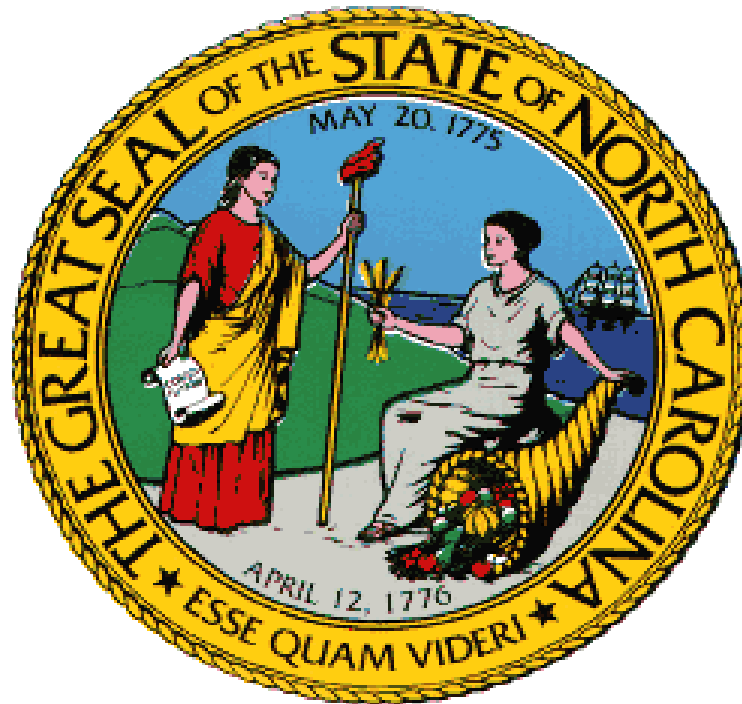


# State Board of Examiners of Plumbing, Heating & Fire Sprinkler Contractors

## Residential Fire Sprinkler Inspections



# Marble Mountain Demonstration

*[https://www.youtube.com/watch?v=UmZlN-j\\_GIg](https://www.youtube.com/watch?v=UmZlN-j_GIg)*

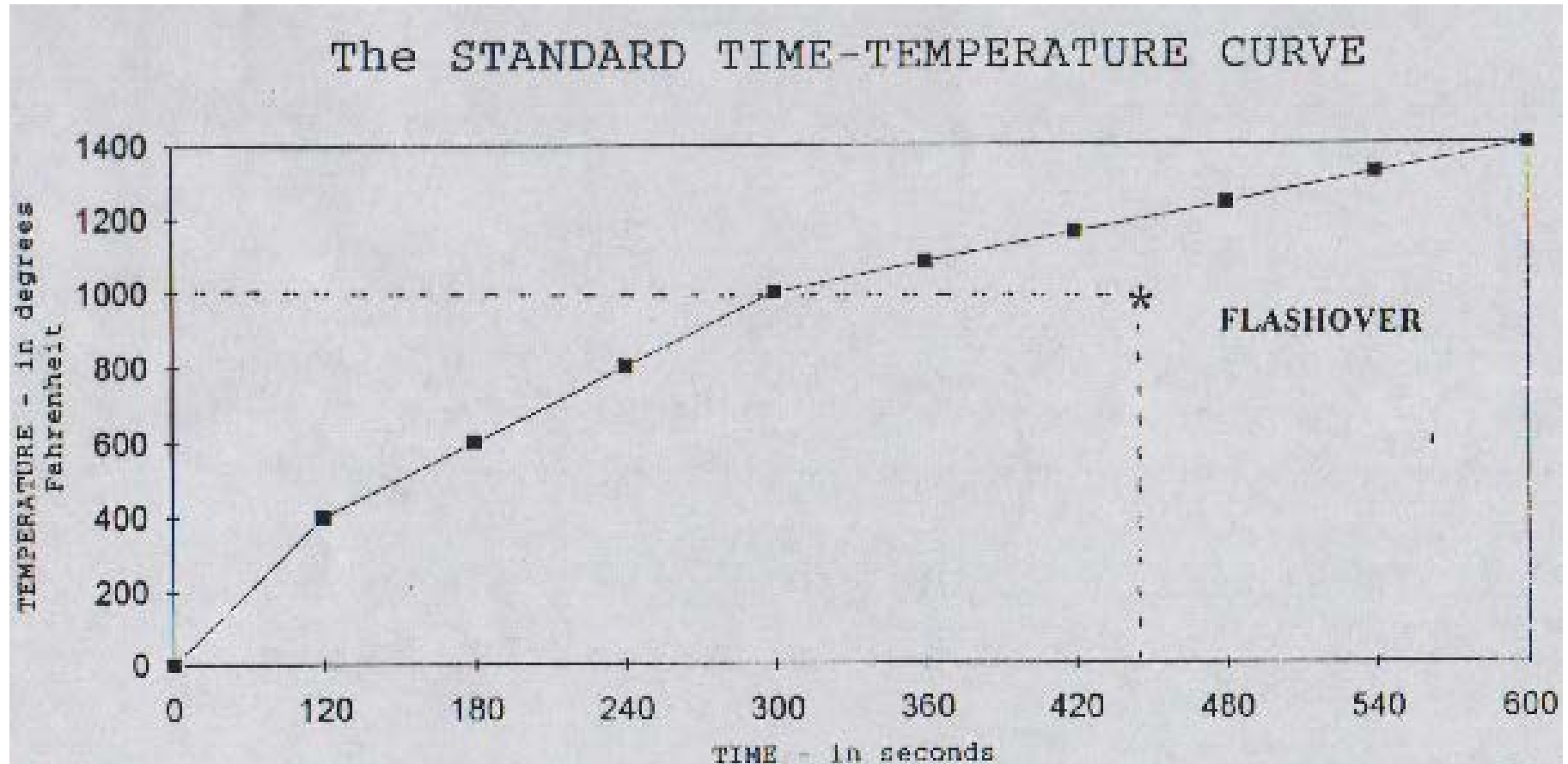


# Facts On Fire



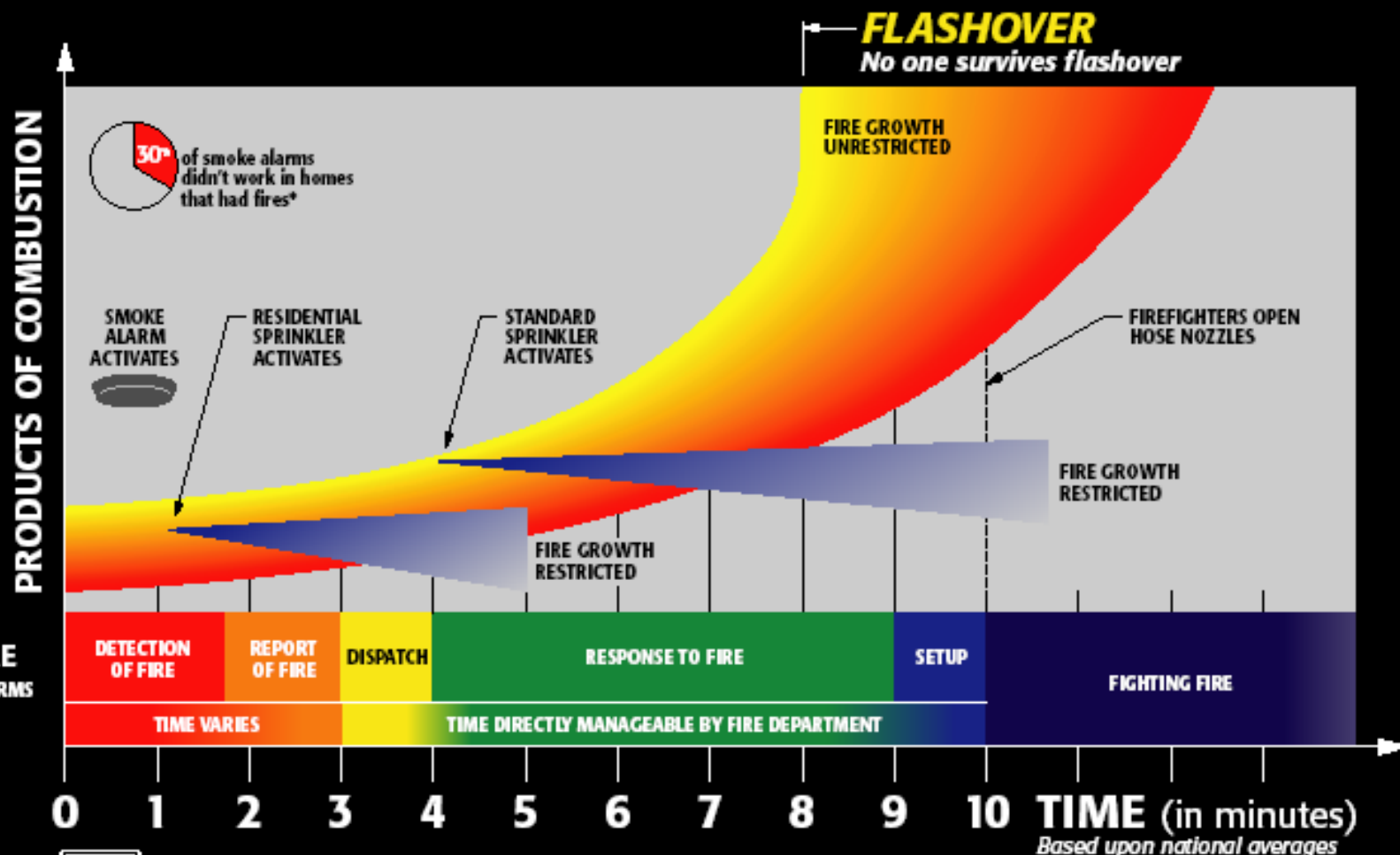
- ▶ 3140 civilian fire deaths in residential occupancies, 80 in non-residential. (NFPA 2007)
- ▶ 84% of all fire deaths occur in the home.
- ▶ 81% of fire deaths occur in single-family dwellings.
- ▶ 44% of all Line of Duty deaths occur in one and two family dwellings - On average, 103 Firefighters die in the line of duty each year
- ▶ There are nearly 298,000 one and two family dwelling home fires each year
- ▶ The highest injury rates per 100 fires occurred in the midnight to 8:00 time frame

It is time to realize that firefighting involves fighting time,  
not fire.



