Fire Protection Association

RISCAuthority

# ACTIVE FIRE PROTECTION GUIDE
# SPRINKLER SYSTEMS FOR PROPERTY PROTECTION

This document has been produced by the RISCAuthority Active Suppression & Detection working group to provide information and outline guidance on the application of fire Sprinkler Systems for Property Protection (PP).


## Summary

Refer to AFPG-01 Overarching Active Fire Protection Guide – All Technologies.

The term 'Sprinkler system' (PP) not only describes the technology, but 'implies' a whole assurance and management scheme that ensures its ability to perform as intended when needed.

Sprinkler systems for property protection:

- are a 'building' fire protection system
- are designed to 'suppress fires' so follow-on actions by fire service are required
- are designed specifically for the hazard of the fuel and its arrangement within the protected space
- assume a single seat of fire
- certificated components are interchangeable
- have the best performance and reliability credentials of any active fire protection system through up-to-date rulesets, certification of product and installers, and strict maintenance regimes
- performance can be severely impaired by poor head location, and inadequate maintenance.


## *Property protection (commercial and industrial) vs. life safety (domestic and residential) sprinkler systems

The performance of property, and life safety, sprinkler installations are very different and to avoid confusion should be thought of as entirely separate systems. Property protection systems strive for much higher levels of resilience (ability to function), through rigor in the supporting standards, design, product specification, and maintenance, that are not matched by life safety (domestic and residential) systems which generally seek to only assist occupant escape. For more information on the differences between life safety and property protection requirements, see AFPG-01.

## Types of sprinkler system

The key types of sprinkler systems are:

**Wet pipe:** uses closed sprinkler heads and the pipe network to them is charged with water. These types of systems are typically used for indoor applications, where temperatures are maintained above 4°C, or when exposed to lower temperatures they are suitably protected against frost.

**Dry pipe:** uses closed sprinkler heads and the pipe network to them is charged with air. This type of system is used where water freezing may be an issue. These systems will be somewhat slower to function owing to their release of charged-air prior to water dispersal.

**Alternate:** a sprinkler system can be seasonally reconfigured to operate as a dry, or wet pipe system. These are now being phased out.

**Deluge:** uses open sprinkler heads and delivers water to all simultaneously upon activation (not considered in the LPC Sprinkler Rules).

**Pre-action:** a combination of wet and dry pipe systems with closed heads used in areas at high risk of water damage. Water is not present in the pipes initially, until a fire is electronically detected (type A), after which they are charged with water ready for head activation (requires both fire detection and head activation to deliver water). Type B pre-action is a dry pipe system that operates on either fire detection or by the operation of a sprinkler head to discharge water.

**Ceiling and in-rack:** usually ceiling mounted to activate where fire gases collect, but also mounted within rack-storage systems to cater to high levels of stored goods and very limited water access.

Sprinklers may be installed:

- as a requirement of insurance provision
- for business and property protection
- to compensate for deviations to the Building Regulations (such as compartmentation)
- as a requirement of Building Regulations or other industrial protection codes.

## Components of a fire sprinkler system

The components of a fire sprinkler system act to deliver water reliably to the seat of a fire and include:

**Water tank(s):** sized for the required duration of protection and may be augmented by mains in-fill.

**Fire pump set:** which may include both electric and diesel options sized to deliver water to sprinklers in the AMAO (see 'How it works' section) at the required flow and pressure.

**Jockey pump (wet systems):** a small maintenance pump that preserves pressure in the pipe network so that when a head activates there will be a pressure drop, which will be sensed by the fire pump's automatic controller, causing the fire pump to start.

**Air compressor (dry systems):** a small compressor that charges the pipe network and holds the alarm valve closed until a sprinkler head operates.

**Alarm check valve:** a pressurised mechanical non-return valve that directs water to the alarm gong when opened; prevents backflow when closed; and allows testing of the water supplies.

**Pipe network:** distributes water to the sprinkler heads hydraulically sized to deliver the correct quantity of water for the hazard.

**Sprinkler heads:** which, depending upon the system type, will be closed by a heat sensitive glass fluid filled bulb, fusible link, or open (deluge system). The water output quantities and spray pattern of heads are matched to the hazard. Different temperature ratings are available to suit the environment's ambient temperature.

