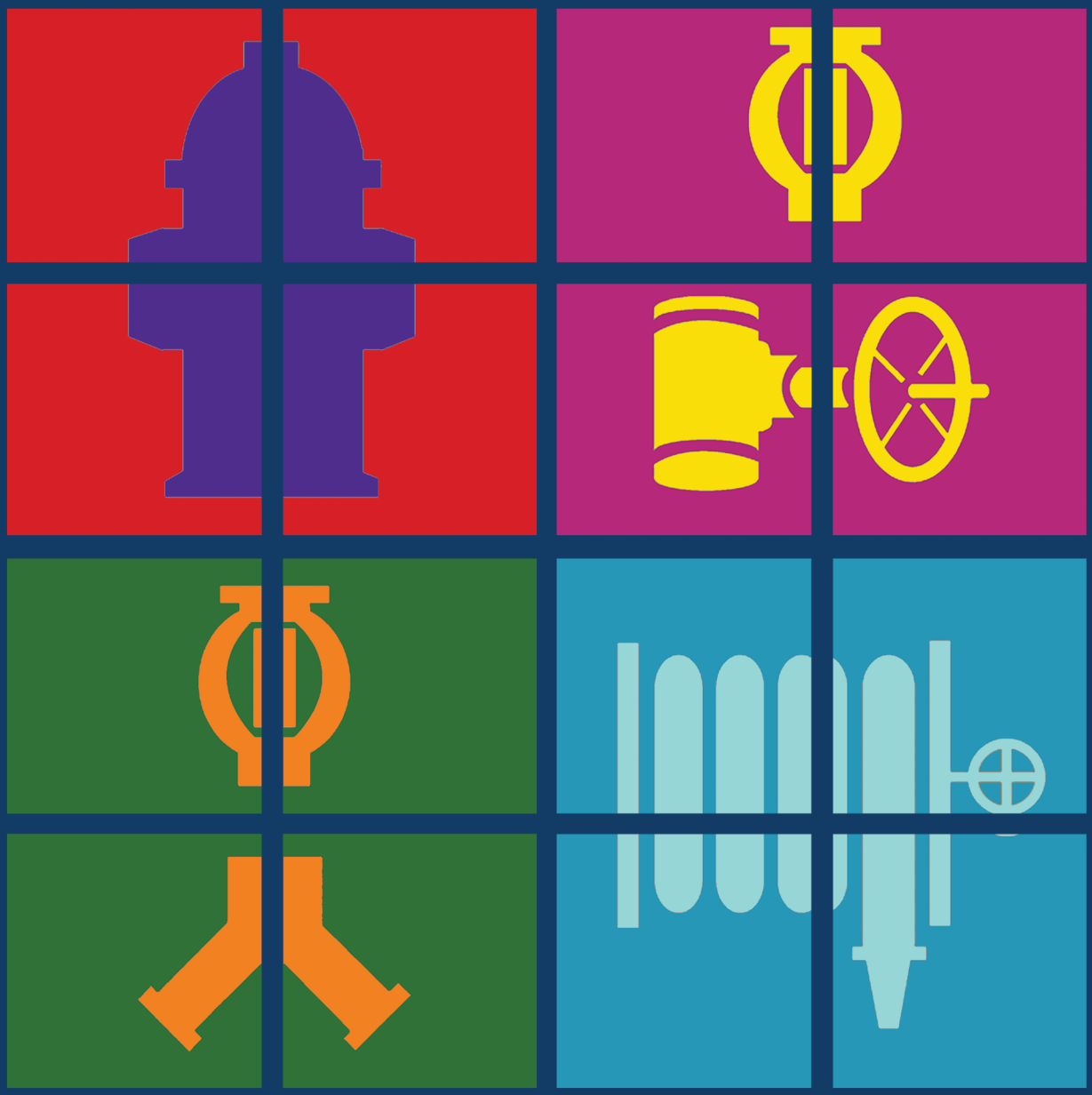
NFPA® 25 2011 edition

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



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ISBN: 978-161665044-5 (Print)
ISBN: 978-161665045-2 (PDF)

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NFPA® 25

Standard for the

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

2011 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 June Association Technical Meeting held June 7–10, 2010, in Las Vegas, NV. It was issued by the Standards Council on August 5, 2010, with an effective date of August 25, 2010, 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, 2010.

Origin and Development of NFPA 25

The first edition of NFPA 25, 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,* which have 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 These documents have since been withdrawn from the NFPA standards system.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 addresses 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 water-flow 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).

The 2008 edition increased the requirement for record retention from one year to five years in order to establish sufficient performance data to determine a performance trend with particular concern for degradation in system or component performance. 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 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 updates testing frequencies based on a growing data base of inspection, testing, and maintenance records. In two new annexes information is provided for classification of needed repairs and hazard evaluation. The 2011 edition also adds new definitions differentiating the levels of deficiency for determining the priority of repair.

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NOTE: Membership on a committee shall not in and of itself constitute an endorsement of the Association or any document developed by the committee on which the member serves.

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, standpipe and hose systems, fire service piping and appurtenances, fire pumps, water storage tanks, fixed water spray systems, foam-water systems, valves, and allied equipment. This Committee shall also develop procedures for the conduct and reporting of routine system impairments.

Documents
Document Sharing Hub
Full document details: NFPA 25 2011

Contents

Chapter 1 Administration 25– 5
1.1 Scope 25– 5
1.2 Purpose 25– 5
1.3 Application 25– 5
1.4 Units 25– 5

Chapter 2 Referenced Publications 25– 6
2.1 General 25– 6
2.2 NFPA Publications 25– 6
2.3 Other Publications 25– 6
2.4 References for Extracts in Mandatory Sections 25– 6

Chapter 3 Definitions 25– 6
3.1 General 25– 6
3.2 NFPA Official Definitions 25– 6
3.3 General Definitions 25– 6
3.4 Deluge Foam-Water Sprinkler and Foam-Water Spray Systems Definitions 25– 9
3.5 Valve Definitions 25– 9
3.6 Water-Based Fire Protection System Definitions 25– 9

Chapter 4 General Requirements 25– 10
4.1 Responsibility of the Property Owner or Designated Representative 25– 10
4.2 Corrective Action 25– 11
4.3 Records 25– 11
4.4 Inspection 25– 11
4.5 Testing 25– 11
4.6 Performanced-Based Programs 25– 11
4.7 Maintenance 25– 11
4.8 Safety 25– 11

Chapter 5 Sprinkler Systems 25– 12
5.1 General 25– 12
5.2 Inspection 25– 13
5.3 Testing 25– 13
5.4 Maintenance 25– 14
5.5 Component Action Requirements 25– 16

Chapter 6 Standpipe and Hose Systems 25– 17
6.1 General 25– 17
6.2 Inspection 25– 17
6.3 Testing 25– 19
6.4 Maintenance 25– 19
6.5 Component Action Requirements 25– 19

Chapter 7 Private Fire Service Mains 25– 20
7.1 General 25– 20
7.2 Inspection and Corrective Action. 25– 21
7.3 Testing 25– 22
7.4 Maintenance 25– 22
7.5 Component Action Requirements 25– 22

Chapter 8 Fire Pumps 25– 23
8.1 General 25– 23
8.2 Inspection 25– 26
8.3 Testing 25– 26
8.4 Reports 25– 28
8.5 Maintenance 25– 28
8.6 Component Replacement Testing Requirements 25– 28

Chapter 9 Water Storage Tanks 25– 30
9.1 General 25– 30
9.2 Inspection 25– 31
9.3 Testing 25– 32
9.4 Maintenance 25– 32
9.5 Automatic Tank Fill Valves 25– 32
9.6 Component Action Requirements 25– 32

Chapter 10 Water Spray Fixed Systems 25– 34
10.1 General 25– 34
10.2 Inspection and Maintenance Procedures 25– 35
10.3 Operational Tests 25– 36
10.4 Ultra-High-Speed Water Spray System (UHSWSS) Operational Tests 25– 37
10.5 Component Action Requirements 25– 37

Chapter 11 Foam-Water Sprinkler Systems 25– 38
11.1 General 25– 38
11.2 Inspection 25– 39
11.3 Operational Tests 25– 41
11.4 Maintenance 25– 41
11.5 Component Action Requirements 25– 42

Chapter 12 Water Mist Systems 25– 44
12.1 Inspection and Testing 25– 44
12.2 Maintenance 25– 46
12.3 Training 25– 47

Chapter 13 Valves, Valve Components, and Trim 25– 47
13.1 General 25– 47
13.2 General Provisions 25– 47
13.3 Control Valves in Water-Based Fire Protection Systems 25– 47
13.4 System Valves 25– 48
13.5 Pressure Reducing Valves and Relief Valves 25– 52
13.6 Backflow Prevention Assemblies 25– 53
13.7 Fire Department Connections 25– 53
13.8 Component Testing Requirements 25– 53

AVA Documents Document Sharing Hub
Full document details: NFPA 25 2011

Chapter 14 Obstruction Investigation **25–** 56
14.1 General **25–** 56
14.2 Internal Inspection of Piping **25–** 56
14.3 Obstruction Investigation and Prevention **25–** 56
14.4 Ice Obstruction **25–** 56

Chapter 15 Impairments **25–** 56
15.1 General **25–** 56
15.2 Impairment Coordinator **25–** 56
15.3 Tag Impairment System **25–** 57
15.4 Impaired Equipment **25–** 57
15.5 Preplanned Impairment Programs **25–** 57
15.6 Emergency Impairments **25–** 57
15.7 Restoring Systems to Service **25–** 57

Annex A Explanatory Material **25–** 57

Annex B Forms for Inspection, Testing, and Maintenance **25–** 88

Annex C Possible Causes of Pump Troubles **25–** 88

Annex D Obstruction Investigation **25–** 91

Annex E Examples of Classifications of Needed Repairs **25–** 99

Annex F Hazard Evaluation Form **25–**108

Annex G Informational References **25–**113

Index **25–**114

Documents
Document Sharing Hub
Full document details: NFPA 25 2011

NFPA 25

Standard for the

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

2011 Edition

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Changes other than editorial are indicated by a vertical rule beside the paragraph, table, or figure in which the change occurred. These rules are included as an aid to the user in identifying changes from the previous edition. Where one or more complete paragraphs have been deleted, the deletion is indicated by a bullet (•) between the paragraphs that remain.

A reference in brackets [ ] following a section or paragraph indicates material that has been extracted from another NFPA document. As an aid to the user, the complete title and edition of the source documents for extracts in mandatory sections of the document are given in Chapter 2 and those for extracts in informational sections are given in Annex G. Extracted text may be edited for consistency and style and may include the revision of internal paragraph references and other references as appropriate. Requests for interpretations or revisions of extracted text shall be sent to the technical committee responsible for the source document.

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

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, including land-based and marine applications.

1.1.1 Coordination with *NFPA 72* Testing Requirements. 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, National Fire Alarm and Signaling Code*.

1.1.1.1 The inspection, testing, and maintenance required by this standard and *NFPA 72, National Fire Alarm and Signaling Code*, 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.

1.1.2 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 Also included in this standard are 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.

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 the appropriate installation standard.

1.1.5 This standard shall not apply to sprinkler systems designed, installed, and maintained in accordance with NFPA 13D, *Standard for the Installation of Sprinkler Systems in One- and Two-Family Dwellings and Manufactured Homes*.

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 document 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 document.

