Hydrant Test

Purpose

The purpose of completing a hydrant test is to exercise the hydrant valves through the full range of operation, clear the hydrant of any built-up debris, and to ensure proper operation of the barrel drainage for dry barrel and wall hydrants. Additionally, the test verifies operation, addresses repair issues, and verifies reliability of the hydrant with a reasonable assurance that the water supply is connected and available for use.

Tools/Equipment

1. A hydrant wrench compatible with the operating nut of the hydrants being tested is required.
2. A timing device to measure the drainage time for dry barrel or wall hydrants is required.

Procedure Steps

1. Prior to any testing, notify the water department, the fire department and/or the alarm monitoring company (if needed), and the facility representatives that testing is going to be conducted.
2. Check the area surrounding the hydrant to ensure that there are no obvious conditions that would prevent water from being discharged safely or cause direct damage in the immediate vicinity. Take appropriate caution to ensure personnel and property are protected from the resultant high-pressure hose stream discharge. The use of a flow diffuser can aid in breaking the directed stream and managing resultant energy of the discharge. Where the discharge of water is to an area subject to potential freezing conditions, the facility representative should be advised of the potential for icing conditions.
3. Remove a hydrant cap from the hydrant. Ensure the non-flowing caps are secured and tight.
4. Open the hydrant fully and allow the flow to continue until all foreign material has cleared, with a minimum flow period of 1 minute. Note that the flow of fire hydrants supplied by a fire pump will result in the operation of the fire pump.
5. Slowly close the hydrant to avoid water hammer.
6. Allow any fire pumps that might have automatically operated to run for 10 minutes, for an electric fire pump, or 30 minutes, for a diesel fire pump. Follow this with a shutdown of the fire pump and restoration of automatic operating condition.
7. For dry barrel or wall hydrants, check the barrel for proper drainage, noting the time required for full drainage.
8. Dry barrel or wall hydrants that fail to drain within 60 minutes must be pumped out.
9. Replace the hydrant cap on the hydrant.
10. Upon completion of all testing, notify the water department, fire department and/or the alarm monitoring company (as needed), and the facility representatives that testing is complete, and reset the fire alarm system as necessary.

Evaluation of Results

The hydrant should cycle through the full range of operation without excessive operating force or disengagement and should fully stop the hydrant flow upon closure.

Dry barrel and wall hydrants must fully drain within a period of not more than 60 minutes. Hydrants that do not properly drain must be pumped out to ensure protection of the hydrant against freeze-up.

The hydrant should produce a substantial water flow when fully open. Obvious degradation in the flow capacity of the hydrant should be investigated, and corrective action should be taken as necessary.

References

National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02169-7471.

Cote, A. E. ed., *Fire Protection Handbook®*, 20th edition, 2008.

NFPA 291, *Recommended Practice for Fire Flow Testing and Marking of Hydrants*, 2019 edition.

American Society of Mechanical Engineers, Three Park Avenue, New York, NY 10016-5990.

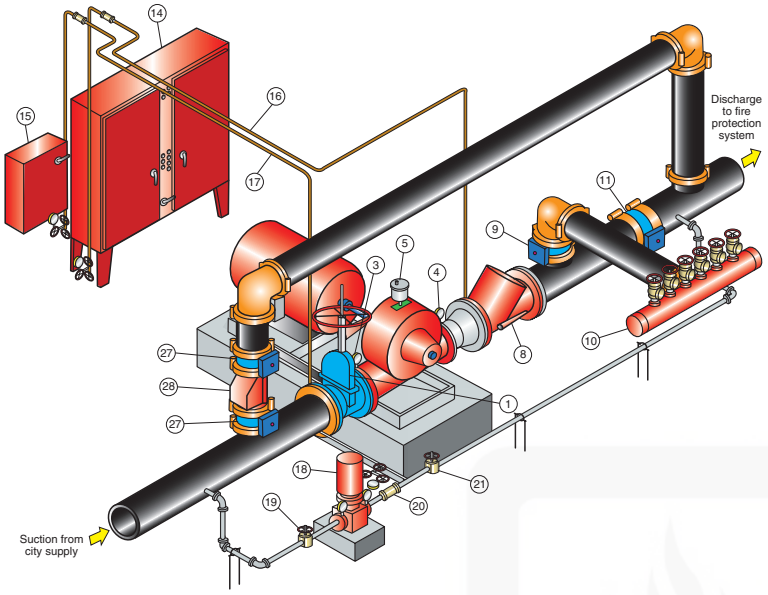
ASME B40.100, *Pressure Gauges and Gauge Attachments*, 2013 edition.

