



# Design and Installation of Fire Sprinkler System in Manufacturing Industry

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**Abstract.** Fire-sprinkler and other extinguishing systems are intended to extinguish or control the fire. Smoke control systems typically are designed to limit the spread of smoke, which keeps egress routes passable for a given period. The fire alarm, through both the activation of the fire-sprinkler system and manual or automatic detection devices, provides warning to building occupants, as well as notification to emergency personnel responding to the alarm. A fire sprinkler framework is a dynamic fire assurance technique, comprising of a water supply framework, giving sufficient weight and stream rate to a water circulation-channeling framework, onto which fire sprinklers are associated. Also it is utilized as a part of processing plants and substantial business structures, frameworks for homes and little structures are presently accessible at a practical cost. Fire sprinkler frameworks are broadly utilized around the world, with more than 40 million sprinkler heads fitted every year. In structures totally secured by flame sprinklers alone controlled sprinkler frameworks, more than 96% of flames. Sprinklers have been being used in the United States since 1874, and were utilized as a part of manufacturing plant applications where fires when the new century rolled over were regularly disastrous as far as both human and property losses. In the US, sprinklers are today required in all new skyscraper and underground structures for the most part 75 feet (23 m) above or beneath flame office get to, where the capacity of firefighters to give sufficient hose streams to flames is restricted. Sprinklers might be required to be introduced by construction standards, or might be prescribed by insurance agencies to decrease potential property losses or business intrusion. Construction standards in the United States for spots of gathering, by and large more than 100 people, and places with overnight dozing convenience, for example, hotels, nursing homes, residences, and hospitals ordinarily require sprinklers under nearby building regulations, as a state of accepting State and Federal financing. In this Project, the aim is to develop a simple Fire Sprinkler, where the sprinkler can be tested. The test of the sprinkler is to be by connecting the pipes and the reservoir that contains the water and how the breaking of the chemical tube is happening as if there is a real fire occurring in a building. Further studies will include the calculations of the radius and the area that one sprinkler can handle during a fire case and how many one we have to install in a building to cover the fire as a given flow rate and pressure.

## 1. Introduction

This project is intended to design and manufacture a simple Fire Sprinklers, where the fire sprinkler can be inserted and tested. The test fire sprinkler is to be fitted with pipes and connections along with the tube bulb that could be exchangeable for many number of testing in which we can show it many times and change the bulb every time we test. The project is very important to the industries, as through understanding the characteristics of different types of the fire sprinklers so that we could be able to use every one in their specific location and task. This is also very important from the safety prospective as this will lead to a safe social environment to cover many areas such as operation plants, schools, hospitals gas stations and more. The project will show more details about the specifications and dimension and radius of covering the area of the intended to put the fire off of it. Also to show the students how the fire sprinklers working mechanism occurs and how does it really work. Also to demonstrate the different kinds of the distribution flow of the nozzle that could give more efficient and effective result as they could be varied with the environment and the nature of the place or building. For example, school would have different type of fire sprinklers than the chemical industry and so the flow rate and the medium used to put the fire such as Foam, Water and weather it will be wet or dry Design and construct a Fire Sprinklers to show flow rate and pressure distributing for fire detected in school or hospital or chemical industry using specific type of sprinkles Study the change in different types of the Fire Sprinklers and how they can be more efficient for their designated area and field. Relate different type and medium used in different weather and conditions depending on the environment and needs. Developing fire sprinklers distribution techniques to prevent huge uncontrolled fire to be put off without the need to make firefighters possess more danger and lessen their exposure to fire as much as possible.

Some of the most important aspect we have to consider is the ceiling height in which it has the means of egress shall have a ceiling height of not less than 7 feet 6 inches (2286 mm). Other things to consider is the number of occupant in the room and it would be calculated and figured upon the table shown below as the standard of NFPA. There are many applications that can be differs depending on the type and weather condition of the environment such as gas station in Alaska would use a type called Dry-Pipe System in which the medium will not be subjected to be frozen and at the same time we keep the sprinklers ready to be used. So there are many types of the Fire Sprinklers and on which the applications will be depending on it. By a wide edge, wet pipe sprinkler frameworks are introduced more frequently than every single other sort of flame sprinkler frameworks. They likewise are the most solid, since they are basic, with the main working