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.

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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,* 2010 edition.

NFPA 13, *Standard for the Installation of Sprinkler Systems,* 2010 edition.

NFPA 13D, *Standard for the Installation of Sprinkler Systems in One- and Two-Family Dwellings and Manufactured Homes,* 2010 edition.

NFPA 14, *Standard for the Installation of Standpipe and Hose Systems,* 2010 edition.

NFPA 15, *Standard for Water Spray Fixed Systems for Fire Protection,* 2007 edition.

NFPA 16, *Standard for the Installation of Foam-Water Sprinkler and Foam-Water Spray Systems,* 2007 edition.

NFPA 20, *Standard for the Installation of Stationary Pumps for Fire Protection,* 2010 edition.

NFPA 22, *Standard for Water Tanks for Private Fire Protection,* 2008 edition.

NFPA 24, *Standard for the Installation of Private Fire Service Mains and Their Appurtenances,* 2010 edition.

NFPA 72®, National Fire Alarm and Signaling Code, 2010 edition.

NFPA 110, *Standard for Emergency and Standby Power Systems,* 2010 edition.

NFPA 307, *Standard for the Construction and Fire Protection of Marine Terminals, Piers, and Wharves,* 2011 edition.

NFPA 409, *Standard on Aircraft Hangars,* 2011 edition.

NFPA 1962, *Standard for the Inspection, Care, and Use of Fire Hose, Couplings, and Nozzles and the Service Testing of Fire Hose,* 2008 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 D 3359, *Standard Test Methods for Measuring Adhesion by Tape Test,* 2008.

2.3.2 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,* 2010 edition.

NFPA 13, *Standard for the Installation of Sprinkler Systems,* 2010 edition.

NFPA 14, *Standard for the Installation of Standpipe and Hose Systems,* 2010 edition.

NFPA 15, *Standard for Water Spray Fixed Systems for Fire Protection,* 2007 edition.

NFPA 16, *Standard for the Installation of Foam-Water Sprinkler and Foam-Water Spray Systems,* 2007 edition.

NFPA 20, *Standard for the Installation of Stationary Pumps for Fire Protection,* 2010 edition.

NFPA 24, *Standard for the Installation of Private Fire Service Mains and Their Appurtenances,* 2010 edition.

NFPA 96, *Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations,* 2011 edition.

NFPA 750, *Standard on Water Mist Fire Protection Systems,* 2010 edition.

NFPA 820, *Standard for Fire Protection in Wastewater Treatment and Collection Facilities,* 2008 edition.

NFPA 1141, *Standard for Fire Protection Infrastructure for Land Development in Suburban and Rural Areas,* 2008 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. A document, the main text of which contains only mandatory provisions using the word "shall" to indicate requirements and which is in a form generally suitable for mandatory reference by another standard or code or for adoption into law. Nonmandatory provisions shall be located in an appendix or annex, footnote, or fine-print note and are not to be considered a part of the requirements of a standard.

3.3 General Definitions.

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

3.3.2* 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.

3.3.3* Automatic Operation. Operation without human intervention.

3.3.4* Deficiency. For the purposes of inspection, testing, and maintenance of water-based fire protection systems, a condition in which a system or portion thereof is damaged, inoperable, or in need of service, but does not rise to the level of an impairment.

3.3.4.1 ***Critical Deficiency.*** A deficiency that, if not corrected, can have an effect on the performance of the fire protection system.

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3.3.4.2 ***Noncritical Deficiency.*** A deficiency that does not have an effect on the performance of the fire protection system, but correction is needed for the proper inspection, testing, and maintenance of the system(s).

3.3.5 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,** 2007]

3.3.6 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.

3.3.7 Drain.

3.3.7.1 ***Main Drain.*** The primary drain connection located on the system riser and also utilized as a flow test connection.

3.3.7.2 ***Sectional Drain.*** A drain located beyond a sectional control valve that drains only a portion of the system (e.g., a drain located beyond a floor control valve on a multi-story building).

3.3.8 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.

3.3.9* 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,** 2008]

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

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

3.3.9.3* ***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.

3.3.9.4* ***Wet Barrel Hydrant.*** A type of hydrant that sometimes is used where there is no danger of freezing weather. Each outlet on a wet barrel hydrant is provided with a valved outlet threaded for fire hose. [**24,** 2010]

3.3.10* Foam Concentrate. A concentrated liquid foaming agent as received from the manufacturer. [**11,** 2010]

3.3.11 Foam Discharge Device. Any device that, when fed with a foam-water solution, produces foam. These devices are permitted to be non-air-aspirating (e.g., sprinklers, water nozzles) or air-aspirating (e.g., foam-water sprinklers, directional foam-water nozzles, foam nozzles). All discharge devices have a special pattern of distribution peculiar to the particular device.

3.3.12 Hose Connection. A combination of equipment provided for connection of a hose to the standpipe system that includes a hose valve with a threaded outlet. [**14,** 2010]

3.3.13* 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.

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

3.3.15 Hose Station. A combination of a hose rack, hose nozzle, hose, and hose connection. [**14,** 2010]

3.3.16 Hose Storage Devices.

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

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

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

3.3.16.4* ***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.

3.3.17* 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.

3.3.17.1 ***Emergency Impairment.*** A condition where a water-based fire protection system or portion thereof is out of order due to an unexpected occurrence, such as a ruptured pipe, an operated sprinkler, or an interruption of the water supply to the system.

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

3.3.18 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,** 2008]

3.3.19 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. This program includes logging and retention of relevant records.

3.3.20 Maintenance. In water-based fire protection systems, work performed to keep equipment operable or to make repairs.

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

3.3.22 Nozzle.

3.3.22.1* ***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.

3.3.22.2* ***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.

3.3.23 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).

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3.3.24* Pressure-Regulating Device. A device designed for the purpose of reducing, regulating, controlling, or restricting water pressure. [**14,** 2010]

3.3.25 Pressure-Restricting Device. A valve or device designed for the purpose of reducing the downstream water pressure under flowing (residual) conditions only. [**14,** 2010]

3.3.26* 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.

3.3.27* Proportioner.

3.3.27.1* ***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.

3.3.27.2* ***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.

3.3.27.3* ***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.

3.3.27.4* ***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.

3.3.27.5* ***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.

3.3.28 Qualified. A competent and capable person or company that has met the requirements and training for a given field acceptable to the AHJ. [**96,** 2011]

3.3.29 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 and below the first check valve. These units are located between two tightly closed resilient-seated shutoff valves, as an assembly, and are equipped with properly located resilient-seated test cocks.

3.3.30 Sprinkler.

3.3.30.1* ***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,** 2010]

3.3.30.2 ***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,** 2010]

3.3.30.3 ***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,** 2010]

3.3.30.4 ***Early Suppression Fast-Response (ESFR) Sprinkler.*** A type of fast-response sprinkler that meets the criteria of 3.6.1(a)(1) of NFPA 13, *Standard for the Installation of Sprinkler Systems*, and is listed for its capability to provide fire suppression of specific high-challenge fire hazards. [**13,** 2010]

3.3.30.5 ***Extended Coverage Sprinkler.*** A type of spray sprinkler with maximum coverage areas as specified in Sections 8.8 and 8.9 of NFPA 13, *Standard for the Installation of Sprinkler Systems.* [**13,** 2010]

3.3.30.6 ***Nozzles.*** A device for use in applications requiring special water discharge patterns, directional spray, or other unusual discharge characteristics. [**13,** 2010]

3.3.30.7 ***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,** 2010]

3.3.30.8 ***Open Sprinkler.*** A sprinkler that does not have actuators or heat-responsive elements. [**13,** 2010]

3.3.30.9 ***Ornamental/Decorative Sprinkler.*** A sprinkler that has been painted or plated by the manufacturer. [**13,** 2010]

3.3.30.10 ***Pendent Sprinkler.*** A sprinkler designed to be installed in such a way that the water stream is directed downward against the deflector. [**13,** 2010]

3.3.30.11 ***Quick-Response Early Suppression (QRES) Sprinkler.*** A type of quick-response sprinkler that meets the criteria of 3.6.1(a)(1) of NFPA 13, *Standard for the Installation of Sprinkler Systems*, and is listed for its capability to provide fire suppression of specific fire hazards. [**13,** 2010]

3.3.30.12 ***Quick-Response Extended Coverage Sprinkler.*** A type of quick-response sprinkler that meets the criteria of 3.6.1(a)(1) of NFPA 13, *Standard for the Installation of Sprinkler Systems*, and complies with the extended protection areas defined in Chapter 8 of NFPA 13. [**13,** 2010]

3.3.30.13 ***Quick-Response (QR) Sprinkler.*** A type of spray sprinkler that meets the fast response criteria of 3.6.1(a)(1) of NFPA 13, *Standard for the Installation of Sprinkler Systems*, and is listed as a quick-response sprinkler for its intended use. [**13,** 2010]

3.3.30.14 ***Recessed Sprinkler.*** A sprinkler in which all or part of the body, other than the shank thread, is mounted within a recessed housing. [**13,** 2010]

3.3.30.15 ***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,** 2010]

3.3.30.16 ***Special Sprinkler.*** A sprinkler that has been tested and listed as prescribed in 8.4.8 of NFPA 13, *Standard for the Installation of Sprinkler Systems.* [**13,** 2010]

3.3.30.17 ***Spray Sprinkler.*** A type of sprinkler listed for its capability to provide fire control for a wide range of fire hazards. [**13,** 2010]

3.3.30.18 ***Standard Spray Sprinkler.*** A spray sprinkler with maximum coverage areas as specified in Sections 8.6 and 8.7 of NFPA 13, *Standard for the Installation of Sprinkler Systems.* [**13,** 2010]

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3.3.30.19 ***Upright Sprinkler.*** A sprinkler designed to be installed in such a way that the water spray is directed upwards against the deflector. [**13,** 2010]

3.3.31* Standpipe System. An arrangement of piping, valves, hose connections, and allied 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,** 2010]

3.3.31.1 ***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.

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

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

3.3.31.4 ***Wet Standpipe System.*** A standpipe system having piping containing water at all times. [**14,** 2010]

3.3.32 Standpipe System Type.

3.3.32.1 ***Class I System.*** A system that provides 2½ in. (65 mm) hose connections to supply water for use by fire departments. [**14,** 2010]

3.3.32.2 ***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,** 2010]

3.3.32.3 ***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,** 2010]

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

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

3.3.35* 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.

3.3.36* Water Spray. Water in a form having a predetermined pattern, particle size, velocity, and density discharge from specially designed nozzles or devices. [**15,** 2007]

3.3.37 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.

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

3.4.1 Foam-Water Spray System. A special system that is pipe-connected to a source of foam concentrate and to a water supply. The system is equipped with foam-water spray nozzles for extinguishing agent discharge (foam followed by water or in reverse order) and for distribution over the area to be protected. System operation arrangements parallel those for foam-water sprinkler systems as described in the definition of Foam-Water Sprinkler System. [**16,** 2007]

3.4.2 Foam-Water Sprinkler System. A special system that is pipe-connected to a source of foam concentrate and to a water supply. The system is equipped with appropriate discharge devices for extinguishing agent discharge and for distribution over the area to be protected. The piping system is connected to the water supply through a control valve that usually is actuated by operation of automatic detection equipment that is installed in the same areas as the sprinklers. When this valve opens, water flows into the piping system, foam concentrate is injected into the water, and the resulting foam solution discharging through the discharge devices generates and distributes foam. Upon exhaustion of the foam concentrate supply, water discharge follows and continues until shut off manually. Systems can be used for discharge of water first, followed by discharge of foam for a specified period, and then followed by water until manually shut off. Existing deluge sprinkler systems that have been converted to the use of aqueous film-forming foam or film-forming fluoroprotein foam are classified as foam-water sprinkler systems. [**16,** 2007]

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. [**14,** 2010]

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,** 2010]

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,** 2010]

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.