The procedure(s) outlined above is not mandated by NFPA 25 and represents only one approach to conducting this test.

NFPA

What Is a Fire Pump?

Fire pumps are used to increase the water supply pressure available from public mains, gravity tanks, reservoirs, or other sources. An entire fire assembly consists of a fire pump, driver, controller, and accessories.



Legend	
1	OS&Y Gate Valve (Suction Control Valve)
3	Suction Pressure Gauge
4	Discharge Pressure Gauge
8	Check Valve (Pump Discharge)
9	Indicating Gate Valve or Butterfly Valve (Test Header)
10	Test Header
11	Indicating Gate Valve or Butterfly Valve (Discharge Control Valve)
14	Fire Pump Controller
15	Pressure Maintenance Pump Controller (Jockey Pump)
16	Pressure Sensing Line (Fire Pump)
17	Pressure Sensing Line (Jockey Pump)
18	Pressure Maintenance Pump (Jockey Pump)
19	Isolation Valve (Jockey Pump Suction)
20	Check Valve (Jockey Pump Discharge)
21	Isolation Valve (Jockey Pump Discharge)

What Are the Types of Fire Pumps?

The fire pump itself is just the provider of water flow and pressure; the driver (diesel engine or electric motor) provides the energy needed for the pump to spin and move the water. There are many different types of fire pumps that can be used.

Centrifugal Pump

A centrifugal pump creates pressure by using centrifugal force (outward force created from rotating an object) to increase the velocity of the water through the rotation of the impeller.

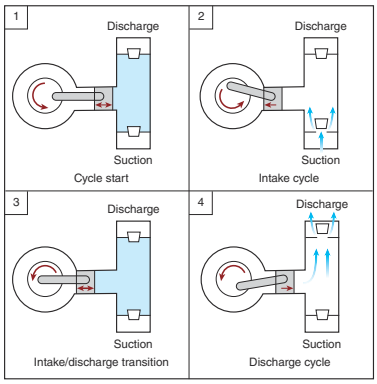
Courtesy of Xylem – AC Fire Pump

Vertical Shaft Turbine-Type Pump

A vertical turbine pump is designed to pump water out of a static source of water (such as a well or an underground tank). This is the only pump that doesn't require the source of water have some pressure coming into the pump, known as suction pressure.

Positive Displacement Pump

A positive displacement pump creates pressure by filling a cavity with water and then pushing it out; these types of pumps can create higher pressures than a centrifugal pump. Positive displacement pumps are generally found as part of water mist and foam-based fire protection systems because of these attributes.

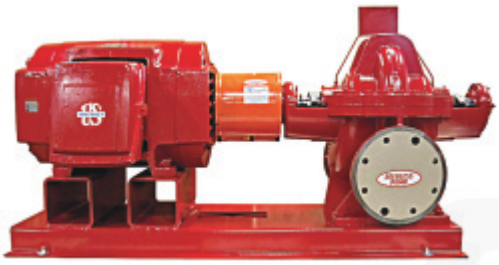


What Are the Types of Fire Pump Drivers?

Power for driving fire pumps is selected on the basis of reliability, adequacy, safety, and economy.

Diesel Engine

Diesel engines have proven to be very reliable and effective, and they are currently the only type of internal combustion engine permitted by NFPA 20, *Standard for the Installation of Stationary Pumps for Fire Protection,* for driving fire pumps. Diesel engines require batteries to power the electric start of the engine and are required to have a fuel storage tank.



Courtesy of Peerless Pump Company

Electric Motor

Electric motors are a reliable, effective means of supplying power to fire pumps. Electric motors need to be supplied by a reliable source of power.

What Is a Fire Pump Controller?

A fire pump controller is a group of devices that serve to control the starting and stopping of the fire pump driver and monitor the signal and status and condition of the fire pump unit.

Steam Turbine

The application of steam as a driver for fire pumps is not as common as that of electric drive or diesel drive, because steam is not as readily available.

