Session No. 606

What If Your Sprinklers System Fails? The Critical Need for Fire Pump Testing

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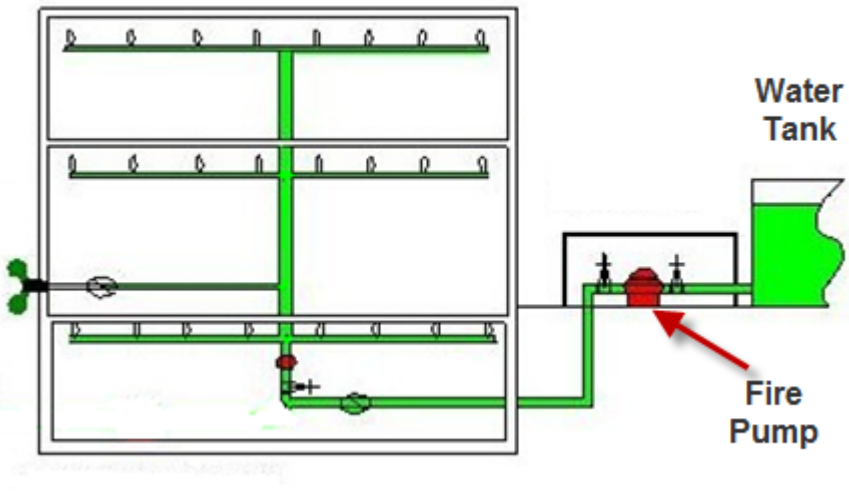
Maintaining Reliability: Essential Component of Your Fire Protection System

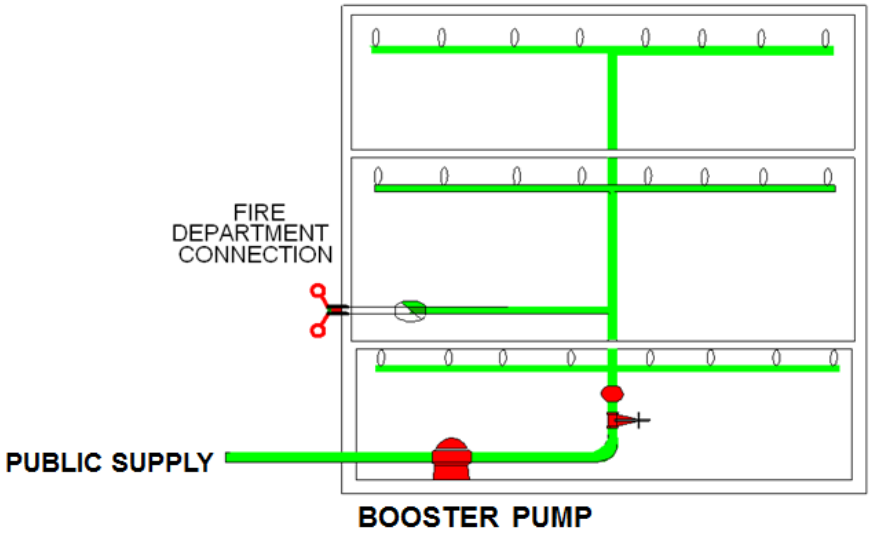
Fire pump systems deliver water with adequate volume and pressure to the sprinkler and standpipe systems. There are several reasons why a sprinkler system would need to be supported by a fire pump:

- There is not enough volume or pressure in the public water supply
- Changes to the operations of the building protected by the sprinkler system increase the fire risk, which requires a higher delivered density to the sprinkler heads
- The volume or pressure of the public water supply has been negatively impacted by the demands of development and expansion, OR no public water supply is present

There are two types of pumping systems based on the source of the water supply:



A fire pump draws water from a private water supply such as a tank, rivers, or underground aquifers. There is often only one fire pump in these types of systems and a limited supply of water based on the NFPA occupancy fire protection requirements.



A booster pump attaches to a public water supply that has adequate capacity but inadequate pressure, when the public supply is not adequate to meet the demands of the sprinkler system due to fire loading, or in high-rise buildings where water must be delivered to upper floors. The system booster pump increases the available pressure to an adequate level.

Fire pump systems are a critical component in the fire suppression system and, as with any other mechanical system, must be tested and maintained to maximize their reliability when needed. These systems are dedicated to the fire suppression system and cannot function as a supply of domestic or process water. In a fire, pumping systems are designed to operate until they no longer function, whether they run out of fuel, experience power supply disconnection or failure, or run to complete failure.

Main Components

Pump*:* The type of pump used depends on the source of the supply. The pumps are sized according to NFPA and the needs of the fire suppression system.

