

NFPA[®] 25

**Standard for the
Inspection, Testing,
and Maintenance
of Water-Based Fire
Protection Systems**

2020



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NFPA® 25

Standard for the

Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems

2020 Edition

This edition of NFPA 25, *Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems*, was prepared by the Technical Committee on Inspection, Testing, and Maintenance of Water-Based Systems and acted on by NFPA at its Association Technical Meeting held June 17–20, 2019, in San Antonio, TX. It was issued by the Standards Council on August 5, 2019, with an effective date of August 25, 2019, and supersedes all previous editions.

This document has been amended by one or more Tentative Interim Amendments (TIAs) and/or Errata. See “Codes & Standards” at www.nfpa.org for more information.

This edition of NFPA 25 was approved as an American National Standard on August 25, 2019.

Origin and Development of NFPA 25

The first edition of NFPA 25, published in 1992, was a collection of inspection, testing, and maintenance provisions that helped ensure the successful operation of water-based fire protection systems. NFPA 25 was developed as an extension of existing documents such as NFPA 13A, *Recommended Practice for the Inspection, Testing, and Maintenance of Sprinkler Systems*, and NFPA 14A, *Recommended Practice for the Inspection, Testing, and Maintenance of Standpipe and Hose Systems*, both of which successfully assisted authorities having jurisdiction and property owners with routine inspections of sprinkler systems and standpipes. These documents have since been withdrawn from the NFPA standards system. NFPA 25 became the main document governing sprinkler systems as well as related systems, including underground piping, fire pumps, storage tanks, water spray systems, and foam-water sprinkler systems.

This document provides instruction on how to conduct inspection, testing, and maintenance activities. It also stipulates how often such activities are required to be completed. Requirements are provided for impairment procedures, notification processes, and system restoration. This type of information, where incorporated into a building maintenance program, enhances the demonstrated favorable experience of all water-based fire protection systems.

The 1995 edition incorporated several improvements that reflected the initial experience with the standard. A new chapter was added that addressed obstructions in pipe as well as appropriate corrective actions.

The 1998 edition refined testing requirements and frequencies and provided additional guidance for preplanned impairment programs. The document scope was expanded to include marine systems.

The 2002 edition continued to refine testing frequencies for waterflow devices and evaluation of the annual fire pump test data. This edition also included additional information regarding evaluation and test methods for microbiologically influenced corrosion (MIC).

In the 2008 edition, a section permitting performance-based testing was added, providing guidance on alternative means for determining testing frequencies based on system/component failure rates. Component replacement testing tables were introduced in this edition to provide guidance for the appropriate tests to be performed following replacement of system components. Inspection, testing, and maintenance requirements for water mist systems were extracted from NFPA 750, *Standard on Water Mist Fire Protection Systems*, and were inserted into a new chapter. This action consolidated inspection, testing, and maintenance requirements for all water-based fire protection systems into one document.

The 2011 edition further updated testing frequencies based on a growing database of inspection, testing, and maintenance records. In two new annexes, information was provided for classification of needed repairs and hazard evaluation. The 2011 edition also added new definitions differentiating the levels of deficiency for determining the priority of repair.

The 2014 edition of NFPA 25 had many significant changes with many specific to the chapter on fire pumps. The operating test requirements were rewritten to consider a baseline weekly test for all pumps, with a series of exceptions that would allow for a modified testing frequency. New language was added to address confirmation of pressure recordings and a new fuel quality test for diesel-driven pumps.

Definitions were added for the various frequencies of inspection, testing, and maintenance tasks to create a “window” for completion of the tasks. The concept of internal inspection was modified to an internal assessment concept, in which a performance-based assessment frequency is explicitly addressed. The scope of the Technical Committee on Inspection, Testing, and Water-Based Systems was updated to address water mist systems specifically. The water mist system was modified such that the extract tags from NFPA 750 were removed because the material in the relevant chapter is now in the jurisdiction of NFPA 25.

A new chapter was added to address NFPA 13D, *Standard for the Installation of Sprinkler Systems in One- and Two-Family Dwellings and Manufactured Homes*, systems that are installed outside of one- and two-family homes. The requirements for inspecting antifreeze systems were updated to include the latest information from the Fire Protection Research Foundation testing on standard spray sprinklers. The table providing examples of classifications for deficiencies and impairments was relocated from Annex E to Annex A and attached to the definition of *deficiency*.

For the 2017 edition, new fire pump terms were defined to align with NFPA 20, *Standard for the Installation of Stationary Pumps for Fire Protection*. Criteria were added to Chapter 4 on automated inspections and testing. Residential sprinkler replacement requirements were added to address sprinklers that are no longer available. New requirements were added regarding missing escutcheons or, if listed, escutcheons that are no longer available. ITM tables were updated throughout the chapters, and new no-flow test requirements for fire pumps were added. Chapter 13 added new requirements for the inspection, testing, and maintenance of waterflow alarm devices; separated and added new requirements for the inspection, testing, and maintenance of preaction and deluge valves; and added criteria for air compressors. As of this edition, it contains all the general pressure gauge criteria. Additionally, two new annexes were added: one on connectivity and data collection and another on color-coded tagging programs.

In the 2020 edition, the term *electrically operated sprinklers*, which is a new technology, has been defined, and inspection, testing, and maintenance requirements have been added. Requirements addressing recalled sprinklers has been added to Chapter 4, and a section on dry hydrants has been added to Chapter 7. Dry sprinkler test requirements have been modified from 10 years to 15 years, and additional clarifications to the automated testing requirements for waterflow alarm devices have been made. Chapter 8 clarifies, for safety reasons, that energized pump controllers should not be opened and introduces the concept of an isolating switch in a separate compartment as part of the pump controller. Fire pump annual flow test and evaluation requirements of the test have been revised. Several new requirements have been added to Chapter 12 regarding water mist systems.

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Committee Scope: This Committee shall have primary responsibility for documents on inspection, testing, and maintenance of systems utilizing water as a method of extinguishment. These include sprinkler systems (excluding sprinkler systems installed in one-and two-family dwellings and manufactured homes), standpipe and hose systems, fire service piping and appurtenances, fire pumps, water storage tanks, fixed water spray systems, water mist systems, foam-water systems, valves, and allied equipment. This Committee shall also develop procedures for the conduct and reporting of routine system impairments.

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2020 Edition

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Information on referenced and extracted publications can be found in Chapter 2 and Annex H.

Chapter 1 Administration

1.1 Scope. This document establishes the minimum requirements for the periodic inspection, testing, and maintenance of water-based fire protection systems and the actions to undertake when changes in occupancy, use, process, materials, hazard, or water supply that potentially impact the performance of the water-based system are planned or identified.

1.1.1 Coordination with NFPA 72 Testing Requirements.

1.1.1.1 The inspection, testing, and maintenance required by this standard and NFPA 72 shall be coordinated so that the system operates as intended.

1.1.1.2* All inspections, testing, and maintenance required by NFPA 72 shall conform to NFPA 72, and all inspections, testing, and maintenance required by this standard shall conform to this standard.

1.1.1.3 This standard does not address all of the inspection, testing, and maintenance of the electrical components of the

automatic fire detection equipment used to activate preaction and deluge systems that are addressed by NFPA 72.

1.1.2 Types of Systems.

1.1.2.1 The types of systems addressed by this standard include, but are not limited to, sprinkler, standpipe and hose, fixed water spray, private fire hydrants, water mist, and foam water.

1.1.2.2 Water supplies that are part of these systems, such as private fire service mains and appurtenances, fire pumps and water storage tanks, and valves that control system flow, are also included in this standard.

1.1.3* This standard addresses the operating condition of fire protection systems as well as impairment handling and reporting and applies to fire protection systems that have been properly installed in accordance with generally accepted practice.

1.1.3.1* This standard does not require the inspector to verify the adequacy of the design of the system.

1.1.4* Corrective action needed to ensure that a system operates in a satisfactory manner shall be in accordance with this standard unless this standard specifically refers to an appropriate installation standard.

1.1.5 Unless required by Chapter 16, this standard shall not apply to sprinkler systems designed, installed, and maintained in accordance with NFPA 13D.

1.2* Purpose.

1.2.1 The purpose of this document is to provide requirements that ensure a reasonable degree of protection for life and property from fire through minimum inspection, testing, and maintenance methods for water-based fire protection systems.

1.2.2 In those cases where it is determined that an existing situation involves a distinct hazard to life or property, the authority having jurisdiction shall be permitted to require inspection, testing, and maintenance methods in excess of those required by the standard.

1.3* Application.

1.3.1 It is not the intent of this standard to limit or restrict the use of other inspection, testing, or maintenance programs that provide an equivalent level of system integrity and performance to that detailed in this standard.

1.3.2 The authority having jurisdiction shall be consulted and approval obtained for such alternative programs.

1.4* Units. Metric units of measurement in this standard are in accordance with the modernized metric system known as the International System of Units (SI).

1.4.1 If a value for measurement as given in this standard is followed by an equivalent value in other units, the first stated shall be regarded as the requirement. A given equivalent value shall be considered to be approximate.

1.4.2 SI units have been converted by multiplying the quantity by the conversion factor and then rounding the result to the appropriate number of significant digits. Where nominal or trade sizes exist, the nominal dimension has been recognized in each unit.

Chapter 2 Referenced Publications

2.1 General. The documents or portions thereof listed in this chapter are referenced within this standard and shall be considered part of the requirements of this document.

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

NFPA 11, *Standard for Low-, Medium-, and High-Expansion Foam*, 2016 edition.

NFPA 13, *Standard for the Installation of Sprinkler Systems*, 2019 edition.

NFPA 13D, *Standard for the Installation of Sprinkler Systems in One- and Two-Family Dwellings and Manufactured Homes*, 2019 edition.

NFPA 14, *Standard for the Installation of Standpipe and Hose Systems*, 2019 edition.

NFPA 15, *Standard for Water Spray Fixed Systems for Fire Protection*, 2017 edition.

NFPA 16, *Standard for the Installation of Foam-Water Sprinkler and Foam-Water Spray Systems*, 2019 edition.

NFPA 20, *Standard for the Installation of Stationary Pumps for Fire Protection*, 2019 edition.

NFPA 22, *Standard for Water Tanks for Private Fire Protection*, 2018 edition.

NFPA 24, *Standard for the Installation of Private Fire Service Mains and Their Appurtenances*, 2019 edition.

NFPA 70E®, *Standard for Electrical Safety in the Workplace®*, 2018 edition.

NFPA 72®, *National Fire Alarm and Signaling Code®*, 2019 edition.

NFPA 101®, *Life Safety Code®*, 2018 edition.

NFPA 110, *Standard for Emergency and Standby Power Systems*, 2019 edition.

NFPA 307, *Standard for the Construction and Fire Protection of Marine Terminals, Piers, and Wharves*, 2016 edition.

NFPA 409, *Standard on Aircraft Hangars*, 2016 edition.

NFPA 750, *Standard on Water Mist Fire Protection Systems*, 2019 edition.

NFPA 1962, *Standard for the Care, Use, Inspection, Service Testing, and Replacement of Fire Hose, Couplings, Nozzles, and Fire Hose Appliances*, 2018 edition.

2.3 Other Publications.

2.3.1 ASTM Publications. ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959.

ASTM D975, *Standard Specification for Diesel Fuel Oils*, 2015.

ASTM D3359, *Standard Test Methods for Rating Adhesion by Tape Test*, 2017.

ASTM D6751, *Standard Specification for Biodiesel Fuel Blend Stock (B100) for Middle Distillate Fuels*, 2015ce1.

ASTM D7462, *Standard Test Method for Oxidation Stability of Biodiesel (B100) and Blends of Biodiesel with Middle Distillate Petroleum Fuel (Accelerated Method)*, 2011.

2.3.2 CGA Publications. Compressed Gas Association, 14501 George Carter Way, Suite 103, Chantilly, VA 20151.

CGA C-6, *Standard for Visual Inspection of Steel Compressed Gas Cylinders*, 2013.

2.3.3 HI Publications. Hydraulic Institute, 6 Campus Drive, First Floor North, Parsippany, NJ 07054-4405.

HI 3.6, *Rotary Pump Tests*, 2016.

2.3.4 Other Publications.

Merriam-Webster's Collegiate Dictionary, 11th edition, Merriam-Webster, Inc., Springfield, MA, 2003.

2.4 References for Extracts in Mandatory Sections.

NFPA 11, *Standard for Low-, Medium-, and High-Expansion Foam*, 2016 edition.

NFPA 13, *Standard for the Installation of Sprinkler Systems*, 2019 edition.

NFPA 14, *Standard for the Installation of Standpipe and Hose Systems*, 2019 edition.

NFPA 15, *Standard for Water Spray Fixed Systems for Fire Protection*, 2017 edition.

NFPA 16, *Standard for the Installation of Foam-Water Sprinkler and Foam-Water Spray Systems*, 2019 edition.

NFPA 20, *Standard for the Installation of Stationary Pumps for Fire Protection*, 2019 edition.

NFPA 24, *Standard for the Installation of Private Fire Service Mains and Their Appurtenances*, 2019 edition.

NFPA 72®, *National Fire Alarm and Signaling Code®*, 2019 edition.

NFPA 96, *Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations*, 2017 edition.

NFPA 110, *Standard for Emergency and Standby Power Systems*, 2019 edition.

NFPA 750, *Standard on Water Mist Fire Protection Systems*, 2019 edition.

NFPA 820, *Standard for Fire Protection in Wastewater Treatment and Collection Facilities*, 2020 edition.

NFPA 1141, *Standard for Fire Protection Infrastructure for Land Development in Wildland, Rural, and Suburban Areas*, 2017 edition.

NFPA 1142, *Standard on Water Supplies for Suburban and Rural Fire Fighting*, 2017 edition.

NFPA 1911, *Standard for the Inspection, Maintenance, Testing, and Retirement of In-Service Emergency Vehicles*, 2017 edition.

Chapter 3 Definitions

3.1 General. The definitions contained in this chapter shall apply to the terms used in this standard. Where terms are not defined in this chapter or within another chapter, they shall be defined using their ordinarily accepted meanings within the context in which they are used. *Merriam-Webster's Collegiate Dictionary*, 11th edition, shall be the source for the ordinarily accepted meaning.

3.2 NFPA Official Definitions.

3.2.1* Approved. Acceptable to the authority having jurisdiction.

3.2.2* Authority Having Jurisdiction (AHJ). An organization, office, or individual responsible for enforcing the requirements of a code or standard, or for approving equipment, materials, an installation, or a procedure.

3.2.3* Listed. Equipment, materials, or services included in a list published by an organization that is acceptable to the authority having jurisdiction and concerned with evaluation of

products or services, that maintains periodic inspection of production of listed equipment or materials or periodic evaluation of services, and whose listing states that either the equipment, material, or service meets appropriate designated standards or has been tested and found suitable for a specified purpose.

3.2.4 Shall. Indicates a mandatory requirement.

3.2.5 Should. Indicates a recommendation or that which is advised but not required.

3.2.6 Standard. An NFPA Standard, the main text of which contains only mandatory provisions using the word “shall” to indicate requirements and that is in a form generally suitable for mandatory reference by another standard or code or for adoption into law. Nonmandatory provisions are not to be considered a part of the requirements of a standard and shall be located in an appendix, annex, footnote, informational note, or other means as permitted in the NFPA Manuals of Style. When used in a generic sense, such as in the phrase “standards development process” or “standards development activities,” the term “standards” includes all NFPA Standards, including Codes, Standards, Recommended Practices, and Guides.

3.3 General Definitions.

3.3.1 Adjust. To maintain or regulate, within prescribed limits, by setting the operating characteristics to specified parameters. [1911, 2017]

3.3.2* Alarm Receiving Facility. The place where alarm or supervisory signals are received.

N 3.3.3 Automated Inspection and Testing. The performance of inspections and tests at a distant location from the system or component being inspected or tested through the use of electronic devices or equipment installed for the purpose.

3.3.4* Automatic Detection Equipment. Equipment that automatically detects heat, flame, products of combustion, flammable gases, or other conditions likely to produce fire or explosion and cause other automatic actuation of alarm and protection equipment.

3.3.5* Automatic Operation. Operation without human intervention.

3.3.6 Automatic Transfer Switch (ATS). Self-acting equipment for transferring the connected load from one power source to another power source. [110, 2019]

3.3.7 Clean. To remove dirt, scale, and debris.

3.3.8* Deficiency. For the purposes of inspection, testing, and maintenance of water-based fire protection systems, a condition that will or has the potential to adversely impact the performance of a system or portion thereof but does not rise to the level of an impairment.

3.3.8.1 Critical Deficiency. A deficiency that, if not corrected, can have a material effect on the ability of the fire protection system or unit to function as intended in a fire event.

3.3.8.2 Noncritical Deficiency. A deficiency that does not have a material effect on the ability of the fire protection system or unit to function in a fire event, but correction is needed to meet the requirements of this standard or for the

proper inspection, testing, and maintenance of the system or unit.

3.3.9 Discharge Device. A device designed to discharge water or foam-water solution in a predetermined, fixed, or adjustable pattern. Examples include, but are not limited to, sprinklers, spray nozzles, and hose nozzles. [16, 2019]

3.3.10 Double Check Valve Assembly (DCVA). This assembly consists of two internally loaded check valves, either spring-loaded or internally weighted, installed as a unit between two tightly closing resilient-seated shutoff valves as an assembly, and fittings with properly located resilient-seated test cocks.

3.3.11 Drain.

3.3.11.1 Main Drain. The primary drain connection located on the system riser.

3.3.11.2* Sectional Drain. A drain located beyond a sectional control valve that drains only a portion of the system.

3.3.12 Fire Department Connection. A connection through which the fire department can pump supplemental water into the sprinkler system, standpipe, or other system furnishing water for fire extinguishment to supplement existing water supplies.

3.3.13* Fire Hydrant. A valved connection on a water supply system having one or more outlets and that is used to supply hose and fire department pumpers with water. [1141, 2017]

3.3.13.1* Dry Barrel Hydrant (Frostproof Hydrant). A type of hydrant with the main control valve below the frost line between the footpiece and the barrel.

N 3.3.13.2* Dry Hydrant. An arrangement of pipe permanently connected to a water source other than a piped, pressurized water supply system that provides a ready means of water supply for fire-fighting purposes and that utilizes the drafting (suction) capability of a fire department pump. [1142, 2017]

3.3.13.3* Monitor Nozzle Hydrant. A hydrant equipped with a monitor nozzle capable of delivering more than 250 gpm (946 L/min).

3.3.13.4* Wall Hydrant. A hydrant mounted on the outside of a wall of a building, fed from interior piping, and equipped with control valves located inside the building that normally are key-operated from the building's exterior.

3.3.13.5* Wet Barrel Hydrant. A type of hydrant that is intended for use where there is no danger of freezing weather and where each outlet is provided with a valve and an outlet. [24, 2019]

3.3.14* Foam Concentrate. A concentrated liquid foaming agent as received from the manufacturer. [11, 2016]

3.3.15 [Foam] Discharge Device. A device designed to discharge water or foam-water solution in a predetermined, fixed, or adjustable pattern. Examples include, but are not limited to, sprinklers, spray nozzles, and hose nozzles. [16, 2019]

3.3.16 Hose Connection. The outlet of a hose valve installed on a standpipe system for connection of fire hose. [14, 2019]

3.3.17* Hose House. An enclosure located over or adjacent to a hydrant or other water supply designed to contain the

necessary hose nozzles, hose wrenches, gaskets, and spanners to be used in fire fighting in conjunction with and to provide aid to the local fire department.

3.3.18 Hose Nozzle. A device intended for discharging water for manual suppression or extinguishment of a fire.

3.3.19 Hose Station. A combination of a hose rack or reel, hose nozzle, hose, and hose connection. [14, 2019]

3.3.20 Hose Storage Devices.

3.3.20.1* Conventional Pin Rack. A hose rack where the hose is folded vertically and attached over the pins.

3.3.20.2* Horizontal Rack. A hose rack where the hose is connected to the valve, then stack-folded horizontally to the top of the rack.

3.3.20.3* Hose Reel. A circular device used to store hose.

3.3.20.4* Semiautomatic Hose Rack Assembly. The same as a “conventional” pin rack or hose reel except that, after the valve is opened, a retaining device holds the hose and water until the last few feet are removed.

3.3.21 Hydrostatic Test. A test of a closed piping system and its attached appurtenances consisting of subjecting the piping to an increased internal pressure for a specified duration to verify system integrity and system leakage rates. [24, 2019]

3.3.22* Impairment. A condition where a fire protection system or unit or portion thereof is out of order, and the condition can result in the fire protection system or unit not functioning in a fire event.

3.3.22.1* Emergency Impairment. A condition where a water-based fire protection system or portion thereof is out of order due to an unplanned occurrence, or the impairment is found while performing inspection testing or maintenance activities.

3.3.22.2 Preplanned Impairment. A condition where a water-based fire protection system or a portion thereof is out of service due to work planned in advance, such as revisions to the water supply or sprinkler system piping.

3.3.23 Inspect. See 3.3.24, Inspection.

3.3.24 Inspection. 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. [820, 2020]

3.3.25* Inspection, Testing, and Maintenance Service. A service program provided by a qualified contractor or qualified property owner’s representative in which all components unique to the property’s systems are inspected and tested at the required times and necessary maintenance is provided.

