Loss Prevention Standards – Asset Classes

Heat and Smoke Venting Systems

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AVIVA

Heat and Smoke Venting Systems

Introduction

Heat and smoke vents are outlets which are designed to allow heat and smoke to escape from a building during and/or after a fire, and are typically installed in ceilings, roofs or high-up in walls. As a protection mechanism they form a critical part of an organisation's loss prevention strategy. Heat and smoke venting systems are very difficult to retro fit, and so are usually considered as part of the initial design and as an intrinsic part of the Fire Safety Engineering of a building.

Vent systems should be considered as a detail of a building fire risk assessment and as part of a wider business impact risk assessment, particularly in relation to smoke contamination of a building, its services and/or its contents.

Heat and smoke vents may be installed to:

- Allow heat and smoke to escape from a building before it effects the building's structural integrity
- Help prevent heat and smoke contamination throughout a larger area, and restrict the spread of a fire – if smoke and heat are not removed quickly, secondary fires may develop
- Improve visibility during an incident
- Allow smoke to escape, helping protect the safety of occupants by enabling visibility for evacuation, e.g. escape stairwells

The vents may be manually or automatically actuated:

- Either by the fire service or a trained on-site responder
- Linked to an electronic fire alarm system
- By temperature operated heat sensitive fusible links or frangible bulbs
- Using a drop out/melt out system

Venting may utilise the natural physical properties of smoke and heat or it may incorporate a form of mechanical forced extraction.

The use of a dedicated heat and smoke venting system for other purposes, e.g. building cooling in the summer, should be avoided.

Finally, particular attention must be paid to the venting arrangements in buildings protected with automatic sprinkler systems.

Types of Vent Actuation

Manual

Vents are manually activated at an appropriate stage of a fire or its decay, by the fire service or a trained site-emergency response team:

- Manual activation devices should be located in a readily accessible and safe location, being clearly and logically arranged and labelled, to avoid any confusion during an incident
- There should be a schematic drawing to support the expected response in the area of the manual activation devices
- Site personnel responsible for implementing manual activation should receive appropriate practical training

Fusible Link/Frangible Glass Bulb Actuation

The vents use a temperature-rated fusible link or frangible bulb to initiate the opening mechanism.

Drop Out/Melt Out

Vents constructed of a temperature sensitive thermoplastic, which deform and drop out when the plastic reaches a predetermined temperature (it essentially melts out of the holding frame).
This should never be used where there are automatic sprinklers in the same area of a building, as there is no control over the vent dropping and its timing, and if it does drop it can smother and compromise any installed sprinkler protection positioned below.

Motor/Compressed Air Operated

Vents rely on an electrically driven or compressed air actuator to operate the vents (often interlocked to the fire alarm activation).

Extract Ventilation Systems

Natural Ventilation

All venting systems employ some degree of extraction by natural means. Natural ventilation uses the natural buoyancy within the heat and smoke (convective air movement and the chimney effect, etc.) to drive the heat and smoke flow through the venting.

Mechanical Ventilation

Mechanical ventilation consists of motor driven fans mounted directly on or in the building structure, or is part of a ducting system, that extracts/forces the heat and smoke from the building.

Any mechanical venting or ducting system should be designed to withstand the maximum temperatures expected within the building during a fire. This includes equipment such as fans, motors, ducting, fixings, filters, cables etc. This is especially important if the system is combined with the building's day-to-day heating and ventilation/temperature management system. If it is a combined system then post-fire contamination, cleaning and decontamination should be given careful attention, as this can dramatically increase the time to recover the business to operational status following an incident.

Single Activation or Group/Zoned Activation

Depending on the type of venting system installed, vents can actuate individually or in zones/groups. The design philosophy is very much dependent on the overall fire protection strategy, including Building Control requirements, fire compartmentation, automatic fixed fire protection and automatic fire detection installations etc.

Motorised Electrical Elements

The wiring/power supply to any motorised elements should be thoroughly reviewed (risk assessed) to ensure they are resilient, not compromised by direct impingement of fire, and that they are not isolated by a site-wide electrical isolation if there is a fire situation. These systems are integral to the fire protection strategy and should not be able to be impaired by the above.

Inspection and Maintenance

Regular inspection and maintenance of the heat and smoke venting system should be undertaken by competent, qualified engineers, in accordance with the manufacturer's specifications, and as part of a preventative maintenance programme. It should include all venting systems equipment both internal and external to the building. All vents should be visually inspected to ensure that no deterioration, damage, obstruction or impairment of the vent has occurred.

