

# Maintenance and Testing of Fire Sprinkler Systems

## Introduction

When properly installed and maintained, automatic fire sprinkler systems have proven to be **the** most effective means for protecting life and property against fire. In recognition of their excellent track record in controlling the spread of fire, both state codes and national standards offer fire sprinklers as a cost-effective alternative to meeting many of their base code requirements.

A lot is riding, therefore, on a sprinkler system's ability to operate and function properly. So much so, in fact, that state law prohibits the occupancy of any portion of a building until the required suppression system has been tested and approved [see MSFC (20), Sec. 901.5.1]. Further, MSFC (20), Sec. 901.6 requires that such systems be maintained in an operative condition at all times and be repaired or replaced when defective.

In order to meet both federal certification requirements and state licensure requirements, automatic fire sprinkler systems are required to be inspected, tested and maintained in accordance with NFPA 25, *Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems*. For federal certification, NFPA 101(12), Sec. 2.2 references the 2011 edition of NFPA 25. For state licensure, MSFC (20), Sec. 901.6.1, as amended, and Table 901.6.1 also reference the 2011 edition of the standard (see Chapter 80, *Referenced Standards*).

## Application:

It must be noted that this document is intended to serve as a quick-reference guide only and is **not** intended to be exhaustive. It covers most, but not all, of the inspection, testing and maintenance requirements applicable to fire sprinkler systems. Some facilities may have additional equipment not covered in this guide. It is important, therefore, that the user have access to, and become familiar with all the requirements found in, NFPA 25. The standard can be ordered from NFPA at 1-800-344-3555 or [NFPA Catalog \(http://catalog.nfpa.org/\)](http://catalog.nfpa.org/)

**Note:** For new installations, NFPA 13(10), Sec. 24.4(2) requires the installing contractor to provide a copy of NFPA 25 for the property owner.

## System types

The requirements contained in NFPA 25 are based on the type of sprinkler system installed. The two types most commonly found in healthcare occupancies are wet pipe and dry pipe sprinkler systems. Some buildings contain both types of systems – a wet pipe system in heated areas and a dry-pipe system in unheated areas (e.g. exterior canopies). Simply put, a *wet pipe sprinkler system* is a piping system containing water so arranged that water discharges immediately from sprinklers activated by heat from a fire. A *dry pipe sprinkler system* is a piping system containing air or nitrogen under pressure so arranged that upon activation of a sprinkler the air or nitrogen is released allowing the water pressure to open a valve and water to then flow into the pipe and out the opened sprinkler.

## Definitions

In order to follow the requirements of the standard, it's important to have a good understanding of what is meant by "inspection", "testing" and "maintenance": Those terms are defined in 1-5 as follows:

- *Inspection* is defined as, "A visual examination of a system or portion thereof to verify that it appears to be in operating condition and is free of physical damage." – see NFPA 25(11), Sec. 3.3.18
- *Testing* is defined as, "A procedure used to determine the operational status of a component or system as intended by conducting periodic physical checks, such as waterflow tests, fire pump tests, alarm tests, and trip tests of dry-pipe valves." – see NFPA 25(11), Sec. 3.3.35

- *Maintenance* is defined as, “In water-based fire protection systems, work performed to keep equipment operable or to make repairs.” – see NFPA 25(11), Sec. 3.3.20

### Personnel qualifications

NFPA 25 makes the owner responsible for properly maintaining the building fire sprinkler system. It is the facility’s responsibility, therefore, to ensure that only properly trained and competent persons perform inspections, testing and maintenance on its system. NFPA 25 simply states that these tasks, “...shall be performed by personnel who have developed competence through training and experience.” [see NFPA 25(11), Sec. 4.1.1.2].

The State of Minnesota, however, has more restrictive requirements that apply to persons who perform work on fire sprinkler systems. Such persons must meet certain license and certification requirements [see MN Statutes, Chapter 299M and MN Rules, Chapter 7512]. What this means is that, unless they meet these requirements, facility personnel are limited to performing inspection and some basic testing activities only. The amount of testing that can be performed will depend on the level of training received. One of the best sources for such training would be the fire sprinkler company that performs the facility’s annual service. Evidence of any training received will need to be maintained in each employee’s personnel file.

