

Pocket Guide to Inspecting, Testing and Maintaining Fire Protection Equipment

Fourth Edition



Emergency Response ConsultantsSM

Member of the FM Global Group

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This pocket guide is produced in partnership with Emergency Response Consultants, a member of the FM Global Group. Emergency Response Consultants offers detailed hands-on training to site-level emergency response staff and management.

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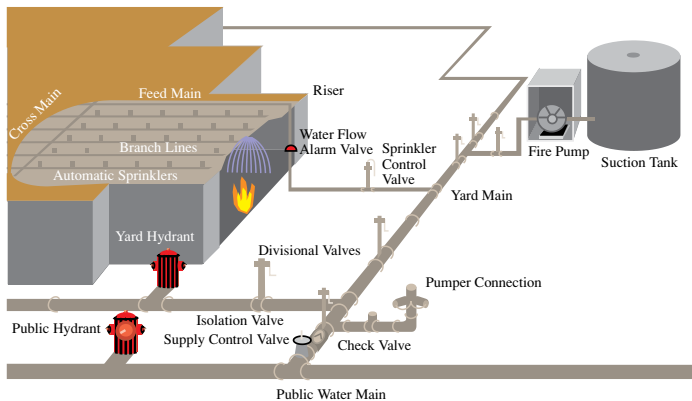
Introduction

Prevention and readiness are the keys to property loss control. The only way to ensure your fire protection equipment is available when needed is to establish a regular inspection, testing and maintenance program.

This pocket guide provides you with instructions on inspecting, testing and maintaining key fire protection equipment. The guide is organized by type of equipment. Within each section, you will find information on:

- Conducting weekly inspections
- Conducting monthly inspections
- Conducting quarterly inspections
- Conducting annual inspections
- Troubleshooting problems

General Sprinkler System Layout



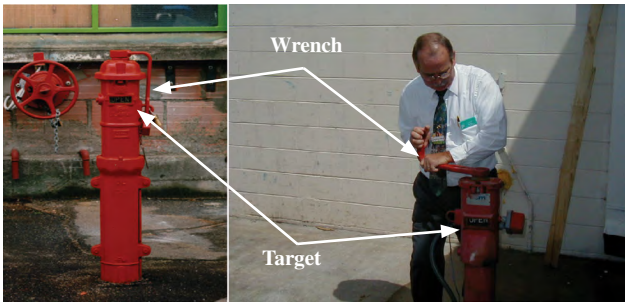
Control Valves

The following pages contain inspection guidelines for control valves, including:

- Post indicator valves (PIVs)
- Wall-mounted post indicator valves (WPIVs)
- Post indicator valve assemblies (PIVAs)
- Indicating butterfly valves (IBVs)
- Outside screw and yoke (OS&Y) valves
- Curb box/roadway valves

Post Indicator Valve (PIV)

The open/shut target may not give a true indication of the valve's position. The valve must be physically tried to confirm its true position.



Weekly Inspection and Test

Inspect valve visually:

- Confirm valve is accessible.
- Verify valve is not mechanically damaged.
- Confirm valve is open and locked.

Monthly Inspection and Test

1. Confirm valve is accessible.
2. Verify valve is not mechanically damaged.
3. Unlock valve (if necessary).
4. Remove wrench from valve.
5. Inspect wrench for mechanical damage.
6. Place long arm of wrench over nut on top of stem.
7. Confirm valve is open by turning handle toward “open.”
8. Close valve three turns to verify maintenance is not required.
9. Reopen completely and apply torque on the valve stem using the wrench. (*Note: When pressure on the wrench is released, the wrench should spring back slightly.*)
10. Reclose valve one-quarter turn.
11. Replace wrench over stem nut on top of valve and over loop on side of valve.
12. Pass shackle through loop on valve to secure wrench and lock valve.

Annual Inspection and Test

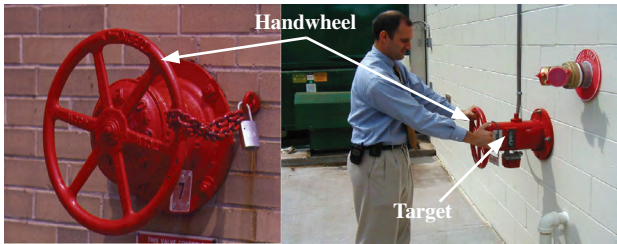
1. Confirm valve is accessible.
2. Verify valve is not mechanically damaged.
3. Unlock valve (if necessary).
4. Remove wrench from valve.
5. Inspect wrench for mechanical damage.
6. Place long arm of wrench over nut on top of stem.
7. Confirm valve is open by turning handle toward “open.”
8. Close valve completely, counting and recording the number of turns it takes to shut the valve. Verify the number of turns to close/open is appropriate.
9. Reopen completely and apply torque on the valve stem using the wrench. (*Note: When pressure on the wrench is released, the wrench should spring back slightly.*)
10. Reclose valve one-quarter turn.
11. Replace wrench over stem nut on top of valve and over loop on side of valve.
12. Pass shackle through loop on valve to secure wrench and lock valve.
13. Perform main drain test (see page 27).

Notes:

- *If the valve is difficult to operate through its full range of motion, lubricate or repair as necessary.*
- *If the number of turns to open or close the valve has been reduced, check the valve for sediment buildup or other obstructions.*

Wall-Mounted Post Indicator Valve (WPIV)

The open/shut target may not give a true indication of the valve's position. The valve must be physically tried to confirm its true position.



Weekly Inspection and Test

Inspect valve visually:

- Confirm valve is accessible.
- Verify valve is not mechanically damaged.
- Confirm valve is open and locked.

Monthly Inspection and Test

1. Confirm valve is accessible.
2. Verify valve is not mechanically damaged.
3. Unlock valve and remove chain (if necessary).
4. Confirm valve is open by turning handwheel toward “open.”
5. Close valve three turns to verify maintenance is not required.
6. Reopen valve completely and apply torque on the valve stem using the handwheel. (*Note: When pressure on the handwheel is released, the handwheel should spring back slightly.*)
7. Reclose valve one-quarter turn.
8. Loop chain through eyebolt on wall and handwheel on valve.
9. Pull chain tight.
10. Pass shackle of lock through chain.
11. Secure chain with lock.

Annual Inspection and Test

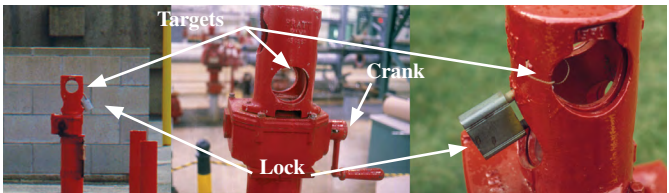
1. Confirm valve is accessible.
2. Verify valve is not mechanically damaged.
3. Unlock valve and remove chain (if necessary).
4. Confirm valve is open by turning handwheel toward “open.”
5. Close valve completely using the handwheel, counting and recording the number of turns it takes to shut the valve.
6. Reopen valve completely and apply torque on the valve stem using the handwheel. (*Note: When pressure on the handwheel is released, the handwheel should spring back slightly.*)
7. Verify the number of turns to close/open is appropriate.
8. Reclose valve one-quarter turn.
9. Loop chain through eyebolt on wall and handwheel on valve.
10. Pull chain tight.
11. Pass shackle of lock through chain.
12. Secure chain with lock.
13. Perform main drain test (see page 27).

