Fire Protection System Basics

Sprinkler Systems

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Introduction

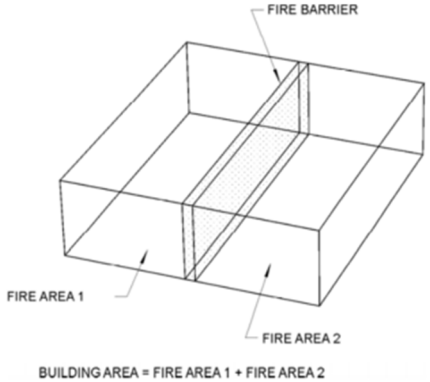
This second installment of the ***Fire Protection System Basics*** white paper series seeks to outline the requirements for various types of fire protection systems your building may require:

- Wet Sprinkler Systems
- Dry Sprinkler Systems
- Pre-Action Systems
- Dry Chemical Systems
- Standpipe and Hose Systems

When are Sprinkler Systems Required

To determine whether or not your building requires a fire sprinkler system, you will first need to know the occupancy type and square footage. The building codes determine the requirements to add sprinklers to buildings. The most common building code is the International Building Code (IBC). Section 903 deals with sprinkler system requirements. As examples, we will touch on Restaurant, Office, and Mercantile occupancies.

First, a definition is in order. IBC Section 903 refers to "Fire Area" in order to determine the need for a fire sprinkler system. *"The Fire Area is defined as the aggregate floor area enclosed and bounded by fire walls, fire barriers, exterior walls or horizontal assemblies of a building. Areas of the building not provided with surrounding walls shall be included in the fire area if such areas are included within the horizontal projection of the roof or floor next above."*



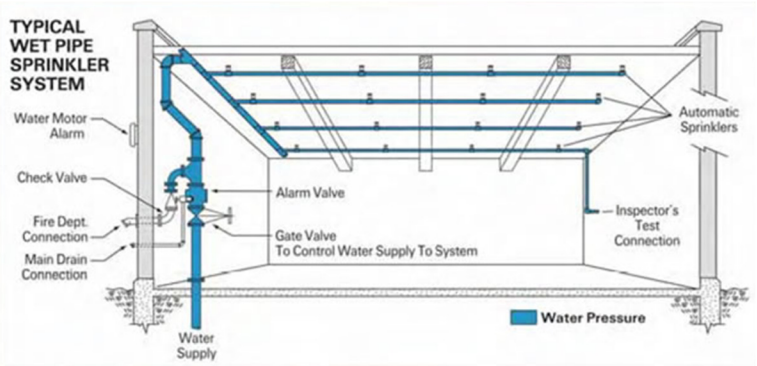
For a restaurant (Occupancy Group A-2), a building is required to have a fire sprinkler system if the fire area exceeds 5,000 square feet, the occupant load exceeds 100 people, or the fire area is located on a floor other than the level of exit discharge.

For an office (Occupancy Group B), a building is not required to have a fire sprinkler system per IBC Section 903. However, if classified as a high-rise building, then a sprinkler system will be required. Also, providing a sprinkler system in the building, even if not required, may alleviate some other requirements such as, different degrees of rated walls in certain areas. Even if sprinklers are not required by code, providing them offers enhanced life safety, greater real estate value and a host of other benefits in terms of code compliance.

For a Mercantile occupancy (Occupancy Group M), a building is required to have a fire sprinkler system if the fire area exceeds 12,000 square feet, the fire area is located more than three stories above grade, or the combined area of all Group M occupancies on all floors exceeds 24,000 square feet.

The wide range of requirements and potential benefits of a fire sprinkler system is what makes it critically important to hire a fire protection engineer who is knowledgeable about the multiple applicable codes to review your design intent and advise on the best overall solutions.