Courtesy of Larry Wenzel

ITM

Fire pumps are required to provide water supply pressure or enhance the existing water supply pressure for a fire protection system, such as an automatic sprinkler system. Without a functional pump, the systems will be unable to provide the design pressure and very likely not be able to adequately suppress the fire and because of that, proper Inspection, testing, and maintenance (ITM) is required.

For more information refer to NFPA 20, *Standard for the Installation of Stationary Pumps for Fire Protection.*

Fire Pump Inspection and Testing

NO DEFICIENCIES OR IMPAIRMENTS

NONCRITICAL DEFICIENCIES

ELECTRICAL POWER TO PUMP SYSTEM

- No power to pressure maintenance pump
- Electrical power is provided — controller pilot light not illuminated, transfer switch pilot light not illuminated, reverse phase alarm pilot light on, normal phase light is not illuminated

STEAM SYSTEM

- Testing — Gauge reading and time for turbine to reach running speed not acceptable

DIESEL ENGINE SYSTEM

- Cooling water level not normal
- Crankcase oil level not normal
- Electrolyte level in batteries not normal
- Engine running time meter not reading
- Oil level in right angle gear drive not normal (not at level mark but visible in sight glass)

CRITICAL DEFICIENCIES

ELECTRIC PUMP SYSTEM

- Oil level in vertical motor sight glass not normal

FIRE PUMP

- Annual test — Circulation relief valve and/or pressure relief valve did not work properly at churn condition
- Annual test — Pressure relief valve did not work properly at each flow condition
- Annual test — Alarms did not properly operate
- Annual test — Parallel or angular alignment not correct
- Annual test — Voltage readings at motor not within 5% below or 10% above rated (nameplate)
- Annual test — Flow test results not within 5% of initial unadjusted acceptance test or nameplate

PUMP HOUSE/ROOM

- Excessive water on floor
- Coupling guard not in place
- Ventilating louvers not free to operate
- Heating, lighting, ventilating systems did not pass test

PUMP SYSTEM

- Waterflow test valves open, hose connection valve open, test line contains water
- Suction reservoir does not have required water level, wet pit suction screens missing
- Testing — System suction and discharge gauge reading, or pump starting pressure outside the acceptable range
- Testing — Pump packing gland discharge not acceptable, unusual noise or vibration, packing boxes, bearings, or pump casing overheating

DIESEL ENGINE SYSTEM

- Battery terminals corroded
- Alarm pilot lights are on
- Battery charging current not normal
- Battery failure pilot lights on
- Battery pilot lights off
- Battery terminals corroded
- Battery voltage readings not normal
- Cooling water level not visible
- Electrolyte level in batteries below top of battery plates
- Fuel tank less than two-thirds full
- Water-jacket heater not operating
- Oil level in right angle gear drive below low level (not visible in sight glass or below one finger knuckle for inspection hole)
- Testing — Time for engine to crank and time for engine to reach running speed not acceptable
- Testing — Low oil pressure, high temperature, high cooling water pressure
- Testing — Time for engine to crank and time for engine to reach running speed not acceptable, low oil pressure, high temperature, high cooling water pressure

STEAM SYSTEM

- Steam pressure gauge reading not normal

IMPAIRMENTS

FIRE PUMP

- Annual Test — Flow test does not meet most demanding system flow and pressure requirements
- Testing — Pump did not start automatically
- Testing — Pump failed to run for 10 minutes
- Testing — Pump failed to run for 30 minutes
- Annual test (with transfer switch) — Overcurrent protective devices opened when simulating a power failure condition at peak load, power not transferred to alternate source, pump did not continue to perform at peak load, pump did not reconnect to normal power after removing power failure condition

PUMP HOUSE/ROOM

- Heat not adequate, temperature less than 40°F
- Heat not adequate, temperature less than 70°F for diesel pumps without engine heaters
- Heat not adequate, temperature less than 40°F, not as recommended by the engine manufacturer, for diesel pumps with engine heaters

PUMP SYSTEM

- Wet pit suction screens obstructed
- Suction reservoir empty
- Suction, discharge, or bypass valves not fully open, major leaking such as spraying or leaking to extent that pump performance might be questioned

ELECTRICAL POWER TO PUMP SYSTEM

- No electrical power — controller pilot light not illuminated, transfer switch pilot light not illuminated, isolating switch not closed, reverse phase alarm pilot light on or normal phase light is off
- Testing — Time for motor to accelerate to full speed, time controller is on first step, or time pump runs after starting not acceptable

DIESEL ENGINE SYSTEM

- Fuel tank empty
- Controller selector switch not in auto position
- Crankcase oil level below low level
- Testing — low rpm
- Diesel fuel annual test — Diesel fuel tested for degradation and failed

Source: Table A.3.3.8

8

FIRE PUMPS

Chapter 8 addresses the inspection, testing, and maintenance (ITM) of fire pumps and related equipment. In most cases where fire pumps are installed, the fire protection systems they connect to would be ineffective in fire control if the pumps and connected drivers were not fully functioning. Therefore, proper maintenance is critical to help ensure constant system readiness at all times.

