A Seminar of the National Fire Sprinkler Association

D·E·S·I·G·N and TRADES CONFERENCE

2016 ▪ 15TH ANNUAL

UNDERSTANDING AND APPLYING NFPA 13D

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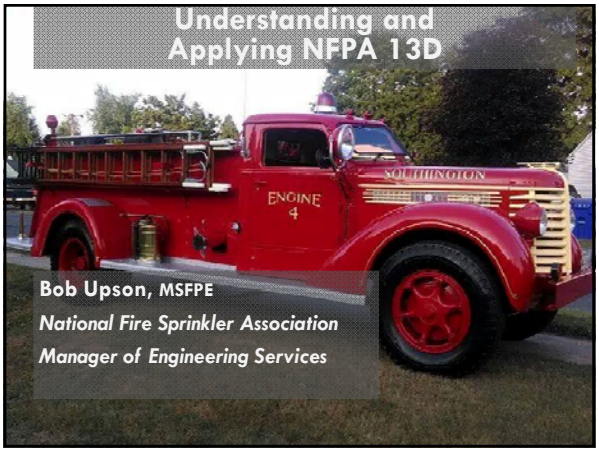

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Seminar Learning Outcomes

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1. Discuss the scope and application of sprinkler standards for one and two family dwellings and townhomes.
2. Identify the requirements for residential fire sprinkler system installation in accordance with NFSA 13D and IRC P2904.
3. Apply the installation requirements and calculation procedures to various residential layouts.

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UA NFPA 13D

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- Origin and History of NFPA 13D
- Administrative Chapters
- General Requirements and Components
- Water Supply
- Installation
- Sprinkler Position and Location
- Protection from Freezing
- Discharge and Hydraulic Calculations
- ~~System Acceptance and ITM~~

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Module 0

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UA NFPA 13D

Origin and History of NFPA 13D

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Origin and History of NFPA 13D

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Origin and History of NFPA 13D

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Fire Research and Safety Act of 1968

- Fire Research and Safety Program
- National Commission on Fire Prevention and Control

1968 – President Johnson signs Act into law

1971 – President Nixon appoints Commissioners

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Origin and History of NFPA 13D

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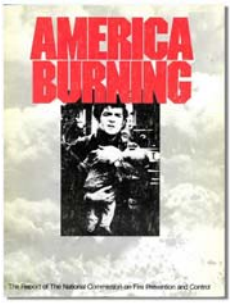

America Burning, 1973

"Support the development of the necessary technology for improved automatic extinguishing systems that would find ready acceptance by Americans in all kinds of dwelling units"

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Origin and History of NFPA 13D

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Federal Fire Prevention and Control Act of 1974

- Congressional Findings
  - 90 Recommendations
  - Highest per capita rate of death and property loss of all major industrialized nations
  - Fire is an undue burden affecting all Americans
  - Firefighting is nation's most hazardous profession
  - Losses unacceptable to Congress

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Origin and History of NFPA 13D

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Federal Fire Prevention and Control Act of 1974

- Congressional Findings
- National Fire Prevention and Control Administration
- National Academy for Fire Prevention and Control
- National Fire Data Center
- Fire Technology

1974 – President Ford signs Act into law

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Origin and History of NFPA 13D

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- Field tests, evaluations, and demonstrations conducted across the US
  - Fort Lauderdale, FL
  - Los Angeles, CA
  - Charleston, SC
  - Hartford, CT

1975 – NFPA 13D, 1st Edition
1980 – NFPA 13D, 2nd Edition
1981 – 1st listed residential sprinkler

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Residential Sprinkler Systems

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NFPA 13D Philosophy

- Economical life safety oriented protection
- Not designed to protect structures
- Sprinklers may be omitted from areas where fatal fires rarely originate
- Approximately 85% of home covered by residential sprinklers

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Residential Sprinkler Systems

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Fatal Fires – Room of Origin	% of Fatal Fires
Living Room, Family Room or Den	24
Bedroom	24
Kitchen	14
Other function area	11
Structural area	4
Crawl space	2
Laundry room	2
Garage	1
Bathroom	1

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Residential Sprinklers

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How is a residential sprinkler different?

- Fast response
  - Response Time Index (RTI) ≤ 50
- Lower water use
  - 0.05 gpm/ft^2
- Higher wall wetting pattern
  - 28" down from ceiling

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Residential Sprinklers

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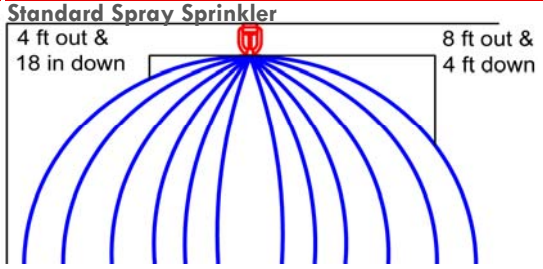
Standard Spray Sprinkler



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Residential Sprinklers

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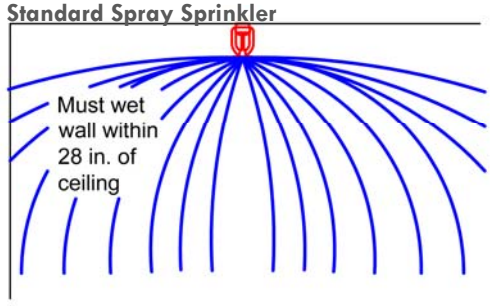
Standard Spray Sprinkler



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Residential Sprinklers

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- UL 1626
  - Simulated upholstered furniture in corner
  - Wood paneling on walls
  - Simulated waste basket fire in corner
  - Fire at extent of sprinkler coverage area and shielded from water spray by furniture

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Residential Sprinklers

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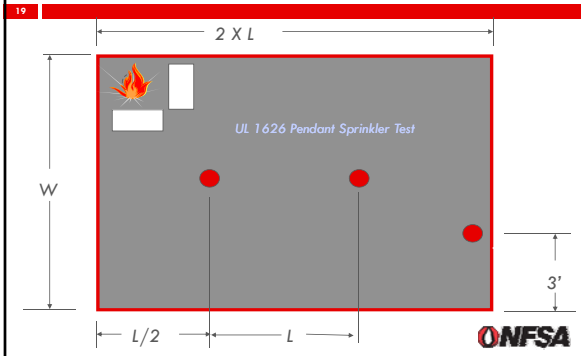

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Residential Sprinklers

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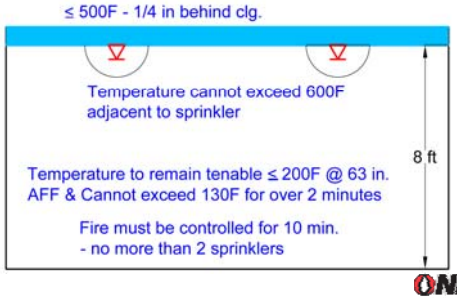
- UL 1626



