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 summarized as follows:

- Risk management strategy for property protection, business continuity protection and/or life safety protection.
- Statutory or planning requirement e.g. building codes.
- 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 these 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°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 minimizes the opening of remaining sprinkler heads on the system by precluding them from reaching their operating temperature.

According to BAFSA (British Automatic Fire Sprinkler Association Limited) European statistics over a 10 year period in fully sprinkler protected 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
- 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.

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 centers.

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, flammable liquids, 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°C, but other temperature ratings are available for specific applications e.g. 57°C, 68°C 79°C, 93°C, 141°C, 182°C, 260°C.

The sprinkler temperature rating chosen should be close to, but no lower than 30°C 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.
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. town’s mains – it should be noted that town’s 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 storage 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:

- 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 recognized standard.

Sprinkler design in the UK is mainly based around the LPC (Loss Prevention Council) Sprinkler Rules – currently these rules are embodied in BS EN12845:2003, although many existing systems were designed to previous standards most notably BS5306:Part 2:1990.

In certain circumstances installations in accordance with other recognized rules can be acceptable e.g. NFPA 13 / NFPA 20.

Within the LPC Sprinkler Rules system design can comprise light, ordinary, or high hazard.

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

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

Within the ordinary hazard classification there are 4 sub groups OH1 to OH4 with increasing sprinkler water density requirements - in the majority of cases OH3 design is the default standard used.

High hazard systems can be found in 2 situations protecting Process & Storage risks respectively with both categories being divided into 4 sub groups 1 to 4 again with increasing sprinkler water density requirements.

High hazard process risks range from paint manufacturers classed as HHP1 to firework manufacturers classed as HHP4.

High hazard storage risks are classified according to the type and height of storage and the combustibility of the commodity stored, which is designated as HHS1 to HHS4.

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 then impacts on the size of the water supply required to provide adequate protection.

Key Sprinkler Factors

In order to ensure that automatic sprinkler systems operate effectively in the event of a fire the undernoted key factors should be adhered to:- Other than exceptions permitted by the LPC (Loss Prevention Council) Sprinkler Rules, all areas of the building(s) to
be protected, 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 latest edition of the LPC (Loss Prevention Council) Rules for Automatic Sprinkler Installations - currently those incorporating BS EN12845:2003, including both the latest revisions thereto and all the associated LPC Technical Bulletins, in force at the time.

Only LPS 1048-1 Approved Sprinkler Contractors with the appropriate Approval Level should be used for the installation of new automatic sprinkler systems.

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 a LPS 1048 Certificate of Conformity.

Automatic sprinkler systems protecting high hazard storage risks must be fully hydraulically calculated, as per LPC Technical Bulletin TB231:2007:1.

Automatic sprinkler systems should be the subject of regular inspection and maintenance by a LPS 1048 Approved Sprinkler Contractor in accordance with Technical Bulletin 203:2004:1.

Automatic sprinkler systems should be tested on a weekly basis in accordance with Technical Bulletin 2003:2004:1 with the results recorded in the AIG Commercial Property 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.