Areas that contain vents or are exposed by vents should be regularly inspected for:

- Debris accumulation
- Projections/obstructions (e.g. temporary storage)
- Water, snow or ice….

……all of which could impede the opening of the vents. Any such occurrences should be removed immediately.

With the exception of drop out vents, all other vents should be physically released and tested, to ensure correct operation and to facilitate the repair or replacement of component parts. This test should be completed at least annually.

For any mechanically operated vents or forced mechanical ventilation systems reliant on electrical power, a means to allow for operation in the event of loss of power should be provided and tested, e.g. emergency generator, pneumatic, manual override etc.

Vents in Sprinkler Protected Buildings

In buildings protected by automatic sprinklers, the heat and smoke vents should only be:

- Arranged to be manually actuated
- Actuated when the sprinkler system has performed as designed and when advised it is safe to do so by the fire brigade

The automatic operation of heat or smoke vents in a sprinkler protected building could severely compromise the sprinkler system actuation and efficiency. Sprinkler heads operate at a predetermined temperature rating with a specific Response Time Index (RTI) and require the build-up of heat.

Therefore the activation of heat and smoke vents at the wrong time in a fire situation, could impact the sprinkler system due to some or all of the following factors:

- Heat is exhausted from the building:
  - This prevents a heat layer being created, and has the potential to delay and sometimes prevent actuation of the installed sprinkler protection
  - It can lead to sprinkler heads activating on the heat path from the seat of the fire to the open heat and smoke vent(s). As a result, sprinkler heads can activate in areas away from the seat of the fire. This can compromise the sprinkler protection and/or associated water supply, can cause increased water damage in areas not affected by the fire, and can create a situation where the protection does not supress the fire at its seat, and which continues to grow
- As heat is removed in one area, cold/fresh air is entrained into the building causing the fire to grow more rapidly and creating an environment where the sprinklers are unable to operate effectively and control the fire. The vents actually feed the fire with oxygen

Only if automatically actuated vents are required by Building Control or for Regulatory requirements then:

- Vents should only actuate individually
- Each normally closed heat and smoke vent should be actuated by its own fusible element/frangible bulb device, which should be rated at Standard response >181°C

To ensure all aspects of the heat and smoke venting proposition are joined up, it may also be appropriate to appoint a qualified fire specialist to investigate: means of escape options (life safety); use of draft curtains; zoning of vents; or other engineered measures, to ensure the operation of the heat and smoke venting does not compromise the installed sprinkler system. Liaison with the fire or planning authority and insurers is also recommended.

Consideration should also be given to the provision of compartmented zones at the ceiling/roof level created by at least 1m deep non-combustible draft curtains. These can help segregate 'smoke/heat' and 'sprinkler' zones.

Vent Design

The design of heat and smoke vent extraction systems should be such that heat and smoke can discharge to the atmosphere in sufficient quantities, and not accumulate in the building or building compartment. Well-designed systems will have the combined effect of reducing the build-up of heat that could cause structural steelwork to fail, as well as reducing the contamination and damage caused by smoke logging. They should also be arranged so that

the extraction points from the building are detached from building air intake, with consideration given to prevailing wind direction and the installation of interlocks to shut down air intakes for the affected or nearby buildings.

Specialist help and assistance should be sought in planning and designing the installation of heat and smoke vents. Designers will consider various factors including the shape and design of the building, compartment sizes, internal/external air movements, building trade and occupancy, etc.

For example, in a storeyed office or residential property, heat and smoke vents may be installed in the walls or ceilings/roofs of fire escape stairwells, whereas in a warehouse building the vents may be positioned in the roof, with the aim of preventing early structural steel failure and reducing smoke contamination. There may be additional vents at low level to allow the passage of fresh air into the building, enabling heat and smoke to be entrained into the heat and smoke vents – this will essentially create a 'chimney effect' within the property.