**Ancillary equipment:** including pressure and flow switches, gauges, devices to speed up water delivery, and firefighting foam proportioning.

## How it works

A sprinkler system provides a means for targeted application of water from the ceiling, or within a storage rack, to the seat of the fire. As each sprinkler head is a detection and activation device in its own right (wet and dry systems), the area of water delivery increases in line with the fire until suppression or extinguishment is achieved. The maximum design area that determines the number of heads that might need to simultaneously operate is based upon the hazard posed by the fuel, and its arrangement within the space, and is known as the Assumed Maximum Area of Operation (AMAO). The typical operation scenario for a wet system is:

- hot gases from the fire collect at the ceiling
- the nearest sprinkler head bulb expands with heat and breaks to release the plug and discharges water at pressure
- the system pressure drops and the jockey pump is unable to keep up
- the low pressure switch operates main pump(s)
- the alarm valve lifts to supply water to the pipe network, sound the alarm gong, and raise the electronic alarm
- further heads operate (as required) to suppress fire
- Fire Service attends to secure fire and isolate the sprinkler system.

A key design parameter for any sprinkler system is the minimum amount of water that must be delivered within the AMAO defined in terms of litres per minute per metre squared (mm/m/m2). By way of example, heavy rainfall is around 0.15mm/m/m2. Sprinkler systems typically operate between 5 and 30mm/m/m2 depending upon the hazard.

Sprinkler systems control fire by:

- cooling the fuel involved in the fire
- removing unburned fuel by wetting (making the flammable, non-flammable)
- inhibiting fire spread by thermal radiation across gaps to adjacent fuel stacks (in-rack)
- destroying the 'chimney-effect' between stacks by downward thrust and air cooling (in-rack).

Sprinkler systems are suitable for the protection of Class A solid fuels, and Class B flammable liquids if augmented with an appropriate foam additive.

Sprinkler systems are not suitable for protecting risks that are intolerant of water, or where extinguishment is paramount (such as unattended processes).

## Challenges and considerations

**Risk change:** Sprinkler systems are designed specifically to the risks considered at the time of installation. It is essential that a periodic review is made of the hazard and its presented configuration to ensure that it remains in scope of the original intent.

**Arson and multiple seats of fire:** Sprinkler systems are designed to protect buildings from a single seat of fire. Multiple seats of fire, resulting typically from arson, have the potential to exceed the AMAO of the system and exhaust water supplies prematurely.

**Head location below ceiling:** Optimised thermal communication between the head and fire gases occurs within 150mm of the ceiling. It is sometimes the case that sprinkler heads are located lower than this to simplify pipework installation under roof structure and ducts but, even small increases can drastically impact the speed of operation and should be avoided at all costs.

**Fluorine free foams:** Augmentation of the system with firefighting foam for managing flammable liquid and plastic fires is common practice. However, with the removal of AFFF foam on environmental grounds, there is a need to replace them with fluorine free alternatives. These foams are unlikely at the current time to be 'drop-in' replacements. See AFPG-12 Migration of foam-enhanced fixed sprinkler and drencher systems to use fluorine-free alternatives for further guidance.

**Combustible building methods:** Some newer forms of construction, such as mass timber, even for residential use, may require sprinklers for property protection. Current rule sets may not yet permit design for these environments and need further development.