Wet Sprinkler Systems



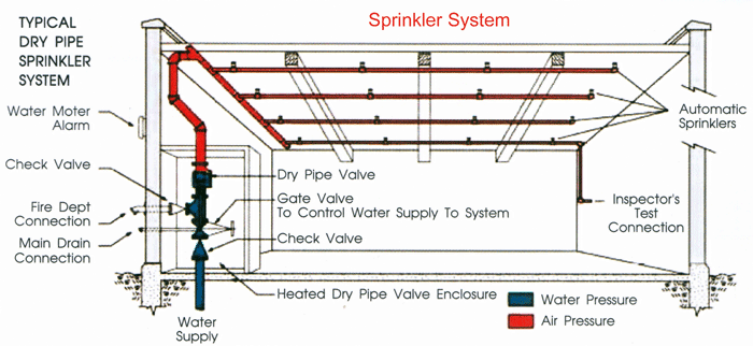
The vast majority of fire sprinkler systems installed in buildings are wet sprinkler systems. This means the entire system is constantly filled with water for quick discharge when necessary. In the event of a fire, heat collects around

the sprinkler heads, causing the glass bulb or fusible link to break and open the sprinkler head orifice. This will allow the pressurized water in the system to discharge through only the heads where the glass bulb or fusible link broke.

A wet sprinkler system is the most reliable and cost effective type of system, which makes it the first system type to consider for your building.

Dry Sprinkler Systems

Dry pipe sprinkler systems are very similar to a wet pipe system with one very major difference. The dry pipe systems are filled with air or nitrogen rather than water.

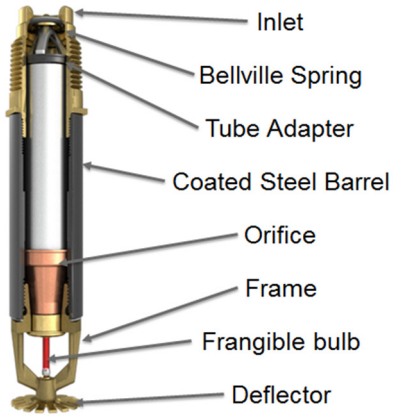


When a sprinkler head opens due to a fire, the air escapes through the sprinkler head orifice allowing water to flow from the dry pipe valve and reach the heads to discharge into the building space. Similar to the wet system, only the heads where the glass bulb or fusible link broke would allow water to flow.

Since there is no water in a dry system, except during a fire situation, they are allowed to be installed in unheated attics, overhangs, garages or warehouses as well as within freezers. This major difference also requires a dry pipe valve and an air or nitrogen supply. These additional pieces of equipment add more complexity and maintenance requirements to a dry pipe system. Some other notable disadvantages to a dry pipe system are higher costs for the additional equipment and a slightly increased sprinkler response time.

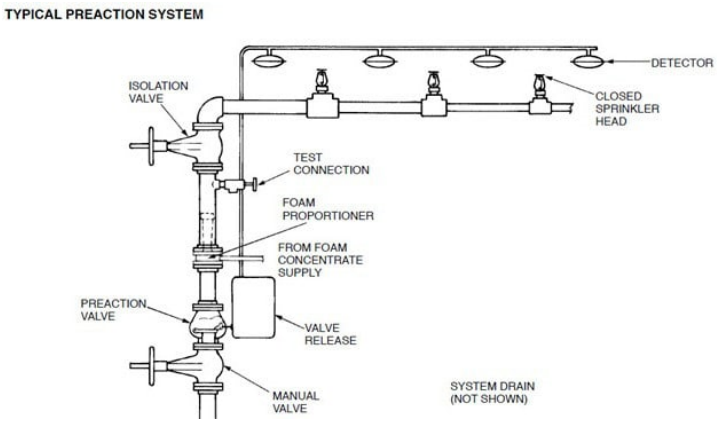
Due to these disadvantages, dry pipe systems should only be used in areas necessary due to a freezing potential.

If the potential freezing location is limited in size, a dry pendant sprinkler head can be tapped off of a wet sprinkler system to serve the limited freezing area. Dry pendant heads are sprinkler heads with a predetermined length of air filled pipe connected to them to protect the section of pipe closest to the freezing conditions. The valve at the inlet is located in a warm area, not subject to freezing conditions. These heads operate just like a dry pipe system where the air will first be released then followed by water.



Pre-Action Systems

Pre-action systems are a combination of a wet and a dry system. The pre-action systems start out as a dry system, which require a pre-action valve to be activated before water will flow into the system. The pre-action valve is connected to a detection device which can detect heat, smoke, or flames. When one of these is detected, a solenoid valve is activated to open the pre-action valve and allow water to flow into the system. At this point, the system is now a typical wet system, so when a head is activated, water will be readily available to flow through the sprinkler head.