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America's Residential Fire Problem

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America's Residential Fire Problem

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- 1,400,000 fires each year
- 500,000 fires in buildings
- 400,000 fires in residential occupancies
- 300,000 fires in single family homes
  - 80% of structure fires
- 3,000 civilian fire deaths
  - 80% of civilian fire deaths occur in residential
- $12 billion in losses

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America's Residential Fire Problem

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The Fire Problem in the United States continues to be a residential fire problem

2013 USFA Data	Residential	Non-Residential Structure
Fires	380,300	93,700
Deaths	2,755	65
Injuries	12,450	1,425
Losses	$6.9 billion	$2.5 billion

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America's Residential Fire Problem

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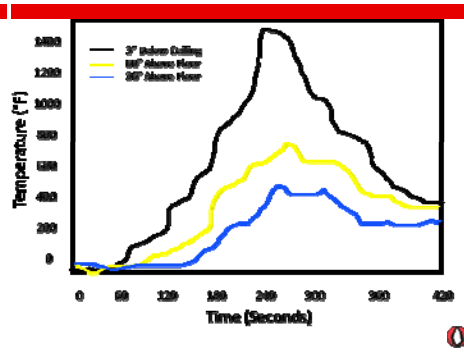

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America's Residential Fire Problem

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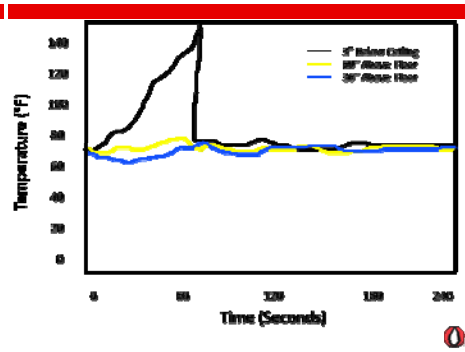

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America's Residential Fire Problem

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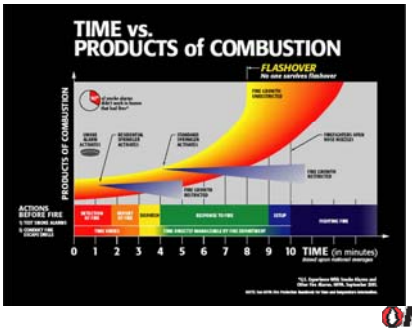

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America's Residential Fire Problem

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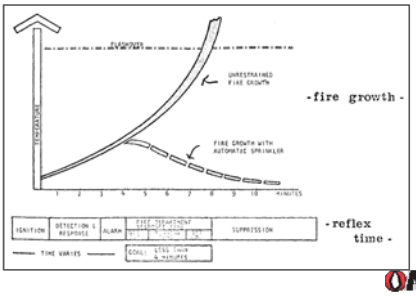
America Burning, Appendix VI, p 174



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Module 1

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UA NFPA 13D

Administrative Chapters

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Chapter 1 – Administration

- Scope
- Purpose
- Retroactivity
- Equivalency
- Units

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Chapter 2 – Referenced Publications

- General
- NFPA Publications
- Other Publications
- References for Extracts in Mandatory Sections

Chapter 3 – Definitions

- General
- NFPA Official Definitions
- General Definitions

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NFPA 13D

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Scope

- Design, installation, and maintenance of automatic sprinkler systems in one- and two-family dwellings and manufactured homes
- Does not include water mist systems
- Protects against single point of ignition fire

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NFPA 13D

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Manufactured Homes

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Townhouses

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Dwelling

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Purpose

NFPA 13 – Property Protection & Life Safety

NFPA 13D – Life Safety
- Detection and Control
- Prevent Flashover

NFPA 13R – Life Safety

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Module 2

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UA NFPA 13D

General Requirements and Components

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Chapter 4 – General Requirements

- Sprinkler Temperature Ratings
- Tube
- Listed or Labeled
- Smoke Alarms
- Documentation
- Qualifications

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Chapter 5 – System Components

- General
- Aboveground Pipe and Equipment
- Underground Pipe
- Pre-engineered Systems

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NFPA 13D Listing Requirements

40

- Are the following required to be listed for fire protection in NFPA 13D?

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Hangers

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- Requirements coordinate with the local plumbing codes
- Listed pipe may have additional requirements
- Not listed

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Valves

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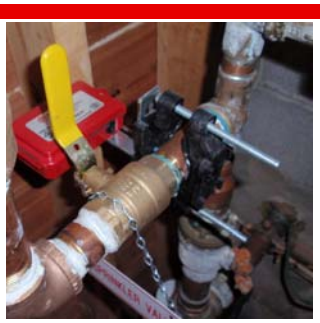
- Control valves
- Not Listed



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Valves

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- Waterflow valves
- Not listed

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Devices

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- Waterflow detection devices
- Not Listed

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Devices

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- Backflow device (where applicable)
- Not Listed

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Water Meters

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- Water meter (where applicable)
- Not Listed

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* Sizing Water Meters

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NFPA 13D (2013) Table 10.4.3(a)

Meter Size	Flow (gpm)					
(in.)	18 or less	23	26	31	39	52
5/8	9	14	18	26	38	*
3/4	7	11	14	22	35	*
1	2	3	3	4	6	10
1 1/2	1	1	2	2	4	7
2	1	1	1	1	2	3

*Above maximum rated flow of commonly available meter

- Table may be used even if flow exceeds the meter's rated continuous flow
- Higher pressure loss specified by manufacturer shall be used in place of table.

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* Sizing Water Meters

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Note on maximum rated flow of water meters:

- A research project conducted by Fire Protection Research Foundation, *"Residential Fire Sprinklers - Water Usage and Water Meter Performance Study"* showed that domestic water meters can by flowed above their maximum rated flow successfully and without damage.

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Pumps

49

- Part of domestic water supply
- Not Listed

Pumps

50

- Not part of the domestic water supply
- Not listed (but some special requirements)

Tanks

51

- Not listed

Bonus

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- What is required by the IRC to be listed?