Whilst design and installation in a new building may follow Building Control or statutory provisions, a building occupier should also consider how the provision or absence of heat and smoke vents will affect their own circumstances and business risk. Any changes in the building or occupancy must also be considered. The building occupier's own assessment should consider factors beyond the statutory requirements, and should include the building, infrastructure, contents and stock damage as well as the disruption that would occur to the business, e.g.:

- Smoke contamination of contents and stock may result in a total loss requiring complete replacement
- Smoke damage to machinery and equipment may result in a long cessation of business operation
- Location of exhaust points, air intakes and prevailing wind directions

Benefits of Installing a Heat and Smoke Venting System

Properly designed, appropriately sized and located heat and smoke vents consistent with the installed protections, the sensitivity of the occupancy and the nature of the building structure, will:

- Allow heat to escape from the structure preventing early and premature building collapse, etc.
- Reduce smoke contamination
- Improve fire service and emergency response intervention within the property
- Help with the safe evacuation of a building

Checklist

A generic Heat and Smoke Venting Systems Checklist is presented in Appendix 1 which can be tailored to your own organisation.

Additional Information

- Aviva Loss Prevention Standard: Smoke Contamination
- RISCAuthority Smoke Venting Position Statement 2015
- NFPA 204: Standard for Smoke and Heat Venting 2015
- The LPC Design Guide for the Fire Protection of Buildings 2000
- FM Global Property Loss Prevention Data Sheets - 1-10: Interaction of Sprinklers, Smoke and Heat Vents and Draft Curtains
- The International Building Code - Section 910: Smoke and Heat Removal (US code used for vent ratio)

Further risk management information can be obtained from Aviva Risk Management Solutions

Appendix 1 – Heat and Smoke Venting Systems Checklist

Location	
Date	
Completed by (name and signature)	

	Heat and Smoke Venting Systems Checklist	Y/N	Comments
1.	Has a quantified risk assessment highlighting the effects heat and smoke could have on your premises, contents, stock, occupants and business operations been completed?		
2.	Has a quantified assessment been made on how long it would take to decontaminate the ventilation systems/site following a fire?		
3.	Is there knowledge or a formal relationship in place with a third-party decontamination specialist to assist in post-event recovery?		
4.	If you do not have heat and smoke vents and/or means of extracting the effects of heat and smoke, would the fitting of such devices provide benefits to your business?		
5.	Are there accurate drawings and detailed specifications showing the location and layouts of the heat and smoke venting system?		
6.	Are all aspects of the heat and smoke venting systems, including any wiring, supports, ducting, etc., constructed to withstand the: • Maximum expected temperatures? • Direct exposure to flame?		
7.	Are the actuation mechanisms of all heat and smoke venting systems formally documented and understood?		
	Heat and Smoke Vents – Where Already Provided Contd.	Y/N	Comments

8.	Is the heat and smoke venting system dedicated or is it part of a combined air conditioning/ventilation system?		
9.	Are the exit points from the vents located in positions to ensure that vented smoke is not entrained into the building or nearby buildings?		
10.	Do the vents actuate individually or are there multiple devices within zones or groups? Is this appropriate for the risk and the protection measures in place?		
11.	Have compartmented zones been created at ceiling/roof level to segregate the heat and smoke venting? Is this with at least 1m deep non-combustible draft curtains?		
12.	Are any interlocks between the heat and smoke vents and other systems formally documented and understood?		
13.	Is heat and smoke venting provided in a building protected **with automatic sprinklers**? If 'yes' is the heat and smoke venting in the building only manually actuated? If 'yes' and if Regulatory requirements formally state heat and smoke venting in a sprinkler protected building should be automatic; for property protection purposes, it should be designed to: • Operate vents singularly • Be actuated by a fusible link/frangible bulb rated at Standard response >181°C		
	Heat and Smoke Venting Systems Checklist	Y/N	Comments
14.	Is heat and smoke venting manually actuated?		

	If 'yes' are these actuation devices: • In readily accessible and safe location(s)? • Clearly and logically labelled to avoid confusion? • Next to a schematic drawing to support expected response?		
15.	For vents that rely on motorised controls or mechanical extraction, are there means to allow for actuation and operation in the event of loss of power?		
16.	Are the public fire service and any on-site trained emergency response teams aware of the heat and smoke venting arrangements, including? • When to utilise it? • How to actuate it? • How to isolate it?		
17.	Is there a formal regular inspection and maintenance programme that covers? • Damage? • Deterioration? • Debris accumulation or obstruction? • Water, snow or ice? Is formal and tracked action taken to address any deficiencies?		
18.	Is there a formal annual physical release and test of all vents, to ensure correct operation? (Excludes Drop Out/Melt Out vents) Does this include the cause and effect/interlocks associated with the heat and smoke venting?		
19.	Additional comments:		

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