Automatic Sprinklers

Understanding the Risk

Automatic sprinkler systems have been used to protect lives and property since the late 1800's and have an unrivalled ability to automatically detect and control outbreaks of fire, thus enabling effective and successful fire brigade intervention.

The main reasons for installing automatic sprinkler systems can be summarised as follows:-

- Risk management strategy for property protection, business continuity protection and/or life safety protection.
- Statutory or planning requirement e.g. Approved Document B.
- Insurance – in response to an insurer's requirement.

How Sprinkler Systems Work

All areas of the building(s) protected by the sprinkler system are covered by a grid of pipes mainly at roof / ceiling level supplied with water from an adequate water supply – see Sprinkler System Components.

Fitted into theses pipes at pre-determined intervals are sealed sprinkler heads, each of which is designed to operate independently, when it reaches a specific temperature, typically 68^{0}C.

In the event of a fire the hot gases produced rise causing the sprinkler head(s) directly above to reach its operating temperature causing it to open, allowing water to be sprayed onto the fire below.

It is a common misconception that in the event of a fire all the sprinkler heads on a sprinkler system activate – this is not the case, as the cooling effect of the water from the activated sprinkler head(s) above the fire prevents the remaining sprinkler heads on the system from reaching their operating temperature.

According to bafsa (British Automatic Fire Sprinkler Association Limited) European statistics over a 10 year period, in fully sprinklered buildings:

- 99% of fires were controlled by sprinklers alone
- 60% of fires were controlled by fewer than 4 sprinkler heads
- Fire brigades often use 10,000 times more water from hoses to do same job as sprinkler systems

Sprinkler Head

Also in connection with another misconception regarding the frequency of accidental discharges of water from automatic sprinkler systems these statistics indicate that these account for only 1 in every 500,000 sprinkler heads per year of service.

Types of Sprinkler System

There are 3 main types of sprinkler system in common use:-

- Wet Pipe
- Alternate
- Dry Pipe

Wet pipe systems are the most common and are used in buildings, where there is no risk of freezing at any time.

These systems are preferred because they are the quickest to operate in the event of a fire, the pipes being permanently charged with water.

Alternate systems are used where there is inadequate heating and therefore a risk of the water in the sprinkler pipes freezing e.g. during the winter months.

In these systems the sprinkler pipes are only charged with water during the summer - typically from the beginning of April to the end of October.

During the winter months when there is a risk of freezing the pipes are drained of water and charged with air under pressure.

In the event of a fire during the winter months alternate systems are slower to operate than wet systems, as the air in the pipes has to be expelled from the sprinkler pipes before water can be discharged.

These systems are not suitable for all applications and specifically they are not allowed in warehouses where there is a requirement for sprinklers to be installed within storage racking.

In premises protected by wet sprinkler systems, but which have a small unheated area(s) vulnerable to freezing e.g. an external loading canopy the sprinkler heads concerned can be supplied by a tail end air valve.

Tail end air valves allow the water in the section of pipe(s) supplying the affected sprinkler heads to be drained off during the winter months and the pipe(s) charged with air under pressure.

As tail end air valves are not always desirable their use can often be eliminated by lagging and electrically trace heating the pipe(s) concerned, to prevent them freezing.

Dry pipe systems are used where there is a permanent risk of freezing e.g. cold stores and are charged with air under pressure at all times.

These systems suffer from the same drawbacks as alternate systems when on air and again are not suitable for all applications.

In addition to the 3 main types of sprinkler system there are other types of sprinkler system that should be mentioned:-

- Pre-action systems
- ESFR systems
- Deluge systems
- Foam enhanced systems

Pre-action systems are used in situations, where it is essential that the risk of water damage due to sprinkler leakage etc is kept to the absolute minimum e.g. data centres.

Like dry pipe systems the pipes in pre-action systems, are permanently filled with air under pressure with water only allowed into the pipes on the operation of an electrically operated valve, activated by an automatic fire detection device. Once the water has entered the sprinkler pipework the system operates as normal in the event of the activation of a sprinkler head.

ESFR (Early Suppression Fast Response) systems are only used in high piled storage situations, where in rack sprinkler protection is not desired by the warehouse operator, and are only acceptable subject to full compliance with specific sprinkler design parameters and to stringent management control requirements.

