NFSA NATIONAL FIRE SPRINKLER ASSOCIATION
The Voice of the Fire Sprinkler Industry

TechNotes

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Fundamentals for Layout Technicians

The modern sprinkler design process involves several roles, such as Estimator, Project Engineer, Project Manager, and Quality Control. However, one of the most important roles is that of the Layout Technician. The career path of a layout technician can begin with a high school diploma and develop into a pivotal role in the fire sprinkler field. With adequate training and mentoring, a new layout technician can become a productive and vital member of the team.

To be a successful fire sprinkler layout technician, one must have intimate knowledge of NFPA 13 and its requirements. This article aims to provide a primer for layout technicians early in their careers or for those contemplating entering this rewarding field.

At first glance, NFPA 13 can be daunting. However, when broken down into smaller parts, the standard can be easily understood. The 2022 Edition of NFPA 13 consists of 32 chapters and 6 annex chapters. When adopted locally, either by ordinance or referenced by the codes, compliance with the 32 chapters of NFPA 13 is required. The annex material is for informational purposes only and is not an enforceable portion of the standard unless adopted separately by the authority having jurisdiction.

In sprinkler system design, the first step involves assessing the hazard level of the building, which is typically performed by a qualified design professional or project engineer. This assessment is then passed on to the layout technician. Although it is not within the technician's responsibilities, it is important for them to understand this step as it plays a critical role in the layout and design process.

The hazard level assessment criteria can be divided into two main categories: Storage and Non-Storage. Storage areas are further classified into three separate criteria: Miscellaneous storage, Low Pile Storage, and High Piled Storage. However, as this article focuses on fundamentals, no further discussion of storage criteria will be provided.

Occupancy Classification

For non-storage applications, the design criteria are categorized according to Occupancy Classifications which in the 2022 edition of NFPA 13 is found in Chapter 4. The Occupancy Classification, also known as hazard classification, is defined by NFPA 13 and is based on the fire hazard level within an area. This should not be confused with the occupancy classification defined by the building code, which describes the overall hazard of the space not just the fire hazard. The NFPA

13 occupancy classifications are broken down into categories, and it is important to note that a single building can contain multiple Occupancy Classifications.

The table below outlines each Occupancy Classification and provides general examples of facilities that fall within each category. For a more extensive list of examples for each Occupancy, Annex Section 4.3 should be consulted.

Occupancy Classification Definition	Example Occupancies	
Light Hazard • Spaces with low quantity and combustibility of contents	• Animal Shelters • Churches • Hospitals	• Educational • Libraries • Museums
Ordinary Hazard Group 1 • Spaces with moderate quantity and low combustibility of contents • Stockpiles of contents with low combustibility that do not exceed 8 ft	• Bakeries • Canneries • Electronics Plants	• Restaurant Service Areas • Mechanical Rooms
Ordinary Hazard Group 2 • Spaces with moderate to high quantity and combustibility of contents • Stockpiles of contents with moderate rates of heat release rate that do not exceed 12 ft and stockpiles of contents with high rates of heat release that do not exceed 8 ft	• Cereal Mills • Distilleries • Dry Cleaners • Feed Mills	• Horse Stables • Leather Goods Manufacturing • Metal Working
Extra Hazard Group 1 • Spaces with very high quantity and combustibility of contents • Spaces where dust, lint, or other materials are present, introducing the probability of rapidly developing fires.	• Die Casting • Metal Extruding • Plywood Manufacturing	• Rubber Reclaiming • Sawmills • Textile Picking
Extra Hazard Group 2 • Spaces with very high quantity and combustibility of contents • Spaces with substantial amounts of combustible or flammable liquids • Spaces where shielding of combustibles is extensive	• Asphalt Saturating • Flammable Liquids Spraying	• Open Oil Quenching • Solvent Cleaning

