



**FIRE
SPRINKLER
SYSTEM TESTING
AND INSPECTION**

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Fire Protection Plans on Site

SPS 361.34(1) Requires fire suppression and fire alarm plans for projects involving more than 20 sprinklers or fire alarm detection and/or notification devices to be present at the job site and made available to the AHJ.



WI Administrative Code SPS

362.9003(5)(c)

As of July 1, 2014:

Occupancy	Threshold	Exceptions
R, Townhouse	Sprinklers Required	13D for townhouses that comply with <u>all</u> of the following: ≤3 stories in height. Each dwelling unit within the townhouse is properly separated from other dwelling units by at least 1-hour fire-resistive-rated separation walls.*

*The separation wall can not include any plumbing equipment or mechanical equipment within does not have to comply with the structural stability requirements of IBC section 706.2 and the horizontal continuity requirements of IBC section 706.5.

Fire Sprinkler System Testing



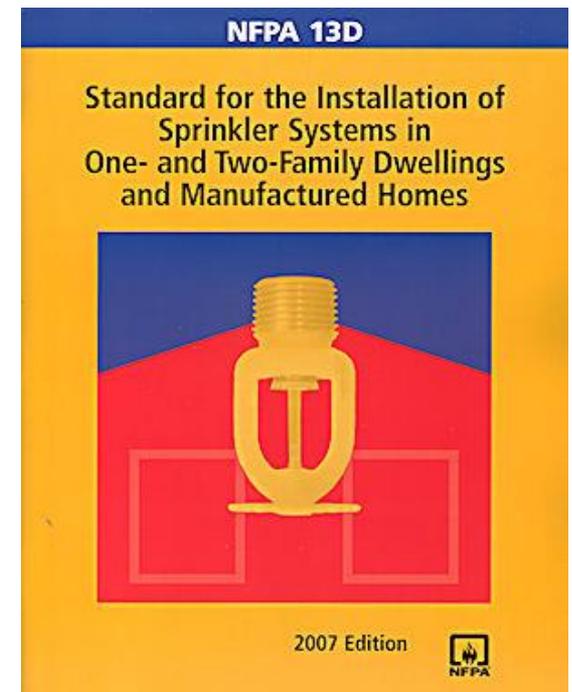
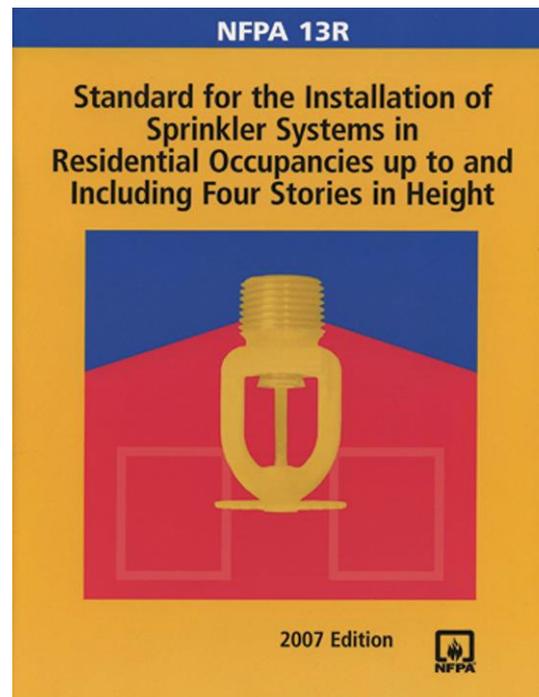
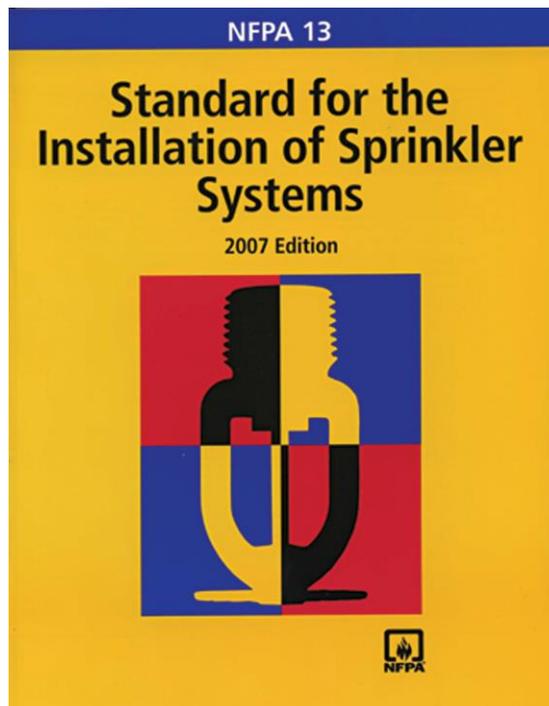
Testing - Subjects Covered

- Applicable Codes & Standards
- Types of Systems
- Underground Supply Testing
- Aboveground System Testing
- Documentation of Testing



Design Standards

- 2007 Editions of NFPA 13, 13R, and 13D



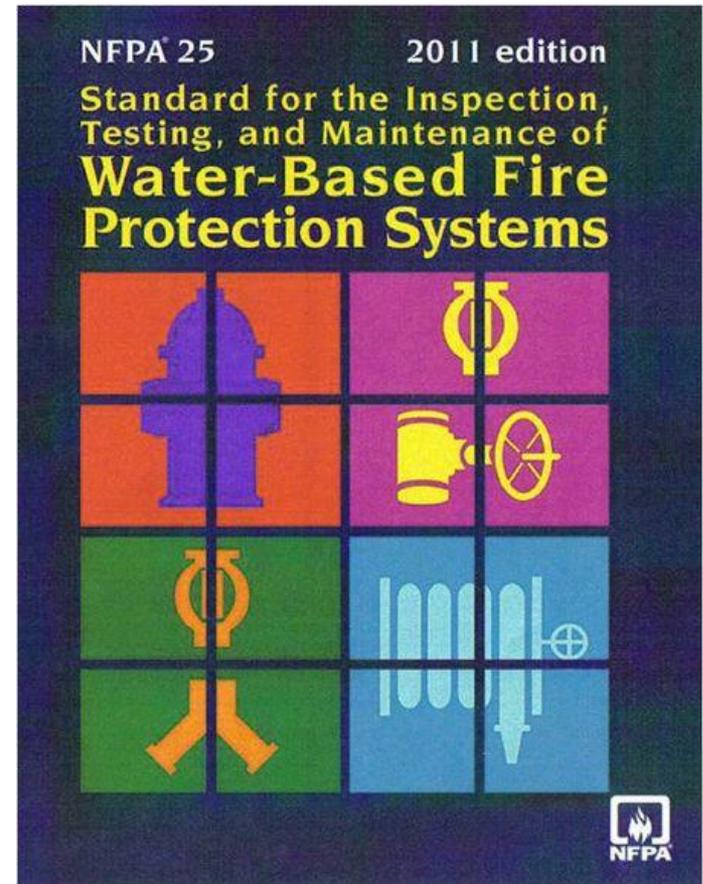
Comparison of Standards

	NFPA 13	NFPA 13R	NFPA 13D
Extent of Protection	Equipped throughout	Occupied Spaces	Occupied Spaces
Scope	All occupancies	Low-rise Residential	One- and two-family dwellings
Sprinkler design	Density/area concept	4-head design	2-head design
Sprinklers	All type	Residential only	Residential only
Duration	30 minutes minimum	30 minutes	10 minutes
Advantage	Property/ Life Safety	Life safety/ tenability	Life safety/ tenability



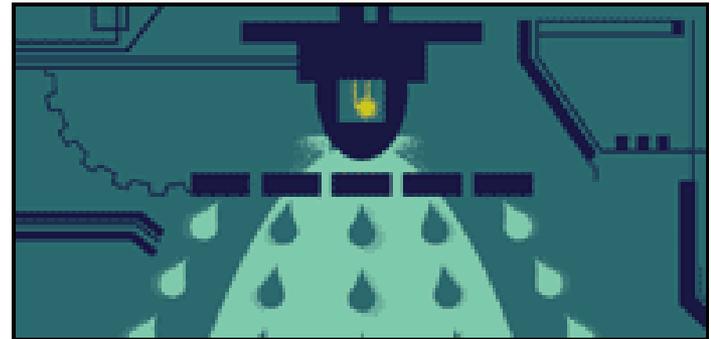
Inspection, Testing and Maintenance Standard

- SPS 314 references NFPA 1 – 2012 edition
- NFPA 1 – 2012 edition references NFPA 25 – 2011 edition for the inspection, testing and maintenance of water based fire protection systems.



Fire Sprinkler System Testing

- Types of Systems
 - Wet System
 - Anti-Freeze System
 - Dry System
 - Pre-action System
 - Deluge System

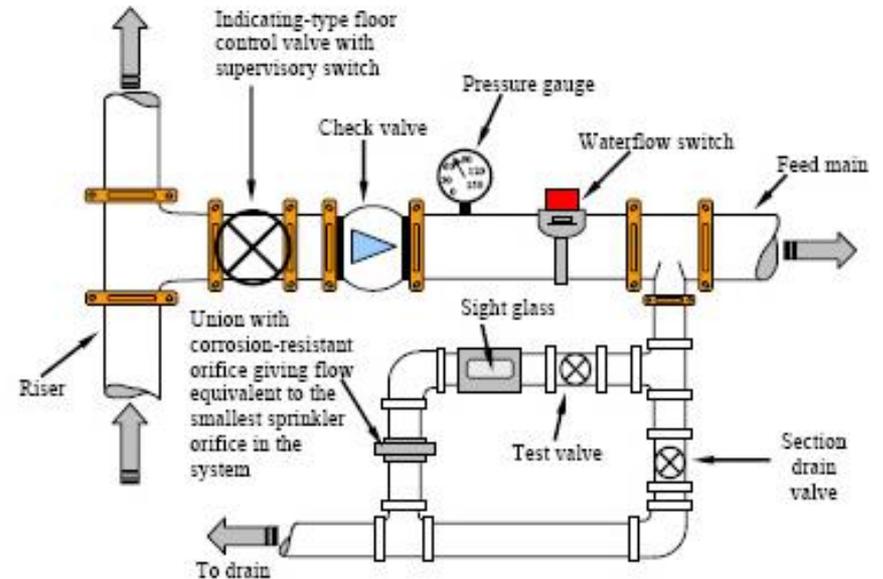
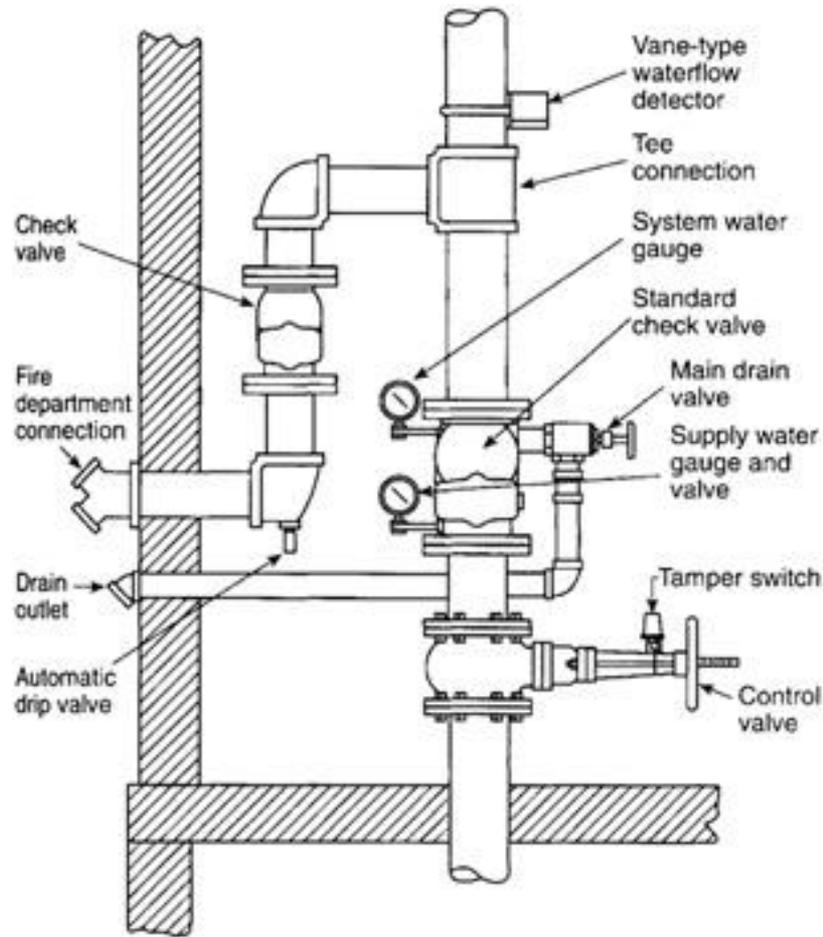


Wet Sprinkler Systems

- A system that employs piping containing water and connected to an automatic supply so that water discharges immediately from sprinklers opened by heat from a fire.



Wet Sprinkler Systems



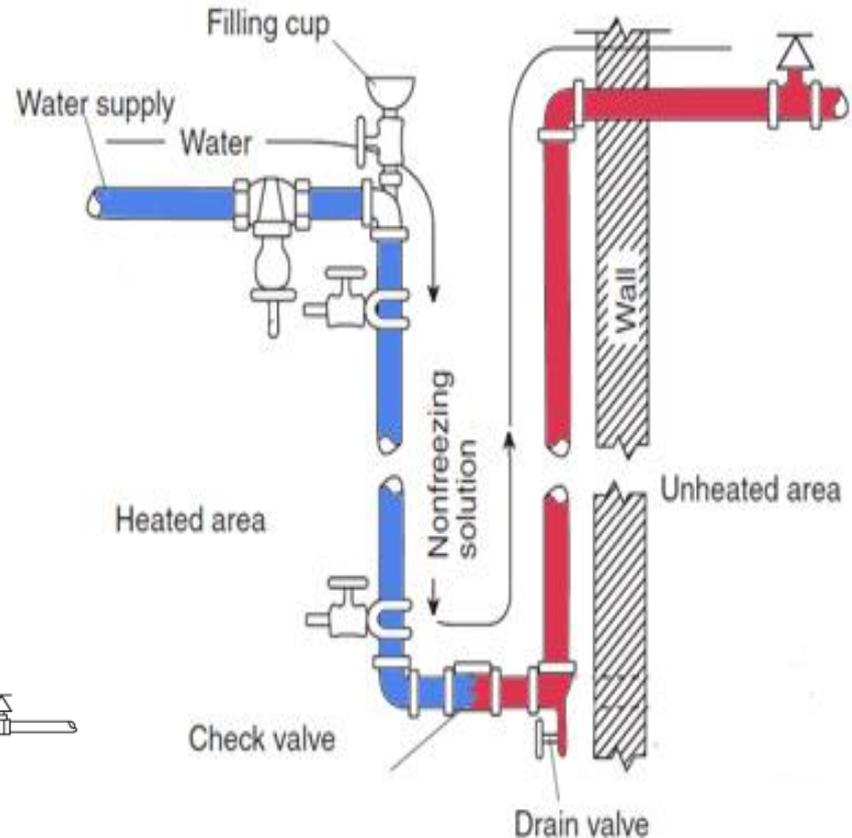
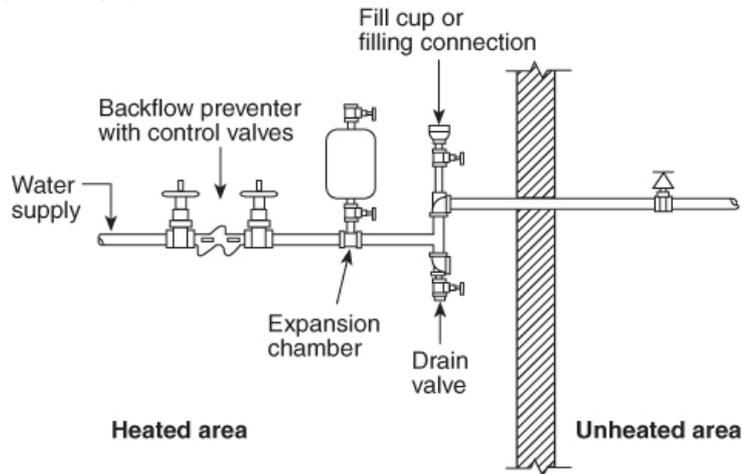
Waterflow Alarms



Paddle-type waterflow alarm indicators shall be installed in wet systems only.