3.6 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. A pump that is a provider of liquid flow and pressure dedicated to fire protection. [**20,** 2010]

3.6.3* Private Fire Service Main. Private fire service main, as used in this standard, is that pipe and its appurtenances on private property (1) between a source of water and the base of the system riser for water-based fire protection systems, (2) between a source of water and inlets to foam-making systems, (3) between a source of water and the base elbow of private hydrants or monitor nozzles, and (4) used as fire pump suction and discharge piping, (5) beginning at the inlet side of the check valve on a gravity or pressure tank. [**24,** 2010]

3.6.4* Sprinkler System. For fire protection purposes, an integrated system of underground and overhead piping designed in accordance with fire protection engineering standards. The

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installation includes at least one automatic water supply that supplies one or more systems. The portion of the sprinkler system above ground is a network of specially sized or hydraulically designed piping installed in a building, structure, or area, generally overhead, and to which sprinklers are attached in a systematic pattern. Each system has a control valve located in the system riser or its supply piping. Each sprinkler system includes a device for actuating an alarm when the system is in operation. The system is usually activated by heat from a fire and discharges water over the fire area. [**13,** 2010]

3.6.4.1 ***Antifreeze Sprinkler System.*** A wet pipe sprinkler system employing automatic sprinklers that are attached to a piping system that contains an antifreeze solution and that are connected to a water supply. The antifreeze solution is discharged, followed by water, immediately upon operation of sprinklers opened by heat from a fire. [**13,** 2010]

3.6.4.2 ***Deluge Sprinkler System.*** A sprinkler system employing open sprinklers 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. When this valve opens, water flows into the piping system and discharges from all sprinklers attached thereto. [**13,** 2010]

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,** 2010]

3.6.4.4 ***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,** 2010]

3.6.4.5* ***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,** 2010]

3.6.5* 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,** 2007]

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

Chapter 4 General Requirements

4.1 Responsibility of the 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 Buildings. The building owner shall ensure that all areas of the building containing water-filled piping shall be maintained at a minimum temperature of 40°F (4.4°C) and not exposed to freezing conditions.

4.1.1.1.1* Inspection, testing, maintenance, and impairment shall be implemented in accordance with procedures meeting 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 personnel who have developed competence through training and experience.

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 impairment of the fire protection systems to a designated representative.

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

4.1.2* 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.

4.1.3 Notification of System Shutdown. 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.

4.1.3.1 The notification of system shutdown shall include the purpose for the shutdown, the system or component involved, and the estimated time of shutdown.

4.1.3.2 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.

4.1.4* Corrections and Repairs.

4.1.4.1 The property owner or designated representative shall correct or repair deficiencies or impairments that are found during the inspection, test, and maintenance required by this standard.

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

4.1.5* 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 systems for their capability to protect the new occupancy, use, or materials.

4.1.5.1 The evaluation required by 4.1.5 shall not be considered part of the normal inspection, testing, and maintenance required by this standard.

4.1.5.2 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

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4.1.6* Addressing Changes in Hazard.

4.1.6.1 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.

4.1.6.2 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.

4.1.6.3 Corrections shall be approved.

4.1.7 Valve Location. The location of shutoff valves shall be identified.

4.1.8 Information Sign.

4.1.8.1 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.

4.1.8.2 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) The presence and location of antifreeze or other auxiliary systems
(4) The presence and location(s) of heat tape

4.1.9 Impairments.

4.1.9.1 Where an impairment to a water-based fire protection system occurs, the procedures outlined in Chapter 15 of this standard shall be followed, including the attachment of a tag to the impaired system.

4.1.9.2 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.

4.2 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 and shall be made available to the authority having jurisdiction upon request.

4.3.2 Records shall indicate the procedure performed (e.g., inspection, test, or maintenance), the organization that performed the work, the results, and the date.

4.3.3* Records shall be maintained by the property owner.

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

4.5 Testing.

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

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

4.5.3 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.

4.5.4 During 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.

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

4.5.6* When a major component or subsystem is rebuilt or replaced, the subsystem shall be tested in accordance with the original acceptance test required for that subsystem.

4.5.7* Automated Testing. (Reserved)

4.6* Performanced-Based Programs. As an alternative means of compliance, subject to the authority having jurisdiction, components and systems shall be permitted to be inspected, tested, and maintained under a performance-based program.

4.7* Maintenance. Maintenance shall be performed to keep the system equipment operable or to make repairs.

4.8 Safety.

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

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

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

4.8.4 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.

4.8.5* Hazardous Materials.

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

4.8.5.2 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.

4.8.6* Electrical Safety. Legally required precautions shall be taken when testing or maintaining electric controllers for motor-driven fire pumps.

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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 Valves and Connections. Valves and fire department connections 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		
Gauges (dry, preaction, and deluge systems)	Weekly/monthly	5.2.4.2, 5.2.4.3, 5.2.4.4
Control valves		Table 13.1
Waterflow alarm devices	Quarterly	5.2.5
Valve supervisory alarm devices	Quarterly	5.2.5
Supervisory signal devices (except valve supervisory switches)	Quarterly	5.2.5
Gauges (wet pipe systems)	Monthly	5.2.4.1
Hydraulic nameplate	Quarterly	5.2.6
Buildings	Annually (prior to freezing weather)	4.1.1.1
Hanger/seismic bracing	Annually	5.2.3
Pipe and fittings	Annually	5.2.2
Sprinklers	Annually	5.2.1
Spare sprinklers	Annually	5.2.1.4
Information sign	Annually	5.2.6.1
Fire department connections		Table 13.1
Valves (all types)		Table 13.1
Obstruction, internal inspection of piping	5 years	14.2
Test		
Waterflow alarm devices		
Mechanical devices	Quarterly	5.3.3.1
Vane and pressure switch type devices	Semiannually	5.3.3.2
Valves supervisory alarm devices		Table 13.1
Supervisory signal devices (except valve supervisory switches)		Table 13.1
Main drain		Table 13.1
Antifreeze solution	Annually	5.3.4
Gauges	5 years	5.3.2
Sprinklers — extra-high temperature	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	At 50 years and every 10 years thereafter	5.3.1.1.1
Sprinklers	At 75 years and every 5 years thereafter	5.3.1.1.1.5
Sprinklers — dry	At 10 years and every 10 years thereafter	5.3.1.1.1.6
Maintenance		
Valves (all types)		Table 13.1
Low-point drains (dry pipe system)		13.4.4.3.2
Sprinklers and automatic spray nozzles protecting commercial cooking equipment and ventilation systems	Annually	5.4.1.9
Investigation		
Obstruction		14.3

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Document Sharing Hub
Full document details: NFPA 25 2011

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

5.1.5 Notification to Supervisory Service. To avoid false alarms where a supervisory service is provided, the alarm receiving facility shall be notified by the property owner or designated representative as follows:

(1) Before conducting any test or procedure that could result in the activation of an alarm
(2) After such tests or procedures are concluded

5.1.6 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* Sprinklers shall not show signs of leakage; shall be free of corrosion, foreign materials, paint, and physical damage; and shall be installed in the correct orientation (e.g., upright, pendent, or sidewall).

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

(1) Leakage
(2) Corrosion
(3) Physical damage
(4) Loss of fluid in the glass bulb heat responsive element
(5)*Loading
(6) Painting unless painted by the sprinkler manufacturer

5.2.1.1.3* Any sprinkler that has been installed in the incorrect orientation shall be replaced.

5.2.1.1.4 Any sprinkler shall be replaced that has signs of leakage; is painted, other than by the sprinkler manufacturer, corroded, damaged, or loaded; or is in the improper orientation.

5.2.1.1.5 Glass bulb sprinklers shall be replaced if the bulbs have emptied.

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

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

5.2.1.2* The minimum clearance required by the installation standard shall be maintained below all sprinkler deflectors.

5.2.1.3 Stock, furnishings, or equipment closer to the sprinkler deflector than permitted by the clearance rules of the installation standard 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 5.4.1.4 and 5.4.1.5
(2) A sprinkler wrench for each type of sprinkler as required by 5.4.1.6

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 in good condition and 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 and Seismic Braces. Sprinkler pipe hangers and seismic braces shall be inspected annually from the floor level.

5.2.3.1 Hangers and seismic braces shall not be damaged or loose.

5.2.3.2 Hangers and seismic braces that are damaged or loose shall be replaced or refastened.

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

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

5.2.4 Gauges.

5.2.4.1* Gauges on wet pipe sprinkler systems shall be inspected monthly to ensure that they are in good condition and that normal water supply pressure is being maintained.

5.2.4.2 Gauges on dry, preaction, and deluge systems shall be inspected weekly to ensure that normal air and water pressures are being maintained.

5.2.4.3 Where air pressure supervision is connected to a constantly attended location, gauges shall be inspected monthly.

5.2.4.4* For dry pipe or preaction systems protecting freezers with two air pressure gauges on the air line(s) between the compressor and the dry pipe or preaction valve, the air pressure gauge near the compressor shall be compared weekly to the pressure gauge above the dry pipe or preaction valve.

5.2.4.4.1 When the gauge near the compressor is reading higher than the gauge near the dry pipe valve, the air line in service shall be taken out of service, and the alternate air line opened to equalize the pressure.

5.2.4.4.2 The air line taken out of service shall be internally inspected, shall have all ice blockage removed, and shall be reassembled for use as a future alternate air line.

5.2.5 Waterflow Alarm and Supervisory Devices. Waterflow alarm and supervisory alarm devices shall be inspected quarterly to verify that they are free of physical damage.

5.2.6* Hydraulic Design Information Sign. The hydraulic design information sign for hydraulically designed systems shall be inspected quarterly to verify that it is attached securely to the sprinkler riser and is legible.

5.2.7 Heat Tape. Heat tape shall be inspected per manufacturer's requirements.

5.2.8* Information Sign. The information sign shall be inspected annually to verify that it is securely attached and is 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 in service for 50 years, they shall be replaced or representative samples from one or more sample areas shall be tested.

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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 in service 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 in service 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 in service for 10 years shall be replaced or representative samples shall be tested and then retested at 10-year intervals.

5.3.1.1.2* Where sprinklers are subjected to harsh environments, including corrosive atmospheres and corrosive water supplies, on a 5-year basis, either sprinklers shall be replaced or representative sprinkler samples shall be tested.

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

5.3.1.2* A representative sample of sprinklers for testing per 5.3.1.1.1 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.

5.3.2* Gauges.

5.3.2.1 Gauges shall be replaced every 5 years or tested every 5 years by comparison with a calibrated gauge.

5.3.2.2 Gauges not accurate to within 3 percent of the full scale shall be recalibrated or replaced.

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 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 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.

5.3.3.5* Testing waterflow alarm devices on dry pipe, preaction, or deluge systems shall be accomplished by using the bypass connection.

5.3.4* Antifreeze Systems. The freezing point of solutions in antifreeze shall be tested annually by measuring the specific gravity with a hydrometer or refractometer and adjusting the solutions if necessary.

5.3.4.1* Solutions shall be in accordance with Table 5.3.4.1(a) and Table 5.3.4.1(b).

5.3.4.1.1* Listed CPVC sprinkler pipe and fittings shall be protected from freezing with glycerin only. The use of diethylene, ethylene, or propylene glycols shall be specifically prohibited.

5.3.4.1.2 The concentration of antifreeze solution shall be limited to the minimum necessary for the anticipated minimum temperature.

5.3.4.2 The use of antifreeze solutions shall be in accordance with any state or local health regulations.

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

5.3.4.3.1 When 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.

5.3.4.3.2 If the test results indicate an incorrect freeze point at any point in the system, the system shall be drained, the solution adjusted, and the systems refilled.

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

5.4 Maintenance.

5.4.1 Sprinklers.

5.4.1.1* 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

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

5.4.1.1.2 Replacement sprinklers for piers and wharves shall comply with NFPA 307, *Standard for the Construction and Fire Protection of Marine Terminals, Piers, and Wharves.*

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

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

5.4.1.4* A supply of spare sprinklers (never fewer than six) shall be maintained on the premises so that any sprinklers that have operated or been damaged in any way can be promptly replaced.

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

5.4.1.4.2 The sprinklers shall be kept in a cabinet located where the temperature in which they are subjected will at no time exceed 100°F (38°C).

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Table 5.3.4.1(a) Antifreeze Solutions to Be Used If Nonpotable Water Is Connected to Sprinklers

Material	Solution (by Volume)	Specific Gravity at 60°F (15.6°C)	Freezing Point °F	Freezing Point °C
Glycerine*				
Diethylene glycol (Not for CPVC)	50% water	1.078	–13	–25.0
	45% water	1.081	–27	–32.8
	40% water	1.086	–42	–41.1
	Hydrometer scale 1.000 to 1.120 (subdivisions 0.002)			
Ethylene glycol (Not for CPVC)	61% water	1.056	–10	–23.3
	56% water	1.063	–20	–28.9
	51% water	1.069	–30	–34.4
	47% water	1.073	–40	–40.0
	Hydrometer scale 1.000 to 1.120 (subdivisions 0.002)			
Propylene glycol* (Not for CPVC)				
Calcium chloride 80% "flake" (Not for CPVC)	lb $CaCl_2$/gal of water			
Fire protection grade†				
Add corrosion inhibitor of sodium bichromate ¾ oz/gal water	2.83	1.183	0	–17.8
	3.38	1.212	–10	–23.3
	3.89	1.237	–20	–28.9
	4.37	1.258	–30	–34.4
	4.73	1.274	–40	–40.0
	4.93	1.283	–50	–45.6

*If used, see Table 5.3.4.1(b).
†Free from magnesium chloride and other impurities.

Table 5.3.4.1(b) Antifreeze Solutions to Be Used If Potable Water Is Connected to Sprinklers

Material	Solution (by Volume)	Specific Gravity at 60°F (15.6°C)	Freezing Point °F	Freezing Point °C
Glycerine C.P. or U.S.P. grade*	50% water	1.145	–20.9	–29.4
	40% water	1.171	–47.3	–44.1
	30% water	1.197	–22.2	–30.1
	Hydrometer scale 1.000 to 1.200			
Propylene glycol (Not for CPVC)	70% water	1.027	+9	–12.8
	60% water	1.034	–6	–21.2
	50% water	1.041	–26	–32.2
	40% water	1.045	–60	–51.1
	Hydrometer scale 1.000 to 1.200 (subdivisions 0.0002)			

*C.P. = Chemically pure; U.S.P. = United States Pharmacopoeia 96.9%.

5.4.1.4.2.1 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.

5.4.1.5 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

5.4.1.6* A special sprinkler wrench shall be provided and kept in the cabinet to be used in the removal and installation of sprinklers.

5.4.1.6.1 One sprinkler wrench shall be provided for each type of sprinkler installed.

5.4.1.7 Sprinklers protecting spray coating areas shall be protected against overspray residue.

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5.4.1.7.1* Sprinklers subject to overspray accumulations shall be protected using cellophane bags having a thickness of 0.003 in. (0.076 mm) or less or thin paper bags.

5.4.1.7.2 Coverings shall be replaced when deposits or residue accumulate.

5.4.1.8* 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.

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

5.4.1.9.1 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.

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 (4.4°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 maintained in accordance with the manufacturer's instructions.

5.4.3* Installation and Acceptance Testing. Where maintenance or repair requires the replacement of sprinkler system components affecting more than 20 sprinklers, those components shall be installed and tested in accordance with NFPA 13, *Standard for the Installation of Sprinkler Systems.*

5.4.4* 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.

Table 5.5.1 Summary of Component Replacement Action Requirements

Component	Adjust	Repair/ Recondition	Replace	Required Action
Water Delivery Components				
Pipe and fittings affecting less than 20 sprinklers	X	X	X	Check for leaks at system working pressure
Pipe and fittings affecting more than 20 sprinklers	X	X	X	Hydrostatic test in conformance with NFPA 13, *Standard for the Installation of Sprinkler Systems*
Sprinklers, less than 20	X		X	Check for leaks at system working pressure
Sprinklers, more than 20	X		X	Hydrostatic test in conformance with NFPA 13
Fire department connections	X	X	X	See Chapter 13
Antifreeze solution	X		X	Check freezing point of solution Check for leaks at system working pressure
Valves				See Chapter 13
Fire pump				See Chapter 8
Alarm and Supervisory Components				
Vane-type waterflow	X	X	X	Operational test using inspector's test connection
Pressure switch–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
High and low air pressure switch	X	X	X	Operational test of high and low settings
Valve supervisory device	X	X	X	Test for conformance with NFPA 13 and/or *NFPA 72, National Fire Alarm and Signaling Code*
Detection system (for deluge or preaction system)	X	X	X	Operational test for conformance with NFPA 13 and/or *NFPA 72*
Status-Indicating Components				
Gauges			X	Verify at 0 bar (0 psi) and system working pressure
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
Main drain	X	X	X	Main drain test
Auxiliary drains	X	X	X	Check for leaks at system working pressure; Main drain test
Inspector's test connection	X	X	X	Check for leaks at system working pressure; Main drain test
Structural Components				
Hanger/seismic bracing	X	X	X	Check for conformance with NFPA 13
Pipe stands	X	X	X	Check for conformance with NFPA 13
Informational Components				
Identification signs	X	X	X	Check for conformance with NFPA 13
Hydraulic placards	X	X	X	Check for conformance with NFPA 13

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Full document details: NFPA 25 2011

5.5.2 A main drain test shall be required if the system control or other upstream valve was operated in accordance with 13.3.3.4.

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

5.5.4 These actions shall not require a design review, which is outside the scope of 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 Table 6.1.2 shall be used for the inspection, testing, and maintenance of all classes of standpipe and hose systems.

6.1.3 Checkpoints and corrective actions outlined in Table 6.1.2 shall be followed to determine that components are free of corrosion, foreign material, physical damage, tampering, or other conditions that adversely affect system operation.

6.1.4 Valves and fire department connections shall be inspected, tested, and maintained in accordance with Chapter 13.

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

6.1.6 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.

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

6.1.8 Notification to Supervisory Service. To avoid false alarms where a supervisory service is provided, the alarm receiving facility shall be notified by the property owner or designated representative as follows:

(1) Before conducting any test or procedure that could result in the activation of an alarm
(2) After such tests or procedures are concluded

6.2 Inspection.

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

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

Item	Frequency	Reference
Inspection		
Control valves		Table 13.1
Pressure regulating devices		Table 13.1
Piping	Annually	6.2.1
Hose connections		Table 13.1
Cabinet	Annually	NFPA 1962
Gauges	Weekly	6.2.2
Hose	Annually	NFPA 1962
Hose storage device	Annually	NFPA 1962
Hose nozzle	Annually and after each use	NFPA 1962
Hydraulic design information sign	Annually	6.2.3
Test		
Waterflow alarm devices		Table 13.1
Valve supervisory alarm devices		Table 13.1
Supervisory signal devices (except valve supervisory switches)		Table 13.1
Hose storage device	Annually	NFPA 1962
Hose	5 years/3 years	NFPA 1962
Pressure control valve		Table 13.1
Pressure reducing valve		Table 13.1
Hydrostatic test	5 years	6.3.2
Flow test	5 years	6.3.1
Main drain test		Table 13.1
Maintenance		
Hose connections	Annually	Table 6.1.2
Valves (all types)	Annually/as needed	Table 13.1

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Table 6.1.2 Standpipe and Hose Systems

Component/Checkpoint	Corrective Action
Hose Connections	
Cap missing	Replace
Fire hose connection damaged	Repair
Valve handles missing	Replace
Cap gaskets missing or deteriorated	Replace
Valve leaking	Close or repair
Visible obstructions	Remove
Restricting device missing	Replace
Manual, semiautomatic, or dry standpipe — valve does not operate smoothly	Lubricate or repair
Piping	
Damaged piping	Repair
Control valves damaged	Repair or replace
Missing or damaged pipe support device	Repair or replace
Damaged supervisory devices	Repair or replace
Hose	
Inspect	Remove and inspect the hose, including gaskets, and rerack or rereel at intervals in accordance with NFPA 1962, *Standard for the Inspection, Care, and Use of Fire Hose, Couplings, and Nozzles and the Service Testing of Fire Hose*
Mildew, cuts, abrasions, and deterioration evident	Replace with listed lined, jacketed hose
Coupling damaged	Replace or repair
Gaskets missing or deteriorated	Replace
Incompatible threads on coupling	Replace or provide thread adapter
Hose not connected to hose rack nipple or valve	Connect
Hose test outdated	Retest or replace in accordance with NFPA 1962
Hose Nozzle	
Hose nozzle missing	Replace with listed nozzle
Gasket missing or deteriorated	Replace
Obstructions	Remove
Nozzle does not operate smoothly	Repair or replace
Hose Storage Device	
Difficult to operate	Repair or replace
Damaged	Repair or replace
Obstruction	Remove
Hose improperly racked or rolled	Remove
Nozzle clip in place and nozzle correctly contained?	Replace if necessary
If enclosed in cabinet, will hose rack swing out at least 90 degrees?	Repair or remove any obstructions
Cabinet	
Check overall condition for corroded or damaged parts	Repair or replace parts; replace entire cabinet if necessary
Difficult to open	Repair
Cabinet door will not open fully	Repair or move obstructions
Door glazing cracked or broken	Replace
If cabinet is break-glass type, is lock functioning properly?	Repair or replace
Glass break device missing or not attached	Replace or attach
Not properly identified as containing fire equipment	Provide identification
Visible obstructions	Remove
All valves, hose, nozzles, fire extinguisher, etc., easily accessible	Remove any material not related

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6.2.2 Gauges.

6.2.2.1 Gauges on automatic standpipe systems shall be inspected monthly to ensure that they are in good condition and that normal water supply pressure is being maintained.

6.2.2.2 Gauges on dry, preaction, and deluge valves shall be inspected weekly to ensure that normal air and water pressure are being maintained.

6.2.2.3 Where air pressure supervision is connected to a constantly attended location, gauges shall be inspected monthly.

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

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 at the hydraulically most remote hose connections of each zone of an automatic standpipe system to verify the water supply still provides the design pressure at the required flow.

