity duct termini.

Possible fire performance ratings: None

3.2 Fire containment air transfer grille

Air transfer grilles that are designed for fire containment only allow the passage of air during normal operation that, when activated by a rise in temperature of the air stream, provides containment of fire. Fire containment only air transfer grilles are typically activated by a thermal release mechanism usually pre-set to operate between 70 °C and 74 °C, or by activation of a suitably tested intumescent matrix within the grille, and are not designed to control smoke at ambient temperature. Fire containment air transfer grilles are therefore only suitable for fitting to doors that are intended to provide fire resistance only (e.g. FD 30, FD60).

3.3 Fire and 'cold' smoke containment air transfer grille

Air transfer grilles that are designed for fire and cold smoke containment allow the passage of air during normal operation, but include an electro-mechanical system that interacts with smoke detectors (either directly or via a fire alarm panel), which seals the grille in order to maintain the smoke leakage rate for the door assembly, as defined in the relevant smoke leakage test standard. Fire and cold smoke containment air transfer grilles also include mechanisms that are activated by a rise in temperature (either mechanical or intumescent-based) that can seal the grille to provide fire containment.

Fire and cold smoke containment air transfer grilles are therefore suitable for fitting to doors that are intended to provide fire resistance and ambient temperature smoke control.

The installation of air transfer grilles should be undertaken only when full fitting instructions and relevant wiring diagrams are available, and should be undertaken only by competent persons.

In the case of electrically interactive air transfer grilles, the installer should liaise with the person(s) responsible for the fire alarm panel or building management system. All air transfer grilles should be installed in accordance with the manufacturer's installation and commissioning instructions, including any additional protection required for wire ways, conduits and receiver loops, as appropriate.

This type of device must be used where air transfer is needed between fire compartment boundaries but where the spread of ambient or 'cold' smoke will pose a threat to life safety. For example: **this type of device must be used where air transfer is necessary through an FD30S or FD60S fire door.**

4. FIRE PERFORMANCE REQUIREMENTS

4.1 Fire integrity (ability to resist spread of combustion gases and flames)

A fire rated air transfer grille should have the same period of fire integrity as that of the supporting construction into which it is installed, for example if fitted to an FD60 fire door, the fire integrity of the air transfer grille should be at least 60 minutes.

Care should be taken to ensure that the fire test evidence is appropriate for the intended application. For example an air transfer grille tested only in a masonry wall or duct termini is not necessarily acceptable for installation in fire doors.

Additionally, fire rated air transfer grilles that have only been tested with cover grilles, must be installed with the tested cover grille design as a complete unit. It should not be assumed that different designs of cover grille can be exchanged between different types of fire resisting air transfer grille. In all cases the manufacturer's technical information for the grille must be followed, which will be based on the supporting test evidence for the design.

4.2 Insulation (resistance to temperature rise on the unexposed face)

In the UK, insulation performance is not normally required for fire resisting door leaves unless the fire strategy or building design requires it, for example, if more than 25% of the length of the compartment wall consists of door openings (Approved Document B Vol. 2) fire resisting door leaf. The definition of insulation performance is the resistance to temperature rise on the unexposed face and is satisfied if the average temperature of the door leaf is <140°C or if the temperature of the leaf at any one point is <180°C, as measured by the thermocouples on the surface of the leaf. If insulation performance is required for a door leaf fitted with a grille it should be checked that the door leaf and air transfer grille is capable of meeting this criteria for the stated period of fire resistance, or whether the approving authorities will consider a dispensation for the grille's insulation performance based on its dimensions and location within the door leaf.

4.3 Smoke leakage

Smoke leakage performance only applies to fire and smoke rated air transfer grilles where the leakage performance is measured at ambient temperature. The maximum allowable smoke leakage rate for door installation can be identified by reference to BS 476: 31.1 or EN 1634-3 and is given as $3m^3$/linear metre of door edge/hour.

There is a clause within the standards that requires the door assembly to be tested as intended to be used in practice, incorporating all hardware, seals and other equipment. Hardware includes any items that may influence the performance of the specimen tested, which would include air transfer grilles.

It is important therefore that any air transfer grille claiming smoke control performance has been evaluated as part of a door assembly to either the BS 476: 31.1 or BS EN 1634-3 standard and demonstrated its ability to maintain smoke leakage below the flow rates given in the standards.

