



Sprinklers are widely acknowledged as the best first line of attack in a fire situation. The reason sprinklers are so effective is because they attack the seat of the fire, before it has time to spread. The latest version of Approved Document B in support of the Building Regulations incorporates clear recognition of the value of sprinklers in improving levels of safety for occupants as well as preventing the spread of fire. Statistics collated by the National Fire Protection Association¹ reveal that in fully sprinklered premises 97% of fires are controlled by the sprinkler system.

Each sprinkler head is held closed by a heat responsive element and operates only when it reaches its predetermined operating temperature. Because sprinklers operate independently from one another, only those closest to the fire will open, ensuring that the available water pressure is optimized over the fire. The other sprinklers in areas where there is no fire remain closed and do not release water.

Even though a sprinkler head only operates once, it **must** operate every time, and may be called upon to operate after many, many years in the field. The design of the head and the choice of materials used take these important and unique requirements into consideration.

Sprinkler System Design

The available flow, pressure, and duration of the water supply are taken into account when determining the size of the piping network in a sprinkler system. The type and size of the occupancy being protected, as well as the nature of the contents of the building are also an important part of the design of a sprinkler system. The sprinkler heads that make up a properly designed, installed and maintained sprinkler system therefore ensure a sufficient flow of water is available so that the fire can either be extinguished or controlled until fire and rescue service arrive.

Sprinkler Discharge Pattern

Standard sprinkler heads are manufactured with three connection sizes 10mm, 15mm and 20mm. These discharge water on to the fire at 57, 80 and 115 litres/minute respectively at a pressure of 1 bar. Compare this figure with discharge rates from a fire hose which can exceed 1000 litres/minute at pressures of up to 7 bars.

Heat Responsive Element

In normal conditions, the heat responsive element acts to hold the waterway of a sprinkler head closed by applying pressure to a special sealing mechanism. When the temperature around the head rises as a result of fire and it reaches the design operating temperature of the sprinkler, the heat responsive element breaks apart, allowing water pressure within the sprinkler piping to overcome the sealing mechanism and spray water on the fire.

The heat responsive element is normally a liquid filled glass bulb. Sprinkler heads are also manufactured with metal fusible links in place of glass bulbs. This type of sprinkler head is predominantly used for example in food production establishments so that in the event of an activation the component parts can be located and removed.

A range of head operating temperature ratings is shown in the table below:

Sprinkler Rating		Temperature which shall not be exceeded where sprinkler is located		Colour of filling of the glass bulb
°C	°F	°C	°F	
57	135	27	81	ORANGE
68	155	38	100	RED
79	175	49	120	YELLOW
93	200	63	145	GREEN
141	286	111	232	BLUE
182	360	152	306	MAUVE

Sprinkler Discharge

Sprinkler heads are spaced on or close to the ceiling level where the heat collects as it rises during a fire. Their spacing, position, and location is dictated by the manner in which water is distributed as it exits an open head. The water discharged from the sprinkler is

¹ Hall JR, US Experience with Sprinklers and other Fire Fighting Equipment: NFPA 2010

distributed by a deflector over the location of the fire. In addition to extinguishing or controlling the fire, the water helps to cool the hot gases which are produced and pre-wets areas immediately adjacent to the fire to inhibit fire growth. The area protected by each sprinkler is determined by the type of hazard and can vary from 9m² to 21m². The selection of the deflector is based upon the specific application, its upright or pendent position within the sprinkler distribution pipework, and its spray pattern.

Different types of sprinkler heads

Conventional Sprinklers

These can be mounted in either the upright or the pendent position, and the deflector is designed to spray a proportion of the water discharge on to the surface of the ceilings.



Conventional Sprinkler Head - Brass finish

Upright and Pendent Spray Sprinklers

Spray sprinklers are used for applications where all the water needs to be discharged downwards.

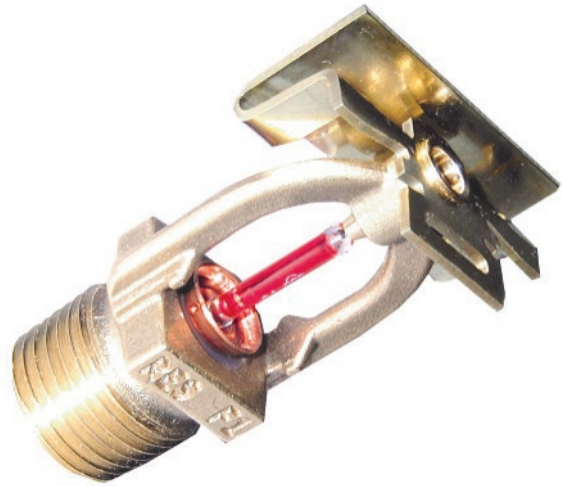


Pendent Spray Sprinkler Head - Chrome finish

Sidewall Sprinklers

These are primarily used to keep ceilings clear of pipework for aesthetic reasons or to avoid having to disturb existing ceilings when installing pipework.

Each sprinkler protects up to 17m² in Light Hazard occupancies and 9m² in Ordinary Hazard occupancies.



Sidewall Sprinkler Head - Chrome finish

Horizontal Sidewall Sprinklers With Extended Coverage

These 'quick response' sprinklers are commonly used for the protection of hotel bedrooms to overcome the need for sprinklers and exposed pipework in the centre of the room. They are specifically designed to give an extended coverage of water of up to 21m² and are designed to inhibit fire growth by extensive wall wetting.