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Sprinklers

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Residential Sprinklers

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- Fast response
  - RTI of 50 $(m \cdot s)^{1/2}$
- Coverage area is part of listing
- UL 1626 or FM 2030
  - Construction tests
  - Performance tests
    - 25-30 different tests
  - Production tests

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Performance Tests

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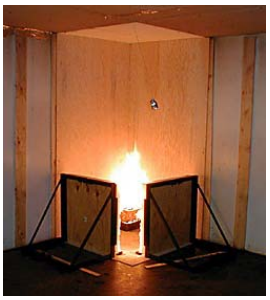
- Fire Test



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Residential Sprinklers in Basements

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- Residential sprinklers can be installed in a position such that an anticipated future ceiling is assumed
  - Pipe restrictions

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Dry-Type Sprinklers

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- Quick Response used for unheated areas

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Pipe and Fittings

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- Steel Pipe
  - Comply with standards referenced or listed
    - **ASTM A795** Standard Specification for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use
    - **ASTM A53** Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
    - **ANSI B36.10M** Welded and Seamless Wrought Steel Pipe
    - **ASTM A135** Standard Specification for Electric-Resistance-Welded Steel Pipe
- Schedule 10 mechanical groove couplings approved for service

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Pipe and Fittings

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- Steel Fittings
  - Comply with standards referenced or listed
    - ASME B16.4
    - ASME B16.1
    - ASME B16.3
    - ASME B16.9
    - ASME B16.25
    - ASTM A234
    - ASME B16.5
    - ASME B16.11

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Copper

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Pipe and Fittings

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- Copper Tube
  - Comply with standards referenced or listed
    - ASTM B75 Standard Specification for Seamless Copper Tube [Copper Tube (Drawn, Seamless)]
    - ASTM B88 Standard Specification for Seamless Copper Water Tube
    - ASTM B251 Standard Specification for General Requirements for Wrought Seamless Copper and Copper-Alloy Tube
    - ASTMB813 Standard Specification for Liquid and Paste Fluxes for Soldering Applications of Copper and Copper-Alloy Tube
    - AWS A5.8 Specification for Filler Metals for Brazing and Braze Welding (BCuP, copper-phosphorus, or copper-phosphorus-silver brazing filler metal)
    - ASTM B32 Standard Specification for Solder Metal [alloy grades containing less than 0.2 percent lead as identified in ASTM B32, Table 5, Section 1, and having a solidus temperature that exceeds 400°F (204°C)]
    - ASTM B43 Standard Specification for Seamless Red Brass Pipe

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Pipe and Fittings

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- Copper Fittings
  - Comply with standards referenced or listed
    - ASME B16.22
    - ASME B16.18
    - ANSI/ASME B16.15

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Pipe and Fittings

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- Nonmetallic
  - Chlorinated polyvinyl chloride (CPVC)
  - Crosslinked polyethene (PEX)

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CPVC

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PEX

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Pipe and Fittings

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- Compatibility
  - Spray foam
  - Detergents
  - Solder flux
  - Glycol
  - Thread sealants
  - Flexible cabling
  - Caulk
  - Electrical tape
  - Insecticides
  - Etc…

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Other Joining Methods

- Investigated
- Listed

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Underground Pipe

- Any type of pipe or tube acceptable under the applicable plumbing code for underground supply pipe shall be acceptable as underground for fire sprinkler system when installed between the point of connection and system riser.

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Module 3

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UA NFPA 13D

Water Supply

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Chapter 6 – Water Supply

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- General Provisions
- Water Supply Sources
- Multipurpose Piping System
- Manufactured Home Water Supply
- Common Supply Piping

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Water Supply

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Duration

- 10 minutes
- 7 minutes
  - One story
  - Less than 2000 ft^2 in area
- Combine storage plus refill rate

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Water Supply

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Source

- Reliable waterworks with or w/o pump
- Elevated tank
- Pressure tank (ASME standards for a pressure vessel w/reliable pressure source)
- Stored water source w/pump
- Well w/pump of sufficient flow and pressure

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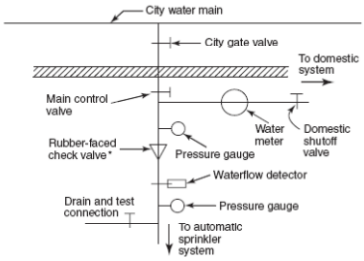
Water Supply

Control Valve

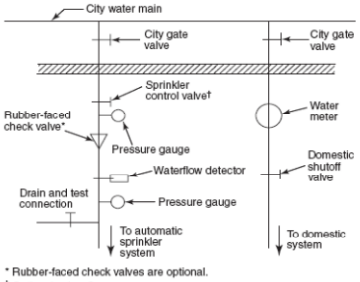
6.2.3 Where more than one dwelling unit is served by the same water supply pipe, each dwelling units shall have an individual control valve that serves the fire sprinklers system in that dwelling unit and the owner shall have access to the valve that controls the sprinkler system in their unit. The control valve shall be permitted to serve the domestic water supply.

Water Supply



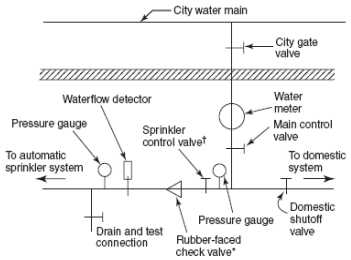
* Rubber-faced check valves are optional.

Water Supply



* Rubber-faced check valves are optional.
† Optional valve: See 7.1.2.

Water Supply



* Rubber-faced check valves are optional.
† Optional valve: See 7.1.2.

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Water Supply

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Pump and Well

A well with a pump of sufficient capacity and pressure to meet the sprinkler system demand. The stored water requirement of 6.1.2 or 6.1.3 shall be permitted to be a combination of the water in the well (including the refill rate) plus the water in the holding tank if such tank can supply the sprinkler system

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Residential Riser on Well

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Water Supply

- Prior to system acceptance, a system utilizing a pump shall be tested by opening the drain/test connection. The pump shall sense the flow, turn on, and flow water for the required duration of 6.1.2 or 6.1.3 (as appropriate) without interruption.

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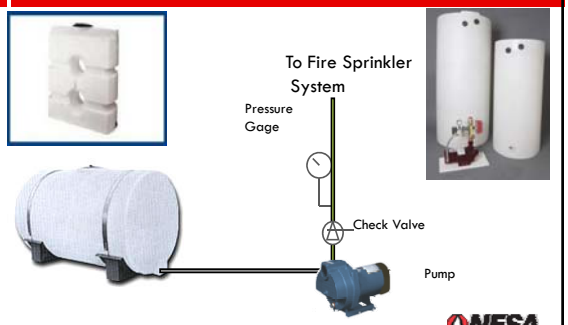
Pump and Tank

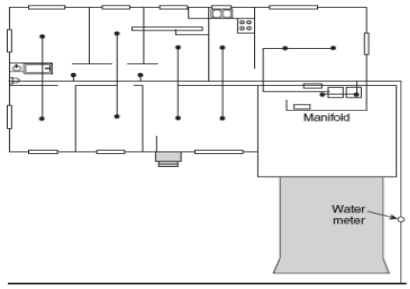
- Where a pump and tank is the source of supply for a fire sprinkler system but is not a portion of the domestic water system, the following shall be met:
  - A test connection
  - Pump motors using ac power shall be connected to a 240 V normal circuit.
  - Approved disconnecting means.
  - Refilling means piped to the tank.
  - Exterior water level indicator for tank
  - Pump not directly on the floor.