Deluge systems are a variation of pre-action systems, using open sprinklers and are installed in special situations where normal sprinkler protection may not be adequate to prevent fire spread e.g. chemical risks, electricity transformers etc.

In these systems operation of the automatic fire detection device releases a deluge valve, which allows water into the sprinkler pipework from where it immediately discharges from all the open sprinklers in the area concerned.

Foam enhancement is used in sprinkler systems, where water alone may not achieve fire control e.g. risks involving flammable liquids or plastic tote storage.

On the activation of the sprinkler system foam stored in an adjacent storage vessel is introduced into the sprinkler pipework via a proportioning device, designed to produce the required concentration of foam - typically a 3% concentration of AFFF (aqueous film forming foam).

Sprinkler System Components

The main components of sprinkler systems comprise:-

- Sprinkler Heads
- Sprinkler Pipes
- Sprinkler Installation Control Valves
- Sprinkler Water Supplies
- Sprinkler Alarms

Sprinkler heads comprise a heat sensitive element normally a glass bulb, seal and a deflector all held within an outer body.

In the event of a fire the heat sensitive element fuses, when it reaches its pre-determined temperature, releasing the seal from the sprinkler pipe and allowing water to be distributed via the deflector in a controlled pattern, both onto the seat of the fire below and usually up to the roof / ceiling above.

The most common sprinkler head operating temperature is 68^0C, but other temperature ratings are available for specific applications e.g. 57^0C, 79^0C, 93^0C, 141^0C, 182^0C, 260^0C.

The sprinkler temperature rating chosen should be close to, but no lower than 30^0C above the highest anticipated ambient temperature.

In certain situations where prompt sprinkler activation is required e.g. in connection with life safety or in rack sprinkler protection it may be necessary to use quick or fast response sprinkler heads.

Quick or fast response sprinkler heads have the same operating temperature as conventional sprinkler heads but have a much quicker response time.

Sprinkler pipes normally of mild steel construction carry the water from the water supply via an installation control valve(s) to the operating sprinkler heads and typically range in size from 200mm at the main sprinkler riser down to the minimum size allowable of 25mm, at the terminal sprinkler range pipe.

Sprinkler installation control valves comprise an isolating valve to control the water supply and an alarm device normally a water motor alarm, to indicate that a sprinkler head has activated.

Typical sprinkler installation control valve

Sprinkler water supply is probably the sprinkler system's most important element for without a reliable supply of water capable of providing the required flow and pressure the system will not achieve fire control.

A number of possible water supply types can be used in connection with sprinkler systems, but the 2 most common are:-

- 1 or more public water supplies i.e. towns mains – it should be noted that towns mains are unlikely to be adequate for high hazard storage risks
- A private pumped water supply comprising one or more fire pumps drawing water from one or more storage tanks

It should be noted that under the current LPC Sprinkler Rules a single water supply is not acceptable, in connection with sprinkler systems designed for the protection of high hazard risks.

Other water supplies that may be considered, depending on the nature of the risk being protected and subject to specific requirements include gravity water storage tanks, pressure tanks and natural water sources such as rivers, lakes, canals etc.

In addition to flow and pressure, the other key element of water supplies is the duration of the supply, which is determined by the sprinkler design criteria as detailed below i.e.

- Light Hazard risks require a minimum of 30 minutes water supply
- Ordinary Hazard risks require a minimum of 60 minutes water supply
- High Hazard risks require a minimum of 90 minutes water supply

Sprinkler alarms are used to raise the alarm in the event of a sprinkler activation and typically this is done via an external water motor operated bell or gong.

Where possible this audible warning should be supplemented by an electrically operated alarm, initiated either by the activation of a pressure switch or flow switch, designed to raise the alarm at a permanently manned location e.g. on site at a continuously occupied security gatehouse or off site, at an approved alarm receiving centre.

Sprinkler Design Criteria

To ensure they are designed correctly and will operate effectively in the event of a fire, all sprinkler systems should be designed in accordance with a recognised standard.