N 3.3.26* Lowest Permissible Suction Pressure. The lowest suction pressure permitted by this standard and the authority having jurisdiction. [20, 2019]

3.3.27* Maintenance. In water-based fire protection systems, work performed to keep equipment operable.

3.3.28 Manual Operation. Operation of a system or its components through human action.

3.3.29 Nozzle.

3.3.29.1* Monitor Nozzle. A permanently mounted device specifically designed with a high flow rate to provide a far-reaching stream for locations where large amounts of water need to be available without the delay of laying hose lines.

3.3.29.2* Water Spray Nozzle. An open or automatic water discharge device that, when discharging water under pressure, will distribute the water in a specific, directional pattern.

3.3.30 Orifice Plate Proportioning. This system utilizes an orifice plate(s) through which passes a specific amount of foam concentrate at a specific pressure drop across the orifice plate(s).

3.3.31 Performance-Based Program. Methods and frequencies that have been demonstrated to deliver equivalent or superior levels of performance through quantitative performance-based analysis.

3.3.32* Pressure-Regulating Device. A device designed for the purpose of reducing, regulating, controlling, or restricting water pressure. [14, 2019]

3.3.33 Pressure-Restricting Device. A valve or device designed for the purpose of reducing the downstream water pressure under flowing (residual) conditions only. [14, 2019]

3.3.34* Pressure Vacuum Vent. A venting device mounted on atmospheric foam concentrate storage vessels to allow for concentrate expansion and contraction and for tank breathing during concentrate discharge or filling.

3.3.35* Proportioner.

3.3.35.1* Bladder Tank Proportioner. A system that is similar to a standard pressure proportioner, except the foam concentrate is contained inside a diaphragm bag that is contained inside a pressure vessel.

3.3.35.2* In-Line Balanced Pressure Proportioner. A system that is similar to a standard balanced pressure system, except the pumped concentrate pressure is maintained at a fixed preset value.

3.3.35.3* Line Proportioner. A system that uses a venturi pickup-type device where water passing through the unit creates a vacuum, thereby allowing foam concentrate to be picked up from an atmospheric storage container.

3.3.35.4* Standard Balanced Pressure Proportioner. A system that utilizes a foam concentrate pump where foam concentrate is drawn from an atmospheric storage tank, is pressurized by the pump, and passes back through a diaphragm balancing valve to the storage tank.

3.3.35.5* Standard Pressure Proportioner. A system that uses a pressure vessel containing foam concentrate where water is supplied to the proportioner, which directs an amount of the supply downward onto the contained concentrate, thereby pressurizing the tank.

3.3.36 Qualified. A competent and capable person who has met the requirements and training for a given field acceptable to the AHJ. [96, 2017]

3.3.37 Rebuild. To restore working condition by replacement or repair of worn or damaged parts.

3.3.38 Reduced-Pressure Principle Backflow Prevention Assembly (RPBA). Two independently acting check valves together with a hydraulically operating, mechanically independent pressure differential relief valve located between the check valves, along with two resilient-seated shutoff valves, all as an assembly, and equipped with properly located test cocks.

3.3.39 Remove. To physically take away or eliminate.

3.3.40 Repair. Restore to sound working condition or to fix damage.

3.3.41 Replace. To remove a component and install a new or equivalent component.

3.3.42 Sprinkler.

3.3.42.1 Installation Orientation. The following sprinklers are defined according to orientation.

3.3.42.1.1 Concealed Sprinkler. A recessed sprinkler with cover plate. [13, 2019]

3.3.42.1.2 Flush Sprinkler. A sprinkler in which all or part of the body, including the shank thread, is mounted above the lower plane of the ceiling. [13, 2019]

3.3.42.1.3 Pendent Sprinkler. A sprinkler designed to be installed in such a way that the water stream is directed downward against the deflector. [13, 2019]

3.3.42.1.4 Recessed Sprinkler. A sprinkler in which all or part of the body, other than the shank thread, is mounted within a recessed housing. [13, 2019]

3.3.42.1.5 Sidewall Sprinkler. A sprinkler having special deflectors that are designed to discharge most of the water away from the nearby wall in a pattern resembling one-quarter of a sphere, with a small portion of the discharge directed at the wall behind the sprinkler. [13, 2019]

3.3.42.1.6 Upright Sprinkler. A sprinkler designed to be installed in such a way that the water spray is directed upwards against the deflector. [13, 2019]

3.3.42.2* Control Mode Specific Application (CMSA) Sprinkler. A type of spray sprinkler that is capable of producing characteristic large water droplets and that is listed for its capability to provide fire control of specific high-challenge fire hazards. [13, 2019]

3.3.42.3 Corrosion-Resistant Sprinkler. A sprinkler fabricated with corrosion-resistant material, or with special coatings or platings, to be used in an atmosphere that would normally corrode sprinklers. [13, 2019]

3.3.42.4 Dry Sprinkler. A sprinkler secured in an extension nipple that has a seal at the inlet end to prevent water from entering the nipple until the sprinkler operates. [13, 2019]

3.3.42.5 Early Suppression Fast-Response (ESFR) Sprinkler. A type of fast-response sprinkler that has a thermal element with an RTI of 50 (meters-seconds)^{1/2} or less and is listed for its capability to provide fire suppression of specific high-challenge fire hazards. [13, 2019]

N 3.3.42.6 Electrically Operated Sprinklers. A sprinkler that is equipped with an integral means of activation using electricity.

3.3.42.7 Extended Coverage Sprinkler. A type of spray sprinkler with maximum coverage areas as specified in Sections 11.2 and 11.3 of NFPA 13. [13, 2019]

3.3.42.8 Nozzle. A device for use in applications requiring special water discharge patterns, directional spray, or other unusual discharge characteristics. [13, 2019]

3.3.42.9 Old-Style/Conventional Sprinkler. A sprinkler that directs from 40 percent to 60 percent of the total water initially in a downward direction and that is designed to be installed with the deflector either upright or pendent. [13, 2019]

3.3.42.10 Open Sprinkler. A sprinkler that does not have actuators or heat-responsive elements. [13, 2019]

3.3.42.11 Ornamental/Decorative Sprinkler. A sprinkler that has been painted or plated by the manufacturer. [13, 2019]

3.3.42.12 Quick-Response Early Suppression (QRES) Sprinkler. A type of quick-response sprinkler that has a thermal element with an RTI of 50 (meters-seconds)^{1/2} or less and is listed for its capability to provide fire suppression of specific fire hazards. [13, 2019]

3.3.42.13 Quick-Response Extended Coverage Sprinkler. A type of quick-response sprinkler that has a thermal element with an RTI of 50 (meters-seconds)^{1/2} or less and complies with the extended protection areas defined in Chapter 8 of NFPA 13. [13, 2019]

3.3.42.14 Quick-Response (QR) Sprinkler. A type of spray sprinkler that has a thermal element with an RTI of 50 (meters-seconds)^{1/2} or less and is listed as a quick-response sprinkler for its intended use. [13, 2019]

Δ 3.3.42.15 Residential Sprinkler. A type of fast-response sprinkler having a thermal element with an RTI of 50 (meters-seconds)^{1/2} or less that has been specifically investigated for its ability to enhance survivability in the room of fire origin and that is listed for use in the protection of dwelling units. [13, 2019]

3.3.42.16 Special Sprinkler. A sprinkler that has been tested and listed as prescribed in Section 15.2 of NFPA 13. [13, 2019]

3.3.42.17 Spray Sprinkler. A type of sprinkler listed for its capability to provide fire control for a wide range of fire hazards. [13, 2019]

3.3.42.18 Standard Spray Sprinkler. A spray sprinkler with maximum coverage areas as specified in Sections 10.2 and 10.3 of NFPA 13. [13, 2019]

3.3.43* Standpipe System. An arrangement of piping, valves, hose connections, and associated equipment installed in a building or structure, with the hose connections located in such a manner that water can be discharged in streams or spray patterns through attached hose and nozzles, for the purpose of extinguishing a fire, thereby protecting a building or structure and its contents in addition to protecting the occupants. [14, 2019]

3.3.43.1 Automatic Standpipe System. A standpipe system that is attached to a water supply capable of supplying the system demand and that requires no action other than opening a hose valve to provide water at hose connections.

3.3.43.2 Dry Standpipe. A standpipe system designed to have piping contain water only when the system is being utilized.

3.3.43.3 Manual Standpipe. Standpipe system that relies exclusively on the fire department connection to supply the system demand.

3.3.43.4 Semiautomatic Dry Standpipe System. A standpipe system permanently attached to a water supply that is capable of supplying the system demand at all times arranged through the use of a device such as a deluge valve and that requires activation of a remote control device to provide water at hose connections. [14, 2019]

3.3.43.5 Wet Standpipe System. A standpipe system having piping containing water at all times. [14, 2019]

3.3.44 Standpipe System Classes.

3.3.44.1 Class I System. A system that provides 2½ in. (65 mm) hose connections to supply water for use by fire departments. [14, 2019]

3.3.44.2 Class II System. A system that provides 1½ in. (40 mm) hose stations to supply water for use primarily by trained personnel or by the fire department during initial response. [14, 2019]

3.3.44.3 Class III System. A system that provides 1½ in. (40 mm) hose stations to supply water for use by trained personnel and 2½ in. (65 mm) hose connections to supply a larger volume of water for use by fire departments. [14, 2019]

3.3.45* Strainer. A device capable of removing from the water all solids of sufficient size that are obstructing water spray nozzles.

3.3.46 Supervision. In water-based fire protection systems, a means of monitoring system status and indicating abnormal conditions.

3.3.47 Test. The operation of a device to verify that it is functioning correctly, or the measurement of a system characteristic to determine if it meets requirements.

3.3.48* Testing. A procedure used to determine the operational status of a component or system by conducting periodic physical checks, such as waterflow tests, fire pump tests, alarm tests, and trip tests of dry pipe, deluge, or preaction valves.

3.3.49 Valve Status Test. Flowing water to verify that valves for a portion of the system are not closed.

3.3.50* Valve Status Test Connection. A point in the system where water is discharged for purposes of performing a valve status test.

3.3.51* Water Spray. Water in a form having a predetermined pattern, particle size, velocity, and density discharge from specially designed nozzles or devices. [15, 2017]

3.3.52 Water Supply. A source of water that provides the flows [gal/min (L/min)] and pressures [psi (bar)] required by the water-based fire protection system.

3.3.53 Waterflow Alarm Device. An attachment to a water-based fire protection system that detects and signals a predetermined waterflow.

3.4 Deluge Foam-Water Sprinkler and Foam-Water Spray Systems Definitions.

3.4.1 Foam-Water Spray System. A foam-water sprinkler system designed to use nozzles rather than sprinklers. [16, 2019]

3.4.2 Foam-Water Sprinkler System. A piping network employing automatic sprinklers, nozzles or other discharge devices, connected to a source of foam concentrate and to a water supply. [16, 2019]

3.5 Valve Definitions.

3.5.1* Control Valve. A valve controlling flow to water-based fire protection systems.

3.5.2* Deluge Valve. A water supply control valve intended to be operated by actuation of an automatic detection system that is installed in the same area as the discharge devices.

3.5.3 Hose Valve. The valve to an individual hose connection with an outlet for attaching a fire hose. [14, 2019]

3.5.4 Pressure Control Valve. A pilot-operated pressure-reducing valve designed for the purpose of reducing the downstream water pressure to a specific value under both flowing (residual) and nonflowing (static) conditions. [14, 2019]

3.5.5 Pressure-Reducing Valve. A valve designed for the purpose of reducing the downstream water pressure under both flowing (residual) and nonflowing (static) conditions. [14, 2019]

3.5.5.1* Master Pressure-Reducing Valve. A pressure-reducing valve installed to regulate pressures in an entire fire protection system and/or standpipe system zone.

3.5.6 [Pressure] Relief Valve. A device that allows the diversion of liquid to limit excess pressure in a system. [20, 2019]

3.5.6.1 Circulation Relief Valve. A valve used to cool a pump by discharging a small quantity of water. This valve is separate from and independent of the main relief valve. [20, 2019]

3.6 Water-Based Fire Protection System Definitions.

3.6.1 Combined Standpipe and Sprinkler System. A system where the water piping services both 2½ in. (65 mm) outlets for fire department use and outlets for automatic sprinklers.

3.6.2 Fire Pump Definitions.

3.6.2.1 Churn. See 3.6.2.4, No Flow (Churn, Shutoff)

3.6.2.2 Discharge Pressure. See 3.6.2.6.1.

3.6.2.2.1 Net Pressure (Differential Pressure). See 3.6.2.6.2.

3.6.2.3 Fire Pump. A pump that is a provider of liquid flow and pressure dedicated to fire protection. [20, 2019]

3.6.2.4* No Flow (Churn, Shutoff). The condition of zero flow when the fire pump is running but the only water passing through the pump is a small flow that is discharged through the pump circulation relief valve or supplies the cooling for a diesel engine driver. [20, 2019]

3.6.2.5* Peak Load. As pertains to annual testing in this standard, the maximum power required to drive the pump at any flow rate up to 150 percent of rated capacity (flow).

3.6.2.6 Pressure.

3.6.2.6.1 Discharge Pressure. The total pressure available at the fire pump discharge flange. [20, 2019]

3.6.2.6.2* Net Pressure (Differential Pressure). For vertical turbine fire pumps, the total pressure at the fire pump discharge flange plus the total suction lift. For other fire pumps, the total pressure at the fire pump discharge flange minus the total pressure at the fire pump suction flange. [20, 2019]

3.6.2.6.3 Rated Pressure. The net pressure (differential pressure) at rated flow and rated speed as marked on the manufacturer's nameplate. [20, 2019]

3.6.2.6.4 Suction Pressure. The total pressure available at the fire pump suction flange. [20, 2019]

3.6.2.7 Rated Flow. The capacity of the pump at rated speed and rated pressure as marked on the manufacturer's nameplate. [20, 2019]

3.6.2.8 Rated Pressure. See 3.6.2.6.3.

3.6.2.9 Shutoff (No Flow, Churn). See 3.6.2.4, No Flow.

3.6.2.10 Suction Pressure. See 3.6.2.6.4.

3.6.2.11 Unadjusted Field Test Curve. A fire pump discharge curve including churn, 100 percent rate flow, and maximum flow up to 150 percent of rated flow, based on discharge gauge readings without speed or velocity pressure adjustments.

N 3.6.2.12 Variable Speed Pump. A fire pump with variable speed pressure limiting control or self-regulating variable speed fire pump unit. [20, 2019]

3.6.3* Private Fire Service Main. A private fire service main, as used in this standard, is that pipe and its appurtenances on private property that is between a source of water and the base of the system riser for water-based fire protection systems; between a source of water and inlets to foam-making systems; between a source of water and the base elbow of private hydrants or monitor nozzles; and used as fire pump suction and discharge piping, beginning at the inlet side of the check valve on a gravity or pressure tank. [24, 2019]

Δ 3.6.4* Sprinkler System. A system, commonly activated by heat from a fire and discharges water over the fire area, that consists of an integrated network of piping designed in accordance with fire protection engineering standards that includes a water supply source, a water control valve, a waterflow alarm, and a drain. The portion of the sprinkler system above ground is a network of specifically sized or hydraulically designed piping installed in a building, structure, or area, generally overhead, and to which sprinklers are attached in a systematic pattern. [13, 2019]

3.6.4.1 Antifreeze Sprinkler System. A wet pipe system using automatic sprinklers that contains a liquid solution to prevent freezing of the system, intended to discharge the solution upon sprinkler operation, followed immediately by water from a water supply. [13, 2019]

3.6.4.1.1 Premixed Antifreeze Solution. A mixture of an antifreeze material with water that is prepared and factory-mixed by the manufacturer with a quality control procedure in place that ensures that the antifreeze solution remains

homogeneous and that the concentration is as specified. [13, 2019]

3.6.4.2 Deluge Sprinkler System. A sprinkler system employing open sprinklers or nozzles that are attached to a piping system that is connected to a water supply through a valve that is opened by the operation of a detection system installed in the same areas as the sprinklers or the nozzles. When this valve opens, water flows into the piping system and discharges from all sprinklers or nozzles attached thereto. [13, 2019]

3.6.4.3 Dry Pipe Sprinkler System. A sprinkler system employing automatic sprinklers that are attached to a piping system containing air or nitrogen under pressure, the release of which (as from the opening of a sprinkler) permits the water pressure to open a valve known as a dry pipe valve, and the water then flows into the piping system and out the opened sprinklers. [13, 2019]

3.6.4.4 Marine System. A sprinkler system installed on a ship, boat, or other floating structure that takes its supply from the water on which the vessel floats.

3.6.4.5 Preaction Sprinkler System. A sprinkler system employing automatic sprinklers that are attached to a piping system that contains air that might or might not be under pressure, with a supplemental detection system installed in the same areas as the sprinklers. [13, 2019]

3.6.4.6* Wet Pipe Sprinkler System. A sprinkler system employing automatic sprinklers attached to a piping system containing water and connected to a water supply so that water discharges immediately from sprinklers opened by heat from a fire. [13, 2019]

3.6.5 Water Mist System. A distribution system connected to a water supply or water and atomizing media supplies that is equipped with one or more nozzles capable of delivering water mist intended to control, suppress, or extinguish fires and that has been demonstrated to meet the performance requirements of its listing and [the applicable] standard. [750, 2019]

3.6.6* Water Spray System. An automatic or manually actuated fixed pipe system connected to a water supply and equipped with water spray nozzles designed to provide a specific water discharge and distribution over the protected surfaces or area. [15, 2017]

3.6.6.1 Ultra High-Speed Water Spray System. A type of automatic water spray system where water spray is rapidly applied to protect specific hazards where deflagrations are anticipated. [15, 2017]

3.6.7 Water Tank. A tank supplying water for water-based fire protection systems.

3.7 Inspection, Testing, and Maintenance (ITM) Task Frequencies.

3.7.1* Frequency. Minimum and maximum time between events.

3.7.1.1 Daily Frequency. Occurring every day.

3.7.1.2 Weekly Frequency. Occurring once per calendar week.

3.7.1.3 Monthly Frequency. Occurring once per calendar month.

3.7.1.4 Quarterly Frequency. Occurring four times per year with a minimum of 2 months and a maximum of 4 months.

3.7.1.5 Semiannual Frequency. Occurring twice per year with a minimum of 4 months and a maximum of 8 months.

3.7.1.6 Annual Frequency. Occurring once per year with a minimum of 9 months and a maximum of 15 months.

3.7.1.7 Three Years Frequency. Occurring once every 36 months with a minimum of 30 months and a maximum of 40 months.

3.7.1.8 Five Years Frequency. Occurring once every 60 months with a minimum of 54 months and a maximum of 66 months.

Chapter 4 General Requirements

4.1 Responsibility of Property Owner or Designated Representative.

4.1.1* Responsibility for Inspection, Testing, Maintenance, and Impairment. The property owner or designated representative shall be responsible for properly maintaining a water-based fire protection system.

4.1.1.1 Inspection, testing, maintenance, and impairment procedures shall be implemented in accordance with those established in this document and in accordance with the manufacturer's instructions.

4.1.1.2 Inspection, testing, and maintenance shall be performed by qualified personnel.

4.1.1.2.1* The owner shall coordinate with the entity conducting the inspection, testing, and maintenance activities to minimize any water damage caused by the discharge of water.

4.1.1.3* Where the property owner or designated representative is not the occupant, the property owner or designated representative shall be permitted to delegate the authority for inspecting, testing, maintenance, and the managing of impairments of the fire protection system to a designated representative.

4.1.1.4 Where a designated representative has received the authority for inspecting, testing, maintenance, and the managing of impairments, the designated representative shall comply with the requirements identified for the property owner or designated representative throughout this standard.

4.1.2* Freeze Protection. The property owner or designated representative shall ensure that water-filled piping is maintained at a minimum temperature of 40°F (4°C) unless an approved antifreeze solution is utilized.

4.1.2.1* All areas of the building containing water-filled piping that does not have another means of freeze protection shall be maintained at a minimum temperature of 40°F (4°C).

N 4.1.2.2* The requirements of 4.1.2 shall not apply where water-filled piping is located in unconditioned building spaces or areas outside the building envelope and are not subject to freezing.

4.1.2.3 Aboveground water-filled pipes that pass through open areas, cold rooms, passageways, or other areas exposed to temperatures below 40°F (4°C), protected against freezing by insulating coverings, frostproof casings, listed heat tracing

systems, or other reliable means, shall be maintained at temperatures between 40°F (4°C) and 120°F (48.9°C).

4.1.2.4 Where other approved means of freeze protection for water-filled piping as described in 4.1.2.3 are utilized, they shall be inspected, tested, and maintained in accordance with this standard.

N 4.1.2.5 Valve enclosures for preaction valves, deluge valves, and dry pipe valves subject to freezing shall be inspected daily during cold weather to verify a minimum temperature of 40°F (4°C).

N 4.1.2.5.1 Valve enclosures equipped with low-temperature alarms shall be allowed to be inspected weekly.

N 4.1.2.5.2 Low-temperature alarms, if installed in valve enclosures, shall be inspected annually at the beginning of the heating season to verify that they are free of physical damage.

4.1.3* Accessibility. The property owner or designated representative shall provide ready accessibility to components of water-based fire protection systems that require inspection, testing, and maintenance.

