

Sprinkler System Installation


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American Fire Sprinkler Association

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AMERICAN FIRE SPRINKLER ASSOCIATION

Bob Caputo, president of the American Fire Sprinkler Association (AFSA), is chair of the NFPA 24 and NFPA 291 technical committees and a member of multiple NFPA technical committees, including NFPA 13 and NFPA 25. Caputo is a contributor of the NFPA 13 and NFPA 25 Handbooks, and the NFPA Inspection Manual. A senior member of NFPA and AFSA faculties, Caputo has written and presented seminars worldwide on fire protection and life safety systems and is a regular speaker at AFSA and NFPA conventions. Caputo is an instructor at the National Fire Academy and an advisory board member at Oklahoma State University School of Fire Protection Engineering & Safety. Caputo's industry distinctions include "Fire Prevention Officer of the Year" from San Diego County in 1994, "Man of the Year" from Fire Protection Contractor magazine in 1997, and the Henry S. Parmelee award from AFSA in 2017. Caputo attended the University of Albuquerque, New Mexico, and is a U.S. Navy veteran and former volunteer firefighter.

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**IT'S A BIG WORLD.
LET'S PROTECT IT TOGETHER.**

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Introduction – Introduce Yourself

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- Name
- Company
- Title
- Experience in the industry
- Something specific you are looking to take away from the next 3-days



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Housekeeping Items

5



- Emergency Exits
- Bathrooms
- Breaks

5



History

NFPA 13



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Major Changes

- 60 revisions
- 1991-Reorganization
 - "User Friendly"
 - Update 1994 definitions
- 1996- Application, placement, location, spacing, and various types of sprinklers

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Major Changes

- 1999-Reorganization
 - Correlating Committee Founded
 - Four Technical Committees
 - Storage Req'ts Added
- Additional revisions in 2002 and 2007

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2010 Changes

- Incorporation of "Manual of Style":
 - Eliminations of exceptions
 - Mandatory reference moved to Chapter 2
 - Definitions moved to Chapter 3
- Additional chapters to consolidate
- Storage revised

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2013 Changes

- Chapter 16 and 17 reorganized
- New chapter- Alternative Approaches for Storage Designs



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2016 Changes

- Redundancies per sprinkler type
- Clarifying storage differences
- Discharge committee redundancy task force

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Reason For Change



- No logical order
- Hard to follow
- Inconsistent redundancy
- Streamlining
- Consistent chapter layout
- Chapter 8....

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2016-2019 Restructure

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	2016	2019
Basic Requirements	8.1	9.1
System Protection Area Limitations	8.2	4.5
Use of Sprinklers	8.3	9.4
Application of Sprinkler Types	8.4	10, 11, & 14
Position, Location, Spacing and Use	8.5	9.5
Standard Spray URs and Pendants	8.6	10
Standard Spray Sidewall Sprinklers	8.7	10
EC URs and Pendant	8.8	11
EC Sidewalls	8.9	11

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2016-2019 Restructure

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	2016	2019
Residential Sprinklers	8.10	12
CMSA Sprinklers	8.11	13
ESFR Sprinklers	8.12	14
In-Rack Sprinklers	8.13	25
Pilot Line Detectors	8.14	8.1
Special Situations	8.15	9.2
Piping Installations	8.16	16
System Attachments	8.17	16
Electrical Bonding and Grounding	8.18	16

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The “Road Map”

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2016–2019 Roadmap

This roadmap has been compiled to assist users familiar with the 2016 edition of the Standard for the Installation of Sprinkler Systems with locating material in the 2019 edition. It is provided for information only and should not be relied upon as the only means of determining the disposition of requirements.

An asterisk on a section number indicates that there is explanatory material for that section in Annex A. While annex sections are not included in this table, all related annex sections have been moved with the parent paragraph.