### System history

A number of requirements applied to a health care facility’s fire protection systems are based on the age and date of installation of those systems. Without an accurate written history of the fire protection system(s) in your facility, it can be difficult to prove to a state or federal life safety surveyor that those systems are being maintained in accordance with applicable state and federal standards. This can result in fire/life safety deficiencies being cited. Turnover of administrative and/or maintenance personnel only serves to compound the problem. One of the best ways to deal with this is to create and maintain an historical log on your system(s).

As with just about anything, the hardest part of creating an historical log is getting started – after that, it is a matter of keeping it up-to-date. You should find the fire sprinkler contractor that provides your annual service to be an excellent source of information about your system. Basic questions that need to be answered include:

- When was the system initially installed? Who installed it?
- Were any additions, modifications or repairs made to the system? When? Who did the work?

It is important to note that certain changes made to your building could necessitate modifications to your fire protection system. Things to watch for include: construction or removal of walls and installation of such things as drop-in ceilings, new suspended light fixtures, tracks for lift systems and new cubicle curtains.

### Where to find the specific requirements...

1. Specific requirements relating to the inspection, testing and maintenance of wet- and dry-pipe fire sprinkler systems can be found in Chapters 5, 13, 14 and 15 of NFPA 25.
2. Specific requirements relating to the inspection, testing and maintenance of fire pumps can be found in Chapter 8 of NFPA 25.

### *Specific Requirements*

The inspection, testing and maintenance requirements that apply to your building’s fire sprinkler system start from the date of initial installation and continue on at specific intervals throughout the life of the system. What follows is a brief synopsis of some of the major requirements you need to be aware of.

## New installations

In order to meet both federal certification requirements and state licensure requirements, automatic fire sprinkler systems are required to be installed in accordance with NFPA 13, *Standard for the Installation of Sprinkler Systems*. NFPA 101(12), Sec. 2.2 references the 2010 edition of NFPA 13. MSFC (20), Sec. 903.3.1.1 also reference the 2010 edition of the standard (see Chapter 80, *Referenced Standards*).

All newly installed fire sprinkler systems are required to meet specific acceptance requirements, such as flushing of underground piping and hydrostatic testing [see NFPA 13(10), Sec. 10.10.2; MSFC (20), Sec. 901.5]. These services must be provided by licensed contractors.

## Weekly/monthly inspections

NFPA 25(11), Sec. 5.1.1.2 and Table 5.1.1.2 require certain weekly and monthly inspections. With proper guidance from your fire sprinkler contractor, the following inspections can be performed by facility staff:

1. All control valves are expected to be visually inspected monthly to ensure that they are [see NFPA 25(11), Sec. 13.3.2]:
  - Accessible
  - In the normal open position
  - Properly sealed, locked and/or supervised
  - Free from external leaks
  - Provided with appropriate signage identifying the portion of the system they control
2. Gauges on wet pipe systems need to be visually inspected monthly to verify that they are in good condition and that normal water pressure is being maintained [see NFPA 25(11), Sec. 5.2.4.1].
3. Gauges on dry, preaction and deluge systems need to be visually inspected weekly to verify that normal air and water pressures are being maintained [see NFPA 25(11), Sec. 5.2.4.2].

Note: Where air pressure is supervised at a constantly attended location, these gauges can be inspected on a monthly basis [see NFPA 25(11), Sec. 5.2.4.3].

## Quarterly inspections and tests

1. The following quarterly inspections are in addition to those required monthly and, with proper guidance from your fire sprinkler contractor, can be performed by facility staff:
  - a. For hydraulically designed sprinkler systems, inspect the hydraulic design information sign (also called a nameplate) to verify that it is securely attached to the sprinkler riser and is legible [see NFPA 25(11), Sec. 5.2.6].