- **Horizontal Centrifugal:** This is the most common type of pump, used in systems where there is some available pressure such as a public supply or an elevated tank.
- **Vertical Lift Turbine:** This pump is lowered into a water supply, which can include underground storage, wells, ponds, and rivers. The turbines have different stages to lift the water depending on the depth and the elevation of the water.

Pump Driver: Numerous factors are considered in the type of pump driver to be used in a pumping system. These can include the location of the pump and the reliability of the power supply. The most common types of pump drivers are as noted below:

Electric: Electric motors are one of the more popular and reliable drive systems. The reliability and integrity of the electrical system should be high and maybe backed up with a secondary supply. The electric supply to the pump requires fire proofing to maintain the supply in the event the fire affects an area through which the power supply passes.

Internal Combustion / Diesel: When electrical supplies are remote or unreliable, internal combustion engines are the preferred method of driving the pump. A high degree of care is needed to maintain reliability, specifically with regard to the fuel supply, which must be maintained and protected.

Controller: This unit controls the starting and stopping of the driver and signals alarms indicating that the system is operating or if there are problems with the power supply or driver. The type of controller is dependent on the type of driver.

The controller should start automatically when a pressure drop occurs in the fire system. Controllers should be arranged so the pumping system requires human response to shut down, rather than shutting down automatically when the pump is the sole source water supply.

	**Electric Fire Pump Controller**
	**Electric Fire Pump Controller with Automatic Transfer Switch** (blue arrow). If the fire pump is connected to a secondary electric supply via a transfer switch at the fire pump it should be tested as per NFPA 25. Monthly under a "no-load" condition and annually during the pump test. During the annual pump test the transfer switch is operated while the pump is operating at 150% of its rating. Power must switch automatically and the pump continues to run on emergency power. Pumps readings must be taken when the pump is operating on emergency power. The readings are compared to when the pump is operating on utility power.

	**Diesel Fire Pump Controller**

Alarms: The National Fire Protection Association recommends the following alarms for fire pumps and their related equipment:

- Fire Pump Running
- Fire Pump Power Failure to indicate loss of power to electric motor
- Fire Pump Failure to Start for diesel engines
- Pump Controller not in Automatic Mode for diesel controller
- Diesel Engine Trouble to signal battery trouble, over speed, or low oil
- Pump House Temperature
- Suction Tank Low Water Level

Maintenance and Testing

Regardless of the type of pumping system, maintenance and testing are necessary to ensure its reliability in a fire event. There are three variable factors to test the pump speed, pressure, and discharge rate. Pump testing can be a dangerous operation, and all safety precautions should be taken while providing maintenance and testing on fire pumps.

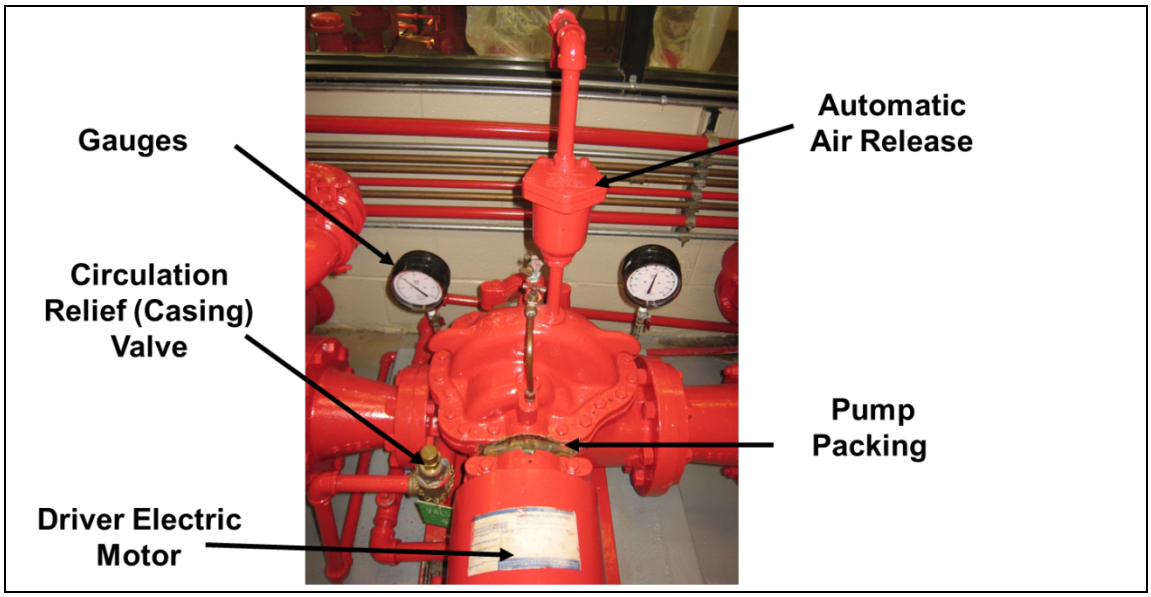
Water supply: There must be an adequate and reliable water supply. This needs to be verified and tested on a regular basis. Typically, a weekly visual check of water levels or pressure is sufficient.