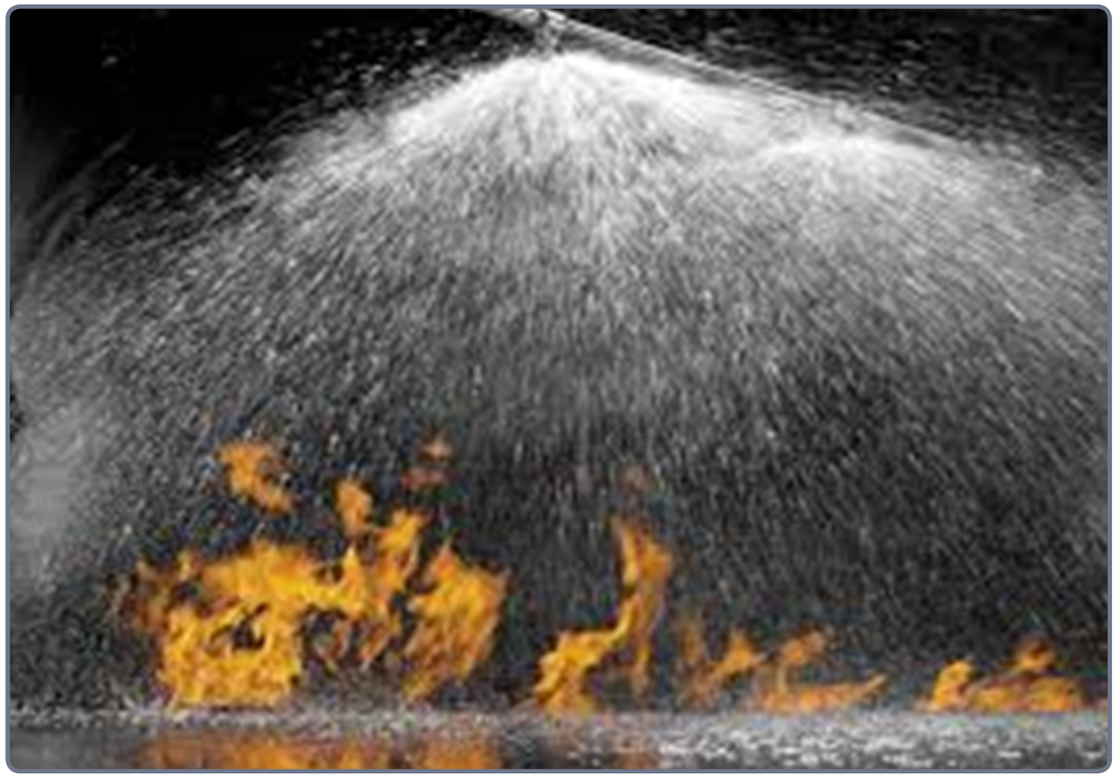
## Applicable standards

*LPC Rules for Automatic Sprinkler Installations 2015 Incorporating BS EN 12845.*

*RISCAuthority Sprinkler System Service and Maintenance: Guidance, Records and Checklists.*

FM Global Property Loss Prevention Data Sheets 2-0 *Installation Guidelines for Automatic Sprinklers.*

NFPA 13: *Standard for the Installation of Sprinkler Systems.*



BS EN 13565-2:2018. *Fixed firefighting systems. Foam systems. Design, construction and maintenance.*

FM Property Loss Prevention Datasheets 4-12 – *Foam Water Sprinkler Systems.*

NFPA 16 – *Standard for the Installation of Foam-Water Sprinkler and Foam Water Spray Systems.*

*For insurance purposes, life safety standards BS EN 12845 (used without the insurance industry enhancements contained within the LPC Rules), BS 9251, BS EN 16925 are not recognised even though BS 9251 allows extension to cover small commercial areas.

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No external representation is permitted. Content is based on fire testing, modelling, data extrapolation, and engineering judgement. Only staff have access to how this affects their view of risk appetite, which may differ from other insurers.

The other standards referenced have consensus representation on committees (typically including manufacturers, installers, certification bodies, government, fire service, third party certifiers, and property insurers) to review and contribute to the content.

## Schemes

LPS 1048 Requirements for the Approval of Sprinkler System Contractors in the UK and Ireland.

Warrington Certification Ltd FIRAS Industrial Sprinkler Certification Scheme.

IFC Certification Commercial Sprinkler Systems.

## Approvals

Underwriters Laboratory Solutions, Underwriters Laboratory Canada, FM Global, Loss Prevention Certification Board, VDS Schadenverhutung.

*A major advantage of sprinkler systems over other suppression systems is that, subject to holding the same approvals listings, components are interchangeable between suppliers and manufacturers safeguarding upkeep through life.

## Best practice

All commercial (PP) automatic sprinkler installations should be certificated to the Loss Prevention Certification Board LPS 1048 scheme or similar.

Fire Services should be consulted on their requirements and necessary provisions for supporting the sprinkler system.

Standards must be adopted in full within a system without cherry-picking between options and engineering down.