Antifreeze Systems

NFPA 25 5.3.4 The freezing point of solutions in antifreeze shall be tested annually by measuring the specific gravity with a hydrometer or refractometer and adjusting the solution if necessary. See Tables 5.3.4(a) & (b).



Antifreeze TIAs

- Require listed antifreeze solution for all new antifreeze systems. Propylene glycol and glycerin are not permitted for new systems.
 - At the moment there are no listed solutions.
 - Existing systems
 - <30% propylene glycol or <38% glycerin – may remain in place
 - >40% propylene glycol or >50% glycerin – must be drained and replaced or converted to dry
 - “Deterministic Risk Assessments”
 - By 2022 all traditional antifreeze systems will be replaced with listed solutions or use other freeze-protection methods.
-

Antifreeze TIAs (cont...)

- Currently, the State does not adopt TIAs
 - Not recommended as good practice
 - Other Freeze-Protection Methods
 - Dry pipe system
 - Pre-action systems
 - Heat Trace
 - Insulation
 - 2013 Edition of NFPA 13,13R, and 13D as well as 2014 Edition of NFPA 25 adopted TIA language
-

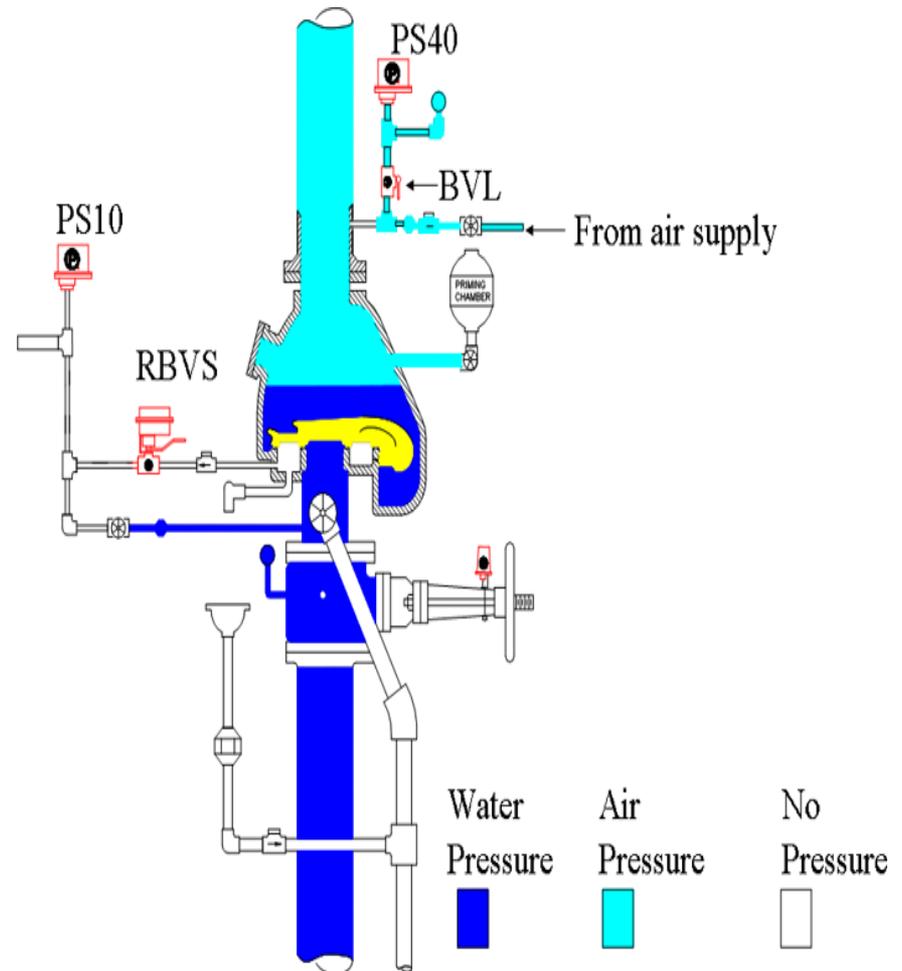
Dry Pipe System



Includes automatic sprinklers attached to a piping system containing air or nitrogen under pressure, the release of which allows the water pressure to open the dry pipe valve allowing water to flow through the system and out the open sprinklers.

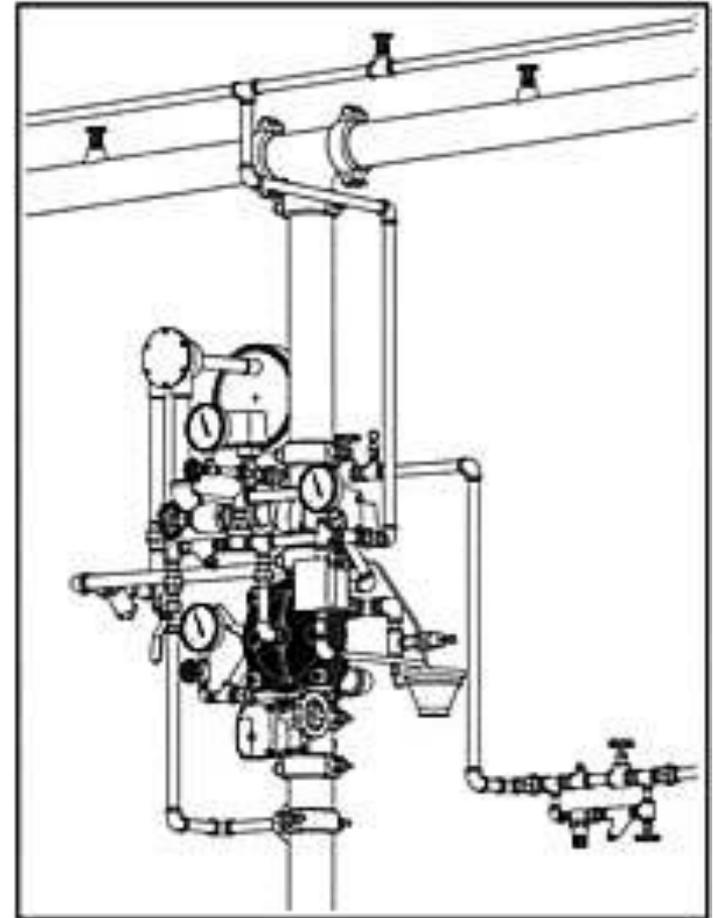
Dry Pipe Systems

- Volume Limitation of 750 gal (exceptions allowed)
- Pipes arranged to facilitate drainage
- Upright sprinkler heads only (see exceptions)
- Can not be gridded
- Valve located in a heated area



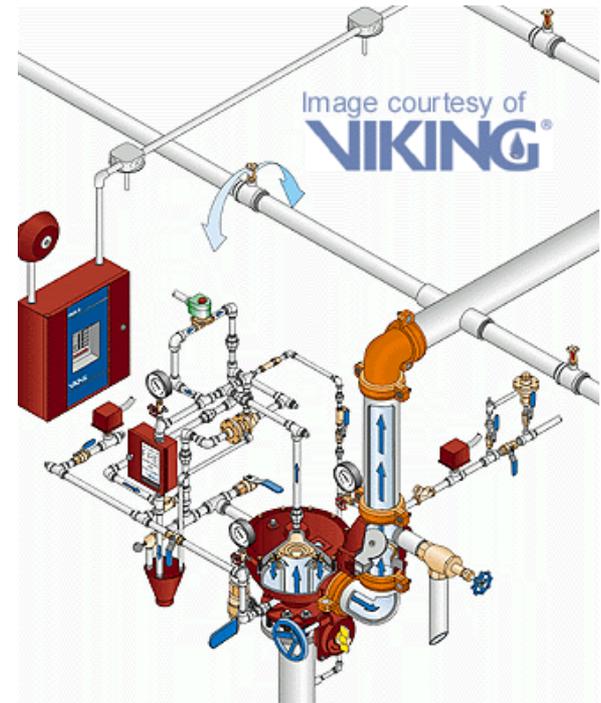
Pre-action Systems

- ❑ Sprinklers attached to a piping system containing air that may be under pressure, with a supplemental detection system installed in the same areas as the sprinklers.
- ❑ Both the detection and the sprinklers must be actuated prior to the release of water.



Pre-action Operation (Electronic Detection)

- If a smoke or heat detector operates, or a pull station is activated...
- The release panel will go into an alarm condition.
- The release circuit will energize.
- This allows water to enter the sprinkler piping.
- Water will be discharged only if a sprinkler now opens.



Single / Double Interlock Pre-action

- Single Interlock Preaction System
 - Admits water into the sprinkler piping upon operation of the detection system.
 - Double Interlock Preaction System
 - Requires operation of both the detection device and the automatic sprinklers.
-

Dry System / Preaction System Air Compressor



The compressed air supply shall be from a source available at all times and have a capacity of restoring air pressure in the system within 30 minutes. (NFPA 13 Section 7.2.6.2)

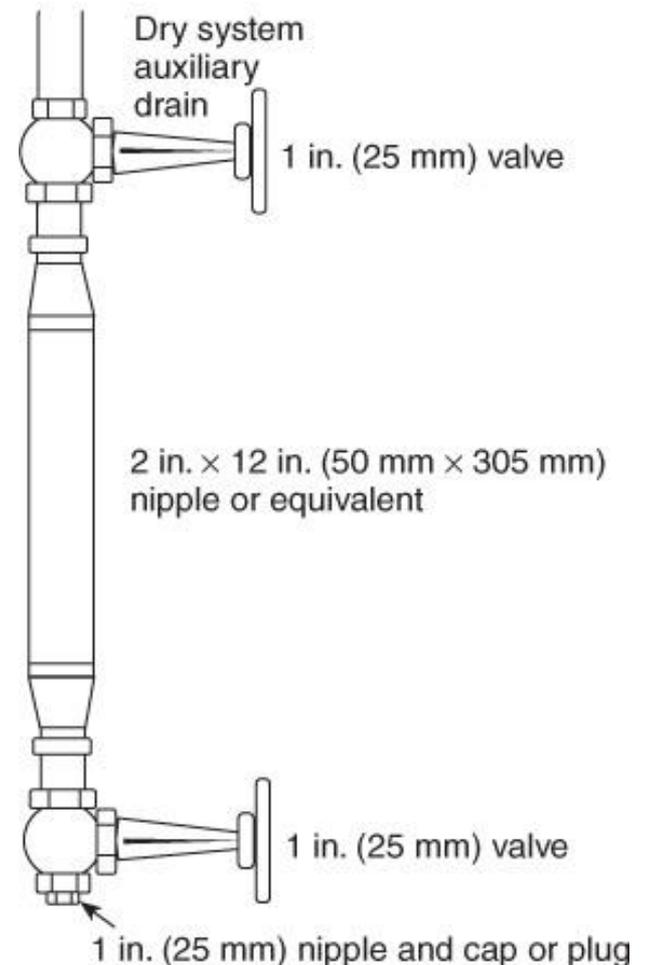
Dry / Preaction System Air Maintenance Device

- Air normally travels through a restricted orifice into the dry / preaction / deluge system.
 - This condition is required to ensure the dry system valve will trip when a sprinkler activates to fight a fire.
 - For returning the system to service, a by-pass valve is utilized to more quickly bring the system back to operating pressure.



Drains on Dry / Preaction Systems

- When installing ensure everything is pitched to drain
- If there are low points, ensure there is a low point drain.
 - All low points shall be drained annually, prior to the onset of freezing weather.
- Drum Drips must have upper valve open and lower closed



Deluge System

- A system employing open sprinklers connected to the water supply through a valve that is opened by the operation of the detection system. When the valve opens, water is discharged immediately through all sprinklers.



Underground Flushing

- Flushed @ hydraulically calculated demand
- Flow necessary for a velocity of 10 ft/sec
- Maximum flow rate available

Table 10.10.2.1.3 Flow Required to Produce a Velocity of 10 ft/sec (3 m/sec) in Pipes

Pipe Size		Flow Rate	
in.	mm	gpm	L/min
4	102	390	1476
6	152	880	3331
8	203	1560	5905
10	254	2440	9235
12	305	3520	13323

[24: Table 10.10.2.1.3]



Underground Pressure Testing

- 200 psi for 2 hours or
- 50 psi above system working pressure
 Whichever is greater
- See NFPA 13 10.10.2.2.4 for permitted leakage



Aboveground Sprinkler Systems Pressure Testing – All Types

- Hydrostatically tested @ 200 psi for 2 hrs
 - Modifications to 20 or fewer sprinklers tested at system pressure
 - Modifications such as relocating drops tested at system pressure
 - Open head deluge sprinkler systems to have heads replaced with plugs and system tested.
-

Tamper Switches

- Verification that the closure of a control valve on the sprinkler system sends a trouble signal to the fire alarm control panel



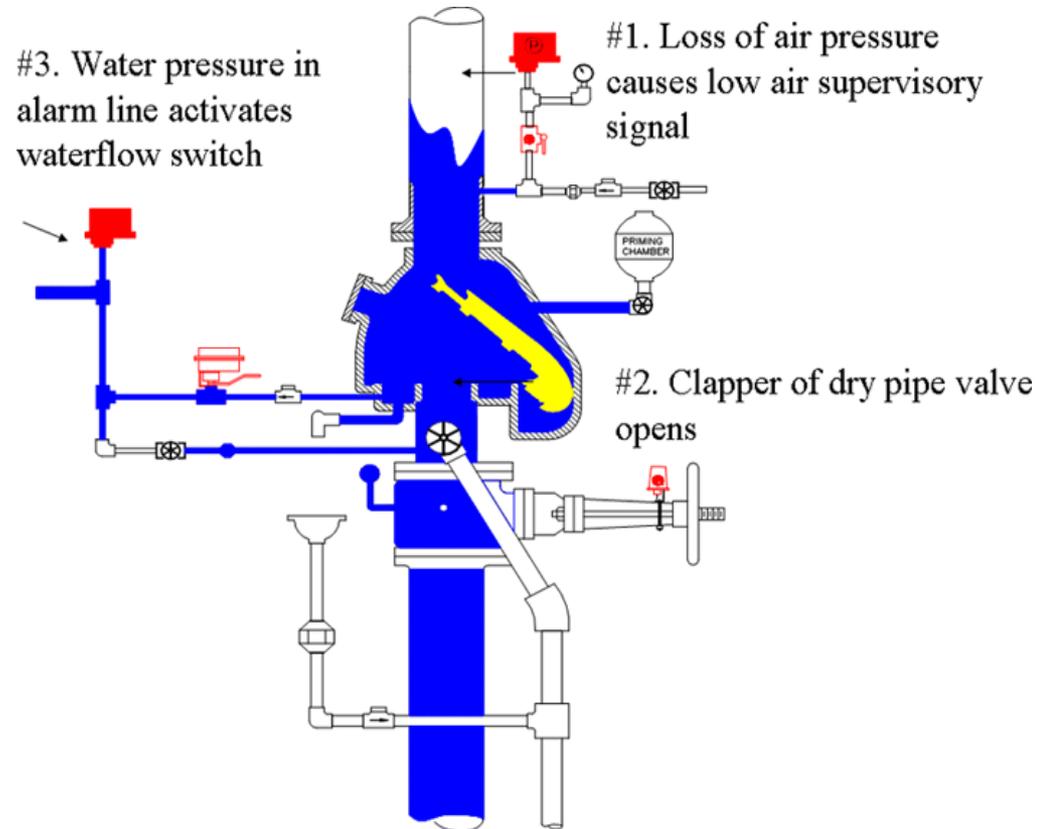
Waterflow Alarms – Wet Systems

- Required on all systems having more than 20 sprinklers.
- Flow of water from an opening equaling a single sprinkler of the smallest orifice on the system shall, within 5 minutes, result in an audible signal on premises.
 - Inspectors test connection



Waterflow / Low Air Alarms – Dry / Preaction / Deluge Systems

- Pressure Actuated Switches (PS10) are designed for the detection of a waterflow condition – Alarm Signal
- The Supervisory Pressure Actuated Switches (PS40) are designed primarily to detect an increase and/or decrease from normal system pressure in automatic fire sprinkler systems – Trouble Signal



Dry / Preaction Sprinkler System Testing

- Systems less than 500 gallons or less than 750 gallons with a quick opening device are not required to meet any specific water delivery requirement.
- If not adhering to these exceptions, water is required to be discharged from the system test connection in not more than 60 seconds
- Alternate water delivery method allowed per NFPA 13 7.2.3.6.

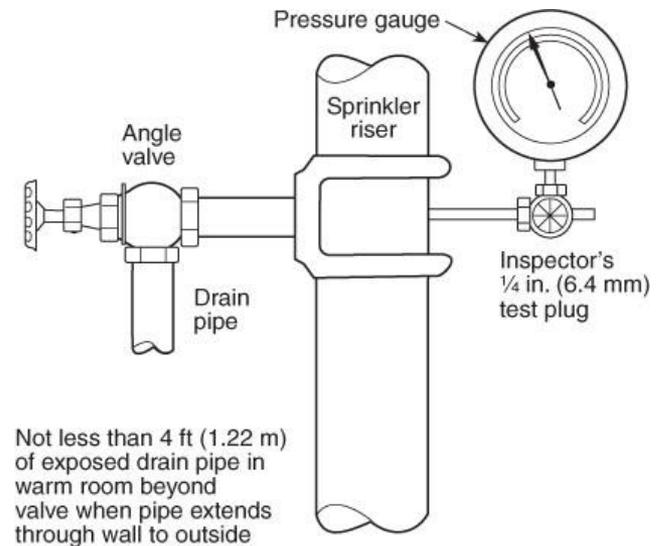


Air Pressure Test – Dry / Double Interlock Preaction Sprinkler Systems

- An air pressure leakage test at 40 psi shall be conducted for 24 hours. Any leakage that results in a loss of pressure in excess of 1 ½ psi for the 24 hours shall be corrected.
 - During freezing temperatures, the initial hydrostatic testing of the dry / double interlock preaction systems can be delayed until freezing temperatures subside.
-

Main Drain Test

- Main Drain test
 - Conducted to verify water supply is consistent with hydraulic calculations
 - Can indicate problems with underground piping system (i.e.: Leaks, Partially closed underground valve, etc.)



Backflow Preventer Test

- Both backflow and full forward flow tests are required to be conducted
- Full forward flow (equal to system demand) must be conducted through one of the following:
 - Piped test connection,
 - Through sprinkler system main drain or,
 - FDC check valve shall be turned around in the pipe to flow through the Fire Department Connection

Double Check/DC Detector Performance Test

Industry Services Division
P.O. Box 780
Madison, WI 53707-7382
Tel: (608) 267-8725
TTY: (608) 264-8777
http://www.dps.wi.gov/23

Personal information you provide may be used for secondary purposes (Privacy Law s. 19.48 (1)(b)).
Please print clearly in ballpoint pen. Additional information on back page.

OWNER INFORMATION
Owner Name _____ Street Address _____
City _____ State _____ Zip Code _____ Owner's Contact Person _____ Telephone Number _____

FACILITY INFORMATION
Facility Name _____ Street Address _____
City _____ State _____ Zip Code _____ County _____
Assembly Location _____
Manufacturer _____ Model _____ Serial Number _____
Size _____ Assembly Type DC DC Detector

INITIAL TEST
First check Closed light Leaked Static _____ PSID _____
Second check Closed light Leaked Static _____ PSID _____

FINAL TEST
Closed light Leaked Static _____ PSID _____
Closed light Leaked Static _____ PSID _____

DETECTOR BYPASS ASSEMBLY INITIAL TEST
First check Closed light Leaked Static _____ PSID _____
Second check Closed light Leaked Static _____ PSID _____

DETECTOR BYPASS ASSEMBLY FINAL TEST
Closed light Leaked Static _____ PSID _____
Closed light Leaked Static _____ PSID _____

ASSEMBLIES IN FIRE PROTECTION SYSTEMS
Expanded Flow Test: Note: Include hose stream demand where applicable.
Designed flow rate _____ GPM Actual flow rate _____ GPM
Indicating Control Valves: No. one control valve open No. two control valve open Valve supervision: Tamper switch Locked
Part (s) Replaced/Comments _____

I HEREBY CERTIFY THE TEST RESULTS ARE TRUE AND THE TEST WAS CONDUCTED BY ME PERSONALLY.
Tester Name (print) _____ Registration No. _____ Time of Day _____
Tester Signature _____ Phone No. _____ Date _____

88D-10754 R03/13

White Copy - Owner, Pink Copy - Purchaser, Yellow Copy - Tester

Owner Information

The backflow preventer is a mechanical device designed to protect the potable water supply system from being contaminated. There is a physical connection to equipment or water of either unknown or questionable quality, thereby requiring the installation of the backflow preventer. In order to ensure that this device is working as designed, it must be periodically tested.

A test shall be conducted on each backflow preventer prior to it being put into service, after any repairs, and a minimum of once a year thereafter.

It is the responsibility of the owner to make sure the device is tested. The test shall be performed by a department registered Cross Connection Control Device tester.

Owner's Contact Person: The owner's contact person is the name of the person responsible for the backflow preventer maintenance and records. (Note: Please provide full name.)

Old Valve Replacement Information

If this test is for a replacement valve, please include all information for the replacement valve on this form. The manufacturer, model no., serial no., size, and the assembly type of the "old" valve must include on the comment line of this form.

Double Check Valves and Double Detector Check Valves Installed in Fire Protection Systems

A copy of this completed test must be attached to or located near the double check valve or double detector check valve.

Minimum Requirements for Passing Test

- DC and DC Detector
 - The first check must close tight, and have a minimum static 1 PSID.
 - The second check must close tight, and have a minimum static 1 PSID.

Do not send a copy of this report to the Industry Services Division. Copies of this report shall be distributed to the following: owner, purchaser, and tester.

88D-10754 R03/13

White Copy - Owner, Pink Copy - Purchaser, Yellow Copy - Tester



Fire Sprinkler System Test Certificate

- Aboveground / Underground Test Certificate
 - Copy of NFPA 25 to be supplied to the owner

Contractor's Material and Test Certificate for Aboveground Piping

Insert logo here

Contractor's Material and Test Certificate for Aboveground Piping						
PROCEDURE Upon completion of work, inspection and tests shall be made by the contractor's representative and witnessed by the property owner or their authorized agent. All defects shall be corrected and system left in service before contractor's personnel finally leave the job. A certificate shall be filed out and signed by both representatives. Copies shall be prepared for approving authorities, owners, and contractor. It is understood the owner's representative's signature in no way prejudices any claim against contractor for faulty material, poor workmanship, or failure to comply with approving authority's requirements or local ordinances.						
Property name		Date				
Property address						
Accepted by approving authorities (names)						
Address						
Plans Installation conforms to accepted plans <input type="checkbox"/> Yes <input type="checkbox"/> No Equipment used is approved <input type="checkbox"/> Yes <input type="checkbox"/> No If no, state deviations _____						
Has person in charge of fire equipment been instructed as to location of control valves and care and maintenance of this new equipment? <input type="checkbox"/> Yes <input type="checkbox"/> No If no, explain _____						
Instructions Have copies of the following been left on the premises? 1. System components instructions <input type="checkbox"/> Yes <input type="checkbox"/> No 2. Care and maintenance instructions <input type="checkbox"/> Yes <input type="checkbox"/> No 3. NFPA 25 <input type="checkbox"/> Yes <input type="checkbox"/> No 4. With whom have the copies been left?						
Location of system Supplies buildings						
Sprinklers						
	Make	Model	Year of manufacture	Office size	Quantity	Temperature rating
Pipes and fittings						
Type of pipe _____						
Type of fittings _____						
Alarm valve or flow indicator						
	Type	Alarm device	Make	Model	Maximum time to operate through test connection	
					Minutes	Seconds

Contractor's Material and Test Certificate for Aboveground Piping

Dry pipe operating test	Dry valve				O.D.D					
	Make	Model	Serial No.	Make	Model	Serial No.				
	Time to trip through test connection**	Water pressure	Air pressure	Time post air pressure	Time water reached test outlet**	Alarm operated properly				
	Minutes	Seconds	psi	psi	psi	Minutes	Seconds	Yes	No	
	Without O.D.D									
	With O.D.D									
If no, explain _____										
Operation <input type="checkbox"/> Pneumatic <input type="checkbox"/> Electric <input type="checkbox"/> Hydraulics										
Piping supervised <input type="checkbox"/> Yes <input type="checkbox"/> No Detending media supervised <input type="checkbox"/> Yes <input type="checkbox"/> No										
Does valve operate from the manual trip, remote, or both control stations? <input type="checkbox"/> Yes <input type="checkbox"/> No										
Is there an accessible facility in each circuit? <input type="checkbox"/> Yes <input type="checkbox"/> No										
If no, explain _____										
Deluge and preaction valves										
	Make	Model	Does each circuit operate suppression loss alarm?	Does each circuit operate valve release?	Maximum time to operate					
			Yes	No	Minutes	Seconds				
Pressure-reducing valve test										
	Location and floor	Make and model	Setting	Static pressure	Residual pressure (flowing)	Flow rate				
				Inlet (psi)	Outlet (psi)	Inlet (psi)	Outlet (psi)	Flow (gpm)		
Test description										
Hydraulic: Hydraulic tests shall be made at not less than 200 psi (13.6 bar) for 2 hours or 50 psi (3.4 bar) above static pressure in excess of 100 psi (7.0 bar) for 2 hours. Differential dry pipe valve clappers shall be left open during the test to prevent damage. All aboveground piping leakage shall be stopped.										
Pneumatic: Establish 40 psi (2.7 bar) air pressure and measure drop, which shall not exceed 1 1/2 psi (0.1 bar) in 24 hours. Test pressure tanks at normal water level and air pressure and measure air pressure drop, which shall not exceed 1 1/2 psi (0.1 bar) in 24 hours.										
All piping hydraulically tested at _____ psi (_____ bar) for _____ hours if no, state reason _____										
Dry piping pneumatically tested <input type="checkbox"/> Yes <input type="checkbox"/> No										
Equipment operates properly <input type="checkbox"/> Yes <input type="checkbox"/> No										
Do you certify as the sprinkler contractor that additives and corrosive chemicals, sodium silicate or derivatives of sodium silicate, lime, or other corrosive chemicals were not used for testing systems or stopping leaks? <input type="checkbox"/> Yes <input type="checkbox"/> No										
Tests										
	Drain test	Reading of gauge located near water supply	Residual pressure with valve in test connection							
		psi	psi	bar	open valve	psi	bar			
		Underground mains and lead-in connections to system risers flushed before connection made to sprinkler piping								
		Verified by copy of the Contractor's Material and Test Certificate for Underground Piping								
		Flushed by installer of underground sprinkler piping								
		If powder-driven fasteners are used in concrete, has representative sample testing been satisfactorily completed?								
		<input type="checkbox"/> Yes <input type="checkbox"/> No		If no, explain _____						

** Measured from line inspector's test connection as opened

** NFPA 13 only requires the 60-second limitation in specific sections

Contractor's Material and Test Certificate for Aboveground Piping

Blank testing gaskets	Number used	Locations	Number removed
Welding piping <input type="checkbox"/> Yes <input type="checkbox"/> No			
If yes, _____			
Do you certify as the sprinkler contractor that welding procedures used complied with the minimum requirements of AWS B2.1, ASME Section IX Welding and Brazing Qualifications, or other applicable qualification standard as required by the AHJ? <input type="checkbox"/> Yes <input type="checkbox"/> No			
Do you certify that all welding was performed by welders or welding operators qualified in accordance with the minimum requirements of AWS B2.1, ASME Section IX Welding and Brazing Qualifications, or other applicable qualification standard as required by the AHJ? <input type="checkbox"/> Yes <input type="checkbox"/> No			
Do you certify that the welding was conducted in compliance with a documented quality control procedure to ensure that (1) all dices are relieved, (2) that openings in piping are smooth, that slag and other welding residue are removed, (3) the internal diameters of piping are not penetrated, (4) completed welds are free from cracks, incomplete fusion, surface porosity greater than 1/32 in. diameter, undercut deeper than the lesser of 25% of the wall thickness or 1/16 in., and (5) completed circumferential butt-weld reinforcement does not exceed 1/16 in.?			
If no, explain _____			
Colourts (discs) Do you certify that you have a control feature to ensure that all colourts (discs) are retrieved? <input type="checkbox"/> Yes <input type="checkbox"/> No			
Nameplate provided <input type="checkbox"/> Yes <input type="checkbox"/> No			
If no, explain _____			
Sprinkler contractor removed all caps and straps? <input type="checkbox"/> Yes <input type="checkbox"/> No			
Remarks Date left in service with all control valves open _____			
Name of sprinkler contractor _____			
Signatures			
The property owner or their authorized agent (sign) _____		Title _____	Date _____
For sprinkler contractor (signed) _____		Title _____	Date _____
Additional explanation and notes _____			

What Should Be Inspected?

- Water Supply
- Control Valves & Other Valves
- Fire Department Connection
- Alarm
- Piping & Sprinklers
- Inspector's Test



Water Supply

- One or More Required per System
 - Municipal Water Main
 - Storage Reservoir
 - Pressure Tank
 - Gravity Tank



Inspecting the Underground

- Cannot be Smaller than the Riser (Minimum 6” for combined systems and when supplying hydrants)
 - Must be Protected Against Freezing (Min 48” bury)
 - Must be Flushed Before Connected to Above Ground Piping
 - Hydrants also required to be flushed and lubricated
 - Must be Hydrostatically Tested
-

Gauges

- Wet System: The pressure gauge should be located on the system side of the backflow prevention device.
- Dry System: The pressure above the dry valve should be lower than the reading on the gauge below the valve. Typically close to a 6:1 ratio.



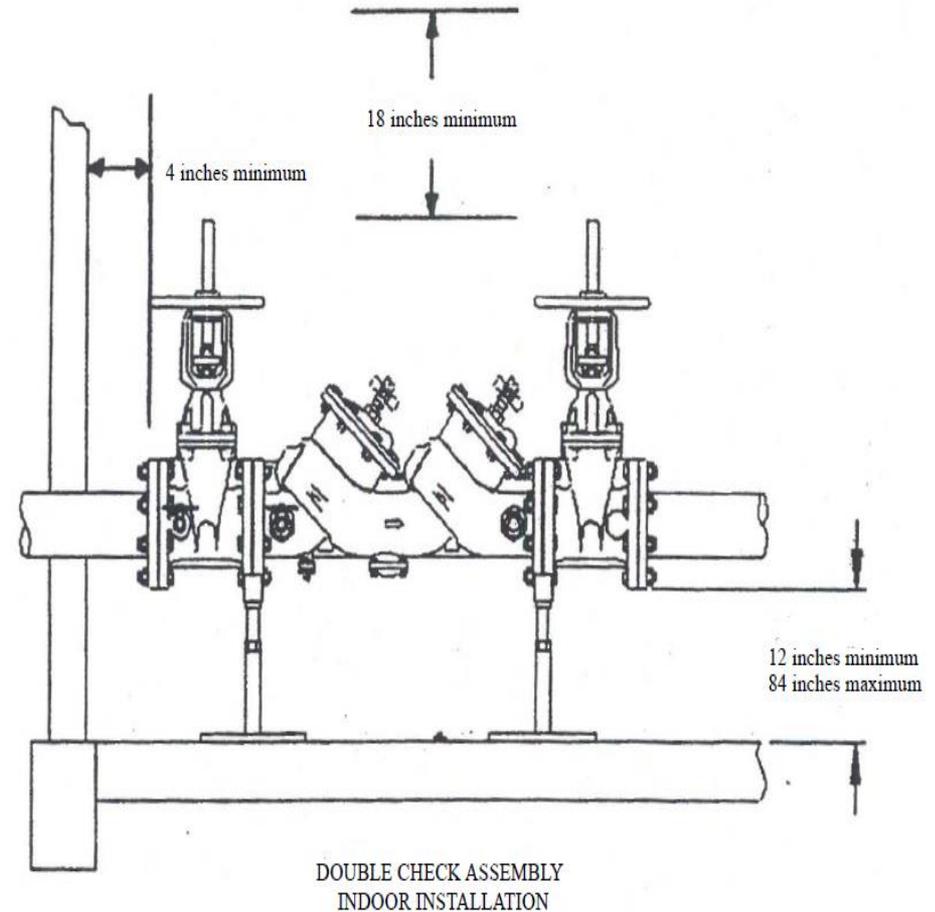
Valves

- Control valves:
 - Must be listed
 - Must be indicating type
- Backflow prevention
 - Double check valve assembly
- Must be supervised:
 - New systems: supervision by alarm system
 - Existing systems can have a lock and chain

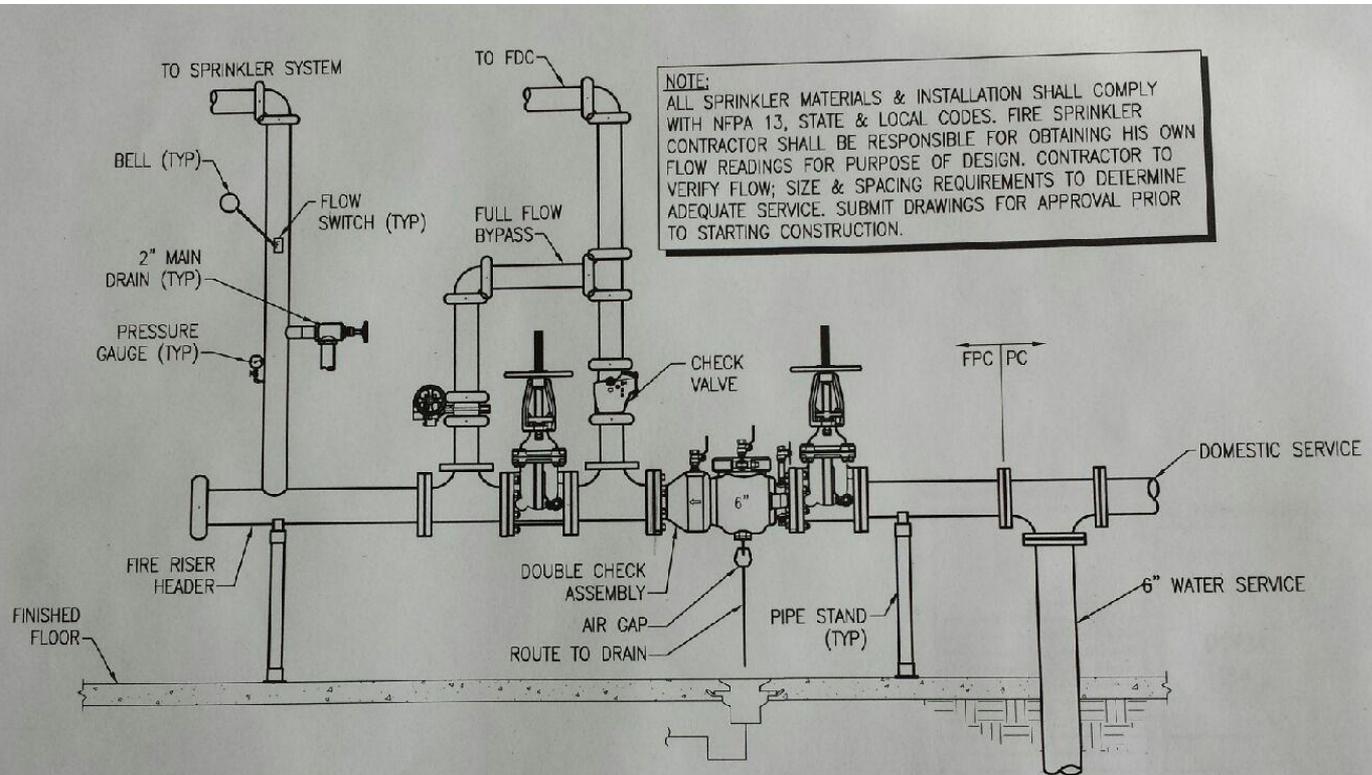


Backflow Preventer

- Distance between the floor/platform and the lowest point of the assembly
 - ≥ 12 inches and ≤ 7 feet
- Distance between a ceiling or other obstruction and the highest point of the assembly
 - ≥ 18 inches
- Distance between a wall or other obstruction and the back of the assembly
 - ≥ 4 inches
- Distance between a wall or other obstruction and the front of the assembly
 - ≥ 24 inches



What's Wrong with this Plan?!?



2 FIRE SPRINKLER RISER DIAGRAM
NOT TO SCALE

Fire Department Connections

- Location is acceptable to local fire chief
- FDC is accessible
- Mounting height 18" to 48" above grade
- Caps in place to protect inlets
- Where there is more than one source of water supply, a check valve shall be installed in each connection.



No Alarms Outside?

- NFPA 13 Section 6.9.3.1
 - Outside alarms can be omitted where the sprinkler system is used as part of a central station, auxiliary, remote station, or proprietary signaling fire alarm system utilizing listed audible inside alarm devices.

Alarms Outside Required

- **IBC 903.4.2 Alarms**
- Approved audible devices shall be connected to every automatic sprinkler system . Such sprinkler waterflow alarm devices shall be activated by waterflow equivalent to the flow of a single sprinkler of the smallest orifice size installed in the system. **Alarm devices shall be provided on the exterior of the building in an approved location.** Where a fire alarm system is installed, actuation of the automatic sprinkler system shall actuate the building fire alarm system.



Sprinkler System Monitoring

- **IBC 901.6.1** Required automatic sprinkler systems shall be monitored by an approved supervising station.



Sprinkler System Monitoring

- Per NFPA 72 – 2007 edition, sprinkler system monitoring is considered a Supervising Station Fire Alarm System.
 - A single pull station is required at a location acceptable to the authority having jurisdiction.
 - If the area where the FACP is located is protected by the sprinkler system, a smoke detector is not required to be provided.
-

Sprinkler System Monitoring / Fire Alarm System Communication Methods

- Cellular communication between the fire alarm control panel and the supervising station is acceptable when adhering the NFPA 72 (2007) 8.6.4 (Alternate Communication Method) and subject to the following additional criteria:
 - A DACT is not utilized with the alternate communication method (not allowed per NFPA 72 (2007) 8.6.3.2.1.4(A)).
 - Documentation is provided to the AHJ proving the cellular signal at the fire alarm control panel location is of adequate strength and reliability.



Sprinklers

- Temperature of Sprinkler
 - Type of Sprinkler
 - Spacing of Sprinklers
 - Obstructions around Sprinklers
 - Physical Damage to Sprinklers
 - Painting or Coating of Sprinkler
 - Provide Extra Sprinklers
-

Sprinklers

- Several thousand different sprinklers available
 - Only new sprinklers allowed
 - Specific application sprinklers used per listing
 - Coatings or finishes must be factory applied
 - Frame arms must be parallel to pipe
 - Deflectors must be parallel to ceiling or deck
 - Distance between deflector and storage
minimum 18 inches (exception)
 - Area per sprinkler per NFPA 13 or listing
-

Temperature of Sprinklers

Maximum Ceiling Temp. (°F)	Temperature Rating (°F)	Temperature Classification
100	135-170	Ordinary
150	175-225	Intermediate
225	250-300	High
300	325-375	Extra High
375	400-475	Very Extra High
475	500-575	Ultra High
625	650	Ultra High



135 °F



155 °F



175 °F



200 °F



280 °F



300 °F

* {

} *

** Residential Sprinklers* ** Quick Response Sprinklers*

Temperature of Sprinklers - Solder Link

- Frame arms of sprinklers color indicates temperature
 - Ordinary Temperature Classification
 - None
 - Intermediate Temperature Classification
 - White
 - High Temperature Classification
 - Blue



Temperature of Sprinklers

Table 8.3.2.5(a) Temperature Ratings of Sprinklers Based on Distance from Heat Sources

Type of Heat Condition	Ordinary Degree Rating	Intermediate Degree Rating	High Degree Rating
(1) Heating ducts			
(a) Above	More than 2 ft 6 in.	2 ft 6 in. or less	
(b) Side and below	More than 1 ft 0 in.	1 ft 0 in. or less	
(c) Diffuser	Any distance except as shown under Intermediate Degree Rating column	<i>Downward discharge:</i> Cylinder with 1 ft 0 in. radius from edge extending 1 ft 0 in. below and 2 ft 6 in. above <i>Horizontal discharge:</i> Semicylinder with 2 ft 6 in. radius in direction of flow extending 1 ft 0 in. below and 2 ft 6 in. above	
(2) Unit heater			
(a) Horizontal discharge		<i>Discharge side:</i> 7 ft 0 in. to 20 ft 0 in. radius pie-shaped cylinder (see Figure 8.3.2.5) extending 7 ft 0 in. above and 2 ft 0 in. below heater; also 7 ft 0 in. radius cylinder more than 7 ft 0 in. above unit heater	7 ft 0 in. radius cylinder extending 7 ft 0 in. above and 2 ft 0 in. below unit heater
(b) Vertical downward discharge (for sprinklers below unit heater, see Figure 8.3.2.5)		7 ft 0 in. radius cylinder extending upward from an elevation 7 ft 0 in. above unit heater	7 ft 0 in. radius cylinder extending from the top of the unit heater to an elevation 7 ft 0 in. above unit heater
(3) Steam mains (uncovered)			
(a) Above	More than 2 ft 6 in.	2 ft 6 in. or less	
(b) Side and below	More than 1 ft 0 in.	1 ft 0 in. or less	
(c) Blowoff valve	More than 7 ft 0 in.		7 ft 0 in. or less

For SI units, 1 in. = 25.4 mm; 1 ft = 0.3048 m.

Temperature of Sprinklers

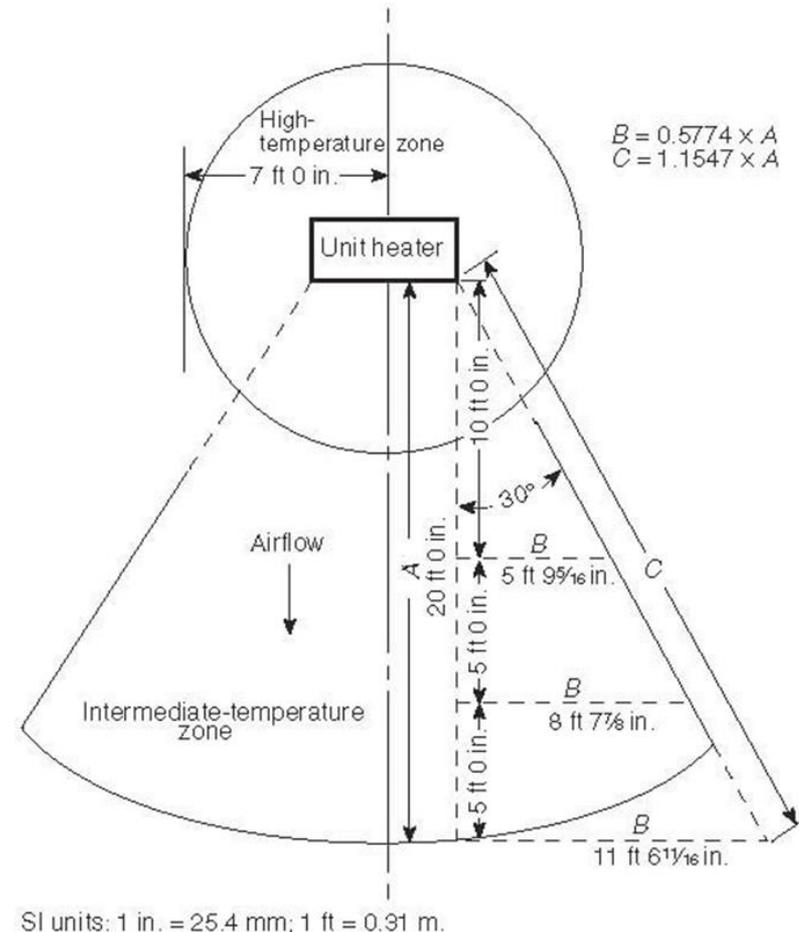
■ Unit Heater

□ Horizontal Discharge

- 7'-0" radius from centerline of unit heater – high temperature
- 30 degrees out from edge of heater to 20' away – intermediate temperature

□ Vertical Discharge

- 7'-0" radius above heater to 7'-0" above and 2'-0" below heater – high temperature
- 7'-0" radius over 7'-0" above heater – intermediate temperature