2016 edition: ≥ 1 ½" above the floor

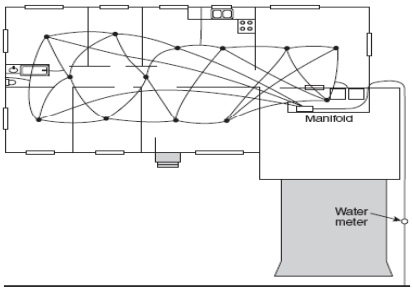
Pump & Tank Supply



Multipurpose Piping



Network System



Network System

Multipurpose Systems

Warning, the water system for this home supplies fire sprinklers that require certain flows and pressures to fight a fire. Devices that restrict the flow or decrease the pressure or automatically shut off the water to the fire sprinkler system, such as water softeners, filtration systems, and automatic shutoff valves, shall not be added to this system without a review of the fire sprinkler system by a fire protection specialist. Do not remove this sign.

Manufactured Home Water Supply

- For sprinklered buildings manufactured off-site, the minimum pressure needed to satisfy the system design criteria on the system side of the meter shall be specified on a data plate by the manufacturer.

2016 edition: flow and pressure

Common Supply Pipes

- Where water treatment and filtration are installed, one of the following conditions shall be met:
  - Equipment shall be taken into account in the hydraulic calculations.
  - An automatic bypass shall be installed around the water treatment equipment that directs all water directly to the system.

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Module 4

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Installation

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Chapter 7 – Installation

- Valves
- Drains & Test Connections
- Pressure Gauges
- Piping Support
- Sprinklers
- Alarms
- Attics

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Valves, Drains, TCs & Gauges

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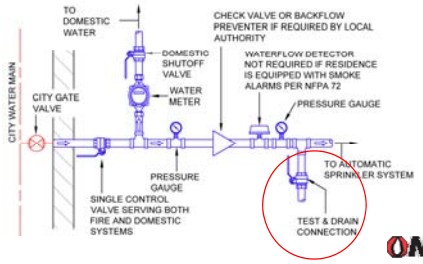
- Minimum ½ inch drain
- Valve in drain pipe



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Valves, Drains, TCs & Gauges

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Valves, Drains, TCs & Gauges

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- Pressure Gauges required:
  - Dry Systems
  - Pressure Tank

2016 edition: Gauges not listed

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Piping Support

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Hangers

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- Not listed
- Requirements coordinate with the local plumbing codes
- Listed pipe may have additional requirements
- Lateral support necessary when laid on joists, etc.
- Prevent movement of piping upon sprinkler operation

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Sprinklers

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Sprinklers

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- Listed
- Residential
  - Wet systems only unless listed for dry
- QR Exceptions:
  - QR dry sprinklers for unheated / not living areas
  - QR sprinklers for mechanical closets
  - QR sprinklers for saunas / high-temperature applications

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Temperature Ratings

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Temperature Ratings

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Sprinklers near specific Heat Sources

Heat Source	Ordinary temp. sprinkler	Intermediate temp. sprinkler
Side of fireplace	36 in.	12 in.
Front of fireplace	60 in.	36 in.
Kitchen range	18 in.	9 in.
Light fixture (0W-250W)	6 in.	3 in.

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Painting

Escutcheon Plates

Solvent Cement

Alarms

- Local waterflow alarms shall be provided on all sprinkler systems in homes not equipped with smoke alarms or smoke detectors in accordance with *NFPA 72, National Fire Alarm and Signaling Code.*
- Smoke alarms in accordance with NFPA 72 required in new construction dwelling units by IRC Section R314.

Attics

- When nonmetallic piping is installed in attics, adequate insulation shall be provided on the attic side of the piping to avoid exposure of the piping to temperatures in excess of the pipe's rated temperature.

Module 5

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UA NFPA 13D

Sprinkler Position and Location

Chapter 8 – Sprinkler Position and Location

- Design Criteria
- Position of Sprinklers
- Location of Sprinklers

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Position and Location

- Design Criteria
  - Sloped ceilings
  - Nonresidential sprinklers
  - Sprinkler coverage
  - Operating pressure

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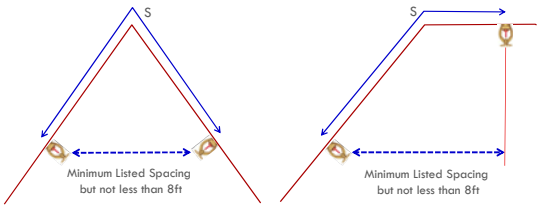
Sloped Ceilings



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Nonresidential Sprinklers

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- Installed in accordance with the coverage criteria specified by NFPA 13.
  - QR dry sprinklers for unheated / not living areas
  - QR sprinklers for mechanical closets
  - QR sprinklers for saunas / high-temperature applications

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Residential Sprinklers

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Courtesy of Reliable Sprinkler

Courtesy of Tyco Fire Products

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Sprinkler Coverage

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Area of Coverage

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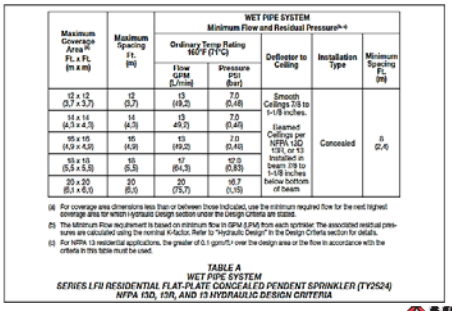

Maximum Coverage Area[a] Ft. x Ft. (m x m)	Maximum Spacing Ft. (m)	WET PIPE SYSTEM Minimum Flow and Residual Pressure[b,c] Ordinary Temp Rating 165°F (71°C) Flow GPM (L/min)	Pressure PSI (bar)	Deflector to Ceiling	Installation Type	Minimum Spacing Ft. (m)
12 x 12 (3,7 x 3,7)	12 (3,7)	13 (49,2)	7.0 (0,48)	Smooth Ceilings 7/8 to 1-1/8 inches.	Concealed	8 (2,4)
14 x 14 (4,3 x 4,3)	14 (4,3)	13 (49,2)	7.0 (0,48)	Recessed Ceilings per NFPA 13D 13R, or 13 Installed in beam (7/8 to 1-1/8 inches below bottom of beam		
15 x 15 (4,9 x 4,9)	15 (4,9)	13 (49,2)	7.0 (0,48)			
18 x 18 (5,9 x 5,9)	18 (5,5)	17 (64,3)	12.0 (0,83)			
20 x 20 (6,1 x 6,1)	20 (6,1)	20 (75,7)	16.7 (1,15)			

(a) For coverage area dimensions less than or between those indicated, use the minimum required flow for the next highest coverage area for which Hydraulic Design section under the Design Criteria are stated.