Horizontal Sidewall Sprinkler Head - White finish

Quick Response Sprinklers for Life Safety

In a fire, few deaths result from direct contact with flames. The greatest threat comes from inhalation of the products of combustion such as carbon dioxide, carbon monoxide and other toxic gases.

The response time of a quick response sprinkler can ensure that the life threatening level of toxic gases and temperature are never reached making it possible for people to survive in the room of fire origin. Where there are people who cannot escape by their own efforts, such as in hospitals or residential care homes, sprinklers provide valuable time for those in charge to aid their escape.

ESFR Sprinklers

Early suppression fast response (ESFR) sprinkler systems are designed to protect warehouse storage risks from fire, particularly in cases where roof only sprinklers are preferred to the more usual in-rack sprinkler protection.



ESFR Sprinkler Head - Brass finish

Research in to the capabilities of ESFR roof-level-only sprinkler systems found that where high sprinkler terminal pressure was used to induce high velocity discharge together with increased water volumes, fires were not only controlled but often extinguished.

The ESFR sprinkler head design therefore provides a large volume of water delivered at high velocity, complemented by a quick response detection element. A range of heads has been developed to cater for various storage and building configurations in storage buildings with relatively flat, smooth ceilings and no obstructions.

Concealed Sprinklers



Concealed Sprinkler Head - White cover plate

These are sprinklers which are located flush with the ceiling; all that is visible is a small diameter metal disc concealing the sprinkler head behind. This disc is soldered to a support bracket which when heated

under a fire condition melts allowing the disc to fall away exposing the actual sprinkler head which will activate following an increase in the local temperature to its operation point.

These sprinklers meet architects requirements for a neat unobtrusive and aesthetically pleasing design for use in false ceilings situated in retail stores, high rise buildings, offices, schools and public buildings. These are also ideal for use where there is restricted headroom or public areas which may be prone to acts of vandalism eg. schools.

Residential

Residential sprinkler heads are especially designed for use in residential and domestic situations. To minimise interference with decor and aesthetics these sprinkler heads can provide coverage to a larger area and the deflector is designed to distribute the water in a pattern that will ensure wetting of the walls. This



Residential Sidewall Sprinkler Head - White finish

requirement stems from the need to wet curtains and other fabrics or combustible material that is likely to be found in a residential location.

Response Time Index (RTI)

The speed of response depends upon a number of factors including the sensitivity of the sprinklers thermal element (bulb or link), plus the velocity and direction of flow of the hot gases. The speed of response is quantified by the term Response Time Index (RTI).

$$RTI = \sqrt{V} \times \frac{MC}{HA}$$

Where V = air velocity used in the test

M = mass of the heat responsive element

C = specific heat of the heat responsive element

H = convective heat transfer co-efficient

A = surface area of heat responsive element

Very old sprinkler heads could have a RTI between 160 and 380 but modern sprinkler heads would not have a RTI in excess of 160 and quick response heads have a RTI of 50 or less.

Conclusions - Finally a few facts:

1. There have been no multiple fatality fires in the UK in buildings with a working sprinkler system.
2. US experience shows that 94% of all fires in sprinklered buildings are extinguished with four sprinkler heads operating or less¹.
3. Only the sprinkler heads in the immediate vicinity of the fire actually operate.
4. Sprinkler heads can be completely concealed.
5. Sprinkler systems do not need pumps or tanks if mains pressure is adequate
6. Sprinklered buildings prevent fire fighter deaths.
7. Sprinklers do not 'false alarm' they will only operate if there is an actual fire.
8. For a small additional cost an alarm switch can be built-in to the system to call the fire brigade automatically should the sprinklers operate.
9. Maintenance costs for sprinklers are very low.
10. Sprinklers save lives - and property - and are the only devices which can detect a fire, sound the alarm, call the fire brigade and extinguish or control the fire.
11. Finally, despite preconceptions, sprinklers are not difficult, unsightly or expensive to install in homes. There will be very few new or refurbished care homes which cannot be fully protected for less than the cost of a medium quality carpet.

¹ Hall JR, US Experience with Sprinklers and other Fire Fighting Equipment: NFPA 2010

Material/Finish

Fire sprinklers are installed in a wide range of locations and applications. The materials and finishes of heads take into account the requirements of their surroundings. External finishes can be specified to meet aesthetic requirements. In other applications, where corrosion in the atmosphere may be a concern, heads can be either made of specialty metals such as stainless steel, or covered with corrosion resistant coatings or wax, or a combination of these.



Residential Sprinkler Head - Wood effect finish

On the inside of the heads, the waterway and sprinkler body and valve seal must be able to resist the corrosive properties that may exist in the air or water within the sprinkler piping, even after many years in the field. For this reason, the sprinkler frame must be made of materials that resist these types of corrosion. The higher percentage of copper in the alloys typically used to manufacture fire sprinklers helps to protect against damage due to corrosion. In extreme cases, sprinklers are manufactured out of specialty metals such as stainless steel, or even titanium.

Product Approval

Sprinkler heads used must have approvals suitable for the system design standard i.e. LPCB, UL/FM or Vds.

Presented by: