Fire Protection Of Ventilation Systems
DAMPERS & AIR TRANSFER
GRILLES

A PRESENTATION
BY
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OF
FIRE ENGINEERING SOLUTIONS
THE AIM OF THE WORKSHOP:

Provide assistance in the selection, installation and operation of ventilation fire protection products for those who have the responsibility for meeting or maintaining the requirements of new legislation.
Section 1 - NEW LEGISLATION AND GUIDANCE

1. The Regulatory Reform Order: 2005 is now in effect and brings in major changes particularly in responsibility and culpability.
   - The “Responsible Person” will have to ensure that the fire safety of a building is in all respects compliant with the relevant codes etc.
   - This includes risk assessment, selection of systems and products, correct installation, operating procedures and servicing.
   - It is imperative that all procurements are accompanied by relevant performance, reliability and durability evidence.
   - Installations shall be completed in accordance with the manufacturers instructions and relevant guidance documents or standards.
   - Qualified persons adhere to a maintenance/servicing schedule.

Failure to comply may result in serious legal consequences.
NEW LEGISLATION AND GUIDANCE

2. Approved Document ‘B’: 2007 has also undergone a major shift in emphasis.
   – It is no longer necessary to adhere to purely prescriptive solutions.
   – Performance based solutions must be backed with substantive evidence of ‘fitness for use’.
   – Encourages the use of certificated products and accredited installers.
   – Contains revised definitions. (e.g. P142 fire damper)
   – Puts greater emphasis on smoke control.
3. **Health Technical Memorandum 05-02: 2007**

Guidance in support of functional provisions for healthcare premises (*Firecode - fire safety in the NHS*).

- Competent persons – must understand their responsibilities and take appropriate actions or decisions. *(This can only be achieved by an awareness of product and system limitations)*
- Certification schemes encouraged.
- Definitions now clarify different damper and grille types.
- Greater emphasis on smoke control.
- Fans continue to run in fire conditions.
- Some errors in ‘cut & paste’ but does give more options.
Section 2 – DEFINITIONS

• **Air transfer grille** – A 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 include: walls, doors and low velocity duct termini that are not part of the boundary of a fire compartment.

• **Fire containment air transfer grille** – A device that when activated by a rise in temperature of the air stream provides containment of fire and hot gases in addition to the normal function of an air transfer grille but is not intended to control cold smoke.

• **Fire and cold smoke containment air transfer grille** - A device which provides containment of cold smoke, fire and hot gases by either interface with smoke sensors or by a rise in temperature of the air stream in addition to the normal function of an air transfer grille.

• **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.

• **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.

• **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 product type is outside of the scope of this document.*
Section 3 – GENERAL PROBLEMS WITH VENTILATION SYSTEMS
Limitations of the product selection process

• Fire resistance tests are always conducted with new specimens.
• Debris, dust and grease soon build up in real installations.
• Mechanisms jam and thermal release devices become masked.
• Bulky damper or air transfer grilles are often difficult to install in the correct location.
• Once fitted limited accessibility discourages servicing.
• Problems of installation, location and accessibility for servicing makes reliability questionable.
• Often poor installation negates the initial purpose of fire protection.
• In many installations the condition and location of dampers and air transfer grilles are not even known.
• The new regulations make it clear:

WE MUST IMPROVE!
CONSEQUENCES

- Dampers with unproven durability and reliability may fail when most needed.
- The failure of one damper may have catastrophic effects on life safety.
- A damper dependent on one set of moving blades which is not regularly serviced is unreliable.
- Where possible choose a fire and smoke damper that has two separate modes of ‘fail safe’.

WE CAN IMPROVE!
Section 4 - CRITICAL SELECTION CRITERIA

- Establish the **performance** requirements for the particular application
  (Fire integrity period, Aerodynamic characteristics, Leakage rate, Insulation value.)
- **Implications to the fire safety model if the air transfer grille or damper should fail** - (Risk Analysis)
  (Would there be a catastrophic failure to the buildings fire protection system?)
- **Product sizes compatible with installation in the correct locations?** (30% restriction of free area has no noticeable effect on pressure loss)
- Ensure products are fit for use (**reliability and durability**)
  (Insist on evidence to prove real time characteristics)
- Insist on seeing **test evidence for fire integrity, cold smoke containment where required and insulation performance if necessary**
  (Examine test evidence to ensure that the product has been tested for relevant applications in accordance with the appropriate standards and is still valid)
Section 5 – CHOICES
MECHANICAL OPTIONS AVAILABLE

• Fire and hot gas containment mechanical air transfer grilles & dampers activated by thermal release mechanisms

• Fire and cold smoke containment mechanical air transfer grilles & dampers electrically activated by interface with smoke sensors and backed up by thermal release mechanisms

The above products can be in the form of:
Curtain type; Single blade; Multi-blade; Sliding plate
INTUMESCENT BASED OPTIONS AVAILABLE

- Intumescent fire and hot smoke containment dampers & air transfer grilles in which the core material expands when exposed to a rise in temperature and fills the apertures through which air would normally flow.