2016 Edition Section Numbers	2019 Edition Section Numbers	2016 Edition Section Numbers	2019 Edition Section Numbers	2016 Edition Section Numbers	2019 Edition Section Numbers
Chapter 1	Chapter 1	3.3.5	3.3.26	3.5.6	3.3.68
Administration	Administration	3.3.5.1	3.3.33	3.5.7	3.3.72
1.1*	1.1*	3.3.5.2	3.3.26.3	3.5.8	3.3.78
1.1.1	1.1.1	3.3.5.3	3.3.26.2	3.5.9	3.3.180
1.1.2	1.1.2	3.3.5.4	3.3.26.3	3.5.10	3.3.180
1.1.3*	1.1.3*	3.3.5.5	3.3.26.4	3.5.11	3.3.205
1.2	1.2	3.6	3.3.39	3.5.12	3.3.213
1.2.1	1.2.1	3.3.7*	3.3.46*	3.5.13	3.3.215
1.2.2	1.2.2	3.3.8*	3.3.52*	3.5.14	3.3.225
1.3	1.3	3.3.9	3.3.58	3.6	3.3.205

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Pipe, Fittings, System Components, System Types

16

Chapter 5 – Water Supplies

Chapter 6 – Installation Underground Piping

Chapter 7 – Requirements for System Components and Hardware

Chapter 8 – System Types and Requirements



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Sprinklers Installation Requirements

17

Chapter 9 – Sprinkler Location Requirements

Chapter 10 – Standard Spray Uprights, Pendants, Sidewalls

Chapter 11 – Extended Coverage Uprights, Pendants, Sidewalls

Chapter 12 – Residential Sprinklers

Chapter 13 – CMSA Sprinklers

Chapter 14 – ESFR Sprinklers

Chapter 15 – Special Sprinklers



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Installation of Piping, Valves, and Appurtenances

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Chapter 16

- Basic Requirements
- Sprinkler Installation
- Piping Installation
- Protection of Piping
- Protection of Risers Subject to Mechanical Damage
- Provision for Flushing Systems
- Air Venting
- Fitting Installation

- Valves
- Drainage
- System Attachments
- Fire Department Connections
- Gauges
- System Connections
- Hose Connections
- Electrical Bonding and Grounding
- Signs

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Hanging and Bracing

Chapter 17

- Hanging and Support



Photo Credit: EATON

Chapter 18

- Seismic Protection *(if required)*

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Design and Discharge

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Chapter 19 – Design Approaches

Storage Chapters

- **Chapter 20** – General Requirements for Storage
- **Chapter 21** - CMDA
- **Chapter 22** – CMSA
- **Chapter 23** – ESFR
- **Chapter 24** – Alternative Designs
- **Chapter 25** – In-rack Sprinklers

Chapter 26 – Special Occupancies

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Hydraulic Calculations

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Chapter 27 – Plans and Calculations

- Working Plans
- Hydraulic Calculation Procedures
- Hose Allowance
- Hydraulic Calculation Forms
- Pipe Schedules

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System Acceptance

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Chapter 28

- Approval of Sprinkler Systems
- Acceptance Test Requirements
- Automated Inspection and Testing Devices and Equipment
- Instructions
- Hydraulic Data Nameplate
- General Information Sign



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Existing System Modifications

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Chapter 29

- Added for the 2019 edition
- Consolidates requirements for existing systems in one place
- In theory...
- Not "all inclusive"



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Marine Systems

24

Chapter 30

- Marine apparatus



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Inspection, Testing, and Maintenance

25

Chapter 31

- Refers the user to NFPA 25

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Annex & Index

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- Annex A – Explanatory Material (*Typical*)
- Annex B – Miscellaneous Topics
- Annex C – Explanation of Test Data and Procedures for Rack Storage
- Annex D – Sprinkler System Information from the 2018 Edition of the Life Safety Code
- Annex E – Development of the Design Approach to Conform with ASCE/SEI 7 and Suggested Conversion Factor Adjustments for Locations Outside the United States
- Annex F – Informational References
- Index



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Standards Development Process

National Fire Protection Association



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Standards Development

NFPA

- Updated: 3-5 yrs.
- About 8,800 volunteers
- About 260 Technical Committees
- Balanced interests

AFSA

- 44 Technical Committees
- 38 documents
- 91 seats (principal/alternate)
- Representing members

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Development Process

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How Can I Get Involved?

