Table 1. General Fire Protection Inspection Frequency Reference.

Frequency	*Component*	*Action*	*Reference*
Weekly	Sprinkler Valves	Inspect	Table 2
	Dry/Deluge/Pre-action Systems	Inspect	Table 3
	Fire Pump	Test	Table 6
	Water Tank	Inspect	Section 2.3.16
	Open Water Supply Suction Screens	Inspect	Section 2.3.16.2
	Pressure Reducing Valves	Inspect	2.3.11
	Special Protection Systems	Inspect	Table 8
	Fire Prevention Inspection	Inspect	Section 2.5.1
Monthly	Sprinkler Valves	Inspect/Physically Try	Table 2
	Dry/Deluge/Pre-action Systems	Inspect/Test Alarms	Table 3 & Section 2.3.5
	Fire Pump Diesel Engine	Inspect Batteries	Table 6
	Pressure Reducing Valves	Operational Test	2.3.11
Quarterly	Sprinkler Water Flow Alarms	Test	Section 2.3.2
	Standpipes and Hose	Inspect	Section 2.3.15
Semi-Annually	Freezer Protection Systems	Inspect	Section 2.3.7
	Special Protection Systems	Check Agent Quantity	Table 8
	Fire Pump Diesel Engine	Maintenance	Table 6
Annually	Sprinkler Valves	Close and Reopen	Table 2
	Dry/Deluge/Pre-action Systems	Partial Trip Test	Table 3
	Fire Hydrant Control Valves [1]	Inspect/Physically Try	Section 2.3.1.3
	Main Drain	Test	Section 2.3.9
	Fire Hydrants	Flow Test	Section 2.3.10
	Back-flow Preventers	Flow Test	Section 2.3.12
	Fire Pumps	Flow Test	Table 6
	Fire Pump Diesel Engine	Maintenance	Table 6
	Open Water Supply Suction Screens	Clean	Section 2.3.16.2
	Pressure Reducing Valves	Flow Test	Section 2.3.11
	All Special Protection Systems	Test Detectors and Actuators	Table 8
	All Special Protection Systems	Inspect and Clean Nozzles	Table 8
	Gaseous Protection Systems	Inspect Protected Area	Table 8
	Foam Water Sprinkler System	Test	Table 8
	Dry Chemical	Inspect for Agent Caking	Table 8
Every 3 Years	Dry/Deluge/Pre-action Systems	Full Flow Trip Test	Table 3 & Section 2.3.5
	Freezer Protection Systems	Internal Inspection	Section 2.3.7
	Underground Main Loop	Flow Test	Section 2.3.10
Every 5 years	Sprinkler Systems with an Open Reservoir Suction Source	Flushing Investigation	Section 2.3.14.1
	Check Valves, Alarm Valves, and Backflow Preventers	Internal Inspection	Sections 2.3.3 & 2.3.12
	Steel Water Tanks	Internal Inspection	Section 2.3.14
Every 10 Years	Dry/Deluge/Pre-action Systems [2]	Flushing Investigation	Table 3
	Sprinklers	Inspect	Section 2.3.8

[1] Increased to weekly for unprotected buildings, exposure protection, or combustible yard storage.

[2] Increased to every 5 years after 20 years of service.

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2.3 Water-Based Fire Protection Systems

2.3.1 Fire Protection System Control Valves

2.3.1.1 Unauthorized Valve Closures

Fire protection system control valves require primary attention since a closed valve at the time of a fire can lead to a loss of all or a major portion of the protected facility. Take strong measures to reduce the possibility of a control valve being closed without authorization, both before and during a fire.

Improperly closed valves are most likely to occur when additions or renovations are made to a fire protection system. Often, individuals working on the system are unaware that the control valve must not be operated without first notifying responsible personnel. In other cases, there is no one assigned the responsibility of ensuring that proper valve impairment procedures are followed.

Implement a valve supervision program that insures the following:

1. The valves are locked in the wide/full open position.
2. Valve inspections are made (visual inspection and physically trying the valves as applicable).
3. The valve inspection list is complete and the inspection form is carried by the inspector during the inspection.
4. The Red Tag Permit System for valve closures is used by employees and contractors (see Section 3.1.1, Fire Protection System Impairment Precautions).
5. Main drain tests are made after a valve is reopened.

2.3.1.2 Valve Locking

All fire protection system control valves larger than 1-½ in. (38 mm) or those controlling more than five sprinklers are required to be locked open where they are under the direct control of the building owner or tenant. This includes electrically supervised valves. Where it is difficult to install and maintain locks on curb box valves, a less desirable alternative is to lock all curb box ”T“ wrenches. See Section 3.1.2 for valve-locking methods.

Until valves are locked, they are required to be sealed open unless electrically supervised. It is preferable that valves 1-½ in. (38 mm) or smaller or those controlling five or fewer sprinklers are locked open, but an acceptable alternative is to seal them open.

Ensure locks and chains used as securing devices are sturdy and resistant to breakage except by heavy bolt cutters. Do not use breakaway or combination locks.

Where exposed to weather or in valve pits, ensure locks are corrosion resistant and are kept well lubricated.

Keep the distribution of valve lock keys to an absolute minimum and restricted to only those individuals directly responsible for the fire protection system.