The standard time-temperature curve shows that temperatures can reach over 1,000°F in five minutes and flashover can begin as early as 7½ minutes after ignition.

# TIME vs. PRODUCTS of COMBUSTION

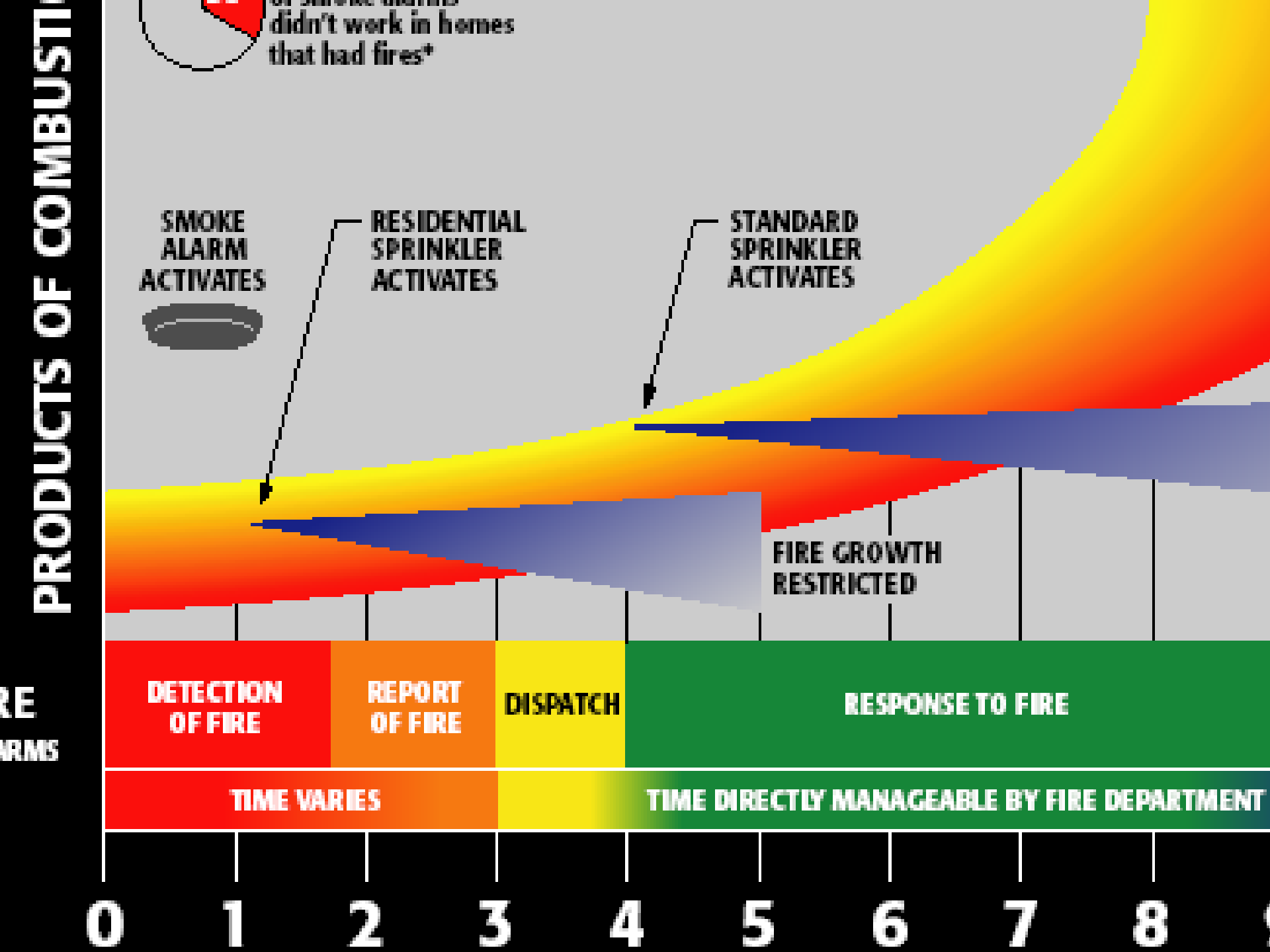


**Northern Illinois  
Fire Sprinkler  
Advisory Board**

[www.fire-sprinkler-niisec.org](http://www.fire-sprinkler-niisec.org)

\*U.S. Experience With Smoke Alarms and  
Other Fire Alarms. NFPA. September 2001.

NOTE: See NFPA Fire Protection Handbook for time and temperature information.



# New safety features in the International Residential Code include:

- In IRC – Fire sprinklers required in all new one- and two-family residences with code adoption. (NFPA 13D systems)
- Fire sprinklers in all new townhomes when the code is adopted.
- Carbon monoxide alarms required in new construction dwelling units with fuel-fired appliances, and in existing homes where interior alterations include fuel-fired appliance replacements or attached garages.



## How has modern building construction affected life safety from a fire survivability viewpoint?

- Lightweight roof truss assemblies
- “I Beam” floor joists
- Fingered 2 x 4 studs
- House Wrap
- Thermal windows
- Chipboard / Particle Board

# Fire sprinkler facts

- ▶ Only the sprinkler closest to the fire will activate, spraying water directly on the fire.
- ▶ Each sprinkler is individually activated by heat.
- ▶ 90% of all home fires are contained with a single sprinkler.
- ▶ The odds of accidental activation due to mechanical failure are 1 in 16 million.
- ▶ 13 to 20% insurance savings in N.C.



# How does a home fire sprinklers' discharge compare to a fire hose attack line discharge?

- A residential low flow pendant sprinkler head delivers approximately 13 to 18 gallons per minute of water
- A fire hose attack line delivers 200 gallons per minute (this does not include a backup line which would double the flow of water)

Sprinkler systems represent a choice, a little water when the fire starts or a lot of water when the fire department arrives



# NFPA 13D Sprinkler systems

- Average water usage for sprinklered home – 341 gallons
- Average water usage for unsprinklered home 2935 gallons
- Average repair costs for sprinklered home \$2,166 dollars
- Average repair costs for unsprinklered home \$45,019 dollars

With both smoke detection and sprinklers,  
death, injury by fire is reduced by 82%

This also equates to a “green value” with less  
contaminated fire water runoff and less water  
turbulence in the mains resulting in water  
clarity issues



# NFPA 13D systems

- Are designed for 1 and 2 family dwellings
- The average sprinkler head discharges 13 to 18 gallons per minute
- Required Sprinkler heads are located in paths of function / egress only – bedrooms, hallways, kitchens, dining rooms and laundry rooms - none in attics, crawl spaces - closets (size dependent, does not exceed 24 square ft. & least dimension does not exceed 3 ft.) or bathrooms (size dependent, 55 square ft. or less )
- This coverage provides fire protection from 83% of all areas fire originates – (Living room 41%, Bedroom 27%, Kitchen 15%)
- Systems are designed for the flow of 1 to 2 sprinkler heads – (typical k-factor 4.3 to 4.9). This represents a density of .05 gpm per square foot
- Designed primarily for life safety only but will contain or frequently extinguish the fire

# Motivation

- An important benefit of the multipurpose sprinkler system installation is the life safety of the residents. Sprinkler systems when properly calculated, designed and installed save lives without question. Eighty-three percent of residential fires originate in the living room, bedroom or kitchen areas. Multi purpose systems use the domestic water supply and cold water distribution piping already required for other fixtures

- Permit process: NC Administrative Code & Policies Section 106
  - Submit drawings to AHJ (local code official) for review
  - Obtain appropriate permit(s)
  - Rough-in inspection
  - Complete project
  - Final inspection – Bucket test

## Definitions used in NFPA 13D describing equipment, materials, spaces or design parameters.

- **Design Discharge** – The rate of water discharged by and automatic sprinkler expressed in g.p.m. (gallons per minute) NFPA 13D – 3.3.2
- **Dwelling** – One or more rooms, arranged for the use of one or more individuals living together, as in a single housekeeping unit, that normally have cooking, living, sanitary, and sleeping facilities. NFPA 13D – 3.3.4
- **System Working Pressure** – The maximum anticipated static (non-flowing) or flowing pressure applied to sprinkler system components exclusive of surge pressures. NFPA 13D – 3.3.6.3



Definitions used in NFPA 13D describing equipment, materials, spaces or design parameters.