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NFPA 13 Subcommittees

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Correlating Committee (AUT-AAC)

Hanging and Bracing (AUT-HBS)

- Chapter 3- Definitions
- Chapter 17- Hanging and Support of System Piping
- Chapter 18- Seismic

Private Water Supply Piping (AUT-PRI)

- NFPA 291
- NFPA 24
- Chapter 3- Definitions
- Chapter 6- Underground Piping

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Discharge Criteria (AUT-SSD)

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Chapter	Topic
3	Definitions
4	General Requirements
5	Water Supplies
19	Design Approaches
20	General Requirements for Storage
21	Protection of High-Piled Storage Using CMSA Sprinklers
22	CMSA Requirements for Storage Applications
23	ESFR Requirements for Storage Applications
24	Alternative Sprinkler System Designs
25	Protection of Rack Storage Using In-Rack Sprinklers
26	Special Occupancy Requirements
27	Plans and Calculations
28	Existing System Modifications

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Installation Criteria (AUT-SSI)

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Chapter	Topic
1	Administrations
2	Referenced Publications
3	Definitions
10	Req'ts for Standard Pendent, Upright, and Sidewall Spray Sprinklers
11	Req'ts for EC Upright, Pendent, and Sidewall Spray Sprinklers
12	Req'ts for Residential Sprinklers
13	Req'ts for CMSA Sprinklers
14	Req'ts for ESFR Sprinklers
15	Req'ts for Special Sprinklers
16	Installation of Piping, Valves, and Appurtenances
29	Existing System Modifications
30	Marine Systems
Annex F	Informational References

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NFPA 13 General Changes

2022 Edition




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Definition Ownership

- Acronym following definitions
 - AUT-AAC
 - AUT-PRI
 - AUT-SSD
 - AUT-SSI

Example:
3.3.8.1 Closed Array. A storage arrangement where air movement through the pile is restricted because of 6 in. (150 mm) or less vertical flues. (AUT-SSD)




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Correlating Committee

AUT-AAC



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Protecting Pipe Against Freezing

The weather temperature used to determine if an unheated portion of a system is subject to freezing and required to be protected in accordance with 16.4.1.1 shall be the lowest mean temperature for one day, obtained from an approved source.

NFPA 13-2022/ 16.4.1.1.1

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Hanging and Bracing

AUT-HBS



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Building Height

For the purposes of seismic protection, the vertical distance from the grade plane to the average elevation of the highest roof surface. (AUT-HBS)




NFPA 13-2022/ 3.3.21

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No Major Changes

AUT-PRI




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Discharge Criteria

AUT-SSD



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Single Point Densities for New Systems

NFPA 13-2022/ Table 19.2.3.1.1

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Single Point Densities for Existing Systems

NFPA 13-2022/ Figure 19.2.3.1.1

43

CMDA Single Point Densities

- Curves still exist for existing systems
- Adjustments for single point densities throughout Chapter 21

NFPA 13-2022/ Table 21.2.2.2.1

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Chapter Reorganization

Topic	2019	2022
Special Designs for Storage Applications	24	26
Special Occupancies	26	27
Plans and Calculations	27	28
Systems Acceptance	28	29
Existing System Modifications	29	30
Marine Systems	30	31
System Inspection Testing and Maintenance	31	32

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Design Approach

Clarification to Section 19.1.1.

More than one design approach can be selected for a single building or system. It is the designer's discretion as to which design approaches or methods to utilize; prior approval by the authority having jurisdiction is not required.



NFPA 13-2022/ A.19.1.1

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Working Plans List

- Reorganized
- Added information

Provides comprehensive plans for:

- AHJ
- Installation Crew



NFPA 13-2022/ 28.1.3

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Working Plans

- Name, telephone number, and address of installing contractor
- Location of all fire-rated partitions, fire barriers, draft stops, and draft curtains
- Location and identification of all major structural members, and identification and labeling of construction types (i.e., obstructed or unobstructed) for each space or portion thereof in the building, as applicable
- Location and identification of spaces, regardless of combustibility, and of architectural and/or structural features not shown or easily identifiable in the floor plan or reflected ceiling plan views
- Water source(s) supply information, including the following:
 - a. Location
 - b. Type
 - c. Size
 - d. Dimensions
 - e. Capacity
 - f. Configuration
 - g. Elevation
 - h. Static pressure
 - i. Flow rate
 - j. Residual pressure
 - k. Flow test locations, dates, and sources (i.e., city or private)
 - l. Any adjustments from the raw data required by the engineer of record (i.e., owner's certificate) or the water authority, if applicable

NFPA 13-2022/ 28.1

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Installation Criteria




AUT-SSI



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Smooth Ceiling

- A continuous ceiling free from significant irregularities, lumps, or indentations greater than 4 in. (100 mm) in depth . (AUT-SSI)



NFPA 13-2022/ 3.3.28.4

50

Exterior Projection

- Construction attached to the primary structure, An extension beyond an exterior wall capable of collecting heat below. (AUT-SSI)