4.1.4 Notification of System Shutdown or Testing. The property owner or designated representative shall notify the authority having jurisdiction, the fire department, if required, and the alarm-receiving facility before testing or shutting down a system or its supply.

4.1.4.1 The notification of system shutdown or test shall include the purpose for the shutdown or test, the system or component involved, the estimated time of shutdown or test, and the expected duration of the shutdown or test.

4.1.4.2 The authority having jurisdiction, the fire department, and the alarm-receiving facility shall be notified when the system, supply, or component is returned to service or when the test is complete.

4.1.5* Corrections and Repairs.

4.1.5.1* The property owner or designated representative shall correct or repair deficiencies or impairments.

N 4.1.5.1.1* Upon discovery of any component and equipment under recall or replacement programs by the owner's maintenance personnel, designated representative, or contractor, the owner shall be notified in writing.

N 4.1.5.1.2* The property owner or designated representative shall correct, remedy, repair, or replace components and equipment under recall or replacement program.

4.1.5.2 Corrections and repairs shall be performed by qualified maintenance personnel or a qualified contractor.

4.1.6* Changes in Occupancy, Use, Process, or Materials. The property owner or designated representative shall not make changes in the occupancy, the use or process, or the materials used or stored in the building without evaluation of the fire protection system(s) for its capability to protect the new occupancy, use, or materials.

4.1.6.1 The evaluation required by 4.1.6 shall not be considered part of the normal inspection, testing, and maintenance required by this standard.

4.1.6.2* The evaluation shall consider factors that include, but are not limited to, the following:

- (1) Occupancy changes such as converting office or production space into warehousing
- (2) Process or material changes such as metal stamping to molded plastics
- (3) Building revisions such as relocated walls, added mezzanines, and ceilings added below sprinklers
- (4) Removal of heating systems in spaces with piping subject to freezing
- (5) Changes to the storage method, arrangement, height or commodities
- (6) Changes in water supplies

4.1.7* Addressing Changes in Hazard.

4.1.7.1 Where changes in the occupancy, hazard, water supply, storage commodity, storage arrangement, building modification, or other condition that affects the installation criteria of the system are identified, the property owner or designated representative shall promptly take steps to evaluate the adequacy of the installed system in order to protect the building or hazard in question.

4.1.7.2 Where the evaluation reveals that the installed system is inadequate to protect the building or hazard in question, the property owner or designated representative shall make the required corrections.

4.1.7.3 Corrections shall be approved.

4.1.8 Valve Location. The location of shutoff valves shall be identified at the system riser or other approved locations.

4.1.9* Information Sign.

4.1.9.1 A permanently marked metal or rigid plastic information sign shall be placed at the system control riser supplying an antifreeze loop, dry system, preaction system, or auxiliary system control valve.

4.1.9.2 Each sign shall be secured with a corrosion-resistant wire, chain, or other approved means and shall indicate at least the following information:

- (1) Location of the area served by the system
- (2) Location of auxiliary drains and low-point drains for dry pipe and preaction systems
- (3) Presence and location of antifreeze or other auxiliary systems
- (4) Presence and location(s) of heat tape

4.1.10 Antifreeze Information Sign. An antifreeze information sign shall be placed on the antifreeze system main valve, which indicates the manufacture type and brand of the antifreeze solution, the concentration by volume of the antifreeze solution used, and the volume of the antifreeze solution used in the system.

4.1.11 Impairments.

4.1.11.1 Where an impairment to a water-based fire protection system occurs or is identified during inspection, testing, or maintenance activities, the procedures outlined in Chapter 15 shall be followed, including the attachment of a tag to the impaired system.

4.1.11.2 Where a water-based fire protection system is returned to service following an impairment, the system shall be verified to be working properly by means of an appropriate

inspection or test as described in the table "Summary of Component Replacement [Action] Requirements" in the applicable chapters of this document.

4.2 Manufacturer's Corrective Action. Manufacturers shall be permitted to make modifications to their own listed product in the field with listed devices that restore the original performance as intended by the listing, where acceptable to the authority having jurisdiction.

4.3 Records.

4.3.1* Records shall be made for all inspections, tests, and maintenance of the system and its components.

4.3.1.1 Records shall be maintained by the property owner.

4.3.1.2* Records shall be permitted to be stored and accessed electronically.

4.3.2 Records shall indicate the following:

- (1) The procedure/activity performed (e.g., inspection, test, or maintenance)
- (2) The organization that performed the activity
- (3) The required frequency of the activity
- (4) The results and date of the activity
- (5) The name and contact information of the qualified contractor or owner, including lead person for activity

4.3.3* Records shall be made available to the authority having jurisdiction upon request.

4.3.4 As-built system installation drawings, hydraulic calculations, original acceptance test records, and device manufacturer's data sheets shall be retained for the life of the system.

4.3.5 Subsequent records shall be retained for a period of 1 year after the next inspection, test, or maintenance of that type required by the standard.

4.4 Water Supply Status. During inspection, testing, and maintenance, water supplies, including fire pumps, shall remain in service unless under constant attendance by qualified personnel or unless impairment procedures in Chapter 15 are followed.

4.5* Inspection. System components shall be inspected at intervals specified in the appropriate chapters.

4.6 Testing.

4.6.1 All components and systems shall be tested to verify that they function as intended.

4.6.1.1 When automated testing in accordance with 4.6.6 is being utilized, the testing shall be observed at a minimum frequency of once every 3 years.

4.6.1.2 Where the automated testing cannot be visually observed, the testing shall be conducted manually at a minimum frequency of once every 3 years.

4.6.2 The frequency of tests shall be in accordance with this standard.

4.6.3 Fire protection system components shall be restored to full operational condition following testing, including reinstallation of plugs and caps for auxiliary drains and test valves.

4.6.4* Test results shall be compared with those of the original acceptance test (if available) and with the most recent test results.

4.6.5* When a component or subsystem is adjusted, repaired, reconditioned, or replaced, it shall be tested in accordance with the original acceptance test required for that subsystem or the requirements where specified by the standard.

4.6.6* Automated Inspection and Testing.

4.6.6.1 Automated inspection and testing procedures performed in accordance with the requirements in this standard shall be permitted to be used.

4.6.6.2* Automated inspection equipment that meets the intent of a required visual inspection shall be permitted to replace the visual inspection.

4.6.6.3 Automated testing equipment shall produce the same action required by this standard to test a device.

4.6.6.4 The testing shall discharge water where required in this standard.

Δ 4.6.6.4.1 Automated testing equipment that **does not discharge water** for a test shall be permitted except as required in 4.6.6.4.2.

4.6.6.4.2* The discharge shall be visually observed at a minimum frequency of once every **3** years.

4.6.6.5 Where required in this standard, personnel shall observe the testing and intervene in the testing procedures when necessary to prevent injury or property damage.

4.6.6.6 Automated test devices and equipment shall be listed for the purpose of the test being conducted.

N 4.6.6.7* Devices and equipment utilized to perform automated inspection and testing procedures that are not subjected to system pressure or are not integral to the operation of the system during a fire event shall not be required to be listed.

4.6.6.8 Failure of the testing equipment shall not impair the operation of the system unless indicated by a supervisory signal in accordance with *NFPA 72*.

4.6.6.9 Failure of a component or system to pass an automated test shall result in an audible supervisory signal.

4.6.6.10 Failure of automated inspection and testing equipment shall result in a trouble signal in accordance with *NFPA 72*.

4.6.6.11 Failure of a component or system that impairs the system shall require that impairment procedures be followed.

4.6.6.12 The testing frequencies of this standard shall be maintained regardless of the functionality of the automated testing equipment.

4.6.6.13 A record of all inspections and testing shall be maintained in accordance with 4.3.2.

4.7* Performance-Based Compliance Programs. Components and systems shall be permitted to be inspected, tested, and maintained under an approved performance-based program.

4.7.1* Performance-based programs shall have clearly identifiable goals and clearly define how the program meets those goals.

4.7.2 Compliance with an approved performance-based program shall be deemed as compliance with this standard.

4.7.3 The goals and goal achievement obtained with the approved performance-based program shall be reviewed a minimum of every **3** years and inspection, testing, and maintenance frequencies adjusted to reflect current conditions and the historical record.

4.7.4 The historical record shall be available for review by the authority having jurisdiction.

4.8 Maintenance. Maintenance shall be performed to keep the system equipment operable.

4.9 Safety.

4.9.1 General. Inspection, testing, and maintenance activities shall be conducted in accordance with applicable safety regulations.

4.9.2 Confined Spaces. Legally required precautions shall be taken prior to entering confined spaces such as tanks, valve pits, or trenches.

4.9.3 Fall Protection. Legally required equipment shall be worn or used to prevent injury from falls to personnel.

4.9.4 Hazards. Precautions shall be taken to address any hazards, such as protection against drowning where working on the top of a filled embankment or a supported, rubberized fabric tank, or over open water or other liquids.

4.9.5* Hazardous Materials.

4.9.5.1 Legally required equipment shall be used where working in an environment with hazardous materials present.

4.9.5.2 The property owner or designated representative shall advise anyone performing inspection, testing, and maintenance on any system under the scope of this document, with regard to hazardous materials stored on the premises.

4.9.6* Electrical Safety.

4.9.6.1 Legally required precautions shall be taken when testing or maintaining electric controllers for motor-driven fire pumps.

Δ 4.9.6.2* At a minimum, the provisions of *NFPA 70E* or an approved equivalent shall be applied.

Chapter 5 Sprinkler Systems

5.1 General.

5.1.1 Minimum Requirements.

5.1.1.1 This chapter shall provide the minimum requirements for the routine inspection, testing, and maintenance of sprinkler systems.

5.1.1.2 Table 5.1.1.2 shall be used to determine the minimum required frequencies for inspection, testing, and maintenance.

5.1.2 Common Components and Valves. Common components and valves shall be inspected, tested, and maintained in accordance with Chapter 13.

5.1.3 Obstruction Investigations. The procedures outlined in Chapter 14 shall be followed where there is a need to conduct an obstruction investigation.

Table 5.1.1.2 Summary of Sprinkler System Inspection, Testing, and Maintenance

Item	Frequency	Reference
Inspection		
Assessment of the internal piping condition		Chapter 14
Control valves		Chapter 13
Fire department connections		Chapter 13
Gauges (wet and deluge systems)		Chapter 13
Gauges (dry and preaction systems)		Chapter 13
Hanger/braces/supports	Annually	5.2.3
Heat tracing	Per manufacturer's requirements	5.2.6
Hydraulic design information sign	Annually	5.2.5
Information signs	Annually	5.2.7, 5.2.8, 5.2.9
Pipe and fittings	Annually	5.2.2
Sprinklers	Annually	5.2.1
Sprinklers (spare)	Annually	5.2.1.4
Supervisory signal devices (except valve supervisory switches)		5.2.4, Chapter 13
System valves		Chapter 13
Valve supervisory signal devices		5.2.4, Chapter 13
Waterflow alarm devices	Quarterly	5.2.4
Test		
Antifreeze solution	Annually	5.3.4
Control valves		Chapter 13
Gauges		Chapter 13
Main drain		Chapter 13
Sprinklers	At 50 years and every 10 years thereafter	5.3.1.1.1, 5.3.1.1.1.1, 5.3.1.1.1.2
Sprinklers	At 75 years and every 5 years thereafter	5.3.1.1.1.5
Sprinklers (dry)	15 years and every 10 years thereafter	5.3.1.1.1.6
Sprinklers (extra-high or greater temperature solder type)	5 years	5.3.1.1.1.4
Sprinklers (fast-response)	At 20 years and every 10 years thereafter	5.3.1.1.1.3
Sprinklers (harsh environments)	5 years	5.3.1.1.2
Supervisory signal devices (except valve supervisory switches)		Chapter 13
System valves		Chapter 13
Valve supervisory signal devices		Chapter 13
Waterflow alarm devices (mechanical)	Quarterly	5.3.3.1
Waterflow alarm devices (vane and pressure switch type)	Semiannually	5.3.3.2
Maintenance		
Low-point drains (dry pipe and preaction systems)		Chapter 13
Sprinklers and automatic spray nozzles protecting commercial cooking equipment and ventilation systems	Annually	5.4.1.7
Replacement of sprinklers	Removed for any reason	5.4.1.1
Valves (all types)		Chapter 13
Investigation		
Obstruction		Chapter 14

5.1.4 Impairments. The procedures outlined in Chapter 15 shall be followed where an impairment to protection occurs.

5.1.5 Hose Connections. Hose connections shall be inspected, tested, and maintained in accordance with Chapters 6 and 13.

5.2* Inspection.

5.2.1 Sprinklers.

5.2.1.1* Sprinklers shall be inspected from the floor level annually.

5.2.1.1.1* Any sprinkler that shows signs of any of the following shall be replaced:

- (1) Leakage
- (2) Corrosion detrimental to sprinkler performance
- (3) Physical damage
- (4) Loss of fluid in the glass bulb heat-responsive element
- (5) Loading detrimental to sprinkler performance
- (6) Paint other than that applied by the sprinkler manufacturer

5.2.1.1.2 Any sprinkler that has been installed in the incorrect orientation shall be corrected by repositioning the branchline, drop, or sprig, or shall be replaced.

5.2.1.1.3* Sprinklers installed in concealed spaces such as above suspended ceilings shall not require inspection.

5.2.1.1.4 Sprinklers installed in areas that are inaccessible for safety considerations due to process operations shall be inspected during each scheduled shutdown.

5.2.1.1.5 Escutcheons and coverplates for recessed, flush, and concealed sprinklers shall be replaced with their listed escutcheon or coverplate if found missing during the inspection.

5.2.1.1.5.1 Where the listed escutcheon or coverplate from a listed assembly is missing and is no longer commercially available, the sprinkler shall be replaced.

5.2.1.1.6 Escutcheons for pendent sprinklers that are not recessed, flush, or concealed shall not be required to be replaced if found missing during the inspection.

5.2.1.2* The minimum clearance to storage as described in 5.2.1.2.1 through 5.2.1.2.6 shall be maintained below all sprinkler deflectors.

5.2.1.2.1* Unless greater distances are required by 5.2.1.2.2, 5.2.1.2.3, or 5.2.1.2.4, or lesser distances are permitted by 5.2.1.2.6, clearance between the deflector and the top of storage shall be 18 in. (457 mm) or greater.

5.2.1.2.2 Where standards other than NFPA 13 specify greater clearance to storage minimums, they shall be followed.

5.2.1.2.3* Clearance between the deflector and the top of storage shall be 36 in. (914 mm) or greater for special sprinklers.

5.2.1.2.4 Clearance from the top of storage to sprinkler deflectors shall be 36 in. (914 mm) or greater where rubber tires are stored.

5.2.1.2.5 In-rack sprinklers shall not be required to meet the obstruction criteria and clearance from storage requirements.

5.2.1.2.6* Clearance between the deflector and the top of storage shall be permitted to be less than 18 in. (457 mm) where shown to be permitted by the installation standard.

5.2.1.3* Storage closer to the sprinkler deflector than permitted by the clearance rules of the installation standard described in 5.2.1.2.1 through 5.2.1.2.4 shall be corrected.

5.2.1.4 The supply of spare sprinklers shall be inspected annually for the following:

- (1) The correct number and type of sprinklers as required by 5.4.1.5
- (2) A sprinkler wrench for each type of sprinkler as required by 5.4.1.5.5
- (3) The list of spare sprinklers as required by 5.4.1.5.6

5.2.2* Pipe and Fittings. Sprinkler pipe and fittings shall be inspected annually from the floor level.

5.2.2.1* Pipe and fittings shall be free of mechanical damage, leakage, and corrosion.

5.2.2.2 Sprinkler piping shall not be subjected to external loads by materials either resting on the pipe or hung from the pipe.

5.2.2.3* Pipe and fittings installed in concealed spaces such as above suspended ceilings shall not require inspection.

5.2.2.4 Pipe and fittings installed in areas that are inaccessible for safety considerations due to process operations shall be inspected during each scheduled shutdown.

5.2.3* Hangers, Braces, and Supports. Sprinkler pipe hangers, braces, and supports shall be inspected annually from the floor level.

5.2.3.1 Hangers, braces, and supports shall not be damaged, loose, or unattached.

5.2.3.2 Hangers, braces, and supports that are damaged, loose, or unattached shall be replaced or refastened.

5.2.3.3* Hangers, braces, and supports installed in concealed spaces such as above suspended ceilings shall not require inspection.

5.2.3.4 Hangers, braces, and supports installed in areas that are inaccessible for safety considerations due to process operations shall be inspected during each scheduled shutdown.

5.2.4 Waterflow Alarm and Supervisory Signal Initiating Device. Waterflow alarm and supervisory signal initiating devices shall be inspected quarterly to verify that they are free of physical damage.

5.2.5* Hydraulic Design Information Sign. The hydraulic design information sign shall be inspected annually to verify that it is provided, attached securely to the sprinkler riser, and is legible.

5.2.5.1 A hydraulic design information sign that is missing or illegible shall be replaced.

5.2.5.2 A pipe schedule system shall have a hydraulic design information sign that reads "Pipe Schedule System."

5.2.6 Heat Tracing. Heat tracing shall be inspected and maintained in accordance with manufacturer's requirements.

5.2.7 Information Sign. The information sign required by 4.1.9 shall be inspected annually to verify that it is provided, securely attached, and legible.

5.2.8* General Information Sign. The general information sign required by NFPA 13 shall be inspected annually to verify that it is provided, securely attached, and legible.

5.2.9 Antifreeze Information Sign. The antifreeze information sign required by 4.1.10 shall be inspected annually to verify that it is present, securely attached, and legible.

5.3 Testing.

5.3.1* Sprinklers.

5.3.1.1* Where required by this section, sample sprinklers shall be submitted to a recognized testing laboratory acceptable to the authority having jurisdiction for field service testing.

5.3.1.1.1 Where sprinklers have been installed for 50 years, they shall be replaced or representative samples from one or more sample areas shall be tested.

5.3.1.1.1.1 Test procedures shall be repeated at 10-year intervals.

5.3.1.1.1.2 Sprinklers manufactured prior to 1920 shall be replaced.

5.3.1.1.1.3* Sprinklers manufactured using fast-response elements that have been installed for 20 years shall be replaced or representative samples shall be tested and then retested at 10-year intervals.

5.3.1.1.1.4* Representative samples of solder-type sprinklers with a temperature classification of extra high [325°F (163°C)] or greater that are exposed to semicontinuous to continuous maximum allowable ambient temperature conditions shall be tested at 5-year intervals.

5.3.1.1.1.5 Where sprinklers have been installed for 75 years, they shall be replaced or representative samples from one or more sample areas shall be submitted to a recognized testing laboratory acceptable to the authority having jurisdiction for field service testing and repeated at 5-year intervals.

5.3.1.1.1.6* Dry sprinklers that have been installed for 15 years shall be replaced or representative samples shall be tested and then retested at 10-year intervals.

5.3.1.1.2* Sprinklers exposed to harsh environments, including corrosive atmospheres, shall be one of the following:

- (1) Replaced
- (2) Tested via representative sprinkler samples on a 5-year basis

N 5.3.1.1.3 Listed corrosion-resistant sprinklers installed in harsh environments shall be permitted to be tested on a 10-year basis.

5.3.1.1.4 Where historical data indicate, longer intervals between testing shall be permitted.

5.3.1.2* A representative sample of sprinklers for testing per 5.3.1.1 shall consist of a minimum of not less than four sprinklers or 1 percent of the number of sprinklers per individual sprinkler sample, whichever is greater.

5.3.1.3 Where one sprinkler within a representative sample fails to meet the test requirement, all sprinklers within the area represented by that sample shall be replaced.

5.3.1.3.1 Manufacturers shall be permitted to make modifications to their own sprinklers in the field with listed devices that restore the original performance as intended by the listing, where acceptable to the authority having jurisdiction.

N 5.3.2 Electrically Operated Sprinklers.

N 5.3.2.1 Electrically operated sprinklers shall be tested in accordance with the manufacturer's requirements.

N 5.3.2.2 The testing of the electronic actuation and supervision shall be in accordance with the manufacturer's requirements and NFPA 72 or the local fire alarm code.

5.3.3 Waterflow Alarm Devices.

5.3.3.1 Mechanical waterflow alarm devices including, but not limited to, water motor gongs, shall be tested quarterly.

5.3.3.2* Vane-type and pressure switch-type waterflow alarm devices shall be tested semiannually.

5.3.3.3 Testing of pressure switch-type waterflow alarm devices on wet pipe systems shall be accomplished by opening the inspector's test connection.

5.3.3.3.1 Where freezing weather conditions or other circumstances prohibit use of the inspector's test connection, the bypass connection shall be permitted to be used.

5.3.3.4 Except as permitted in 5.3.3.4.1, testing of vane-type waterflow alarm devices on wet pipe systems shall be accomplished by a flow of water equivalent to the flow out of the smallest single k-factor sprinkler (or smaller) past the flow switch.

N 5.3.3.4.1 A vane-type waterflow alarm device listed with an integral automated test feature that is capable of verifying the presence of water at the location of the water flow alarm device and function of the water flow device and alarm shall be permitted to be used.

5.3.3.4.2 Vane-type waterflow alarm devices tested semiannually using circulated water or as described in 5.3.3.4.1 shall be tested by opening the inspector's test connection at a minimum frequency of once every 3 years.