2.3.1.3 Valve Inspections

Inspect all fire protection system water control valves at the frequencies outlined in Table 2. Section 3.1 describes appropriate techniques for conducting valve inspections. The intent of the inspections is to ensure fire protection valves remain in an open, locked, operable and accessible condition.

Inspect fire hydrant control valves annually unless the hydrants are the only means of fire protection at the facility or if the hydrants are required for hose stream protection of outdoor hazards such as combustible yard storage, outdoor chemical processes, or adjacent property exposure protection, then inspect hydrant control valves as outlined in Table 2.

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Table 2. Valve Inspection Frequency Guidelines

Valve Type	*Action*	*Frequency*
Outside screw and yoke (OS&Y), Indicating butterfly valves (IBV's), Post indicator valve assemblies (PIVA's)	Visually inspect for the full open position and locked.	Weekly
	Full turn operation, return to and re-lock in the full open position, and conduct drain test. **Note 1 & 2**	Annually
Post indicator valve (PIV), Wall post indicator valve (WPIV), Inside screw gate valves	Visually inspect for the open position and locked.	Weekly
	Physically test for the full open position and re-lock in the full open position. **Note 1**	Monthly
	Full turn operation, return to and re-lock in the full open position, and conduct drain test. **Note 1 & 2**	Annually
Curb-box/roadway	Visually inspect cover and for accessibility.	Weekly
	Physically test for the full open position and leave in the full open position.	Monthly
	Full turn operation, return to the full open position, and conduct drain test. **Note 1 & 2**	Annually

NOTE 1: Any physical test or full-turn operation will likely activate any tamper switch that is electrically supervised. Take proper precautions to ensure the alarm station is notified both before and after any operation of the valve(s).

NOTE 2: Annual full turn operation creates an impairment condition and needs to be handled as a planned impairment utilizing the Red Tag Impairment Kit. (see Section 3.1.1, Fire Protection System Impairment Precautions)

2.3.2 Sprinkler Water Flow Alarms

Test all water flow alarms at a minimum frequency of quarterly. In large facilities it may useful to stagger testing so a certain number of alarms are tested every month with the end result being that all alarms are tested quarterly.

Ensure that testing is conducted by well-trained facility personnel or by a qualified inspection service. Any outside contracted services must be under the direction of facility personnel to ensure such services are adequate from a scope and frequency standpoint and that all impairment precautions are properly carried out during the performance of such services. Take precautions to avoid unnecessary local disturbances and response by the public fire service.

Do not turn off fire pumps or isolate pumps from fire protection systems during water flow alarm testing unless the pump(s) is not required for sprinkler adequacy. Proper fire protection impairment handling procedures need to be followed if pump impairment is unavoidable.

In wet-pipe systems, use the inspectors test connection at the extreme end of the system. Ensure that this connection has an orifice size equal to the size of a single sprinkler and therefore provides a minimum flow test of the alarm. In systems such as those in high-rise buildings where there is a test connection integral with the water supply connection feeding the sprinklers on each floor, the water flow alarm test can be made at the sprinkler system feed for each floor.

In dry-pipe systems, use the hydraulic test connections at the dry-pipe valve riser. (See Section 3.1.4, Dry Pipe Systems)

Small valves controlling the water supply to pressure switches or other alarm devices need to be sealed or locked in the open position. Ensure that the valves are included on the alarm testing form and indicate if the valve was open or closed.

In freezing weather, take precautions to prevent ice from accumulating in areas were it could become a hazard.

2.3.3 Alarm Check Valve

Verify that alarm check valves reset properly after water flow alarm testing. Inspect wet alarm check valves internally for corrosion every 5 years.

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2.3.4 Dry-Pipe Systems

Dry-pipe valves require more inspection, testing and maintenance than wet-pipe systems because of their greater complexity and susceptibility to internal corrosion. Preventive maintenance and inspection of these systems is an essential part of a good loss prevention control program. Besides ensuring proper operation during a fire, regular dry-pipe system maintenance helps prevent unnecessary false trips and freeze-ups.

In addition to normal water control valve inspections, follow the inspection and testing guidelines in Table 3.

Additional information is provided in Section 3.1.4.

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Table 3. Dry-Pipe System Inspection and Testing Guidelines.

Frequency	*Action*
Weekly **NOTE 1**	1. Check to ensure system air and water pressures are adequate. 2. Verify that air supply valves to accelerators and exhausters are open, accelerator/ exhauster air pressure is equalized with system air pressure, and excess water is drained off. 3. Make sure the valve room/house temperature is at a minimum of 40°F (5°C).
Monthly	1. Verify that the automatic drain (ball drip valve) from the intermediate chamber is free to move. 2. Check the level of priming water above the clapper and drain any excess water. 3. Make sure no air leakage is occurring. 4. Check the operability of accelerators and exhausters without tripping the dry pipe valve. 5. Check the condition of air compressors and air dryers (if required). Follow manufacturers recommended maintenance schedule for these components. 6. Before and during cold weather check the sprinkler systems low point drains and drain as necessary.
Annually **NOTE 2**	Partial Flow Trip Test — Record air and water pressure. With the water control valve closed perform a partial flow dry pipe valve trip test using the inspectors test connection to exhaust the air. Record the time and air pressure at which the system trips and compare to previous tests. If the time has increased, investigate and fix the deficiency. Drain the system and inspect internal dry pipe valve components. Clean, repair and replace components as necessary. Reset the dry pipe valve per the manufacturers instructions, making sure the water and air pressures are normal and that the air supply system is working properly. Check and service the air dryer (if provided) based on the manufacturer's guidelines. Perform a 2 in. (51 mm) drain test after the dry pipe valve is placed back in service.
Every 3 Years **NOTE 2**	Perform a full flow trip test in the same manner as the annual partial flow trip test, but with the water control valve fully open. Compare the results with previous full flow trip times. Ensure that the valve trips and water arrives at the inspectors test connection within 60 seconds. Observe condition of the water. Conduct a flushing investigation if scale or debris sufficient to clog a sprinkler is evident. Restore to service in the same manner as for the annual partial flow trip test.
Every 10 Years **NOTES 2, 3, 4, & 5**	Perform a flushing investigation on plain (black) steel pipe systems. See Table 7 for additional frequency detail. See Section 3.1.5.3 for flushing investigation procedure. See Note 5 below for galvanized piping systems.