segments being the programmed sprinklers and (normally, however not generally) the programmed alert check valve. A programmed water supply gives water under strain to the framework funneling. Dry pipe frameworks are the second most basic sprinkler framework write. Dry pipe frameworks are introduced in spaces in which the surrounding temperature might be sufficiently chilly to solidify the water in a wet pipe framework, rendering the framework inoperable. Dry pipe frameworks are regularly utilized as a part of unheated structures, in parking structures, in outside shelters connected to warmed structures (in which a wet pipe framework would be given), or in refrigerated coolers. In areas utilizing NFPA directions, wet pipe frameworks can't be introduced unless the scope of encompassing temperatures stays over 40 °F (4 °C)[4] Water is absent in the channeling until the point that the framework works; rather, the funneling is loaded with air at a weight beneath the water supply weight. To keep the bigger water supply weight from rashly constraining water into the channeling, the plan of the dry pipe valve (a particular kind of check valve) brings about a more noteworthy power over the check valve clapper by the utilization of a bigger valve clapper zone presented to the funneling gaseous tension, when contrasted with the higher water weight however littler clapper surface region. When at least one of the programmed sprinkler heads is activated, it opens enabling the air in the channeling to vent from that sprinkler . "Storm" frameworks are frameworks in which all sprinklers associated with the water- funneling framework are open, in that the warmth detecting working component is expelled, or particularly outlined all things considered.

These frameworks are utilized for unique dangers where fast fire spread is a worry, as they give a concurrent use of water over the whole peril. They are in some cases introduced in staff departure ways or building openings to moderate go of flame (e.g. openings in a fire-evaluateddivider) Water is absent in the funneling until the point when the framework works. Since the sprinkler openings are open, the funneling is at climatic weight. To keep the water supply weight from compelling water into the channeling, a "downpour valve" is utilized as a part of the water supply association, which is a mechanically locked valve. It is a non-resetting valve, and remains open once stumbled. Since the warmth detecting components introduce in the programmed sprinklers have been evacuated (bringing about open sprinklers), the downpour valve must be opened as motioned by a fire caution framework. The sort of flame caution starting gadget is chosen for the most part in view of the danger (e.g. pilot sprinklers, smoke indicators, warm locators, or optical fire finders). The start gadget flags the fire caution board, which thus flags the downpour valve to open. Actuation can likewise be manual, contingent upon the framework objectives. Manual initiation is typically by means of an electric or pneumatic fire alert force station, which flags the fire caution board, which thusly flags the storm valve to open Task - Activation of a fire caution starting gadget, or a manual force station, flags the fire alert board, which thusly flags the storm valve to open, enabling water to enter the channeling framework. Water streams from all sprinklers at the same time Pre-activity sprinkler frameworks are particular for use in areas where incidental enactment is undesired, for example, in exhibition halls with uncommon works of art, original copies, or books; and server farms, for security of PC hardware from unplanned water release. Pre-activity frameworks are half and halves of wet, dry, and downpour frameworks, contingent upon the correct framework objective. There are two principle sub- sorts of pre-activity frameworks: single interlock, and twofold interlock The task of single interlock frameworks are like dry frameworks aside from that these frameworks require that a "first" fire identification occasion, ordinarily the enactment of a warmth or smoke locator, happens before the "activity" of water presentation into the framework's funneling by opening the pre-activity valve, which is a mechanically locked valve (i.e. like a downpour valve) Along these lines, the framework is basically changed over from a dry framework into a wet framework. The goal is to diminish the bothersome time postponement of water conveyance to sprinklers that is inborn in dry frameworks. Before flame recognition, if the sprinkler works, or the channeling framework builds up a break, loss of gaseoustension in the funneling will initiate an inconvenience alert. For this situation, the pre-activity valve won't open because of loss of supervisory weight, and water won't enter the channeling.