Note: Most newly installed fire sprinkler systems are now hydraulically designed. When in doubt, ask your fire sprinkler contractor.
  - b. Inspect waterflow alarm devices and valve supervisory alarm devices to verify that they are free of physical damage [see NFPA 25(11), Sec. 5.2.5].
  - c. Inspect fire department connections to verify that [see NFPA 25(11), Sec. 13.7]:
    - They are visible and accessible
    - Couplings or swivels are not damaged and rotate smoothly
    - Plugs or caps are in place and not damaged (if the plugs or caps are not in place, the interior of the connection must be inspected for obstructions and it must be verified that the fire department connection clapper is operational over its full range)
    - Gaskets are in place and in good condition
    - Identification signs are in place

- The check valve is not leaking
  - The automatic drain valve is in place and operating properly
  - The fire department connection clapper(s) is in place and operating properly
2. Mechanical waterflow alarm devices (e.g. water motor gongs) are required to be tested *quarterly*; vane-type and pressure switch-type waterflow alarm devices need only be tested *semiannually* [see NFPA 25(11), Sections 5.3.3 and 13.2.6]. With proper training the following tests can be performed by facility staff:
    - a. Test the waterflow alarm on wet pipe sprinkler systems by opening the inspector's test connection. This simulates the opening of a sprinkler head.
 

Note: Where freezing weather conditions or other circumstances prohibit the use of the inspector's test connection, the bypass connection is allowed to be used.
    - b. Test the waterflow alarm on dry pipe sprinkler systems *by using the bypass connection*.
 

Caution: *Opening the inspector's test connection can cause the system to trip accidentally, allowing the pipes to fill with water and creating a potential for a serious freeze problem.*
  3. If provided, low pressure alarms and quick-opening devices on dry pipe sprinkler systems must be tested quarterly [see NFPA 25(11), Sections 13.4.3.2.13 and 13.4.4.2.4].
  4. Pressure reducing valves need to be inspected quarterly to verify that the valves are in the following condition [see NFPA 25(11), Sec. 13.1.1.2, Table 13.1.1.2, and Sec. 13.5.1.1]:
    - In the open position
    - Not leaking
    - Maintaining downstream pressures in accordance with the design criteria
    - In good condition, with handwheels installed and unbroken
  5. New to the 2011 edition of NFPA 25 is a requirement that, in systems where the sole water supply is through a backflow preventer and/or pressure reducing valves, the main drain test of at least one system downstream of the devices must be conducted on a quarterly basis [see NFPA 25(11), Sec. 13.2.5.1 and Table 13.1.1.2].

## Annually

In addition to the monthly and quarterly inspections and tests, NFPA 25 has very detailed and specific inspection, testing and maintenance services that need to be performed on an annual basis [see NFPA 25(11), Sec. 5.1.1.2 and Table 5.1.1.2]. Because of their complexity, and to comply with Minnesota state law, these services must be performed by a licensed sprinkler contractor and would include such things as:

- An inspection of the facility's supply of spare sprinkler heads to ensure that there are a minimum of two sprinklers of each type and temperature rating and that there is a sprinkler wrench for each type of sprinkler.
- A check of all sprinklers, hangers, pipe and fittings
- Testing of the main drain
- Testing of any antifreeze solution used
- Testing and maintenance of valves – including pressure reducing valves

Sprinklers must be inspected from the floor level at least once a year [see NFPA 25(11), Sec. 5.2.1]. Special considerations to keep in mind include:

1. Any sprinkler that shows signs of any of the following is required to be replaced:
  - Leakage

- Corrosion
  - Physical damage
  - Loss of fluid in the glass bulb responsive element
  - Loading (in lieu of replacing sprinklers that are loaded with a coating of dust, many AHJs will allow the sprinklers to be cleaned with compressed air or by a vacuum, provided the equipment does not touch the sprinkler)
  - Painting by other than the sprinkler manufacturer
2. Sprinklers installed in the incorrect orientation are also required to be replaced (e.g. an upright sprinkler installed in the pendent position or vice versa).
  3. Equipment, furnishings, stock, supplies or other obstructions closer to the sprinkler than allowed by the clearance rules of NFPA 13 must be removed [see NFPA 25(11), Sec. 5.2.1.3] – NFPA 13 typically requires a minimum 18 inches clearance below standard spray sprinklers.
  4. The spare sprinkler head cabinet needs to be inspected at least annually to ensure that an adequate stock of the correct number and type of sprinklers, as required by NFPA 25(11), Sections 5.4.1.4 and 5.4.1.5, as well as a sprinkler wrench for each type of sprinkler, are present.