- Intumescent fire and cold smoke dampers & air transfer grilles that incorporate an electrically activated mechanical system activated by interface with smoke sensors and backed up by heat activated intumescent elements.

The above products can be obtained in the form of: Multi-slatted matrix; Honeycomb, Corrugated layers’ Perforated blocks. Combined fire and smoke air transfer grilles & dampers are only available in multiple slat matrix types.
Section 6 - COMPARISONS

Fire and hot smoke containment only
FACTORS THAT SHOULD INFLUENCE SELECTION
‘A’

Mechanical Thermal Release Air Transfer Grilles & Fire Dampers:
• Failure to close can be caused by incorrect alignment or distortion during installation or a build up of deposits during normal use.
• No back up to the thermal release mechanism, failure to operate means that fire and smoke travel unchecked.
• All mechanical systems need regular servicing & testing.
• Some Curtain blade dampers are guaranteed to close only in still air.
• Single blade dampers of large area need long casings to accommodate the blade when it is in the open position.
• Most purely mechanical systems suffer high leakage rates when closed.
• Thermal release products will not stop the spread of cold smoke.
FACTORS THAT SHOULD INFLUENCE SELECTION
‘B’

Intumescent Air Transfer Grilles & Fire Dampers:
• Intumescent products will activate at different temperatures dependent on the material used in their construction.
• Some designs are superior aerodynamically resulting in less pressure drop and minimising build up of deposits.
• Some products are better protected from moisture.
• No moving parts means nothing to jam in the open position
• Usually only require periodic inspection or cleaning in very hostile environments
• Distortion to the ductwork is unlikely to affect the fire performance
• Slim section allows easy installation in difficult locations
• Good quality products give negligible leakage at high pressure differentials and will tolerate high air velocities
• Products relying only on intumescent activation are not designed to stop the spread of cold smoke
A Very Bad Choice

Installed 2007, failed 2009
A COMPARISON OF BEHAVIOUR IN FIRE CONDITIONS

It is popularly believed that because Fusible Link or Thermal Release Mechanical dampers are designed to activate at $74^\circ\text{C}$. they will operate more quickly than Intumescent dampers that activate at temperatures not less than $100^\circ\text{C}$. in fire conditions.

The following diagrams show why this is often not the case.
WHY DO THERMAL RELEASES SOMETIMES ACT SLOWLY?

The Coanda Effect

Thermal release

COOL AIRSTREAM CAUSING FAILURE TO CLOSE

Mechanical Fire Damper

Fire Compartment Wall

Why do thermal releases sometimes act slowly?

Cool airstream causing failure to close

Mechanical Fire Damper
HOW DO INTUMESCENT DAMPERS COPE WITH THE COANDA EFFECT?

The Coanda Effect

Slat Type Intumescent Damper

Fire Compartment Wall
ODPM sponsored simultaneous mechanical and intumescent damper fire integrity test at BRE in 2004

COMPARATIVE CLOSING TIME OF DAMPERS
COMPARISON OF BEHAVIOUR IN FIRE CONDITIONS

• Systems using intumescent elements absorb heat energy as intumescence occurs and provide insulation performance when activated, thereby limiting the rise in downstream temperatures.

• Steel mechanical systems absorb little heat energy in the early stages of a fire but radiate heat as the fire develops, and may cause secondary ignition downstream.
ODPM sponsored simultaneous mechanical and intumescent damper fire integrity test at BRE in 2004

COMPARATIVE DOWN STREAM TEMPERATURES

Possibility of secondary ignition
Section 7 - FUNCTION
INTUMESCENT VERSUS MECHANICAL

Why are good quality intumescent air transfer grilles & dampers so reliable?

Consider the design and how they function
EXAMPLE OF INTUMESCENT SLAT CONSTRUCTION

- Metallic protective skin
- Intumescent core
- Steel edge guards

CROSS SECTION
ACTIVATION PROCESS

Gases inflating outer skin

Intumescent activating

CROSS SECTION OF INTUMESCENT SLATS IN AN AIR TRANSFER GRILLE OR DAMPER
Activated Intumescent Damper
Duct Condition After Fire Test
VALUE FOR MONEY

- QUALITY MADE INTUMESCENT PRODUCTS CAN PROVIDE MORE RELIABILITY THAN THEIR MECHANICAL COUNTER-PARTS BECAUSE THEY DO NOT JAM
- INSTALLATION IS EASIER AND LESS CRITICAL TO FUNCTION
- REQUIRE MUCH LESS ATTENTION IN NORMAL USE
- INTUMESCENT SYSTEMS CAN ACTIVATE AS QUICKLY AS THERMAL RELEASE TYPE MECHANICAL SYSTEMS
- LOWER ‘DOWN STREAM’ AIR TEMPERATURES REDUCE THE RISK OF SECONDARY IGNITION
- GOOD QUALITY INTUMESCENT PRODUCTS HAVE EXCELLENT AERODYNAMIC PERFORMANCE
- THE OVERALL COST OF PROCUREMENT, INSTALLATION AND MAINTENANCE WILL USUALLY BE LESS THAN PURELY MECHANICAL SYSTEMS
Section 8 - CHOICES