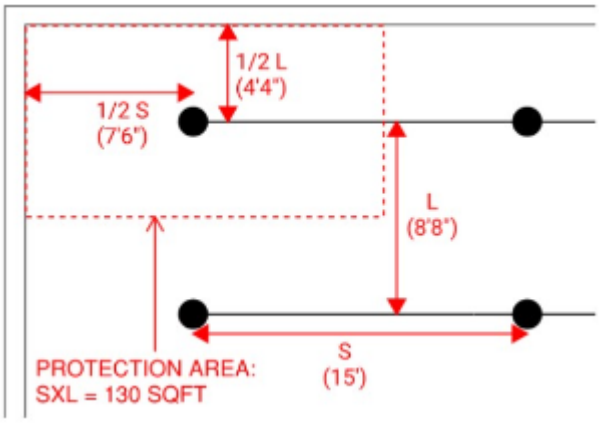
Sprinkler Spacing

Once the occupancy classification is determined based on the information provided in Chapter 4, the sprinkler layout can begin. The actual layout of the sprinklers will vary greatly depending on the type of sprinkler used, such as standard spray, extended coverage, or sidewall sprinklers. However, for the

purposes of this article, we will focus on the requirements for standard spray pendent and upright sprinklers as dictated by Section 10.2. Chapter 10 specifies the maximum sprinkler spacing and coverage area based on the level of hazard. Light hazard occupancies are permitted to have sprinklers spaced further apart, while the spacing for Ordinary Hazard and Extra Hazard Occupancies must be closer. A summary of the sprinkler spacing is found in the table below.

Occupancy Classification	Maximum Protection Area	Maximum Spacing
Light Hazard	120-225 sqft[1]	15 ft
Ordinary Hazard	130 sqft	15 ft
Extra Hazard	90-130 sqft[2]	12-15 ft[2]

1. Maximum Protection Area varies based on construction and system type. See Table 10.2.4.2.1(a) for complete breakdown of protection areas for Light Hazard Occupancies.
2. Maximum Protection Area and sprinkler spacing varies based on System Type see Table 10.2.4.2.1(c) for complete breakdown of protection areas for Extra Hazard Occupancies.



You may have noticed that the maximum protection area limits the spacing of sprinklers. For example, in an Ordinary Occupancy Classification, the maximum sprinkler spacing allowed is 15 feet. This implies that if sprinklers are placed 15 feet apart in one direction, they are limited to 8 feet and 8 inches in the perpendicular direction to maintain the maximum 130 square foot protection area. To aid us in this process, we use the “S X L rule”, where the dimension S represents the distance between the sprinklers along the branch lines, and L represents the distance between sprinklers on adjacent branch lines.

To comply with the maximum protection area, the total area obtained by multiplying the distance (S) and the distance (L) must not exceed the specified limit. Additionally, each sprinkler only truly covers half the distance (L or S) between sprinklers. As a result, the distance to walls is restricted to half the respective distance in that direction (i.e., ½ S or ½ L).

Obstructions

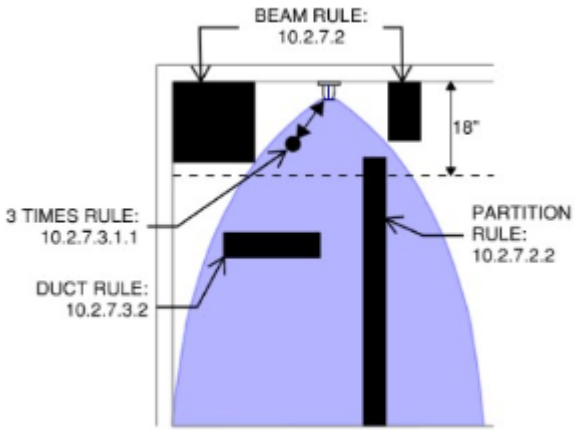
While it is important to properly space sprinklers to ensure adequate coverage, there are often objects or structural members that can impede the sprinkler discharge from properly reaching the fire. NFPA 13 refers to these as obstructions. As you can imagine, an obstruction has more impact on a sprinkler performance the closer it is to the sprinkler itself. For this reason, NFPA 13 provides two separate categories for obstructions; Obstructions to pattern development which are obstructions which are within the area 18 inches below the sprinkler deflector, and Obstructions that prevent sprinkler

discharge from reaching the hazard which are obstructions located more than 18 inches below the sprinkler deflector.

Beam Rule

In order to avoid obstructions to pattern development the goal is to spray over the obstruction, under the obstruction or sufficiently spray on both sides of the obstruction. The position of the sprinkler relative to an obstruction in order to spray under the obstruction is provided by Section 10.2.7.2(1) along with Table and Figure 10.2.7.2(a), this section is often referred to as the “beam rule”. In order to adequately spray under an obstruction, the sprinkler must be spaced a distance (A) away from the obstruction dependent on the maximum distance (B) the deflector is above the bottom of the obstruction.

