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Sprinkler System Installation
Instructor:
Bob Caputo, CFPS

Bob Caputo, CFPS

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 1 and NFPA 15. Caputo is a contributor of the NFPA 13 and NFPA 25 Handbooks and the NFPA Inspection Manual. He served on NFPA’s and AFSA’s location. 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 1997, “Man of the Year” from Fire Prevention, 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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DISCLAIMER
This seminar and its content is not a formal interpretation issued pursuant to NFPA regulations. Any opinion expressed is the personal opinion of the author and presenter and does not necessarily present the official position of the NFPA and its Technical Committees.
Introduction – Introduce Yourself

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

Housekeeping Items

• Emergency Exits
• Bathrooms
• Breaks

History

NFPA 13
Major Changes

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

Major Changes

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

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
2013 Changes
• Chapter 16 and 17 reorganized
• New chapter - Alternative Approaches for Storage Designs

2016 Changes
• Redundancies per sprinkler type
• Clarifying storage differences
• Discharge committee redundancy task force

Reason For Change
• No logical order
• Hard to follow
• Inconsistent redundancy
• Streamlining
• Consistent chapter layout
• Chapter 8...
2016-2019 Restructure

<table>
<thead>
<tr>
<th>Basic Requirements</th>
<th>2016</th>
<th>2019</th>
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<td>Use of Sprinklers</td>
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<td>Position, Location, Spacing and Use</td>
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<td>Standard Spray Upright and Pendent</td>
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<td>Standard Spray Sidewall Sprinklers</td>
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<td>EC Upright and Pendent</td>
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<td>EC Sidewalls</td>
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2016-2019 Restructure

<table>
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<th>Residential Sprinklers</th>
<th>2016</th>
<th>2019</th>
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<td>ESFR Sprinklers</td>
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<td>In-Rack Sprinklers</td>
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<td>Pilot Line Detectors</td>
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<td>Special Situations</td>
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<td>Piping Installations</td>
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<td>System Attachments</td>
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<tr>
<td>Electrical Bonding and Grounding</td>
<td>8.17</td>
<td>16</td>
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</tbody>
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The “Road Map”
**Pipe, Fittings, System Components, System Types**

- Chapter 5 – Water Supplies
- Chapter 6 – Installation
- Underground Piping
- Chapter 7 – Requirements for System Components and Hardware
- Chapter 8 – System Types and Requirements

**Sprinklers Installation Requirements**

- 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

**Installation of Piping, Valves, and Appurtenances**

- 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
Hanging and Bracing

Chapter 17
• Hanging and Support

Chapter 18
• Seismic Protection (if required)

Design and Discharge

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

Hydraulic Calculations

Chapter 27 – Plans and Calculations
• Working Plans
• Hydraulic Calculation Procedures
• Hose Allowance
• Hydraulic Calculation Forms
• Pipe Schedules
System Acceptance

Chapter 28
• Approval of Sprinkler Systems
• Acceptance Test Requirements
• Automated Inspection and Testing Devices and Equipment
• Instructions
• Hydraulic Data Nameplate
• General Information Sign

Existing System Modifications

Chapter 29
• Added for the 2019 edition
• Consolidates requirements for existing systems in one place
• In theory...
• Not “all inclusive”

Marine Systems

Chapter 30
• Marine apparatus
Inspection, Testing, and Maintenance

Chapter 31
• Refers the user to NFPA 25

Annex & Index
• Annex A – Explanatory Material (Typical)
• Annex B – Miscellaneous Topics
• Annex C – Explanation of Test Data and Procedures for Rack Storage
• 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

Standards Development Process
National Fire Protection Association
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

Development Process

How Can I Get Involved?
NFPA 13 Subcommittees

Correlating Committee (AUT-AAC)
- Chapter 3- Definitions
- Chapter 17- Hanging and Support of System Piping
- Chapter 18- Seismic

Hanging and Bracing (AUT-HBS)
- Chapter 3- Definitions
- Chapter 18- Seismic

Private Water Supply Piping (AUT-PRI)
- NFPA 291
- NFPA 24
- Chapter 3- Definitions
- Chapter 6- Underground Piping

---

Discharge Criteria (AUT-SSD)