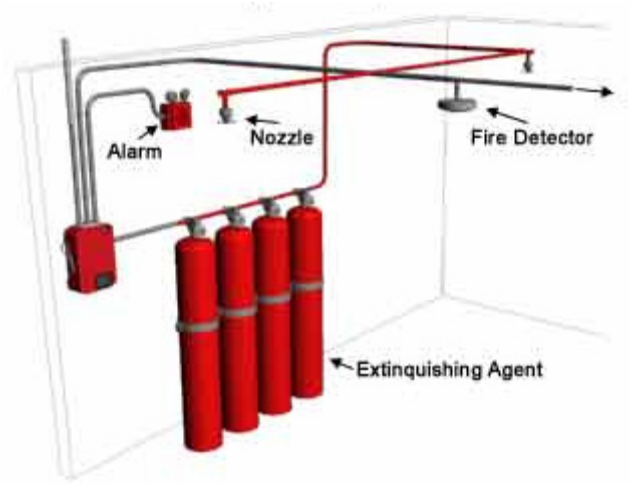
Pre-action systems are typically used in sensitive areas where an accidental discharge of water could be catastrophic to the equipment or operations in the space. This two-step activation process will help eliminate any accidental sprinkler head discharges. Some common locations are freezer warehouses, museums, libraries, and smaller computer rooms.

A pre-action system has the same disadvantages as the dry system, as it would require extra equipment and complexity, which cost more for the initial installation as well as for long-term maintenance.

Dry Chemical Systems

Dry chemical systems are a type of fire suppression system which uses a dry chemical powder to extinguish a fire in lieu of water. Typically, these systems require a large tank or tanks filled with the chemical agent, which is then pressurized to serve the piping system. These chemicals are typically sodium bicarbonate or mono-ammonium phosphate, depending on the class of potential fire.

Chemical systems are a more specialized sprinkler system only used in limited areas. They are commonly used in industrial applications such as chemical storage areas and paint booths.



Dry chemical systems are very reliable, as they discharge a lot of chemical that quickly extinguishes any fire. The system can also be recharged after any discharge to keep the system in operation. Although the ability to recharge is an advantage, it can also be a disadvantage as your maintenance staff must remember to recharge the system. Dry chemical systems are substantially more expensive than any of the water based systems, so their application is fairly limited. Another disadvantage is that there is a lot of specialized cleanup required for the dry chemicals after a discharge occurs.

Standpipe and Hose Systems

As stated in our first paper of this series, a standpipe system is the piping which runs vertically from floor to floor delivering the water supply for hose connections, and for sprinklers on each floor in the case of a combined sprinkler/standpipe system. The maximum required flow rate through a standpipe system is 1,000 gpm if the building is fully sprinkled, or 1,250 gpm if the building is not sprinkled.

Per NFPA 14, which deals with standpipe systems, there are three classes of standpipe systems.

Class I systems are for use by the fire department only and are typically required in buildings that have more than three stories above or below grade. Class I systems do not provide any hose available for use in fighting fires without the presence of the fire department. Common locations for standpipe hose connections are at stairwell floor landings, the roof, and at exit passageways. Additional standpipe hose connection locations may be required if all portions of each floor are not within 200 feet of a required hose connection location. The Class I standpipe systems require a minimum of 100 psi supply pressure and a flow rate of 500 gpm through the two most remote hose connections. Additional standpipes to meet the minimum spacing requirements

noted above may require an additional flow rate of 250 or 500 gpm.

Class II standpipe systems are for use by trained personnel or by the fire department. These systems consist of a cabinet with a hose for quick use to fight fires. These are typically used in large un-sprinkled buildings, large exhibit halls or stages. Class II systems must provide enough hose cabinet locations so that every portion of the floor may be reached by a 130 foot hose off of a 1 ½" standpipe connection.

These systems require a minimum pressure of 65 psi and a flow rate of at least 100 gpm for the most remote hose connection. No additional flow is required where more than one hose connection is provided. If your building is protected throughout by an approved automatic sprinkler system, you may not be required to install a Class II standpipe system, subject to the approval of the Authority Having Jurisdiction (AHJ).

Class III systems are a combination of a Class I and a Class II system as they contain both Class I and Class II hose connections. These are intended for use by fire departments and trained personnel. Class III systems must meet all of the placement, pressure, and flow rate requirements for both Class I and Class II systems.