Sprinkler Types



UPRIGHT



PENDENT



EXTENDED COVERAGE
PENDENT



RECESSED
EXTENDED COVERAGE
PENDENT



VERTICAL
SIDEWALL



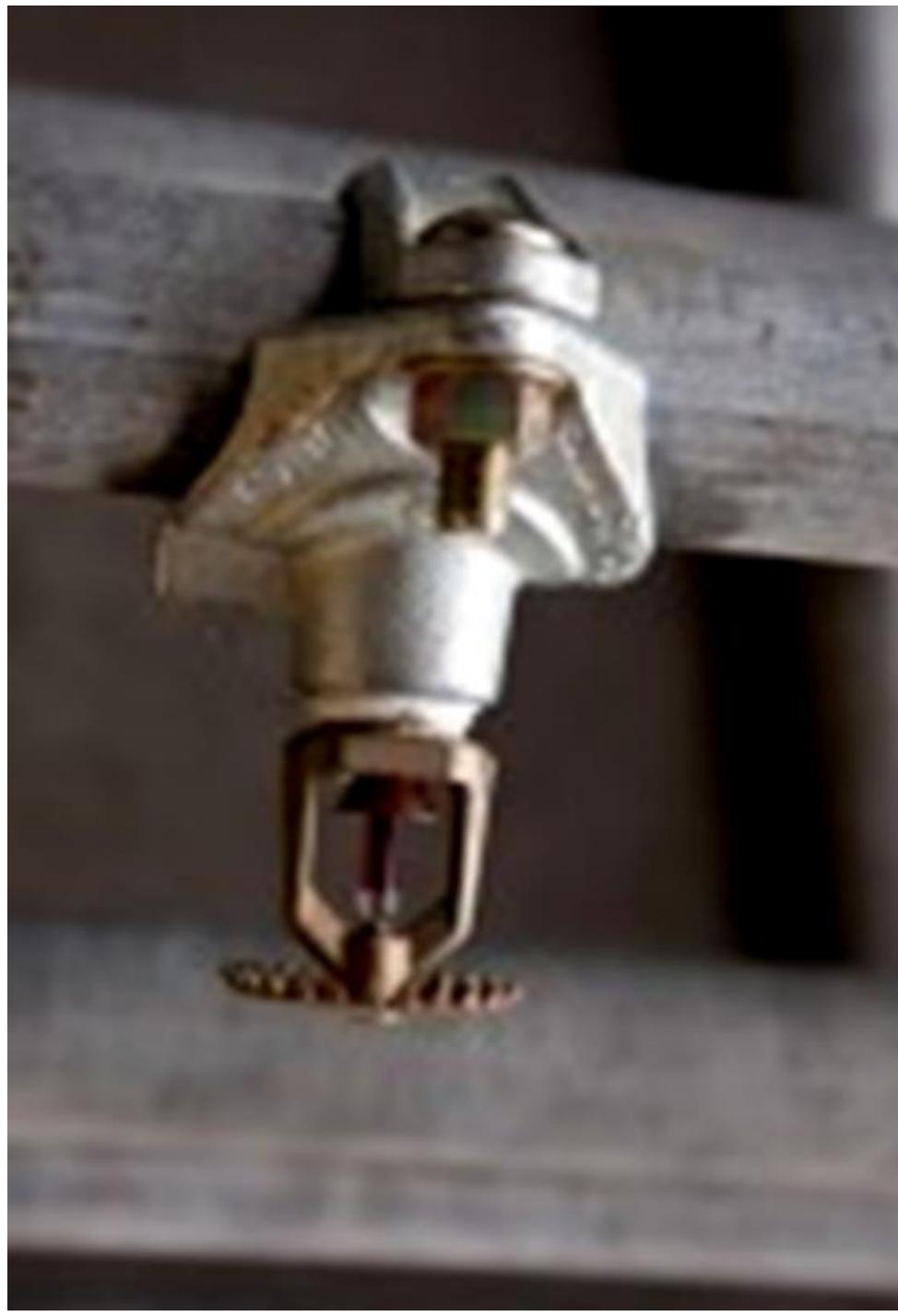
HORIZONTAL
SIDEWALL



EXTENDED COVERAGE
HORIZONTAL SIDEWALL



RECESSED
EXTENDED COVERAGE
HORIZONTAL SIDEWALL



Quick Response Sprinklers



Required in Light Hazard Occupancies

Not Allowed in Extra Hazard Occupancies

Residential Sprinklers

- For use in residential occupancies
- NFPA 13, 13R or 13D



Residential Pendant



Residential
Horizontal Sidewall



Semi-recessed
Residential Sidewall



Semi-recessed
Residential Pendant

Large Drop / ESFR Sprinklers

- Large Drop-
 - Used in high piled storage applications
- ESFR-
 - Often used in storage situations to avoid in rack sprinklers
 - Designed to minimize the impact of obstructions
 - Suppress rather than control



In-Rack Sprinklers

- Standard head may be used
- Racks with multi-level sprinklers have water shields
- The water shield helps prevent cold solder of lower level sprinklers



UPRIGHT



PENDENT

Dry Sprinklers

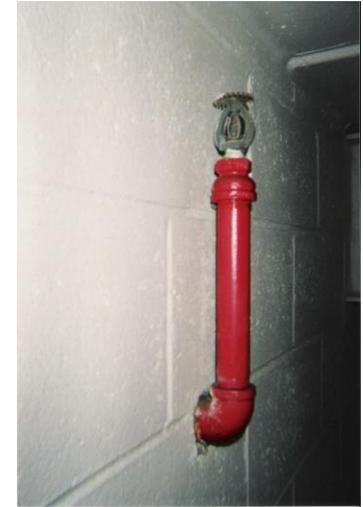


What's Wrong with this Picture?!?



Spacing; Uprights and Pendants

- Standard Spray
 - Minimum of 4 inches from wall
 - Minimum of 6 feet from other sprinklers
- Extended Coverage
 - Minimum of 4 inches from wall
 - Minimum of 8 feet from other sprinklers
- Maximum distance from wall - $\frac{1}{2}$ max allowable
- Small Room Rule (Light Hazard Only) - Max 9 feet off one wall if room 800 sq ft or less



Hazards / Spacing

■ Standard spray upright / pendent sprinklers

Table 8.6.2.2.1(a) Protection Areas and Maximum Spacing (Standard Spray Upright/Standard Spray Pendent) for Light Hazard

Construction Type	System Type	Protection Area		Spacing (maximum)	
		ft ²	m ²	ft	m
Noncombustible obstructed and unobstructed and combustible unobstructed with members 3 ft (0.91 m) or more on center	Pipe schedule	200	18.6	15	4.6
Noncombustible obstructed and unobstructed and combustible unobstructed with members 3 ft (0.91 m) or more on center	Hydraulically calculated	225	20.9	15	4.6
Combustible obstructed with members 3 ft (0.91 m) or more on center	All	168	15.6	15	4.6
Combustible obstructed or unobstructed with members less than 3 ft (0.91 m) on center	All	130	12.1	15	4.6
Combustible concealed space under a pitched roof having combustible wood joist or wood truss construction with members less than 3 ft (0.91 m) on center with slopes having a pitch of 4 in 12 or greater	All	120	11.1	15 parallel to the slope 10 perpendicular to the slope*	4.6 parallel to the slope 3.05 perpendicular to the slope*

*Where the dimension perpendicular to the slope exceeds 8 ft (2.4 m), the minimum pressure shall be 20 psi (1.4 bar).

Hazards / Spacing

■ Standard spray upright / pendent sprinklers

Table 8.6.2.2.1(b) Protection Areas and Maximum Spacing (Standard Spray Upright/Standard Spray Pendent) for Ordinary Hazard

Construction Type	System Type	Protection Area		Spacing (maximum)	
		ft ²	m ²	ft	m
All	All	130	12.1	15	4.6

Table 8.6.2.2.1(c) Protection Areas and Maximum Spacing (Standard Spray Upright/Standard Spray Pendent) for Extra Hazard

Construction Type	System Type	Protection Area		Spacing (maximum)	
		ft ²	m ²	ft	m
All	Pipe schedule	90	8.4	12	3.7
				[In buildings with storage bays 25 ft (7.6 m) wide, 12 ft 6 in. (3.8 m) shall be permitted.]	
All	Hydraulically calculated with density ≥ 0.25	100	9.3	12	3.7
				[In buildings with storage bays 25 ft (7.6 m) wide, 12 ft 6 in. (3.8 m) shall be permitted.]	
All	Hydraulically calculated with density < 0.25	130	12.1	15	4.6

Hazards / Spacing

■ Extended coverage upright / pendent sprinklers

Table 8.8.2.1.2 Protection Areas and Maximum Spacing (Extended Coverage Upright and Pendent Spray Sprinklers)

Construction Type	Light Hazard		Ordinary Hazard		Extra Hazard		High-Piled Storage	
	Protection Area (ft ²)	Spacing (ft)	Protection Area (ft ²)	Spacing (ft)	Protection Area (ft ²)	Spacing (ft)	Protection Area (ft ²)	Spacing (ft)
Unobstructed	400	20	400	20	—	—	—	—
	324	18	324	18	—	—	—	—
	256	16	256	16	—	—	—	—
	—	—	196	14	196	14	196	14
	—	—	144	12	144	15	144	15
Obstructed noncombustible (when specifically listed for such use)	400	20	400	20	—	—	—	—
	324	18	324	18	—	—	—	—
	256	16	256	16	—	—	—	—
	—	—	196	14	196	14	196	14
	—	—	144	12	144	15	144	15
Obstructed combustible	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

For SI units, 1 ft = 0.3048 m; 1 ft² = 0.0929 m².

Obstructed Construction

- **Obstructed Construction.** Panel construction and other construction where beams, trusses, or other members impede heat flow or water distribution in a manner that materially affects the ability of sprinklers to control or suppress a fire.



Unobstructed Construction

- **Unobstructed Construction.** Construction where beams, trusses, or other members do not impede heat flow or water distribution in a manner that materially affects the ability of sprinklers to control or suppress a fire. Unobstructed construction has horizontal structural members that are not solid, where the openings are at least 70 percent of the cross-section area and the depth of the member does not exceed the least dimension of the openings, or all construction types where the spacing of structural members exceeds 7 1/2 ft. on center.



Spacing; Uprights and Pendants

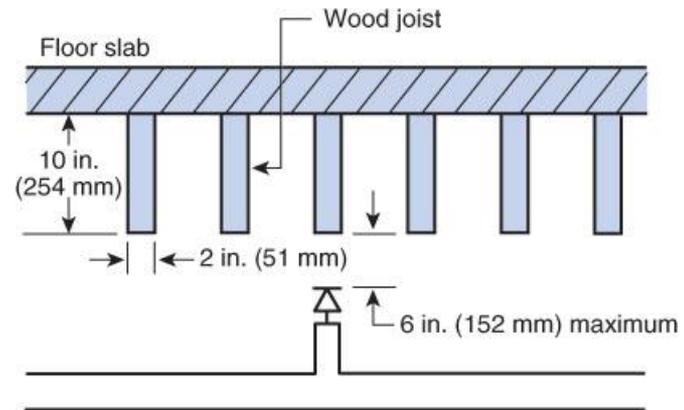
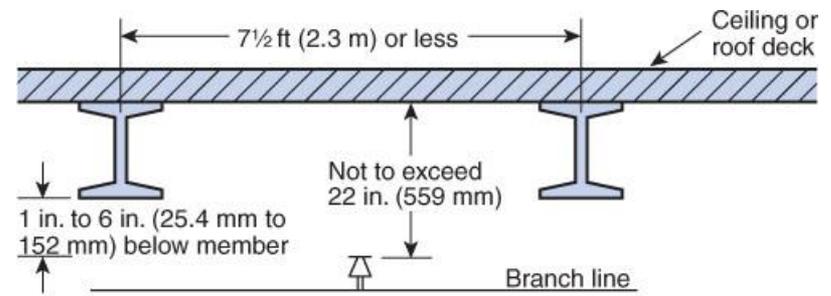
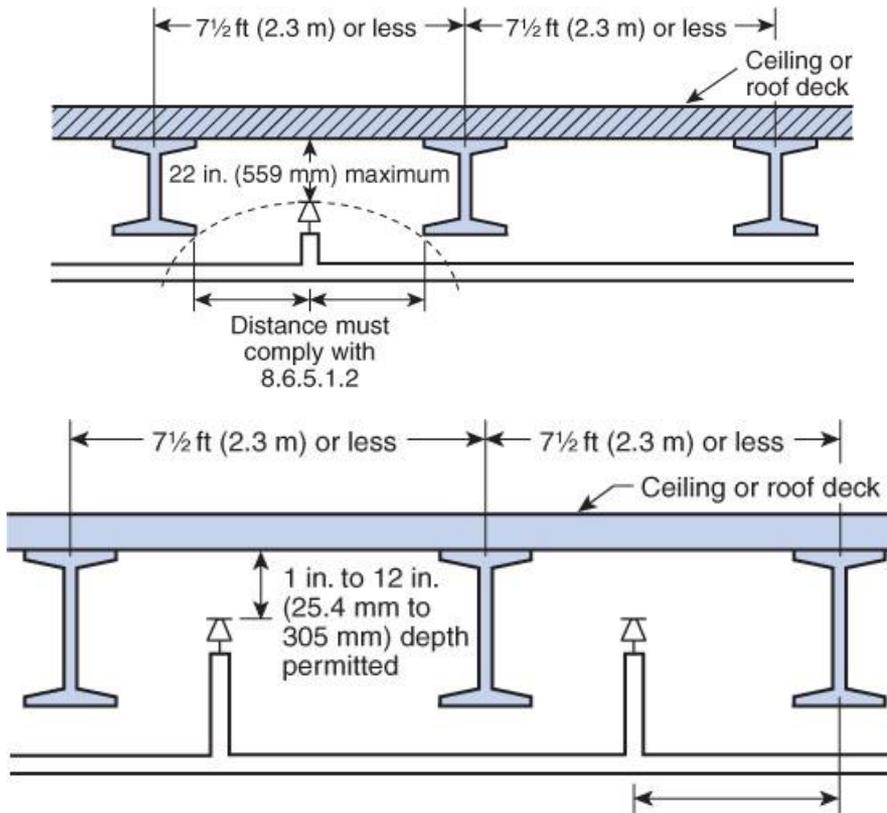
- Standard Spray – Unobstructed Construction
 - Deflectors 1” – 12” down from ceiling / roof deck
 - Standard Spray – Obstructed Construction
 - Deflectors 1” – 6” below structural member up to 22” down from ceiling / roof deck
 - Deflectors at or above structural members at a max distance of 22” below the ceiling/roof deck when adhering to obstruction rules of NFPA 13 8.6.5.1.2
 - Deflectors 1” – 12” down from ceiling / roof deck spaced in each bay
 - Deflectors 1” – 6” below structural member up to 22” down from joist channels filled with material equivalent to web construction when each channel area does not exceed 300 square feet
 - Deflectors at bottom of concrete tee construction spaced >3 ft to <7½ ft on center
-

Spacing; Uprights and Pendants

- Extended Coverage – Unobstructed Construction
 - Deflectors 1” – 12” down from ceiling / roof deck
 - Extended Coverage – Obstructed Construction
 - Deflectors 1”- 6” below the structural members and a maximum distance of 22” below the ceiling/roof deck.
 - Deflectors at or above structural members at a max distance of 22” below the ceiling/roof deck when adhering to obstruction rules of NFPA 13 8.8.5.1.2
 - Deflectors 1” – 12” down from ceiling / roof deck spaced in each bay
 - Where listed for use under other ceiling construction features or for different distances, they shall be installed per their listing.
-