(b) The Minimum Flow requirement is based on minimum flow in GPM (LPM) from each sprinkler. The associated residual pressures are calculated using the nominal K-factor. Refer to "Hydraulic Design" in the Design Criteria section for details.

(c) For NFPA 13 residential applications, the greater of 0.1 gpm/ft.² over the design area or the flow in accordance with the criteria in this table must be used.

TABLE A
WET PIPE SYSTEM
SERIES LFII RESIDENTIAL FLAT-PLATE CONCEALED PENDENT SPRINKLER (TY2524)
NFPA 13D, 13R, AND 13 HYDRAULIC DESIGN CRITERIA

NFSA

Position and Location

- Position of Sprinklers
  - Upright & Pendent
  - Sidewall
  - Nonresidential
  - Basements without ceilings
  - Obstructions
  - Exposed barrel lengths

NFSA

Upright, Pendent, Sidewall

114

- Upright & Pendent
  - 1 to 4 inches from ceiling
  - Listing Requirements
  - 12 inches in closets to avoid obstructions
- Sidewall
  - 4 to 6 inches from ceiling
  - Listing Requirements
  - No more than 6 inches from the wall on which they are mounted.

NFSA

Basements Without Ceilings

115

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Obstructions

116

- Closets
- Pendent Sprinklers
- Sidewall sprinklers
- Continuous Obstructions to Pendent Sprinklers
- Continuous Obstructions to Sidewall Sprinklers
- Soffits & Cabinets

NFSA

Closets

NFSA

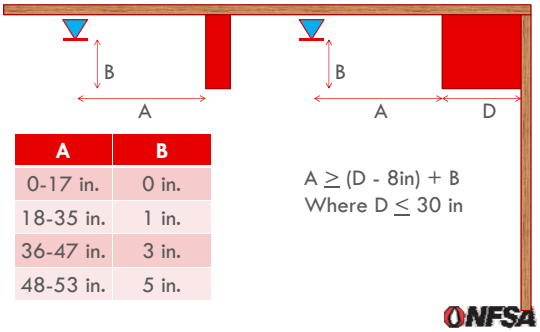
Pendent Sprinklers

Sidewall Sprinklers

Pendent Sprinklers

Obstructions

121



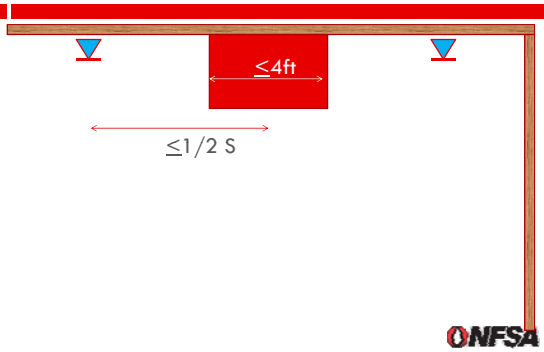
A	B
0-17 in.	0 in.
18-35 in.	1 in.
36-47 in.	3 in.
48-53 in.	5 in.

$A \geq (D - 8in) + B$
Where $D \leq 30$ in

NFSA

Obstructions

122



NFSA

Sidewall Sprinklers

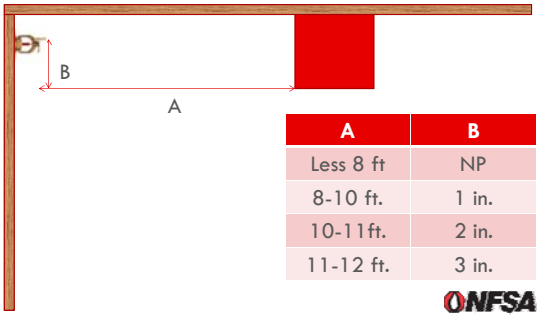
123

- Same basic rules
- More sensitive to obstructions
- Some unique rules

NFSA

Obstructions

124



A	B
Less 8 ft	NP
8-10 ft.	1 in.
10-11ft.	2 in.
11-12 ft.	3 in.

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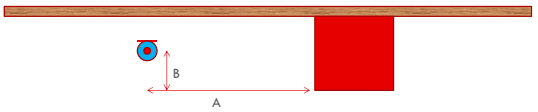
Obstructions

125



A	B
0-17 in.	0 in.
18-35 in.	1 in.
36-47 in.	3 in.
48-53 in.	5 in.

NFSA

Obstructions

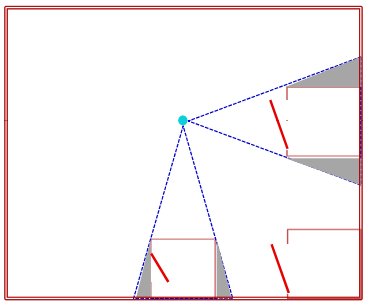
NFSA

Potential Obstructions

NFSA

Shadow Areas

128



NFSA

New in 2016 Edition

- Certain Architectural Features
  - NFPA 13D Section 8.2.5.7
  - Moved from Annex A to body of the standard
  - Related but distinct from Shadow Areas
  - *"Small areas created by architectural features, such as planter box windows, bay windows, and similar features…"*

NFSA

New in 2016 Edition

8.2.5.7 Architectural features

(1) No floor area created, no additional sprinklers required

(2) Floor area created, no additional sprinklers required if:

(a) ≤ 18ft^2

(b) ≤ 2 ft deep

(c) ≤ 9 ft long

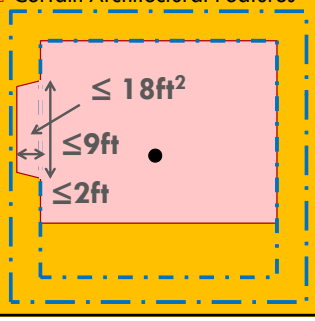
(d) deepest point to sprinkler ≤ maximum listed sprinkler spacing

(3) Hydraulic design may omit area

NFSA

New in 2016 Edition

- Certain Architectural Features



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Dry Sprinklers

132

NFSA

Dry Sprinklers

133

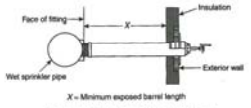
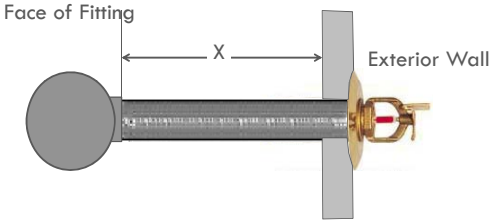


Table 8.2.6.1(a) Exposed Barrel Lengths for Dry Sprinklers (U.S. Customary Units)