Notes:

- *If the valve is difficult to operate through its full range of motion, lubricate or repair as necessary.*
- *If the number of turns to open or close the valve has been reduced, check the valve for sediment buildup or other obstructions.*

Post Indicator Valve Assembly (PIVA)

This valve is mechanically designed to give an operator a true indication of its actual position. The valve's position can be determined by visual examination of the target. If the valve is fully open, the target will be fully open. If the valve is partially or fully shut, the target will be shut a corresponding amount.



Weekly Inspection and Test

Inspect valve visually:

- Confirm valve is accessible.
- Verify valve is not mechanically damaged.
- Confirm valve is open and locked.

Annual Inspection and Test

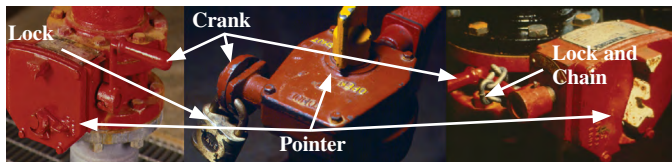
1. Confirm valve is accessible.
2. Verify valve is not mechanically damaged.
3. Unlock valve by removing shackle of lock from matching holes in inner and outer sleeves forming the valve position indicator (if necessary).
4. Confirm valve is open by turning crank toward “open.”
5. Close valve completely using the crank, counting and recording the number of turns it takes to shut the valve.
6. Reopen valve completely and apply torque on the valve stem with crank. (*Note: When pressure on the crank is released, the crank should spring back slightly.*)
7. Verify the number of turns to close/open is appropriate.
8. Reclose crank handle one-quarter turn.
9. Pass shackle of lock through matching holes in inner and outer sleeves forming valve position indicator.
10. Secure lock.
11. Perform main drain test (see page 27).

Notes:

- *If the valve is difficult to operate through its full range of motion, lubricate or repair as necessary.*
- *If the number of turns to open or close the valve has been reduced, check the valve for sediment buildup or other obstructions.*

Indicating Butterfly Valve (IBV)

This valve is mechanically designed to give an operator a true indication of its actual position. The valve's position can be determined by visual examination. A pointer indicates the true position of the valve—open, shut or some point in between.



Weekly Inspection and Test

Inspect valve visually:

- Confirm valve is accessible.
- Verify valve is not mechanically damaged.
- Confirm valve is open and locked.

Annual Inspection and Test

1. Confirm valve is accessible.
2. Verify valve is not mechanically damaged.
3. There are two types of indicating butterfly valves and they are secured differently. One of the following options for unlocking the valve should apply:
 - Unlock valve by removing shackle of lock from matching holes in the flanges of the crank and the body of the valve (if necessary); or
 - Unlock valve by removing shackle of lock from chain that secures crank to body of valve (if necessary).
4. Confirm valve is open by turning crank toward “open.”
5. Close valve completely using the crank, counting and recording the number of turns it takes to shut the valve.
6. Reopen valve completely and apply torque on the valve stem with crank. (**Note:** *When pressure on the crank is released, the crank should spring back slightly.*)
7. Verify the number of turns to close/open is appropriate.
8. Reclose crank handle one-quarter turn.

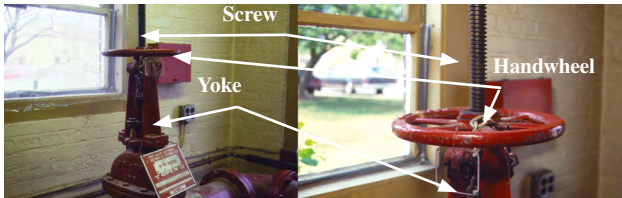
9. There are two types of indicating butterfly valves and they are secured differently. One of the following options for locking the valve should apply:
 - Pass shackle of lock through matching holes in the flanges of the crank and the body of the valve; or
 - Wrap chain around the valve body and crank the handle so the valve cannot be operated without first removing the chain. Pull chain tight. Pass the shackle of the lock through the chain.
10. Secure lock.
11. Perform main drain test (see page 27).

Notes:

- *If the valve is difficult to operate through its full range of motion, lubricate or repair as necessary.*
- *If the number of turns to open or close the valve has been reduced, check the valve for sediment buildup or other obstructions.*

Outside Screw and Yoke (OS&Y) Valve

This valve is mechanically designed to give an operator a true indication of its actual position. The valve's position can be determined by visual examination. The height of the valve stem (screw) above the handwheel corresponds to the diameter of the valve. If the stem is completely visible, the valve is fully open. If the stem is partially or completely obscured, the valve is partially or fully closed.



Weekly Inspection and Test

Inspect valve visually:

- Confirm valve is accessible.
- Verify valve is not mechanically damaged.
- Confirm valve is open and locked. The screw threads should be exposed approximately one pipe diameter.

Annual Inspection and Test

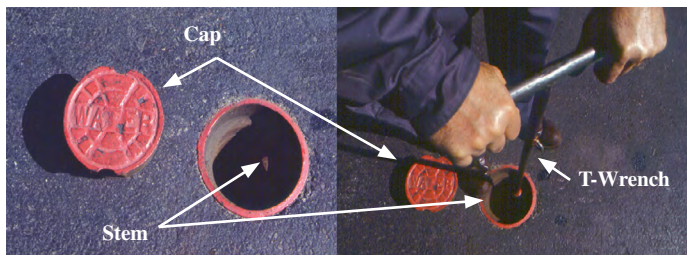
1. Confirm valve is accessible.
2. Verify valve is not mechanically damaged.
3. Unlock valve by removing shackle of lock from chain securing handwheel to yoke.
4. Confirm valve is open by turning handwheel toward “open.”
5. Close valve completely using the handwheel, counting and recording the number of turns it takes to shut the valve.
6. Reopen valve completely, applying torque on the valve stem with handwheel.
7. Verify the number of turns to close/open is appropriate.
8. Reclose valve one-quarter turn.
9. Loop chain through yoke and handwheel on valve.
10. Pull chain tight.
11. Pass shackle of lock through chain and secure valve.
12. Perform main drain test (see page 27).

Notes:

- *If the valve is difficult to operate through its full range of motion, lubricate or repair as necessary.*
- *If the number of turns to open or close the valve has been reduced, check the valve for sediment buildup or other obstructions.*

Curb Box or Roadway Valve

The curb box or roadway valve does not give any indication of the valve's position. It is very important to confirm the direction the valve must be turned to open or close the valve. The valve must be physically tried to confirm its true position. To ensure the valve remains open, store the T-wrench used to open and close the valve in a secure location.