Exercise the pump: Pumps need to be started on a weekly* basis by pressure drop (see photo below, green arrow). This simulates actual starting conditions. The pump operates in churn, meaning the only water flowing will be from casing relief valve. The main difference between diesel and electric system churn tests is the time of operation. Electric systems need to run for only 10 minutes, while diesel-driven systems should operate for 30 minutes. This is the most overlooked part of the maintenance routine. *Please note the 2011 edition of NFPA 25 has changed the frequency for electric driven fire pump from weekly to monthly starting.

Open Valve To Start Pump Via Pressure Drop

During this weekly operation, the following recordings should be taken (see photo below):

- Record the system suction and discharge pressure gauge readings
- Check the pump packing glands for slight discharge, about one drip per second on either side of the pump, adjust gland nuts if necessary
- Check packing boxes, bearings for overheating
- Record the pump starting pressure
- Check pump casing relief for water flow adjust as needed



Electrical system procedure:

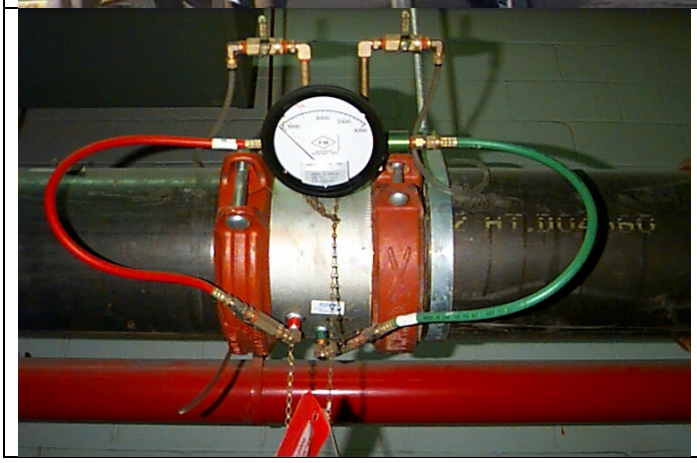
- Observe the time it takes for the motor to accelerate to full speed
- Record the time the controller is on the first step (for reduced voltage or reduced current starting)
- Record the time the pump runs after starting (for automatic stop controllers)

Diesel engine system procedure:

- Observe the time for engine to crank
- Observe the time for engine to reach running speed
- Observe the engine oil pressure gauge, speed indicator, water, and oil temperature indicators periodically while engine is running
- Record any abnormalities
- Check the heat exchanger for cooling water flow

Annual Flow Test

Annual Flow Testing: Pumps should be flow tested annually. This is done by either connecting hoses to the pump header or the use of a bypass flowmeter. If testing involves the use of a bypass flowmeter, hoses must still be used at least once every three years.



Follow these common steps during the annual flow test when using the flowmeter. The flow meter should be calibrated based on the manufactures recommendations.

At no-flow condition (churn):

- Check the circulation relief valve for operation to discharge water
- Check the pressure relief valve (if installed) for proper operation
- Continue the test for 30 minutes

At each flow condition:

- Record the electric motor voltage and current (all lines)
- Record the pump speed in rpm
- Record the simultaneous (approximately) readings of pump suction and discharge pressures and pump discharge flow

Proper maintenance and testing of fire and booster pumps will ensure these vital components work as designed when needed. These are highly engineered systems, which are also very reliable. The maintenance programs should be incorporated into your facility's preventative maintenance program.

Resources

National Fire Protection Association (NFPA). 2013. *Standard for the Installation of Stationary Pumps for Fire Protection* (NFPA 20). Quincy, MA: National Fire Protection Association

National Fire Protection Association (NFPA). 2011. *Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems* (NFPA 25). Quincy, MA: National Fire Protection Association

NOTE: This informational paper is necessarily general in content and intended to provide an overview of certain aspects of fire pump testing with an edition date of June 2013. This document is advisory in nature and is for informational purposes only. No liability is assumed by reason of the information this document contains. The information provided should not be relied upon as legal advice or a definitive statement of the law in any jurisdiction. For such advice, a listener or reader should consult their own legal counsel.