The task of Double interlock frameworks is like downpour frameworks with the exception of that programmed sprinklers are utilized. These frameworks require that both a "former" fire location occasion, commonly the enactment of a warmth or smoke finder, and a programmed sprinkler task happen before the "activity" of water presentation into the framework's funneling. Actuation of either the fire finders alone, or sprinklers alone, without the simultaneous activity of the other, won't enable water to enter the channeling. Since water does not enter the funneling until the point when a sprinkler works, twofold interlock frameworks are considered as dry frameworks as far as water conveyance times, and comparatively require a bigger plan zone A Foam water fire sprinkler framework is an extraordinary application framework, releasing a blend of water and low development froth think, bringing about a froth splash from the sprinkler. These frameworks are normally utilized with exceptional dangers inhabitations related with high test fires, for example, combustible fluids, and airplane terminal storages. Task is as portrayed above, contingent upon the framework write into which the froth is infused "Water spray" frameworks are operationally indistinguishable to a storm framework, however the channeling and release spout splash designs are intended to secure an exceptionally arranged peril, as a rule being three-dimensional parts or gear. The spouts utilized may not be recorded fire sprinklers, and are generally chosen for a particular splash example to fit in with the three-dimensional nature of the risk. Cases of dangers secured by water splash frameworks are electrical transformers containing oil for cooling or turbo- generator heading. Water splash frameworks can likewise be utilized remotely on the surfaces of tanks containing combustible fluids or gases, (for example, hydrogen). Here the water splash is planned to cool the tank and its substance to forestall tank break/blast and fire spread Water mist frameworks are utilized for extraordinary applications in which it is chosen that making a warmth retentive vapor is the essential target. This sort of framework is commonly utilized where water harm might be a worry, or where water supplies are restricted By making a fog, an equivalent volume of water will make a bigger aggregate surface zone presented to the fire. The bigger aggregate surface territory better encourages the exchange of warmth, along these lines enabling more water beads to swing to steam all the more rapidly. A water fog, which ingests more warmth than water per

unit time, because of uncovered surface territory, will all the more successfully cool the room, in this manner lessening the temperature of the fire. Activity - Water fog frameworks can work with an indistinguishable usefulness from downpour, wet pipe, dry pipe, or pre-activity frameworks. The distinction is that a water fog framework utilizes a packed gas as an atomizing medium, which is pumped through the sprinkler pipe. Rather than compacted gas, a few frameworks utilize a high- weight pump to pressurize the water so it atomizes as it leaves the sprinkler nozzle. Systems can be connected utilizing nearby application technique or aggregate flooding strategy, like Clean Agent Fire Protection Systems.

Sprinkler frameworks are expected to either control the fire or to stifle the fire. Control mode sprinklers are expected to control the warmth discharge rate of the fire to counteract building structure crumple, and pre-wet the encompassing combustibles to avoid fire spread. The fire isn't smothered until the point that the consuming combustibles are depleted or manual extinguishment is affected by firefighters. Concealment mode sprinklers (in the past known as Early Suppression Fast Response (ESFR) sprinklers) are planned to bring about a serious sudden decrease of the warmth discharge rate of the fire, took after rapidly by entire extinguishment, preceding manual intercession Most sprinkler frameworks introduced today are composed utilizing a territory and thickness approach. In the first place the building use and building substance are broke down to decide the level of flame danger Typically structures are named light peril, conventional risk gather 1, common danger amass 2, additional risk bunch 1, or additional danger aggregate 2. In the wake of deciding the danger order, a plan territory and thickness can be controlled by referencing tables in the National Fire Protection Association (NFPA) models The outline territory is a hypothetical zone of the building speaking to the most pessimistic scenario region where a fire could consume. The plan thickness is an estimation of how much water per square foot of floor territory ought to be connected to the outline region. For instance, in an office building delegated light risk, a run of the mill outline zone would be 1,500 square feet (140 m<sup>2</sup>) and the plan thickness would be 0.1 US gallons for each moment (0.38 l/min) per 1 square foot (0.093 m<sup>2</sup>) or at least 150 US gallons for each moment (570 l/min) connected over the 1,500-square-foot (140 m<sup>2</sup>) outline zone. Another illustration would be an assembling office named conventional danger gather 2 where a regular outline zone would be 1,500 square feet (140 m<sup>2</sup>) and the plan thickness would be 0.2 US gallons for every moment (0.76 l/min) per 1 square foot (0.093 m<sup>2</sup>) or at least 300 US gallons for each moment (1,100 l/min) connected over the 1,500-square-foot (140 m<sup>2</sup>) outline zone [3]. After the plan zone and thickness have been resolved, computations are performed to demonstrate that the framework can convey the required measure of water over the required outline territory. These figuring's represent the greater part of the weight that is lost or picked up between the water supply source and the sprinklers that would work in the plan region This incorporates weight misfortunes because of grinding inside the funneling and misfortunes or increases due to elevationcontrasts between the source and the releasing sprinklers. Once in a while force weight from water speed inside the channeling is likewise computed. Ordinarily these counts are performed utilizing PC programming yet before the coming of PC frameworks these occasionally entangled computations were performed by hand This expertise of ascertaining sprinkler frameworks by hand is as yet required preparing for a sprinkler framework outline technologist who looks for senior level accreditation from building confirmation associations, for example, the National Institute for Certification in Engineering Technologies (NICET) Sprinkler frameworks in private structures are winding up more typical as the cost of such frameworks turns out to be more down to earth and the advantages turn out to be more self-evident. Private sprinkler frameworks more often than not fall under a private arrangement isolate from the business orders said above . A business sprinkler framework is intended to shield the structure and the inhabitants from a fire Most private sprinkler frameworks are principally intended to smother a fire in such an approach to take into consideration the sheltered escape of the building tenants While these frameworks will regularly additionally shield the structure from significant fire harm, this is an auxiliary thought. In private structures sprinklers are frequently excluded from wardrobes, washrooms, galleries, carports and upper rooms on the grounds that a fire in these zones would not more often than not affect the tenant's escape course This innovation has been a work in progress for more than 50 years.