### Dry pipe sprinkler systems

Dry pipe sprinkler systems require additional care and maintenance to ensure proper operation and to help protect against accidental tripping.

1. Partial flow trip test  
Dry pipe sprinkler systems are required to be trip tested annually with the control valve partially open [see NFPA 25(11), Sections 13.4.4.2.2 and 13.4.4.2.2.3].
  - a. Many fire sprinkler contractors prefer to do trip testing in late spring or early summer to allow any water that may have entered into the system or condensation to properly drain before cold weather arrives. Guidance on performing a partial flow trip test can be found in Annex A to NFPA 25 [see NFPA 25(11), Sec. A.13.4.4.2.2.3].
  - b. The interior of the dry pipe valve is required to be inspected when the annual trip test is conducted [see NFPA 25(11), Sec. 13.4.4.1.5]. In addition, the interior of the dry pipe valve must be thoroughly cleaned and parts repaired or replaced as needed [see NFPA 25(11), Sec. 13.4.4.3.1].
2. Full flow trip test  
A full flow trip test is required for dry pipe sprinkler systems every 3 years or whenever the system is altered, whichever comes first [see NFPA 25(11), Sec. 13.4.4.2.2.2]. Guidance on performing a full flow trip test can be found in Annex A to NFPA 25 [see NFPA 25(11), Sec. A.13.4.4.2.2.2].
3. Air leakage test  
Dry pipe sprinkler systems are required to be tested for air leakage at least once every 3 years using one of the two test methods outlined in NFPA 25(11), Sec. 13.4.4.2.9.

### Long term

1. NFPA 25 has specific requirements dealing with testing of sprinkler heads that have been in service for an extended period of time [see NFPA 25(11), Sec. 5.3.1]. These requirements, which emphasize the importance of knowing the history of your facility's fire sprinkler system, would include:
  - Sprinklers manufactured prior to 1920 must be replaced.

- Sprinklers that have been in service for 50 years must be replaced. An alternative is to submit representative samples from one or more sample areas to a recognized testing laboratory acceptable to the AHJ for testing. Such tests are required to be repeated at 10-year intervals.
- Sprinklers manufactured using fast response elements that have been in service for 20 years are required to be replaced or representative samples tested and then retested at 10-year intervals.

**Note:** The first residential sprinkler was listed for service in 1981 and the first quick-response sprinkler was listed for service in 1983.

- Representative samples of solder-type sprinklers classified as extra-high temperature or greater (i.e.  $\geq 325^{\circ}$  F) that are exposed to semi-continuous or continuous maximum allowable ambient temperature conditions are required to be tested at 5 year intervals.

Note: These would be sprinklers you might find, for example, in your boiler room and would have red-, green or orange-colored frame arms or have purple or black glass bulb colors.

- Sprinklers in service for 75 years are required to be replaced or representative samples submitted for testing. Retesting is then required at 5-year intervals.
- Dry sprinklers that have been in service for 10 years must be tested or replaced. They must be retested at 10-year intervals.
- Where sprinklers are subjected to harsh environments, including corrosive atmospheres and corrosive water supplies, the sprinklers must be replaced or representative samples tested every 5 years.

**Note:** “Harsh environments” have been interpreted to include areas exposed to outside weather (e.g. sprinklers installed under exterior canopies), cold storage areas (e.g. coolers and freezers) and storage battery rooms.

A “representative sample” for purposes of application of Sec. 5.3.1 is expected to consist of a minimum of not less than 4 sprinklers or one (1) percent of the number of sprinklers per individual sprinkler sample, whichever is greater. *Where one sprinkler within a representative sample fails to meet the test requirements, the code specifies that all sprinklers within the area represented by the sample must be replaced.* See NFPA 25(11), Sections 5.3.1.2 and 5.3.1.3.