NOTE 1. During extreme cold weather (-20°F [-11°C] below normal low temperature) check the temperature of the valve room/house and the air and water pressures daily.
NOTE 2. This test can create an impairment condition and needs to be handled as a planned impairment utilizing the Red Tag Impairment Kit. (See Section 3.1.1, Fire Protection System Impairment Precautions)
NOTE 3. Reduced to every 5 years after 20 years of service.
NOTE 4. Systems in service for 20 years or longer with no history of flushing investigation maintenance are likely obstructed and a full flushing is required.
NOTE 5. For internally galvanized piping systems flushing investigations are only required if the suction source is an open water supply or if obstructions are suspected.

2.3.5 Deluge and Preaction Systems

All applicable dry pipe inspection and maintenance frequencies apply (Table 3).

Test supervisory trouble signals monthly.

Test fire detection system annually as outlined in Data Sheet 5-48, *Automatic Fire Detectors.*

Trip-test and inspect deluge and preaction systems annually. If water damage will result from a full flow test, systems can be tripped with a partially closed (throttled) control valve.

Employ a qualified contractor to make any necessary repairs and adjustments. Keep records of the valve trip test at the valve specifying details of the test method and results (e.g., detection system used, trip time, and who did the testing.)

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Where thermo-pneumatic actuated preaction or deluge systems are exposed to freezing temperatures, check the condition of the drying agent annually.

Where the system is not exposed to freezing temperatures, check the drying agent every three years. The drying agent of older systems is checked by weighing the canister. If the weight of the canister and alumina exceed the manufacturer's recommended limits, replace the alumina or dry it in an oven. The drying agent is usually blue, indicating calcium sulfate; it turns pink or white when it needs replacing.

2.3.6 Antifreeze Automatic Sprinkler Systems

Test sprinkler systems utilizing antifreeze solutions to prevent freezing annually by measuring the solution's specific gravity. If required, add additional antifreeze to the sprinkler system until the specific gravity is greater than or equal to the values given in Tables 4 and 5.

Table 4. Antifreeze Solutions to be used if potable water is connected to sprinklers.[1]

Material	*Solution (by volume)*	*Specific Gravity at 60°F (15.6 °C)*	*Freezing Point*	
			°F	°C
Glycerine C.P. or U.S.P. Grade*	50% Water	1.133	-15	-26.1
	40% Water	1.151	-22	-30.0
	30% Water	1.165	-40	-40.0
Hydrometer Scale 1.000 to 1.200				
Propylene Glycol	70% Water	1.027	+9	-12.8
	60% Water	1.034	-6	-21.1
	50% Water	1.041	-26	-32.2
	40% Water	1.045	-60	-51.1
Hydrometer Scale 1.000 to 1.200 (Subdivisions 0.002)				

*C.P.–Chemically Pure. U.S.P.—United States Pharmacopoeia 96.5%.
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Table 5. Antifreeze solutions to be used if non-potable water is connected to sprinklers.[1]

Material	*Solution (by volume)*	*Specific Gravity at 60°F (15.6°C)*	*Freezing Point*	
			°F	°C
Glycerine	If glycerine is used, see Table 4			
Diethylene Glycol	50% Water	1.078	-13	-25.0
	45% Water	1.081	-27	-32.8
	40% Water	1.086	-42	-41.1
Hydrometer Scale 1.000 to 1.120 (Subdivisions 0.002)				
Ethylene Glycol	61% Water	1.056	-10	-23.3
	56% Water	1.063	-20	-28.9
	51% Water	1.069	-30	-34.4
	47% Water	1.073	-40	-40.0
Hydrometer Scale 1.000 to 1.120 (Subdivisions 0.002)				
Propylene Glycol	If propylene glycol is used, see Table 4			

†Free from magnesium chloride and other impurities.
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2.3.7 Refrigerated Area Automatic Sprinkler Systems

Dry automatic sprinkler systems within refrigerated areas and freezers with constant temperatures below 32°F (0°C) have a history of obstruction problems from ice plug formation. An FM Approved double-interlock refrigerated area sprinkler system with an appropriately arranged and maintained dried air supply significantly reduce the risk of ice plugs within automatic sprinkler piping. Ice plugs are most prevalent within 10 ft (3.0 m) of the point where the sprinkler piping enters the freezer environment. Also, the first elbow or tee fitting in the freezer, regardless of proximity to the point of entry, is a common point of ice formation and needs to be inspected.