5.3.3.5 Fire pumps shall not be taken out of service during testing unless constantly attended by qualified personnel or all impairment procedures contained in Chapter 15 are followed.

5.3.4* Antifreeze Systems. Annually, before the onset of freezing weather, the antifreeze solution shall be tested using the following procedure:

- (1) Using the antifreeze information sign required by 4.1.10, installation records, maintenance records, information from the owner, chemical tests, or other reliable sources of information, the type of antifreeze in the system shall be determined and (a) or (b) implemented if necessary:
 - (a) If the antifreeze is found to be a type that is no longer permitted, the system shall be drained completely and the antifreeze replaced with an acceptable solution.

- (b) If the type of antifreeze cannot be reliably determined, the system shall be drained completely and the antifreeze replaced with an acceptable solution in accordance with 5.3.4.4.
- (2) If the antifreeze is not replaced in accordance with 5.3.4(1)(a) and 5.3.4(1)(b), test samples shall be taken at the top of each system and at the bottom of each system as follows:
 - (a) If the most remote portion of the system is not near the top or the bottom of the system, an additional sample shall be taken at the most remote portion.
 - (b) If the connection to the water supply piping is not near the top or the bottom of the system, an additional sample shall be taken at the connection to the water supply.
- (3) The specific gravity of each solution shall be checked using a hydrometer with a suitable scale or a refractometer having a scale calibrated for the antifreeze solution.
- (4) If any of the samples exhibits a concentration in excess of what is permitted by 5.3.4.4, the system shall be emptied and refilled with a new acceptable solution.
- (5) If a concentration greater than what is currently permitted by 5.3.4.4 was necessary to keep the fluid from freezing, alternative methods for preventing the pipe from freezing shall be employed.

5.3.4.1 The antifreeze solution shall be tested at its most remote portion and where it interfaces with the wet pipe system.

5.3.4.2 Where antifreeze systems have a capacity larger than 150 gal (568 L), tests at one additional point for every 100 gal (379 L) shall be made.

5.3.4.2.1 If the results indicate an incorrect freeze point at any point in the system, the system shall be drained and refilled with new premixed antifreeze.

5.3.4.2.2 For premixed solutions, the manufacturer's instructions shall be permitted to be used with regard to the number of test points and the refill procedure.

5.3.4.3 The use of antifreeze solutions shall be in conformity with state and local health regulations.

5.3.4.3.1* Listed CPVC sprinkler pipe and fittings shall be protected from freezing with glycerine only.

5.3.4.3.1.1 The use of diethylene, ethylene, or propylene glycols shall be specifically prohibited.

5.3.4.4 Except as permitted by 5.3.4.4.1 and 5.3.4.4.3, all antifreeze systems shall utilize listed antifreeze solutions.

5.3.4.4.1* For systems installed prior to September 30, 2012, listed antifreeze solutions shall not be required until September 30, 2022, where one of the following conditions is met:

- (1)* The concentration of the antifreeze solution shall be limited to 30 percent propylene glycol by volume or 38 percent glycerine by volume.
- (2)* Antifreeze systems with concentrations in excess of 30 percent but not more than 40 percent propylene glycol by volume and 38 percent but not more than 50 percent glycerine by volume shall be permitted based upon an approved deterministic risk assessment prepared by a qualified person approved by the authority having jurisdiction.

5.3.4.4.2 Newly introduced solutions shall be factory premixed antifreeze solutions (chemically pure or United States Pharmacopeia 96.5 percent).

5.3.4.4.3 Premixed antifreeze solutions of propylene glycol exceeding 30 percent concentration by volume shall be permitted for use with ESFR sprinklers where the ESFR sprinklers are listed for such use in a specific application.

5.4 Maintenance.

5.4.1 Sprinklers.

5.4.1.1 Where a sprinkler has been removed for any reason, it shall not be reinstalled.

5.4.1.2* Replacement sprinklers shall have the proper characteristics for the application intended, which include the following:

- (1) Style
- (2) Orifice size and K-factor
- (3) Temperature rating
- (4) Coating, if any
- (5) Deflector type (e.g., upright, pendent, sidewall)
- (6) Design requirements

5.4.1.2.1* Spray sprinklers shall be permitted to replace old-style sprinklers.

5.4.1.2.2* Where replacing residential sprinklers manufactured prior to 2003 that are no longer available from the manufacturer and are installed using a design density less than 0.05 gpm/ft² (204 mm/min), a residential sprinkler with an equivalent K-factor (± 5 percent) shall be permitted to be used provided the currently listed coverage area for the replacement sprinkler is not exceeded.

5.4.1.2.3 Replacement sprinklers for piers and wharves shall comply with NFPA 307.

5.4.1.3 Only new, listed sprinklers shall be used to replace existing sprinklers.

5.4.1.4* Special and quick-response sprinklers as defined by NFPA 13 shall be replaced with sprinklers of the same orifice, size, temperature range and thermal response characteristics, and K-factor.

5.4.1.5* A supply of at least six spare sprinklers shall be maintained on the premises so that any sprinklers that have operated or been damaged in any way can be promptly replaced.

5.4.1.5.1 The sprinklers shall correspond to the types and temperature ratings of the sprinklers in the property.

5.4.1.5.2 The stock of spare sprinklers shall be kept in a cabinet located where the temperature to which they are subjected will at no time exceed the maximum ceiling temperatures specified in Table 5.4.1.5.2 for each of the sprinklers within the cabinet.

5.4.1.5.3 Where dry sprinklers of different lengths are installed, spare dry sprinklers shall not be required, provided that a means of returning the system to service is furnished.

N Table 5.4.1.5.2 Temperature Ratings, Classifications, and Color Codings

Maximum Ceiling Temperature		Temperature Rating		Temperature Classification	Color Code	Glass Bulb Colors
°F	°C	°F	°C			
100	38	135–170	57–77	Ordinary	Uncolored or black	Orange or red
150	66	175–225	79–107	Intermediate	White	Yellow or green
225	107	250–300	121–149	High	Blue	Blue
300	149	325–375	163–191	Extra high	Red	Purple
375	191	400–475	204–246	Very extra high	Green	Black
475	246	500–575	260–302	Ultra high	Orange	Black
625	329	650	343	Ultra high	Orange	Black

[13:Table 7.2.4.1]

5.4.1.5.4 The stock of spare sprinklers shall include all types and ratings installed and shall be as follows:

- (1) For protected facilities having under 300 sprinklers — no fewer than 6 sprinklers
- (2) For protected facilities having 300 to 1000 sprinklers — no fewer than 12 sprinklers
- (3) For protected facilities having over 1000 sprinklers — no fewer than 24 sprinklers

5.4.1.5.5* One sprinkler wrench as specified by the sprinkler manufacturer shall be provided in the cabinet for each type of sprinkler installed to be used for the removal and installation of sprinklers in the system.

5.4.1.5.6 A list of the sprinklers installed in the property shall be posted in the sprinkler cabinet.

5.4.1.5.6.1* The list shall include the following:

- (1) Sprinkler identification number (SIN) if equipped; or the manufacturer, model, orifice, deflector type, thermal sensitivity, and pressure rating
- (2) General description
- (3) Quantity of each type to be contained in the cabinet
- (4) Issue or revision date of the list

5.4.1.6* Sprinklers shall not be altered in any respect or have any type of ornamentation, paint, or coatings applied after shipment from the place of manufacture.

5.4.1.7 Sprinklers and automatic spray nozzles used for protecting commercial-type cooking equipment and ventilating systems shall be replaced annually.

5.4.1.7.1 Where automatic bulb-type sprinklers or spray nozzles are used and annual examination shows no buildup of grease or other material on the sprinklers or spray nozzles, such sprinklers and spray nozzles shall not be required to be replaced.

N 5.4.1.8 Electrically operated sprinklers shall be maintained in accordance with the manufacturer's requirements.

5.4.1.9 Protective Coverings.

5.4.1.9.1* Sprinklers protecting spray areas and mixing rooms in resin application areas installed with protective coverings shall continue to be protected against overspray residue so that they will operate in the event of fire.

5.4.1.9.2 Sprinklers installed as described in 5.4.1.9.1 shall be protected using cellophane bags having a thickness of 0.003 in. (0.076 mm) or less or thin paper bags.

5.4.1.9.3 Coverings shall be replaced periodically so that heavy deposits of residue do not accumulate.

5.4.2* Dry Pipe Systems. Dry pipe systems shall be kept dry at all times.

5.4.2.1 During nonfreezing weather, a dry pipe system shall be permitted to be left wet if the only other option is to remove the system from service while waiting for parts or during repair activities.

5.4.2.2 Refrigerated spaces or other areas within the building interior where temperatures are maintained at or below 40°F (4°C) shall not be permitted to be left wet.

5.4.2.3 Air driers shall be maintained in accordance with the manufacturer's instructions.

5.4.2.4 Compressors used in conjunction with dry pipe sprinkler systems shall be inspected, tested, and maintained in accordance with Chapter 13 and the manufacturer's instructions.

5.4.3* Marine Systems. Sprinkler systems that are normally maintained using fresh water as a source shall be drained and refilled, then drained and refilled again with fresh water following the introduction of raw water into the system.

5.5 Component Action Requirements.

5.5.1 Whenever a component in a sprinkler system is adjusted, repaired, reconditioned, or replaced, the actions required in Table 5.5.1 shall be performed.

5.5.2 Where the original installation standard is different from the cited standard, the use of the appropriate installing standard shall be permitted.

5.5.3 These actions shall not require a design review, which is outside the scope of this standard.

Table 5.5.1 Summary of Component Action Requirements

Component	Adjust	Repair/ Recondition	Replace	Required Action
Water Delivery Components				
Antifreeze solution	X		X	Inspect freezing point of solution Inspect for leaks at system working pressure
Fire department connections	X	X	X	See Chapter 13
Pipe and fittings affecting not more than 20 sprinklers	X	X	X	Inspect for leaks at system working pressure
Pipe and fittings affecting more than 20 sprinklers	X	X	X	Hydrostatic test in conformance with NFPA 13
Sprinklers, regardless of number	X		X	Inspect for leaks at system working pressure
Alarm and Supervisory Components				
Detection system (for deluge or preaction system)	X	X	X	Operational test for conformance with NFPA 13 and/or NFPA 72
High- and low- air pressure switch	X	X	X	Operational test of high and low settings
Pressure switch-type waterflow	X	X	X	Operational test using the inspector's test connection or alarm bypass test valve
Valve supervisory signal initiating device	X	X	X	Test for conformance with NFPA 13 and/or NFPA 72
Vane-type waterflow	X	X	X	Operational test using inspector's test connection
Water motor gong	X	X	X	Operational test using inspector's test connection
Testing and Maintenance Components				
Air compressor	X	X	X	Operational test for conformance with NFPA 13
Automatic air maintenance device	X	X	X	Operational test for conformance with NFPA 13
Auxiliary drains	X	X	X	Inspect for leaks at system working pressure; main drain test
Gauges	X		X	Verify at 0 bar (0 psi) and system working pressure
Inspector's test connection	X	X	X	Inspect for leaks at system working pressure; main drain test
Main drain	X	X	X	Main drain test
Structural Components				
Hanger/seismic bracing	X	X	X	Inspect for conformance with NFPA 13
Pipe stands	X	X	X	Inspect for conformance with NFPA 13
Informational Components				
Antifreeze information sign	X	X	X	Inspect for conformance with this standard
General information sign	X	X	X	Inspect for conformance with this standard
Hydraulic design information sign	X	X	X	Inspect for conformance with NFPA 13 and this standard
Identification sign	X	X	X	Inspect for conformance with NFPA 13 and this standard
Information sign	X	X	X	Inspect for conformance with this standard

Chapter 6 Standpipe and Hose Systems

6.1 General.

6.1.1 Minimum Requirements.

6.1.1.1 This chapter shall provide the minimum requirements for the routine inspection, testing, and maintenance of standpipe and hose systems.

6.1.1.2 Table 6.1.1.2 shall be used to determine the minimum required frequencies for inspection, testing, and maintenance.

6.1.2 Inspection, testing, and maintenance activities required by this chapter shall be followed to determine that components are free of corrosion, foreign material, physical damage,

tampering, or other conditions that adversely affect system operation.

6.1.3 Common components and valves shall be inspected, tested, and maintained in accordance with Chapter 13.

6.1.4 The procedures outlined in Chapter 14 shall be followed where there is a need to conduct an obstruction investigation.

6.1.5 Where the inspection, testing, and maintenance of standpipe and hose systems results or involves a system that is out of service, the impairment procedures outlined in Chapter 15 shall be followed.

6.1.6 Where approved by the authority having jurisdiction, existing hose shall be permitted to be removed and shall not be recorded as a deficiency.

Table 6.1.1.2 Summary of Standpipe and Hose Systems Inspection, Testing, and Maintenance

Item	Frequency	Reference
Inspection		
Cabinet	Annually	6.2.8
Control valves		Chapter 13
Gauges		Chapter 13
Hose	Annually	6.2.5
Hose connection	Annually	6.2.3
Hose nozzle	Annually and after each use	6.2.6
Hose storage device	Annually	6.2.7
Hydraulic design information sign	Annually	6.2.2
Hose valves		Chapter 13
Piping	Annually	6.2.4
Pressure-regulating devices		Chapter 13
Supervisory devices (except valve supervisory devices)		Chapter 13
Valve supervisory devices		Chapter 13
Test		
Control valves		Chapter 13
System valves		Chapter 13
Flow test	5 years	6.3.1
Hose		NFPA 1962
Hose connection pressure regulating devices		Chapter 13
Hose valves		Chapter 13
Hydrostatic test	5 years	6.3.2
Main drain test		Chapter 13
Pressure control valve		Chapter 13
Pressure-reducing valve		Chapter 13
Supervisory signal devices (except valve supervisory switches)		Chapter 13
Valve status test		Chapter 13
Valve supervisory devices		Chapter 13
Waterflow alarm devices		Chapter 13
Maintenance		
Hose valves		Chapter 13
Pressure gauges		Chapter 13
Valves (all types)	Annually/as needed	Chapter 13

6.2 Inspection.

6.2.1 Components. Components of standpipe and hose systems shall be visually inspected annually or as specified in Table 6.1.1.2.

6.2.2* Hydraulic Design Information Sign. The hydraulic design information sign for standpipe systems shall be inspected annually to verify that it is provided, attached securely, and legible.

6.2.2.1 A hydraulic design information sign that is missing or illegible shall be replaced.

6.2.2.2 A standpipe system that was not sized by hydraulic design shall have a hydraulic design information sign that reads "Pipe Schedule System."

6.2.3 Hose Connections.

6.2.3.1 Hose connections shall be inspected annually for the following conditions:

- (1) Valve cap(s) missing or damaged
- (2) Fire hose connection damaged
- (3) Valve handles missing or damaged
- (4) Cap gaskets missing or deteriorated
- (5) Valve leaking
- (6) Visible and physical obstructions to hose connections
- (7) Pressure restricting device missing
- (8) Manual, semiautomatic, or dry standpipe valve does not operate smoothly
- (9) Valve threads damaged

6.2.3.2 Where any deficiency is noted, the appropriate corrective action shall be taken.

6.2.4 Piping.

6.2.4.1 Piping shall be inspected annually for the following conditions:

- (1) Damaged piping
- (2) Damaged control valves

- (3) Missing or damaged pipe support device (i.e., missing or damaged hanger or seismic brace)
- (4) Damaged supervisory signal initiating device

6.2.4.2 Where any deficiency is noted, the appropriate corrective action shall be taken.

6.2.5 Hose.

6.2.5.1 Hose shall be inspected annually for the following conditions as required by NFPA 1962:

- (1) Mildew, cuts, abrasions, and deterioration
- (2) Couplings hose threads damaged
- (3) Gaskets missing or deteriorated
- (4) Incompatible threads on coupling
- (5) Hose not connected to hose rack nipple or valve
- (6) Hose test outdated

6.2.5.2 Where any deficiency is noted, the appropriate corrective action shall be taken.

6.2.6 Hose Nozzle.

6.2.6.1 Hose nozzles shall be inspected annually for the following conditions:

- (1) Hose nozzle missing
- (2) Gasket missing or deteriorated
- (3) Obstructions
- (4) Does not operate smoothly

6.2.6.2 Where any deficiency is noted, the appropriate corrective action shall be taken.

6.2.7 Hose Storage Device.

6.2.7.1 Hose storage devices shall be inspected annually for the following conditions:

- (1) Difficult to operate
- (2) Damaged
- (3) Visible or physical obstruction
- (4) Hose improperly racked or rolled
- (5) Nozzle clip not in place and nozzle not correctly contained
- (6) Hose rack enclosed in cabinet not swinging out at least 90 degrees

6.2.7.2 Where any deficiency is noted, the appropriate corrective action shall be taken.

6.2.8 Cabinet.

6.2.8.1 Cabinets shall be inspected annually for the following conditions:

- (1) Overall for corroded or damaged parts
- (2) Difficult to open
- (3) Cabinet door not opening fully
- (4) Door glazing cracked or broken
- (5) Lock on break glass-type cabinet not functioning properly
- (6) Glass break device missing or not attached
- (7) Not properly identified as containing fire equipment
- (8) Visible or physical obstructions
- (9) All valves, hose, nozzles, fire extinguishers, and so forth, easily accessible

6.2.8.2 Where any deficiency is noted, the appropriate corrective action shall be taken.

6.3 Testing. Where water damage is a possibility, an air test shall be conducted on the system at 25 psi (1.7 bar) prior to introducing water to the system.

6.3.1 Flow Tests.

6.3.1.1* A flow test shall be conducted every 5 years on all automatic standpipe systems to verify that the required flow and pressure are available at the hydraulically most remote hose valve outlet(s) while flowing the standpipe system demand.

6.3.1.1.1 Where a flow test of the hydraulically most remote outlet(s) is not practical, the authority having jurisdiction shall be consulted for the appropriate location for the test.

6.3.1.1.2 Pressure gauges maintained in accordance with **8.3.3.5.2** shall be provided for the test.

6.3.1.2* Class I and Class III standpipe system demand shall include 500 gpm (1892 L/min) for the most remote standpipe and 250 gpm (946 L/min) for each additional standpipe until the total system demand is simultaneously flowing.

6.3.1.2.1* The 250 gpm (946 L/min) required from each additional Class I and Class III standpipe shall be allowed to be flowed from the most convenient hose valve on that standpipe.

6.3.1.2.2* Where the 250 gpm (946 L/min) cannot be flowed from each additional Class I and Class III standpipe, the authority having jurisdiction shall determine where the additional flow can be taken.

6.3.1.3 Class II standpipe system demand shall include 100 gpm (379 L/min) for the most remote standpipe connection.

6.3.1.4 The standpipe system demand shall be based on the design criteria in effect at the time of the installation.

6.3.1.4.1 Where the standpipe system demand cannot be determined, the authority having jurisdiction shall determine the standpipe system demand.

6.3.1.4.2 The actual test method(s) and performance criteria shall be discussed in advance with the authority having jurisdiction.

6.3.1.5 Standpipes, sprinkler connections to standpipes, or hose stations equipped with pressure-reducing valves or pressure-regulating valves shall have these valves inspected, tested, and maintained in accordance with the requirements of Chapter 13.

6.3.1.6 A main drain test shall be performed on all standpipe systems with automatic water supplies in accordance with the requirements of Chapter 13.

6.3.1.6.1 The test shall be performed at the low point drain for each standpipe or the main drain test connection where the supply main enters the building (when provided).

6.3.1.6.2 Pressure gauges maintained in accordance with Chapter 13 shall be provided for the test.

6.3.2 Hydrostatic Tests.

6.3.2.1* Hydrostatic tests of not less than 200 psi (13.8 bar) pressure for 2 hours, or at 50 psi (3.4 bar) in excess of the maximum pressure, where maximum pressure is in excess of 150 psi (10.3 bar), shall be conducted every 5 years on manual

standpipe systems and semiautomatic dry standpipe systems, including piping in the fire department connection.

6.3.2.1.1 Manual wet standpipes that are part of a combined sprinkler/standpipe system shall not be required to be tested in accordance with 6.3.2.1.

6.3.2.2 The hydrostatic test pressure shall be measured at the low elevation point of the individual system or zone being tested.

6.3.2.2.1 The inside standpipe piping shall show no leakage.

6.3.3 Waterflow Alarm and Supervisory Alarm Devices.

6.3.3.1 Where provided, waterflow alarm and supervisory alarm devices shall be tested in accordance with 13.2.4 and 13.3.3.5.

6.3.3.2 Where freezing conditions necessitate a delay in testing, tests shall be performed as soon as weather allows.

6.4 Maintenance.

6.4.1 Maintenance and repairs shall be in accordance with 6.1.3 and Table 6.1.1.2.

6.4.2 Equipment that does not pass the inspection or testing requirements shall be repaired and tested again or replaced.

6.5 Component Action Requirements.

6.5.1 Whenever components in standpipe and hose systems are adjusted, repaired, reconditioned, or replaced, the actions required in Table 6.5.1 shall be performed.

6.5.2 Where the original installation standard is different from the cited standard, the use of the appropriate installing standard shall be permitted.