Fire pumps and their associated equipment also constitute a major investment, ranging in cost from $20,000 to more than $1,000,000 when suction tanks are required.

Fire pumps are typically required for effective fire protection system operations. When pumps that were put in place to protect a facility must be removed from service for repairs, the facility can become unprotected for the duration of the repair. In some of these situations, the protection of property and life is considered impaired, resulting in a shutdown of operations mandated by the authority having jurisdiction (AHJ) until repairs are made. This shutdown could result in major business interruption loss, in addition to costly pump repairs. Thus, the failure to properly maintain fire pumps and related equipment can quickly result in significant direct and indirect costs.

8.1* General.

A.8.1 A fire pump assembly provides waterflow and pressure for private fire protection. The assembly includes the water supply suction and discharge piping and valving; pump; electric, diesel, or steam turbine driver and control; and the auxiliary equipment appurtenant thereto.

Fire pumps and associated piping are installed in accordance with NFPA 20, *Standard for the Installation of Stationary Pumps for Fire Protection*. For more information on the installation and design requirements, refer to that standard.

8.1.1 Minimum Requirements.

8.1.1.1 This chapter shall provide the minimum requirements for the routine inspection, testing, and maintenance of fire pump assemblies.

FAQ What is the testing frequency for a fire pump that only services a standpipe system in a municipal or private office building?

All stationary fire pumps must be tested weekly or monthly, depending on the driver type and a complete annual test per the requirements of Table 8.1.1.2, regardless of the type of system they are connected to or building occupancy they are installed in.

Exhibit 8.1 shows a typical horizontal split-case fire pump installation, and Exhibit 8.2 shows a typical vertical turbine fire pump installation.

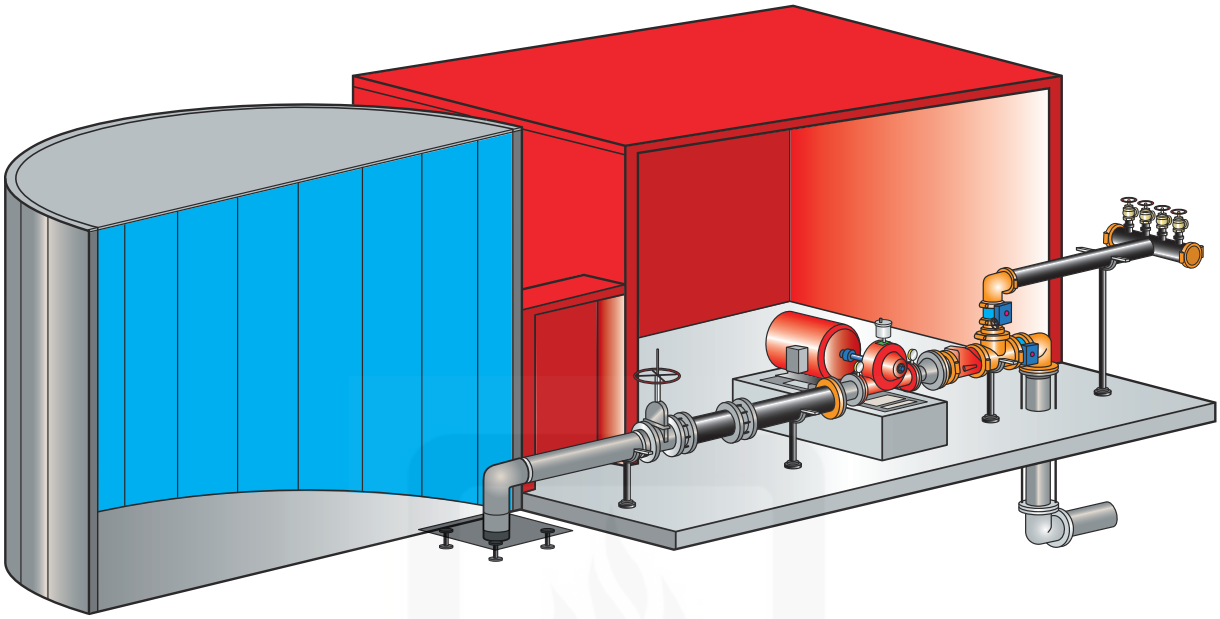
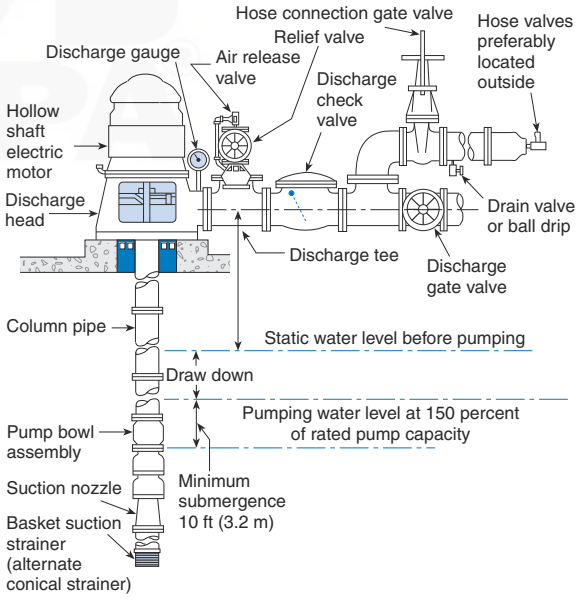