Weekly Inspection and Test

Inspect valve visually:

- Confirm valve is accessible and locked (where practical).
- Verify valve is not mechanically damaged.
- Verify T-wrench is stored in a secure location.

Monthly Inspection and Test

1. Confirm valve is accessible and locked (where practical).
2. Verify valve is not mechanically damaged.
3. Retrieve T-wrench from secure location.
4. Inspect T-wrench for mechanical damage.
5. Remove cap from curb box or roadway valve.
6. Place T-wrench over the stem of valve.
7. Verify the direction of rotation to open/close the valve.
8. Confirm valve is open by turning handle toward “open.”
9. Close valve three turns to verify maintenance is not required.
10. Reopen completely and apply torque on the valve stem using the T-wrench. (**Note:** *When pressure on the T-wrench is released, the T-wrench should spring back slightly.*)
11. Reclose valve one-quarter turn.
12. Restore T-wrench to safe location and secure.
13. Replace cap to curb box or roadway valve.

Annual Inspection and Test

1. Confirm valve is accessible.
2. Verify valve is not mechanically damaged.
3. Retrieve T-wrench from secure location.
4. Inspect T-wrench for mechanical damage.
5. Place T-wrench over the stem of valve.
6. Verify the direction of rotation to open/close the valve.
7. Confirm valve is open by turning handle toward “open.”
8. Close valve completely, counting and recording the number of turns it takes to shut the valve.
9. Reopen valve completely and apply torque on the valve stem using the T-wrench. (*Note: When pressure on the T-wrench is released, the T-wrench should spring back slightly.*)
10. Verify the number of turns to close/open is appropriate.
11. Reclose valve one-quarter turn.
12. Restore T-wrench to safe location and secure.
13. Replace cap to curb box or roadway valve.
14. Perform main drain test (see page 27).

Notes:

- *If the valve is difficult to operate through its full range of motion, lubricate or repair as necessary.*
- *If the number of turns to open or close the valve has been reduced, check the valve for sediment buildup or other obstructions.*

Performing a Main Drain Test

1. Notify central station alarm monitoring agency/personnel, fire brigade (if applicable) and the fire service.
2. Notify employees to ignore the alarm for the system involved.
3. Check the safety of the discharge area.
4. Locate pressure gauges on appropriate sprinkler riser.
5. Record the pressure on the water supply gauge with no water flowing (also known as “static pressure”).
6. Slowly open the main drain valve completely.
7. After the pressure stabilizes, record the lowest pressure indicated on the water supply gauge (also known as “residual pressure”). Compare with previous tests.

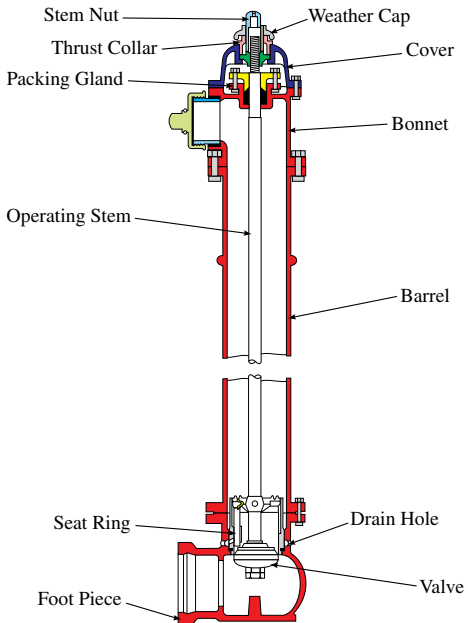
8. Note the color and clarity of the water at the discharge outlet.
9. Slowly close the main drain valve completely.
10. Record the final pressure reading from the water supply gauge.
11. Go outside and verify the water has stopped flowing.
12. Notify central station alarm monitoring agency/personnel, fire brigade, fire service and employees when all tests are completed.

Warning: *Performing a main drain test may pose a risk of injury to personnel and/or result in property damage. To minimize the likelihood of injury and/or property damage, such testing should only be performed under controlled conditions by qualified persons knowledgeable of the potential hazards.*

Common Valve Problems

- Post indicator valves (PIVs) may become inoperative as a result of corrosion or freezing due to a leaking valve.
- PIVs may be broken as a result of frost action or being struck by a vehicle.
- Targets in PIVs may be improperly adjusted and may prevent full valve travel.
- Targets may be accidentally or improperly adjusted to read “open” when the valves are actually closed.
- The directional arrows on a PIV may have two points or may have the wrong point chiseled off.
- Valve gates may become separated from operating stems by corrosion.
- Valve gates may be separated from operating stems by excessive strain when forced in either the open or closed direction against obstructions, heavy deposits or friction.

Hydrants



Weekly Inspection and Test

Check for general condition:

- Accessibility (including snow removal in winter)
- Availability of hydrant wrench
- Hose, nozzles and related equipment, which should be stored dry

Monthly Inspection and Test

- Examine nozzle and cap threads and gasket; lubricate and replace if needed.
- Check dry-barrel-type hydrants for proper drainage:
 1. Remove the cap from one of the discharge outlets.
 2. Determine if water or ice is present.
 3. Inspect for proper drainage.

Annual Inspection and Test

1. Open and flush each hydrant by removing caps and opening valves. Caution: Ensure the stream of water from this test will not cause any damage.
2. Shut valve and check to ensure barrel is empty, or clear drain, and repair any leaks.
3. Lubricate threaded fittings, especially operating stem nut. Depending on the model, the threads of the stem nut can be lubricated through grease fittings or by removing a nut on the weather cap or stem nut, and pouring oil in the bolt hole.

Warning: *Performing a hydrant flow test may pose a risk of injury to personnel and/or result in property damage. To minimize the likelihood of injury and/or property damage, such testing should only be performed under controlled conditions by qualified persons knowledgeable of the potential hazards.*

Troubleshooting Hydrant Problems

- If a hydrant is leaking at a valve, the cause may be an obstruction or a defective valve facing. Attempt to remove the obstruction by opening the valve and flowing water from the outlet; disassembly of the unit for removal of the obstruction may be needed if this does not solve the problem. In the case of dry-type hydrants, the cause also may be a defective valve facing or seat ring; replacement also will require disassembly.
- For dry hydrants not draining properly, the cause may be due to groundwater, a plugged drain or leakage through the hydrant valve. Attempt to clear the drain hole by opening the hydrant one or two turns with the hose outlets closed. If this is not successful, most hydrants must be dug up to expose and clear the drain hole with a rod. Some may give access to the drain hole by disassembly. In locations where the groundwater level is above that of the drain, the hole may need to be plugged and the hydrant drained after each use; such hydrants should be marked.

Sprinklers and Piping

Sprinkler system problems include:

- Corrosion
- Obstruction
- Ice plugs
- Freeze
- Damaged or covered sprinklers
- Missing sprinklers
- Bent pipes



Sprinkler systems must be inspected periodically to ensure they will work properly when needed.