4.4 Intumescents in Grilles

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 permeability is decreased if the expanded intumescent is contained and compressed. Intumescent materials require little or no maintenance and cannot malfunction when heated, thereby providing a very 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.

5. VARIETIES OF AIR TRANSFER GRILLES

5.1 Standard Ventilation air transfer grilles (non-fire or smoke rated)

The most common type is manufactured from steel with horizontal louvres formed by 'punching and pressing'. Other varieties include assemblies of extruded aluminium or steel louvres, metal gauze, perforated metal plates and metal or plastic adjustable 'hit & miss' shutter plates.

5.2 Fire rated air transfer grilles - Intumescent Grilles

Intumescent grilles 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 grilles are now the most common type used but are available in many forms and using different types of intumescent material. The following table identifies the varieties of material and construction forms manufactured by IFSA members at the time of publication:

Intumescent Material Type	Sodium Silicate	Intercalated graphite
Matrix of intumescent slats encapsulated in plastic	✓	✓
Matric of intumescent slats encapsulated in metal foil	✓	✓
Matrix of non-encapsulated intumescent slats	-	✓
Expanded metal grid coated with intumescent	-	✓

5.3 Fire and smoke rated air transfer grilles

Intumescent electro-mechanical grilles are usually manufactured by combining an intumescent fire rated grille 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 grille can close off the aperture in two entirely separate ways, firstly by smoke detection, which operates 'hit and miss' plates or rotating blades and later by a rise in temperature, which causes the intumescent to activate, i.e. expand and close off the vents.

6. RECOMMENDED INSTALLATION METHODS

An air transfer grille should only be fitted in a fire door assembly if it has been provided with the grille manufacturer's information confirming that the grille has been tested in a similar leaf construction to determine fire integrity at the pressure differentials appropriate to the height of its intended application. For example an air transfer grille that has been tested below 1000mm from the threshold in a BS476: Part 22 test (1000mm is the height of the neutral pressure axis in a BS 476: Part 22 test – below 1000mm from the threshold is the negative pressure zone and above is the positive pressure zone) may not be suitable for installation in a door assembly above 1000mm as the increased pressure may exploit the intumescents quicker leading to premature integrity failure.

Before fitting an air transfer grille in a fire rated door leaf it is advised to obtain the following information, which is likely to be contained in the supporting documentation (i.e. test evidence, assessment documents or manufacturers technical guidance) for the door design or the air transfer grille, as appropriate:

1. Verify whether the door design requires the aperture for a fire rated air transfer grille to be lined with a dense hardwood glued in position on all four sides.
2. Check that the door design has test evidence for apertures at the required dimensions and location within the leaf
3. Check the required installation specification for the specific air transfer grille, including specific lining materials, additional intumescent protection and fixings.

When installing fire and smoke rated air transfer grilles that need to be connected with electrical wiring, the drill sizes for the wire-ways in the door leaf must be kept to a minimum. Reputable manufacturers of fire and smoke rated air transfer grilles provide detailed installation and commissioning instructions and these should be closely adhered to, in conjunction with any specific detailing required for the selected door design.

7. DIMENSIONAL AND POSITIONAL LIMITATIONS

The product 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. If the test evidence for a product is restricted to a particular vertical position (e.g. in the positive or negative zone) then it should only be employed where the same pressure is anticipated.

Care should also be taken to ensure that the aperture dimensions of the selected product do not exceed the maximum allowed in the associated structure. For example, if it is to be installed in a fire door the maximum aperture size should be established with the door manufacturer. Excessive dimensions of the aperture may result in premature integrity failure of the door in fire conditions as it could influence the amount that the leaf bows during a fire test. Similarly, if the grille is fitted too close to the edge of the leaf, this may also cause excessive distortion.

8. NON-FIRE PERFORMANCE REQUIREMENTS

8.1 Volumetric flow

Ventilation system designers will have established the rate of air change required for each compartment zone of a building and should determine the pressure differentials that will ensue from the supply air and make up air arrangement where applicable. Fire engineers should also provide information concerning the pressure variables necessary in the building to conform to their fire safety strategy. Once the two inputs are reconciled air transfer grilles 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.

8.2 Acoustic considerations

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

a) Generated sound is the result of air passing through an air transfer grille causing rattling or reed type noise, particularly at higher velocities of air. This can be exacerbated by the design of the grille type. Also, in the case of fire and smoke containment air transfer grilles, sound can be generated by electro-mechanical actuation. Where these issues are likely to be of some consequence performance data should be sought from the manufacturer

b) Transferred sound is that which is carried from its source in the air that is passing through the grille. Significant attenuation of transferred sound through grilles installed in fire doors is unlikely due to the thickness limitations of fire door leaves.