6.3.1.2 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.

6.3.1.3 All systems shall be flow tested and pressure tested at the requirements for the design criteria in effect at the time of the installation.

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

6.3.1.4 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.

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

6.3.1.5.1 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).

6.3.1.5.2 Pressure gauges shall be provided for the test and shall be maintained in accordance with 5.3.2.

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 semi-automatic 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* Hydrostatic tests shall be conducted in accordance with 6.3.2.1 on any system that has been modified or repaired.

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

6.3.2.3.1 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 13.2.6 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.

6.3.4* Gauges.

6.3.4.1 Gauges shall be replaced every 5 years or tested every 5 years by comparison with a calibrated gauge.

6.3.4.2 Gauges not accurate to within 3 percent of the full scale shall be recalibrated or replaced.

6.4 Maintenance.

6.4.1 Maintenance and repairs shall be in accordance with 6.1.3 and Table 6.1.2.

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 A main drain test shall be required if the control valve or other upstream valve was operated in accordance with 13.3.3.4.

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

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Table 6.5.1 Summary of Component Replacement Action Requirements

Component	Adjust	Repair	Replace	Required Action
Water Delivery Components				
Control valves	X	X	X	See Chapter 13
Hose valve pressure regulating devices	X	X	X	See Chapter 13
System pressure regulating devices	X	X	X	See Chapter 13
Piping	X	X	X	Hydrostatic test in conformance with NFPA 14, *Standard for the Installation of Standpipe and Hose Systems*
Fire hose			X	
Hose valve	X	X	X	See Chapter 13
Fire department connections	X	X	X	See Chapter 13
Backflow prevention device	X	X	X	See Chapter 13
Valves				See Chapter 13
Fire pump				See Chapter 8
Alarm and Supervisory Components				
Vane-type waterflow	X	X		Operational test using inspector's test connection
Vane-type waterflow			X	Operational test using inspector's test connection
Pressure switch–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
Valve supervisory device	X	X	X	Operational test for receipt of alarms and verification of conformance with NFPA 14 and/or *NFPA 72, National Fire Alarm and Signaling Code*
Status-Indicating Components				
Gauges			X	Verify at 0 psi and system working pressure
System Housing and Protection Components				
Cabinet	X	X	X	Verify compliance with NFPA 14
Hose storage rack	X	X	X	Verify compliance with NFPA 14
Testing and Maintenance Components				
Drain riser	X	X	X	Check for leaks while flowing from connection above the repair
Auxiliary drains	X	X	X	Check for leaks at system working pressure
Main drain	X	X	X	Check 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				
Identification signs	X	X	X	Verify conformance with NFPA 14
Hydraulic placards	X	X	X	Verify conformance with NFPA 14

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 Valves and Connections. Valves and fire department connections 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, *Standard for the Inspection, Care, and Use of Fire Hose, Couplings, and Nozzles and the Service Testing of Fire Hose.*

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

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

Item	Frequency	Reference
Inspection		
Hose houses	Quarterly	7.2.2.7
Hydrants (dry barrel and wall)	Annually and after each operation	7.2.2.4
Monitor nozzles	Semiannually	7.2.2.6
Hydrants (wet barrel)	Annually and after each operation	7.2.2.5
Mainline strainers	Annually and after each significant flow	7.2.2.3
Piping (exposed)	Annually	7.2.2.1
Piping (underground)	See 7.2.2.2	7.2.2.2
Test		
Monitor nozzles	Flow, annually (range and operation)	7.3.3
Hydrants	Flow, annually	7.3.2
Piping (exposed and underground) (flow test)	5 years	7.3.1
Maintenance		
Mainline strainers	Annually and after each operation	7.2.2.3
Hose houses	Annually	7.2.2.7
Hydrants	Annually	7.4.2
Monitor nozzles	Annually	7.4.3

7.1.6 Notification to Supervisory Service. To avoid false alarms where a supervisory service is provided, the alarm receiving facilities always shall be notified by the property owner or designated representative as follows:

(1) Before conducting any test or procedure that could result in the activation of an alarm
(2) After such tests or procedures are concluded

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, and the necessary corrective action shall be taken as specified in Table 7.2.2.1.2.

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.

7.2.2.2* Underground Piping.

7.2.2.3* Mainline Strainers. Mainline strainers shall be inspected and cleaned after each system flow exceeding that of a nominal 2 in. (50 mm) orifice and shall be removed and inspected annually for failing, damaged, and corroded parts, with the necessary corrective action taken as specified in Table 7.2.2.3.

7.2.2.4 Dry Barrel and Wall Hydrants. Dry barrel and wall hydrants shall be inspected annually and after each operation, with the necessary corrective action taken as specified in Table 7.2.2.4.

Table 7.2.2.1.2 Exposed Piping

Condition	Corrective Action
Leaks	Repair
Physical damage	Repair or replace
Corrosion	Clean or replace and coat with corrosion protection
Restraint methods	Repair or replace

Table 7.2.2.3 Mainline Strainers

Condition	Corrective Action
Plugging or fouling	Clean
Corrosion	Replace or repair

Table 7.2.2.4 Dry Barrel and Wall Hydrants

Condition	Corrective Action
Inaccessible	Make accessible
Barrel contains water or ice (presence of water or ice could indicate a faulty drain, a leaky hydrant valve, or high groundwater table)	Repair and drain; for high groundwater it could be necessary to plug the drain and pump out the barrel after each use
Improper drainage from barrel	Repair drain
Leaks in outlets or at top of hydrant	Repair or replace gaskets, packing, or parts as necessary
Cracks in hydrant barrel	Repair or replace
Tightness of outlet caps	Lubricate if necessary; tighten if necessary
Worn outlet threads	Repair or replace
Worn hydrant operating nut	Repair or replace
Availability of operating wrench	Make sure wrench is available

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7.2.2.5 Wet Barrel Hydrants. Wet barrel hydrants shall be inspected annually and after each operation, with the necessary corrective action taken as specified in Table 7.2.2.5.

7.2.2.6 Monitor Nozzles. Monitor nozzles shall be inspected semiannually, with the necessary corrective action taken as specified in Table 7.2.2.6.

7.2.2.7 Hose Houses. Hose houses shall be inspected quarterly, with the necessary corrective action taken as specified in Table 7.2.2.7.

7.3 Testing.

7.3.1* Underground and Exposed Piping Flow Tests. Underground and exposed piping shall be flow tested to determine the internal condition of the piping at minimum 5-year intervals.

7.3.1.1 Flow tests shall be made at flows representative of those expected during a fire, for the purpose of comparing the friction loss characteristics of the pipe with those expected for the particular type of pipe involved, with due consideration given to the age of the pipe and to the results of previous flow tests.

7.3.1.2 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.

Table 7.2.2.5 Wet Barrel Hydrants

Condition	Corrective Action
Inaccessible	Make accessible
Leaks in outlets or at top of hydrant	Repair or replace gaskets, packing, or parts as necessary
Cracks in hydrant barrel	Repair or replace
Tightness of outlet caps	Lubricate if necessary; tighten if necessary
Worn outlet threads	Repair or replace
Worn hydrant operating nut	Repair or replace
Availability of operating wrench	Make sure wrench is available

Table 7.2.2.6 Monitor Nozzles

Condition	Corrective Action
Leakage	Repair
Physical damage	Repair or replace
Corrosion	Clean or replace, and lubricate or protect as necessary

Table 7.2.2.7 Hose Houses

Condition	Corrective Action
Inaccessible	Make accessible
Physical damage	Repair or replace
Missing equipment	Replace equipment

7.3.1.3 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 A main drain test shall be required if the system control or other upstream valve was operated.

7.5.3.1* 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.

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Table 7.5.1 Summary of Component Replacement 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, *Standard for the Installation of Private Fire Service Mains and Their Appurtenances*
Hydrants	X	X	X	Hydrostatic test in conformance with NFPA 24 Water flow in conformance with NFPA 24 Check for proper drainage
Monitor nozzles	X	X	X	Hydrostatic test in conformance with NFPA 24 Flush in conformance with NFPA 24
Mainline strainers	X	X	X	Flow test downstream of strainer
Fire department connection	X	X	X	See Chapter 13
Valves				See Chapter 13
Fire pump				See Chapter 8
Alarm and Supervisory Components				
Valve supervisory device	X	X	X	Operational test for conformance with NFPA 24 and/or *NFPA 72, National Fire Alarm and Signaling Code*
System-Indicating Components				
Gauges			X	Verify at 0 psi and system working pressure
System Housing and Protection Components				
Hose houses	X	X	X	Verify integrity of hose and hose house components
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 Table 8.1.1.2 shall be used to determine the minimum required frequencies for inspection, testing, and maintenance.

8.1.2 Alternative Inspection, Testing, and Maintenance Procedures. In the absence of manufacturer's recommendations for preventive maintenance, Table 8.1.2 shall be used for alternative requirements.

8.1.3 Valves and Connections. Valves and fire department connections shall be inspected, tested, and maintained in accordance with Chapter 13.

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

8.1.5* 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

8.1.6 Water Supply to Pump Suction.

8.1.6.1 The suction supply for the fire pump shall provide the required flow at a gauge pressure of 0 psi (0 bar) or higher at the pump suction flange to meet the system demand.

8.1.6.2 Those installations for which NFPA 20, *Standard for the Installation of Stationary Pumps for Fire Protection*, 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 8.1.6.

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Table 8.1.2 Alternative Fire Pump Inspection, Testing, and Maintenance Procedures

Complete as Applicable	Visual Inspection	Check	Change	Clean	Test	Frequency
Pump System						
Lubricate pump bearings			X			Annually
Check pump shaft end play		X				Annually
Check accuracy of pressure gauges and sensors		X	X			Annually (change or recalibrate when 5% out of calibration)
Check pump coupling alignment		X				Annually
Wet pit suction screens		X		X		After each pump operation
Mechanical Transmission						
Lubricate coupling			X			Annually
Lubricate right-angle gear drive			X			Annually
Electrical System						
Exercise isolating switch and circuit breaker					X	Monthly
Trip circuit breaker (if mechanism provided)					X	Annually
Operate manual starting means (electrical)					X	Semiannually
Inspect and operate emergency manual starting means (without power)	X				X	Annually
Tighten electrical connections as necessary		X				Annually
Lubricate mechanical moving parts (excluding starters and relays)		X				Annually
Calibrate pressure switch settings		X				Annually
Grease motor bearings			X			Annually
Voltmeter and ammeter for accuracy (5%)		X				Annually
Any corrosion on printed circuit boards (PCBs)	X					Annually
Any cracked cable/wire insulation	X					Annually
Any leaks in plumbing parts	X					Annually
Any signs of water on electrical parts	X					Annually
Diesel Engine System						
Fuel						
Tank level	X	X				Weekly
Tank float switch	X				X	Weekly
Solenoid valve operation	X				X	Weekly
Strainer, filter, or dirt leg, or combination thereof				X		Quarterly
Water and foreign material in tank				X		Annually
Water in system		X		X		Weekly
Flexible hoses and connectors	X					Weekly
Tank vents and overflow piping unobstructed		X			X	Annually
Piping	X					Annually
Lubrication system						
Oil level	X	X				Weekly
Oil change			X			50 hours or annually
Oil filter(s)			X			50 hours or annually
Lube oil heater		X				Weekly
Crankcase breather	X		X	X		Quarterly
Cooling system						
Level	X	X				Weekly
Antifreeze protection level					X	Semiannually
Antifreeze		X				Annually
Adequate cooling water to heat exchanger		X				Weekly
Rod out heat exchanger				X		Annually
Water pump(s)	X					Weekly
Condition of flexible hoses and connections	X	X				Weekly
Jacket water heater		X				Weekly
Inspect duct work, clean louvers (combustion air)	X	X	X			Annually
Water strainer				X		Quarterly