Spacing; Uprights and Pendants

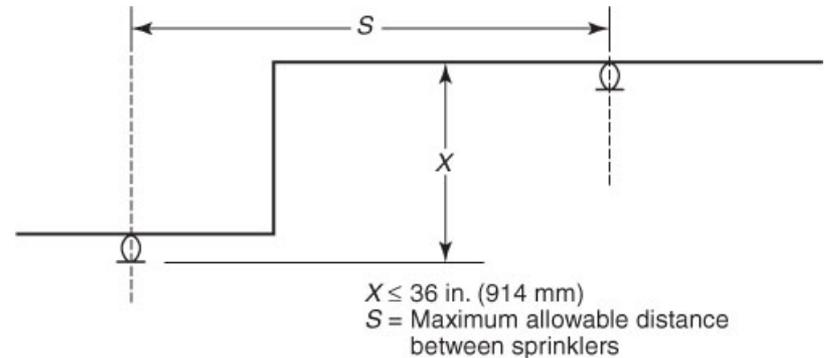
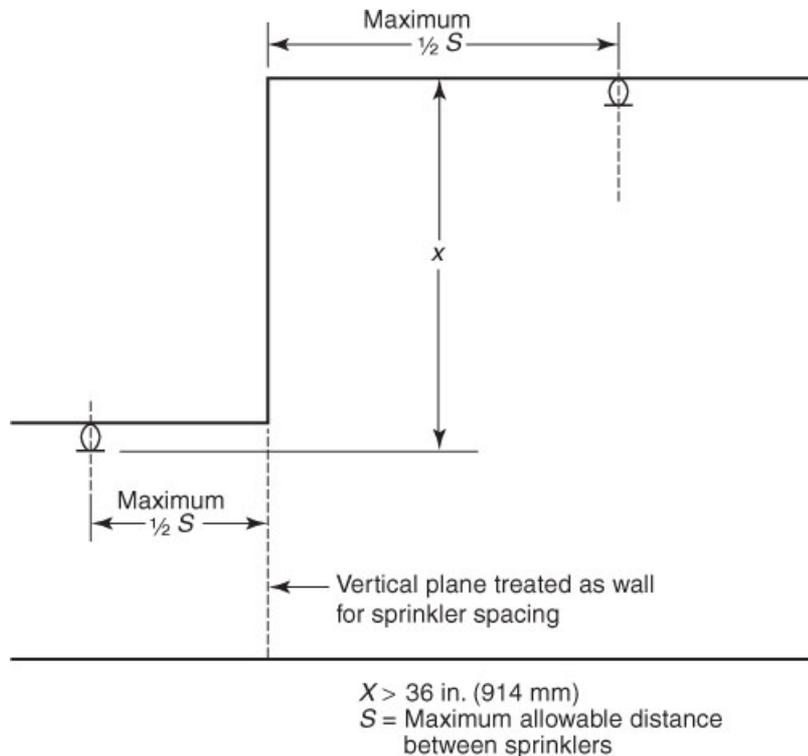
■ Obstructed Construction



Spacing; SC / EC Uprights and Pendants

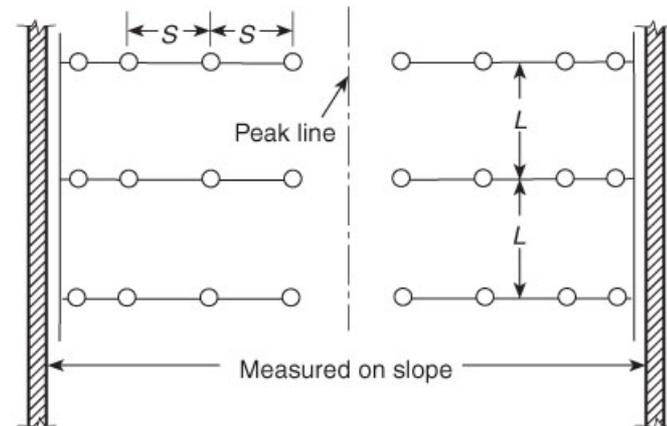
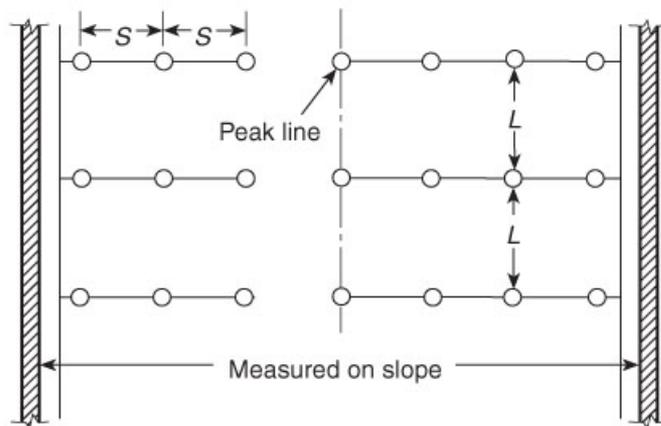
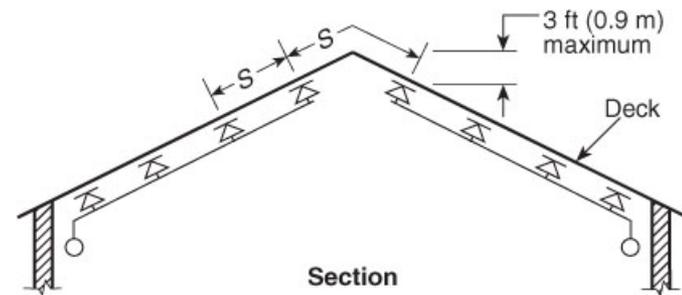
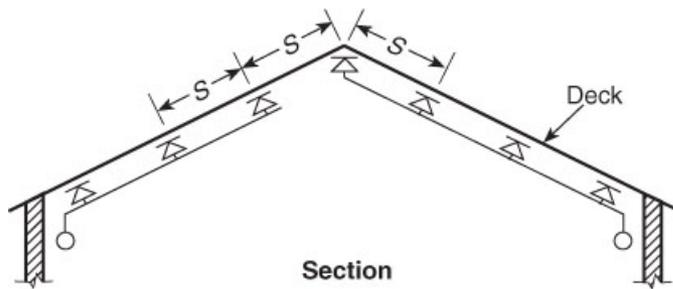
Special condition in light and ordinary hazard occupancies with change in ceiling elevation

Applicable obstruction rules still required to be adhered to



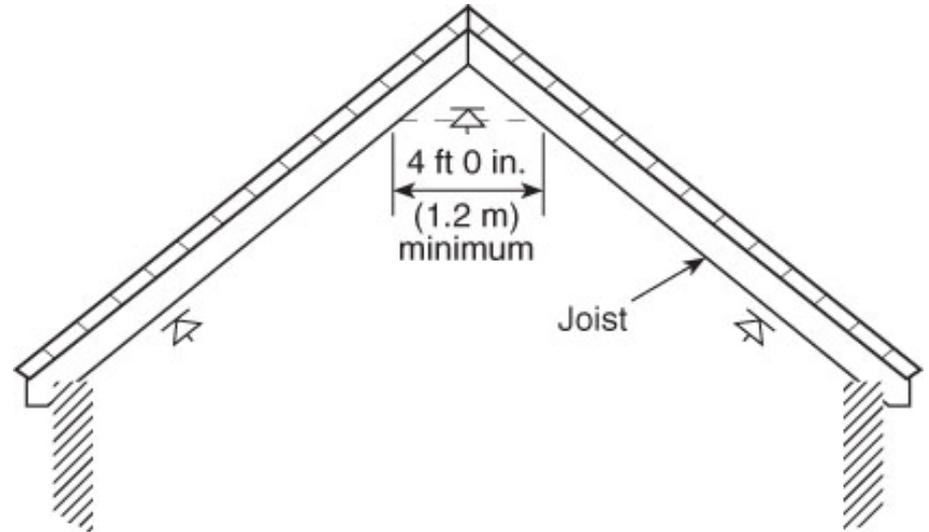
SC / EC Spacing; Sloped Ceilings

- The sprinklers shall be sloped with the pitch of the roof
 - Exception – sprinkler located directly at peak.
 - A sprinkler must be located within 3 ft. vertically of the peak.



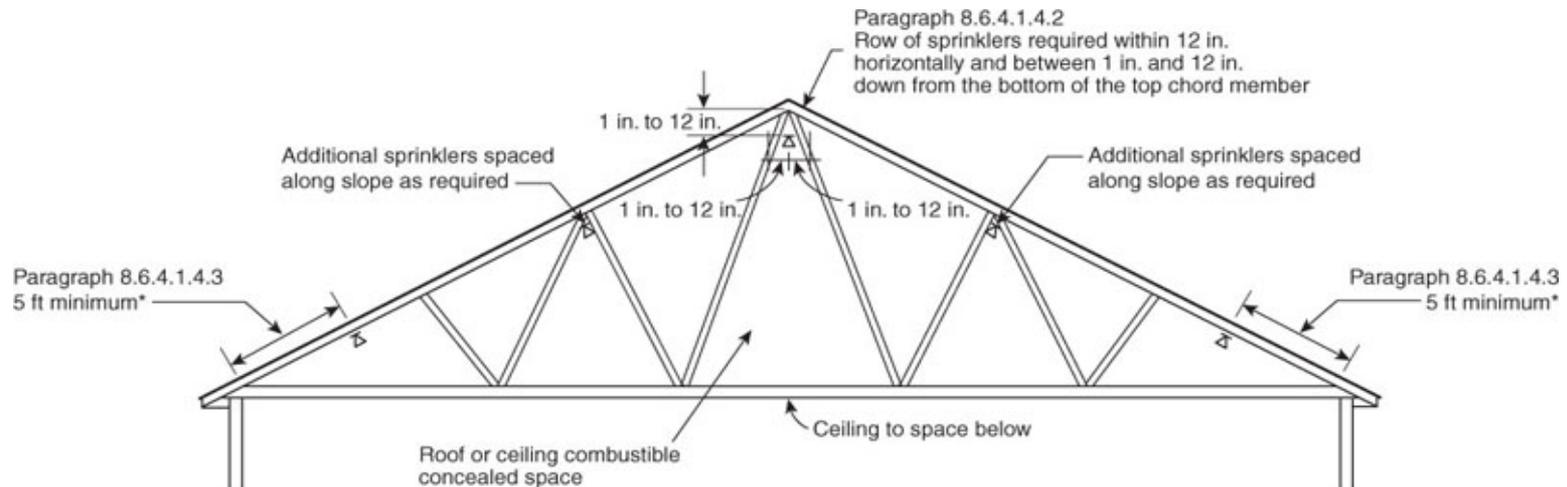
Spacing; Highly Pitched Roofs

- The sprinkler at the peak shall be provided with a clearance of 4 feet to allow the spray pattern to develop.



Spacing; Attics

- Sprinklers Under a Roof or Ceiling in Combustible Concealed Spaces of Wood Joist or Wood Truss Construction with Members 3 ft. or Less on Center and a Slope Having a Pitch of 4 in 12 or Greater.
 - Standard coverage sprinklers only.
 - Sprinkler at peak within 12" horizontally and vertically of the peak
 - Eaves sprinklers spaced 5 ft. from the intersection of the upper and lower chords / rafters
 - Special sprinklers installed in accordance with their listing

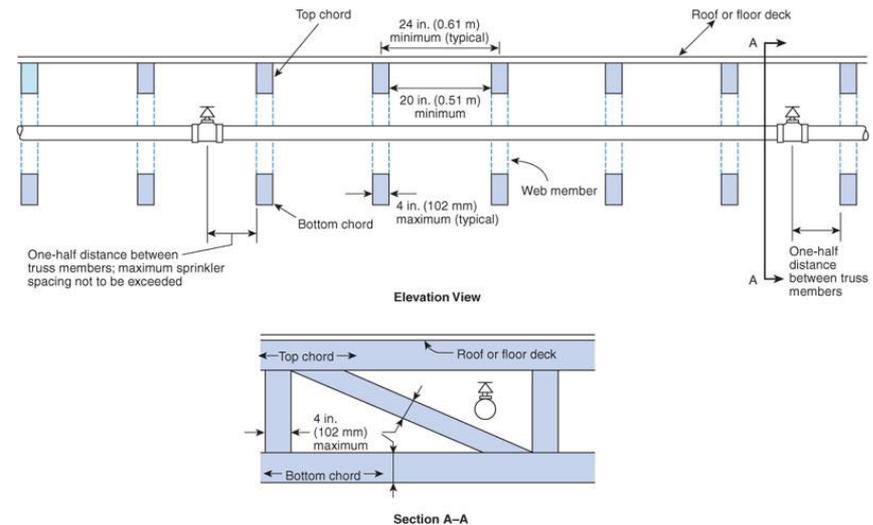


For SI units, 1 in. = 25.4 mm; 1 ft = 0.3048 m.

*Note: The 5 ft minimum dimension is measured from the intersection of the upper and lower truss chords, or the wood rafters and ceiling joists.

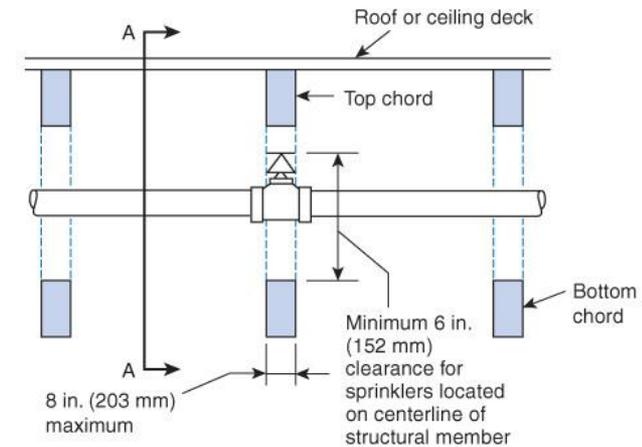
Spacing; Horizontal Trusses Option #1

- Sprinklers spaced one-half the distance between the obstructions.
- Open trusses 20 in. or greater apart
- All truss members are not greater than 4 in. (nominal) in width.

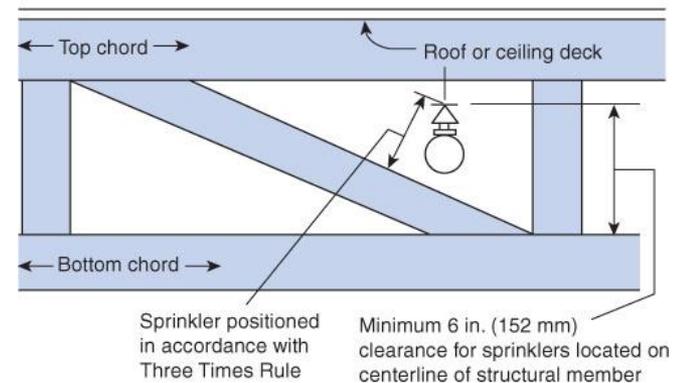


Spacing; Horizontal Trusses Option #2

- Sprinkler allowed to be located on centerline of truss
 - Truss or chord not more than 8" in
 - Minimum 6" clearance to all members
- Non-sloped truss space (2 in 12 pitch or less) required to be protected with sprinklers specifically listed for truss space when depth of truss does not exceed 36 in.



Elevation View



Section A-A

Spacing: Sidewalls

Standard Spray

- ❑ Minimum of 4 inches from adjacent wall
- ❑ Minimum of 6 feet from other sprinklers
- ❑ Min 4" to max 6" from ceiling (6-12" or 12-18" where listed under noncombustible or limited combustible ceiling)

Extended Coverage

- ❑ Minimum of 4 inches from wall
- ❑ No sprinklers shall be located within the maximum protection area of any other sprinkler (cold solder).
- ❑ Max of 6 inches from ceiling (6-12" or 12-18" where listed under noncombustible or limited combustible ceiling)

Maximum distance from wall - 1/2 max allowable



Spacing; Sidewalls

- Standard Coverage
 - Allowed with smooth horizontal flat ceilings only
 - Ordinary Hazard
 - 10 ft. x 10 ft. maximum spacing
 - Light Hazard
 - 14 ft. x 14 ft. maximum spacing
- Extended Coverage
 - Allowed with smooth horizontal flat ceilings only
 - Light and Ordinary Hazard
 - Per listing (400 sq. ft. Max.)

