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Technical Information

How to design easily a smoke management system?

A crucial need for safe compartmentation

To prevent the risk of fire propagation by any means

Compartmentation is the only effective solution to prevent the risk of fire propagation through the HVAC system.

The **main dangers** caused by a fire are due to the **flames, heat, smoke, and toxic combustion gases**:

- Smoke inhalation
- Panic due to the smoke and reduced visibility
- Dangerous fire fighting in under-ventilated fire (eg flashover, backdraft…)

*"**Smoke** is recognized as the **major killer** in fire situations. Smoke often migrates to building locations remote from the fire space, threatening life and damaging property. Stairwells and elevator shafts frequently become smoke logged, thereby blocking evacuation and inhibiting rescue and fire fighting".*
Source: Design of smoke management systems, J. Klote J. Milke, ASHRAE Special Publications, 1992

➞ 1st example: MGM Grand Hotel fire in 1980 – Smoke inhalation

According to the "Investigation report on the MGM Grand Hotel fire – Las Vegas, Nevada - November 21, 1980 (Best and Demers 1982)" available on NFPA website, *"the HVAC systems operated during the fire and contributed to smoke spread through the high-rise tower. The equipment was not equipped with smoke detector arranged to shut down the systems upon sensing products of combustion. In addition, some fire dampers were arranged so that they could not close when the fusible links melted and others did not close completely".*

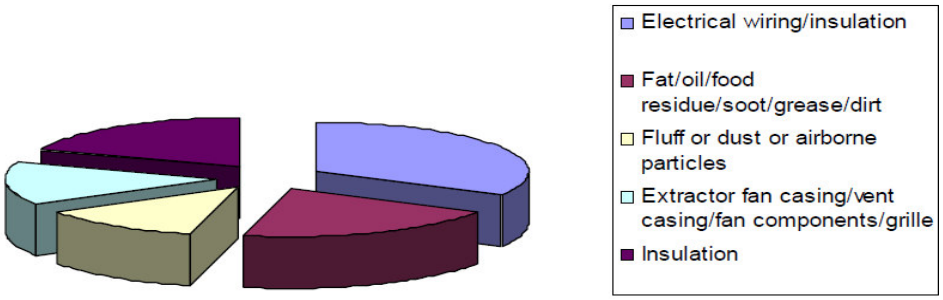
Consequently, *"the fire was limited to the first floor, but smoke spread throughout the building. Some occupants on upper floors were exposed to smoke for hours before rescue. The death toll was 85, and the majority of the deaths were on floors far above the fire."*

➞ 2nd example: Hilton New York hotel fire in 2005 – Smoke inhalation

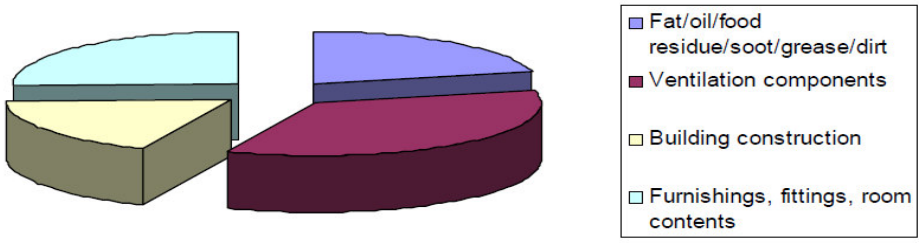
"A fire in an electrical shaft at the Hilton New York hotel forced the evacuation of the 45-story Midtown building, sent 33 people to the hospital with smoke inhalation [...]. No one was seriously injured. The fire started about 4 p.m.[...]. The smoke spread rapidly throughout the 2,017-room hotel through the ventilation system. Hotel guests from the 8th to the 33rd floors said that the hallways were thick with smoke".
Source: http://www.iklimnet.com/hotelfires/case52.html

The report « **Examination of the fire resistance requirements for ducts and dampers** » made by Building Research Establishment (BRE) in UK in 2005 shows the principle causes of **ignition** and **fire spread** in ducts:

Principle causes of ignition involving HVAC systems
LFB data



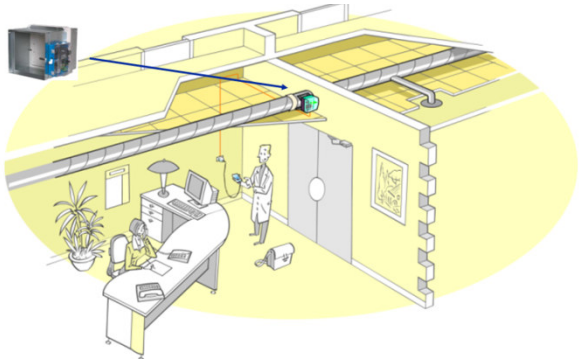
Principle contributors to fire
LFB data spread of fire in ducts