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Table 8.1.2 *Continued*

Complete as Applicable	Visual Inspection	Check	Change	Clean	Test	Frequency
Exhaust system						
Leakage	X	X				Weekly
Drain condensate trap		X				Weekly
Insulation and fire hazards	X					Quarterly
Excessive back pressure					X	Annually
Exhaust system hangers and supports	X					Annually
Flexible exhaust section	X					Semiannually
Battery system						
Electrolyte level		X				Weekly
Terminals clean and tight	X	X				Quarterly
Case exterior clean and dry	X	X				Monthly
Specific gravity or state of charge					X	Monthly
Charger and charge rate	X					Monthly
Equalize charge		X				Monthly
Clean terminals				X		Annually
Cranking voltage exceeds 9 volts on a 12 volt system or 18 volts on a 24 volt system		X				Weekly
Electrical system						
General inspection	X					Weekly
Tighten control and power wiring connections		X				Annually
Wire chafing where subject to movement	X	X				Quarterly
Operation of safeties and alarms		X			X	Semiannually
Boxes, panels, and cabinets				X		Semiannually
Circuit breakers or fuses	X	X				Monthly
Circuit breakers or fuses			X			Biennially
Voltmeter and ammeter for accuracy (5%)		X				Annually
Any corrosion on printed circuit boards (PCBs)	X					Annually
Any cracked cable/wire insulation	X					Annually
Any leaks in plumbing parts	X					Annually
Any signs of water on electrical parts	X					Annually

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

Item	Frequency	Reference
Inspection		
Pump house, heating ventilating louvers	Weekly	8.2.2(1)
Fire pump system	Weekly	8.2.2
Test		
Pump operation		
No-flow condition		8.3.1
Diesel engine driven fire pump	Weekly	
Electric motor driven fire pump	Monthly	
Flow condition	Annually	8.3.3
Fire pump alarm signals	Annually	8.3.3.5
Maintenance		
Hydraulic	Annually	8.5
Mechanical transmission	Annually	8.5
Electrical system	Varies	8.5
Controller, various components	Varies	8.5
Motor	Annually	8.5
Diesel engine system, various components	Varies	8.5

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8.1.7 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.

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

8.1.9* 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.

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

8.1.11 Notification to Supervisory Service. To avoid false alarms where a supervisory service is provided, the alarm receiving facility always shall be notified by the property owner or designated representative as follows:

(1) Before conducting any test or procedure that could result in the activation of an alarm
(2) After such tests or procedures are concluded

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 as follows:
  (a) Heat is adequate, not less than 40°F (5°C) for pump room with diesel pumps without engine heaters.
  (b) Ventilating louvers are free to operate.
(2) Pump system conditions 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 is full.
  (f) Wet pit suction screens are unobstructed and in place.
  (g) Waterflow test valves are in the closed position.
(3) Electrical system conditions 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 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 Diesel engine–driven fire pumps shall be operated weekly.

8.3.1.2* Electric motor–driven fire pumps shall be operated monthly.

8.3.2 No-Flow Condition.

8.3.2.1 A test of fire pump assemblies shall be conducted without flowing water.

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 shall be permitted to be substituted for the starting procedure.

8.3.2.7 Qualified operating personnel shall be in attendance whenever the pump is in operation.

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

(1) Pump system procedure as follows:
  (a) Record the system suction and discharge pressure gauge readings
  (b) Check the pump packing glands for slight discharge
  (c) Adjust gland nuts if necessary
  (d) Check for unusual noise or vibration
  (e) Check packing boxes, bearings, or pump casing for overheating
  (f) Record the pump starting pressure
(2) Electrical system procedure 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 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) Check the heat exchanger for cooling waterflow
(4) Steam system procedure as follows:
  (a) Record the steam pressure gauge reading
  (b) Observe the time for turbine to reach running speed

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8.3.3 Annual Flow Testing.

8.3.3.1* An annual test of each pump assembly shall be conducted by qualified personnel under minimum, rated, and peak flows of the fire pump by controlling the quantity of water discharged through approved test devices.

8.3.3.1.1 If available suction supplies do not allow flowing of 150 percent of the rated pump capacity, the fire pump shall be permitted to operate at maximum allowable discharge.

8.3.3.1.2* The annual test shall be conducted as described in 8.3.3.1.2.1, 8.3.3.1.2.2, or 8.3.3.1.2.3.

8.3.3.1.2.1 Use of Pump Discharge via Hose Streams.

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

(B) Care shall be taken to prevent water damage by verifying there is adequate drainage for the high pressure water discharge from hoses.

8.3.3.1.2.2 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.

8.3.3.1.2.3 Use of Pump Discharge via Bypass Flowmeter to Pump Suction (Closed-Loop Metering). Pump suction and discharge pressures and the flowmeter measurements shall determine the total pump output.

8.3.3.1.3 Where the annual test is conducted periodically in accordance with 8.3.3.1.2.3, a test shall be conducted every 3 years in accordance with 8.3.3.1.2.1 or 8.3.3.1.2.2 in lieu of the method described in 8.3.3.1.2.3.

8.3.3.1.4 Where 8.3.3.1.2.2 or 8.3.3.1.2.3 is used, the flowmeter shall be adjusted immediately prior to conducting the test in accordance with the manufacturer's instructions.

8.3.3.1.4.1 If the test results are not consistent with the previous annual test, 8.3.3.1.2.1 shall be used.

8.3.3.1.4.2 If testing in accordance with 8.3.3.1.2.1 is not possible, a flowmeter calibration shall be performed and the test shall be repeated.

8.3.3.2 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) as follows:
  (a) Check the circulation relief valve for operation to discharge water
  (b) Check the pressure relief valve (if installed) for proper operation
(2) At each flow condition as follows:
  (a) Record the electric motor voltage and current (all lines)
  (b) Record the pump speed in rpm
  (c) Record the simultaneous (approximately) readings of pump suction and discharge pressures and pump discharge flow
(3) For electric motor–driven pumps, the pump shall not be shut down until the pump has run for 10 minutes.
(4) For diesel motor–driven pumps, the pump shall not be shut down until the pump has run for 30 minutes.

8.3.3.3* 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.

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

8.3.3.3.2 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.

8.3.3.4 For installations having an automatic transfer switch, the following test shall be performed to ensure that the overcurrent 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) Verify that the pump continues to perform at peak load
(4) Remove the power failure condition and verify that, after a time delay, the pump is reconnected to the normal power source

8.3.3.5* Alarm conditions shall be simulated by activating alarm circuits at alarm sensor locations, and all such local or remote alarm indicating devices (visual and audible) shall be observed for operation.

8.3.3.6* Safety. Section 4.8 shall be followed for safety requirements while working near electric motor–driven fire pumps.

8.3.3.7* 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.

8.3.3.8* 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 Other Tests.

8.3.4.1 Engine generator sets supplying emergency or standby power to fire pump assemblies shall be tested routinely in accordance with NFPA 110, *Standard for Emergency and Standby Power Systems.*

8.3.4.2 Automatic transfer switches shall be tested routinely and exercised in accordance with NFPA 110, *Standard for Emergency and Standby Power Systems.*

8.3.4.3 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.

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

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Full document details: NFPA 25 2011

8.3.5 Test Results and Evaluation.

8.3.5.1* Interpretation.

8.3.5.1.1 The interpretation of the test results shall be the basis for determining performance of the pump assembly.

8.3.5.1.2 Qualified individuals shall interpret the test results.

8.3.5.2 Engine Speed.

8.3.5.2.1 Theoretical factors for correction to the rated speed shall be applied where determining the compliance of the pump per the test.

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

8.3.5.3 The fire pump assembly shall be considered acceptable if either of the following conditions is shown during the test:

(1)*The test is no less than 95 percent of the pressure at rated flow and rated speed of the initial unadjusted field acceptance test curve, provided that the original acceptance test curve matches the original certified pump curve by using theoretical factors.

(2) The fire pump is no less than 95 percent of the performance characteristics as indicated on the pump nameplate.

8.3.5.4* Degradation in excess of 5 percent of the pressure of the initial unadjusted acceptance test curve or nameplate shall require an investigation to reveal the cause of degraded performance.

8.3.5.5 Current and voltage readings whose product does not exceed the product of the rated voltage and rated full-load current multiplied by the permitted motor service factor shall be considered acceptable.

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

8.3.5.7 The pump performance shall be evaluated using the unadjusted flow rates and pressures to ensure the pump can supply the system demand as supplied by the owner.

8.4 Reports.

8.4.1 Any abnormality observed during inspection or testing shall be reported promptly to the property owner or designated representative.

8.4.2* Test results shall be recorded and retained for comparison purposes in accordance with Section 4.3.

8.4.3 All time delay intervals associated with the pump's starting, stopping, and energy source transfer shall be recorded.

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.

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, *Standard for the Installation of Stationary Pumps for Fire Protection*, shall be consulted for the minimum requirements for design and installation, including acceptance testing and component replacement.

Table 8.6.1 Summary of Component Replacement Testing Requirements

Component	Adjust	Repair	Rebuild	Replace	Test Criteria
Fire Pump System					
Entire pump assembly				X	Perform acceptance test in accordance with NFPA 20, *Standard for the Installation of Stationary Pumps for Fire Protection*
Impeller/rotating assembly		X		X	Perform acceptance test in accordance with NFPA 20
Casing		X		X	Perform acceptance test in accordance with NFPA 20
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 8.3.2
Electrical System/Controller					
Entire controller		X	X	X	Perform acceptance test in accordance with NFPA 20
Isolating switch				X	Perform test in accordance with 8.3.2 and exercise six times

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Full document details: NFPA 25 2011

Table 8.6.1 *Continued*

Component	Adjust	Repair	Rebuild	Replace	Test Criteria
Circuit breaker	X				Perform six momentary starts in accordance with NFPA 20
Circuit breaker				X	Perform a 1-hour full-load current test
Electrical connections	X				Perform test in accordance with 8.3.2
Main contactor			X		Perform test in accordance with 8.3.2
Main contactor				X	Perform acceptance test in accordance with NFPA 20
Power monitor				X	Perform test in accordance with 8.3.2
Start relay				X	Perform test in accordance with 8.3.2
Pressure switch	X			X	Perform test in accordance with 8.3.2 and exercise six times automatically
Pressure transducer	X			X	Perform acceptance test in accordance with NFPA 20
Manual start or stop switch				X	Perform six operations under load
Transfer switch — load carrying parts		X	X	X	Perform a 1-hour full-load current test, and transfer from normal power to emergency power and back one time
Transfer switch — non-load parts		X	X	X	Perform si x no-load operations of transfer of power
Electric Motor Driver					
Electric motor		X	X	X	Perform acceptance test in accordance with NFPA 20
Motor bearings				X	Perform annual test in accordance with 8.3.3
Incoming power conductors				X	Perform a 1-hour full-load current test
Diesel Engine Driver					
Entire engine			X	X	Perform acceptance test in accordance with NFPA 20
Fuel transfer pump	X		X	X	Perform test in accordance with 8.3.2
Fuel injector pump	X			X	Perform test in accordance with 8.3.2
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 8.3.2
Batteries		X		X	Perform a start/stop sequence in accordance with NFPA 25
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 annual 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					
Base plate		X		X	Perform test in accordance with 8.3.2 with alignment check
Foundation		X	X	X	Perform test in accordance with 8.3.2 with alignment check
Suction/discharge pipe		X		X	Perform visual inspection in accordance with 8.3.3.7
Suction/discharge fittings		X		X	Perform visual inspection in accordance with 8.3.3.7
Suction/discharge valves		X	X	X	Perform operational test in accordance with 13.3.3.1

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Full document details: NFPA 25 2011

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 Valves and Connections. Valves and fire department connections 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.