6.5.3 These actions shall not require a design review, which is outside the scope of this standard.

Table 6.5.1 Summary of Component Action Requirements

Component	Adjust	Repair	Replace	Required Action
Water Delivery Components				
Backflow prevention device	X	X	X	See Chapter 13
Control valves	X	X	X	See Chapter 13
Fire department connections	X	X	X	See Chapter 13
Fire hose			X	No action required
Fire hose		X		Perform hydrostatic test in accordance with NFPA 1962
Hose valve	X	X	X	See Chapter 13
Hose valve pressure-regulating devices	X	X	X	See Chapter 13
Piping	X	X	X	Hydrostatic test in conformance with NFPA 14
System pressure-regulating devices	X	X	X	See Chapter 13
Alarm and Supervisory Components				
Pressure switch—type waterflow	X	X	X	Operational test using inspector's test connection
Valve supervisory device	X	X	X	Operational test for receipt of alarms and verification of conformance with NFPA 14 and/or NFPA 72
Vane-type waterflow	X	X	X	Operational test using inspector's test connection
Water motor gong	X	X	X	Operational test using inspector's test connection
Status-Indicating Components				
Gauges	X		X	Verify at 0 psi (0 bar) and system working pressure
System Housing and Protection Components				
Cabinet	X	X	X	Verify conformance with NFPA 14
Hose storage rack	X	X	X	Verify conformance with NFPA 14
Testing and Maintenance Components				
Auxiliary drains	X	X	X	Inspect for leaks at system working pressure
Drain riser	X	X	X	Inspect for leaks while flowing from connection above the repair
Main drain	X	X	X	Inspect for leaks and residual pressure during main drain test
Structural Components				
Hanger/seismic bracing	X	X	X	Verify conformance with NFPA 14
Pipe stands	X	X	X	Verify conformance with NFPA 14
Informational Components				
Hydraulic design information sign	X	X	X	Verify conformance with NFPA 14
Identification signs	X	X	X	Verify conformance with NFPA 14

Shaded text = Revisions. **Δ** = Text deletions and figure/table revisions. • = Section deletions. **N** = New material



Chapter 7 Private Fire Service Mains

7.1 General.

7.1.1 Minimum Requirements.

7.1.1.1 This chapter shall provide the minimum requirements for the routine inspection, testing, and maintenance of private fire service mains and their appurtenances.

7.1.1.2 Table 7.1.1.2 shall be used to determine the minimum required frequencies for inspection, testing, and maintenance.

7.1.2 Common Components and Valves. Common components and valves shall be inspected, tested, and maintained in accordance with Chapter 13.

7.1.3 Obstruction Investigations. The procedures outlined in Chapter 14 shall be followed where there is a need to conduct an obstruction investigation.

7.1.4 Fire Hose. Fire hose shall be maintained in accordance with NFPA 1962.

7.1.5 Impairments. The procedures outlined in Chapter 15 shall be followed wherever such an impairment to protection occurs.

7.2 Inspection and Corrective Action.

7.2.1 General. Private fire service mains and their appurtenances shall be inspected at the intervals specified in Table 7.1.1.2.

7.2.2* Procedures. All procedures shall be carried out in accordance with the manufacturer's instructions, where applicable.

7.2.2.1 Exposed Piping.

7.2.2.1.1 Exposed piping shall be inspected annually.

7.2.2.1.2 Piping shall be inspected for the following conditions:

- (1) Leaks
- (2) Physical damage
- (3) Corrosion
- (4) Restraint methods

7.2.2.1.2.1 Where any deficiency is noted, the appropriate corrective action shall be taken.

7.2.2.1.3 Piping installed in areas that are inaccessible for safety considerations due to process operations shall be inspected during each scheduled shutdown.

Table 7.1.1.2 Summary of Private Fire Service Main Inspection, Testing, and Maintenance

Item	Frequency	Reference
Inspection		
Backflow preventer		Chapter 13
Check valve		Chapter 13
Control valve		Chapter 13
Fire department connection		Chapter 13
Hose houses	Quarterly	7.2.2.8
Hydrants (dry barrel and wall)	Annually and after each operation	7.2.2.4
Hydrants (wet barrel)	Annually and after each operation	7.2.2.5
Mainline strainers	Annually and after each significant flow	7.2.2.3
Monitor nozzles	Semiannually	7.2.2.7
Pipe and fittings (exposed)	Annually	7.2.2.1
Valve supervisory devices		Chapter 13
Test		
Backflow preventer		Chapter 13
Control valve		Chapter 13
Hydrants	Flow, annually	7.3.2
Monitor nozzles	Flow, annually (range and operation)	7.3.3
Piping (exposed and underground) (flow test)	5 years	7.3.1
Valve status test		Chapter 13
Valve supervisory devices		Chapter 13
Maintenance		
Backflow preventer		Chapter 13
Check valve		Chapter 13
Control valve		Chapter 13
Hydrants	Annually	7.4.2
Mainline strainers	Annually and after each operation	7.2.2.3
Monitor nozzles	Annually	7.4.3

7.2.2.2* Underground Piping.**7.2.2.3* Mainline Strainers.**

7.2.2.3.1 Mainline strainers shall be inspected and cleaned after each system flow exceeding that of a nominal 2 in. (50 mm) orifice.

7.2.2.3.2 Mainline strainers shall be removed and inspected annually for plugging, fouling, and damaged and corroded parts.

7.2.2.4 Dry Barrel and Wall Hydrants. Dry barrel and wall hydrants shall be inspected annually and after each operation for the following conditions:

- (1) Inaccessibility
- (2) Presence of water or ice in barrel, which could indicate a faulty drain, a leaky hydrant valve, or high groundwater table)
- (3) Improper drainage from barrel
- (4) Leaks in outlets or at top of hydrant
- (5) Cracks in hydrant barrel
- (6) Tightness of outlet caps
- (7) Worn outlet threads
- (8) Worn hydrant operating nut
- (9) Availability of operating wrench
- (10) Corrosion detrimental to hydrant integrity

7.2.2.4.1 Where any deficiency is noted, the appropriate corrective action shall be taken.

7.2.2.5 Wet Barrel Hydrants. Wet barrel hydrants shall be inspected annually and after each operation for the following conditions:

- (1) Inaccessibility
- (2) Leaks in outlets or at top of hydrant
- (3) Cracks in hydrant barrel
- (4) Tightness of outlet caps
- (5) Worn outlet threads
- (6) Worn hydrant operating nut
- (7) Availability of operating wrench
- (8) Corrosion detrimental to hydrant integrity

7.2.2.5.1 Where any deficiency is noted, the appropriate corrective action shall be taken.

N 7.2.2.6* Dry Hydrants. Dry hydrants shall be inspected at least quarterly and maintained as necessary to keep them in good operating condition. [1142, 2017]

N 7.2.2.6.1 Thorough surveys shall be conducted, to reveal any deterioration in the water supply situation in ponds, streams, or cisterns. [1142, 2017]

N 7.2.2.6.2 Vegetation shall be cleared for a minimum 3 ft (0.9 m) radius from around hydrants. [1142, 2017]

N 7.2.2.6.3 The reflective material marking the hydrant and signage shall be inspected at least annually to verify that it is being maintained in accordance with 8.4.7 of NFPA 1142. [1142, 2017]

N 7.2.2.6.4 Hydrant risers shall be protected from ultraviolet (UV) degradation by painting or other measures. [1142, 2017]

N 7.2.2.6.5* The hydrants shall be flow tested at least annually with an approved pump to ensure that the minimum design flow is maintained. [1142, 2017]

7.2.2.7 Monitor Nozzles. Monitor nozzles shall be inspected semiannually for the following conditions:

- (1) Leakage
- (2) Physical damage
- (3) Corrosion

7.2.2.7.1 Where any deficiency is noted, the appropriate corrective action shall be taken.

7.2.2.8 Hose Houses. Hose houses shall be inspected quarterly for the following conditions:

- (1) Inaccessibility
- (2) Physical damage
- (3) Missing equipment

7.2.2.8.1 Where any deficiency is noted, the appropriate corrective action shall be taken.

7.3 Testing.

7.3.1* Underground and Exposed Piping Flow Tests. Underground and exposed piping shall be flow tested at minimum 5-year intervals.

7.3.1.1 Any flow test results that indicate deterioration of available waterflow and pressure shall be investigated to the complete satisfaction of the authority having jurisdiction to ensure that the required flow and pressure are available for fire protection.

7.3.1.2 Where underground piping supplies individual fire sprinkler, standpipe, water spray, or foam-water sprinkler systems and there are no means to conduct full flow tests, tests generating the maximum available flows shall be permitted.

7.3.2 Hydrants. Hydrants shall be tested annually to ensure proper functioning.

7.3.2.1 Each hydrant shall be opened fully and water flowed until all foreign material has cleared.

7.3.2.2 Flow shall be maintained for not less than 1 minute.

7.3.2.3 After operation, dry barrel and wall hydrants shall be observed for proper drainage from the barrel.

7.3.2.4 Full drainage shall take no longer than 60 minutes.

7.3.2.5 Where soil conditions or other factors are such that the hydrant barrel does not drain within 60 minutes, or where the groundwater level is above that of the hydrant drain, the hydrant drain shall be plugged and the water in the barrel shall be pumped out.

7.3.2.6 Dry barrel hydrants that are located in areas subject to freezing weather and that have plugged drains shall be identified clearly as needing pumping after operation.

7.3.3 Monitor Nozzles.

7.3.3.1 Monitor nozzles that are mounted on hydrants shall be tested as specified in 7.3.2.

7.3.3.2 All monitor nozzles shall be oscillated and moved throughout their full range annually to ensure proper operability.

7.4 Maintenance.

7.4.1 General. All equipment shall be maintained in proper working condition, consistent with the manufacturer's recommendations.

7.4.2 Hydrants.

7.4.2.1 Hydrants shall be lubricated annually to ensure that all stems, caps, plugs, and threads are in proper operating condition.

7.4.2.2* Hydrants shall be kept free of snow, ice, or other materials and protected against mechanical damage so that free access is ensured.

7.4.3 Monitor Nozzles. Monitor nozzles shall be lubricated annually to ensure proper operating condition.

7.5 Component Action Requirements.

7.5.1 Whenever a component in a private fire service system is adjusted, repaired, reconditioned, or replaced, the action required in Table 7.5.1 shall be performed.

7.5.2 Where the original installation standard is different from the cited standard, the use of the appropriate installing standard shall be permitted.

7.5.3* Where a main drain is not provided, other equivalent means of flow testing shall be permitted.

7.5.4 The actions of 7.5.1 shall not require a design review, which is outside the scope of this standard.

Table 7.5.1 Summary of Component Action Requirements

Component	Adjust	Repair/ Recondition	Replace	Test Criteria
Water Delivery Components				
Pipe and fittings (exposed and underground)	X	X	X	Hydrostatic test in conformance with NFPA 24 Flush in conformance with NFPA 24 or NFPA 20, as appropriate
Hydrants	X	X	X	Hydrostatic test in conformance with NFPA 24 Waterflow in conformance with NFPA 24 Inspect for proper drainage
Monitor nozzles	X	X	X	Flow test to confirm required coverage
Mainline strainers	X	X	X	Flow test downstream of strainer
Fire department connection	X	X	X	See Chapter 13
Alarm and Supervisory Components				
Valve supervisory device	X	X	X	Operational test for conformance with NFPA 24 and/or NFPA 72
System-Indicating Components				
Gauges			X	Verify at 0 psi (0 bar) and system working pressure
System Housing and Protection Components				
Hose houses	X	X	X	Verify integrity of hose house and hose house components
Hose		X		Repair and test hose in accordance with NFPA 1962
Hose			X	No action required
Structural Components				
Thrust blocks	X	X	X	Test at system working pressure
Tie rods	X	X	X	Test at system working pressure
Retainer glands	X	X	X	Test at system working pressure
Informational Components				
Identification signs	X	X	X	Verify conformance with NFPA 24

Chapter 8 Fire Pumps

8.1* General.

8.1.1 Minimum Requirements.

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

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

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

Δ 8.1.1.2.2 Electrical Connections.

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

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

8.1.1.2.3 Pump and motor bearings and couplings shall be greased annually or as required.

Δ 8.1.1.2.4 Printed Circuit Boards.

N 8.1.1.2.4.1 Printed circuit boards (PCBs) shall be inspected annually for corrosion to the extent that such work can be completed without opening an energized electric-motor-driven fire pump controller. (See A.8.1.1.2.2.2.)

N 8.1.1.2.4.2 The isolating switch in the fire pump controller that is located in a separate compartment from the other controller components shall be permitted to be used to meet the requirement of 8.1.1.2.4.1. (See A.8.1.1.2.2.1.)

Δ 8.1.1.2.5 Cable and Wire Insulation.

N 8.1.1.2.5.1 Cable and/or wire insulation shall be inspected annually for cracking to the extent that such work can be completed without opening an energized electric-motor-driven fire pump controller. (See A.8.1.1.2.2.2.)

N 8.1.1.2.5.2 The isolating switch in the fire pump controller that is located in a separate compartment from the other controller components shall be permitted to be used to meet the requirement of 8.1.1.2.5.1. (See A.8.1.1.2.2.1.)

Δ 8.1.1.2.6 Plumbing.

N 8.1.1.2.6.1 Plumbing parts, both inside and outside of electrical panels, shall be inspected annually for any leaks to the extent that such work can be completed without opening an energized electric-motor-driven fire pump controller. (See A.8.1.1.2.2.2.)

N 8.1.1.2.6.2 The isolating switch in the fire pump controller that is located in a separate compartment from the other controller components shall be permitted to be used to meet the requirement of 8.1.1.2.6.1. (See A.8.1.1.2.2.1.)

8.1.1.2.7 Fuel tanks, float switches, and supervisory signals for interstitial space shall be **tested** quarterly for liquid intrusion.

8.1.1.2.8 Supervisory signal circuitry shall be **tested** annually for high cooling water temperature.

8.1.1.2.9 Fuel tanks shall be **tested** annually for water and foreign materials.

8.1.1.2.10 Fuel tank vents and overflow piping shall be **inspected** annually for any obstructions.

8.1.1.2.11 All flexible hoses and connections shall be **inspected** annually for cracks and leaks.

8.1.1.2.12 Engine crankcase breathers shall be **inspected** quarterly.

8.1.1.2.13 Exhaust systems, drain condensate traps, and silencers shall be **inspected** annually.

8.1.1.2.14 Back pressure on the engine turbos shall be measured annually.

Δ 8.1.1.2.15 Batteries shall be checked annually as follows:

- (1) **Test** the specific gravity, state of charge, and charger rates of the batteries
- (2) **Clean** the terminals of any corrosion
- (3) **Ensure** that the cranking voltage exceeds 9 V on a 12 V system or 18 V on a 24 V system
- (4) **Ensure** that only distilled water is used in batteries

Δ 8.1.1.2.16 Inspections of Controls and Power Wire Connections.

N 8.1.1.2.16.1 All controls and power wiring connections shall be inspected annually and repaired as necessary to the extent that such work can be completed without opening an energized electric-motor-driven fire pump controller. (See A.8.1.1.2.2.2.)

N 8.1.1.2.16.2 The isolating switch in the fire pump controller that is located in a separate compartment from the other controller components shall be permitted to be used to meet the requirement of 8.1.1.2.16.1. (See A.8.1.1.2.2.1.)

8.1.1.2.17 Lubricating oil in engines shall be changed every 50 hours of operation or annually.

8.1.1.2.18 Lubricating oil filters shall be changed every 50 hours of operation or annually.

N 8.1.1.2.19 Fuel filter(s) shall be changed as needed, but at a minimum every 50 hours of operation or annually.

8.1.1.2.20 The condition of sacrificial anodes shall be **inspected** annually and replaced as necessary.

8.1.1.2.21 Circulating water filters shall be replaced annually.

8.1.1.2.22 The accuracy of pressure gauges and sensors shall be inspected annually and replaced or recalibrated when more than 5 percent out of calibration to the extent that such work can be completed without opening an energized electric-motor-driven fire pump controller. (See A.8.1.1.2.2.2.)

N 8.1.1.2.22.1 The isolating switch in the fire pump controller that is located in a separate compartment from the other controller components shall be permitted to be used to meet the requirement of 8.1.1.2.22. (See A.8.1.1.2.2.1.)

N 8.1.1.2.22.2 If replacement or recalibration is required, proper personal protective equipment in accordance with NFPA 70E or an approved equivalent shall be used.

Table 8.1.1.2 Summary of Fire Pump Inspection, Testing, and Maintenance

Item	Frequency	Reference
Inspection		
Alignment	Annually	8.3.6.4
Cable/wire insulation	Annually	8.1.1.2.5
Diesel engine system	Weekly	8.2.2(4)
Electric system	Weekly	8.2.2(3)
Engine crankcase breather	Quarterly	8.1.1.2.12
Exhaust system, drain condensate trap, and silencers	Annually	8.1.1.2.13
Flexible hoses and connections	Annually	8.1.1.2.11
Fuel tank vents and overflow	Annually	8.1.1.2.10
Plumbing parts — inside and outside of panels	Annually	8.1.1.2.6
Printed circuit board (PCB) corrosion	Annually	8.1.1.2.4
Pump	Weekly	8.2.2(2)
Pump house/room	Weekly	8.2.2(1)
Shaft movement or endplay while running	Annually	8.1.1.2.1
Steam pump system	Weekly	8.2.2(5)
Suction screens	Annually	8.3.3.15
Test		
Automatic transfer switch	Annually	8.3.3.12
Automatic transfer switch and emergency/standby generators	Per NFPA 110	8.3.6.1, 8.3.6.2
Diesel engine-driven fire pump (no flow)	Weekly	8.3.1.1
Diesel fuel testing	Annually	8.3.4.1
Electric motor-driven fire pump (no flow)	Weekly/monthly	8.3.1.2
Electronic control module (ECM)	Annually	8.3.3.16
Fire pump alarm signals	Annually	8.3.3.13
Flow meters	Annually	8.3.3.5.3
Fuel tank, float switch, and supervisory signal for interstitial space	Quarterly	8.1.1.2.7
Gauges, transducers, and other devices used for testing	Annually	8.3.3.5.2
Main pressure relief valve	Annually	8.3.3.11, 13.5.6.2.3
Pump house/room environmental conditions		8.3.6.3
Pump operation (no flow)	Weekly/monthly	8.3.2, 8.3.5
Pump performance (flow)	Annually	8.3.3, 8.3.5
Supervisory signal for high cooling water temperature	Annually	8.1.1.2.8
Maintenance		
Batteries	Annually	8.1.1.2.15
Circulating water filter	Annually	8.1.1.2.21
Control and power wiring connections	Annually	8.1.1.2.16
Controller and all other components of the pump assembly	Per manufacturer	8.5
Diesel active fuel maintenance system	Annually or per manufacturer	8.3.4.3
Diesel engine system	Per manufacturer	8.5
Electric motor and power system	Per manufacturer	8.5
Electrical connections	Annually	8.1.1.2.2
Engine lubricating oil	50 operating hours or annually	8.1.1.2.17
Engine oil filter	50 operating hours or annually	8.1.1.2.18
Fuel filter	50 operating hours or annually	8.1.1.2.19
Fuel tank — check for water and foreign materials	Annually	8.1.1.2.9
Measure back pressure on engine turbo	Annually	8.1.1.2.14
Power transmission components with elastomeric materials (including torsional couplings)	5 years or per manufacturer	8.1.1.2.23
Pressure gauges and sensors	Annually	8.1.1.2.22
Pump and motor bearings and coupling	Annually or as required	8.1.1.2.3
Sacrificial anode	Annually	8.1.1.2.20

8.1.1.2.23 Power transmitting components used in pump drives that include elastomeric materials, such as torsional couplings, shall be replaced every 5 years or as required by the component manufacturer for a specific elastomeric material.

8.1.2 Common Components and Valves. Common components and valves shall be inspected, tested, and maintained in accordance with Chapter 13.

8.1.3 Obstruction Investigations. The procedures outlined in Chapter 14 shall be followed where there is a need to conduct an obstruction investigation.

8.1.4* Auxiliary Equipment. The pump assembly auxiliary equipment shall include the following:

- (1) Pump accessories as follows:
 - (a) Pump shaft coupling
 - (b) Automatic air release valve
 - (c) Pressure gauges
 - (d) Circulation relief valve (not used in conjunction with diesel engine drive with heat exchanger)
- (2) Pump test device(s)
- (3) Pump relief valve and piping (where maximum pump discharge pressure exceeds the rating of the system components or the driver is of variable speed)
- (4) Alarm sensors and indicators
- (5) Right-angle gear sets (for engine-driven vertical shaft turbine pumps)
- (6) Pressure maintenance (jockey) pump and accessories

8.1.5 Water Supply to Pump Suction.

8.1.5.1 The suction supply for the fire pump shall provide the required flow at or above the lowest permissible suction pressure to meet the system demand.

8.1.5.2 Those installations for which NFPA 20 permitted negative suction gauge pressures at the time of pump installation, where the system demand still can be met by the pump and water supply, shall be considered to be in compliance with 8.1.5.

8.1.6 Energy Source. The energy sources for the pump driver shall supply the necessary brake horsepower of the driver so that the pump meets system demand.

8.1.7 Driver. The pump driver shall not overload beyond its rating (including any service factor allowance) when delivering the necessary brake horsepower.