- **Residential Sprinkler** – A type of fast-response sprinkler having a thermal element with an RTI (Response Time Index) of 50 (meters·second)<sup>½</sup> or less, that has been specifically investigated for its ability to enhance survivability in the room of fire origin, and that is listed for use in the protection of dwelling units. NFPA 13D – 3.3.8.2

Definitions used in NFPA 13D describing equipment, materials, spaces or design parameters.

- **Multipurpose Piping System** – A piping system intended to serve both domestic and fire protection needs. NFPA 13D – 3.3.9.3
- **Network System** – A type of multipurpose system utilizing a common piping system supplying domestic fixtures and fire sprinklers where each sprinkler is supplied by a minimum of three separate paths. NFPA 13D – 3.3.9.4

## Definitions used in NFPA 13D describing equipment, materials, spaces or design parameters.

- **Sprinkler System** – For fire protection purposes, an integrates system of underground and overhead piping designed in accordance with fire protection engineering standards. The installation includes one or more automatic water supplies. The portion of the sprinkler system above the ground is a network of specially sized or hydraulically designed piping installed in a building, structure, or area, generally overhead, and to which sprinklers are attached in a systematic pattern. The system is usually activated by heat from a fire and discharges water over the fire area. NFPA 13D – 3.3.9.7

Definitions used in NFPA 13D describing equipment, materials, spaces or design parameters.

- **Wet Pipe Sprinkler System** – A sprinkler system employing automatic sprinklers attached to a piping system containing water and connected to a water supply so that water discharges immediately from sprinklers opened by heat from a fire. NFPA13D – 3.3.9.8
- **Townhouse** – A one-family dwelling constructed in attached groups of three or more units in which each unit extends from the foundation to the roof and has open space on at least two sides. (only allowed by P-I license with a residential fire sprinkler contractor license)  
NFPA 13D – 3.3.10

# NFPA 13D Purpose

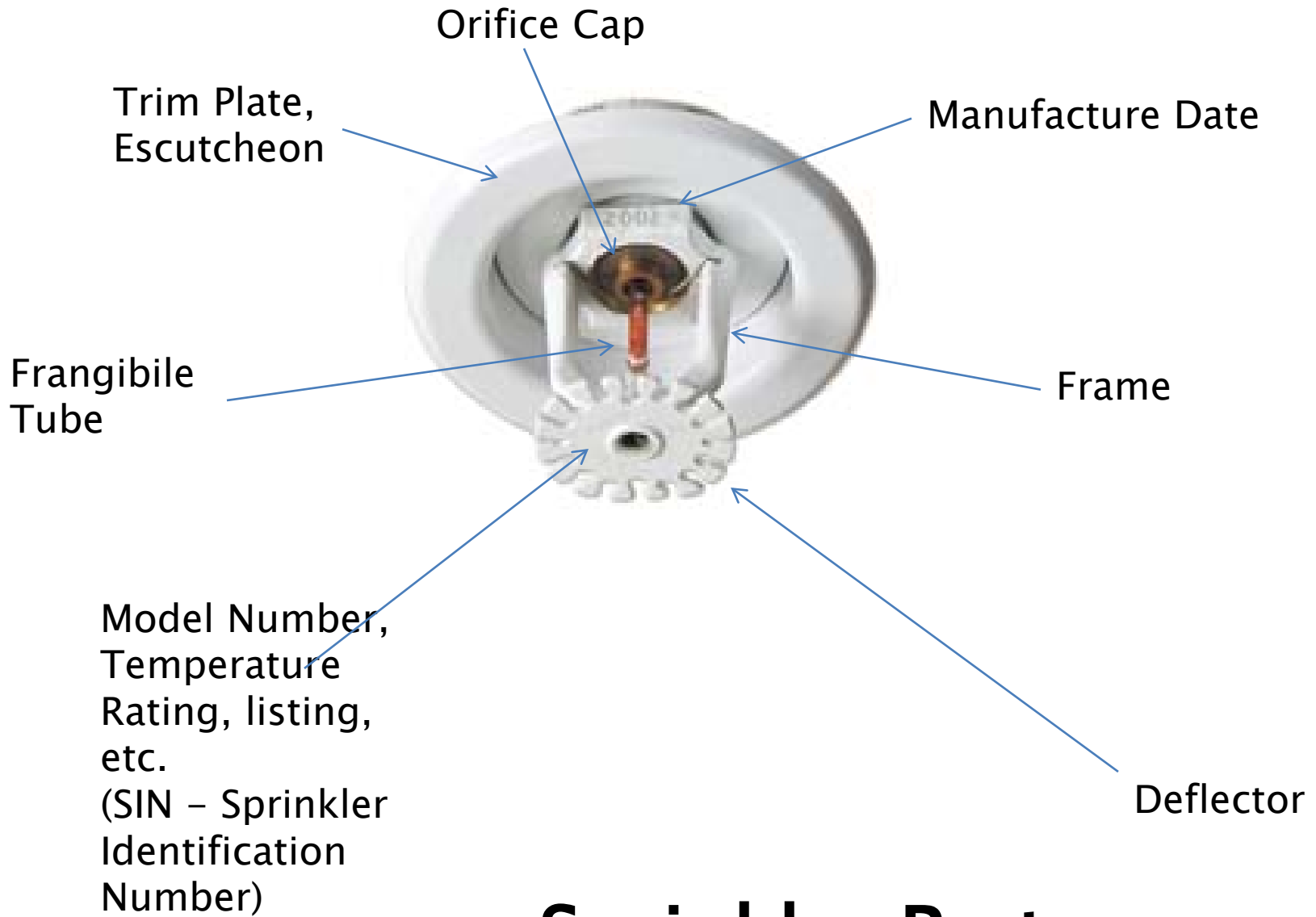
- ▶ Sprinkler systems designed and installed to NFPA 13D shall be expected to improve the chance for occupants to escape or be evacuated by preventing the room of origin from reaching flashover. NFPA 13D – 1.2.2

# Design Requirements

- Multipurpose sprinkler systems shall be designed and calculated by a Licensed Fire Sprinkler Contractor or Professional Engineer.
  - Licensed by the NC Board of Plumbing, Heating and Fire Sprinkler Contractors.
  - Licensed North Carolina Professional Engineer

# System Function

- ▶ The basic the operation of a multipurpose sprinkler system.
  - Sprinkler systems are reactive, must work when needed.
  - System is a combination of domestic and fire water distribution piping
  - Heat gathers around the element (glass bulb)
  - Fluid in the bulb has a very low boiling point- as it is heated the bulb begins to expand and eventually breaks
  - Once the bulb breaks, the plug is forced out by the water and a spray pattern is devolved by the sprinkler deflector



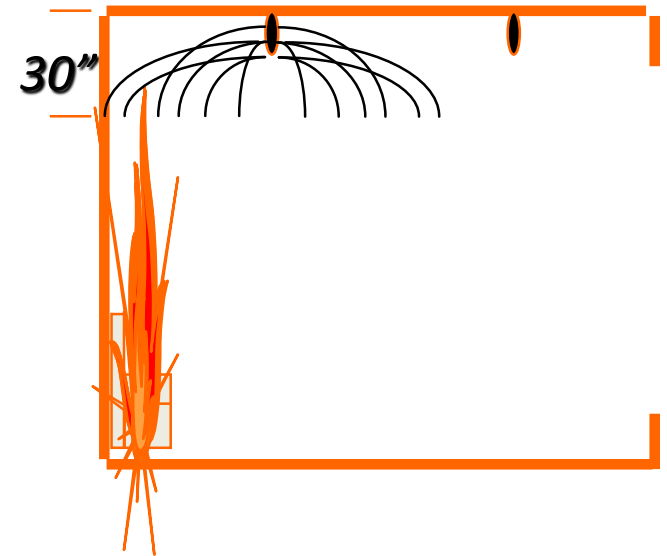
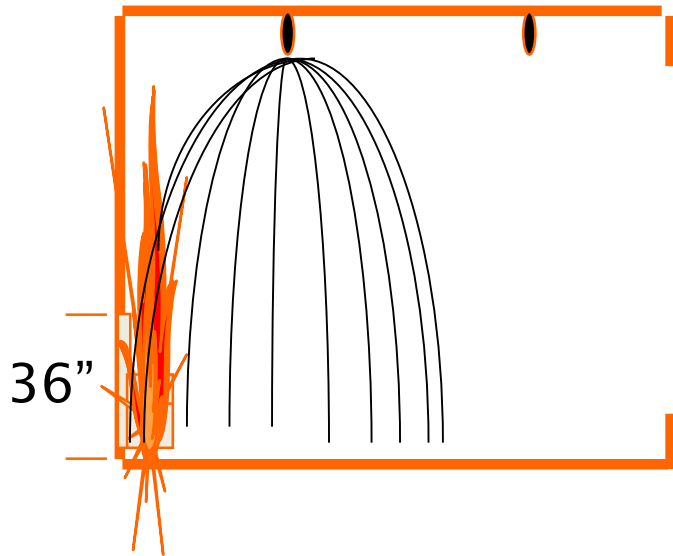
# Sprinkler Parts



# Benefits of Multipurpose systems

- ▶ **Multipurpose Systems** -Keep water flowing, reducing the possibility of freezing, uses the same plumbing piping already being installed throughout the dwelling.
- ▶ **Multipurpose Systems** – Are always on, as long as water is available at normal plumbing fixtures the Fire Protection system is active.
- ▶ *Sprinklers designed specifically for residential applications, activate quickly, spray higher on the wall and provide time for occupants to evacuate*

# High Wall Wetting Capability



# Design Changes

- The systems have been designed a specific way and must be installed as shown on the drawings as provided by a Licensed Fire Sprinkler contractor or Professional Engineer.
  - Notify the designer of **any changes in the piping configurations** during the installation whether intentional or unavoidable.
  - **Any** changes or modifications due to new obstructions shall be reported to the designer for redesign / calculation. **No Exceptions**

# Installation Procedures

- CPVC – Cutting
  - Always follow Manufacturers installation instructions
  - Straight level cuts are critical to the integrity of the system
  - Bottom third of the fitting holds 90%
  - Use wheel cutters or ratchet cutters (with a sharp blade) or chop saw
  - Use only wheel cutters in temperatures below 50°F, as ratchet cutters can crack/fracture pipe

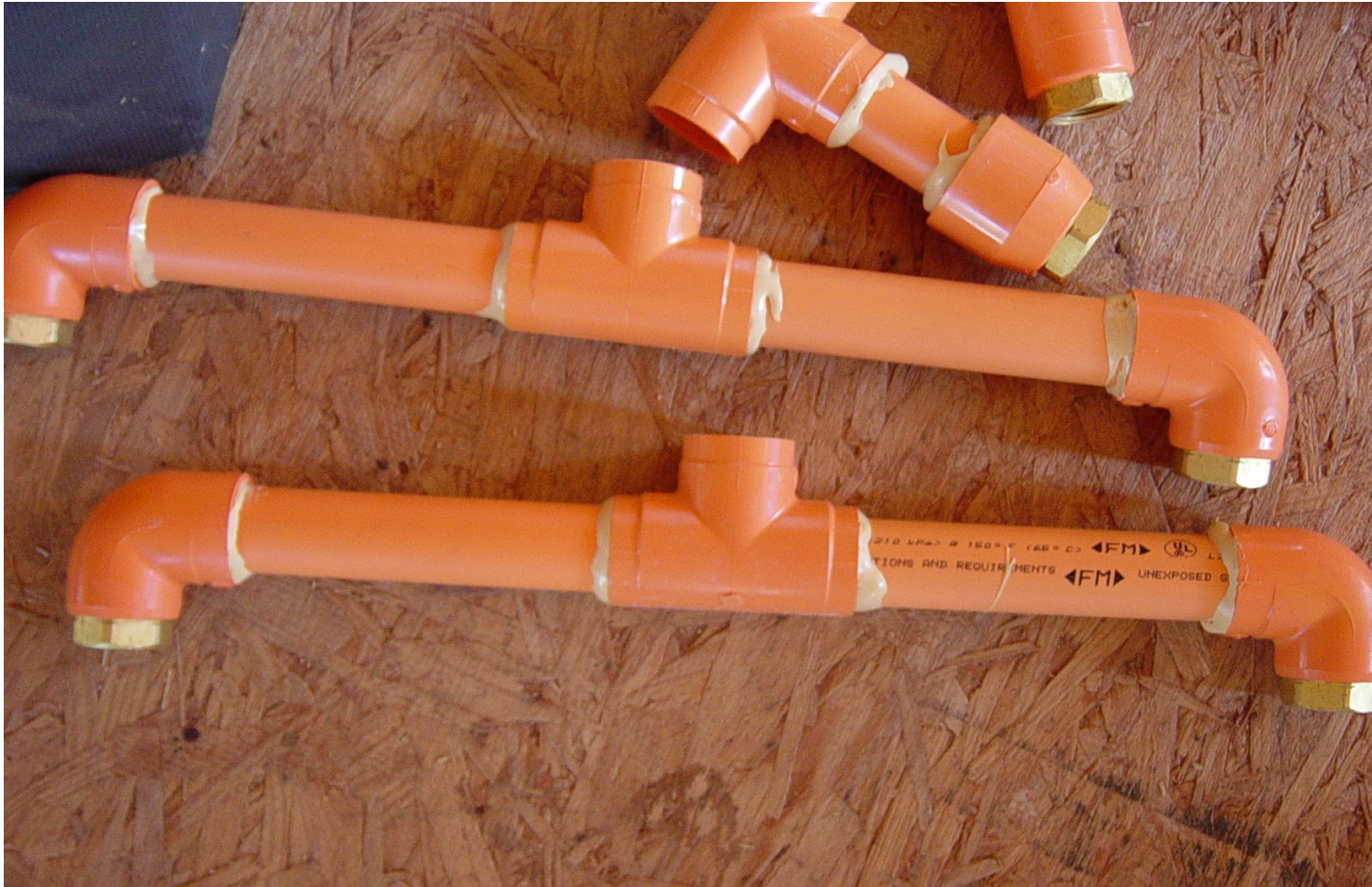
# CPVC Cutting (cont.)

- Provide a slight bevel. This will help prevent sheeting of the solvent or other obstructions.
- Ream piping in one direction only (reamers only cut in one direction). Both inside and outside of the pipe
- Check fitting for tolerance (snugness) Do not insert piping all the way into the fitting (beyond 2/3 depth of the fitting).
- Inspect ends of piping for cracks, fractures or other signs of potential failure

# CPVC – Fitting

- Use dabber  $\frac{1}{2}$  the pipe size, for example for  $\frac{3}{4}$  - 1 inch piping use  $\frac{1}{2}$  inch dabber (Pint sized canister), for 1  $\frac{1}{4}$  inch piping and above use  $\frac{3}{4}$  inch dabber (Quart size canister).
- Turn piping  $\frac{1}{4}$  turn while fully inserting the pipe into the fitting
- Hold piping and fitting for **30 Seconds**.
- When temperatures are below 50°F hold piping and fittings for an increased amount of time.
- Carefully remove excess solvent (drips)

# Cold water connection





Manifold  
assembly –  
point of  
attachment of  
cold water  
domestic  
supply

Pipe wrap  
insulation for  
6.7 R value

Cold water feed  
off sprinkler loop  
providing supply  
to water closet,  
shower and sink







System connection to cold water domestic demand

# Basics of System Operation

- ▶ The water supply source must be acceptable to both NFPA 13D and the North Carolina State Plumbing Code (NCSPC). NFPA 13D – 6.2
  - Connections to reliable waterworks systems with or without an automatically operated pump
  - An elevated tank (when necessary)
  - A pressure tank designed to ASME standards for a pressure vessel with a reliable pressure source
  - A stored water source with an automatically operated pump
  
- ▶ A well with a pump of sufficient capacity and pressure to meet the sprinkler system demand

# Water Requirements

- ▶ When a pressure tank is utilized as a source of water a gauge must be installed to indicate the tank pressure. NFPA 13D – 7.3.2
- ▶ When water is required by the designer to be stored to facilitate the required demand the minimum quantity must be equal to the demand rate times ten minutes. NFPA 13D – 6.1.2
  - When stored water is the only supply the minimum storage capacity must be equal to the two sprinkler demand times seven minutes when the dwelling unit is single story and less than 2000ft<sup>2</sup>. NFPA 13D – 6.1.3

# Water Requirements

- ▶ The minimum water required to be stored by sections 6.1.2 or 6.1.3 can be a combination of the well water plus the holding tank water with a reduction for the refill rate of the well. NFPA 13D – 6.1.4
- ▶ Systems utilizing a pump, prior to their acceptance, must be tested by opening the drain/test connection. NFPA 13D – 6.2.1
  - The pump shall automatically operate, turn on and flow water, for the duration required by sections 6.1.2 or 6.1.3 without any interruptions. NFPA 13D – 6.2.1.1



# System Requirements

- ▶ NFPA 13D uses the words pipe and tube interchangeably. NFPA 13D – 4.4
- ▶ All multipurpose residential fire sprinkler systems will be a 'Wet pipe fire sprinkler system'. NFPA 13D – 3.3.9.3, 3.3.9.8
  - Systems may be designed containing dry pendant or dry sidewall sprinkler heads in areas where maintaining 40°F may not be possible.
  - When dry pendant or dry sidewall heads are called for by the designer. They shall be listed and labeled for use in residential occupancies. NFPA 13D – 4.3

# System Requirements

- Multipurpose fire sprinkler systems must be installed in accordance with NFPA 13D – 6.3.2 through 6.5.4. NFPA 13D – 6.3.1
  - Systems shall be inspected and approved by the local plumbing or health authority. NFPA 13D – 6.3.2
- Piping/tubing in the system supplying sprinklers must be listed and conform to the specifications of NFPA 13D. NFPA 13D – 6.3.3

# Multipurpose systems

- Piping/tubing that is only connected to the plumbing system must comply with the NC State Plumbing Code. NFPA 13D – 6.3.3.1

# Signage

- ▶ Signs must be posted at the main shut off valve using a minimum of ¼ letters and must read as follows. NFPA 13D – 6.5.3
  - 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 shut-off 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.



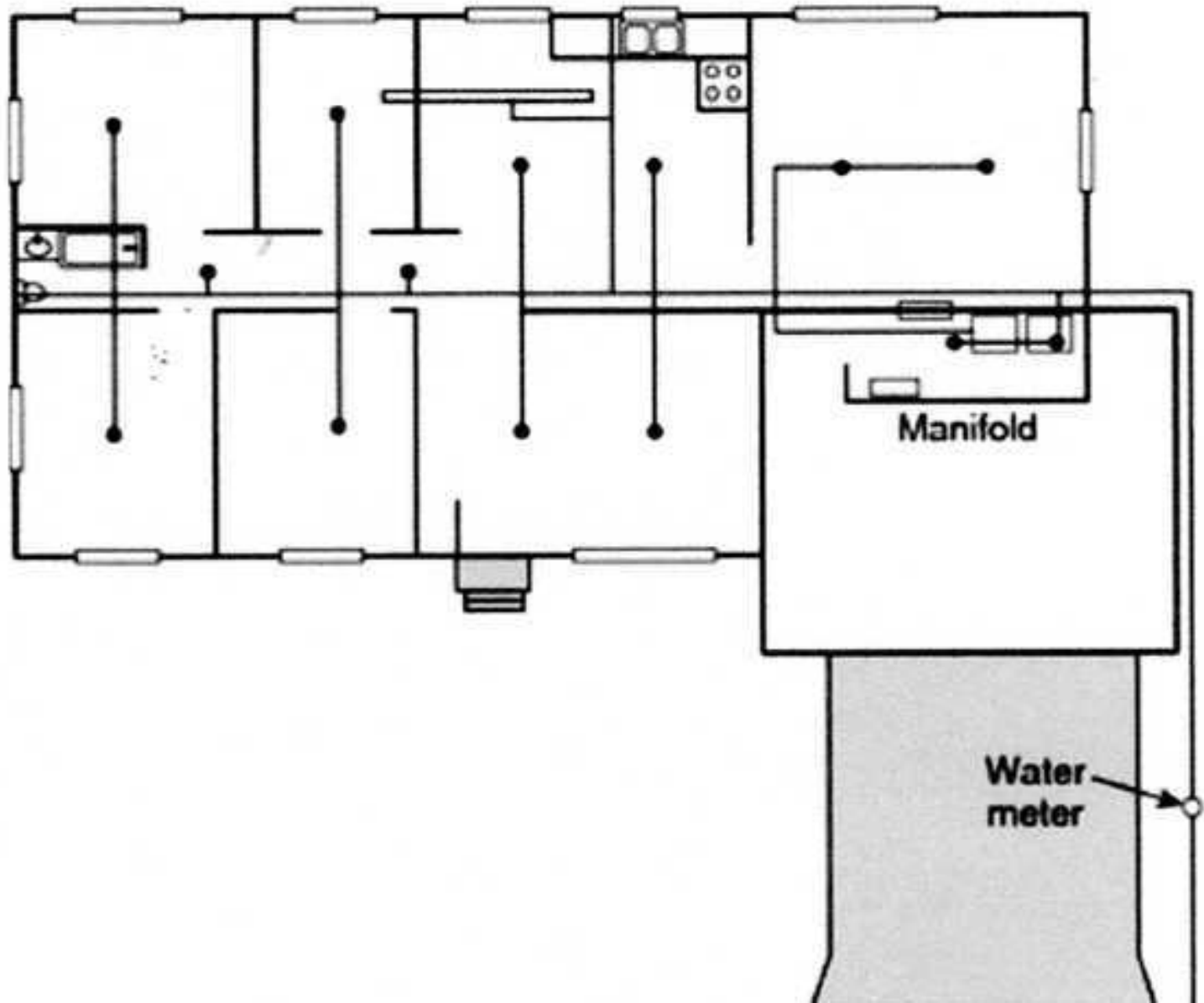
# Water Filter Systems

- ▶ When water treatment or filtration systems are installed on the system one of the following conditions must be met: NFPA 13D – 6.5.4
  - The flow restriction and pressure loss through the water treatment equipment must be taken into account in the hydraulic calculations performed by a NC Licensed Fire Sprinkler Installation Contractor or NC Professional Engineer.
  - An automatic bypass must be installed around the water treatment equipment that directs all water directly to the system.

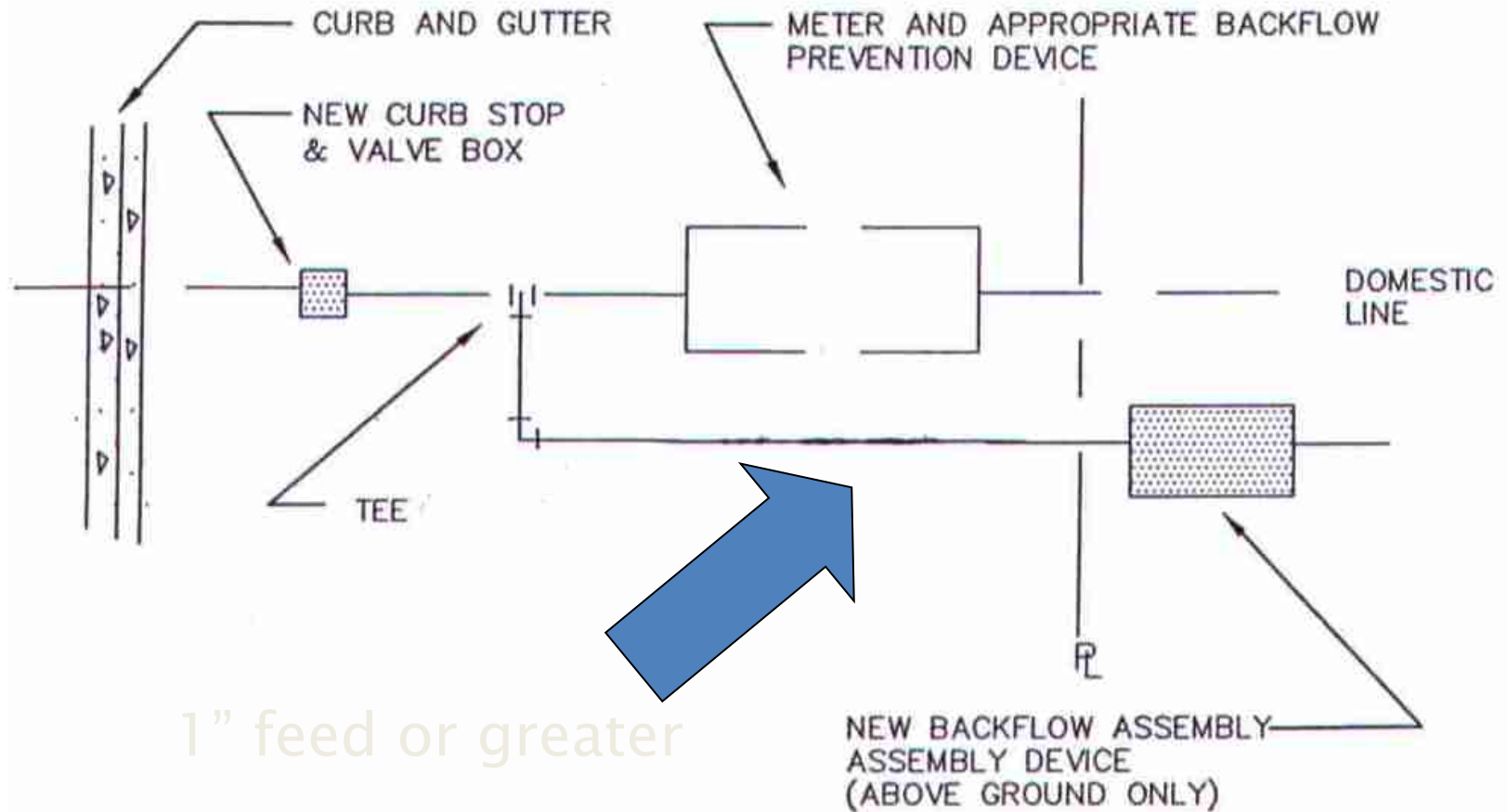
# System Types

- Multipurpose fire sprinkler systems serve both the fire protection and domestic plumbing demands. NFPA 13D – A.6.3
  - Looped – Systems in which ‘main’ pipe returns from the riser to the riser. NFPA 13D – Figure A.6.3(b)
  - Network – Minimum of 3 connections to one sprinkler head – typically designed with tubing. NFPA 13D – 3.3.9.4, Figure A.3.3.9.4, Figure A.6.3(c)

# Stand Alone System



# Typical connection to municipal water / stand alone system





Stand Alone  
System

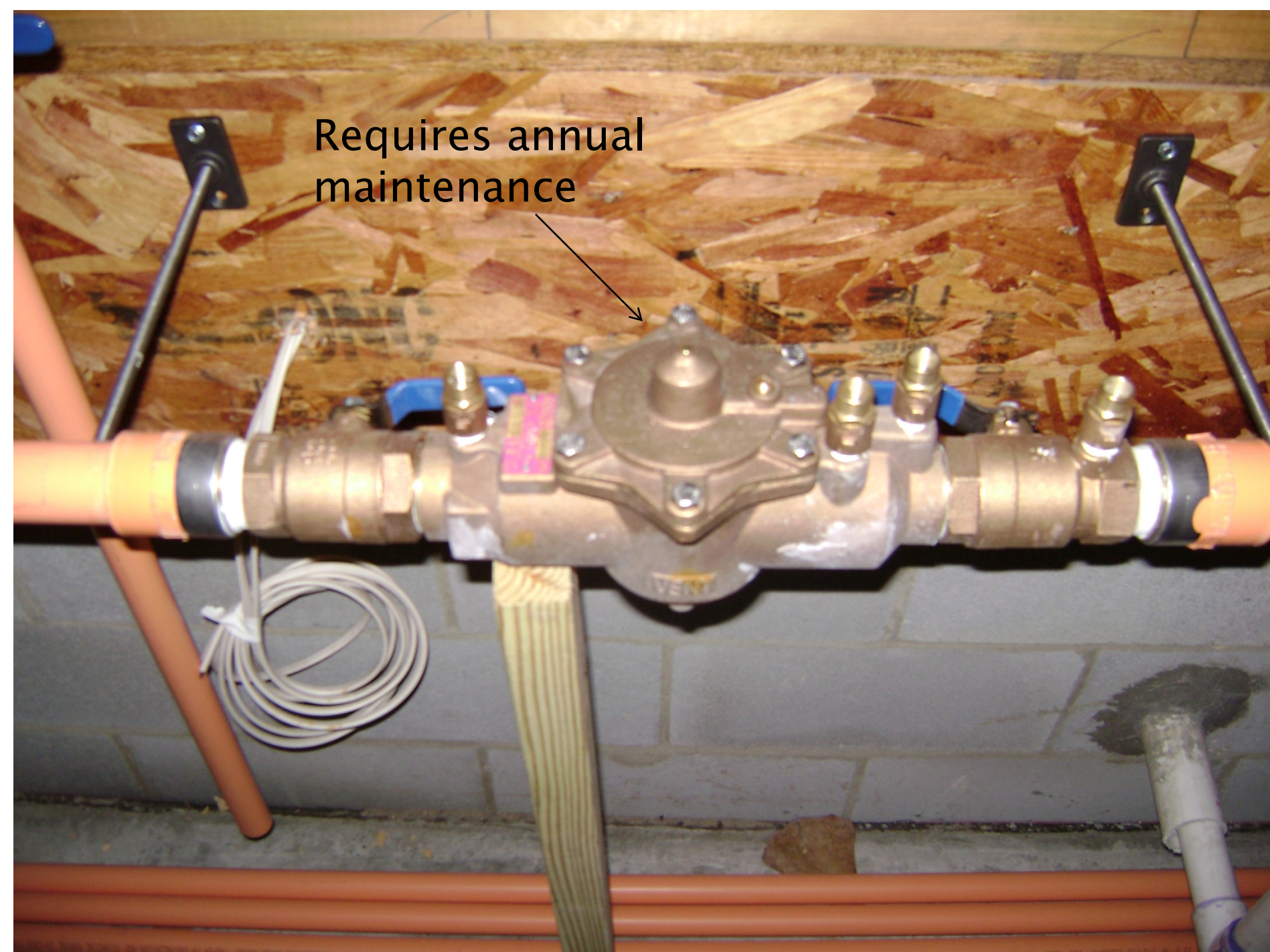
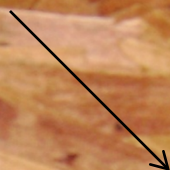
Residential Riser Assembly

Domestic  
Water  
Feed





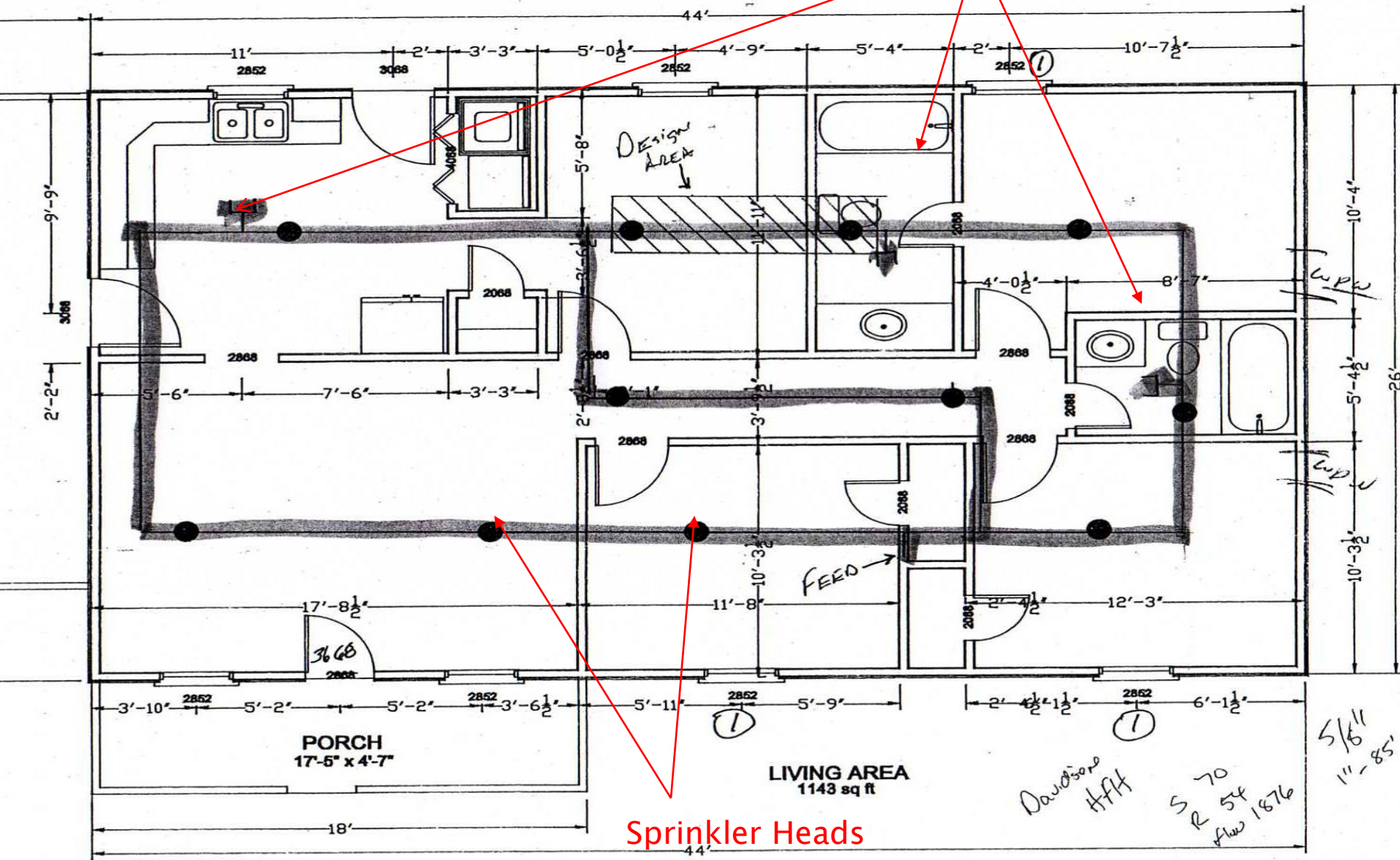
Requires annual  
maintenance





# Multi Purpose System

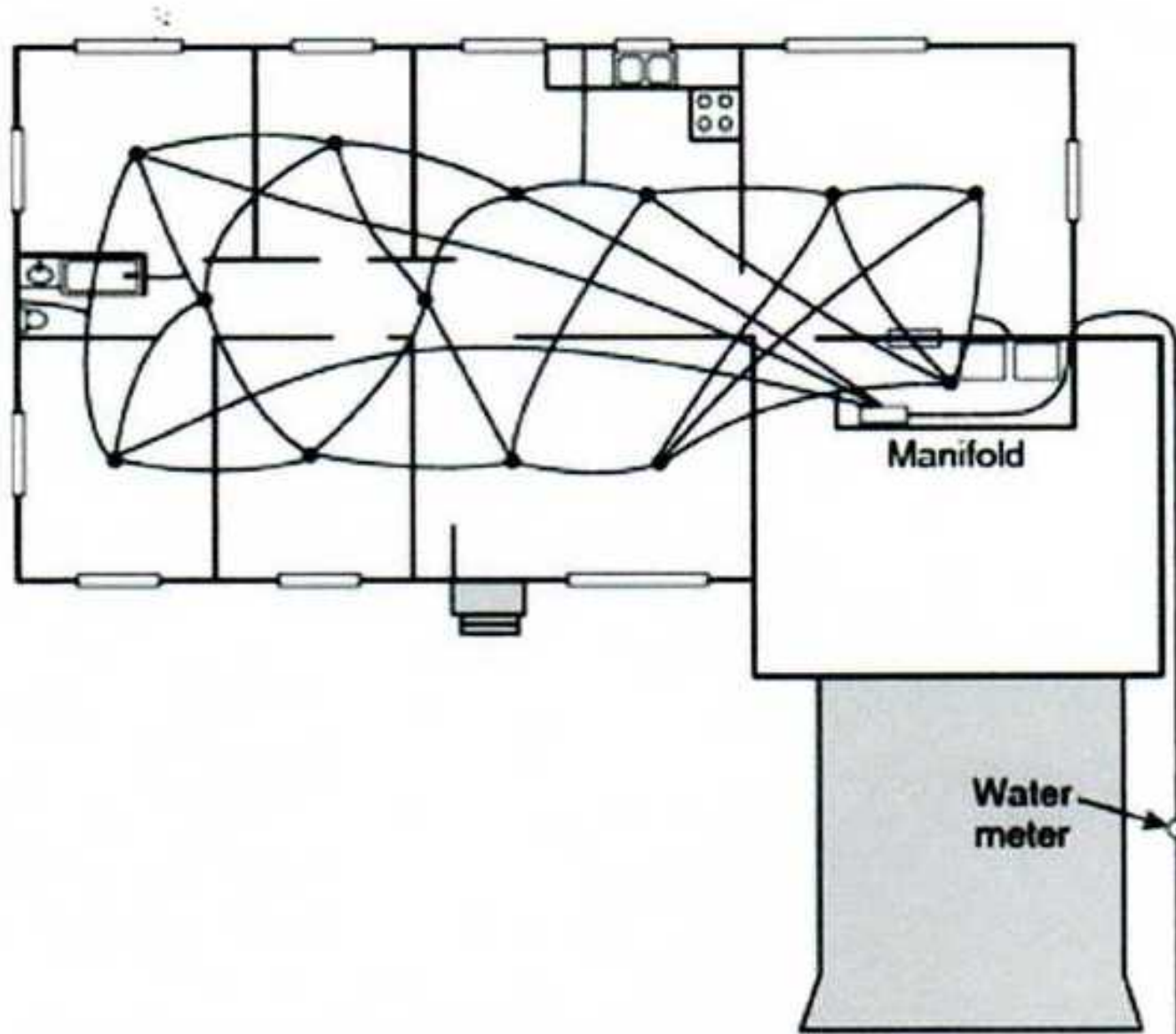
Cold water domestic feed



Sprinkler Heads

(1) 111 Reduce window to meet Egress

# Network System





# Piping

- Piping used in Multipurpose Residential fire sprinkler systems must meet all applicable testing and standards for both fire protection service and domestic water service. NFPA 13D
  - 6.3.2, 6.3.3
    - UL 1821 & FM 1635
    - NSF Approval for Potable Water
    - Other standards – Plumbing as well as Fire Sprinkler.

# Piping

- ▶ Acceptable piping listed in the North Carolina State Plumbing Code (NCSPC) Section 605.3; Table 605.3 will be acceptable for supplying the fire sprinkler system provided that the piping is only installed between the point of connection and the system riser. NFPA 13D – 5.3
  - Piping and fittings allowed between the point of connection and the system riser must have a minimum working pressure rating of 160psi
  - Except where the minimum working pressure rating exceeds 160psi, piping from the point of connection to the system riser must then have a working pressure rating equal to the highest available pressure.

# Control Valves

- A single valve must be installed to shut-off both the domestic and sprinkler piping. NFPA 13D – 7.1.1

Point of  
attachment of  
sprinkler  
system to  
domestic  
water entry



To water  
heater

To  
sprinkler  
system  
loop and  
all cold  
water  
domestic  
uses

Feed from water meter

# Materials

- ▶ All materials and devices used in a multipurpose sprinkler system must be listed except the following: NFPA 13D – 5.1.2, 5.1.3
  - Other standards or the manufactures listing may require that hangers be listed for use with the material.
  - Always check manufactures listings.
  - Tanks
  - Expansion tanks
  - Pumps
  - Water flow detection devices
  - Water flow valves
  - Hangers – Hangers and strapping materials shall be of an approved material that will not promote galvanic action. NCPC 308.3

# Non metallic piping

- Nonmetallic piping and fittings installed for multipurpose systems shall be designed and installed to withstand a minimum working pressure of 130psi. NFPA 13D – 5.2.1.3, 5.2.5.3
- Different types of water distribution piping used for multipurpose residential sprinkler systems. NFPA 13D – 5.2.1
  - Metallic – Copper
  - CPVC
  - Tubing –PEX
  - Piping/Tubing shall be listed for fire sprinkler service

# Piping Materials

- Types of pipe/tubing that are not listed in table 5.2.1.1 can be used when listed for both fire sprinkler system use and domestic plumbing use. NFPA 13D – 5.2.2
- When other types of pipe/tubing than those shown in table 5.2.1.1 are used they must be installed in accordance with the manufacture's installation instructions and their listing. NFPA 13D – 5.2.2.1

**TABLE 605.3  
WATER SERVICE PIPE**

<b>MATERIAL</b>	<b>STANDARD</b>
Acrylonitrile butadiene styrene (ABS) plastic pipe	ASTM D 1527; ASTM D 2282
Asbestos-cement pipe	ASTM C 296
Brass pipe	ASTM B 43
Chlorinated polyvinyl chloride (CPVC) plastic pipe	ASTM D 2846; ASTM F 441; ASTM F 442; CSA B137.6
Copper or copper-alloy pipe	ASTM B 42; ASTM B 302
Copper or copper-alloy tubing (Type K, WK, L, <u>WL</u> )	ASTM B 75; ASTM B 88; ASTM B 251; ASTM B 447
Cross-linked polyethylene (PEX) plastic tubing	ASTM F 876; ASTM F 877; CSA B137.5
Cross-linked polyethylene/aluminum/cross-linked polyethylene (PEX-AL-PEX) pipe	ASTM F 1281; CSA B137.10M
Cross-linked polyethylene/aluminum/high-density polyethylene (PEX-AL-HDPE)	ASTM F 1986
Ductile iron water pipe	AWWA C151; AWWA C115
Galvanized steel pipe	ASTM A 53
Polybutylene (PB) plastic pipe and tubing	ASTM D 2662; ASTM D 2666; ASTM D 3309; CSA B137.8M
Polyethylene (PE) plastic pipe	ASTM D 2239; CSA B137.1
Polyethylene (PE) plastic tubing	ASTM D 2737; CSA B137.1
Polyethylene/aluminum/polyethylene (PE-AL-PE) pipe	ASTM F 1282; CSA B137.9
Polypropylene (PP) plastic pipe or tubing	ASTM F 2389; CSA B137.11
Polyvinyl chloride (PVC) plastic pipe	ASTM D 1785; ASTM D 2241; ASTM D 2672; CSA B137.3
Stainless steel pipe (Type 304/304L)	ASTM A 312; ASTM A 778
Stainless steel pipe (Type 316/316L)	ASTM A 312; ASTM A 778



**TABLE 605.4  
WATER DISTRIBUTION PIPE**

<b>MATERIAL</b>	<b>STANDARD</b>
Brass pipe	ASTM B 43
Chlorinated polyvinyl chloride (CPVC) plastic pipe and tubing	ASTM D 2846; ASTM F 441; ASTM F 442; CSA B137.6
Copper or copper-alloy pipe	ASTM B 42; ASTM B 302
Copper or copper-alloy tubing (Type K, WK, L, WL, M or WM) <sup>a</sup>	ASTM B 75; ASTM B 88; ASTM B 251; ASTM B 447
Cross-linked polyethylene (PEX) plastic tubing	ASTM F 877; CSA B137.5
Cross-linked polyethylene/aluminum/cross-linked polyethylene (PEX-AL-PEX) pipe	ASTM F 1281; CSA B137.10M
Cross-linked polyethylene/aluminum/high-density polyethylene (PEX-AL-HDPE)	ASTM F 1986
Galvanized steel pipe	ASTM A 53
Polybutylene (PB) plastic pipe and tubing	ASTM D 3309; CSA B137.8M
Polyethylene/Aluminum/Polyethylene (PE-AL-PE) composite pipe	ASTM F 1282
Polypropylene (PP) plastic pipe or tubing	ASTM F 2389; CSA B137.11
Stainless steel pipe (Type 304/304L)	ASTM A 312; ASTM A 778
Stainless steel pipe (Type 316/316L)	ASTM A 312; ASTM A 778

<sup>a</sup> Below grade type K, WK, L, WL.

**TABLE 605.5  
PIPE FITTINGS**

<b>MATERIAL</b>	<b>STANDARD</b>
Acrylonitrile butadiene styrene (ABS) plastic	ASTM D 2468
Cast-iron	ASME B16.4; ASME B16.12
Chlorinated polyvinyl chloride (CPVC) plastic	ASTM F 437; ASTM F 438; ASTM F 439; CSA B137.6
Copper or copper alloy	ASME B16.15; ASME B16.18; ASME B16.22; ASME B16.23; ASME B16.26; ASME B16.29
Cross-linked polyethylene/aluminum/high-density polyethylene (PEX-AL-HDPE)	ASTM F 1986
Fittings for cross-linked polyethylene (PEX) plastic tubing	ASTM F 877; ASTM F 1807; ASTM F 1960; ASTM F 2080; ASTM F 2159; CSA B137.5
Gray iron and ductile iron	AWWA C110; AWWA C153
Malleable iron	ASME B16.3
Metal (brass) insert fittings for Polyethylene/Aluminum/Polyethylene (PE-AL-PE) and Cross-linked Polyethylene/Aluminum/Cross-linked Polyethylene (PEX-AL-PEX)	ASTM F 1974
Polybutylene (PB) plastic	CSA B137.8
Polyethylene (PE) plastic	ASTM D 2609; CSA B137.1
Polypropylene (PP) plastic pipe or tubing	ASTM F 2389; CSA B137.11
Polyvinyl chloride (PVC) plastic	ASTM D 2464; ASTM D 2466; ASTM D 2467; CSA B137.2
Stainless steel (Type 304/304L)	ASTM A 312; ASTM A 778
Stainless steel (Type 316/316L)	ASTM A 312; ASTM A 778
Steel	ASME B16.9; ASME B16.11; ASME B16.28

# Incompatible Materials

- All nonmetallic piping or tubing can possibly be damaged by contact with the chemicals found in some construction products. NFPA 13D – A.5.2.2.2
  - Always check manufactures listings for compatibility issues before installing nonmetallic piping.
  - Installers are responsible to get compatibility information from manufactures and avoid storing, installing and placing incompatible products together.