Ambient Temperature Exposed to Discharge End of Sprinkler (°F)	Minimum Exposed Barrel Length when Exposed to 40°F (in.)	Minimum Exposed Barrel Length when Exposed to 50°F (in.)	Minimum Exposed Barrel Length when Exposed to 60°F (in.)
40	0	0	0
30	0	0	0
20	4	0	0
10	8	1	0
0	12	3	0
−10	14	4	1
−20	14	6	3
−30	16	8	4
−40	18	8	4
−50	20	10	6
−60	20	10	6

NFSA

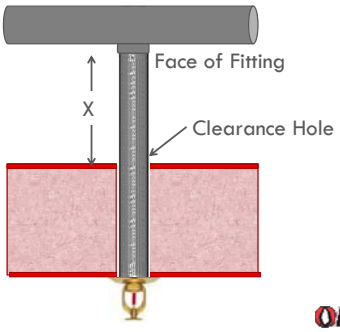
Dry Sidewall Sprinklers



NFSA

Dry Pendent Sprinklers

135



NFSA

Position and Location

- Location of Sprinklers
  - *All areas EXCEPT*
  - Bathrooms <55 ft^2
  - Certain small closets
  - Garages, carports, open attached porches
  - Attics & concealed spaces not used for living
  - Certain Fuel Fire Equipment Spaces
  - Entrance vestibules (not the only means of egress)
  - Ceiling Pockets
  - Exterior closets

NFSA

Module 6

137

UAE NFPA 13D

Protection from Freezing

NFSA

Chapter 9 – Protection from Freezing

NFSA

Systems in Areas Below 40°F

139

- Dry Pipe or Preaction System
- Antifreeze System
- Listed Standard Dry Pendent or Sidewall Sprinklers
- Listed Heat Tracing
- Listed Residential Dry Pendent or Sidewall Sprinklers

NFSA

Antifreeze

140

- Antifreeze solution must be listed
  - Except for existing systems
    - Glycerine - 50% maximum
    - Propylene glycol - 40% maximum
  - Except where acceptable to AHJ
    - Glycerine - 48% maximum
    - Propylene glycol - 38% maximum
  - Must be premixed
- Expansion tanks (where applicable) do not have to be listed

NFSA

Protection from Freezing

141

Tenting

NFSA

Protection from Freezing

142

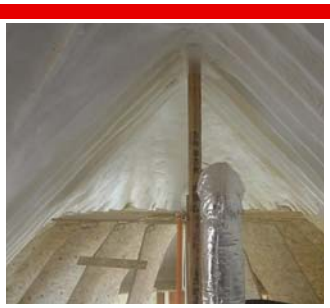
Hard Tenting

NFSA

Protection from Freezing

143

Heated Attic Space with Spray on Insulation



NFSA

Module 7

144

UA NFPA 13D

Discharge and Hydraulic Calculations

NFSA

Chapter 10 – Discharge & Calculations

145

- Design Discharge
- Number of Design Sprinklers
- Pipe Configurations
- Pipe Sizing

NFSA

Design Area for NFPA 13D

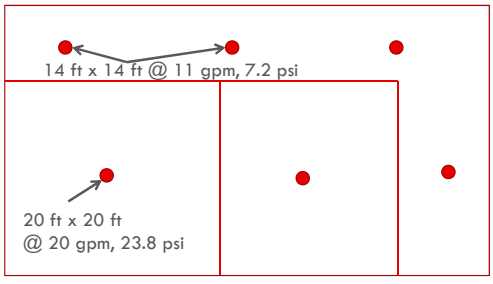
146

- All of the sprinklers in a compartment up to **2**
  - If all compartments are protected with one sprinkler, design area would be one sprinkler
  - If some rooms have one sprinkler and others have two or more, may need to do two sets of calculations

NFSA

Same Sprinkler (V2902) - Different Listings

147



NFSA

Sprinkler Calculations for Example on Previous Slide

148

- Two Sprinkler Calculation
  - 22 gpm at 32.2 psi
- Single Sprinkler Calculation
  - 20 gpm at 47 psi

NFSA

Two Sprinkler Design

149

Five ceiling configurations

1. Flat smooth horizontal ceiling up to 24 feet above the floor.
2. Flat horizontal beamed ceiling
   - Maximum ceiling height of 24 feet
   - Maximum beam depth of 14 inches

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Two Sprinkler Design

150

3. Smooth flat sloped ceiling
   - Maximum slope of 8:12
   - Peak not more than 24 feet
   - Highest sprinkler above openings to other rooms

NFSA

Two Sprinkler Design

151

4. Sloped ceiling with beams
   - Maximum beam depth of 14 inches
   - Pendent sprinklers under beams
   - Maximum 600 cu ft compartment
   - Slope between 2:12 and 8:12
   - Maximum 24 feet ceiling at peak
   - Highest sprinkler above openings to other rooms

NFSA

Two Sprinkler Design

152

5. Sloped ceiling with beams
   - Any depth to beams
   - Pendent or sidewall sprinklers in each pocket
   - Maximum 600 cubic feet compartment
   - Slope between 2:12 and 8:12
   - Maximum 24 feet ceiling at peak

NFSA

Design Area

153

- For ceilings not meeting one of the last five configurations
  - Residential sprinklers can still be used
  - Number of sprinklers in the design area will need to be determined with AHJ
  - There is some limited test data on more steeply pitched ceilings

NFSA

Flow and Pressure Requirements

154

- Residential sprinklers
  - Listed for a specific area at a specific flow
  - Pendent sprinklers, area is square
  - Sidewall sprinklers can be a rectangle

NFSA

Flow and Pressure Requirements

155

- Same sprinkler can have many different listings
  - Different area of coverage
  - Different distance from ceiling
  - Concealed, recessed, semi, etc.
- Example – R3531 HSW
  - 16 x 16 @ 16 gpm (13.3 psi) 4-6" below ceiling
  - 16 x 16 @ 17 gpm (15 psi) 6-12" below ceiling

NFSA

Flow and Pressure Requirements

156

- Which sprinkler is selected?
- How it is being used?
  - Area
  - Special characteristics
  - Flow and pressure demand

NFSA

Water Supply Additions

157

- No hose stream demand
- Add 5 gpm for combined domestic/sprinkler systems that serve more than one dwelling unit
  - Add where sprinkler system is connected to domestic

NFSA

Sizing Tanks

158

- 7 minute duration
  - 1 story
  - Less than 2000 sq ft
- Other dwellings, 10 minute duration
- Size of tank

  Tank size = Flow x Duration
  - (Reliable refill rate)

NFSA

Tank Sizing Example 1

159

- Single story home, 1800 sq ft
- TY1234 sprinklers
  - 14 x 14 spacing
  - 11 gpm
- Demand at tank
  - 22 gpm
  - 7 minutes

NFSA

Tank Sizing Example 1

160

- Single story home, 1800 sq ft
- TY1234 sprinklers
  - 14 x 14 spacing
  - 11 gpm
- Demand at tank
  - 22 gpm
  - 7 minutes
- **Tank size = 22 x 7 = 154 gal**