EXHIBIT 8.1 *Horizontal Split-Case Fire Pump Assembly. (Courtesy of Stephan Laforest)*

EXHIBIT 8.2 *Vertical Turbine Fire Pump Assembly. (Source: NFPA 20, 2019, Figure A.7.2.2.1)*



Note: The distance between the bottom of the strainer and the bottom of the wet pit should be one-half of the pump bowl diameter but not less than 12 in. (305 mm).

8.1.1.2* The minimum frequency of inspection, testing, and maintenance shall be in accordance with the manufacturer's recommendations and Table 8.1.1.2.

Δ ***TABLE 8.1.1.2*** *Summary of Fire Pump Inspection, Testing, and Maintenance*

Item	*Frequency*	*Reference*
Inspection		
Alignment	Annually	8.3.6.4
Cable/wire insulation	Annually	8.1.1.2.5
Diesel engine system	Weekly	8.2.2(4)
Electric system	Weekly	8.2.2(3)
Engine crankcase breather	Quarterly	8.1.1.2.12
Exhaust system, drain condensate trap, and silencers	Annually	8.1.1.2.13
Flexible hoses and connections	Annually	8.1.1.2.11
Fuel tank vents and overflow	Annually	8.1.1.2.10
Plumbing parts — inside and outside of panels	Annually	8.1.1.2.6
Printed circuit board (PCB) corrosion	Annually	8.1.1.2.4
Pump	Weekly	8.2.2(2)
Pump house/room	Weekly	8.2.2(1)
Shaft movement or endplay while running	Annually	8.1.1.2.1
Steam pump system	Weekly	8.2.2(5)
Suction screens	Annually	8.3.3.15
Test		
Automatic transfer switch	Annually	8.3.3.12
Automatic transfer switch and emergency/standby generators	Per NFPA 110	8.3.6.1, 8.3.6.2
Diesel engine–driven fire pump (no flow)	Weekly	8.3.1.1
Diesel fuel testing	Annually	8.3.4.1
Electric motor–driven fire pump (no flow)	Weekly/monthly	8.3.1.2
Electronic control module (ECM)	Annually	8.3.3.16
Fire pump alarm signals	Annually	8.3.3.13
Flow meters	Annually	8.3.3.5.3
Fuel tank, float switch, and supervisory signal for interstitial space	Quarterly	8.1.1.2.7
Gauges, transducers, and other devices used for testing	Annually	8.3.3.5.2
Main pressure relief valve	Annually	8.3.3.11, 13.5.6.2.3
Pump house/room environmental conditions		8.3.6.3
Pump operation (no flow)	Weekly/monthly	8.3.2, 8.3.5
Pump performance (flow)	Annually	8.3.3, 8.3.5
Supervisory signal for high cooling water temperature	Annually	8.1.1.2.8
Maintenance		
Batteries	Annually	8.1.1.2.15
Circulating water filter	Annually	8.1.1.2.21
Control and power wiring connections	Annually	8.1.1.2 16
Controller and all other components of the pump assembly	Per manufacturer	8.5
Diesel active fuel maintenance system	Annually or per manufacturer	8.3.4.3
Diesel engine system	Per manufacturer	8.5
Electric motor and power system	Per manufacturer	8.5
Electrical connections	Annually	8.1.1.2.2
Engine lubricating oil	50 operating hours or annually	8.1.1.2.17
Engine oil filter	50 operating hours or annually	8.1.1.2.18
Fuel filter	50 operating hours or annually	8.1.1.2.19
Fuel tank — check for water and foreign materials	Annually	8.1.1.2.9
Measure back pressure on engine turbo	Annually	8.1.1.2.14
Power transmission components with elastomeric materials (including torsional couplings)	5 years or per manufacturer	8.1.1.2.23
Pressure gauges and sensors	Annually	8.1.1.2.22
Pump and motor bearings and coupling	Annually or as required	8.1.1.2.3
Sacrificial anode	Annually	8.1.1.2.20