3 Times Rule



As stated above there are two aspects of an obstruction that can affect the severity of the obstruction. The larger the obstruction, the greater the obstruction, also the closer to the sprinkler the greater the obstruction. Section 10.2.7.3.1.3 dictates that a sprinkler must be spaced a minimum of 3 times the largest dimension of an obstruction. This section is often called the “3 Times Rule”. This requirement only applies to horizontal obstructions within 24 inches of the sprinkler and vertical obstructions at any distance. Even in a well-coordinated project appliances often are installed without representation on the plans, making it nearly impossible to anticipate all potential obstructions with the 3 times rule. For this reason, in Light and Ordinary Hazard occupancies, this rule only applies to structural elements.

Partition Rule (Suspended or Floor Mounted Vertical Obstructions)

If the sprinklers are unable to spray under or on both sides of an obstruction, another option is to spray over the obstruction. Section 10.2.7.3.2.1 along with the associated figures and tables dictates the distance (A) away from the obstruction based on the minimum distance (B) above an obstruction in light hazard occupancies. This is commonly called the partition rule which is essentially the inverse of the beam rule.

It should also be noted that the 2022 edition also includes guidance in Section 10.2.7.3.2.3 for these vertical obstructions in ordinary hazard occupancies as well.

Wide Obstruction Rule

The three previous obstruction rules apply only to objects within 18 inches below the sprinkler. Obstructions further than 18 inches below the sprinkler have less stringent requirements. Obstructions in this area are Obstructions that Prevent Sprinkler Discharge from Reaching the Hazard, and the rule

for this area can be found in section 10.2.7.4 which requires sprinkler protection to be extended to the area below fixed obstructions over 4 feet wide. This rule is commonly called the Duct Rule, and it is important to recognize that it only applies to fixed obstructions therefore objects that are not fixed such as conference tables do not require sprinklers below. This rule also does not apply to non-combustible obstructions over 4 feet that are 24 inches or less from the floor.

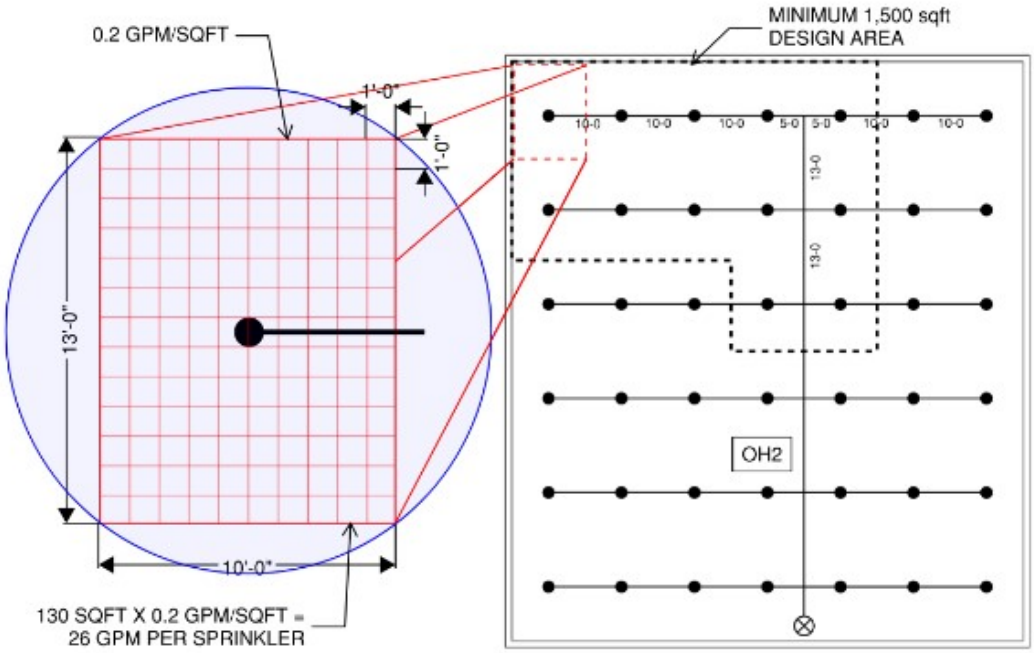
Other types of sprinklers such as sidewall, extended coverage, CMSA, and ESFR sprinklers have their own unique obstruction rules which are dictated in the installation chapters for those respective designs.