The LPC (Loss Prevention Council) Rules for Automatic Sprinkler Installations is the primary design code specified by UK insurers. The current edition comprises of BSEN12845 supplemented by technical bulletins that define additional criteria considered necessary to ensure an appropriate standard of fire protection for assets. These also incorporate regular updates that maintain pace with technological developments and the ever changing risks of the modern world.

In certain circumstances installations in accordance with other recognised design codes can be acceptable e.g. NFPA13 / NFPA20.

Within the LPC Sprinkler Rules system design is defined as either Light, Ordinary or High Hazard.

Light hazard systems are typically installed in premises with low fire loads and of low combustibility e.g. hospitals, schools, etc.

Ordinary hazard systems are installed in premises where medium fire loads are present or manufactured e.g. engineering risks, food & beverage, retail, etc.

Within the ordinary hazard classification there are 4 sub groups OH1 to OH4 with increasing designed areas of operation - in the majority of cases OH3 design is the default standard used.

High hazard systems protect either Process or Storage risks with high fire loads. Both categories are divided into sub groups 1 to 4 with increasing requirements in respect of design density of discharge and area of operation.

High hazard process risks range from paint manufacturers classed as HHP group1 to firework manufacturers classed as HHP group 4.

With high hazard storage risks (HHS) the sub classification is the categorisation of the stored commodity (I, II, III or IV) that is defined by the combustibility of the commodity and associated packaging. Storage height limitations are defined by the commodity category, the storage configuration and the minimum design density of discharge of the sprinkler system.

As the fire risk increases the amount of water required to control the fire i.e. the water discharge density and the area over which the water is required to be discharged both increase – this impacting on the size of the water supply required to provide adequate protection.

For specific storage configurations / heights it is necessary to provide in-rack sprinklers as the primary means of fire control supplemented by roof level sprinklers to protect the structure.

Key Factors for Reliable & Effective Fire Protection

In order to ensure that automatic sprinkler systems operate effectively in the event of a fire the undernoted key factors need be adhered to:-

- Other than exceptions permitted by the LPC (Loss Prevention Council) Sprinkler Rules, all areas of the building(s), including those communicating with them, should be covered by the automatic sprinkler system.
- New sprinkler systems should be designed and installed in conformity with the current edition of the LPC Rules for Automatic Sprinkler Installations incorporating BS EN12845 and the latest editions of all the LPC Technical Bulletins, in force at the time.
- It is recommended that all systems are designed, installed, commissioned and maintained by contractors whose competence is third party certified to the appropriate approval level of the LPS1048-1 Approved Sprinkler Contractors Scheme.
- Only equipment listed in the current edition of the LPCB (Loss Prevention Certification Board) List of Approved Fire & Security Products & Services Red Book should be used in connection with the installation of automatic sprinkler systems.
- On completion of a new automatic sprinkler system the Sprinkler Contractor should be required to issue an LPS 1048 Certificate of Conformity.
- Automatic sprinkler systems protecting high hazard storage risks must be fully hydraulically calculated, as per LPC Technical Bulletin TB231.
- Automatic sprinkler systems should be the subject of regular inspection and maintenance by a LPS 1048 Approved Sprinkler Contractor in accordance with Technical Bulletin 203.
- Automatic sprinkler systems should be tested on a weekly basis in accordance with Technical Bulletin 203 with the results recorded in the AIG Sprinkler Test Card(s).
- An adequate number of staff should be trained to understand how the automatic sprinkler system works including the required weekly sprinkler testing and the actions required to be taken in the event of a sprinkler activation – this should include adequate cover to provide for holidays, illness etc.
- The activation of automatic sprinkler systems should be continuously monitored, preferably at an approved alarm receiving centre via BT RedCARE or similar alarm communication system.
- Where part or all of an automatic sprinkler system is to be isolated, AIG should be informed in advance via the AIG Sprinkler Impairment Notification Form.

References

LPC (Loss Prevention Council) Rules for Automatic Sprinkler Installations, incorporating BS EN12845.

LPCB (Loss Prevention Certification Board) List of Approved Fire & Security Products & Services Red Book

NFPA 13 Standard for the Installation of Sprinkler Systems

NFPA 20 Standard for the Installation of Stationary Pumps for Fire Protection

For further information please contact your local AIG Risk Engineer.

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