Photo Credit: Microsoft PowerPoint

NFPA 13-2022/ 3.3.73

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Electrically Operated Sprinkler

- A sprinkler equipped with an integral means of activation using electricity. (AUT-SSI)



Photo Credit: JCI

NFPA 13-2022/ 3.3.215.4.6

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Electrically Operated Sprinkler

Permitted when evaluated and listed under the following conditions:

- Fire tests related to the intended hazard
- Distribution of spray pattern:
 - Floor and wall wetting
 - Respect to obstructions
- Performance under horizontal and sloped ceilings
- Area of design
- Allowable clearance to ceilings



Photo Credit: JCI

NFPA 13-2022/ 15.6

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Temperature Rating Table

OLD

NEW

Table 7.2.4.1(a)

Table 7.2.4.1

Table 7.2.4.1(b)

NFPA 13-2022/ 7.2.4.1

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Ordinary or Intermediate Temperature

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NFPA 13-2022/ 9.4.2.1

55

Weld Repairs

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NFPA 13-2022/ 7.5.2.2.1

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System Air Pressure

- Low air pressure at least 5 psi above trip pressure
- High pressure 5 psi above system pressure

Notification:

- Audible at location
- FACP supervisory



Photo Credit: Viking

NFPA 13-2022/ 8.2.6.7

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Porte-cochères

- Sprinklers are required when located directly below floors intended for occupancy



NFPA 13-2022/ 9.2.3.2.1

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Bathrooms Under Stairs

- Do not require sprinklers when separated from the stairs by fire-resistive construction



NFPA 13-2022/ 9.2.4.1.1.1

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Small Temporarily Occupied Enclosures

- Do not require sprinklers when:
- Do not extend to the ceiling
- No storage
- Maximum: 24 ft²



NFPA 13-2022/ 9.3.20

60

Partitions in OH Occupancies

- Sprinkler located to the side
- Sprinkler located directly above

NFPA 13-2022/ 10.2.7.3.2.3, 10.2.7.3.2.4

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Sidewall Spray Sprinklers

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- Annex language added for car stackers
- Allowance to install sidewall sprinklers:
- Under cars in car stackers
- Cars stacked vertically placed under each level of cars

NFPA 13-2022/ 10.3.2

62

Sprinkler Obstructions in Hallways

NFPA 13-2022/ 10.3.6.1.7, 12.1.10.1.2

63

Clearance to Storage

- Rubber tire storage: 36 in.



NFPA 13-2022/10.2.8.3, 11.2.6.3

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Concealed Sprinklers in Beams

- Concealed sprinklers
- Increased from 4 in. to 14 in.-deep beam



Photo credit: Globe

NFPA 13-2022/ 12.1.8.1.2

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Upright ESFR on Branch lines

- Attached directly to branch lines ≤ 4 in. (nominal)
- Offset horizontally minimum of 12 in. from the pipe
- Supplied by a riser nipple to elevate the sprinkler 12 in. from centerline of pipe > 4 in. (nominal)



Photo credit: Viking Group Inc.

NFPA 13-2022/ 14.2.11.3.3

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Protection of Piping Subject to Mechanical Damage

- Must provide nail plates when pipe other than steel is run through wood or metal studs:
- Steel shield plates:
- Where the face of piping is less than 1.25 in from nearest edge of member
- Minimum thickness of .0575 in. (No. 16 gauge)
- Cover the area of the pipe where the member is notched and bored



NFPA 13-2022/ 16.4.5

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Pipe Schedule Nameplate

- Installing contractor must provide
- Permanently marked weatherproof or rigid plastic sign
- Corrosion-resistant wire, chain, or other approved means
- Placed at the corresponding system riser

Table 27.5.2.2.1

Table 27.5.3.4

NFPA 13-2022/ 29.5

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Waterflow Alarm Devices

Mechanical



5 minutes

Electrical



100 seconds

NFPA 13-2022/ 7.7

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Dwelling Delivery Time

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Table 8.2.3.6.1

NFPA 13-2022/ 8.2.3.6.1

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Nitrogen Supply for Increased C-factor

- Restore air pressure within 30/60 minutes
- Listed and permanently installed
- Maintain 98% at minimum leakage rate of 1.5 psi/hr
- Installed per manufacturer's instructions



