Fire Protection System Basics

Fire Sprinkler Pumps

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Introduction

This third installment of the ***Fire Protection System Basics*** white paper series seeks to outline the requirements for fire sprinkler pumps:

- When are they required?
- Basic sizing requirements
- Types of Pumps
- Jockey Pumps
- Space planning requirements
- Ventilation requirements
- Testing Requirements

When are Fire Sprinkler Pumps Required

It is critically important to provide adequate water pressure and flow to a fire sprinkler system. NFPA 13 specifies minimum pressure and flow requirements at different sprinkler head types and different occupancy types. The first step to determine if a sprinkler booster pump is required is to request a hydrant flow test in the area of the project from the local fire department or water utility company. This flow test will help the design engineer determine if the building's fire sprinkler service has enough pressure and flow to serve the system with, or without, the need for a booster pump. There is no "rule of thumb" to determine when a pump is required and when one is not. Hydraulic calculations need to be performed by a qualified Fire Protection Engineer on every project to make this determination.

Pumps used in a fire protection system must be dedicated to and listed for fire protection service. Acceptable forms of powering a fire pump are electric motors, diesel engines, steam turbines, or a combination thereof. Electrical and diesel driven are the most common.

Basic Sizing Requirements

When a pump is determined to be required, there are many pieces of information that are required to properly select an appropriate booster pump for your specific project. Some of the information, as well as a description of that information is listed below:

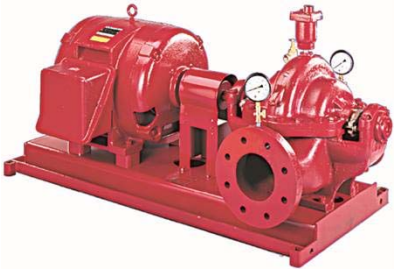
- Flow test
    - The flow test must be performed within 12 months of design calculations and must be performed at fire hydrants nearest the site.
- Flow rate
    - The flow rate will vary based on the design of the building. Any flow rate requirements for automatic standpipe systems must also be included in the total require flow rate.
- Building height
    - This information is used to determine vertical pressure requirements in the system from the pump location up to the highest portion of the building that will be required to be sprinkled.
- Secondary water supply
    - Depending on the code requirements of the building type and water supply, a secondary water supply may be required.
- Power availability
    - Fire booster pumps can be powered many different ways so a review of the code requirements and local power availability will be necessary to determine the best way to power the pump.

This is not an exhaustive list of information that the Fire Protection Engineer will need to properly size a booster pump. Other information that would be required includes the diameter of fire sprinkler piping, secondary pressure losses through equipment, pressure losses through horizontal piping, etc.

Types of Pumps

The most common fire pump is a centrifugal pump because they are able to support high flow rates and high pressure requirements. The pumps discussed below are capable of being used with either diesel or electric drives, unless otherwise noted below. All pumps will require vibration isolators to limit any potential for motor vibrations to disseminate through the building. There are many different sub-types of centrifugal pumps, which we will describe below.

- Horizontal Split Case
  - The water flow enters and exits the pump impeller from opposite sides of the pump housing. The pump is covered by a "split" casing, which can be opened for pump maintenance. The impeller is connected to the drive by a horizontal shaft. This type of pump is very reliable and available in a wide range of flow and pressure ranges. Unfortunately, this style of pump, typically, requires the largest floor space also.



- Vertical Turbine
  - Vertical turbine pumps are the only pumps allowed by NFPA 20 to start with a negative pressure on the suction side of the pump or lift water from below grade sources such as subgrade tanks. Vertical turbine pumps are also available in a wide range of capacities.

- In-Line Pump
  - These pumps are useful in small spaces, however, they have limited capacities and are harder to maintain. They are typically limited to no more than 1,500 gpm. In order to maintain them the motor must be lifted off the pump. In-line pumps tend to be less expensive and take up less floor space than other horizontal pumps. Another potential down side to this type of pump is that they can only be used with an electric motor.

- End Suction
  - Like the In-line pump, the end suction pump is limited in capacity to around 1,500 gpm. However, if the capacity works out, these pumps require less floor space than their similar horizontal split case pump and are less costly.

Jockey Pumps

Jockey Pumps are smaller pumps connected to the fire sprinkler system to maintain the system pressure when there is no call for fire sprinkler water in the building. This pump ensures that the system sees a large enough pressure drop when a sprinkler head is activated to start the main fire pump. Jockey pumps are typically sized to a flow rate less than a single sprinkler head. Since these pumps are so small they are typically a multi-stages centrifugal pump. Jockey pumps do not need to be listed for use in fire system applications. Any pump capable of producing the necessary pressure is acceptable.

Space Planning Requirements

When fire booster pumps are required, the codes have specific requirements for the room that houses the booster pump as well as access to the room. Depending on the building design, the fire pump room will need to be constructed with either 1 or 2 hour wall separation from the rest of the building. Access to this room is preferred to be from the exterior, however that is not always possible. If the room does not have direct exterior access, the corridor or stairwell leading to the room also must be constructed with 1 or 2 hour walls to match the fire pump room rating. The access to the room

must be pre-planned and approved by the local fire department.

The fire pump room must be dedicated to the fire service and equipment directly associated with the booster pump. The only other devices that are allowed to be in the fire pump room are the domestic water service equipment. There is no pre-determined pump room size as all equipment and building requirements are different. The room must be sized large enough to house all of the equipment required for the fire service and booster pump, as well as any required clearances for installation and maintenance. Fire pump rooms tend to be quite large, so early coordination is critical.

A couple other things to consider for the fire pump room are lighting, floor drainage, and ventilation (which we will discuss in the next section). The room and any access corridors are required to have both normal and emergency lighting for fire department access. The rooms are also required to have adequate floor drainage to prevent any water build up in the room.

Ventilation Requirements

Ventilation is required for fire booster pump rooms per NFPA 20 and the applicable Mechanical Code requirements. For standard, electric powered pumps minimal ventilation is required per Mechanical Codes. However, if a diesel pump is provided ventilation requirements become more complex and critical. Per NFPA 20, ventilation of the pump room must be provided for the following functions:

- To control the maximum temperature 120 degrees fahrenheit at the combustion air cleaner inlet with the engine running at rated load.
- To supply air for engine combustion.
- To remove any hazardous vapors.
- To supply and exhaust air as necessary for radiator cooling of the engine when required.

All ventilation requirements must be coordinated and designed by a Registered Mechanical Engineer.

Testing Requirements

NFPA 20 and 25 have strict testing requirements for all fire pump installations. The suction and discharge piping must be hydrostatically tested at not less than 200 psi, or 50 psi greater than the maximum pressure of the system, for a minimum of 2 hours. The pumps must be tested to show they are capable of reaching and maintaining the system design pressure and flow rate. The manufacturer, or their authorized representatives, must be present for the field acceptance testing.

Per NFPA 25 the pump performance, including flow rate, must be tested annually, at a minimum. Some components that are part of the overall fire pump system have a more frequent testing requirement, such as weekly for all fire pumps under no flow. NFPA 25 also states the requirements for inspection and maintenance of the entire fire pump system and components.

About Layne

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