Weekly Inspection and Test

- Check for signs of damage, corrosion or deposits.
- Examine heads for leakage.
- Check for missing heads.
- Check for heads obstructed by storage, ductwork or construction features.

Winter Precautions

- Determine if area heating is adequate.
- Check for openings allowing heat to escape the building.

Every Five Years

Perform a full internal inspection—check internal components per manufacturer recommendations, including:

- Strainers
- Filters
- Gaskets
- Restriction orifices
- Mechanical integrity of moving parts

Alarm Check Valves (Wet Valves)

When a wet sprinkler system operates, water flows through activated sprinkler heads. The flow of water causes the clapper in the alarm check valve to open, activating water flow alarms or mechanical/electrical bells. There is water in the piping above and below the alarm check valve.



Monthly Inspection

Conduct an exterior inspection to ensure:

- Gauges indicate normal pressure
- The valve is free of mechanical damage
- Trim valves are in appropriate open or closed position
- Piping is not leaking

Quarterly Inspection and Test

Test alarm from inspector's test connection (ITC):

- Notify personnel at alarm panel and/or central station of the test to be conducted.
- Instruct one person to stay at the alarm.
- Open ITC valve on the extreme end of the system.
- Note time from opening of valve until alarm is received; this should be less than 60 seconds.

Annually and Following System Impairment

Perform a main drain test:

1. Notify personnel at alarm panel and/or central station of the test to be conducted.
2. Verify the flow from the outlet will not cause any damage.
3. Record static pressure (no water flowing) on the water supply pressure gauge.
4. Open the 2-in. (50-mm) main drain connection completely.
5. Record residual pressure (water flowing) on the water supply pressure gauge.
6. Close drain.
7. Verify pressure under no-flow conditions and compare pressure drop with reference values.

Note: *In extended cold weather (below 0° F [-18° C]), underground mains are subject to freezing. Main drain tests are advisable at least weekly during extreme cold temperatures to ensure there is no freezing in underground mains.*

Warning: *Performing a main drain test may pose a risk of injury to personnel and/or result in property damage.*

To minimize the likelihood of injury and/or property damage, such testing should only be performed under controlled conditions by qualified persons knowledgeable of the potential hazards.

Every Five Years

Perform a full internal inspection—check internal components per manufacturer recommendations, including, but not limited to:

- Strainers
- Filters
- Gaskets
- Restriction orifices
- Mechanical integrity of moving parts

Check Valves

Check valves prevent water from passing from your underground mains back into the potable public water supply.



Five-Year Inspection Guidelines

Every five years:

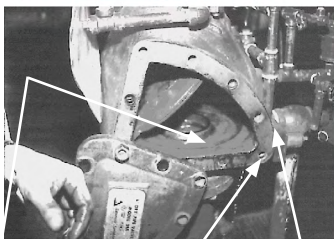
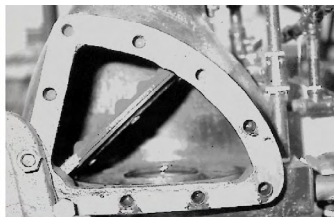
1. Drain and open the check valve.
2. Inspect clapper to verify it can move freely on its hinge.
3. Check gasket to verify it is pliable. Look for wear and tear, brittleness, etc.
4. Check valve seat to verify it is free from corrosion or pitting.
5. Clean and reseal valve.

Dry-Pipe Valves

Dry-Pipe Valve
Water Gauge



Clapper in Latched or Tripped Position



Intermediate Chamber

Automatic Drain

Main Drain



Quick Opening Device

Dry-pipe valves contain water below the clapper and air (or nitrogen) above the clapper. Each psi (bar) of air (or nitrogen) pressure is capable of holding back more water pressure based on the design characteristics of the valve.

When a sprinkler head actuates, air (or nitrogen) is released from the system, causing the differential pressure to change. This releases the clapper, allowing water to flow to the actuated sprinkler head(s).

For large dry-pipe sprinkler systems, a quick opening device (accelerator or exhaustor) is often used to sense small changes in air pressure and to accelerate the tripping of the dry-pipe valve or release air (or nitrogen) from the system.

Weekly Inspection and Test

- Check system air pressure and add air pressure as necessary.
- Check water pressure, inspecting piping for excessive leakage and repairing leaks as necessary.
- Verify the air supply valves to accelerators and exhausters are open.
- Verify accelerator and exhauster air pressure and system air pressure are equalized.
- Drain excess water to prevent it from collecting in accelerators and exhausters.
- Maintain valve room or valve house temperature at a minimum of 40° F (5° C).

***Note:** During extremely cold weather, check entire system daily. Also, check the system low-point drains and drain as necessary.*

Monthly Inspection and Test

- Verify the automatic drain (ball-drip valve) from the intermediate chamber is free to move.
- Check the level of priming water above the clapper and drain excess water.
- Check the operability of accelerators and exhausters per manufacturer's instructions, without tripping the dry-pipe valves.

Annual Inspection and Test

1. Complete a main drain test.
2. Record air/nitrogen pressure.
3. Record water-supply pressure.
4. Perform a partial-flow trip test unless advised otherwise:
 - a. Throttle the sprinkler control valve to within two-and-a-half turns of being fully closed.
 - b. Open inspector's test connection to release air pressure from the system.
 - c. Record the time and air pressure at which the system trips.
 - d. Compare the results with previous tests and take appropriate corrective action if trip time has increased.
5. Drain system and inspect internal valve components.
6. Repair or replace worn components as necessary.
7. Reset valve per the manufacturer's instructions.
8. Check the air-supply system. Verify the air compressor is in good condition. Maintain the air compressor as necessary.

Prior to Cold Weather

- Locate all low points in the system. Install low-point drains as necessary.
- Drain water weekly until no flow is observed.
- Verify the heating system for the dry-pipe valve room or valve house is working properly.

Every Three Years

Perform a full-flow trip test:

1. Keep the sprinkler control valve open fully.
2. Complete the main drain test.
3. Record air/nitrogen pressure.
4. Record water pressure.
5. Open the inspector's test connection.
6. Record the time to trip the valve and the air pressure at the trip point.
7. Record the time for water to arrive at the inspector's test connection. Steady water flow should arrive within 60 seconds. If it doesn't, a flushing investigation (see page 49) or a quick-opening device may be warranted.

Performing a Flushing Investigation

A flushing investigation should be performed on dry-pipe sprinkler systems as detailed in the chart below:

Type of system and conditions	Piping type	Frequency
Dry-pipe and preaction fed from clean water supply	Uncoated ferrous sprinkler piping	After in service for 10 years, after 20 years, and every 5 years thereafter.
Dry-pipe and preaction fed from clean water supply	Internally galvanized ferrous sprinkler piping	Flushing investigations for galvanized piping systems are only needed when the water supply is from an open body of water or when obstructing materials are suspected.
Wet, dry-pipe or preaction fed from open water supply	any	Every 5 years.
Dry-pipe or preaction fed from open water supply where system is tripped more than twice a year	any	Annually.
When any of the following conditions exist: <ul style="list-style-type: none"> ▫ Discharge of obstructive material during a yard main water test. ▫ Foreign material in fire pumps, dry-pipe valves or check valves. ▫ Plugging of pipe or foreign material ▫ Failure to flush underground piping or surrounding public mains following new installations or repairs. ▫ Plugged sprinklers or piping found during building alterations or after a fire. ▫ Defective intake screens for fire pumps taking suction from open bodies of water. 	any sprinkler system or underground piping	As soon as the condition is discovered.