<table>
<thead>
<tr>
<th>Chapter</th>
<th>Title</th>
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<tbody>
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<td>Definitions</td>
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<td>3</td>
<td>Water Duration</td>
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<td>Design Arrangement</td>
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<td>Internal Resistance to Drain</td>
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<td>6</td>
<td>Evaluation of High-Point Drainage Using NFPA Section 6</td>
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<td>Water Requirements for Storage Applications</td>
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<td>2018 Revision to Water Requirementsfor Storage Applications</td>
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<td>Alternative Water Supply Designs</td>
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<td>Prevention of Flood Damage Using in Backflow Preventers</td>
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<td>Special-Occupancy Requirements</td>
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<td>Plans and Calculations</td>
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<tr>
<td>13</td>
<td>Existing System Modifications</td>
</tr>
</tbody>
</table>

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Installation Criteria (AUT-SSI)
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 flue. (AUT-SSD)
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

Hanging and Bracing

AUT-HBS

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
No Major Changes

Discharge Criteria

Single Point Densities for New Systems
NFPA 13-2022/ Table 19.2.3.1.1
Single Point Densities for Existing Systems

CMDA Single Point Densities

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

Chapter Reorganization

<table>
<thead>
<tr>
<th>Topic</th>
<th>2019</th>
<th>2022</th>
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<td>Marine Systems</td>
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<tr>
<td>System Inspection Testing and Maintenance</td>
<td>31</td>
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</tbody>
</table>
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.

Working Plans List

- Reorganized
- Added information

Provides comprehensive plans for:
- AHJ
- Installation Crew

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. Flow rate
  f. Flow duration
  g. Pressure
  h. Flow test locations, dates, and sources (i.e., city or private)
  i. Any adjustments from the raw data required by the owner or engineer of record or the water authority, if applicable
Installation Criteria

Smooth Ceiling

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

Exterior Projection

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

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

NFPA 13-2022/ 3.3.215.4.6

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

NFPA 13-2022/ 15.6

Temperature Rating Table

<table>
<thead>
<tr>
<th>OLD</th>
<th>NEW</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 7.2.4.1(a)

Table 7.2.4.1(b)

NFPA 13-2022/ 7.2.4.1
Ordinary or Intermediate Temperature

Weld Repairs

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
Porte-cochères

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

NFPA 13-2022/ 9.2.3.2.1

Bathrooms Under Stairs

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

NFPA 13-2022/ 9.2.4.1.1.1

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
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

Sidewall Spray Sprinklers

- 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

Sprinkler Obstructions in Hallways

NFPA 13-2022/ 10.3.6.1.7, 12.1.10.1.2
Clearance to Storage

- Rubber tire storage: 36 in.

Concealed Sprinklers in Beams

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

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)
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

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

Waterflow Alarm Devices

- Mechanical: 5 minutes
- Electrical: 100 seconds
Dwelling Delivery Time

Table 8.2.3.6.1

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

Circular Obstructions
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

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

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

NFPA 13-2022/ 14.2.11.3
ESFR - Continuous Obstructions

Table 14.2.11.1(a)

Campus Arrangement of Spare Sprinklers

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

Backflow Preventers

Installation Requirements
When is Backflow Prevention Required?

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

Backflow Types

- **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.

Photo Credit: Zurn

NFPA 25-2020: 3.3.8
Backflow Types

▪ 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

Forward Flow Requirements

▪ System Demand
▪ Total Demand

Friction Loss Curves
Installation Requirements

**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.

---

Installation Requirements

**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.
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.

Contractor’s Material and Test Certificate

NFPA 13-2019: Figure 6.10.1

What do you “means?”

NFPA 13, 2022
What do you “means”?
Antifreeze Installation

Installation

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

NFPA 13

2022 Changes
Backflow Prevention Valves

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

Shop Drawings

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

Backflow ITM

NFPA 25-2020CA Edition
**Inspection**

- 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**

---

**Testing**

- 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

---

**What do you “means?”**
What do you “means?”

Maintenance

- Per manufacturer’s instructions

Inspecting Backflow Preventers
For additional questions regarding the content in today’s presentation, please contact:

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President
American Fire Sprinkler Association
bcaputo@firesprinkler.org
214-349-5965 x124

You can contact the AFSA Technical Services staff at technical@firesprinkler.org.

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