2. Sprinkler system gauges typically have a life expectancy of 10 to 15 years. As a result, these gauges must be replaced every 5 years or tested every 5 years by comparison to a calibrated gauge. Gauges not accurate to within 3 percent of the full scale must be recalibrated or replaced [see NFPA 25(11), Sec. 5.3.2].
3. System check valves must be inspected internally every 5 years to verify that all components operate properly, move freely and are in good condition [see NFPA 25(11), Sec. 13.4.2.1].
4. A full flow test of pressure reducing valves is required to be conducted at 5-year intervals and compared to previous test results [see NFPA 25(11), Sec. 13.5.1.2]. Please note that a partial flow test of these valves, adequate to move the valve from its seat, needs to be conducted annually [see NFPA 25(11), Sec. 13.5.1.3].
5. **New** to the 2011 edition of NFPA 25 is a requirement for an internal inspection of piping and branch line conditions every 5 years [see NFPA 25(11), Sec. 14.2.1]. At a minimum, this involves opening a flushing connection at the end of one main and removing a sprinkler at the end of one branch line to inspect for the presence of foreign or organic material [The use of alternative nondestructive examination methods is allowed by NFPA 25(11), Sec. 14.2.1.1]. Non-metallic piping is not required to be inspected internally [see NFPA 25(11), Sec. 14.2.1.4].

## Fire pumps

Fire pumps, where present, are subject to very specific inspection, testing and maintenance requirements to help ensure that they will function properly when needed – see NFPA 25(11), Chapter 8. Table 8.1.1.2 outlines the required frequencies for performing these activities. Some of the basics include:

1. Fire pumps must be inspected weekly to verify that the pump assembly appears to be in operating condition and is free from physical damage. See NFPA 25(11), Sec. 8.2 for specific conditions that must be checked.
2. Diesel engine-driven fire pumps must be operated *weekly* without flowing water. Electric motor-driven fire pumps, on the other hand, need only operated *monthly*; again, without flowing water. See NFPA 25(11), Sec. 8.3.2 for specific observations and adjustments that need to be made while the pump is running.
3. An annual test of the fire pump assembly is required. This test must be conducted under minimum, rated and peak flows of the pump. NFPA 25(11), Sec. 8.3.3.1.2 offers a choice of three testing methods. See NFPA 25(11), Sec. 8.3.3.2 for specific visual observations, measurements and adjustments that need to be made while the pump is running and flowing water under the specified output condition.
4. Fire pump installations having an automatic transfer switch are required to be tested annually under simulated power failure conditions. Information about the proper test procedure can be found in NFPA 25(11), Sec. 8.3.3.4.
5. NFPA 25 requires that a preventive maintenance program be established on all components of the pump assembly in accordance with manufacturer's recommendations [see NFPA 25(11), Sec. 8.5.1].  
Note: NFPA 25 provides a helpful table to use in the absence of manufacturer's recommendations for preventive maintenance [see Table 8.1.2].

## Impairments

Provisions dealing with conditions in which a fire sprinkler system, or portion thereof, is out of order or out of service can be found in Chapter 15 of NFPA 25. This chapter addresses both preplanned and emergency impairments. The requirements are too detailed to go into in this guide, but it should be noted that Sec. 15.5.2(4) changes the requirement for a fire watch or building evacuation when a required fire protection system is out of service from more than 4 hours to *more than 10 hours in a 24-hour period*.

## ***Documentation Requirements***

Just as important as conducting required inspections, testing and maintenance is documenting the fact that they occurred. Both NFPA 13 and NFPA 25 require that these services be properly recorded. What follows is a brief synopsis of some of the major documentation requirements you need to be aware of.