***Note:** The frequency assumes the dry-pipe sprinkler system is supplied by clean water. Perform flushing investigations for all dry-pipe sprinkler systems supplied by open bodies of water (e.g., lakes, ponds, rivers) at a minimum frequency of five years. Contact your local FM Global office for more information.*

The purpose of the flushing investigation is to remove pipe scale, sediment or other obstructions that may have accumulated in the sprinkler piping.

The following equipment is needed:

- Cross main with flushing connection
- Elbow
- Drop nipple
- Bushing
- 2.5-in. (64-mm) hose gate valve
- 2.5-in. (64-mm) hose
- Burlap bag and rope

Flushing Investigation Procedures

Flushing the underground piping is recommended prior to initiating a flushing investigation to prevent pipe scale, sediment and other obstructions from being drawn into the sprinkler system. Buildup of this material may be present after repairs or new construction. In addition, it is recommended that a dry-pipe sprinkler system be tripped and allowed to soak for 24 hours prior to conducting the flushing investigation. This will allow the foreign material in the system to soften and help achieve the best results.

1. Select spot in system to conduct investigation:
 - Hydraulically remote area
 - Any area where velocity decreases
 - Usually at the ends of a cross main and two or three branch lines

Note: *Cross main must be at least 2 in. (50 mm) to allow sufficient flow.*

2. Close control valve using FM Global's *Red Tag Permit System Wall Hanger* (P7427).
3. Drain the system water or remove system air if system was not flooded.
4. Dismantle piping to visually inspect inside pipe.
5. Attach the following to the flushing connection at the cross main and branch lines:
 - Elbow
 - Drop nipple
 - 2.5-in. (64-mm) gate valve or 1.5-in. (38-mm) gate or ball valve for installation on cross main and branch lines
 - 2.5-in. (64-mm) hose or 1.5-in. (38-mm) hose, as appropriate
 - Burlap bag and rope for each flushing connection
6. Reset dry valve and restore the normal system air pressure.
7. Start fire pump (if applicable) for best flow and pressure.
8. Open 2.5-in. (64-mm) cross main flushing valve and allow the system to trip, simulating normal action.

9. Close 2.5-in. (64-mm) cross main flushing valve when water flow clears.
10. Open 1.5-in. (38-mm) branch line flushing valve.
11. Close 1.5-in. (38-mm) branch line flushing valve when water flow clears.
12. Check burlap bags.

Important: Complete flushing is not necessary if material in bag is less than one-half cup (118 ml) or is composed of fine scale (not large enough to block sprinkler orifices).

Fire Pumps – Diesel



Weekly Inspection and Test

Check the general condition of the following items:

Item:	Check:
Valves, piping	Pump suction, discharge and bypass valves to ensure they are open and piping is free of leaks (if access to pump room is not restricted, valves should be locked)

Item:	Check:
Controller	<ul style="list-style-type: none">■ Switch is set on “auto” for automatic operation■ Operation of battery charger (battery pilot lights should be on or failure warning lights off, and voltage and current reading normal on both sets of batteries)■ For lights indicating alarm conditions
Fuel system	<ul style="list-style-type: none">■ Tank level to ensure it is at least three-quarters full■ Any valves in the fuel supply lines from the tank to the driver filter or pump system to ensure they are locked in the open position
Water suction tank	<ul style="list-style-type: none">■ Water suction tank to ensure it is full■ Priming tank to ensure it is full where pumps are taking suction under lift■ Suction screens for obstructions where pumps take suction from open bodies of water

Item:	Check:
Cooling system	<ul style="list-style-type: none"><li data-bbox="311 183 816 244">■ Strainers by removing plug and cleaning as necessary <p data-bbox="350 289 840 385"><i>Note: Use manual bypass lines to ensure system remains in service while performing the procedure.</i></p>
Driver	<ul style="list-style-type: none"><li data-bbox="311 465 705 526">■ Oil level using the dip stick on the engine crankcase<li data-bbox="311 544 508 568">■ Coolant level<li data-bbox="311 591 757 652">■ Oil level on right-angle gear drives, where present
Ventilation louvers in pump house	<ul style="list-style-type: none"><li data-bbox="311 700 591 724">■ Operation of louvers
Winter conditions	<ul style="list-style-type: none"><li data-bbox="311 847 850 938">■ Room heating (should be at least 70° F [21° C] unless an oil heater is provided on the diesel driver)<li data-bbox="311 961 705 985">■ Suction screens for ice buildup<li data-bbox="311 1009 868 1032">■ Water jacket heater to ensure it is operational

The following are weekly test procedures:

1. Start fire pumps automatically by dropping system pressure. Record start pressure; where controller is activated by flow, water can be drawn from the yard main at a hydrant or sprinkler system. This should be done for each set of batteries. Observe any abnormalities related to the following:
 - Start pressures for jockey and fire pump—check against recommended settings
 - Time for engine to crank
 - Time for engine to reach running speed

2. Run for at least 30 minutes, then check and/or record:
 - Operation of the engine governor
 - Operation of pressure-relief valve, if applicable
 - Suction and outlet pressures
 - Cooling water flow from heat exchanger outlet; check circulation relief flow, if applicable
 - Engine gauges periodically during run time (oil pressure, water and oil temperature, speed); record any abnormalities and take any actions needed
 - Packing glands for slight discharge (normal) and adjust, if necessary
 - For unusual noise or vibration
 - Packing boxes, bearings and pump casing for overheating
3. Perform a manual start from each battery.

Monthly Inspection and Test

On a monthly basis, check:

- Battery electrolytes
- For corrosion of battery terminals and condition of conductors and connections

Annual Inspection, Test and Maintenance

Performance test of the pump: Test flow at churn, rated and peak flow (150 percent of rated capacity), and compare results with original acceptance testing and/or manufacturer curves. The test generally will have the pump running for one hour. Flow measuring devices (such as flow meters or pitot tube readings from nozzle streams) should be available, and the test generally will be conducted in the presence of an FM Global engineer and/or contractor.

1. Test at churn pressure. While at no-flow conditions, check the following and continue test for approximately 30 minutes:
 - Pressure-relief valve operation (if one is installed)
 - Circulation-relief valve operation (if one is installed)
2. At each flow condition (100 percent and 150 percent of rated flow):
 - Record suction and discharge pressures.
 - Record engine/pump speed in rpm.
 - Observe any visible abnormality or alarm.