8.1.8* Controller. Automatic and manual controllers for applying the energy source to the driver shall be capable of providing this operation for the type of pump used.

8.1.9 Impairments. The procedures outlined in Chapter 15 shall be followed where an impairment to protection occurs.

8.2 Inspection.

8.2.1 The purpose of inspection shall be to verify that the pump assembly appears to be in operating condition and is free from physical damage.

8.2.2* The pertinent visual observations specified in the following checklists shall be performed weekly:

- (1) Pump house conditions are determined as follows:

- (a) Heat is adequate, not less than 40°F (4°C) for pump room with electric motor or diesel engine-driven pumps with engine heaters.
- (b) Heat is adequate, not less than 70°F (21°C) for pump room with diesel engine-driven pumps without engine heaters.
- (c) Ventilating louvers are free to operate.
- (d) Excessive water does not collect on the floor.
- (e) Coupling guard is in place.

- (2) Pump system conditions are determined as follows:

- (a) Pump suction and discharge and bypass valves are fully open.
- (b) Piping is free of leaks.
- (c) Suction line pressure gauge reading is within acceptable range.
- (d) System line pressure gauge reading is within acceptable range.
- (e) Suction reservoir has the required water level.
- (f) Wet pit suction screens are unobstructed and in place.
- (g) Waterflow test valves are in the closed position, the hose connection valve is closed, and the line to test valves is free of water.

- (3) Electrical system conditions are determined as follows:

- (a) Controller pilot light (power on) is illuminated.
- (b) Transfer switch normal pilot light is illuminated.
- (c) Isolating switch is closed — standby (emergency) source.
- (d) Reverse phase alarm pilot light is off, or normal phase rotation pilot light is on.
- (e) Oil level in vertical motor sight glass is within acceptable range.
- (f) Power to pressure maintenance (jockey) pump is provided.

- (4) Diesel engine system conditions are determined as follows:

- (a) Fuel tank is at least two-thirds full.
- (b) Controller selector switch is in auto position.
- (c) Batteries' (2) voltage readings are within acceptable range.
- (d) Batteries' (2) charging current readings are within acceptable range.
- (e) Batteries' (2) pilot lights are on or battery failure (2) pilot lights are off.
- (f) All alarm pilot lights are off.
- (g) Engine running time meter is reading.
- (h) Oil level in right angle gear drive is within acceptable range.
- (i) Crankcase oil level is within acceptable range.
- (j) Cooling water level is within acceptable range.
- (k) Electrolyte level in batteries is within acceptable range.
- (l) Battery terminals are free from corrosion.
- (m) Water-jacket heater is operating.

- (5)* Steam system conditions: Steam pressure gauge reading is within acceptable range.

8.3* Testing.

8.3.1 Frequency.

8.3.1.1* A no-flow test shall be conducted for diesel engine-driven fire pumps on a test frequency in accordance with 8.3.1.1.1 or 8.3.1.1.2.

8.3.1.1.1 Except as permitted in 8.3.1.1.2, a weekly test frequency shall be required.

8.3.1.1.2* The test frequency shall be permitted to be established by an approved risk analysis.

8.3.1.2* A no-flow test shall be conducted for electric motor-driven fire pumps on a test frequency in accordance with 8.3.1.2.1, 8.3.1.2.2, 8.3.1.2.3, or 8.3.1.2.4.

8.3.1.2.1 Except as permitted in 8.3.1.2.2 and 8.3.1.2.3, a weekly test frequency shall be required for the following electric fire pumps:

- (1) Fire pumps that serve fire protection systems in buildings that are beyond the pumping capacity of the fire department
- (2) Fire pumps with limited service controllers
- (3) Vertical turbine fire pumps
- (4) Fire pumps taking suction from ground level tanks or a water source that does not provide sufficient pressure to be of material value without the pump

8.3.1.2.2 A monthly test frequency shall be permitted for electric fire pumps not identified in 8.3.1.2.1.

8.3.1.2.3* A monthly test frequency shall be permitted for electric fire pump systems having a redundant fire pump.

8.3.1.2.4* The test frequency shall be permitted to be established by an approved risk analysis.

8.3.1.3 An annual flow test shall be conducted in accordance with 8.3.3.

8.3.2 No-Flow Test.

8.3.2.1 A no-flow test of fire pump assemblies shall be conducted in accordance with 8.3.2.

8.3.2.1.1 Except as permitted in 8.3.2.1.2 and 8.3.2.1.3, a main pressure relief valve (where installed) shall be permitted to weep but not discharge a significant quantity of water.

8.3.2.1.1.1 Except as required in 8.3.2.1.1.2, the circulation relief valve shall discharge a small flow of water.

8.3.2.1.1.2 The circulation relief valve shall not operate when the flow through the main pressure relief valve is greater than weeping.

8.3.2.1.2 For fire pump installations that were installed under a standard (1993 and earlier editions of NFPA 20) that did not prohibit a design that required operation of a pressure relief valve to keep the discharge pressure below the rating of the system components, the pressure relief valve shall be permitted to operate as designed during a no-flow test.

8.3.2.1.2.1* The pressure readings on the discharge and suction gauges shall be recorded, and a pressure difference that is greater than 95 percent of the rated pump pressure shall be investigated and corrected.

8.3.2.1.2.2* The discharge temperature of the water shall be monitored and the pump shut down if necessary to prevent exposing the pump and/or driver to excessive temperatures.

8.3.2.1.3 For positive displacement pumps, the pressure relief valve shall operate during a no-flow test.

8.3.2.1.3.1 Where the pressure relief valve is piped back to suction, the pump circulation relief valve shall not operate.

8.3.2.1.3.2 On electric motor and radiator cooled engine drives, a circulation pressure relief valve located downstream of the main pressure relief valve shall discharge sufficient water to prevent overheating of the pump.

8.3.2.2 The test shall be conducted by starting the pump automatically.

8.3.2.3 The electric pump shall run a minimum of 10 minutes.

8.3.2.4 The diesel pump shall run a minimum of 30 minutes.

8.3.2.5 A valve installed to open as a safety feature shall be permitted to discharge water.

8.3.2.6 An automatic timer that meets 8.3.2.6.1 through 8.3.2.6.3 shall be permitted to be substituted for the starting procedure.

8.3.2.6.1 A solenoid valve drain on the pressure control line shall be the initiating means for a pressure-actuated controller.

8.3.2.6.2 In a pressure-actuated controller, performance of this program timer shall be recorded as a pressure drop indication on the pressure recorder.

8.3.2.6.3 In a non-pressure-actuated controller, the test shall be permitted to be initiated by means other than a solenoid valve.

8.3.2.7 Qualified personnel shall be in attendance whenever the pump is in operation unless automated inspection and testing is performed in accordance with 8.3.2.10 including the provision for automated engine shutdown indicated in 8.3.2.10.3 for diesel engine drives.

8.3.2.7.1* The use of the automatic timer allowed in 8.3.2.6 shall not eliminate the requirement of 8.3.2.7 to have qualified personnel present during the test.

▲ 8.3.2.8 The pertinent visual observations or adjustments specified in the following checklists shall be conducted while the pump is idle:

- (1) Record the system suction and discharge pressure gauge readings
- (2) For pumps that use electronic pressure sensors to control the fire pump operation, record the current pressure and the highest and the lowest pressure shown on the fire pump controller event log where such information is available without having to open an energized electric motor-driven fire pump controller
- (3) If the highest or lowest pressure is outside of the expected range, record all information from the event log that helps identify the abnormality

8.3.2.9* The pertinent visual observations or adjustments specified in the following checklists shall be conducted while the pump is running:

- (1) Pump system procedure is as follows:
 - (a) Record the pump starting pressure from the pressure switch or pressure transducer.
 - (b) Record the system suction and discharge pressure gauge readings.
 - (c) Inspect the pump packing glands for slight discharge.
 - (d) Adjust gland nuts if necessary.
 - (e) Inspect for unusual noise or vibration.

- (f) Inspect packing boxes, bearings, or pump casing for overheating.
- (g) Record pressure switch or pressure transducer reading and compare to the pump discharge gauge.
- (h) For pumps that use electronic pressure sensors to control the fire pump operation, record the current pressure and the highest and the lowest pressure shown on the fire pump controller event log.
- (i) For electric motor and radiator cooled diesel pumps, check the circulation relief valve for operation to discharge water.
- (2) Electrical system procedure is as follows:
 - (a) Observe the time for motor to accelerate to full speed.
 - (b) Record the time controller is on first step (for reduced voltage or reduced current starting).
 - (c) Record the time pump runs after starting (for automatic stop controllers).
- (3) Diesel engine system procedure is as follows:
 - (a) Observe the time for engine to crank.
 - (b) Observe the time for engine to reach running speed.
 - (c) Observe the engine oil pressure gauge, speed indicator, water, and oil temperature indicators periodically while engine is running.
 - (d) Record any abnormalities.
 - (e) Inspect the heat exchanger for cooling waterflow.
- (4) Steam system procedure is as follows:
 - (a) Record the steam pressure gauge reading.
 - (b) Observe the time for turbine to reach running speed.

N 8.3.2.10 Remotely Monitored Automated Testing.

N 8.3.2.10.1 Remotely monitored automated testing performed in accordance with 4.6.6 shall be permitted for the no-flow test.

N 8.3.2.10.2 All of the pertinent observations or adjustments specified in the checklists described in 8.3.2.8 and 8.3.2.9 shall be performed.

N 8.3.2.10.2.1 Any abnormalities shall be recorded.

N 8.3.2.10.2.2 If, during the automated test, it becomes apparent that the packing gland nuts need to be adjusted as described in 8.3.2.9(1)(d), the need for adjustment shall be recorded and the necessary adjustment shall be made by qualified personnel.

N 8.3.2.10.3 The controller for a diesel engine-driven fire pump shall be equipped with automatic engine shutdown as referenced in 12.7.2.7 of NFPA 20.

N 8.3.2.10.4 Qualified personnel shall be able to respond to the pump location upon abnormal condition within 5 minutes.

8.3.3 Annual Flow Testing.

8.3.3.1* Except as permitted in 8.3.3.4, an annual test of each constant speed pump assembly shall be conducted by qualified personnel under no-flow (churn), rated flow, and 150 percent of the pump rated capacity flow of the fire pump by controlling the quantity of water discharged through approved test devices.

N 8.3.3.2* Except as permitted in 8.3.3.4, an annual test of each variable-speed pump assembly shall be conducted by qualified personnel under variable-speed control under no-flow (churn),

25 percent, 50 percent, 75 percent, 100 percent, 125 percent, and 150 percent of the rated pump capacity flow of the fire pump by controlling the quantity of water discharge through approved test devices.

N 8.3.3.3 Except as permitted in 8.3.3.4, an annual test of each variable speed pump assembly shall be conducted by qualified personnel under constant speed control under no-flow (churn), 100 percent rate, and 150 percent of the pump rated capacity flow of the fire pump by controlling the quantity of water discharged through approved test devices.

N 8.3.3.4 If available suction supplies do not allow flowing of 150 percent of the rated pump capacity, the fire pump shall be tested at flow rates at 100 percent of the rated pump flow rate, and at the maximum flow allowed at the lowest permissible suction pressure.

8.3.3.5 Test Equipment. Calibrated test equipment shall be provided to determine net pump pressures, rate of flow through the pump, and speed.

Δ 8.3.3.5.1 Gauges, transducers, and other devices used for measurement during the test shall bear a label with the latest date of calibration.

8.3.3.5.2 Gauges, transducers, and other devices, with the exception of flow meters, used for measurement during the test shall be calibrated a minimum of annually to an accuracy level of ± 1 percent.

8.3.3.5.3* Flow meters shall be calibrated annually to an accuracy level of ± 3 percent.

8.3.3.6 Discharge and sensing orifices that can be visually observed without disassembling equipment, piping, or valves shall be visually inspected and be free of damage and obstructions that could affect the accuracy of the measurement.

8.3.3.7 The sensing/measuring elements in a flow meter shall be calibrated in accordance with 8.3.3.5.

8.3.3.8 Discharge orifices shall be listed or constructed to a recognized standard with a known discharge coefficient.

8.3.3.9 The annual test shall be conducted as follows:

- (1) The arrangement described in 8.3.3.9.1 or 8.3.3.9.2 shall be used at a minimum of every third year.
- (2)* The arrangement described in 8.3.3.9.3 shall be permitted to be used 2 out of every 3 years.

8.3.3.9.1 Use of Pump Discharge via Hose Streams.

8.3.3.9.1.1 Pump suction and discharge pressures and the flow measurements of each hose stream shall determine the total pump output.

8.3.3.9.1.2* Prior to flow testing, the entity performing testing shall make the owner or their representative aware of the location, approximate flow rate, and duration of flow testing.

8.3.3.9.2 Use of Pump Discharge via Bypass Flowmeter to Drain or Suction Reservoir. Pump suction and discharge pressures and the flowmeter measurements shall determine the total pump output.

8.3.3.9.3 Use of Pump Discharge via Bypass Flowmeter to Pump Suction (Closed-Loop Metering).

8.3.3.9.3.1 Pump suction and discharge pressures and the flowmeter measurements shall determine the total pump output.

8.3.3.9.3.2 When testing includes recirculating water back to the fire pump suction, the temperature of the recirculating water shall be monitored to verify that it remains below temperatures that could result in equipment damage as defined by the pump and engine manufacturers.

8.3.3.9.3.3 If the test results are not consistent with the previous annual test, the test shall be repeated using the test arrangement described in 8.3.3.9.1.

8.3.3.9.3.4 If testing in accordance with 8.3.3.9.1 is not possible, a flowmeter calibration shall be performed and the test shall be repeated.

▲ **8.3.3.10** The pertinent visual observations, measurements, and adjustments specified in the following checklists shall be conducted annually while the pump is running and flowing water under the specified output condition:

- (1) At no-flow condition (churn), the procedure is as follows:
 - (a) Inspect the circulation relief valve for operation to discharge water
 - (b) Inspect the pressure relief valve (if installed) for proper operation
- (2) At each flow condition, the procedure is as follows:
 - (a) Where an external means is provided on the controller, record the electric motor voltage and current (all lines)
 - (b) Record the pump speed in rpm
 - (c) Record the simultaneous (approximate) readings of pump suction and discharge pressures and pump discharge flow
- (3)* For electric motor-driven pumps, do not shut down the pump until it has run for 10 minutes
- (4) For diesel motor-driven pumps, do not shut down the pump until it has run for 30 minutes

8.3.3.11* For installations having a pressure relief valve, the operation of the relief valve shall be closely observed during each flow condition to determine whether the pump discharge pressure exceeds the normal operating pressure of the system components.

8.3.3.11.1* The pressure relief valve shall also be observed during each flow condition to determine whether the pressure relief valve closes at the proper pressure.

8.3.3.11.2 The pressure relief valve shall be closed during flow conditions if necessary to achieve minimum rated characteristics for the pump and reset to normal position at the conclusion of the pump test.

8.3.3.11.2.1 When it is necessary to close the relief valve to achieve minimum rated characteristics for the pump, the pump discharge control valve shall be closed if the pump churn pressure exceeds the system rated pressure.

8.3.3.11.3 When pressure relief valves are piped back to the fire pump suction, the temperature of the recirculating water shall be monitored to verify that it remains below temperatures

that could result in equipment damage as defined by the pump and engine manufacturers.

▲ **8.3.3.12** For installations having an automatic transfer switch, the following test shall be performed to ensure that the over-current protective devices (i.e., fuses or circuit breakers) do not open:

- (1) Simulate a power failure condition while the pump is operating at peak load
- (2) Verify that the transfer switch transfers power to the alternate power source
- (3) While the pump is operating at peak load and alternate power, record the following to include in the pump test results:
 - (a) The voltage where an external means is provided on the controller
 - (b) The amperage where an external means is provided on the controller
 - (c) The rpm
 - (d) Suction pressure
 - (e) Discharge pressure
- (4) Verify that the pump continues to perform at peak horsepower load on the alternate power source for a minimum of 2 minutes
- (5) Remove the power failure condition and verify that, after a time delay, the pump is reconnected to the normal power source

8.3.3.13* Alarm conditions shall be simulated by activating alarm circuits at alarm sensor locations and confirmed for proper operation.

8.3.3.13.1* Alarm sensors located within electric motor-driven fire pump controllers that cannot be accessed without opening an energized electric motor-driven fire pump controller shall be tested at an alternative location outside of the controller.

8.3.3.14 Safety. (See also A.4.9.6.)

8.3.3.14.1 Section 4.9 shall be followed for safety requirements while working near electric motor-driven fire pumps.

• **8.3.3.15* Suction Screens.** After the waterflow portions of the annual test or fire protection system activations, the suction screens shall be inspected and cleared of any debris or obstructions.

8.3.3.16* Where engines utilize electronic fuel management control systems, the backup electronic control module (ECM) and the primary and redundant sensors for the ECM shall be tested annually.

8.3.4 Diesel Fuel Testing and Maintenance.

8.3.4.1 Diesel fuel shall be tested for degradation no less than annually.

8.3.4.1.1* Fuel degradation testing shall comply with ASTM D975, *Standard Specification for Diesel Fuel Oils*, or ASTM D6751, *Standard Specification for Biodiesel Fuel Blend Stock (B100) for Middle Distillate Fuels*, as approved by the engine manufacturer, using ASTM D7462, *Standard Test Method for Oxidation Stability of Biodiesel (B100) and Blends of Biodiesel with Middle Distillate Petroleum Fuel (Accelerated Method)*.

8.3.4.2* If diesel fuel is found to be deficient in the testing required in 8.3.4.1.1, the fuel shall be reconditioned or

replaced, the supply tank shall be cleaned internally, and the engine fuel filter(s) shall be changed.

8.3.4.2.1 After the restoration of the fuel and tank in 8.3.4.2, the fuel shall be retested every 6 months until experience indicates the fuel can be stored for a minimum of 1 year without degradation beyond that allowed in 8.3.4.1.1.

8.3.4.3 When provided, active fuel maintenance systems shall be listed for fire pump service.

8.3.4.3.1 Maintenance of active fuel maintenance systems shall be in accordance with the manufacturer's recommendations.

8.3.4.3.2 Maintenance of active fuel maintenance systems shall be performed at a minimum annual frequency for any portion of the system that the manufacturer does not provide a recommended maintenance frequency.

8.3.4.3.3 Where utilized, fuel additives shall be used and maintained in accordance with the active fuel maintenance system manufacturer's recommendations.

8.3.5 Positive Displacement Pumps. [20:14.2.6.4.3]

8.3.5.1 Except as provided in 8.3.5.1 through 8.3.5.7, positive displacement pumps shall be tested in accordance with 8.3.1 through 8.3.3.

8.3.5.2 The pump flow for positive displacement pumps shall be tested and determined to meet the specified rated performance criteria where only one performance point is required to establish positive displacement pump acceptability. [20:14.2.6.4.3.1]

8.3.5.3 The pump flow test for positive displacement pumps shall be accomplished using a flowmeter or orifice plate installed in a test loop back to the supply tank, to the inlet side of a positive displacement water pump, or to drain. [20:14.2.6.4.3.2]

8.3.5.4 The flowmeter reading or discharge pressure shall be recorded and shall be in accordance with the pump manufacturer's flow performance data. [20:14.2.6.4.3.3]

8.3.5.5 If orifice plates are used, the orifice size and corresponding discharge pressure to be maintained on the upstream side of the orifice plate shall be made available to the authority having jurisdiction. [20:14.2.6.4.3.4]

8.3.5.6 Flow rates shall be as specified while operating at the system design pressure. Tests shall be performed in accordance with HI 3.6, *Rotary Pump Tests*. [20:14.2.6.4.3.5]

8.3.5.7 Positive displacement pumps intended to pump liquids other than water shall be permitted to be tested with water; however, the pump performance will be affected, and manufacturer's calculations shall be provided showing the difference in viscosity between water and the system liquid. [20:14.2.6.4.3.6]

8.3.6 Other Tests.

8.3.6.1* Engine generator sets supplying emergency or standby power to fire pump assemblies shall be tested routinely in accordance with NFPA 110.

8.3.6.2 Automatic transfer switches shall be tested routinely and exercised in accordance with NFPA 110.

8.3.6.3 Tests of appropriate environmental pump room space conditions (e.g., heating, ventilation, illumination) shall be

made to ensure proper manual or automatic operation of the associated equipment.

8.3.6.4* Parallel and angular alignment of the pump and driver shall be inspected during the annual test, and any misalignment shall be corrected.

8.3.7 Test Results and Evaluation.

8.3.7.1* Data Interpretation.

8.3.7.1.1 The interpretation of the flow test performance relative to the manufacturer's performance shall be the basis for determining performance of the pump assembly.

8.3.7.1.2 Qualified individuals shall interpret the test results.

8.3.7.1.3 Where applicable, speed and velocity pressure adjustments shall be applied to the net pressure and flow data obtained to determine compliance with 8.3.7.2.3(3).

8.3.7.2 Evaluation of Fire Pump Test Results.

8.3.7.2.1 The fire pump test results shall be evaluated in accordance with 8.3.7.2.2 through 8.3.7.2.9.

8.3.7.2.2 Increasing the engine speed beyond the rated speed of the pump shall not be permitted as a method for meeting the rated pump performance.