FIRE AND COLD SMOKE
CONTAINMENT SYSTEMS
COLD SMOKE CONTAINMENT

• Temperatures in ventilation air streams may rise slowly in real fires
• During this period cool smoke may spread unhindered by thermally activated fire dampers or air transfer grilles
• Correctly sited smoke sensors interfaced with smoke containment systems are the only way to prevent the spread of cool smoke
SMOKE SENSING SYSTEMS OPTIONS

a) Mechanical thermal release fire damper or air transfer grille with a second release mechanism electrically interfaced with smoke sensors

b) Intumescent fire damper or air transfer grille incorporating a mechanical smoke control system electrically interfaced with smoke sensors
Vulnerability of purely mechanical fire & smoke dampers

- If the electrically operated release mechanism fails the thermal release should activate when the prescribed temperature is achieved
- **If the moving plates are jammed neither fire or cold smoke will be contained, no ‘back up’**
- Dampers functioning by mechanical motion should be cycled regularly
- Most mechanical fire and smoke dampers are not designed for frequent operation such as auto-cycling
Aspects of good quality intumescent fire and smoke dampers

- If the electrically operated mechanism fails to close, the intumescent elements will activate when the prescribed temperature is achieved
- If the moving blades or plates are jammed the intumescent elements will provide a fire stopping ‘back up’
- Quality fire and smoke air transfer grilles & dampers are designed to survive a life of automatic cycling for at least 10 years
- Quality systems employ regular auto-cycling to keep mechanisms clear and to identify faults
- Audio alarms options are also available
Section 10
UPGRADING FIRE PROTECTION

• Quality intumescent air transfer grilles and dampers are of slim section and relatively easy to install in restricted spaces
• Intumescent dampers can be fitted in line with existing mechanical dampers as ‘back up’
• In most applications good intumescent fire dampers & air transfer grilles can be fitted and forgotten
• Fire and smoke containment air transfer grilles and dampers that incorporate an auto-cycling and status reporting feature will provide confidence and reduce operating costs
Section 11 - Standards

• Currently most fire dampers have only been tested to BS 476 part 20 which is now regarded as inadequate.
• EN 1366-2 : 2000 is the current European fire resistance test standard for mechanical dampers. EN 1366-2 is now under revision to remove the anomalies discovered in the 2000 edition by practical experience.
• A new prEN standard has been drafted which identifies the particular requirements of fire dampers that incorporate intumescent materials.
• ISO 10294-1 is the current International fire resistance test standard for mechanical dampers and is similar to EN 1366-2.
• BS ISO 10294-5: 2005 is the first fire resistance test standard specifically for intumescent fire dampers.
• BS5588 Part 9 : 2000 clearly verifies the role of intumescent dampers and air transfer grilles.
• A draft ETAG 026 which will be the equivalent of a product standard for air transfer grilles has been completed, awaiting publication.
• A new ISO fire test standard for air transfer grilles has just been drafted.
• BS9999 allows performance related solutions to compete with traditional prescriptions.
Section 12 - OVERALL COST CONSIDERATIONS

1. Establish the performance requirements of the various fire and smoke containment elements of a building’s ventilation system.
2. Now weigh the various cost options.
3. Assume a working life of 10 years
4. Add the procurement cost of the satisfactory product options to the costs of installation, commissioning, servicing and repair.
5. The overall costs may be surprising.
6. The higher procurement cost items may be significantly cheaper overall yet provide greater reliability.
## Section 13 - RELIABILITY

<table>
<thead>
<tr>
<th>TYPE</th>
<th>FIRE DAMPERS &amp; AIR TRANSFER GRILLES</th>
<th>FIRE &amp; SMOKE DAMPERS &amp; AIR TRANSFER GRILLES</th>
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<tr>
<td>Options</td>
<td>MECHANICAL DAMPER</td>
<td>ELECTRO-MECHANICAL</td>
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<td>Hot smoke &amp; fire containment</td>
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<td>Actuation method</td>
<td>Fusible link or other thermal release mechanism</td>
<td>Combined thermal &amp; electrical release mechanism</td>
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<td>Intumescent action</td>
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<td>Back up for mechanical jamming</td>
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<td>No moving parts to jam</td>
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<tr>
<td></td>
<td>No moving parts to jam</td>
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<td>If electro-mechanical element fails, fire is contained by the intumescent action</td>
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<tr>
<td>Frequency of service</td>
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<tr>
<td></td>
<td>Rarely</td>
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<tr>
<td></td>
<td>Only when prompted by the status reporting system</td>
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</tr>
<tr>
<td>Most reliable option</td>
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<td></td>
<td>Most reliable option</td>
<td>Most reliable option</td>
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Section 14 - YOUR DECISION

• Be aware of your current responsibilities.
• Take account of your risk assessment.
• Re-examine the viable product options available.
• Make your choice by **logic** not **habit**.
• Ensure that what is specified is correctly installed.
• Conformance with prescription is no defence if things go wrong and better choices were ignored.
• **Protect yourself by effectively protecting others!**