Perform maintenance of equipment per manufacturer recommendations. Annual maintenance includes (but is not limited to) the items below:

Item:	Check:
Pump system	<ul style="list-style-type: none">■ Pump bearing lubrication■ Pump shaft end play■ Accuracy of gauges and sensors■ Battery expiration■ Pump coupling alignment
Mechanical transmission	<ul style="list-style-type: none">■ Lubrication of coupling■ Lubrication of right-angle gear drive, if applicable

Item:	Check:
Diesel engine fuel	<ul style="list-style-type: none">■ Tank level switches■ Solenoid valve operation■ Strainers, filters, etc.■ For water and foreign material in fuel tank■ Flexible hose and connectors■ Tank vents and overflow piping for obstructions■ General condition of piping■ Speed governor and over-speed shutdown operation
Diesel engine lubrication system	<ul style="list-style-type: none">■ Oil level; change as necessary■ Filters; change as necessary■ Lube oil heater■ Crankcase breather■ Low-oil-pressure switch

Item:	Check:
Diesel engine cooling system	<ul style="list-style-type: none">■ Antifreeze level/quality; change as necessary■ For adequate flow of cooling water to heat exchanger (flow requirements vary by model and manufacturer and can be obtained from the vendor; the data can be compared with the cooling system output, which can be estimated with use of a 5- or 10-gal. [18.9- or 37.9-L] container and a timer)■ Heat exchanger; clean (rod out) as necessary■ Water pump■ Condition of flexible hose and connections■ Jacket water heater■ Water strainer■ High-water temperature switch■ Solenoid valve operation

Item:	Check:
Exhaust system	<ul style="list-style-type: none">■ For leakage■ Condensate trap; drain as necessary■ Insulation and fire hazards■ For excessive back pressure■ Exhaust system hangers and supports■ Flexible exhaust section
Battery system	<ul style="list-style-type: none">■ Charger and charge rate/equalize charge
Intake system/ ventilation	<ul style="list-style-type: none">■ Air filter■ Room louver operation■ Obstructions (debris, insects, etc.)

Fire Pumps – Electrical

Weekly Inspection and Test

Check the general condition of the following items:

Item:	Check:
Valves, piping	<ul style="list-style-type: none"> ■ Pump suction, discharge and bypass valves to ensure they are open and piping is free of leaks (if access to pump room is not restricted, valves should be locked)
Controller	<ul style="list-style-type: none"> ■ Power available to controller ■ Reverse phase alarm to ensure it is not activated ■ For lights indicating alarm conditions; correct as necessary
Motor	<ul style="list-style-type: none"> ■ Oil level in sight glass if the motor is mounted in the vertical position
Suction tank	<ul style="list-style-type: none"> ■ Suction tank to ensure it is full ■ Priming tank (pumps taking suction under lift), if one is provided, to ensure it also is full ■ Suction screens for obstructions if pump takes suction from open bodies of water

Item:	Check:
Winter conditions	<ul style="list-style-type: none"><li data-bbox="350 181 822 244">■ Room temperature should be at least 40° F [5° C]<li data-bbox="350 263 757 291">■ Suction screens for ice buildup

The following are weekly test procedures:

1. Start pump automatically by pressure drop and record start pressure. Observe any abnormalities related to the following:
 - Time for motor to accelerate to full speed
 - Time controller is on first step (for reduced voltage/current starting)
2. Run for at least 10 minutes and check/record:
 - Suction and outlet pressure
 - Circulation-relief valve flow
 - Packing glands for slight discharge and adjust, if necessary
 - For unusual noise or vibration
 - Packing boxes, bearings and pump casing for overheating

Annual Inspection, Test and Maintenance

Performance test of the pump: Test flow at churn, rated and peak flow (150 percent of rated capacity), and compare results with original acceptance testing and/or manufacturer curves. The test generally will have the pump running for one hour. Flow measuring devices (such as flow meters or pitot tube readings) should be available, and the test generally will be conducted in the presence of an FM Global engineer and/or contractor.

1. Test at churn pressure. While at no-flow conditions, check the following and continue test for approximately 30 minutes:
 - Pressure-relief valve operation (if one is installed)
 - Circulation-relief valve operation (if one is installed)

2. At each flow condition (100 percent and 150 percent of rated flows):
- Record suction and discharge pressure readings.
 - Record engine/pump speed in rpm.
 - Observe any visible abnormality or alarm.

Perform maintenance of equipment per manufacturer recommendations. Annual maintenance includes (but is not limited to):

Item:	Check:
Pump system	<ul style="list-style-type: none"> ■ Pump bearing lubrication ■ Pump shaft end play ■ Accuracy of gauges and sensors ■ Pump coupling alignment
Mechanical transmission	<ul style="list-style-type: none"> ■ Lubrication of coupling ■ Lubrication of right-angle gear drive, if applicable

Item:	Check:
Electrical system	<ul style="list-style-type: none"><li data-bbox="348 181 819 244">■ Isolating switch and circuit breakers; exercise as necessary<li data-bbox="348 263 774 291">■ Circuit breaker; trip as necessary<li data-bbox="348 310 757 373">■ Manual starting means; inspect and operate<li data-bbox="348 392 888 456">■ Emergency manual starting means; inspect and operate<li data-bbox="348 475 891 503">■ Electrical connections; tighten as necessary<li data-bbox="348 522 951 550">■ Mechanical moving parts; lubricate as necessary<li data-bbox="348 569 930 597">■ Pressure switch settings; calibrate as necessary<li data-bbox="348 616 812 644">■ Motor bearings; grease as necessary

Warning: *The interior of the fire pump controller cabinet contains exposed high voltage parts that may pose a risk of injury or death to personnel and/or result in property damage. To minimize the likelihood of electric*

shock and/or property damage, maintenance and testing requiring the opening of the controller cabinet door should be performed only under controlled conditions by qualified persons knowledgeable of the potential hazards.

Pressure-Reducing Valves (PRVs)

Pressure-reducing valves reduce the high pressure developed by fire pumps serving high-rise buildings to a level that's safe for sprinkler lines and hose connections.



Weekly Inspection and Test

1. Perform a visual inspection to ensure the valve is open and locked.

2. Confirm inlet and outlet pressure readings are within range.
3. Check for leakage.

Monthly Inspection and Test

1. Test the valve to ensure it is operational.
2. Open and close the drain valve downstream of the PRV, establishing flow to ensure proper functioning of the PRV.
3. Confirm inlet and outlet pressure readings are within range.

Annual Inspection and Test

1. Conduct a full-flow test to confirm performance.
2. Open a drain valve downstream of the PRV to establish a flow equivalent to the rated flow of the valve.
3. Verify the PRV regulates outlet pressure within range and rated flow is achieved.

Note: More frequent testing may be required where water is “hard” or considered corrosive to the valve.

Pumper and Standpipe Connections

Pumper and standpipe connections enhance your fire protection system by adding additional water supplies or providing additional hose streams.