NFPA 13-2022/ 8.2.6.9

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Circular Obstructions



NFPA 13-2022/ 8.2.6.9

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ESFR in Light and Ordinary Hazard

- For retrofits
- Light and Ordinary Hazard

Utilize Spray Sprinkler Guidance for:

- Protection Areas and Maximum Spacing for Light Hazard
- Spacing
- Obstruction Criteria



NFPA 13-2022/ 14.2.7

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ESFR Isolated Obstructions

Sprinklers not required for isolated noncontiguous obstruction :

- ≤ 1.5 in. in width located horizontally a minimum of 12 in. below deflector
- ≤ 6 in. in width and located a minimum of 6 in. horizontally from the sprinkler
- ≤ 24 in. in width and a minimum of 12 in. horizontally from the sprinkler

High-piled storage is not physically separated from an adjacent light or ordinary hazard area:

- Criteria applies to sprinkler located 6 ft. horizontally of any high-piled storage



NFPA 13-2022/ 14.2.11.2

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ESFR - Continuous Obstructions

Sprinklers not required for isolated noncontiguous obstruction :

- ≤ 1.5 in. in width located horizontally a minimum of 12 in. below deflector
- ≤ 6 in. in width and located a minimum of 6 in. horizontally from the sprinkler
- ≤ 24 in. in width and a minimum of 12 in. horizontally from the sprinkler

ESFRs shall be arranged with respect to the bottom chord of bar joist or open truss:

- Bottom cord is ≤ 6 in. in width, located a minimum of 6 in. horizontally from nearest edge of bottom cord
- Bottom cord is ≤ 24 in. in width, located a minimum of 12 in. horizontally from nearest edge of bottom cord

NFPA 13-2022/ 14.2.11.3

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ESFR - Continuous Obstructions

Table 14.2.11.1.1(a)

NFPA 13-2022/ Table 2.11.1.1

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Campus Arrangement of Spare Sprinklers



- Sprinklers and wrenches do not need to be stored at individual systems locations
- Hospitals
- Multifamily complexes
- Schools

NFPA 13-2022/ 16.2.7.1

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Backflow Preventers

Installation Requirements



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When is Backflow Prevention Required?

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- Connection to Public Water
- When is an RPZ Required?
 - Antifreeze
 - Foam
 - Corrosion Inhibitor

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Backflow Types

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- **Double Check Valve Assembly**
A double check assembly (DCA) consists of two independently operating spring-loaded check valves
- **Double Check Detector Assembly**
A double check detector assembly (DCDA) is hydraulically balanced to include a metered bypass assembly to detect system leakage
- **Reduced Pressure Zone Assembly**
Two independently acting check valves together with a hydraulically operating, mechanically independent pressure differential relief valve



NFPA 25-2020: 3.3.8

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Backflow Types

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Photo Credit: Zum

NFPA 25-2020: 3.3.8

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Backflow Types

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Two independently acting check valves together with a hydraulically operating, mechanically independent pressure differential relief valve



Photo Credit: Watts

NFPA 25-2020: 3.3.8

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Forward Flow Requirements

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- System Demand
- Total Demand

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Friction Loss Curves

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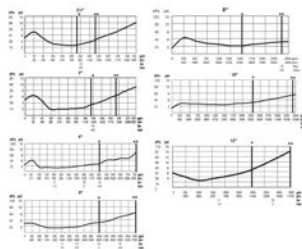


Photo Credit: Watts

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Water Purveyor

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Photo Credit: Zurn

- May require a reduced pressure backflow preventer
- May not allow discharge to atmosphere for installation and testing

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Installation Requirements

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16.9.3.3.5 A listed backflow prevention assembly shall be permitted to be considered a control valve, provided both control valves are listed for fire protection system use and an additional control valve shall not be required.

16.9.4* Check Valves.

16.9.4.1 Where there is more than one source of water supply, a check valve shall be installed in each connection.

16.9.4.2 A listed backflow prevention device shall be considered a check valve, and an additional check valve shall not be required.



NFPA 13-2022

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Installation Requirements

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- **16.14.5.1*** **Backflow Prevention Valves.** A test connection shall be provided downstream of all backflow prevention valves for the performance of forward flow tests required by this standard and NFPA 25 at a minimum flow rate of the system demand including hose allowance where applicable.