A.8.1.1.2 Alternative Inspection, Testing, and Maintenance Procedures. In the absence of manufacturer's recommendations for preventive maintenance, Table A.8.1.1.2 can be used for alternative requirements.

Δ ***TABLE A.8.1.1.2*** *Alternative Fire Pump Inspection, Testing, and Maintenance Procedures*

Complete as Applicable	*Visual Inspection*	*Inspect*	*Change*	*Clean*	*Test*	*Frequency*
Pump System						
Pump bearings		X				Annually
Lubricate pump bearings			X			As needed
Inspect pump shaft end play		X				Annually
Inspect accuracy of pressure gauges and sensors		X	X			Annually (replace or recalibrate when 5% out of calibration)
Inspect pump coupling alignment		X				Annually
Wet pit suction screens		X		X		After each pump operation
Mechanical Transmission						
Lubricate coupling/flexible connecting shaft (driveshaft)		X				Annually
Lubricate right-angle gear drive		X				Annually
Electrical System						
Exercise isolating switch and circuit breaker					X	Monthly
Trip circuit breaker (if mechanism provided)					X	Annually
Operate manual starting means (electrical)					X	Semiannually
Inspect and operate emergency manual starting means (without power)	X				X	Annually
Lubricate mechanical moving parts (excluding starters and relays)		X				Annually
Calibrate pressure switch settings*		X				Annually
Grease motor bearings		X				Annually
			X			Annually or as needed
Any corrosion on printed circuit boards (PCBs)*	X					Annually
Any cracked cable/wire insulation*	X					Annually
Any leaks in plumbing parts*	X					Annually
Any signs of water on electrical parts*	X					Annually
Diesel Engine System						
Fuel						
Tank level	X	X				Weekly
Tank float switch	X				X	Weekly
Solenoid valve operation	X				X	Weekly
Strainer, filter, or dirt leg, or combination thereof				X		Quarterly
Water and foreign material in tank				X		Annually
Water in system		X		X		Weekly
Flexible hoses and connectors	X					Weekly
Tank vents and overflow piping unobstructed		X			X	Annually
Piping	X					Annually