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1. Check automatic sprinkler piping within freezer environments for ice plugs between 4 and 6 months after commissioning. Where an appropriately arranged and maintained dried air supply is provided and no ice build-up is present in the sprinkler piping, perform a re-inspection within one year. After two consecutive years of ice plug inspection with no problems developing, this inspection procedure can be extended to 3 years subject to any problems developing during the interim period (e.g., false trips, air compressor problems, poor maintenance of air dryer systems/components, etc.). Verify proper facility maintenance and inspection of refrigerated area automatic sprinkler system components, including air dryer systems.
2. If problems with ice plugs are encountered following the initial commissioning period or beyond, identify the icing source and take corrective action. Where ice plug problems exist, conduct internal inspections more frequently until corrections are completed for the compressed air supply system (maximum 6 month intervals).
3. When ice plugs are discovered, consider the automatic sprinkler system involved impaired until repairs are made.

Additional guidance and reference information can be found in Data Sheet 8-29, *Refrigerated Storage*.

2.3.8 Sprinklers

Sprinklers in clean locations may be expected to give good protection indefinitely, however after they have been in service for 10 years conduct a close examination. Exposure to adverse conditions may in time reduce performance or may result in unnecessary water damage by premature opening. Recognition of these conditions and proper remedies are essential to effective protection. If any of the conditions outlined below appear, remove representative sprinklers and have them tested.

2.3.8.1 Sprinkler Overheating

Ensure the sprinkler temperature rating is appropriate for the occupancy, which is typically 50°F (28°C) above ambient. For additional guidance, see Section 3.1.6.

Changes in occupancy that may affect room temperatures, such as increased drier temperatures, installation of new heat-producing equipment, overhead heating coils or unit heaters, frequently cause premature opening of sprinklers through overheating. When such changes are made, install sprinklers of higher ratings, if needed.

Following a fire, replace all non-operated sprinklers within 20 ft (6 m) of any operated sprinklers.

2.3.8.2 Sprinkler Freezing

Freezing may cause sprinklers to operate prematurely. Indications of freezing are difficult to detect. Depending upon the type of sprinkler, the evidence may be reduced link tension, metal gaskets forced upward, bent hook pieces, tilted glass or metal buttons, badly dished or distorted diaphragms, or bent struts.

2.3.8.3 Sprinkler Leakage

Slow leaking sprinklers will typically show evidence of leakage by a green or white deposit or discoloration around the orifice seal. Replace sprinklers exhibiting this condition as the water leakage can cause corrosion and mineral deposits that can impair sprinkler operation.

2.3.8.4 Sprinkler Corrosion

Test or replace sprinklers that show signs of external corrosion or are suspected of having internal corrosion. See Section 3.1.6 for additional information.

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2.3.8.4.1 Protection Against Corrosion

Ensure that sprinklers installed in areas containing corrosive atmospheres or vapors are suitably protected against corrosion. When selecting sprinklers ensure that the corrosive environment and the sprinkler frame and heat responsive element or factory coating materials are compatible with the corrosives. Ensure the sprinkler is made of compatible corrosion resistant materials or is factory coated to prevent corrosion from the environment. See Section 3.1.8 for additional information.

2.3.8.5 Sprinkler Mechanical Injury

Ensure that sprinklers subject to possible impact from normal material handling and facility operations are mechanically protected. FM Approved sprinkler guards are one method of protection.

If a sprinkler is subjected to an impact, the damage may not be sufficient to cause immediate opening but may cause trouble later. It is best to replace such a sprinkler with a new one. Replace sprinklers that have bent or dented deflectors or cracked glass bulbs. Replace any glass bulb type sprinkler that has a clear bulb (no color present).

2.3.8.6 Sprinkler Loading

Ensure sprinklers are free of accumulations of process residue.

In certain occupancies, spray or other residue collects on sprinklers, forming a loading that may interfere with prompt sprinkler operation. It may be possible to protect sprinklers in confined areas such as paint spray booths where rapid heat buildup or flash fires can be expected, with a coating of medium-heavy grease or with the use of thin plastic or paper bags. Periodically wipe off and replace the protective grease coating or replace the bags. Do not cover sprinklers in open areas with bags or grease. Rapid sprinkler operation in such areas depends on convective heat, and covering them will retard operation.

In occupancies such as core oven rooms of foundries, cumulative long-term loading, possibly involving all sprinklers in the room, may interfere with prompt sprinkler operation. Residues of this type cannot be effectively removed. Replace all affected sprinklers.

2.3.8.7 Sprinkler Painting

Replace sprinklers that have paint overspray accumulations from ceiling painting or occupancy processes with new sprinklers and ensure suitable measures are taken to prevent a reoccurrence. Even small amounts of paint can interfere with the free movement of parts or thermal response and render the sprinklers inoperative.

2.3.8.8 Used Sprinklers

Do not install used sprinklers. Install only new sprinklers. Used sprinklers may be unreliable due to non-obvious mechanical damage, reduced link tension, weakened soldered members or hardened or oxidized solder.