## 2. Design Methodology

Item	Size	Geometry	Environment	Weight	Cost
Room Pipe	We have chosen the size of the room that can handle two sprinklers as to replicate an actual roomsize,4x4, in a smaller scale. The Dimensions are: 1m x 1m x 2m.	<u>CubedRectangular:</u>  *Easy to Manufacture.	It is applicable to be designed to be regular room with a room temperature 25 degree Celsius.	- NA	-NA
Sprinkler head	The size of the sprinkler head is determined by the application that is used for. The Fire sprinkler head must have the ability to cover the area od the room desired to be equipped with it in	<u>Deflector :</u>  *Has the ability to distribute the water in circular pattern .	The material of the Fire sprinkler head should not be corrosion resistantto increase the life duration and usually it is painted by chrome.	The weight of the fire sprinkler head is around 60 gs.	The material must be corrosion resistant and easily installed.  The

	which it covers 130-200 Square feet per head. The Dimensions are: Diameter; 34mm length; 74.6mm				Price: 40 SR
Glass Bulb	The size of the glass bulb must be very small to ensure breaking easily and make sure it blocks the water as it resist the pressure applied upon it.  The length dimensions are: 24 mm.	<u>Chemical inside the bulb:</u>  *Chemical thermally expanding and enables significant improvement in responsetime	*Can be handled very easy and not hazardous for the body or environment.	The Weight is: 10 grams	The glass bulb costs: 10 SR
Elbow	½ inch size	<u>Circular shape</u>	Easy to control And easy to connect other steal parttogether	500 gram	4 SR EACH
Seal	The size of the seal in diameter The dimensions are: Diameter: 27mm	<u>Cone Shape</u>	The material of the Seal rubber can be recycled and safe for the environment.	-	The cost of the Seal is usually 5 SR.

### 3. Conclusion

Safety is always a main concern where the lives of people who are using the fire sprinkler have to take into consideration. The main one is the corrosion of the piece in which it will reduce its efficiency and it might not work at all. The other thing is that to when there is some maintenance in the building, which the fire sprinkler system could be shut off, and then forgetting to out the system back online which might lead to disastrous results. So to solve that, there were a standard developed to recover this and reduce the time of the interruption of the system brought by NFPA. Also if the system is inappropriate for the hazardous in which the wrong type is installed in the wrong place for example if we are a very cold area we shall go for a Dry System not to make the water inside the pipe be frozen and leading to failure of the fire sprinkler system. Another thing to mention is that the fire sprinkler is not intended to be used many times; means that one fire sprinkler can handle only one fire a time. So we have o make sure that the fire sprinklers are changed and replaced if fire had happened to ensure the functionality of the system. And after testing the Fire Sprinkler we have achieved the following:

1. Successfully designed and construct a Fire Sprinklers to show flow rate and pressure distributing for fire detected in school or hospital or chemical industry using specific type of sprinkles
2. We studied the change in different types of the Fire Sprinklers and how they can be more efficient for their designated area and field.
3. We chose the right type and medium used in specific weather and conditions.
4. Developing fire sprinklers distribution techniques to prevent huge uncontrolled fire to be put off without the need to make firefighters possess more danger and lessen their exposure to fire as much as possible.

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