Δ 8.3.7.2.3 The fire pump test results shall be considered acceptable if **all** of the following conditions are satisfied:

- (1) Fire pump meets the flow and pressure requirements of the most demanding system(s) being supplied by the fire pump based on owner-provided system design information
- (2)* Fire pump supplies 100 percent of rated flow
- (3)* The net pressure at each flow point is at least 95 percent of one of the following:
 - (a) Original manufacturer's pump curve
 - (b) Original unadjusted field test curve
 - (c) Test curve generated from the fire pump nameplate

Δ 8.3.7.2.4* The following actions shall be required upon failure to meet the criteria in 8.3.7.2.3:

- (1) The owner shall be notified in writing of the unacceptable test results.
- (2) An investigation shall be conducted into the cause of the unacceptable test results.
- (3) Failure to provide the maximum system demand shall be deemed an impairment.
- (4) Excessive vibration and/or excessively worn or loose components shall be deemed a deficiency.
- (5) Degraded performance that still provides the maximum system demand shall be deemed a noncritical deficiency.
- (6) The owner shall be notified in writing of corrections completed.

Δ 8.3.7.2.5 For electric motor-driven fire pumps operating at constant speed, the current at each flow rate test point and at each phase shall not exceed the product of the electric motor service factor and the full-load amperage rating of the motor.

Δ 8.3.7.2.6 Where the current at each flow rate test point and at each phase exceeds the product of the electric motor service factor and the full-load amperage rating of the motor, the source of the problem shall be identified and corrected.

▲ **8.3.7.2.7** For electric motor-driven fire pumps operating at varying voltage, the product of the test voltage and the current at each test point and on each phase shall not exceed the product of the voltage and the full-load current times the motor service factor.

▲ **8.3.7.2.8** Where the product of the test voltage and the current at each test point and on each phase exceeds the product of the voltage and the full-load current times the motor service factor, the source of the problem shall be identified and corrected.

8.3.7.2.9 Voltage readings at the motor within 5 percent below or 10 percent above the rated (i.e., nameplate) voltage shall be considered acceptable.

8.3.7.2.10 A written or electronic record of the results of the investigation and the corrective action shall be prepared and maintained by the owner.

8.4 Reports.

8.4.1* A complete written report of the fire pump test results shall be prepared for and retained by the owner.

8.4.1.1 At a minimum, the report shall contain the following information:

- (1) All raw data necessary for a complete evaluation of the fire pump performance, including suction and discharge pressures, voltage and amperage readings, and pump speed at each flow rate tested
- (2) The fire protection system demand as furnished by the owner
- (3) Pump performance, whether satisfactory or unsatisfactory
- (4) Deficiencies noted during the testing and identified during analysis, with recommendations to address deficiencies as appropriate

- (5) Manufacturer's performance data, actual performance, and the available pump discharge curves required by this standard
- (6) Time delay intervals associated with the pump's starting, stopping, and energy source transfer
- (7) Where applicable, comparison with previous test results

8.5 Maintenance.

8.5.1* A preventive maintenance program shall be established on all components of the pump assembly in accordance with the manufacturer's recommendations or an approved alternative maintenance plan.

8.5.2 Records shall be maintained on all work performed on the pump, driver, controller, and auxiliary equipment.

8.5.3 The preventive maintenance program shall be initiated immediately after the pump assembly has passed acceptance tests.

8.6 Component Replacement Testing Requirements.

8.6.1 Whenever a component in a fire pump is adjusted, repaired, rebuilt, or replaced, the tests required to restore the system to service shall be performed in accordance with Table 8.6.1.

8.6.2 NFPA 20 shall be consulted for the minimum requirements for design, installation, and acceptance testing.

8.6.3 Replacement parts shall be provided that will maintain the listing for the fire pump component assembly whenever possible.

8.6.3.1 If the part is no longer available from the original equipment manufacturer, then an approved like part shall be permitted to be used.

Table 8.6.1 Summary of Component Action Requirements

Component	Adjust	Repair	Rebuild	Replace	Test Criteria
Fire Pump System					
Entire pump assembly				X	Perform acceptance test in accordance with NFPA 20
Impeller/rotating assembly		X		X	Perform acceptance test in accordance with NFPA 20
Casing		X		X	Perform acceptance test in accordance with NFPA 20 with alignment inspection
Bearings				X	Perform annual test in accordance with 8.3.3
Sleeves				X	Perform annual test in accordance with 8.3.3
Wear rings				X	Perform annual test in accordance with 8.3.3
Main shaft		X		X	Perform annual test in accordance with 8.3.3
Packing	X			X	Perform test in accordance with 8.3.2
Mechanical Transmission					
Gear right-angle drives		X	X	X	Perform acceptance test in accordance with NFPA 20
Drive coupling	X	X	X	X	Perform test in accordance with 8.3.3 with alignment inspection
Electrical System/Controller					
Entire controller				X	Perform acceptance test in accordance with NFPA 20
Electronic component or module that can prevent the controller from starting or running			X	X	Perform acceptance test in accordance with NFPA 20
Electronic component or module that will not prevent the controller from starting or running			X	X	Perform weekly test in accordance with 8.3.2
Plumbing part				X	Perform weekly test in accordance with 8.3.2
Isolating switch				X	Perform test in accordance with 8.3.2 and exercise six times
Circuit breaker	X				Perform six momentary starts in accordance with NFPA 20
Circuit breaker				X	Test in accordance with 8.3.3, including six starts at peak load and operate pump for a minimum of 1 hour
Electrical connections	X				Perform test in accordance with 8.3.2
Main contactor		X		X	Perform test in accordance with 8.3.3 with six starts
Power monitor				X	Perform six operations of the circuit breaker/isolation switch disconnect (cycle the power on/off)
Start relay				X	Perform test in accordance with 8.3.2 with six starts
Pressure switch	X			X	Perform test in accordance with 8.3.2 and exercise six times automatically
Pressure transducer	X			X	Perform six automatic no-load starts
Manual start or stop switch				X	Perform six operations under load
Transfer switch — load-carrying parts		X	X	X	Test in accordance with 8.3.3, including six starts at peak horsepower load, operate pump for a minimum of 1 hour, and transfer from normal power to emergency power and back one time
Transfer switch — no-load parts		X	X	X	Perform six no-load operations of transfer of power
Electric Motor Driver					
Electric motor		X	X	X	Perform acceptance test in accordance with NFPA 20 with alignment inspection
Motor bearings				X	Perform annual test in accordance with 8.3.3
Incoming power conductors				X	Test in accordance with 8.3.3 and operate pump for a minimum of 1 hour, including six starts at peak load
Diesel Engine Driver					
Entire engine			X	X	Perform acceptance test in accordance with NFPA 20 with alignment inspection
Fuel transfer pump	X		X	X	Perform test in accordance with 8.3.2

(continues)

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Table 8.6.1 *Continued*

Component	Adjust	Repair	Rebuild	Replace	Test Criteria
Fuel injector pump or ECM	X			X	Perform test in accordance with 8.3.3
Fuel system filter		X		X	Perform test in accordance with 8.3.2
Combustion air intake system		X		X	Perform test in accordance with 8.3.2
Fuel tank		X		X	Perform test in accordance with 8.3.2
Cooling system		X	X	X	Perform test in accordance with 8.3.3
Batteries				X	Perform start/stop sequence from replaced battery in accordance with 8.3.2
Battery charger		X		X	Perform test in accordance with 8.3.2
Electric system		X		X	Perform test in accordance with 8.3.2
Lubrication filter/oil service		X		X	Perform test in accordance with 8.3.2
Steam Turbines					
Steam turbine		X		X	Perform acceptance test in accordance with NFPA 20
Steam regulator or source upgrade		X		X	Perform acceptance test in accordance with NFPA 20
Positive Displacement Pumps					
Entire pump				X	Perform acceptance test in accordance with NFPA 20
Rotors				X	Perform annual test in accordance with 8.3.3
Plungers				X	Perform annual test in accordance with 8.3.3
Shaft				X	Perform annual test in accordance with 8.3.3
Driver		X	X	X	Perform acceptance test in accordance with NFPA 20
Bearings				X	Perform annual test in accordance with 8.3.3
Seals				X	Perform test in accordance with 8.3.2
Pump House and Miscellaneous Components					
Baseplate		X			Perform test in accordance with 8.3.2 with alignment inspection
Baseplate				X	Perform test in accordance with 8.3.3 with alignment inspection
Foundation		X	X	X	Perform test in accordance with 8.3.2 with alignment inspection
Suction/discharge pipe		X		X	Perform visual inspection in accordance with 8.2.2(2)
Suction/discharge fittings		X		X	Perform visual inspection in accordance with 8.2.2(2)
Suction/discharge valves		X	X	X	Perform operational test in accordance with 13.3.3.1

Chapter 9 Water Storage Tanks**9.1* General.****9.1.1 Minimum Requirements.**

9.1.1.1 This chapter shall provide the minimum requirements for the routine inspection, testing, and maintenance of water storage tanks dedicated to fire protection use.

9.1.1.2 Table 9.1.1.2 shall be used to determine the minimum required frequencies for inspection, testing, and maintenance.

9.1.2 Common Components and Valves. Common components and valves shall be inspected, tested, and maintained in accordance with Chapter 13.

9.1.3 Obstruction Investigations. The procedures outlined in Chapter 14 shall be followed where there is a need to conduct an obstruction investigation.

9.1.4 Impairments. The procedures outlined in Chapter 15 shall be followed where an impairment to protection occurs.

9.2 Inspection.**9.2.1 Water Level.**

9.2.1.1* The water level in tanks equipped with supervised water level alarms that are supervised in accordance with NFPA 72 shall be inspected quarterly.

9.2.1.2 The water level in tanks not equipped with supervised water level alarms connected to a constantly attended location shall be inspected monthly.

N 9.2.1.3 Water Level Verification.

N 9.2.1.3.1 Inspection of water level shall be verified through the level indicator, where provided.

N 9.2.1.3.2* The tank shall be at full or at the designed water level.

9.2.2 Heating System.

9.2.2.1 Tank heating systems installed on tanks equipped with low water temperature alarms supervised in accordance with NFPA 72, connected to a constantly attended location shall be inspected quarterly during the heating season.

Table 9.1.1.2 Summary of Water Storage Tank Inspection, Testing, and Maintenance

Item	Frequency	Reference
Inspection		
Catwalks and ladders	Quarterly	9.2.4.1
Check valves		Chapter 13
Control valves		Chapter 13
Expansion joints	Annually	9.2.4.3
Foundation	Quarterly	9.2.4.1
Heating system — tanks with supervised low-temperature alarms connected to constantly attended location	Quarterly	9.2.2.1
Heating system — tanks without supervised low-temperature alarms connected to constantly attended location	Daily*	9.2.2.2
Hoops and grillage	Annually	9.2.4.4
Interior — all other tanks	5 years	9.2.5.1.2
Interior — steel tanks without corrosion protection	3 years	9.2.5.1.1
Painted, coated, or insulated surfaces	Annually	9.2.4.5
Support structure	Quarterly	9.2.4.1
Surrounding area	Quarterly	9.2.4.2
Tank — exterior	Quarterly	9.2.4.1
Temperature alarms — connected to constantly attended location	Quarterly*	9.2.3.2
Temperature alarms — not connected to constantly attended location	Weekly*	9.2.3.3
Vents	Quarterly	9.2.4.1
Water level — tanks equipped with supervised water-level alarms connected to constantly attended location	Quarterly	9.2.1.1
Water level — tanks without supervised water-level alarms connected to constantly attended location	Monthly	9.2.1.2
Test		
High-temperature limit switches	Prior to heating season	9.3.4
Level indicators	5 years	9.3.1
Low-water temperature alarms	Prior to heating season	9.3.3
Pressure gauges		Chapter 13
Tank heating system	Prior to heating season	9.3.2
Valve status test		Chapter 13
Water-level signals (high and low)	Annually	9.3.5
Maintenance		
Check valves		Chapter 13
Control valves		Chapter 13
Embankment-supported coated fabric (ESCF)	2 years or per manufacturer	9.4.6.2
Water level		9.4.2

*Cold weather/heating season only.

9.2.2.2 Tank heating systems without a supervised low temperature alarm connected to a constantly attended location shall be inspected daily during the heating season.

9.2.3 Water Temperature.

9.2.3.1 The temperature of water in tanks shall not be less than 40°F (4°C).

9.2.3.2 The temperature of water in tanks with low temperature alarms supervised in accordance with *NFPA 72*, connected to a constantly attended location shall be inspected and recorded quarterly during the heating season when the mean temperature is less than 40°F (4°C).

9.2.3.3 The temperature of water in tanks without low temperature alarms connected to a constantly attended location shall be inspected and recorded weekly during the heating season when the mean temperature is less than 40°F (4°C).

9.2.4 Exterior Inspection.

9.2.4.1* The exterior of the tank, supporting structure, vents, foundation, and catwalks or ladders, where provided, shall be inspected quarterly for signs of obvious damage or weakening.

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9.2.4.2 The area surrounding the tank and supporting structure, where provided, shall be inspected quarterly to ensure that the following conditions are met:

- (1) The area is free of combustible storage, trash, debris, brush, or material that could present a fire exposure hazard.
- (2) The area is free of the accumulation of material on or near parts that could result in accelerated corrosion or rot.
- (3) The tank and support are free of ice buildup.
- (4) The exterior sides and top of embankments supporting coated fabric tanks are free of erosion.

9.2.4.3 Expansion joints, where provided, shall be inspected annually for leaks and cracks.

9.2.4.4 The hoops and grillage of wooden tanks shall be inspected annually.

9.2.4.5 Exterior painted, coated, or insulated surfaces of the tank and supporting structure, where provided, shall be inspected annually for signs of degradation.

9.2.5 Interior Inspection.

9.2.5.1 Frequency.

9.2.5.1.1* The interior of steel tanks without corrosion protection shall be inspected every 3 years.

9.2.5.1.2* The interior of all other types of tanks shall be inspected every 5 years.

9.2.5.2 Where interior inspection is made by means of underwater evaluation, silt shall first be removed from the tank floor.

9.2.5.3 The tank interior shall be inspected for signs of pitting, corrosion, spalling, rot, other forms of deterioration, waste materials and debris, aquatic growth, and local or general failure of interior coating.

9.2.5.4 Steel tanks exhibiting signs of interior pitting, corrosion, or failure of coating shall be tested in accordance with 9.2.6.

9.2.5.5* Tanks on ring-type foundations with sand in the middle shall be inspected for evidence of voids beneath the floor.

9.2.5.6 The heating system and components including piping shall be inspected.

9.2.5.7 The anti-vortex plate shall be inspected for deterioration or blockage.

9.2.6 Tests During Interior Inspection. Where a drained interior inspection of a steel tank is required by 9.2.5.4, the following tests shall be conducted:

- (1) Evaluation of tank coatings shall be made in accordance with the adhesion test of ASTM D3359, *Standard Test Methods for Rating Adhesion by Tape Test*, generally referred to as the "cross-hatch test."
- (2) Dry film thickness measurements shall be taken at random locations to determine the overall coating thickness.
- (3) Nondestructive ultrasonic readings shall be taken to evaluate the wall thickness where there is evidence of pitting or corrosion.

- (4) Interior surfaces shall be spot wet-sponge tested to detect pinholes, cracks, or other compromises in the coating. Special attention shall be given to sharp edges such as ladder rungs, nuts, and bolts.
- (5) Tank bottoms shall be tested for metal loss and/or rust on the underside by use of ultrasonic testing where there is evidence of pitting or corrosion. Removal, visual inspection, and replacement of random floor coupons shall be an acceptable alternative to ultrasonic testing.
- (6) Tanks with flat bottoms shall be vacuum-box tested at bottom seams in accordance with test procedures found in NFPA 22.

9.3 Testing.

9.3.1* Level indicators shall be tested every 5 years for accuracy and freedom of movement.

9.3.2 The tank heating system, where provided, shall be tested prior to the heating season to make certain it is in the proper working order.

9.3.3 Low water temperature signals, where provided, shall be tested prior to the heating season.

9.3.4* High water temperature limit switches on tank heating systems, where provided, shall be tested prior to the heating season.

9.3.5* High and low water level signals shall be tested annually.

9.4 Maintenance.

9.4.1 Voids discovered beneath the floors of tanks shall be filled by pumping in grout or accessing the sand and replenishing.

9.4.2 The tank shall be maintained full or at the designed water level.

9.4.3 The hatch covers in the roofs and the door at the top of the frostproof casing shall always be kept securely fastened with substantial catches as a protection against freezing and wind-storm damage.

9.4.4 No waste materials, such as boards, paint cans, trim, or loose material, shall be left in the tank or on the surface of the tank.

9.4.5 Silt shall be removed during interior inspections or more frequently as needed to avoid accumulation to the level of the tank outlet.

9.4.6 Maintenance of Embankment-Supported Coated Fabric (ESCF) Suction Tanks.

9.4.6.1 The maintenance of ESCF tanks shall be completed in accordance with this section and the tank manufacturer's instructions.

9.4.6.2 The exposed surfaces of ESCF tanks shall be cleaned and painted every 2 years or in accordance with the manufacturer's instructions.

9.5 Automatic Tank Fill Valves.

9.5.1 Inspection.

9.5.1.1 Automatic tank fill valves shall be inspected in accordance with Table 9.5.1.1.

9.5.1.1.1 OS&Y isolation valves that are a part of the automatic fill valves shall be inspected in accordance with Chapter 13.

9.5.1.2 Valves secured with locks or electrically supervised in accordance with applicable NFPA standards shall be inspected monthly.

Table 9.5.1.1 Summary of Automatic Tank Fill Valve Inspection and Testing

Item	Frequency	Reference
Inspection		
Enclosure (during cold weather)	Daily/weekly	Chapter 4
Exterior	Monthly	Chapter 13
Interior	Annually/5 years	Chapter 13
Strainers, filters, orifices (inspect)	5 years	Chapter 13
Test		
Automatic tank fill valve	Annually	9.5.3
Maintenance		
Strainers (clean)	Quarterly	9.5.2.3

9.5.1.3 The enclosure shall be inspected to verify that it is heated and secured.

9.5.2 Maintenance.

9.5.2.1 Maintenance of all automatic tank fill valves shall be conducted by a qualified person following the manufacturer's instructions in accordance with the procedure and policies of the authority having jurisdiction.

9.5.2.2 Rubber parts shall be replaced in accordance with the frequency required by the authority having jurisdiction and the manufacturer's instructions.

9.5.2.3 Strainers shall be cleaned quarterly.

9.5.3 Testing. All automatic tank fill valves shall be tested yearly in accordance with the following:

- (1) The valve shall be actuated automatically by lowering the water level in the tank.
- (2) The refill rate shall be measured and recorded.

9.6 Component Action Requirements.

9.6.1 Whenever a component in a water storage tank is adjusted, repaired, reconditioned, or replaced, the action required in Table 9.6.1 shall be performed.

9.6.2 Where the original installation standard is different from the cited standard, the use of the appropriate installing standard shall be permitted.

9.6.3 These actions shall not require a design review, which is outside the scope of this standard.

Table 9.6.1 Summary of Component Action Requirements

Component	Adjust	Repair/ Recondition	Replace	Test Criteria
Tank Components				
Catwalks and ladders	X	X	X	Verify integrity in conformance with NFPA 22
Expansion joints	X	X	X	Verify integrity in conformance with NFPA 22
Heating system	X	X	X	Verify heating system is in conformance with NFPA 22
Hoops and grillage	X	X	X	Verify integrity in conformance with NFPA 22
Insulation		X	X	Verify integrity in conformance with NFPA 22
Overflow piping	X	X	X	Verify integrity in conformance with NFPA 22
Support structure		X	X	Verify integrity in conformance with NFPA 22
Tank exterior		X	X	Verify integrity in conformance with NFPA 22
Tank interior		X	X	Remove debris; verify integrity in conformance with NFPA 22
Alarm and Supervisory Components				
Enclosure temperature	X	X	X	Operational test for conformance with NFPA 22 and/or NFPA 72
High and low water level	X	X	X	Operational test for conformance with NFPA 22 and/or NFPA 72 and the design water levels
Valve supervision	X	X	X	Operational test for conformance with NFPA 22 and/or NFPA 72
Water temperature	X	X	X	Operational test for conformance with NFPA 22 and/or NFPA 72
Fill and Discharge Components				
Automatic fill valves	X	X		Perform annual test in accordance with 9.5.3
Valves	X	X	X	See Chapter 13
Status Indicators				
Level indicators	X	X	X	Verify conformance with NFPA 22
Pressure gauges			X	Verify at 0 psi (0 bar) and at system working pressure

Chapter 10 Water Spray Fixed Systems

10.1* General.

10.1.1 Minimum Requirements.

10.1.1.1 This chapter shall provide the minimum requirements for the routine inspection, testing, and maintenance of water spray protection from fixed nozzle systems only.

10.1.1.2 Table 10.1.1.2 shall be used to determine the minimum required frequencies for inspection, testing, and maintenance.

10.1.2 Water Spray Protection. This chapter shall not cover water spray protection from portable nozzles, sprinkler systems, monitor nozzles, or other means of application.

10.1.3* Design and Installation. NFPA 15 shall be consulted to determine the requirements for design and installation, including acceptance testing.

10.1.4 Obstruction Investigations. The procedures outlined in Chapter 14 shall be followed where there is a need to conduct an obstruction investigation.