NFPA 13, 2022

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Installation Requirements

- **16.14.5.1.1** A 2 1/2 in. (65 mm) hose valve shall be provided downstream of the backflow prevention valve for every 250 gpm (950 L/min) of flow rate required by the system demand including hose allowance where applicable.
- **16.14.5.1.2*** Existing hose connections downstream of the backflow prevention valve shall be allowed to be utilized.
- **16.14.5.1.3*** Other means shall be permitted as long as the system doesn't require modification to perform the test and it is sized to meet the system demand.



NFPA 13, 2022

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Contractor's Material and Test Certificate

NFPA 13-2019: Figure 6.10.1

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What do you "means?"



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What do you "means"?

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What do you "means?"

92



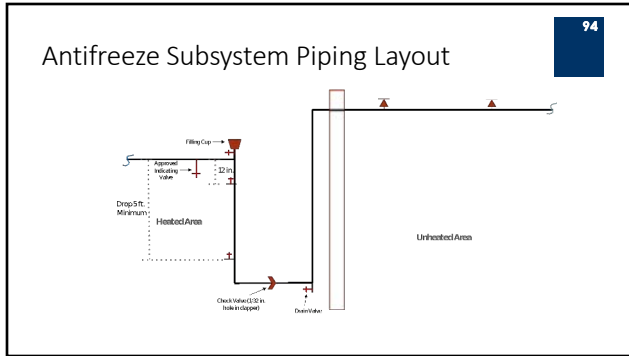
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What do you "means?"

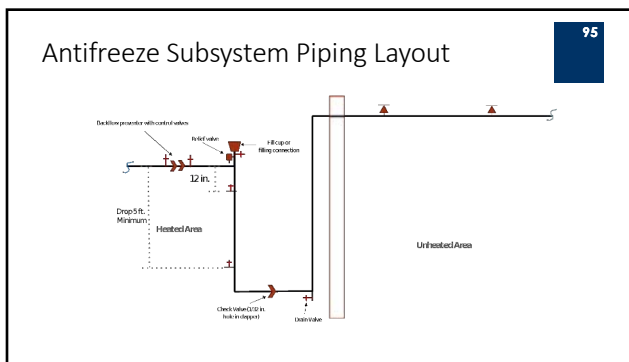
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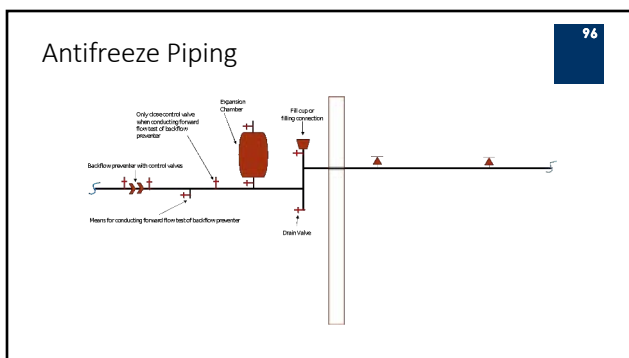
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Antifreeze Installation

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Installation

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- Provide a means downstream to forward flow test
- Required flow
 - System demand
 - Applicable hose allowance
- Means cannot require modification
- **Verify at acceptance**

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NFPA 13
2022 Changes



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Backflow Prevention Valves

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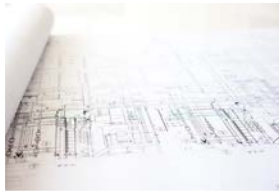


- 2.5 in. valve down stream per 250 of flow rate
- Existing hose connection downstream are permitted
- Other means not requiring modification also permitted

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Shop Drawings

101



- Paren 18: Location and labeling of forward flow connections required

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Backflow ITM
NFPA 25-2020CA Edition



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Inspection

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- RPZ – Weekly
 - Relief valve not discharging
- After repairs
 - Verify system in service
 - Normally open valves are open
- Internal Inspection – 5 years
 - All BFP

NFPA 25-2020: 13.7

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Testing

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- Exercised Annually
 - Forward flow test
 - System demand
 - Plus, applicable hose/hydrant
 - Maximum possible
- Drought?
 - Internally inspect
 - No flow required
- Fire Pump connected?
 - Forget about it



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What do you “means?”

105



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What do you “means?”

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Maintenance

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- Per manufacturer's instructions

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Inspecting Backflow Preventers

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Inspecting Backflow Preventers

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Inspecting Backflow Preventers

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Any Questions?

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For additional questions regarding the content in today's presentation, please contact:

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SPRINKLER AGE



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