2.3.9 Main (2 inch) Drain Testing

Flow the main 2 in. (50 mm) drain valve at each sprinkler riser at least annually. Investigate any of the following conditions: an observed rapid loss of pressure, lower than typical residual pressures, or failure for the pressure to restore itself promptly after the drain valve is closed. Repeat the drain test after the problem has been corrected.

Maintain records of the riser static and residual pressures during each main drain test for comparison from year to year.

Always conduct a main drain test after an upstream sprinkler valve has been impaired to verify that water flow to the sprinklers has been restored. (See Section 3.1.1 for impairment handling procedures) Also conduct a drain test after known or suspected work on municipal water mains, if the facility fire protection water is supplied from this source.

Conduct a main drain test weekly during periods of extreme freezing weather (20°F [10°C] below normal low temperatures for more than a week) to verify that water in the feed piping has not frozen.

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2.3.10 Yard Hydrants and Underground Mains

Flow hydrants annually to ensure there are no obstructions in the piping or other problems. Ensure dry barrel hydrant weep holes are clear and water drains from the barrel properly.

Every three years, conduct performance flow tests on yard mains, isolating and checking each “leg” of looped underground systems. Investigate any unexplained differences in observed flow and pressure that would indicate a shut valve or obstruction in the underground main.

See Data Sheet 3-10, *Installation and Maintenance of Private Fire Service Mains and Their Appurtenances* for additional guidance.

2.3.11 Pressure Reducing Valves

Conduct weekly visual inspections, monthly operational testing, and annual full flow testing of pressure reducing valves in accordance with FM Global Data Sheet 3-11, *Pressure Reducing Valves*.

2.3.12 Backflow Preventers

Conduct annual full-flow testing of backflow preventers flowing at least the system demand. These tests are best conducted by a qualified contractor, and it may be required in some areas that the tester be licensed. Conduct internal inspection for debris and corrosion every 5 years.

2.3.13 Exposure Protection

Conduct annual flow tests on open sprinkler systems installed outside buildings for exposure or hazard protection.

These tests are recommended to determine whether the piping and sprinklers are plugged and are otherwise in good condition. The tests also allow a visual evaluation of the effectiveness of the water curtain. Take suitable precautions to provide adequate drainage so the water cannot enter the building or otherwise cause damage. Clean or replace any sprinklers or piping determined to be obstructed. Consider the risk of electrical shock when testing open sprinkler systems protecting outdoor transformers and switchgear and employ alternative inspection and test methods as appropriate.

2.3.14 Fire Pumps

Do not isolate pumps from the fire protection systems during weekly start tests or annual flow performance testing unless there is a secondary fully adequate water supply source that remains connected to the system during testing. Follow proper fire protection impairment procedures if the pump must be isolated.

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Table 6. Fire Pump Inspection, Testing and Maintenance Guidelines

Frequency	*Item*
Weekly	Start the pump driver in the automatic mode (or the manual mode if that is the normal starting method), either by pressure drop, or by water flow (if that means is the primary automatic start feature), or manual start means(if that is the primary start feature). Do the following before running the weekly start test: - For diesel engine-driven pumps, check the crankcase oil level and quality to ensure it is adequate, and if not replenish. Also, check to make sure the engine block heaters are working properly. - Make sure suction and discharge pressure readings are proper. - Make sure wet pit suction screens and bar racks are unobstructed and in place. If pump suction is taken from open water, make sure the pipe and intake are located so they will at all times be completely below frost level underground and deep enough in the water to prevent their being obstructed by ice. Keep intake screens clear of ice obstructions. - Fire pump suction reservoirs or wet pits may develop a foot or more of ice covering during the winter. If a potential for vacuum conditions exists during water draw- down, maintain a hole in the ice by steam injection, water bubbling or other reliable means. - Overflow suction tanks or check them visually. - Make sure in cold weather that adequate heat is provided to the supply lines and the suction source. - Confirm fuel tank is ¾ full for diesel pump installations, and fuel inlet valve to the engine is in the open and locked condition. - Confirm adequate heat is provided in the pump room/house. This is generally 40°F (5°C). Ensure the following during weekly pump testing: - For diesel engine driven pumps, run the engine at rated speed for at least 30 minutes. - For electric motor-driven pumps, run the motor at rated speed for at least 10 minutes. - Make sure there is adequate water flow from any pump packing glands, that temperature is not excessive, and that there is not excessive water flow past the pump packings. Also check the following: - Circulation relief valve, pressure relief valve and heat exchanger (when provided for diesel engine-driven pumps) discharge line are flowing properly. - Confirm ventilation for diesel engine drivers is working properly. - Condition of batteries and battery charger, and electrolyte level. - Record gauge/meter readings (suction/discharge pressure, driver rpm, oil pressure, engine coolant temperature, amps, etc.) - Change pressure recorder chart. - Pump controller set for automatic start.
Monthly	Check the specific gravity of the electrolyte for diesel engine batteries.
Semi-annually	Replace diesel engine oil filter. If the oil is fouled or has lost viscosity, replace the engine oil.
Annually	- For diesel engines change the oil and the oil filter. - For diesel fuel tanks remove any accumulated water. - Lubricate coupling and right angle gear drive (if provided). - Check pump coupling alignment. Correct if necessary. - Check diesel engine coolant protection level and also the condition of the coolant fluid. Correct and replace as necessary. - Conduct water flow tests to obtain three test points (churn, 100 and 150 capacity) by actually flowing water (no re-circulating to pump suction). Ensure proper fire protection impairment procedures if the pump is isolated. Compare the test results with previous test points and if any deterioration in performance is noted, find the problem and correct it without delay. - Include the following readings during flow tests: voltage/amperage and rpm for electric driven pumps, rpm, cooling water temperature, and oil pressure for diesel driven pumps. - Confirm the pump controller is arranged for manual stop only and the unit does not cycle on/off during flow testing. Additionally, make sure by testing to start the pump that the emergency manual start feature is operational. - Confirm the pump is electronically supervised (loss of power, running condition, failure to start cranking cycle, overspeed failure, etc.) and alarms are operating properly. - Confirm that suction pressure regulating devices, if provided, are operating properly. - Confirm proper start pressure for the fire pump and start/stop pressures for the jockey pump. - Check wet pit bar racks and suction screens and clean as necessary after the test. - Leave the pump in the automatic start position.

