



Loss Control Department
Technical Information Paper Series

Fire Pumps

An Overview

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Fire Pumps: An Overview

Introduction

A fire pump is an integral component of a total fire protection system. A fire protection system at a facility may include automatic sprinkler systems, standpipes, hose stations, and/ or fire hydrants.

The purpose of a fire pump is to provide or enhance the water supply *pressure* from public mains, suction tanks, gravity/elevated tanks, lakes, and other bodies of water.

Listed and Approved

The pump, driver, controller, and auxiliary equipment should be U.L. Listed (Underwriters Laboratories) and/or F.M. Approved (Factory Mutual) to ensure that the equipment has been thoroughly examined and appropriately tested for fire pump installations.

NFPA 20, *Standard for the Installation of Centrifugal Fire Pumps* require the use of listed equipment, or approved equipment, or both. Under the testing and listing approval system, the manufacturer is responsible for providing a listed or approved pump that will perform satisfactorily when installed in conformance with NFPA 20. Individuals responsible for installing the pump and auxiliary equipment must also follow the provisions of NFPA 20.

Types and Characteristics

The two most common types of fire pumps are the *horizontal-shaft centrifugal pump* and the *vertical-shaft turbine pump*. The horizontal shaft centrifugal pump is one in which the pressure is developed by impelling water outward from a center of rotation. The impeller is mounted on a horizontal shaft. The vertical shaft centrifugal pump is similar, but the impeller is mounted on a vertical shaft.

These pumps can be driven by electric motor, internal combustion engines, or steam turbine. Fire pumps are available with rated capacities from 25 to 5,000 gallons per minute (gpm). Pressure ratings range from 40 to 394 pounds per square inch (psi) for horizontal pumps and 26 to 510 psi for vertical-shaft turbine pumps. Note that natural gas, L-P Gas, or gasoline engines are not recognized by NFPA 20.

Horizontal-shaft centrifugal fire pumps are required to be installed to operate under positive suction head (e.g., municipal water supply). For new installations, NFPA 20 no longer allows the use of horizontal centrifugal fire pumps taking suction under lift (e.g., from a pond, reservoir, lake, etc.). If the water supply is such that suction lift cannot be avoided, a vertical-shaft turbine fire pump should be installed.

Fire pump design characteristics provide maximum reliability and specific head-discharge in psi (pounds per square inch). Fire pumps are designed to provide their rated capacity with a built-in safety factor (150 percent of rated capacity at 65 percent of rated pressure) to provide a cushion in the event that there is a greater than expected demand at the time of a fire.

Auxiliary Equipment

Fire pump accessories have an important bearing on the complete functioning of a fire pump. An understanding of the following auxiliary equipment is worthy of attention.

A *motor controller* is a critical component to ensure the successful operation of the pump. The controller includes timers, disconnecting means, circuit breakers, and similar devices.

The *power supply* to the fire pump should be positioned upstream from the facility's main electrical disconnect. In the event of a fire, this will allow the fire pump to continue to run, even though the power to the facility has been disconnected (e.g., standard operating procedures for the fire department may be to disconnect the main power supply to minimize the danger of electrical shock to fire department personnel). All electrical wiring should be in accordance with NFPA 70, *National Electrical Code*.

Circulation relief valves are used to prevent the pump from overheating. Their function is to open at slightly above-rated pressure when there is little or no discharge, so that sufficient water is discharged. These valves are not needed on diesel pumps where cooling water is taken from the pump discharge.

Relief valves are required on the discharge line when the operation of the pump can result in excess pressure.

Jockey pumps maintain pressure in the underground, compensate for leakage, and reduce the number of times the fire pump starts. Jockey pumps are not needed on all fire pump installations; however, they are usually found where there is an extensive underground piping system. They are equipped with gauges, control valves, and a check valve.

Hose valves are used in testing pumps. 2 1/2" valves are attached to a manifold placed outside the pump room to avoid any damage to the pump, driver, and controller.

Pump Room

Pump rooms and power facilities should be as free as possible from exposure to fire, explosion, flood, and windstorm damage. Light, heat, ventilation, and floor drainage should be provided for pump rooms. Pumps should be located in fire resistive or non-combustible buildings. A dry location above grade is recommended. Pump rooms should be large enough to accommodate personnel as well as all equipment and devices for inspection, maintenance, and testing.