NFSA

Tank Sizing Example 2

161

- Two story home, 4000 sq ft
- GL4248 sprinklers
  - 20 x 20 spacing
  - 20 gpm
- Demand at tank
  - 40 gpm
  - 10 minutes

NFSA

Tank Sizing Example 2

162

- Two story home, 4000 sq ft
- GL4248 sprinklers
  - 20 x 20 spacing
  - 20 gpm
- Demand at tank
  - 40 gpm
  - 10 minutes
- **Tank size = 40 x 10 = 400 gal**

NFSA

Selecting Pipe Size

163

- Four acceptable calculation Methods
  1. NFPA 13
  2. General method
  3. Prescriptive method (similar to IRC P2904)
  4. Network systems

2016 edition: clarified language

NFSA

Selecting Pipe Size

164

- NFPA 13 with 2 variations
  - Count flow straight through tees
  - Compare demand pressure to static pressure
- Required for ½ inch pipe in network system
- Required for loops or grids

NFSA

Interpolation of Tables

165

- The 12-step General Method and the 8-step Prescriptive Method use a lot of tables
- Don't interpolate unless the standard permits
  - Tables 10.4.9.2(c) through (h)

NFSA

Prescriptive Pipe Sizing Method

166

1. Determine P_{sup} – static water supply pressure
2. Determine PL_{svc} – pressure loss in the service pipe, Table 10.4.9.2(a)
3. Determine PL_m – meter loss Table 10.4.3(a)
4. Determine PL_d – loss from other devices (backflow, filter, PRV, softener)
5. Determine PL_e – loss due to elevation, Table 10.4.9.2(b)
6. Determine PL_{sp} – pressure needed for sprinkler

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Prescriptive Pipe Sizing Method

167

7. Calculate PL_t – pressure available for friction loss
8. Determine maximum allowable pipe length, Tables 10.4.9.2(c) through (h)

$$PL_t = P_{sup} - PL_{svc} - PL_m - PL_d - Pl_e - PL_{sp}$$

NFSA

Prescriptive Pipe Sizing Method

168

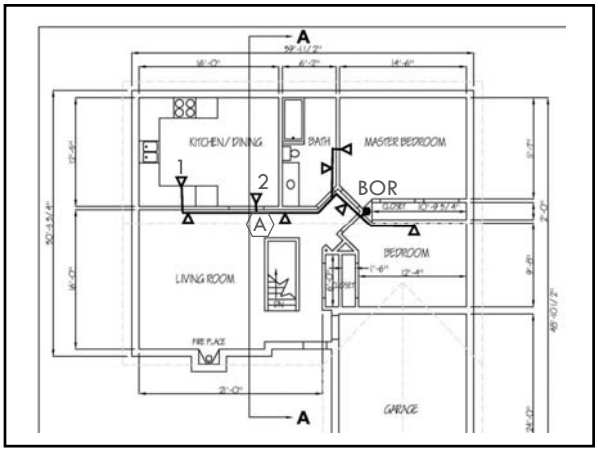
- No special accounting for fittings
  - Friction loss tables for pipe are very conservative and already account for fittings

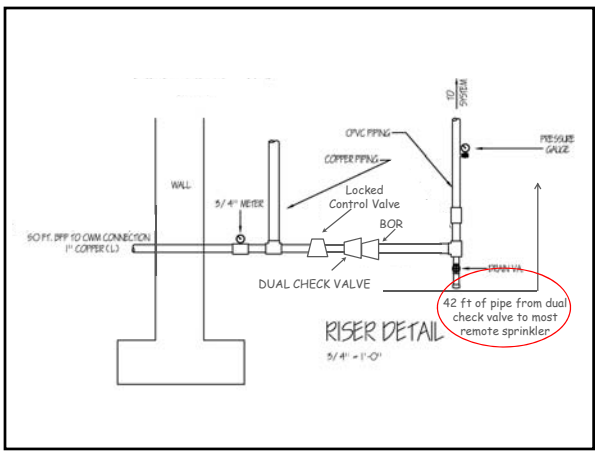
NFSA

Prescriptive Pipe Sizing Method Example

169

- Sprinkler
  - VK486, Recessed HSW (k-4.0)
  - 16 ft x 16 ft listing, 13 gpm, 10.6 psi
- Pipe
  - 1" CPVC above ground
  - 1" Type L copper underground
- ¾ inch meter
- Water Supply
  - 50 ft from the duel check valve
  - Static Pressure of 60 psi





Prescriptive Pipe Sizing Method Example

172

1. P_{sup} = 60 psi
2. PL_{svc} : Table 10.4.9.2(a) Water Service Pressure Loss (PL_{svc})

Flow Rate* (gpm)	¾ in. Water Service Pressure Loss (psi)				1 in. Water Service Pressure Loss (psi)			
	40 ft or less	41 ft to 75 ft	76 ft to 100 ft	101 ft to 150 ft	40 ft or less	41 ft to 75 ft	76 ft to 100 ft	101 ft to 150 ft
8	5.1	8.7	11.9	17.4	1.5	2.5	3.4	5.1
10	7.7	13.1	17.8	26.5	2.3	3.8	5.2	7.7
12	10.8	18.4	24.9	NP	3.2	5.4	7.3	10.7
14	14.4	24.5	NP	NP	4.2	7.1	9.6	14.3
16	18.4	NP	NP	NP	5.4	9.1	12.4	18.3
18	22.9	NP	NP	NP	6.7	11.4	15.4	22.7
20	27.8	NP	NP	NP	8.1	13.8	18.7	27.6
22	NP	NP	NP	NP	9.7	16.5	22.3	NP
24	NP	NP	NP	NP	11.4	19.3	26.2	NP
26	NP	NP	NP	NP	13.2	22.4	NP	NP
28	NP	NP	NP	NP	15.1	25.7	NP	NP
30	NP	NP	NP	NP	17.2	NP	NP	NP
32	NP	NP	NP	NP	19.4	NP	NP	NP
34	NP	NP	NP	NP	21.7	NP	NP	NP
36	NP	NP	NP	NP	24.1	NP	NP	NP

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Prescriptive Pipe Sizing Method Example

173

3. PL_m = 14 psi
4. PL_d = 2.2 psi (dual check valve)
5. PI_e = 6.5 psi

Table 10.4.9.2(b) Elevation Loss (PL_e)

Elevation (ft)	Pressure Loss (psi)
5	2.2
10	4.4
15	6.5
20	8.7
25	10.9
30	13.0
35	15.2
40	17.4