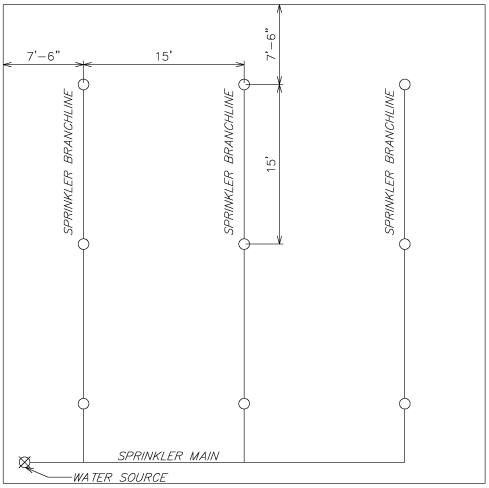
Sprinkler Head Locations & Coverage

The first step in laying out proper sprinkler head coverage is to determine the hazard classification for the occupancy type and planned storage per NFPA 13. This classification sets the maximum sprinkler coverage each head is allowed to provide. Sprinklers are required to be located a minimum of 4" from any wall and as far as half of the maximum sprinkler spacing allowed per the hazard classification type. The NFPA Standards have many other rules for spacing based on obstructions, small rooms, roof pitch, soffits, beams, elevator shafts, etc… The numerous intricacies required to be considered when laying out sprinkler heads, are another reason why it is critically important to hire a fire sprinkler engineer to discuss the specific requirements for your project.

The main hazard classifications are listed below with a brief definition of the classification type, typical occupancies, and head coverage limits:

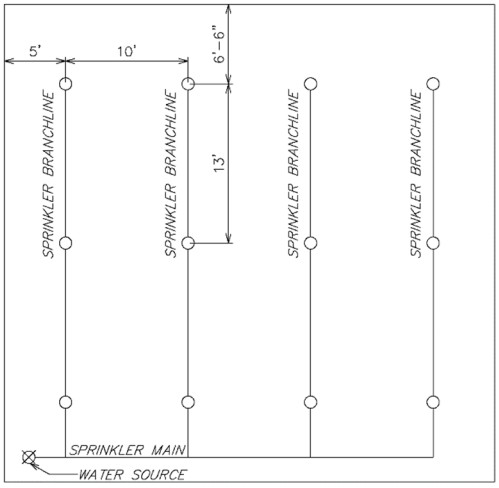
Light Hazard:

- Light hazard occupancies are defined as occupancies or portions of other occupancies where the quantity and/or combustibility of contents is low and fires with relatively low rates of heat release are expected. (Ex. Classrooms, office space, etc.)
    - The maximum sprinkler coverage in Light Hazard Areas is 225 square feet or 15' x 15'.



Ordinary Hazard:

- (Group 1): Ordinary hazard (Group 1) occupancies are defined as occupancies or portions of other occupancies where combustibility is low, quantity of combustibles is moderate, stockpiles of combustibles do not exceed 8 ft, and fires with moderate rates of heat release are expected. (Ex. Clothing stores, general mercantile)
- (Group 2): Ordinary hazard (Group 2) occupancies are defined as occupancies or portions of other occupancies where the quantity and combustibility of contents are moderate to high, stockpiles do not exceed 12 ft, and fires with moderate to high rates of heat release are expected. (Ex. Warehouses)
    - The maximum sprinkler coverage for Ordinary Hazard Occupancies is 130 square feet and the maximum distance between heads remains 15', however the other dimension would need to be adjusted to still limit the total coverage area to 130 square feet (8'-8" in this case).



Extra Hazard:

- (Group 1): Extra hazard (Group 1) occupancies are defined as occupancies or portions of other occupancies where the quantity and combustibility of contents are very high and dust, lint, or other materials are present, introducing the probability of rapidly developing fires with high rates of heat release but with little or no combustible or flammable liquids. (Ex. Wood shops)
- (Group 2): Extra hazard (Group 2) occupancies are defined as occupancies or portions of other occupancies with moderate to substantial amounts of flammable or combustible liquids or occupancies where shielding of combustibles is extensive. (Ex. Ethanol refinery)
    - The maximum sprinkler coverage for Extra Hazard Occupancies varies with the hydraulic density required for proper coverage and require special design considerations beyond the scope of this white paper.

About Layne

Layne Micek, P.E., Vice President of Plumbing Engineering, has been involved in the design of plumbing and fire protection systems for malls, mixed-use developments, corporate offices, national retail rollouts, schools, hospitals, medical facilities, commercial and institutional buildings for over 18 years with Schnackel Engineers. Email Layne at lmicek@schnackel.com.

About Greg

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