## Initial installation records

As mentioned earlier, MSFC (20), Sec. 901.5.1 makes it unlawful to occupy any portion of a building until the required fire suppression system has been tested and approved. In order to meet both federal certification requirements and state licensure requirements, automatic fire sprinkler systems in health care occupancies are required to be designed and installed in accordance with NFPA 13, *Standard for the Installation of Sprinkler Systems*. For federal certification, NFPA 101(12), Sec. 2.2 references the 2010 edition of NFPA 13. For state licensure, MSFC (20), Sec. 903.1.1.1 also references the 2010 edition of the standard (see Chapter 80, *Referenced Standards*).

The AHJ will want proof that all underground and aboveground piping related to the fire sprinkler system has been properly tested, including flushing of underground piping and hydrostatic testing of aboveground piping [see NFPA 13(10), Sections 10.10.2 and 24.2]. Proper documentation serves as evidence that this has occurred.

1. Initial records must, at a minimum, include:
  - a. Name of installation contractor
  - b. *Contractor's Material and Test Certificate for Aboveground Piping* [see NFPA 13(10), Figure 24.1]

- c. *Contractor's Material and Test Certificate for Underground Piping* [see NFPA 13(10), Figure 10.10.1]
2. In addition, the installing contractor is required to provide you with the following [see NFPA 13(10), Sec. 24.4]:
  - a. All literature and instructions provided by the manufacturer describing proper operation and maintenance of all equipment and devices installed, and
  - b. A copy of NFPA 25 (Be aware that you very likely will **not** receive a copy of the 2011 edition of NFPA 25, but rather the latest edition of the standard adopted by NFPA).
3. The installing contractor is required to identify hydraulically designed systems with a permanently marked weatherproof metal or rigid plastic sign properly secured with corrosion-resistant wire, chain or other approved means near the valve controlling the corresponding hydraulically designed area [see NFPA 13(10), Sec. 24.5]. This sign must include the following information:
  - a. Location of the design area(s)
  - b. Discharge densities over the design area(s)
  - c. Required flow and residual pressure demand at the base of the riser
  - d. Occupancy classification or commodity classification and maximum permitted storage height and configuration
  - e. Hose stream allowance included in addition to the sprinkler demand
  - f. Name of the installing contractor

**Note:** A sample information sign can be found in Annex A to NFPA 13 [see Figure A.24.5].

4. **New** to the 2010 edition of NFPA 13 is a requirement that the installing contractor also provide a general information sign [see NFPA 13(10), Sec. 24.6]. This sign, too, is expected to be of weatherproof metal or rigid plastic construction and properly secured with corrosion-resistant wire, chain or other approved means at each system control riser, antifreeze loop and auxiliary system control valve.

Note: The information required on this sign is outlined in NFPA 13(10), Sec. 24.6.2. A sample of this sign can be found in Annex A to NFPA 13 [see Figure A.24.6].

### Monthly, quarterly, annual and long term records

NFPA 25(11), Sec. 4.3 requires that:

- Records be made for all inspections, tests and maintenance of a fire sprinkler system and its components – these records must be made available to the AHJ upon request.
- These records indicate the procedure performed (i.e. inspection, test or maintenance), who performed the work, the results and the date.
- As-built system installation drawings, hydraulic calculations, original acceptance test records and device manufacturer's data sheets be retained for the life of the system.

Information about the forms that need to be completed related to the inspection, testing and maintenance of fire sprinkler systems can be found in Annex B of the 2011 edition of NFPA 25. These forms should be available through your local fire sprinkler contractor.

### Dry pipe system trip tests

1. A tag or card showing the following must be attached to dry pipe system valves [see NFPA 25(11), Sec. 13.4.4.2.5]:
  - Date dry pipe valve last tripped
  - Name of person and organization conducting the test



2. Separate records of initial air and water pressure, tripping air pressure and dry pipe valve operating conditions must be maintained on the premises for comparison with previous test results [see NFPA 25(11), Sec. 13.4.4.2.5.1].
3. Records of tripping time need to be maintained for full flow trip tests [see NFPA 25(11), Sec. 13.4.4.2.5.2].

It is important that at least two people in your facility know where your records are kept to increase the likelihood that they can be readily provided if requested during an inspection. MSFC (20), Sec. 901.6.2 requires that these records be maintained on the premises for at least three years and must be copied for the fire code official on request.