Δ ***TABLE A.8.1.1.2*** *(Continued)*

Complete as Applicable	*Visual Inspection*	*Inspect*	*Change*	*Clean*	*Test*	*Frequency*
Lubrication system						
Oil level	X	X				Weekly
Oil change			X			50 hours or annually
Oil filter(s)			X			50 hours or annually
Lube oil heater		X				Weekly
Crankcase breather	X		X	X		Quarterly
Cooling system						
Level	X	X				Weekly
Antifreeze protection level					X	Semiannually
Antifreeze		X				Annually
Adequate cooling water to heat exchanger		X				Weekly
Rod out heat exchanger				X		Annually
Water pump(s)	X					Weekly
Condition of flexible hoses and connections	X	X				Weekly
Jacket water heater		X				Weekly
Inspect duct work, clean louvers (combustion air)	X	X	X			Annually
Water strainer				X		Quarterly
Exhaust system						
Leakage	X	X				Weekly
Drain condensate trap		X				Weekly
Insulation and fire hazards	X					Quarterly
Excessive back pressure					X	Annually
Exhaust system hangers and supports	X					Annually
Flexible exhaust section	X					Semiannually
Battery system						
Electrolyte level		X				Weekly
Terminals clean and tight	X	X				Quarterly
Case exterior clean and dry	X	X				Monthly
Specific gravity or state of charge					X	Monthly
Charger and charge rate	X					Monthly
Equalize charge		X				Monthly
Clean terminals				X		Annually
Cranking voltage exceeds 9 volts on a 12 volt system or 18 volts on a 24 volt system		X				Weekly
Electrical system						
General inspection	X					Weekly
Tighten control and power wiring connections		X				Annually
Wire chafing where subject to movement	X	X				Quarterly
Operation of safeties and alarms		X			X	Semiannually
Boxes, panels, and cabinets				X		Semiannually
Circuit breakers or fuses	X	X				Monthly
Circuit breakers or fuses			X			Biennially
Voltmeter and ammeter for accuracy (5%)		X				Annually
Any corrosion on printed circuit boards (PCBs)	X					Annually
Any cracked cable/wire insulation	X					Annually
Any leaks in plumbing parts	X					Annually
Any signs of water on electrical parts	X					Annually

*Required only where the extent of such work can be completed without the opening of energized electric motor-driven fire pump controller.

The purpose of Table A.8.1.1.2 is to provide the owner and fire pump service provider with minimum ITM guidance when information from the manufacturer is not available. When that information is available, however, it should be followed. Manufacturers know their products best and often provide much more detail on how to maintain their products. This table is more "generic" in nature and while it may provide sufficient guidance for basic fire pump ITM, it might not address specific circumstances encountered in the field.

8.1.1.2.1* Shaft movement or end play shall be inspected annually with the pump operating.

A.8.1.1.2.1 Shaft movement should be less than 1/8 in. (3 mm).

Δ **8.1.1.2.2 Electrical Connections.**

The electrical components of fire pump assemblies are a specialty system, and as such, any work on or around them requires special attention both from a technical as well as a safety perspective. For more information on the safety requirements, see 4.9.6 and the associated commentary. NFPA 20 refers to *NFPA 70®*, *National Electrical Code®*, for proper installation of these components. ITM of electrical systems associated with fire pumps must be in accordance with this chapter and *NFPA 70* as required.

N **8.1.1.2.2.1*** Electrical connections shall be inspected annually and repaired as necessary to the extent that such work can be completed without opening an energized electric-motor-driven fire pump controller.

NFPA 25 now restricts the opening of energized electric fire pump controllers in order to limit personnel exposure to arc flash or shock hazards. This change came as a result of TIA 17-2, which was issued on the 2017 edition. It has been determined that the benefits of opening energized controllers to take voltage and ampere readings or to check connections do not outweigh the risks. Other tests that are performed regularly on a fire pump can be used to indicate whether there are electrical issues, such as a variance in voltage or amperes. If it is determined that further investigation is required and an energized electric controller needs to be opened, it should be done by a qualified individual under the guides of NFPA *70E®*, *Standard for Electrical Safety in the Workplace®*, or by another approved safety standard as required by 4.9.6.

N **A.8.1.1.2.2.1** Where available, a disconnect switch upstream of the fire pump controller can be opened and the isolated electrical connections inside the electric-motor-driven controller inspected. In some cases the fire pump controller cannot be isolated without shutting off power to the building, and shutting off power to the building could be impractical.

N **8.1.1.2.2.2*** The isolating switch in the fire pump controller that is located in a separate compartment from the other controller components shall be permitted to be used to meet the requirement of 8.1.1.2.2.1.

An isolating switch that is located in its own rated enclosure as part of a rated fire pump controller enclosure ahead of all the electrical components can be used to de-energize the fire pump controller. This makes it safe for personnel to open the controller and perform ITM activities on electrical connections and components. See Exhibit 8.3 for a fire pump controller with a separate isolation switch enclosure.

N **A.8.1.1.2.2.2** Some manufacturers are including an isolation switch upstream of all controller components in an isolated sub-cabinet as part of the controller. This permits de-energizing the circuit boards and other controller components and allows the controller to be opened for ITM activities.