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2.3.15 Standpipe and Hose Systems

Visually inspect valves, hose, piping, and cabinets quarterly to ensure equipment is in good condition and accessible. Test any pressure reducing valves in accordance with FM Global Data Sheet 3-11, *Pressure Reducing Valves*.

2.3.16 Water Storage Tanks and Fire Pump Suction Supplies

Weekly, for pump suction tanks or reservoirs, pressure tanks or gravity tanks, report if any of the following conditions are not being met: (a) full; (b) heating system in use; and (c) adequacy of temperature at cold water return. Ensure that the water temperature is maintained at 42°F (6°C) or higher.

Inspect ferrous metal tanks for internal corrosion every 5 years. Remote camera inspection or other means not requiring the tank to be drained is the preferred method. If corrosion activity is evident, measure the wall thicknesses at several points around the tank using x-ray, ultrasonic, or equivalent non-destructive techniques. Compare the wall thicknesses with nominal values. In the event that the tank requires interior cleaning and restoration, this long duration impairment needs to be managed and precautions taken as outlined in Section 3.1.1, *FM Global Red Tag Permit System and Impairment Precautions*.

Whenever water supplies for fire protection service are supplied from an open body of water, the potential for obstructing material to enter fire protection piping systems will exist. The exposure level will vary depending on multiple factors such as construction features of the water containment body, arrangement and protection features of the intake piping/wet pits, surrounding terrain, frequency of cleaning activities, etc.

For locations where open bodies of fire protection water exist, conduct the following maintenance and inspections:

1. Conduct an obstruction investigation on all automatic sprinkler systems every 5-years through visual inspection and/or hydraulic flushing investigation methods. Where automatic sprinkler systems have pendent style automatic sprinkler systems, physically remove several sprinklers at multiple locations on the system and check for obstructions in the sprinkler and any pipe drops.

Where the second flushing investigation (at 10 years) determines there are no obstruction problems in the automatic sprinkler systems, the investigation frequency can be extended to every 10 years. However, if problems are observed during follow-up visits through flowing of fire pumps, yard mains, 2 in. drains or Inspector's Test Connections, reinstate the 5 year flushing investigation frequency.

2. Verify proper screens and bar racks are installed on vertical fire pump wet pit intakes and are inspected weekly and cleaned annually. Clean suction screens on the pump intake bowls annually when the wet pit is cleaned.

2.3.17 Internal Pipe Corrosion

Perform the following to slow internal corrosion in automatic sprinkler systems.

- Purge air pockets from wet systems following system draining;
- Use die-electric unions between dissimilar metals to prevent galvanic corrosion;
- Use corrosion resistant piping such as galvanized or stainless steel for dry systems;
- If corrosion is suspected conduct water analysis and inspect pipe interior.

See Section 3.1 for additional information.

Locations with an existing pipe corrosion problem are advised to seek qualified assistance to develop a comprehensive corrosion mitigation plan. Reference FM Global Data Sheet 2-1, *Prevention and Control of Internal Corrosion in Automatic Sprinkler Systems,* for additional guidance.

2.3.18 Chemical Cleaners and Corrosion Inhibitors.

In general, the use of chemical cleaners and corrosion inhibitors are to be discouraged.

Piping cleaning treatments and corrosion inhibitors for the purpose of halting identified corrosion activity have proven to be troublesome when used in fire protection systems. The introduction of a treatment solution into a sprinkler piping network with dead-end pipe runs and pendent drops can result in a large variation of solution concentrations and exposure time throughout the system. Consistent concentration levels and full

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removal of the treatment solution and any dislodged pipe scale are necessary to ensure a successful system treatment. This has proven to be very difficult in practice for sprinkler systems. Most vulnerable to these treatments are pendent sprinkler heads, which can serve as low points for the collection of stratified treatment chemicals, pipe scale, or both. This can result in accelerated sprinkler corrosion (leaks) or restricted sprinkler orifices.

2.4 Fire Protection System Obstructions

2.4.1 General

For effective control and extinguishment of fire, automatic sprinklers must receive an unobstructed flow of water. Although the overall performance record of automatic sprinklers has been very satisfactory, there have been numerous instances of impaired efficiency because sprinkler piping or sprinklers were plugged with pipe scale, mud, stones, or other foreign material. If a fire occurs and the sprinklers are plugged, the fire may not be extinguished or controlled. In such a situation, the fire may grow to uncontrollable size resulting in greater fire damage, causing excessive sprinkler operations and threatening the structural integrity of the building. In a worst case, the building may be completely destroyed.