ONFSA

Prescriptive Pipe Sizing Method Example

174

6. PL_{sp} = 10.6 psi
7. $PL_t = P_{sup} - PL_{svc} - PL_m - PL_d - PI_e - PL_{sp}$

$PL_t = 60 - 22.4 - 14 - 2.2 - 6.5 - 10.6$

$PL_t = 4.3$ psi

ONFSA

Table 10.4.9.2(f) for 1" CPVC

175

Sprinkler Flow Rate* (gpm)	Water Distribution Size (in.)	Available Pressure, P, (psi) 15	20	25	30	35	40	45
		Allowable Length of Pipe from Service Valve to Furth						
8	1	1040	1398	1748	2098	2447	2797	3146
9	1	843	1125	1406	1687	1968	2249	2530
10	1	694	925	1157	1388	1619	1851	2082
11	1	582	770	970	1164	1358	1552	1746
12	1	495	660	826	991	1156	1321	1486
13	1	427	570	712	854	997	1139	1281
14	1	372	497	621	745	869	993	1117
15	1	328	437	546	656	765	874	983
16	1	291	388	485	582	679	776	873
17	1	260	347	433	520	607	693	780
18	1	234	312	390	468	546	624	702
19	1	212	282	353	423	494	565	636
20	1	193	257	321	385	449	513	578
21	1	176	235	293	352	410	469	528
22	1	161	215	269	323	377	430	484
23	1	149	198	248	297	347	396	446
24	1	137	183	229	275	321	366	412
25	1	127	170	212	255	297	340	382
26	1	118	158	197	237	276	316	355
27	1	111	147	184	221	258	295	332
		158	172	207	241	275	310	
		129	161	194	226	258	290	
		121	152	182	212	242	273	

PL_t = 4.3 psi

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Challenges with Example

176

- Can't use this layout because you need P_t to be at least 15 psi to use the table
- Change incoming service to 1¼"
- Changes PL_{svc} from 22.4 to 8.5 psi

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Prescriptive Pipe Sizing Method Example

177

Table 10.4.9.2(g)

Flow Rate* (gpm)	1 in. Water Service Pressure Loss (psi) 40 ft or less	41 ft to 75 ft	76 ft to 100 ft	101 ft to 150 ft	1¼ in. Water Service Pressure Loss (psi) 40 ft or less	41 ft to 75 ft	76 ft to 100 ft	101 ft to 150 ft
8	1.5	2.5	3.4	5.1	0.6	1.0	1.3	1.9
10	2.3	3.8	5.2	7.7	0.8	1.4	2.0	2.9
12	3.2	5.4	7.3	10.7	1.2	2.0	2.7	4.0
14	4.2	7.1	9.6	14.3	1.6	2.7	3.6	5.4
16	5.4	9.1	12.4	18.3	2.0	3.4	4.7	6.9
18	6.7	11.4	15.4	22.7	2.5	4.3	5.8	8.6
20	8.1	13.8	18.7	27.6	3.1	5.2	7.0	10.4
22	9.7	16.5	22.3	NP	3.7	6.2	8.4	12.4
24	11.4	19.3	26.2	NP	4.3	7.3	9.9	14.6
26	13.2	22.4	NP	NP	5.0	8.5	11.4	16.9
28	15.1	25.7	NP	NP	5.7	9.7	13.1	19.4
30	17.2	NP	NP	NP	6.5	11.0	14.9	22.0
32	19.4	NP	NP	NP	7.3	12.4	16.8	24.8
34	21.7	NP	NP	NP	8.2	13.9	18.8	NP
36	24.1	NP	NP	NP	9.1	15.4	20.9	NP

ONFSA

1 ¼ Inch Water Service

178

- Changes PL_{svc} from 22.4 to 8.5 psi

$PL_t = 60 - 8.5 - 14 - 2.2 - 6.5 - 10.6$

$PL_t = 18.2$ psi

NFSA

Table 10.4.9.2(f) for 1" CPVC

179

Sprinkler Flow Rate* (gpm)	Water Distribution Size (in.)	Available Pressure, P, (psi) 15	20	25	30	35	40	45
		Allowable Length of Pipe from Service Valve to Each						
8	1	1049	1398	1748	2098	2447	2797	3146
9	1	843	1125	1406	1687	1968	2249	2530
10	1	694	925	1157	1388	1619	1851	2082
11	1	582	776	970	1164	1358	1552	1746
12	1	495	660	826	991	1156	1321	1486
13	1	427	570	712	854	997	1139	1281
14	1	372	497	621	745	869	993	1117
15	1	328	437	546	656	765	874	983
16	1	291	388	485	582	679	776	873
17	1	260	347	433	520	607	693	780
18	1	234	312	390	468	546	624	702
19	1	212	282	353	423	494	565	636
20	1	193	257	321	385	449	513	578
21	1	176	235	293	352	410	469	529
22	1	161	215	269	323	377	430	484
23	1	149	198	248	297	347	396	446
24	1	137	183	229	275	321	366	412
25	1	127	170	212	255	297	340	382
26	1	118	158	197	237	276	316	355
27	1	111	147	184	221	258	295	332
		103	138	172	207	241	275	310
		97	129	161	194	226	258	290
		91	121	152	182	212	242	273

$PL_t = 18.2$ psi

NFSA

Prescriptive Pipe Sizing Method Example

180

- Our revised layout will work as long as there is not more than 118 ft of 1" CPVC from the control valve to the most remote sprinkler
- In our layout, the distance to the most remote sprinkler is only 42 ft
- The revised layout works

NFSA

Comparing Demand Calculation to Static Pressure

181

- 10.4.9.2(1) specifically says to use the static pressure for the 8 Step Prescriptive Method
- 10.4.3 implies that it is the static pressure that is used for the 12 Step General Method
- Use of static pressure for calculated systems should be permitted as an equivalency

2016 edition: static pressure only for mains ≥4"

NFSA

Module 8

182

UA NFPA 13D

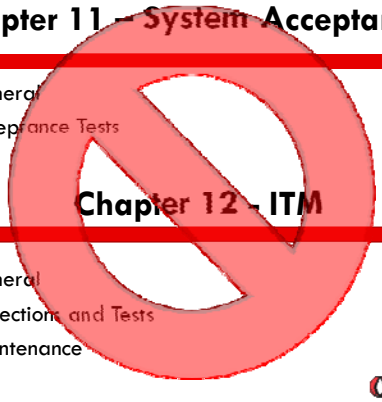
System Acceptance and ITM

NFSA

Chapter 11 – System Acceptance

183

- General
- Acceptance Tests



Chapter 12 – ITM

- General
- Inspections and Tests
- Maintenance

NFSA

Seminar Learning Outcomes

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1. Discuss the scope and application of sprinkler standards for one and two family dwellings and townhomes.
2. Identify the requirements for residential fire sprinkler system installation in accordance with NFSA 13D and IRC P2904.
3. Apply the installation requirements and calculation procedures to various residential layouts.

NFSA

UA NFPA 13D

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Questions?

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