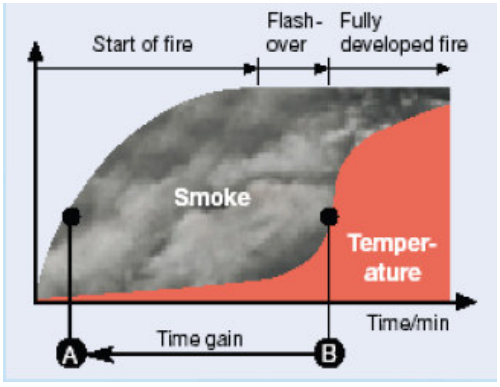


These graphs show that fluff, dust, food residue, grease can have an impact on both fire ignition and fire spread inside the HVAC ducts. This means that **heat transfer** through fire dampers could ignite any fluff or dust on the opposite side, and then spread the fire throughout the building.

The need for an effective & safe compartmentation

Consequently, an efficient **compartmentation** is fundamental to ensure a minimum level of safety inside a building. The main objective is to subdivide a building into fire compartments to isolate a fire at birth and limit spread of **fire, smoke & heat** through a HVAC ductwork with fire dampers.





A **fire damper** is a device, installed in an air distribution system, designed to close automatically upon detection of heat, to interrupt migratory airflow, and to restrict the passage of flame, smoke and heat.

→ 1st Priority: NO SMOKE LEAKAGE

As smoke is developing rapidly at the start of the fire and spreading quickly throughout the building, **stopping the smoke propagation shall be the main priority of a compartmentation system with quick activation** through a smoke detection system.

Therefore, fire dampers shall be:

1. **Motorized with a quick and instantaneous (1s) operation** via a fire alarm control panel (FACP) connected to smoke detectors.
2. **Airtight at low and high temperatures** with intumescent fire seal.
3. **Installed in a HVAC system with fan shut-off** quickly after the start of the fire via also a fire alarm control panel (FACP) connected to smoke detectors.

Any **curtain fire damper shall be prohibited** from any building in the world as these fire dampers are neither airtight nor motorized, and their level of safety is thus not meeting anymore the real need for a safe compartmentation.

A "UL" combination fire and smoke damper is nothing more than a motorized and airtight fire damper meeting UL 555 and UL 555S requirements for the fire test and the leakage test. But UL 555S ensures a proper air tightness for cold smoke and fumes only, up to 120°C (250°F) or 175°C (350°F) maximum whereas the **EN 1366-2 ensures a proper air-tightness for cold and hot smoke and fumes** prior and during the whole fire resistance test. To meet the stringent requirements from EN 1366-2, **intumescent fire seal** are used to prevent any smoke leakage through the fire dampers especially at high temperatures.

Concerning the **fan operation**, according to the report « Examination of the fire resistance requirements for ducts and dampers » made by Building Research Establishment (BRE) in UK in 2005, "the importance of **shutting off the fan quickly after the start of a fire** is highlighted. If the fan is not shut off, the air can feed the fire as well as aiding the spread smoke and hot gases around the building".

→ 2nd Priority: NO FLAME & NO HEAT TRANSFER

The **second priority would be to prevent the flames and the heat transfer** from one compartment to another in the post-flash over situation as the temperature is then increasing a lot in a fully developed fire.

A comparative study between UL type "curtain fire dampers" and European EIS type "fire dampers" with a specific fire test carried out in Aldes France Headquarter in front of **UAE Civil Defence authorities** has shown that within 10min already:

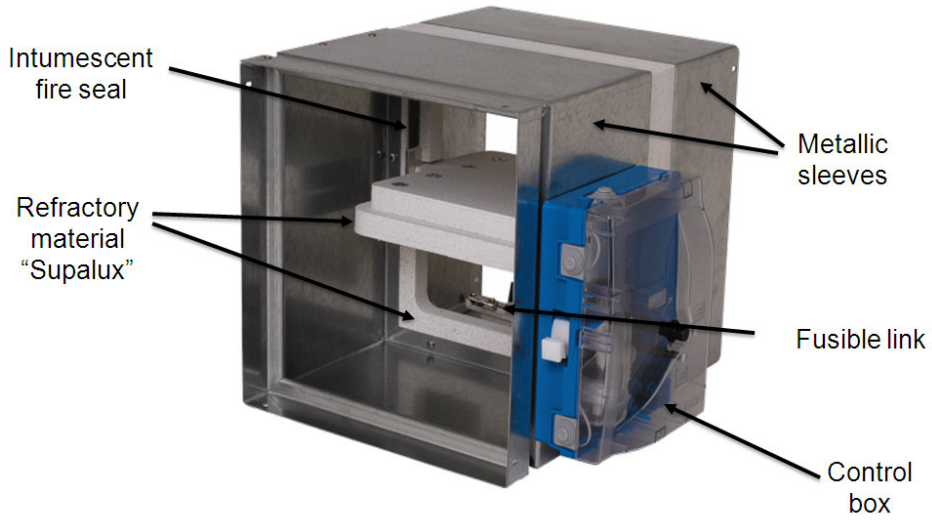
1. UL type Curtain Fire Damper creates heat transfer by radiation effect (T°C> 400°C) on its blade and on its casing,
2. UL type Curtain Fire Damper creates heat transfer by conduction when T°C>200°C (blade, casing),
3. UL type Curtain Fire Damper creates heat transfer by convective effect (through smoke leakage),
4. UL type Curtain Fire Damper lets smoke pass in a huge quantity.

The main danger due to the heat transfer comes from the **pyrolysis of any material and dust** behind the fire damper blade on the opposite side of the fire. For example, the pyrolysis of a piece of wood starts at 200°C, and the **pyrolysis of the products (gases...) starts to burn (with flames) between 500°C and 700°C.**

⇒ Consequently, the fire compartmentation with a **UL type GI blade fire damper is not preventing any risk of fire propagation through heat transfer**.

⇒ European fire dampers like ISONE fire damper are usually constructed with an efficient **isolating blade made of refractory material** (calcium silicate). This refractory blade – 100% asbestos free – prevents any heat transfer through the damper, thus reducing future fire hazards.

To conclude, the level of safety inside buildings can be easily increased with efficient fire dampers in compliance to EN1366-2. These fire dampers will prevent any risks due to smoke leakage and fire propagation by heat transfer.



The need for easy maintenance & energy savings

→ Easy maintenance

To ensure a **quick and easy maintenance**, fire dampers shall be **motorized with a reset motor** for remote maintenance and inspection purposes through the Building Management System. Consequently, fire dampers should be able to be operated through a **Fire Alarm Control Panel in case of fire** and through a **Building Management System in case of preventive maintenance**.

→ Energy savings

An easy way to save energy is to operate a fire damper in a **power emission mode** rather than a **power cut-off mode**. The power emission mode allows **no power consumption** at all for any low-energy building requirements. In comparison, a motorized fire damper equipped with conventional electrical actuator will have power consumption around 6 to 8W just for holding the actuator in the open position during the life time of the building. This can be considered as a real **waste of energy**. Consequently, all fire dampers shall be **operated under power emission**.

→ How to select the right fire damper for your building?

Here below is a comparative table between the different type of fire dampers and their key features to allow you to select the right fire damper:

Fire Dampers Comparison

Type		Curtain Fire Dampers	Combination Fire & Smoke Dampers	Motorized Fire, Smoke & Heat Dampers
Model		FD 150 AH & CH	FD 125	ISONE
Standards		UL 555	UL 555 & UL 555S	EN 1366-2 & EN 13501-3
Key Features	Fire Resistance	1.5h	1.5h	2h
	Quick Activation	Fusible link only (70°C)	Actuator (15s) + Fusible link (70°C)	Actuator (1s) + Fusible link (70°C)
	No Smoke Leakage	No seal	Ok for cold smoke and fumes up to 120°C or 175°C	Ok for cold and hot smoke and fumes
	No Heat transfer	GI blades	GI blades	Refractory blade
	Easy Maintenance	Manual only	Remote control with BMS	Remote control with BMS
	Energy Saving	No actuator	Only power cut-off	Power cut-off + Power emission available

If you are looking for a **high level of safety** for your buildings along with **easy maintenance** and **energy saving**, there is only ONE SOLUTION: **EUROPEAN ISONE FIRE DAMPER**.

For any information or enquiry, please contact us!
www.aldes.ae

And let's come to visit our factory and showroom!