Keeping the inside of sprinkler system piping free of scale, silt or other obstructing material is an integral part of an effective loss prevention program.

2.4.2 Obstruction Prevention

Conduct obstruction investigations in accordance with Table 7. Section 3.1.5 contains information regarding obstruction sources and techniques for carrying out flushing investigations as well as full flushing procedures.

If a dry or preaction system has been in service for 20 years or more, there has not been any flushing or investigative work conducted on the system, and the area protected is unheated, then a full flushing is warranted.

Table 7. Frequencies for Flushing Investigations.

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 (e.g., ponds, rivers, etc.)	Any	Every 5 years. (See Section 2.4.2.2)
Dry Pipe or Preaction fed from Open Water Supply(e.g., ponds, rivers, etc.) where system is tripped more than 2 times per year.	Any	Annually (See Section 2.4.2.2)
When any of the following conditions exist: - Discharge of obstructive material is noted during a yard main water test. - Foreign material is noted in fire pumps, dry pipe valves or check valves. - Plugging of pipe or foreign material noted coming from Inspector's Test Connection. - 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.

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2.4.2.1 Dry-Pipe and Preaction Systems – Scale Prevention

Do not convert a dry system to a wet system seasonally.

After a trip, use compressed air to drive residual water out of the system.

Use internally galvanized piping for new dry-pipe and preaction sprinkler system installations.

Repair and minimize air leaks to reduce introduction of additional oxygen.

The use of inert gas, such as nitrogen, will reduce or eliminate the amount of oxygen in the system, and will likely be beneficial in reducing corrosion that can result in scale formation.

2.4.2.2 Fire Protection Systems Fed from an Open Water Supply

Conduct a flushing investigation of wet and dry sprinkler systems fed from open water supplies every 5 years.

Obstructing materials may be drawn into the fire protection system from the bottoms of rivers, ponds or open reservoirs by fire pumps with poorly arranged or inadequately screened intakes, and forced into the system. Sometimes floods damage intakes. Obstructions include fine compacted materials such as rust, mud and sand. Coarse materials such as stones, cinders, cast-iron tubercles, chips of wood and sticks also are common. In addition to checking piping, examine pendent sprinklers and pipe drops to make sure they are not obstructed.

Annual flushing is warranted when the system trips more than two times during a 12 month period. The rapid flow of water caused by a valve trip can draw in obstructing materials.

2.5 Special Hazard Protection Systems

Maintain systems in operating condition at all times and restore to service promptly after any impairment or operation. Manage all impairments and take precautions as outlined in Section 3.1.1, *FM Global Red Tag Permit System and Impairment Precautions.*

Establish and follow a program of scheduled inspections, tests and maintenance as indicated in Table 8.

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Table 8. Special Protection System, Inspection, Testing and Maintenance Guidelines

Type of System	*Action*	*Frequency*
All Systems	Verify the system is being inspected, tested and maintained in accordance with the system manufacturer's guidelines. FM Approved systems are required to include a manual containing this guidance.	General
	Inspect to see that nozzles or discharge devices are clear and in proper position, all operating controls are properly set, and components have not been damaged.	Weekly
	1. Inspect and test all actuating and operating devices. Ensure that actuation/release devices are electronically supervised. Test pressure-operated devices, preferably by a complete or partial discharge. Maintain regular service contracts with the manufacturer or authorized representative. 2. Inspect pressurized agent containers and system components for conditions such as corrosion or pitting in excess of manufacturer's limits, structural damage, fire damage, repairs by soldering, welding or brazing. Replace the affected part(s) or hydrostatically test in accordance with the recommendations of the manufacturer and/or the original certifying agency. 3. Retrain facility personnel who may be called on to inspect, test, maintain, operate, or restore the system.	Annually
CO_2 Systems	Ensure the following: 1. High-pressure cylinders are fully charged in place and properly secured. 2. For low-pressure storage unit, that liquid level gauge indicates tank is full/normal, that pressure gauge shows normal pressure (300 psi [21 bar]), that the tank shutoff valve is open, and that pilot pressure supply valve is open. 3. Carbon dioxide storage is connected to discharge piping and actuators. 4. All manual actuators and pull stations are in place and tamper seals are intact. 5. Nozzles are connected, properly aligned, and free from obstructions and foreign matter. 6. Detectors are in place and free from foreign matter and obstructions. 7. System release panel is connected and showing "normal-ready" condition.	Weekly
	Verify carbon dioxide cylinders are being weighed every 6 months, with weights recorded and date of last hydrostatic test noted. A weight decrease of more than 10% requires refilling.	Semiannually
	Verify complete functional testing of all system operating controls/components (exclusive of system discharge) is being conducted at least annually preferably via a system service contract with the system manufacturer or his authorized representative/system installer. Check applicable inspection, testing and maintenance report.	Annually
	Hydrostatically test all CO_2 cylinders, valve assemblies, hoses and fittings, check valves, zone valves, manifolds at an interval not to exceed 12 years.	Every 12 years
Water Mist Systems	Reference Data Sheet 4-2, *Water Mist Systems* for specific system inspection and testing information.	