Annual Inspection and Test

1. Verify the following:
 - Connections are visible and accessible
 - Couplings or swivels are not damaged and rotate smoothly
 - Plugs or caps are in place and undamaged
 - Gaskets are in place and in good condition
 - Identification signs are in place
 - The check valve is not leaking (pumper connection)
 - The automatic drain valve is in place and operating properly (pumper connection)
 - The clappers are in place and operating properly
2. If plugs or caps are not in place, inspect for obstructions, and verify clappers are fully operational.

Special Protection Systems

Special protection systems include clean agent, carbon dioxide (CO₂), dry chemical, wet chemical, foam, water spray and water-mist systems. FM Global recommends these complex systems be maintained by qualified contractors.

Weekly Inspection and Test

1. Check for signs of damage.
2. Determine if discharge nozzles and detection devices are properly positioned.
3. Determine if any nozzles are missing.
4. Check release panel for power and alarm conditions.
5. Verify controls are properly set.
6. Check agent pressure and/or level gauges.

Monthly Inspection and Test

For low-pressure CO₂ systems, check the low-pressure alarm.

Semiannual Inspection and Test

1. Check cylinders for weight and/or pressure of agent containers; refill or replace if net weight and/or pressure falls outside of proper range.
2. Check dry chemical agent for caking; replace as necessary.

Annual Inspection and Test

1. Check all devices and controls to ensure they are properly aimed and/or set.
2. Conduct a trip test without releasing the agent. Verify the system worked as designed and place system back in service.
3. Test for operation of detection devices.

Fire Alarm Systems

Fire alarm systems provide early fire detection and notify building occupants to evacuate. Fire alarm systems may be used to trigger special protection systems in the event of a fire. FM Global recommends these complex systems be maintained by qualified contractors.



Weekly Inspection and Test

- Operate engine-driven generators for 30 minutes; verify the generator is running smoothly and coolant temperature and lubrication pressure are within normal range.
- Inspect batteries for electrolyte level and corrosion.

Quarterly Inspection and Test

- Check a representative number of notification appliances, so all are tested annually.
- Check open circuit voltage of nickel cadmium batteries.

Semiannual Inspection and Test

- Verify the manual pull stations are capable of sending alarms.
- Check one or more devices on each circuit of all restorable and non-restorable heat detectors (except fixed-temperature, spot-type detectors).
- Verify supervisory signal devices give appropriate signals upon activation.
- Check open circuit voltage and specific gravity for lead acid batteries.

Annual Inspection and Test

- Check voltage of storage batteries under full-load conditions. Replace expired batteries.
- Verify control panel lights and fuses are working.

Other Inspections and Tests

- Check samples of restorable and non-restorable fixed-temperature, spot-type heat detectors 15 years after installation, and then every five years.
- Check primary and secondary power supplies according to existing standards.

Extinguishers



Weekly Inspection and Test

1. Verify the fire extinguisher is visible and accessible.
2. Verify the fire extinguisher is in good physical condition.
3. Confirm the fire extinguisher has been inspected within the last year and is properly tagged.
4. Verify the extinguisher type is appropriate for the occupancy.

Monthly Inspection and Test

1. Check gauges for adequate charge.
2. Ensure lock pin and seal are in place.

Semiannual Inspection and Test

Weigh CO₂ extinguishers and recharge as necessary.

Annual Inspection and Test

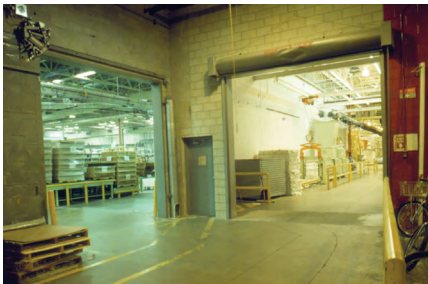
1. Weigh gas cylinder on dry chemical extinguishers (cartridge type). Recharge as necessary.
2. Determine if agent is caked in dry chemical extinguishers. Replace as necessary.
3. Check specific gravity of solution in calcium chloride-type antifreeze fire extinguishers. Replace as necessary.
4. Discharge, clean and refill pump tanks.

At Five and 12 Years

Fire extinguishers are pressure vessels and must be hydrostatically tested at five- or 12-year intervals based on type. See the manufacturer's guidelines for testing intervals.

Fire Doors

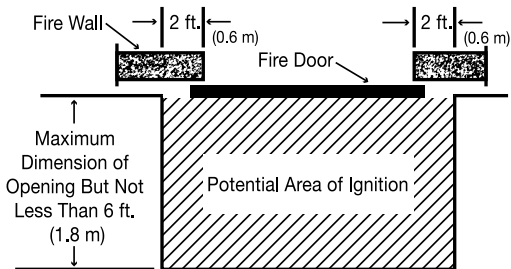
Fire doors are an integral part of your fire protection systems. They help limit the spread of fire and limit property damage and related business interruption. To limit the severity of a fire loss, your fire doors must operate properly.



Weekly Inspection and Test

1. Exercise fire doors, ensuring they move freely.
2. Check for damage to doors and operating hardware. Repair as necessary using FM Approved parts and trained service technicians.
3. Remove items that prevent operation, such as wedges, storage, lift trucks, etc.
4. Clear all combustible material away from fire door.

Note: Below is a diagram illustrating the clearance area of combustible material, such as finished goods, raw material, etc., at fire doors.



PLAN

Annual Inspection and Test

1. Trip-test all fire doors.
2. Adjust or repair any problems and perform a retest.
3. Lubricate moving parts.

***Note:** MFL fire doors need to be trip-tested semiannually. An FM Global engineer must witness at least one trip-test per year. Contact your local FM Global office for more information.*

Establishing an Inspection, Testing and Maintenance Program

An effective inspection, testing and maintenance program for fire protection equipment ensures property loss prevention measures are in place to reduce the frequency of loss, and property loss control measures are in place to control the severity of loss. This two-pronged approach minimizes the incidence and severity of property loss.

Management Responsibilities

Establish and support the program on an ongoing basis by:

- Choosing a qualified person to head the program
- Working with the program manager to implement and maintain an effective program
- Providing inspectors with authority to match their responsibilities
- Involving inspectors in form design and program implementation
- Communicating with inspectors on an ongoing basis regarding the importance of their jobs and the overall status of the program

Inspector Responsibilities

The inspector is responsible for carrying out the day-to-day inspections, testing and maintenance required by the program.

Inspector Qualifications

- A sincere interest in property loss prevention and control
- A working knowledge of fire protection equipment
- Effective communication skills

Conducting an Effective Inspection

1. Detect the problem.
2. Determine the cause and how to correct it.
3. Correct the problem immediately.
4. Document the solution.
5. Verify the implementation of the solution.
6. Audit the situation for ongoing compliance.