9.1.5* Notification to Supervisory Service. To avoid false alarms where a supervisory service is provided, the alarm receiving facility always shall be notified by the property owner or designated representative as follows:

(1) Before conducting any test or procedure that could result in the activation of an alarm
(2) After such tests or procedures are concluded

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

Item	Frequency	Reference
Inspection		
Water temperature — low temperature alarms connected to constantly attended location	Monthly	9.2.4.2
Water temperature — low temperature alarms not connected to constantly attended location	Weekly	9.2.4.3
Heating system — tanks with supervised low temperature alarm connected to constantly attended location	Weekly*	9.2.3.1
Heating system — tanks without supervised low temperature alarm connected to constantly attended location	Daily*	9.2.3.2
Control valves		Table 13.1
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
Air pressure — tanks that have their air pressure source supervised	Quarterly	9.2.2.1
Air pressure — tanks without their air pressure source supervised	Monthly	9.2.2.2
Tank — exterior	Quarterly	9.2.5.1
Support structure	Quarterly	9.2.5.1
Catwalks and ladders	Quarterly	9.2.5.1
Surrounding area	Quarterly	9.2.5.2
Hoops and grillage	Annually	9.2.5.4
Painted/coated surfaces	Annually	9.2.5.5
Expansion joints	Annually	9.2.5.3
Interior — tanks without corrosion protection	3 years	9.2.6.1.1
Interior — all other tanks	5 years	9.2.6.1.2
Temperature alarms — connected to constantly attended location	Monthly*	9.2.4.2
Temperature alarms — not connected to constantly attended location	Weekly*	9.2.4.3
Check valves		Table 13.1
Test		
Tank heating system	Prior to heating season	9.3.2
Low water temperature alarms	Monthly*	9.3.3
High temperature limit switches	Monthly*	9.3.4
Water level alarms	Semiannually	9.3.5
Level indicators	5 years	9.3.1
Pressure gauges	5 years	9.3.6
Maintenance		
Water level	—	9.4.2
Control valves	—	Table 13.1
Embankment-supported coated fabric (ESCF)	—	9.4.6
Check valves	—	13.4.2.2

*Cold weather/heating season only.

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9.2 Inspection.

9.2.1 Water Level.

9.2.1.1* Tanks equipped with supervised water level alarms that are connected to a constantly attended location shall be inspected quarterly.

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

9.2.2 Air Pressure.

9.2.2.1 Pressure tanks that have their air pressure source supervised in accordance with *NFPA 72, National Fire Alarm and Signaling Code*, shall be inspected quarterly.

9.2.2.2 The air pressure in pressure tanks with a nonsupervised air pressure source shall be inspected monthly.

9.2.3 Heating System.

9.2.3.1 Tank heating systems installed on tanks equipped with a supervised low water temperature alarm that are connected to a constantly attended location shall be inspected weekly.

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

9.2.4 Water Temperature.

9.2.4.1 The temperature of water tanks shall not be less than 40°F (4.4°C).

9.2.4.2 The temperature of water in tanks with low temperature alarms connected to a constantly attended location shall be inspected and recorded monthly during the heating season when the mean temperature is less than 40°F (4.4°C).

9.2.4.3 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 (4.4°C).

9.2.5 Exterior Inspection.

9.2.5.1* 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.

9.2.5.2 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.

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

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

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

9.2.6 Interior Inspection.

9.2.6.1 Frequency.

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

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

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

9.2.6.3 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.

9.2.6.4 Steel tanks exhibiting signs of interior pitting, corrosion, or failure of coating shall be tested in accordance with 9.2.7.

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

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

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

9.2.7 Tests During Interior Inspection. Where a drained interior inspection of a steel tank is required by 9.2.6.4, the following tests shall be conducted:

(1) Evaluation of tank coatings shall be made in accordance with the adhesion test of ASTM D 3359, *Standard Test Methods for Measuring 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, *Standard for Water Tanks for Private Fire Protection*.

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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 alarms, where provided, shall be tested monthly (cold weather only).

9.3.4* High water temperature limit switches on tank heating systems, where provided, shall be tested monthly whenever the heating system is in service.

9.3.5* High and low water level alarms shall be tested semiannually.

9.3.6 Pressure Gauges.

9.3.6.1 Pressure gauges shall be tested every 5 years with a calibrated gauge in accordance with the manufacturer's instructions.

9.3.6.2 Gauges not accurate to within 3 percent of the scale of the gauge being tested shall be recalibrated or replaced.

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 windstorm 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 weekly to ensure that the OS&Y isolation valves are in the normal open position in accordance with Table 9.5.1.1.

Table 9.5.1.1 Summary of Automatic Tank Fill Valve Inspection and Testing

Item	Frequency	Reference
Inspection		
Strainers, filters, orifices (inspect/clean)	Quarterly	13.4.1.2
Enclosure (during cold weather)	Daily/weekly	13.4.3.1.1
Exterior	Monthly	13.4.3.1.6
Interior	Annually/5 years	13.4.3.1.7
Test		
Automatic tank fill valve	Annually	

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

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 A main drain test shall be required if the system control or other upstream valve was operated in accordance with 13.3.3.4.

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

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Full document details: NFPA 25 2011

Table 9.6.1 Summary of Component Replacement Action Requirements

Component	Adjust	Repair/ Recondition	Replace	Test Criteria
Tank Components				
Tank interior		X	X	Remove debris Verify integrity in conformance with NFPA 22, *Standard for Water Tanks for Private Fire Protection*
Tank exterior		X	X	Verify integrity in conformance with NFPA 22
Support structure		X	X	Verify integrity in conformance with NFPA 22
Heating system	X	X	X	Verify heating system is in conformance with NFPA 22
Catwalks and ladders	X	X	X	Verify integrity in conformance with NFPA 22
Hoops and grillage	X	X	X	Verify integrity in conformance with NFPA 22
Expansion joints	X	X	X	Verify integrity in conformance with NFPA 22
Overflow piping	X	X	X	Verify integrity in conformance with NFPA 22
Insulation		X	X	Verify integrity in conformance with NFPA 22
Valves				See Chapter 13
Alarm and Supervisory Components				
High and low water level	X	X	X	Operational test for conformance with NFPA 22 and/or *NFPA 72, National Fire Alarm and Signaling Code*, and the design water levels
Water temperature	X	X	X	Operational test for conformance with NFPA 22 and/or *NFPA 72*
Enclosure temperature	X	X	X	Operational test for conformance with NFPA 22 and/or *NFPA 72*
Valve supervision	X	X	X	Operational test for conformance with NFPA 22 and/or *NFPA 72*
Fill and Discharge Components				
Automatic fill valves				See Chapter 13
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

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

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	Weekly (sealed)	Chapter 13
Control valves	Monthly (locked, supervised)	Chapter 13
Deluge valve		10.2.2, Chapter 13
Detection systems		*NFPA 72, National Fire Alarm and Signaling Code*
Detector check valves		Chapter 13
Drainage	Quarterly	10.2.8
Electric motor		10.2.9, Chapter 8
Engine drive		10.2.9, Chapter 8
Fire pump		10.2.9, Chapter 8
Fittings	Quarterly	10.2.4, 10.2.4.1
Fittings (rubber-gasketed)	Quarterly	10.2.4.1, A.10.2.4.1
Gravity tanks		10.2.10, Chapter 9
Hangers	Annually and after each system activation	10.2.4.2
Heat (deluge valve house)	Daily/weekly	10.2.1.5, Chapter 13
Nozzles	Annually and after each system activation	10.2.1.1, 10.2.1.2, 10.2.1.6, 10.2.5.1, 10.2.5.2
Pipe	Annually and after each system activation	10.2.1.1, 10.2.1.2, 10.2.4, 10.2.4.1
Pressure tank		10.2.10, Chapter 9
Steam driver		10.2.9, Chapter 8
Strainers	Manufacturer's instruction	10.2.7
Suction tanks		10.2.10, Chapter 9
Supports	Quarterly	10.2.1.1, 10.2.1.2, 10.2.4.2
Water supply piping		10.2.6.1, 10.2.6.2
UHSWSS — detectors	Monthly	10.4.2
UHSWSS — controllers	Each shift	10.4.3
UHSWSS — valves	Each shift	10.4.4
Operational Test		
Backflow preventer		Chapter 13
Check valves		Chapter 13
Control valves	Annually	13.3.3.1
Deluge valve		10.2.2, Chapter 13
Detection systems		*NFPA 72*
Detector check valve		Chapter 13
Electric motor		10.2.9, Chapter 8
Engine drive		10.2.9, Chapter 8
Fire pump		10.2.9, Chapter 8
Flushing	Annually	10.2.1.3, Section 10.3 (flushing of connection to riser, part of annual test)
Gravity tanks		10.2.10, Chapter 9
Main drain test	Annually	13.3.3.4
Manual release	Annually	10.2.1.3, 10.3.6
Nozzles	Annually	10.2.1.3, 10.2.1.6, Section 10.3
Pressure tank		Section 10.2, Chapter 9
Steam driver		10.2.9, Chapter 8
Strainers	Annually	10.2.1.3, 10.2.1.7, 10.2.7
Suction tanks		10.2.10, Chapter 9
Waterflow alarm	Quarterly	Chapter 5
Water spray system test	Annually	Section 10.3, Chapter 13
Water supply flow test		7.3.1
UHSWSS	Annually	Section 10.4

Documents
Document Sharing Hub
Full document details: NFPA 25 2011

Table 10.1.1.2 *Continued*

Item	Frequency	Reference
Maintenance		
Backflow preventer		Chapter 13
Check valves		Chapter 13
Control valves	Annually	10.2.1.4, Chapter 13
Deluge valve		10.2.2, Chapter 13
Detection systems		*NFPA 72*
Detector check valve		Chapter 13
Electric motor		10.2.9, Chapter 8
Engine drive		10.2.9, Chapter 8
Fire pump		10.2.9, Chapter 8
Gravity tanks		10.2.10, Chapter 9
Pressure tank		10.2.6, Chapter 9
Steam driver		10.2.9, Chapter 8
Strainers	Annually	10.2.1.4, 10.2.1.6, 10.2.7
Strainers (baskets/screen)	5 years	10.2.1.4, 10.2.1.7, A.10.2.7
Suction tanks		10.2.10, Chapter 9
Water spray system	Annually	10.2.1.4, Chapter 13

10.1.3* NFPA 15, *Standard for Water Spray Fixed Systems for Fire Protection*, 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 Valves and Connections. Valves and fire department connections 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 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 10.2.4.1, 10.2.4.2, and 10.2.5.1.