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Type of System	*Action*	*Frequency*
Foam and Foam-Water Sprinkler Systems	1. Visually inspect the systems as part of the weekly fire protection equipment inspection program. Include all foam control valves on the sprinkler control valve list as part of the valve supervision program. 2. Test run foam concentrate pumps. (see Table 6)	Weekly
	1. For all pre-primed closed-head AFFF systems: drain, flush and re-prime the system. 2. Inspect the stored foam concentrate for an excessive increase in viscosity (sludging) or deterioration. Send samples to the manufacturer or qualified laboratory for quality/condition testing. Replace foam if expired. Verify there is proper quantity in the tanks or containers. 3. Verify the foam proportioning system is satisfactorily tested annually. Ensure that foam-water sprinkler systems are provided with a test connection to avoid the need to flow foam solution through the system discharge piping. Deviations of more than 10% from prior testing results need to be corrected. 4. Thoroughly inspect all mechanical and electrical foam system components and individually checked for proper operation.	Annually
Dry Chemical Systems	Immediately after use, all hand-hose lines need to be blown clear of dry chemical to prevent the possibility of plugging upon subsequent operation.	After Any Use
	Verify the correct quantity of expellant gas by cylinder pressure or weight. The minimum acceptable limitation of expellant gas varies with the design of the equipment and is indicated on the system nameplate. In stored pressure systems, check the pressure gauge to determine that the pressure is in the operable range.	Semiannually
	1. Check the dry chemical in gas-cartridge or cylinder pressurized systems to make sure it is free-flowing and without lumps. 2. When annual inspection of the dry chemical containers or system components reveals conditions such as corrosion or pitting in excess of manufacturer's limits, structural damage, fire damage, repairs by soldering, welding or brazing, replace the affected part(s) or hydrostatically test in accordance with the recommendations of the manufacturer and/or the original certifying agency.	Annually
	Check the dry chemical in stored pressure (normally pressurized) systems to make sure it is free flowing and without lumps.	Every 6 years
	Hydrostatically test all dry chemical containers less than 150 lb (68 kg) nominal capacity (based on sodium bicarbonate agent), auxiliary pressure containers, valve assemblies, hoses and fittings, check valves, directional valves, manifolds, and hose nozzles at an interval not to exceed 12 years. Do not reuse the dry chemical removed from the container prior to testing. During such testing, ensure preventive measures are taken to minimize the probability of a fire unless a connected reserve is provided. Dry all equipment thoroughly prior to recharging.	Every 12 years

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Type of System	*Action*	*Frequency*
Clean Agent and Halon 1301 Systems	Check the agent quantity and pressure of clean agent containers. Refill or replace halocarbon clean agent containers if they show a loss in agent quantity of more than 5% or loss in pressure (adjusted for temperature) of more than 10%. Refill or replace inert gas clean agent containers if they show a loss in pressure (adjusted for temperature) of more than 5%.	Semiannually
	1. Inspect and test the system for proper operation exclusive of a discharge test. Inspect and test all actuating and operating devices in accordance with the system manufacturer's recommendations as outlined in the appropriate system design, installation, operation and maintenance manual. Regular service contracts with the system manufacturer's authorized representative are recommended. 2. Inspect the protected enclosure to determine if penetrations or other changes have occurred that could adversely affect agent leakage or change the volume of the protected space or both. Correct any conditions discovered during the inspection that could result in the inability to maintain the clean agent concentration. If uncertainty still exists with regard to the enclosure integrity, conduct an enclosure integrity test of the enclosure. **Note:** Keep a record of all changes made to or within the protected enclosure to facilitate the inspection and maintenance of the enclosure integrity. Maintain clean agent systems in operating condition at all times and restore to service promptly after any impairment or operation. Manage impairments using the FM Global *Red Tag Permit System* (See Section 3.1.1). Seal any penetrations made through the clean agent system protected enclosures immediately.	Annually
Water-Spray Fixed Systems	Conduct an annual water flow test of all systems. Where a flow test is not practical, conduct operational tests of at least the automatic water control valves and of all initiating devices (heat detectors, etc.).	Annually

2.6 Property Loss Fire Prevention Inspections

In addition to the previously recommended inspections, make regular inspections covering other vital aspects of fire prevention. Tailor the inspection report to the individual facility, including only those items that would apply. Provide a space on the report to record details of deficiencies and any special hazard conditions. Include a space on the form for the inspector's signature and that of management responsible for taking action to correct any deficiencies. Correct those deficiencies that can be quickly remedied (e.g., blocked fire doors) during the inspection. Record these deficiencies as a reminder for preventive action.

2.6.1 Weekly Fire Prevention Inspections

Complete the following items, where applicable, during a weekly fire prevention inspection (See Appendix C, *Fire Protection Inspection Form*):

1. Ensure all fire protection systems are in service.
2. Inspect for changes in occupancy that have increased the fire hazard.
3. Inspect fire doors and indicate if found in good order. Ensure the door can move freely and exercise it if possible. Report any doors that are blocked open or inoperative.
4. Record the sprinkler system water pressure. Check to see that it is consistent on the various pressure gauges, allowing for check valves and excess pressure pumps.
5. Sprinkler inspection: a) needed or disconnected; b) obstructed by high-piled storage; c) signs of leakage; d) pipe hanger missing or damaged, or e) located near broken windows or open doors that may permit freezing.

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