10.1.5 Common Components and Valves. Common components and valves shall be inspected, tested, and maintained in accordance with Chapter 13.

10.1.6* Impairments. The procedures outlined in Chapter 15 shall be followed where an impairment to protection occurs.

10.1.6.1 When a water spray fixed system or any portion thereof is out of service for any reason, notice shall be given to facility management, the local fire department, the on-site fire brigade, and other authorities having jurisdiction, as applicable.

10.1.6.2 A sign shall be posted at each fire department connection or system control valve indicating which portion of the system is out of service.

10.2 Inspection and Maintenance Procedures.

10.2.1 Components. The components described in this section shall be inspected and maintained at the frequency specified in Table 10.1.1.2 and in accordance with this standard and the manufacturer's instructions.

10.2.1.1 Items in areas that are inaccessible for safety considerations due to factors such as continuous process operations and energized electrical equipment shall be inspected during each scheduled shutdown but not more than every 18 months.

10.2.1.2 Inspections shall not be required for items in areas with no provision for access and that are not subject to the conditions noted in 10.2.3.1, 10.2.3.2, and 10.2.4.1.

Table 10.1.1.2 Summary of Water Spray Fixed System Inspection, Testing, and Maintenance

Item	Frequency	Reference
Inspection		
Backflow preventer		Chapter 13
Check valves		Chapter 13
Control valves		Chapter 13
Deluge valve		Chapter 13
Detection systems and components		<i>NFPA 72</i>
Detector check valves		Chapter 13
Drainage	Quarterly	10.2.7
Fire pump system		Chapter 8
Fittings	Annually	10.2.3, 10.2.3.1
Fittings (rubber-gasketed)	Annually and after each system activation	10.2.3.1
Gravity tanks		Chapter 9
Hangers, braces, and supports	Annually and after each system activation	10.2.3.2
Heat (deluge valve house)		Chapter 13
Nozzles	Annually and after each system activation	10.2.4
Piping	Annually and after each system activation	10.2.3.1
Pressure tank		Chapter 9
	Mainline — annually and after each system activation	
Strainers	Others — per manufacturer's instruction	10.2.6
Suction tanks		Chapter 9
Water supply piping		10.2.5.2
UHSWSS — controllers	Start of each shift	10.4.3
UHSWSS — detectors	Monthly	10.4.2
UHSWSS — valves	Start of each shift	10.4.4
Operational Test		
Backflow preventer		Chapter 13
Check valves		Chapter 13
Control valves		Chapter 13
Deluge valve		Chapter 13
Detection systems		<i>NFPA 72</i>
Detector check valve		Chapter 13
Fire pump system		Chapter 8
Gravity tanks		Chapter 9
Main drain test		Chapter 13
Manual release	Annually	10.3.5
Nozzles	Annually	Section 10.3
Pressure tank		Chapter 9
Strainers	Annually	10.2.6
Suction tanks		Chapter 9
Waterflow alarm		Chapter 5
Water spray system test		Chapter 13
Water supply flow test		Chapter 7
UHSWSS	Annually	Section 10.4
Valve status test		Chapter 13

(continues)

Table 10.1.1.2 Continued

Item	Frequency	Reference
Maintenance		
Backflow preventer		Chapter 13
Check valves		Chapter 13
Control valves		Chapter 13
Deluge valve		Chapter 13
Deluge valve enclosures		Chapter 4
Detection systems		<i>NFPA 72</i>
Detector check valve		Chapter 13
Fire pump system		Chapter 8
Gravity tanks		10.2.9, Chapter 9
Pressure tank		10.2.9, Chapter 9
Strainers	Annually	10.2.1.4, 10.2.1.6, 10.2.6
Strainers (baskets/screen)	5 years	10.2.1.4, 10.2.1.7, A.10.2.6
Suction tanks		Chapter 9
Water spray nozzles	Annually	10.2.4

10.2.1.3 Items in areas that are inaccessible for safety considerations shall be tested at longer intervals in accordance with 13.4.4.2.3.2.

10.2.1.4 Other maintenance intervals shall be permitted, depending on the results of the visual inspection and operating tests.

10.2.1.5 Deluge valve enclosures shall be inspected in accordance with the provisions of Chapter 13.

10.2.1.6 Nozzle strainers shall be removed, inspected, and cleaned during the flushing procedure for the mainline strainer.

10.2.1.7 Mainline strainers shall be removed and inspected every 5 years for damaged and corroded parts.

10.2.2 Deluge Valves. Deluge valves shall be inspected, tested, and maintained in accordance with Chapter 13.

10.2.3* System Components. System piping, fittings, hangers, and supports shall be inspected and maintained to ensure continuity of water delivery to the spray nozzles at full water-flow and design pressure.

10.2.3.1* Piping and Fittings. System piping and fittings shall be inspected for the following:

- (1) Mechanical damage (e.g., broken piping or cracked fittings)
- (2) External conditions (e.g., missing or damaged paint or coatings, rust, and corrosion)
- (3) Misalignment or trapped sections
- (4) Condition of low-point drains (automatic or manual)
- (5) Protection for rubber-gasketed fittings

10.2.3.2* Hangers, Braces, and Supports. Hangers, braces, and supports shall be inspected for the following and repaired or replaced as necessary:

- (1) Condition (e.g., missing or damaged paint or coating, rust, and corrosion)
- (2) Secure attachment to structural supports and piping
- (3) Damaged or missing hangers, braces, and supports

10.2.4* Water Spray Nozzles.

10.2.4.1 Water spray nozzles shall be inspected and maintained to ensure that they are in place, continue to be aimed or pointed in the direction intended, and are free from external loading and corrosion.

10.2.4.2 Where caps or plugs are required, the inspection shall confirm they are in place and free to operate as intended.

10.2.4.3 Misaligned water spray nozzles shall be adjusted (aimed) by visual means, and the discharge patterns shall be inspected at the next scheduled flow test.

10.2.5 Water Supply.

10.2.5.1 The dependability of the water supply shall be ensured by regular inspection and maintenance, whether furnished by a municipal source, on-site storage tanks, a fire pump, or private underground piping systems.

10.2.5.2* Water supply piping shall be maintained free of internal obstructions.

10.2.6* Strainers.

10.2.6.1 Mainline strainers (basket or screen) shall be flushed until clear after each operation or flow test.

10.2.6.2 Individual water spray nozzle strainers shall be removed, cleaned, and inspected after each operation or flow test.

10.2.6.3 All strainers shall be inspected and cleaned in accordance with the manufacturer's instructions.

10.2.6.4 Damaged or corroded parts shall be replaced or repaired.

10.2.7 Drainage. The area beneath and surrounding a water spray fixed system shall be inspected visually on a quarterly basis to ensure that drainage facilities, such as trap sumps and drainage trenches, are not blocked and retention embankments or dikes are in good repair.

10.2.8 Fire Pumps. Chapter 8 shall be followed for inspection and maintenance requirements.

10.2.9 Water Tanks (Gravity, Pressure, or Suction Tanks, or Reservoirs). Chapter 9 shall be followed for inspection and maintenance requirements.

10.3 Operational Tests.

10.3.1 Performance.

10.3.1.1 Frequency of system tests shall be in accordance with Table 10.1.1.2.

10.3.1.2 Water spray fixed systems shall be serviced in accordance with this standard and with the manufacturer's instructions.

10.3.2* Test Preparation. Precautions shall be taken to prevent damage to property during the test.

10.3.3 Operational Test Performance. Operational tests shall be conducted to ensure that the water spray fixed systems respond as designed, both automatically and manually.

10.3.3.1* Response Time.

10.3.3.1.1 Under test conditions, the heat detection systems, where exposed to a heat test source, shall operate within 40 seconds.

10.3.3.1.2 Under test conditions, the flammable gas detection system, where exposed to a standard test gas concentration, shall operate within the time frame specified in the system design.

10.3.3.1.3 These response times shall be recorded.

10.3.3.2 Discharge Time. The time lapse between operation of detection systems and water delivery time to the protected area shall be recorded.

10.3.3.3* Discharge Patterns.

10.3.3.3.1* The water discharge patterns from all of the open spray nozzles shall be observed to ensure that patterns are not impeded by plugged nozzles, to ensure that nozzles are correctly positioned, and to ensure that obstructions do not prevent discharge patterns from wetting surfaces to be protected.

10.3.3.3.1.1 Where the nature of the protected property is such that water cannot be discharged, the nozzles shall be inspected for proper orientation and the system tested with air to ensure that the nozzles are not obstructed.

10.3.3.3.2 Where obstructions occur, the piping and nozzles shall be cleaned and the system retested.

10.3.3.4 Pressure Readings.

10.3.3.4.1 Pressure readings shall be recorded at the hydraulically most remote nozzle to ensure the waterflow has not been impeded by partially closed valves or by plugged strainers or piping.

10.3.3.4.2 A second pressure reading shall be recorded at the deluge valve to ensure the water supply is adequate.

10.3.3.4.3 Readings shall be compared to the hydraulic design pressures to ensure the original system design requirements are met and the water supply is adequate to meet the design requirements.

10.3.3.4.3.1 Where the hydraulically most remote nozzle is inaccessible, nozzles shall be permitted to be checked visually without taking a pressure reading on the most remote nozzle.

10.3.3.4.3.2 Where the reading taken at the riser indicates that the water supply has deteriorated, a gauge shall be placed on the hydraulically most remote nozzle and the results compared with the required design pressure.

10.3.4 Multiple Systems. The maximum number of systems expected to operate in case of fire shall be tested simultaneously to inspect the adequacy of the water supply.

10.3.5 Manual Operation. Manual actuation devices shall be operated annually.

10.3.6 Return to Service. After the full flow test, the water spray system shall be maintained and returned to service in accordance with the manufacturer's instructions.

10.3.6.1 Low Point Drains.

10.3.6.1.1 To prevent freezing and corrosion, all low point drains in aboveground piping shall be opened, the pipe drained, and the valves closed and plugs replaced.

10.3.6.1.2 Where weep holes are provided in lieu of low-point drains, they shall be inspected to ensure they are clear and unobstructed.

10.4 Ultra-High-Speed Water Spray System (UHSWSS) Operational Tests.

10.4.1 A full operational test, including measurements of response time, shall be conducted at intervals not exceeding 1 year.

10.4.1.1 Systems out of service shall be tested before being placed back in service.

10.4.2 All detectors shall be tested and inspected monthly for physical damage and accumulation of deposits on the lenses of optical detectors.

10.4.3 Controllers shall be inspected for faults at the start of each working shift.

10.4.4 Valves.

10.4.4.1 Valves on the water supply line shall be inspected at the start of each working shift to verify they are open.

10.4.4.2 Valves secured in the open position with a locking device or monitored by a signaling device that sounds a trouble signal at the deluge system control panel or other central location shall not require inspection.

10.4.5 Response Time.

10.4.5.1 The response time shall be verified during the operational test.

10.4.5.2 The response time shall be in accordance with the requirements of the system but not more than 100 milliseconds.

10.5 Component Action Requirements.

10.5.1 Whenever a component in a water spray fixed system is adjusted, repaired, reconditioned, or replaced, the action required in Table 10.5.1 shall be performed.

10.5.2 Where the original installation standard is different from the cited standard, the use of the appropriate installing standard shall be permitted.

10.5.3 The actions of 10.5.1 shall not require a design review, which is outside the scope of this standard.

Table 10.5.1 Summary of Component Action Requirements

Component	Adjust	Repair/ Recondition	Replace	Required Action
Water Delivery Components				
Fire department connections				See Chapter 13
Manual release	X	X	X	(1) Operational test (2) Check for leaks at system working pressure (3) Test all alarms
Nozzles	X	X	X	Operational flow test
Pipe and fittings	X	X	X	Operational flow test
Alarm and Supervisory Components				
Detection system	X	X	X	Operational test for conformance with NFPA 15 and/or NFPA 72
Pressure-switch-type waterflow	X	X	X	Operational test using inspector's test connection
Valve supervisory device	X	X	X	Test for conformance with NFPA 15 and/or NFPA 72
Water motor gong	X	X	X	Operational test using inspector's test connection
Status-Indicating Components				
Gauges			X	Verify at 0 psi (0 bar) and system working pressure
Testing and Maintenance Components				
Auxiliary drains	X	X	X	(1) Inspect for leaks at system working pressure (2) Main drain test
Main drain	X	X	X	Full-flow main drain test
Structural Components				
Hanger/seismic bracing	X	X	X	Inspect for conformance with NFPA 15 and/or NFPA 13
Pipe stands	X	X	X	Inspect for conformance with NFPA 15 and/or NFPA 13
Informational Components				
Identification signs	X	X	X	Inspect for conformance with NFPA 15

Shaded text = Revisions. Δ = Text deletions and figure/table revisions. • = Section deletions. N = New material



Chapter 11 Foam-Water Sprinkler Systems

11.1 General.

11.1.1 Minimum Requirements.

11.1.1.1 This chapter shall provide the minimum requirements for the routine inspection, testing, and maintenance of foam-water sprinkler systems.

11.1.1.2 Table 11.1.1.2 shall be used to determine the minimum required frequencies for inspection, testing, and maintenance.

11.1.2 Other System Components. Fire pumps, water storage tanks, common components, and valves common to other types of water-based fire protection systems shall be inspected, tested, and maintained in accordance with Chapters 8, 9, and 13, respectively, and as specified in Table 11.1.1.2.

11.1.3 Foam-Water Sprinkler Systems.

11.1.3.1 This section shall apply to foam-water sprinkler systems as specified in NFPA 16.

11.1.3.2 This section shall not include systems detailed in NFPA 11.

11.1.4 Foam-Water Sprinkler System.

11.1.4.1 If during routine inspection and testing the foam-water sprinkler system is determined to have been altered or replaced (e.g., equipment replaced, relocated, or foam concentrate replaced), it shall be determined whether the system operates properly.

11.1.5 Obstruction Investigations. The procedures outlined in Chapter 14 shall be followed where there is a need to conduct an obstruction investigation.

11.1.6 Impairments. The procedures outlined in Chapter 15 shall be followed where an impairment to protection occurs.

11.2 Inspection. Systems shall be inspected in accordance with the frequency specified in Table 11.1.1.2.

11.2.1 Deluge Valves. Deluge valves shall be inspected in accordance with the provisions of Chapter 13.

11.2.2 System Piping and Fittings. System piping and fittings shall be inspected for the following:

- (1) Mechanical damage (e.g., broken piping or cracked fittings)
- (2) External conditions (e.g., missing or damaged paint or coatings, rust, and corrosion)
- (3) Misalignment or trapped sections
- (4) Low-point drains (automatic or manual)
- (5) Location and condition of rubber-gasketed fittings

11.2.3 Hangers, Braces, and Supports. Hangers, braces, and supports shall be inspected for the following and repaired or replaced as necessary:

- (1) Condition (e.g., missing or damaged paint or coating, rust, and corrosion)
- (2) Secure attachment to structural supports and piping
- (3) Damaged or missing hangers, braces, and supports

Table 11.1.1.2 Summary of Foam-Water Sprinkler System Inspection, Testing, and Maintenance

System/Component	Frequency	Reference
Inspection		
Control valve(s)		Chapter 13
Deluge/preaction valve(s)		Chapter 13
Discharge device location (spray nozzle)	Monthly	11.2.4
Discharge device location (sprinkler)	Annually	11.2.4
Discharge device position (spray nozzle)	Monthly	11.2.4
Discharge device position (sprinkler)	Annually	11.2.4
Drainage in system area	Quarterly	11.2.7
Fire pump system		Chapter 8
Fittings corrosion	Annually	11.2.2
Fittings damage	Annually	11.2.2
Foam concentrate strainer(s)	Quarterly	11.2.6.4
Gauges		Chapter 13
Hangers/braces/supports	Annually	11.2.3
Pipe corrosion	Annually	11.2.2
Pipe damage	Annually	11.2.2
Proportioning system(s) — all	Monthly	11.2.8
Strainer(s) — Mainline	5 years	11.2.6.1
Water supply piping		11.2.5.1
Water supply tank(s)		Chapter 9
Waterflow alarm devices		Chapter 13
Test		
Backflow preventer(s)		Chapter 13
Complete foam-water sprinkler system(s) (operational test)	Annually	11.3.2, 11.3.3
Control valve(s)		Chapter 13
Deluge/preaction valve(s)		Chapter 13
Discharge device location	Annually	11.3.2.6
Discharge device obstruction	Annually	11.3.2.6
Discharge device position	Annually	11.3.2.6
Fire pump system		Chapter 8
Foam-water solution	Annually	11.3.5
Manual actuation device(s)	Annually	11.3.4
Valve status test		Chapter 13
Water supply flow test		Chapter 7
Water supply tank(s)		Chapter 9
Waterflow alarm devices		Chapter 13
Maintenance		
Backflow preventer(s)		Chapter 13
Bladder tank type		
Foam concentrate tank — hydrostatic test	10 years	11.4.5.2
Sight glass	10 years	11.4.5.1
Check valve(s)		Chapter 13
Control valve(s)		Chapter 13
Deluge/preaction valves		Chapter 13
Detector check valve(s)		Chapter 13
Fire pump system		Chapter 8
Foam concentrate pump operation	Monthly	11.4.7.1

(continues)

Table 11.1.1.2 *Continued*

System/Component	Frequency	Reference
Foam concentrate samples	Per manufacturer's recommendation	11.4.2
Foam concentrate strainer(s)	Quarterly	Section 11.4
In-line balanced pressure type		
Balancing valve diaphragm	5 years	11.4.8.3
Foam concentrate pump(s)	5 years*	11.4.8.2
Foam concentrate tank	10 years	11.4.8.4
Line type		
Foam concentrate tank — corrosion and pickup pipes	10 years	11.4.6.1
Foam concentrate tank — drain and flush	10 years	11.4.6.2
Pressure vacuum vents	5 years	11.4.9
Proportioning system(s)		
standard pressure type		
Ball drip (automatic type) drain valves	5 years	11.4.4.1
Corrosion and hydrostatic test	10 years	11.4.4.4
Foam concentrate tank — drain and flush	10 years	11.4.4.2
Standard balanced pressure type		
Balancing valve diaphragm	5 years	11.4.7.3
Foam concentrate pump(s)	5 years*	11.4.7.2
Foam concentrate tank	10 years	11.4.7.4
Strainer(s) — mainline	5 years	11.2.6.1
Water supply	Annually	11.2.5.2
Water supply tank(s)		Chapter 9

*Also refer to manufacturer's instructions and frequency. Maintenance intervals other than preventive maintenance are not provided, as they depend on the results of the visual inspections and operational tests. For foam-water sprinkler systems in aircraft hangars, refer to the inspection, test, and maintenance requirements of Table 11.1.1 in NFPA 409.

11.2.4* Foam-Water Discharge Devices.

11.2.4.1 Foam-water discharge devices shall be inspected visually and maintained to ensure that they are in place, continue to be aimed or pointed in the direction intended in the system design, and are free from external loading and corrosion.

11.2.4.2 Where caps or plugs are required, the inspection shall confirm they are in place and free to operate as intended.

11.2.4.3 Misaligned discharge devices shall be adjusted (aimed) by visual means, and the discharge patterns shall be inspected at the next scheduled flow test.

11.2.4.4* Inspection shall verify that unlisted combinations of discharge devices and foam concentrate have not been substituted.

11.2.5 Water Supply.

11.2.5.1 The dependability of the water supply shall be ensured by regular inspection and maintenance, whether furnished by a municipal source, on-site storage tanks, a fire pump, or private underground piping systems.

11.2.5.2* Water supply piping shall be maintained free of internal obstructions.

11.2.6 Strainers.

11.2.6.1 Mainline and individual discharge device strainers (basket or screen) shall be inspected every 5 years for damaged and corroded parts.

11.2.6.2 Other maintenance intervals shall be permitted, depending on the results of the visual inspection and operating tests.

11.2.6.3 Discharge device strainers shall be removed, inspected, and cleaned during the flushing procedure for the mainline strainer.

11.2.6.4 Foam concentrate strainers shall be inspected visually to ensure the blowdown valve is closed and plugged.

11.2.6.5 Baskets or screens shall be removed and inspected after each operation or flow test.

11.2.7 Drainage. The area beneath and surrounding a foam-water spray system shall be inspected to ensure that drainage facilities, such as trap sumps and drainage trenches, are not blocked, and retention embankments or dikes are in good repair.

11.2.8* Proportioning Systems.

11.2.8.1 The components of the various proportioning systems described in 11.2.8 shall be inspected in accordance with the frequency specified in Table 11.1.1.2.

11.2.8.2 Valves specified to be inspected shall be permitted to be open or closed, depending on specific functions within each foam-water sprinkler system.

11.2.8.3 The position (open or closed) of valves shall be verified in accordance with specified operating conditions.

11.2.8.4* Inspection of the concentrate tank shall include verification that the quantity of foam concentrate satisfies the requirements of the original design.

11.2.8.5 Additional inspection requirements shall be performed as detailed for the proportioning systems specified in 11.2.8.

11.2.8.5.1 Standard Pressure Proportioner.

11.2.8.5.1.1* The pressure shall be removed before the inspection to prevent injury.

11.2.8.5.1.2 The inspection shall verify the following:

- (1) Ball drip valves (automatic drains) are free and opened.
- (2) External corrosion on foam concentrate storage tanks is not present.