TABLE 8.7.2.2.1 Protection Areas and Maximum Spacing (Standard Sidewall Spray Sprinkler)

	<i>Light Hazard</i>		<i>Ordinary Hazard</i>	
	<i>Combustible Ceiling Finish</i>	<i>Noncombustible or Limited-Combustible Ceiling Finish</i>	<i>Combustible Ceiling Finish</i>	<i>Noncombustible or Limited-Combustible Ceiling Finish</i>
Maximum distance along the wall (<i>S</i>)	14 ft	14 ft	10 ft	10 ft
Maximum room width (<i>L</i>)	12 ft	14 ft	10 ft	10 ft
Maximum protection area	120 ft ²	196 ft ²	80 ft ²	100 ft ²

For SI units, 1 ft = 0.3048 m; 1 ft² = 0.0929 m².

Dwelling Units - NFPA 13

- Sprinklers are not required in bathrooms not exceeding 55 sq ft including the tub or shower area.
 - **Walls / ceilings must be noncombustible or limited combustible to act as 15 minute thermal barrier**
 - **Note: This includes walls behind tub / shower stall!**
 - Sprinklers are not required in closets in hotels and motels not exceeding 24 sq ft where least dimension does not exceed 3 ft.
 - Sprinklers not required in closets in new apartments not exceeding 12 sq ft where least dimension does not exceed 3 ft.
 - Sprinklers are not required in closets existing apartments not exceeding 24 sq ft where least dimension does not exceed 3 ft.
-

Combustible Concealed Spaces

Require sprinklers unless one of the exceptions listed in NFPA 13 8.15.1.2



Obstructions



Obstructions – 4' Rule

- Sprinklers shall be installed under fixed obstructions over 4 ft wide such
 - Ducts, decks, open grate flooring, cutting tables, and overhead doors.
- Sprinklers shall not be required under obstructions that are not fixed in place such as conference tables.

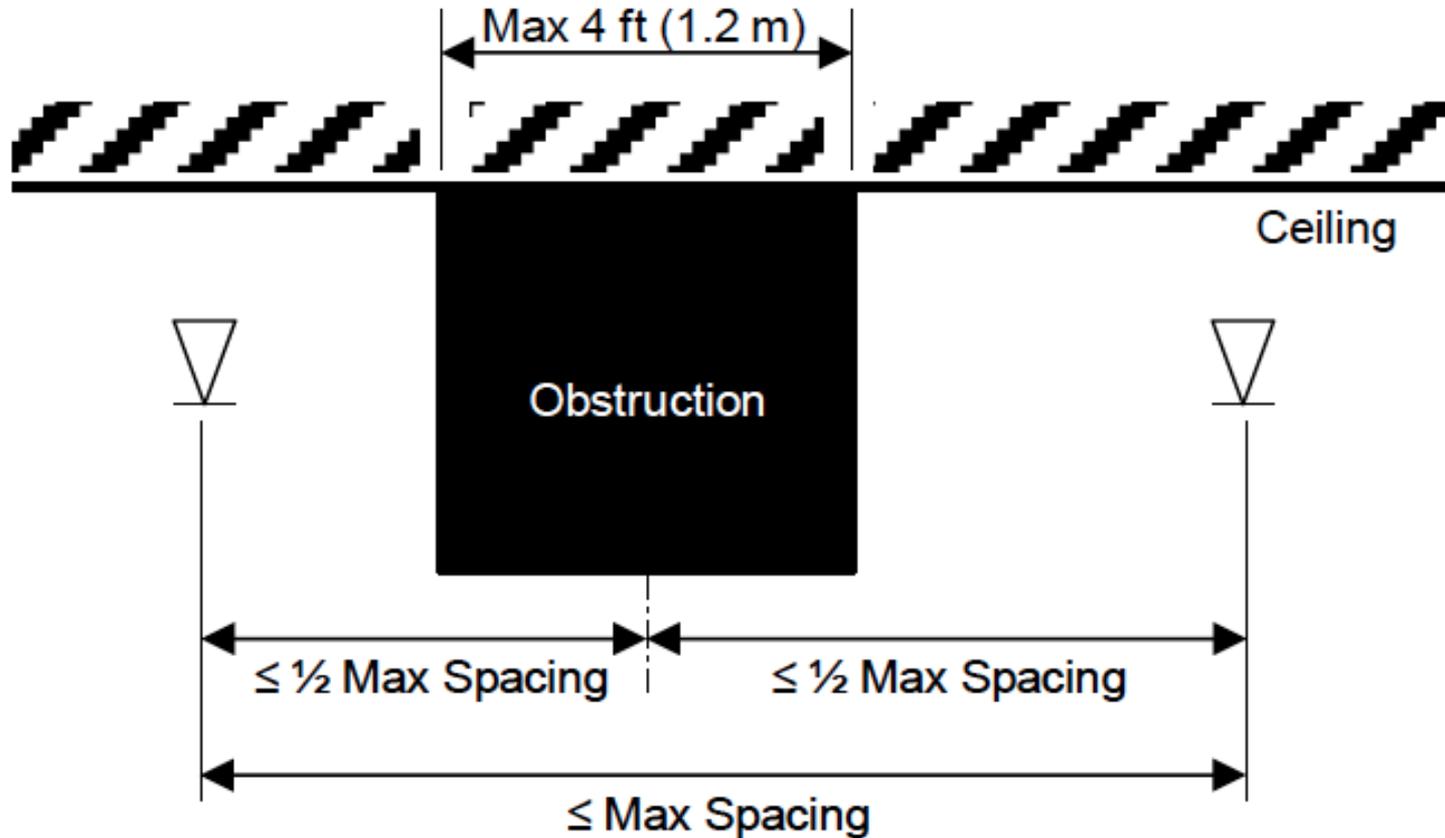


Obstructions - Storage

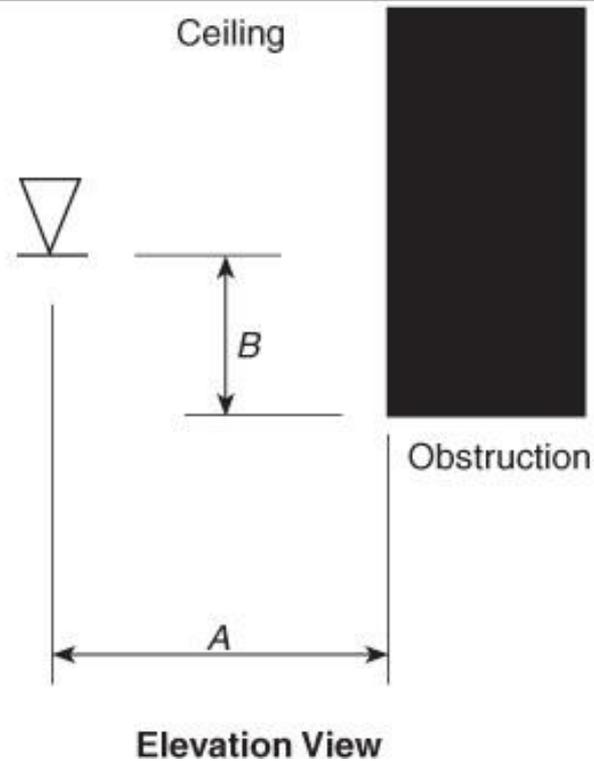
- The clearance between the deflector and the top of storage shall be 18 inches or greater.
- Do the requirements of 8.6.6.1 apply to shelving against or installed on a wall?
- Sprinklers installed near wall-mounted shelves or piled storage located against a wall are not intended to be governed by the 18” requirement. The clear space beneath the sprinkler is needed for the spray pattern to fully develop to allow proper wetting of the floor and not the wall.



Obstructions – Beam Rule



Obstructions – Standard Coverage Beam Rule



<i>Distance from Sprinklers to Side of Obstruction (A)</i>	<i>Maximum Allowable Distance of Deflector Above Bottom of Obstruction (in.) (B)</i>
Less than 1 ft	0
1 ft to less than 1 ft 6 in.	2½
1 ft 6 in. to less than 2 ft	3½
2 ft to less than 2 ft 6 in.	5½
2 ft 6 in. to less than 3 ft	7½
3 ft to less than 3 ft 6 in.	9½
3 ft 6 in. to less than 4 ft	12
4 ft to less than 4 ft 6 in.	14
4 ft 6 in. to less than 5 ft	16½
5 ft to less than 5 ft 6 in.	18
5 ft 6 in. to less than 6 ft	20
6 ft to less than 6 ft 6 in.	24
6 ft 6 in. to less than 7 ft	30
7 ft to less than 7 ft 6 in.	35

For SI units, 1 in. = 25.4 mm; 1 ft = 0.3048 m.

Note: For A and B, refer to Figure 8.6.5.1.2(a).

Obstructions – Extended Coverage Beam Rule

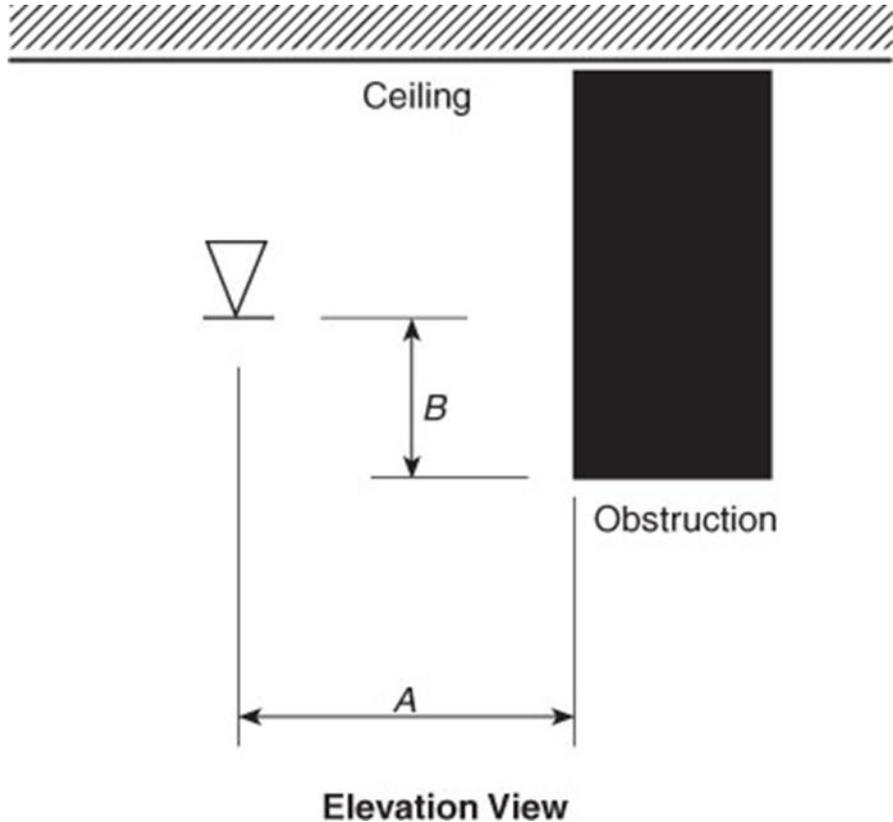


TABLE 8.8.5.1.2 *Position of Sprinklers to Avoid Obstructions to Discharge (Extended Coverage Upright and Pendent Spray Sprinklers)*

<i>Distance from Sprinklers to Side of Obstruction (A)</i>	<i>Maximum Allowable Distance of Deflector Above Bottom of Obstruction (in.) (B)</i>
Less than 1 ft	0
1 ft to less than 1 ft 6 in.	0
1 ft 6 in. to less than 2 ft	1
2 ft to less than 2 ft 6 in.	1
2 ft 6 in. to less than 3 ft	1
3 ft to less than 3 ft 6 in.	3
3 ft 6 in. to less than 4 ft	3
4 ft to less than 4 ft 6 in.	5
4 ft 6 in. to less than 5 ft	7
5 ft to less than 5 ft 6 in.	7
5 ft 6 in. to less than 6 ft	7
6 ft to less than 6 ft 6 in.	9
6 ft 6 in. to less than 7 ft	11
7 ft to less than 7 ft 6 in.	14
7 ft 6 in. to less than 8 ft	14
8 ft to less than 8 ft 6 in.	15
8 ft 6 in. to less than 9 ft	17
9 ft to less than 9 ft 6 in.	19
9 ft 6 in. to less than 10 ft	21

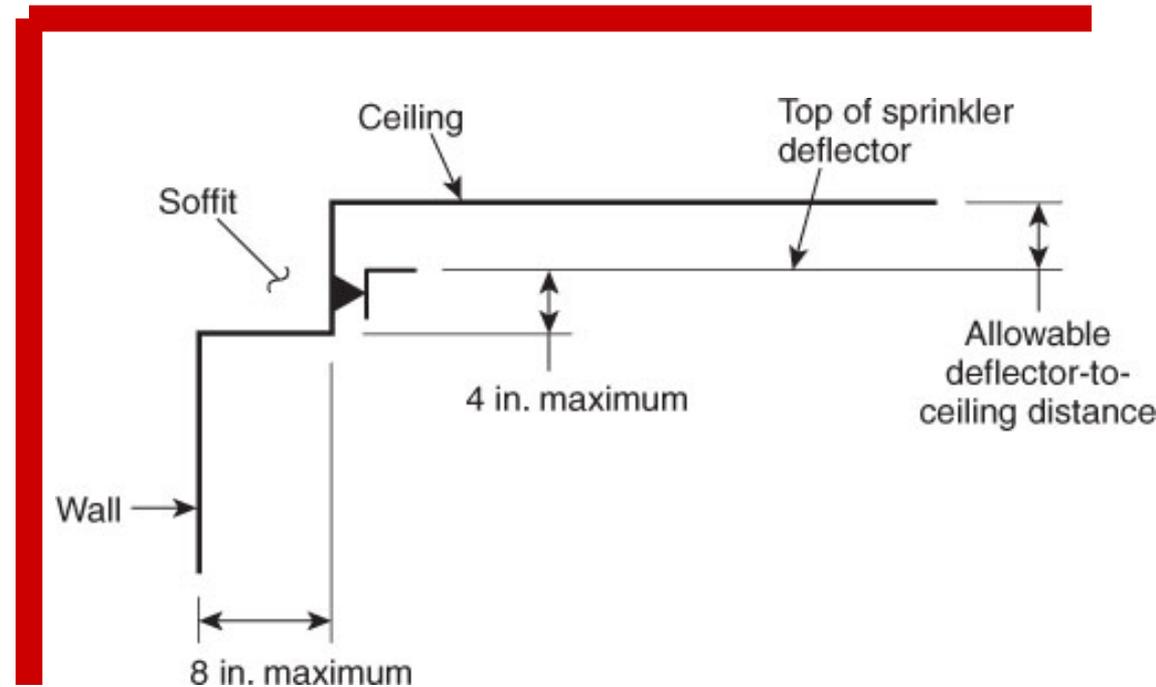
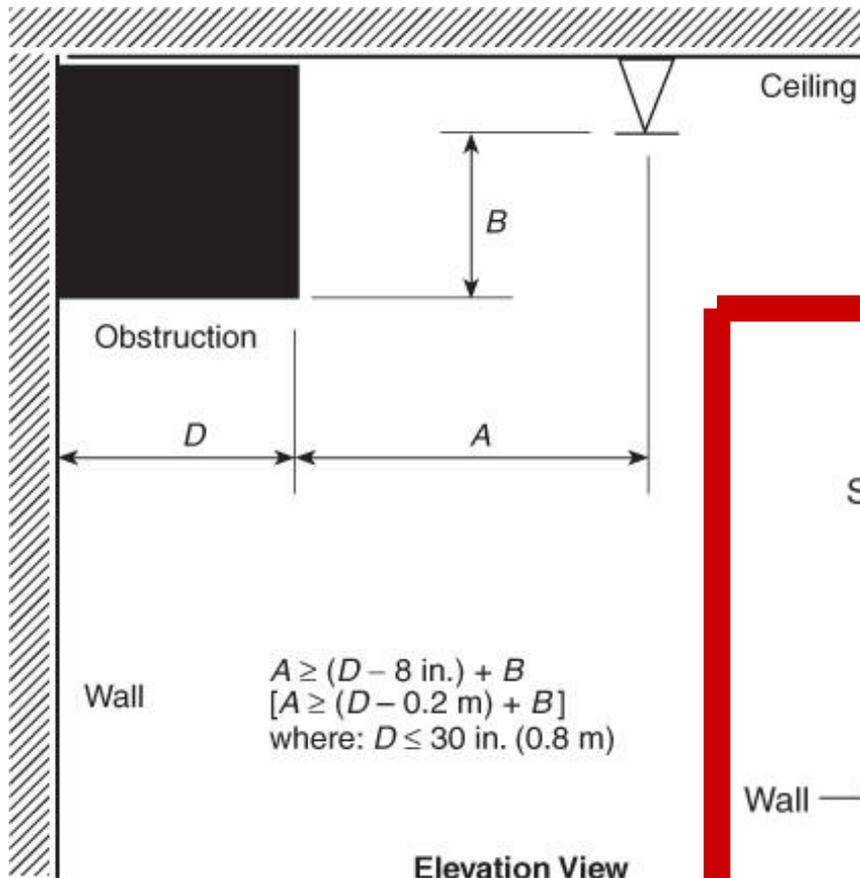
For SI units, 1 in. = 25.4 mm; 1 ft = 0.3048 m.