10.2.1.3 Items in areas that are inaccessible for safety considerations shall be tested at longer intervals in accordance with 13.4.3.2.2.3.

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 Automatic Detection Equipment.

10.2.3.1 Automatic detection equipment shall be inspected, tested, and maintained in accordance with *NFPA 72*, *National Fire Alarm and Signaling Code*.

10.2.3.2 Automatic fire detection equipment not covered by *NFPA 72*, *National Fire Alarm and Signaling Code*, shall be inspected, tested, and maintained to ensure that the detectors are in place, securely fastened, and protected from corrosion, weather, and mechanical damage and that the communication wiring, control panels, or tubing system is functional.

10.2.4* 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 waterflow and design pressure.

10.2.4.1* 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) Low-point drains (automatic or manual)
(5) Location of rubber-gasketed fittings

10.2.4.2* Hangers and Supports. Hangers 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

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10.2.5* Water Spray Nozzles.

10.2.5.1 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 in the system design, and are free from external loading and corrosion.

10.2.5.2 Where caps or plugs are required, the inspection shall confirm they are in place and free to operate as intended.

10.2.5.3 Misaligned water spray nozzles shall be adjusted (aimed) by visual means, and the discharge patterns shall be checked at the next scheduled flow test.

10.2.6 Water Supply.

10.2.6.1 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.

10.2.6.2* Water supply piping shall be maintained free of internal obstructions.

10.2.7* Strainers.

10.2.7.1 Mainline strainers (basket or screen) shall be flushed until clear after each operation or flow test.

10.2.7.2 Individual water spray nozzle strainers shall be removed, cleaned, and inspected after each operation or flow test.

10.2.7.3 All strainers shall be inspected and cleaned in accordance with the manufacturer's instructions.

10.2.7.4 Damaged or corroded parts shall be replaced or repaired.

10.2.8 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.

10.2.9 Fire Pumps. Chapter 8 shall be followed for inspection and maintenance requirements.

10.2.10 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 Notification.

10.3.2.1 To avoid false alarms where a supervisory service is provided, the alarm receiving facility always shall be notified by the property owner or designated representative as follows:

(1) Before conducting any test or procedure that could result in the actuation of an alarm
(2) After such tests or procedures are concluded

10.3.2.2 All personnel whose operations could be affected by the system operation shall be notified.

10.3.3* Test Preparation. Precautions shall be taken to prevent damage to property during the test.

10.3.4 Operational Test Performance. Operational tests shall be conducted to ensure that the water spray fixed systems respond as designed, both automatically and manually.

10.3.4.1* Response Time.

10.3.4.1.1 Under test conditions, the heat detection systems, where exposed to a heat test source, shall operate within 40 seconds.

10.3.4.1.2 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.

10.3.4.1.3 These response times shall be recorded.

10.3.4.2 Discharge Time. The time lapse between operation of detection systems and water delivery time to the protected area shall be recorded.

10.3.4.3* Discharge Patterns.

10.3.4.3.1* 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.

10.3.4.3.1.1 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.

10.3.4.3.2 Where obstructions occur, the piping and nozzles shall be cleaned and the system retested.

10.3.4.4 Pressure Readings.

10.3.4.4.1 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.

10.3.4.4.2 A second pressure reading shall be recorded at the deluge valve to ensure the water supply is adequate.

10.3.4.4.3 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.

10.3.4.4.3.1 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.

10.3.4.4.3.2 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.

10.3.5 Multiple Systems. The maximum number of systems expected to operate in case of fire shall be tested simultaneously to check the adequacy of the water supply.

10.3.6 Manual Operation. Manual actuation devices shall be operated annually.

10.3.7 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.

10.3.7.1 Main Drain Tests.

10.3.7.1.1 Main drain tests shall be conducted at the main riser to determine whether there has been any change in the condition of the water supply piping and controlling valves.

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Full document details: NFPA 25 2011

10.3.7.1.2 Static and residual water pressures shall be recorded respectively before, during, and after the operation of the fully opened drain valve.

10.3.7.1.3 Readings shall be compared with those made at the time of the original acceptance tests or with those made at the time of the last test to determine whether there has been any deterioration of the water supply.

10.3.7.2 Low Point Drains.

10.3.7.2.1 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.

10.3.7.2.2 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.

Table 10.5.1 Summary of Component Replacement Action Requirements

Component	Adjust	Repair/ Recondition	Replace	Required Action
Water Delivery Components				
Pipe and fittings	X	X	X	Operational flow test
Nozzles	X	X	X	Operational flow test
Manual release	X	X	X	(1) Operational test (2) Check for leaks at system working pressure (3) Test all alarms
Fire department connections				See Chapter 13
Valves	X	X	X	See Chapter 13
Fire pump	X	X	X	See Chapter 8
Alarm and Supervisory Components				
Pressure switch–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
Valve supervisory device	X	X	X	Test for conformance with NFPA 15, *Standard for Water Spray Fixed Systems for Fire Protection*, and/or *NFPA 72, National Fire Alarm and Signaling Code*
Detection system	X	X	X	Operational test for conformance with NFPA 15 and/or NFPA 72
Status-Indicating Components				
Gauges			X	Verify at 0 psi (0 bar) and system working pressure
Testing and Maintenance Components				
Main drain	X	X	X	Full flow main drain test
Auxiliary drains	X	X	X	(1) Check for leaks at system working pressure (2) Main drain test
Structural Components				
Hanger/seismic bracing	X	X	X	Check for conformance with NFPA 15 and/or NFPA 13, *Standard for the Installation of Sprinkler Systems*
Pipe stands	X	X	X	Check for conformance with NFPA 15 and/or NFPA 13
Informational Components				
Identification signs	X	X	X	Check for conformance with NFPA 15

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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 A main drain test shall be required if the system control or other upstream valve was operated in accordance with 13.3.3.4.

10.5.4 The actions of 10.5.1 shall not require a design review, which is outside the scope of this standard.

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 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 Fire pumps, water storage tanks, 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 Systems.

11.1.3.1 This section shall apply to foam-water systems as specified in NFPA 16, *Standard for the Installation of Foam-Water Sprinkler and Foam-Water Spray Systems.*

11.1.3.2 This section shall not include systems detailed in NFPA 11, *Standard for Low-, Medium-, and High-Expansion Foam.*

Table 11.1.1.2 Summary of Foam-Water Sprinkler System Inspection, Testing, and Maintenance

System/Component	Frequency	Reference
Inspection		
Discharge device location (sprinkler)	Annually	11.2.5
Discharge device location (spray nozzle)	Monthly	11.2.5
Discharge device position (sprinkler)	Annually	11.2.5
Discharge device position (spray nozzle)	Monthly	11.2.5
Foam concentrate strainer(s)	Quarterly	11.2.7.2
Drainage in system area	Quarterly	11.2.8
Proportioning system(s) — all	Monthly	11.2.9
Pipe corrosion	Annually	11.2.3
Pipe damage	Annually	11.2.3
Fittings corrosion	Annually	11.2.3
Fittings damage	Annually	11.2.3
Hangers/supports	Annually	11.2.4
Waterflow devices	Quarterly	11.2.1
Water supply tank(s)		Chapter 9
Fire pump(s)		Chapter 8
Water supply piping		11.2.6.1
Control valve(s)	Weekly/monthly	—
Deluge/preaction valve(s)		11.2.1, Chapter 13
Detection system	See *NFPA 72, National Fire Alarm and Signaling Code*	11.2.2
Test		
Discharge device location	Annually	11.3.2.6
Discharge device position	Annually	11.3.2.6
Discharge device obstruction	Annually	11.3.2.6
Foam concentrate strainer(s)	Annually	11.2.7.2
Proportioning system(s) — all	Annually	11.2.9
Complete foam-water system(s)	Annually	11.3.3
Foam-water solution	Annually	11.3.5
Manual actuation device(s)	Annually	11.3.4
Backflow preventer(s)	Annually	Chapter 13
Fire pump(s)	See Chapter 8	—
Waterflow devices	Quarterly/semiannually	11.3.1.3
Water supply piping	Annually	Chapter 10
Control valve(s)	See Chapter 13	—
Strainer(s) — mainline	See Chapter 10	11.2.7.1
Deluge/preaction valve(s)	See Chapter 13	11.2.1
Detection system	See *NFPA 72*	11.2.2
Backflow preventer(s)	See Chapter 13	—
Water supply tank(s)	See Chapter 9	—
Water supply flow test	5 years	7.3.1

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Full document details: NFPA 25 2011

Table 11.1.1.2 *Continued*

System/Component	Frequency	Reference
Maintenance		
Foam concentrate pump operation	Monthly	11.4.6.1, 11.4.7.1
Foam concentrate strainer(s)	Quarterly	Section 11.4
Foam concentrate samples	Annually	11.2.10
Proportioning system(s) standard pressure type		
Ball drip (automatic type) drain valves	5 years	11.4.3.1
Foam concentrate tank — drain and flush	10 years	11.4.3.2
Corrosion and hydrostatic test	10 years	11.4.3.3
Bladder tank type		
Sight glass	10 years	11.4.4.1
Foam concentrate tank — hydrostatic test	10 years	11.4.4.2
Line type		
Foam concentrate tank — corrosion and pickup pipes	10 years	11.4.5.1
Foam concentrate tank — drain and flush	10 years	11.4.5.2
Standard balanced pressure type		
Foam concentrate pump(s)	5 years *(see Note)*	11.4.6.2
Balancing valve diaphragm	5 years	11.4.6.3
Foam concentrate tank	10 years	11.4.6.4
In-line balanced pressure type		
Foam concentrate pump(s)	5 years *(see Note)*	11.4.7.2
Balancing valve diaphragm	5 years	11.4.7.3
Foam concentrate tank	10 years	11.4.7.4
Pressure vacuum vents	5 years	11.4.8
Water supply tank(s)	See Chapter 9	—
Fire pump(s)	See Chapter 8	—
Water supply	Annually	11.2.6.1
Backflow preventer(s)	See Chapter 13	—
Detector check valve(s)	See Chapter 13	—
Check valve(s)	See Chapter 13	—
Control valve(s)	See Chapter 13	—
Deluge/preaction valves	See Chapter 13	11.2.1
Strainer(s) — mainline	See Chapter 10	—
Detection system	See *NFPA 72*	11.2.2

Note: 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 systems in aircraft hangars, refer to the inspection, test, and maintenance requirements of NFPA 409, *Standard on Aircraft Hangars*, Table 11.1.1.

11.1.4 Foam-Water System.

11.1.4.1 If during routine inspection and testing the foam-water system is determined to have been altered or changed (e.g., equipment replaced, relocated, or foam concentrate replaced), it shall be determined whether the design intent has been altered and whether the system operates properly.

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

11.1.4.1.2 Valve-type and pressure switch–type waterflow devices shall be tested semiannually.

11.1.4.1.3 Waterflow Devices. Waterflow devices shall be inspected quarterly to verify that they are free of physical damage.

11.1.4.2 The inspection shall verify that all components, including foam concentrate discharge devices and proportioning equipment, are installed in accordance with their listing.

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.

11.1.7 Notification to Supervisory Service. To avoid false alarms where a supervisory service is provided, the alarm receiving facility shall be notified by the property owner or designated representative as follows:

(1) Before conducting any test or procedure that could result in the activation of an alarm
(2) After such tests or procedures are concluded

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.

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