Flushing and Hydrostatic Tests

New fire pump installations require the suction piping to be flushed at designated flow rates or at the hydraulically calculated demand rate of the system, whichever is greater. The designated flow rates are dependent upon the size of the suction pipe. (Refer to the following table.)

Pipe Size (Inches)	4	5	6	8	10	12
Flow (GPM)	390	620	880	1560	2440	3520

Suction and discharge piping should be hydrostatically tested at not less than 200 psi pressure, or at 50 psi in excess of the maximum pressure to be maintained in the system, whichever is greater. The pressure should be maintained for two hours.

Field Acceptance Tests

Field acceptance tests are required when a new fire pump has been installed. This test procedure ensures that the pump, driver, controller, and auxiliary equipment has been properly installed and is operating per the manufacturer's specifications. The pump manufacturer or a representative should be present during the field acceptance test.

Inspection, Maintenance, and Testing

The building owner or a representative (e.g., management company) is responsible for the maintenance of the fire pump. Fire pumps should be inspected, maintained, and tested per the manufacturer's specifications. If the manufacturer's specifications are unavailable, refer to the standard for the maintenance of fire pumps NFPA 25 (*Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems*) or The Hartford's *Automatic Sprinkler Systems Inspection, Maintenance, and Testing Procedures Guide*.

A comprehensive maintenance program is generally broken down into three components: inspection, maintenance, and testing.

Inspection. A visual examination of the fire pump to verify that it appears to be in operating condition and is free of physical damage. Examples include:

- Heat in pump room is minimum 40 degrees F (70 degrees F for diesel engines)
- Pump suction, discharge, and bypass valves are open.
- Controller pilot light (power on) is illuminated.

Maintenance. The work that is performed on the fire pump to make repairs or to keep it operable. Examples include:

- Lubricate pump bearings
- Clean pump room louvers
- Clean strainer and filter in diesel fuel system

Testing. A procedure used to determine the status of the fire pump and auxiliary equipment by conducting periodic physical checks. Examples include:

- Conduct a weekly churn test (run pump without water flowing)
- Conduct an annual full-flow performance test
- Operate alarm, supervisory, and trouble signals

Analyze Inspection, Maintenance, and Test Results

The building owner or a representative should analyze inspection, maintenance, and test results to ensure that the fire pump and auxiliary equipment is working properly. Where the results have identified deficiencies, steps should be immediately taken to correct the problem(s). This important step is often overlooked, potentially leaving fire pumps inoperable. Be sure to include this step in the overall fire pump maintenance program.

What to Do When a Pump Doesn't Operate Properly

Measures should be taken during an impairment to ensure that increased risks are minimized and that the duration of the impairment is limited. NFPA 20 provides a trouble-shooting checklist to help in identifying causes of pump problems. Qualified personnel must make the necessary repairs and adjustments to ensure proper pump operation.

If the pump output is so deficient that it will not properly supply the required water pressure for the total fire protection system, an appropriate Impairment Program (e.g., notify the fire department, institute a fire watch, discontinue hazardous operations, etc.) should be incorporated, and repairs should be completed as quickly as possible.

Conclusion

Understanding the proper selection, installation, and maintenance of a fire pump can make the difference between business as usual and a catastrophe at a facility.

Ensure that:

- a pump, driver, controller, and auxiliary equipment is U.L. Listed or F.M. Approved
- the appropriate type of pump and auxiliary equipment is selected and properly installed
- the pump room and power facility is free from fire, explosion, flood, and windstorm damage
- for new installations, flushing, hydrostatic and field acceptance tests have been conducted
- a comprehensive inspection, maintenance, and testing schedule has been incorporated in the facilities overall preventive maintenance program.

References

1. AISG *Fire Protection Bulletin*, "Fire Pump Maintenance," Number 43.04
2. The Hartford, *Automatic Sprinkler Systems, Inspection, Maintenance, and Testing Procedures Guide*
3. NFPA 20, *Standard for the Installation of Centrifugal Fire Pumps*
4. NFPA 25 *Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems*
5. NFPA *Fire Protection Handbook*, 18th Edition, Section 6, Chapter 4.

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