Note: For A and B, refer to Figure 8.8.5.1.2(a).

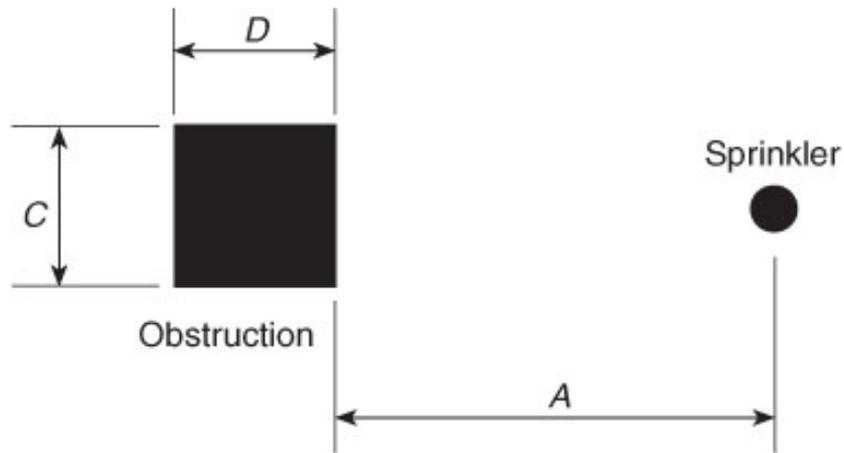
Obstructions – Beam Rule



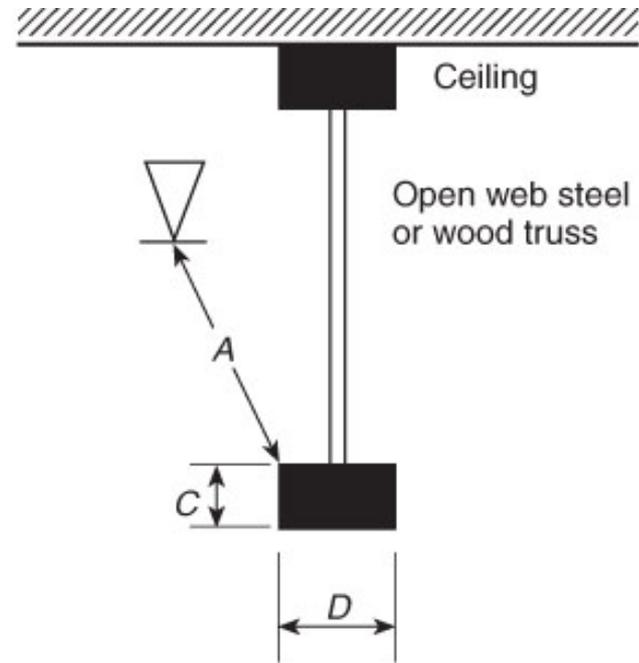
Obstructions – Soffits SC / EC



Obstructions – 3x/4x Rule



Plan View of Column



Elevation View of Truss

Standard Coverage

$$A \geq 3C \text{ or } 3D$$

$$A \leq 24 \text{ in.}$$

Extended Coverage

$$A \geq 4C \text{ or } 4D$$

$$A \leq 36 \text{ in.}$$

For light and ordinary hazard occupancies, structural members only shall be considered when applying the requirements.

Obstructions – Floor Mounted

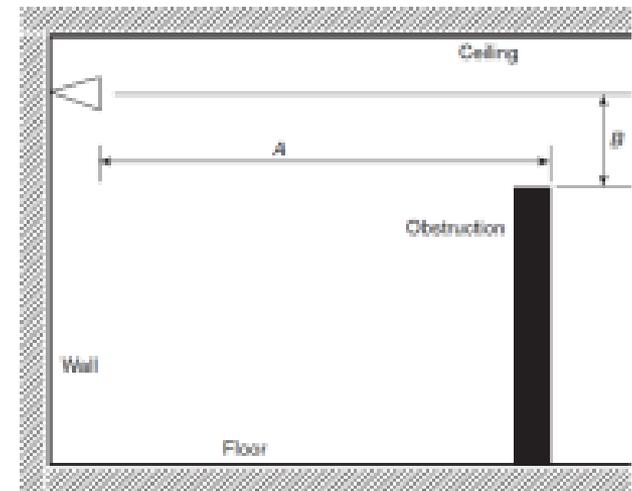
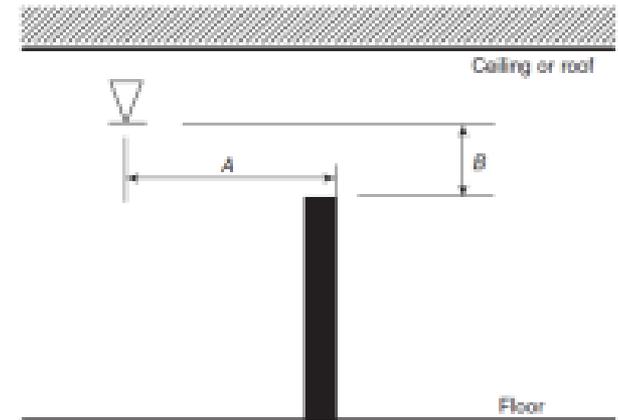
■ Light Hazard Occupancies Only

TABLE 8.6.5.2.2 *Suspended or Floor-Mounted Obstructions in Light Hazard Occupancies Only (SSU/SSP)*

<i>Horizontal Distance (A)</i>	<i>Minimum Vertical Distance Below Deflector (in.) (B)</i>
6 in. or less	3
More than 6 in. to 9 in.	4
More than 9 in. to 12 in.	6
More than 12 in. to 15 in.	8
More than 15 in. to 18 in.	9½
More than 18 in. to 24 in.	12½
More than 24 in. to 30 in.	15½
More than 30 in.	18

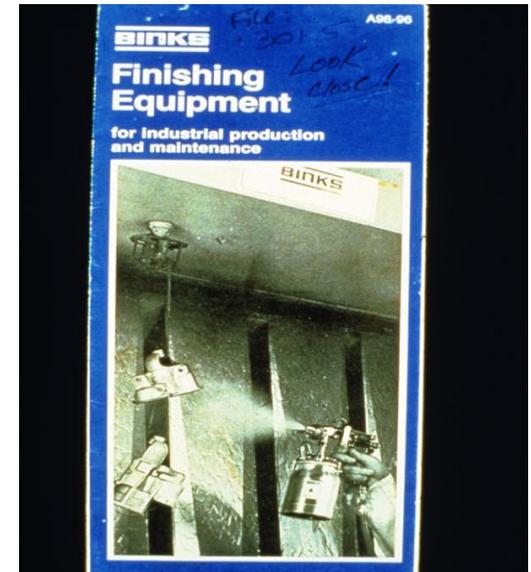
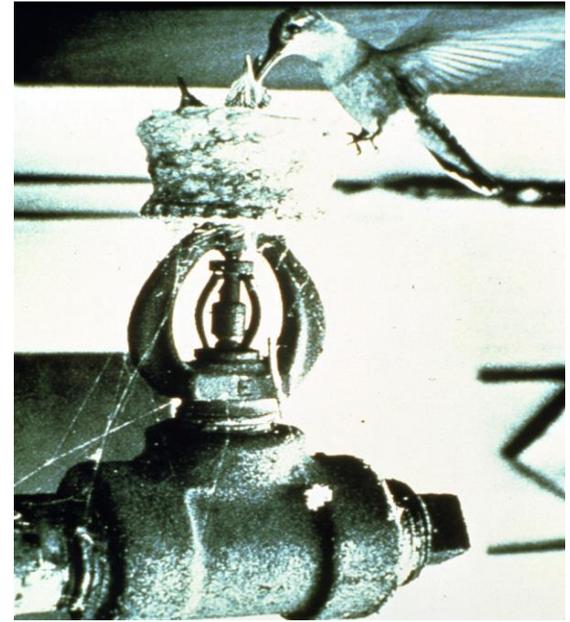
For SI units, 1 in. = 25.4 mm.

Note: For A and B, refer to Figure 8.6.5.2.2.



Physical Damage

- Sprinklers free of corrosion
- Piping free of mechanical damage
- No external loads on piping
- Hangers not damaged or loose



Head Guards

- NFPA 13 6.2.8 Sprinklers subject to mechanical injury shall be protected with listed guards.



Painted Sprinklers

- Sprinkler heads can only be factory painted.
- Ensure sprinklers are free of paint.
 - Replace when painted.
 - Ensure they are not still taped or covered



Spare Sprinklers



- System with less than 300 sprinklers, not fewer than 6.
- System with 300 to 1000 sprinklers, not fewer than 12.
- System with over 1000 sprinklers, not fewer than 24.
- Special sprinkler wrenches shall be provided.
- A list of the sprinklers installed at the facility shall be included in the box.

Sprinkler Replacement or Testing

- Sprinklers manufactured prior to 1920 shall be replaced
 - Standard Response Sprinklers that are 50 years old shall be replaced or tested.
 - Retested every 10 years
 - Quick Response Sprinklers that are 20 years old shall be replaced or tested.
 - Retested every 10 years
 - Dry Sprinklers that are 10 years old shall be replaced or tested.
 - Retested every 10 years
 - Sprinklers that are 75 years old shall be replaced or tested.
 - Retested every 5 years.
-

Hangers

- Must be ferrous material unless specifically listed for FP
 - Must support five times the weight of water filled pipe plus 250 lbs
 - Cannot be used to support non system components
 - Must conform to spacing requirements of NFPA 13 Chapter 9
 - Span hangers must conform to NFPA 13
 - Table 9.1.1.6.1(a) & (b)
 - Max distance between hangers per NFPA 13
 - Table 9.2.2.1(a)
-

Hangers

- Generally look for one hanger for each piece of pipe
 - 15'-0" maximum or less depending on pipe materials
- Correct hangers for the application
- Max distance between hanger and end sprinkler
 - 36 inches for 1 inch pipe
 - 48 inches for 1¼ inch pipe
 - 60 inches for 1½ inch pipe
- Max length of unsupported armover
 - 24 inches for steel pipe
 - 12 inches for copper





#2005

Grand Kiosk

MAY 13 2005

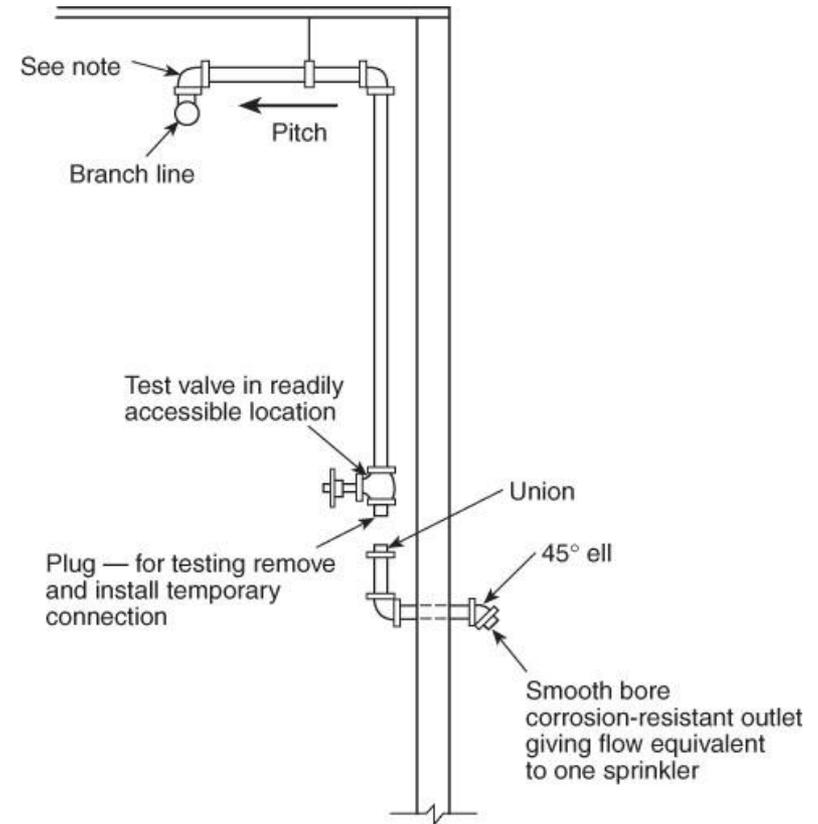
Inspector's Test Connection

- Location:
 - Wet system can be anywhere
 - Dry system must be most distant branch line from DPV
- Connection must terminate in a sprinkler of smallest orifice on system
- Details as shown in NFPA 13 Figure A 8.17.4.2(a) and Figure A8.17.4.3
- Terminates to outside or a drain capable of handling flow



Inspector's Test Connection

- Method of Testing Sprinkler System Alarms
- Found on branch line usually at the most remote point.
- Flowing water through the test connection ensures that water is flowing through the entire system.



Note: To minimize condensation of water in the drop to the test connection, provide a nipple-up off of the branch line.

Questions?



**"You're not allowed to use
the sprinkler system to keep
your audience awake."**

REMEMBER:

**FIRE PROTECTION
SYSTEMS SAVE
LIVES!**