Develop an Inventory of What Must Be Inspected

- Mains
- Hydrants
- Control valves
- Check valves
- Backflow preventers
- Alarm check valves
- Dry-pipe valves
- Deluge valves
- Preaction valves
- Accelerators and exhausters
- Alarms
- Main drains
- Pumper connections
- Standpipe connections
- Fire pumps
- Tanks
- Inspector's test connections
- Other

Determine Frequencies for Inspecting, Testing and Maintaining Fire Protection Equipment

Frequencies should be based on:

- FM Global Property Loss Prevention Data Sheets
- National Fire Protection Association (NFPA) standards
- Local standards (national, state, county, municipal, etc.)
- Manufacturer's recommendations

Determine Frequencies for Inspection, Testing and Maintenance Procedures

- Provide detailed steps or procedures.
- Develop forms and checklists.
- Create job aids.

Develop a Comprehensive Inspection, Testing and Maintenance Program Utilizing Inventory, Frequencies and Procedures

The options are:

- Computerized maintenance management systems:
 - Software program
 - Scheduling of events/triggering of events
 - Data storage and retrieval
 - Database management

- Non-computerized maintenance management systems:
 - A paper file with 52 schedule folders, appropriate steps and procedures, forms and checklists, job aids, etc.
 - Wall-mounted systems with magnetic boards and clips
 - Visual monthly and annual organizers

Important: Perform scheduled inspections, tests and maintenance of fire protection equipment per the inspection, testing and maintenance program, identifying deficient or inoperative equipment and taking remedial action to bring the equipment into compliance with standards.

Note: The inspection, testing and maintenance program must be audited at least annually to verify the program is all-inclusive and reflects changes, additions or deletions to the fire protection equipment protecting your property.

Maintenance of Fire Protection Equipment

Equipment	Typical Maintenance	Frequency	FM Global Property Loss Prevention Data Sheet
Alarm check valves	<ul style="list-style-type: none"> ▪ Inspect and clean 	<ul style="list-style-type: none"> ▪ Every five years 	2-81, <i>Fire Protection System Inspection, Testing and Maintenance and Other Fire Loss</i>
Alarms	<ul style="list-style-type: none"> ▪ Test electric and hydraulic ▪ Lubricate 	<ul style="list-style-type: none"> ▪ Monthly ▪ Monthly 	2-81, <i>Fire Protection System Inspection, Testing and Maintenance and Other Fire Loss</i>
Carbon dioxide (CO ₂) systems	<ul style="list-style-type: none"> ▪ Inspect and check system ▪ Weigh cylinders 	<ul style="list-style-type: none"> ▪ Semiannually ▪ Semiannually 	4-11, <i>Carbon Dioxide Extinguishing Systems</i>
Check valves	<ul style="list-style-type: none"> ▪ Inspect and clean 	<ul style="list-style-type: none"> ▪ Every five years 	2-81, <i>Fire Protection System Inspection, Testing and Maintenance and Other Fire Loss</i>
Clean agent systems (Halon, Inergen, FM 200)	<ul style="list-style-type: none"> ▪ Inspect and check system ▪ Weigh cylinders 	<ul style="list-style-type: none"> ▪ Annually ▪ Semiannually 	4-9, <i>Clean Agent Fire Extinguishing Systems</i>
Control valves (PIV, WPiV, OS&Y, IBV, etc.)	<ul style="list-style-type: none"> ▪ Fully close and reopen (counting turns) ▪ Lubricate and inspect 	<ul style="list-style-type: none"> ▪ Annually ▪ Weekly/monthly 	2-81, <i>Fire Protection System Inspection, Testing and Maintenance and Other Fire Loss</i>
Dry chemical systems	<ul style="list-style-type: none"> ▪ Inspect and check system ▪ Weigh cylinders ▪ Inspect agent for caking 	<ul style="list-style-type: none"> ▪ Annually ▪ Semiannually ▪ Semiannually 	4-10, <i>Dry Chemical Systems</i>

Equipment	Typical Maintenance	Frequency	FM Global Property Loss Prevention Data Sheet
Dry-pipe sprinkler system	<ul style="list-style-type: none"> ▪ Perform flushing investigation 	<ul style="list-style-type: none"> ▪ At 10 years ▪ At 20 years ▪ Every five years thereafter 	2-81, <i>Fire Protection System Inspection, Testing and Maintenance and Other Fire Loss</i>
Dry-pipe valves, preaction valves, deluge valves	<ul style="list-style-type: none"> ▪ Trip-test ▪ Inspect ▪ Clean 	<ul style="list-style-type: none"> ▪ Annually ▪ Annually ▪ Annually 	2-81, <i>Fire Protection System Inspection, Testing and Maintenance and Other Fire Loss</i>
Fire doors	<ul style="list-style-type: none"> ▪ Inspect and lubricate ▪ Trip-test 	<ul style="list-style-type: none"> ▪ Weekly ▪ Annually (semiannually if MFL door) 	1-23, <i>Fire Barriers and Protection of Openings</i>
Fire extinguishers	<ul style="list-style-type: none"> ▪ Check gauge, seal, hose ▪ Weigh cylinder ▪ Perform hydrostatic testing 	<ul style="list-style-type: none"> ▪ Annually ▪ Annually ▪ Varies 	4-5, <i>Portable Extinguishers</i>
Fire pumps	<ul style="list-style-type: none"> ▪ Test start automatically ▪ Test and lubricate driver ▪ Flow test 	<ul style="list-style-type: none"> ▪ Weekly ▪ Weekly ▪ Annually 	3-7, <i>Fire Protection Pumps</i>
Hydrants	<ul style="list-style-type: none"> ▪ Inspect and clean ▪ Flush ▪ Lubricate 	<ul style="list-style-type: none"> ▪ Annually ▪ Annually ▪ Annually 	3-10, <i>Installation/Maintenance of Private Fire Service Mains and Their Appurtenances</i>

Maintenance of Fire Protection Equipment

Equipment	Typical Maintenance	Frequency	FM Global Property Loss Prevention Data Sheet
Main drains (2 in. [50 mm])	<ul style="list-style-type: none"> ▪ Flow 	<ul style="list-style-type: none"> ▪ Annually and after system impairments (weekly in temperatures below 0° F [-16° C]) 	2-81, <i>Fire Protection System Inspection, Testing and Maintenance and Other Fire Loss</i>
Pressure-reducing valves (PRVs)	<ul style="list-style-type: none"> ▪ Inspect ▪ Test ▪ Flow test 	<ul style="list-style-type: none"> ▪ Weekly ▪ Monthly ▪ Annually 	3-11, <i>Pressure- Reducing Valves for Fire Protection Service</i>
Pumper and standpipe connections	<ul style="list-style-type: none"> ▪ Inspect 	<ul style="list-style-type: none"> ▪ Annually 	3-10, <i>Installation/ Maintenance of Interconnected Fire Service and Public Mains</i>
Sprinklers and piping	<ul style="list-style-type: none"> ▪ Inspect 	<ul style="list-style-type: none"> ▪ Weekly 	2-0, <i>Installation Guidelines for Automatic Sprinklers (available February 2010)</i>
Wet chemical systems	<ul style="list-style-type: none"> ▪ Inspect and check system ▪ Weigh cylinders 	<ul style="list-style-type: none"> ▪ Annually ▪ Annually 	4-0, <i>Special Protection Systems</i>

Notes

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