8.3 Durability & Reliability

The environment in which the product will be located should be taken into account when specifying. Ensure that the product selected has evidence of its compatibility with 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 mechanical 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 and implement the necessary measures.

Some early types of intumescent activated grilles are prone to premature clogging and deteriorate in humid conditions (such as honeycomb type grilles). Also they are difficult to clean effectively due to the fibrous nature of the materials used in their construction. These types of products are best avoided where the atmospheric conditions are contaminated with dirt, grease and other particulates and where the atmosphere is likely to be humid. Other designs of air transfer grille may be more suitable, this can be checked with air transfer grille manufacturer.

9. TEST STANDARDS RELEVANT TO THE PERFORMANCE OF AIR TRANSFER GRILLES

9.1 Fire Resistance & Smoke Leakage Test Standards

BS 476-22: 1987 Fire tests on building materials and structures. Method for determination of the fire resistance of non-loadbearing elements of construction

BS 476-31.1: 1983 Fire tests on building materials and structures. Methods for measuring smoke penetration through doorsets and shutter assemblies. Method of measurement under ambient temperature conditions

BS EN 1634- 1: 2014 Fire resistance and smoke control tests for door and shutter assemblies, openable windows and elements of building hardware. Fire resistance test for door and shutter assemblies and openable windows

BS EN 1634-3: 2004 Fire resistance and smoke control tests for door and shutter assemblies, openable windows and elements of building hardware. Smoke control test for door and shutter assemblies

9.2 Other related standards and guidance documents

EN1751	Ventilation in buildings - air terminal devices- aerodynamic testing
EN ISO 513	Acoustics - determination of sound levels from air terminals
EOTA TR01	Determination of impact resistance
EOTA TR024	Characterisation- Durability and FPC for reactive materials
ETAG 026-4	Fire stopping and sealing- Reactive air transfer grilles

10. CONCLUSIONS

It can be appreciated that fire and smoke restricting air transfer grilles already provide a versatile means of allowing the movement of air within buildings without the risk of excessive fire and smoke spread. Sadly there are many cases where products have already been selected and installed that are wholly inappropriate for the application.

The correct specification of the 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 smoke rated air transfer grilles supported by relevant up to date test evidence.

Links to members can be accessed from the IFSA web site:
www.ifsa.org.uk.

Finally air transfer grilles, like any other technical product, will only perform adequately if their installation is conducted in accordance with the manufacturer's instructions by competent installers. It is therefore recommended that the guidance in Approved Document 'B' should be followed and that only third party accredited installers should be used to install these critical products.

There are a number of third party certification bodies that certify the installers of passive fire protection products, e.g.
IFC Certification Ltd.

11. INFORMATION ABOUT IFSA

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

- To promote the life safety benefit associated with the use of intumescent and smoke seals
- To promote research and development into extending the areas where these benefits can be utilised
- To participate in the development of test procedures for fire protection products in BSI, CEN and ISO which are fair, repeatable and reproducible.

IFSA maintains close links with the fire community. The Secretariat is based at International Fire Consultants, from which the association receives technical advice and support.

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 is planned to investigate 25 years exposure to a variety of

controlled and uncontrolled environments. Early findings showed no detectable visual decline and tests are being undertaken soon to confirm these findings.

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.

The move away from brickwork, blockwork and cast concrete forms of construction, towards a greater use of studwork and joisted walls, floors and ceilings, has left many of our fire separating constructions compromised by the fitting of electrical services (switches, plug sockets, concealed lighting, extract fans). IFSA has cooperated with the Electrical Safety Council (ESC), in the preparation of their guide, 'Electrical installations and their impact on the fire performance of buildings; Part 1, Domestic Premises'.

Intumescent materials can seriously reduce the impact that such installations may produce. Correctly fitted sealing systems make a greater contribution to life safety in a fire than almost any other measure. If you do nothing else to enhance life safety- at least seal up the building with fire and smoke seals, preferably from an IFSA Member because they take fire safety seriously.

CURRENT IFSA MEMBERS AND CONTRIBUTORSTO THE INFORMATION SHEET

Technical Consultants to IFSA

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