Density/Area Method

Providing proper spacing and avoiding obstructions means nothing if the sprinkler is not able to provide sufficient water. NFPA dictates the amount of water required based on the level of hazard. By reviewing the examples in the table above you can imagine it could take significantly more water to control a fire in a space used for flammable liquid spraying than it would for a office area. The level of protection or amount of water is referred to the sprinkler density and is measured in gallons per minute per square foot (gpm/sqft). This is the rate of water a sprinkler must discharge in gallons each minute in each square foot of area in its protection area. For example, the required density for an Ordinary Group 2 (OH2) occupancy is 0.2 gpm/sqft, this means the sprinkler must discharge enough water to spray a minimum of 0.2 gallons of water every minute over each square foot it covers. In the example shown the sprinkler in an OH2 occupancy protects an area 10 feet by 13 feet for a total of 130 square feet. To determine the minimum amount of water required to discharge from this sprinkler you simply multiply the density 0.2 gpm/sqft by the total area 130 sqft which equals 26 gallons.

Along with the minimum density for each sprinkler, NFPA 13 also dictates the design area, or the area used to determine the number of sprinklers flowing in the calculation. The design area is not necessarily an estimated fire size and is not directly based on testing, however it is the area NFPA 13 dictates that must be used to determine how many sprinklers operate in a fire for that occupancy classification.The densities and required area of operation for each occupancy classification can be found in table 19.2.3.1.1 in NFPA 13, a summary is provided in the table below.

Occupancy Classification	Required Density/Area
Light Hazard	0.1 gpm/sqft over 1,500 sqft
Ordinary Hazard Group 1	0.15 gpm/sqft over 1,500 sqft
Ordinary Hazard Group 2	0.2 gpm/sqft over 1,500 sqft
Extra Hazard Group 1	0.3 gpm/sqft over 2,500 sqft
Extra Hazard Group 2	0.4 gpm/sqft over 2,500 sqft



Conclusion

The intent of this edition of TechNotes is to provide the fundamentals for a layout technician and either provide a primer for the beginner or a refresher for the experienced technician. This article primarily focused on layout requirements for standard spray sprinklers using the density area application. There are however other types of sprinklers such as extended coverage which have the same criteria for standard spray except the spacing and obstruction rules are different. Another type is sidewall sprinklers which have a different spray pattern altogether as they are installed as the name implies, on the wall. For storage applications NFPA 13 also has Control Mode Specific Application (CMSA Sprinklers) and Early Suppression Fast Response (ESFR) Sprinkler, for these sprinklers the calculation, spacing and obstruction criteria differ considerably.

Learning and Development

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NOTE: Students must register for Part 1: Application at least one month before the start of in-person Part 2: session in order to allow enough time to complete the on-line modules.

Layout Technician Pathway cost:
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2023 Registration Deadlines	Part 1: Fundamentals completion deadline	Part 2: Application session dates	Part 2: Application session locations
Feb. 28	March 27	March 28-30	Virtual
April 23	May 22	May 23-25	Linthicum Heights, MD
June 25	July 24	July 25-27	Shoreview, MN
Aug. 28	Sept. 25	Sept. 26-28	Tacoma, WA
Oct. 14	Nov. 13	Nov. 14-16	Linthicum Heights, MD

Check Out All Options Here

All 2023 Tech Tuesdays are NOW available for registration!

Our next Tech Tuesday will be April 18th, 2023 at 12:30 - 1:30 PM eastern time. The topic will be Fundamentals for Layout Technicians.

Whether you’ve been a design technician for 2 months or 20 years the fundamentals of fire sprinkler design are an important topic to learn well and refresh periodically. While the basic theory may be the same some design aspects have changed along with the standards that dictate the requirements.
This course will cover the fundamentals of fire sprinkler design and layout, including sprinkler spacing, obstructions, pipe routing and developing the remote area for a design density approach. Sprinkler design requirements for storage criteria will not be discussed in this course.

Register for the next Tech Tuesday Here

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1-800-683-NFSA (6372)