# Incompatible Materials

- Examples of possible incompatible chemicals found on typical construction sites. NFPA 13D – A.5.2.2.2
  - Thread Sealants,
  - Leak Detectors,
  - Fire stops, Fire caulking
  - Insulation
  - Spray foams
  - Cutting oils
  - Insecticides
  - Antifreeze
  - Coupling lubes
  - Communication cables
  - Wires
  - Flux

# Compatibility Issues

- <http://www.lubrizon.com/BuildingSolutions/ChemicalCompatibility/incompatible.html>
- [http://www.spearsmfg.com/flameguard/FG-3-0509\\_0509\\_web.pdf](http://www.spearsmfg.com/flameguard/FG-3-0509_0509_web.pdf) (page 53)
- <http://www.uponor-usa.com/en/Header/Systems/Fire/Installer/Overview.aspx>
- <http://na.rehau.com/construction/fire.protection...plumbing/residential.fire.protection/residential.fire.protection.shtml>

Not representative of all manufactures

# Sprinkler Head installations

- Compatible thread sealant or Teflon tape may be utilized in a CPVC sprinkler head adapter. The manufactures instructions must be followed for each sprinkler head adapter used. NFPA 13D – A.5.2.4

# Sprinkler Fittings

- Not all fittings manufactured to the ASTM standards listed in Table 5.2.9.2 are specifically listed for fire sprinkler installations. The fittings that are listed are identified by the logo of the listing agency. NFPA 13D – A.5.2.9.2
- Only new sprinkler heads shall be installed in any sprinkler system. NFPA 13D – 5.1.1

# Sprinkler head temperature ratings.

- Sprinklers with a rating between 135°F and 175°F are classified as ordinary temperature-rated sprinklers. NFPA 13D – 4.3.1
- Sprinklers with a rating between 175°F and 225°F are classified as intermediate temperature-rated sprinklers. NFPA 13D – 4.3.2



# Sprinkler head temperature ratings.

- Sprinklers installed in spaces where the maximum ambient ceiling temperatures do not exceed 101°F must be of the ordinary temperature-rated sprinkler type unless otherwise directed by another section of NFPA 13D. NFPA 13D – 7.5.5.1
- Sprinklers installed in spaces where the maximum ambient ceiling temperatures are between 101°F and 150°F must be of the intermediate temperature-rated sprinkler type unless otherwise directed by another section of NFPA 13D. NFPA 13D – 7.5.5.2

# Sprinkler head temperature ratings.

- The following practices must be observed when installing residential sprinklers, unless higher expected ambient temperatures require a higher sprinkler head temperature rating: NFPA 13D – 7.5.5.3
  - Sprinklers installed under skylights (glass or plastic) exposed to direct rays of the sun must be of the intermediate temperature classification.

# External Heat Sources

- Sprinklers installed near specific heat sources identified in Table 7.5.5.3 must be of the temperature rating indicated in the table, unless sprinklers are specifically listed for positioning closer to the heat source. NFPA 13D – Table 7.5.5.3
- Combination exhaust fan and heater units need to be treated as wall mounted diffusers when using Table 7.5.5.3. These units create heat and could possibly activate the sprinkler head. Identify this problem to the owner/occupant during the installation and inform them that if a unit that provides heat and exhaust is installed, consideration must be taken for the sprinkler heads location to the unit. NFPA 13D – A.7.5.5.3

# Sprinkler Types

- In multipurpose systems a residential type listed sprinkler head will be used.
  - **Residential sprinklers** - Required in residential occupancies; can only be used on wet pipe systems unless listed for use with other systems. NFPA 13D – 3.3.8.2, 7.5.2
  - **Pendant sprinkler** – can be recessed, semi-recessed or extend down from the ceiling. The deflector points downward.

# Sprinkler Types

- **Upright sprinkler** – installed within its listing with the deflector pointed upward.
- **Sidewall sprinkler** – designed to be installed on the horizontal position.
- **Listed dry-pendant or dry-sidewall sprinklers** are permitted to be installed in unheated areas and extended to heated areas. NFPA 13D – 7.5.3

# Pictures of Sprinkler Heads



# Sprinkler Head installation

- Sprinklers heads **shall not** be placed into fittings until the fittings have been cemented into place. NFP A13D – 7.5.8
  - Sprinkler heads should not be installed during rough-in without the manufacturer supplied protective covers.
  - Sprinkler heads should be installed according to manufacturer's recommendations.

# Support for piping and sprinklers.

- Listed piping shall be supported in accordance with its limitations
- Pipe laid on open joist shall be supported to prevent lateral movement.
- Piping shall be supported such in such a manner that movement is prevented upon sprinkler activation



# Support for piping and sprinklers.

- Listed pipe shall be supported in accordance with its listing limitations.
- Piping not containing support requirements within its listing limitations must be supported from structural members using support methods stated in or comparable to those of the NCSPC. NFPA 13D – 7.4.2
- Piping laid on open joists or rafters shall be supported in a manner that prevents lateral movement.

# Support for piping and sprinklers.

- Piping shall be supported by structural members using methods comparable to those required by the current edition North Carolina State Plumbing Code
- Recommend strapping 6 inches from the sprinkler head.
- Sprinkler piping shall be supported in a manner that prevents the movement of piping upon sprinkler operation
  - Reaction forces caused by the operation of a sprinkler could displace the sprinkler if not properly restrained from movement and thereby adversely affect the discharge of the sprinkler. NFPA 13D – A.7.4.4

# Support for piping and sprinklers.

- Tubing shall be strapped at any change of direction
- Tubing shall be strapped in accordance with the manufacturer and the North Carolina State Plumbing Code
- Strapping requirements for copper to be in accordance with the manufacturer and the North Carolina State Plumbing Code
- Vertical piping through stories will require a mid-story guide
- Recommend either using a riser clamp with area for expansion or a block and a 2hole strap

# Care and Maintenance

- Sprinklers or escutcheon plates must not be painted. Only those painted or enameled by the manufacturer are allowed. Stress the importance of keeping the protective covers on the sprinkler heads as long as possible. NFPA 13D – 7.5.6
- The ornamental finish applied by the factory to a sprinkler head must not be confused with the sprinkler heads temperature-rating. The temperature rating colors of colored elements are as follows. NFPA 13D – A.7.5.6, NFPA 13 – Table 6.2.5.1

# Materials Listing / Dead ends

- When nonmetallic escutcheon plates or recessed escutcheons are used, metallic or nonmetallic, they must be listed as an assembly with the residential sprinkler head. NFPA 13D – 7.5.7
- No dead ends are allowed on the sprinkler piping.
  - Dead ends on the sprinkler piping compromises water quality.
  - Extensions from the sprinkler piping loop to plumbing fixtures are allowed.

# System Characteristics

- Design changes to a multipurpose residential sprinkler system must be made by a licensed fire sprinkler installation contractor or professional engineer. 21 NCAC 50.0516
- Residential sprinklers are designed to provide a spray pattern higher on the wall than standard sprinklers.

# Sprinkler Head Discharge Requirements

- The minimum discharge from two sprinkler heads in the design area is not less than 13 gpm per sprinkler head. NFPA 13D – 8.1.1.1
- The minimum discharge from a single sprinkler head in the system is not less than 18 gpm. NFPA 13D – 8.1.1.2

# Flow Requirements

- Multipurpose residential fire systems are designed to provide at least the minimum flow required for the multiple and single sprinkler operating criteria specified by the sprinklers listings. NFPA 13D – 8.1.1.2.1



# Compatible installation

- Sprinkler heads must be installed in the manner in which they were listed. The ceiling configuration of the installation must match the types of construction referenced in the listing. NFPA 13D – 8.1.3.1.1

# Performance Information

- Basis for the requirements for a two sprinkler head design. NFPA 13D – A.8.1.
- In a majority of cases, where residential sprinklers have been installed, the fire is typically controlled or even suppressed with the operation of just one sprinkler head. While this may or may not be a true statement, what is true is that the water supplies for these systems were designed with the operation of two sprinkler heads in mind.

# Sprinkler Head Spacing

- Sprinkler heads have minimum spacing requirements which is part of their listing. Sprinklers must be installed by maintaining this spacing.
- The minimum spacing allowed between residential sprinkler heads when measured between the sprinkler heads in plan view is 8 feet. NFPA 13D – 8.1.3.1.3.2, Figure 8.1.3.1.3.1

# Sprinkler Installation

- Demonstrate the proper orientation of pendant or upright residential sprinkler heads
- Always check the sprinkler heads listing criteria for deflector positioning. Some sprinkler heads have distances other than those specified in NFPA 13D.
- Picture of pendant and upright heads

# Sprinkler Installation

- Residential pendant or upright sprinkler heads must be installed such that their deflectors with 1 to 4 inches of the ceiling unless otherwise permitted by NFPA 13D or listed.  
NFPA 13D – 8.2.1.1
- Residential pendant or upright sprinkler heads that have specific positioning criteria must be installed in accordance with their listings unless otherwise permitted by NFPA 13D.  
NFPA 13D – 8.2.1.2

# Residential sidewall sprinkler heads.

- Residential sidewall sprinkler heads must be installed such that their deflector is within 4 to 6 inches of the ceiling. NFPA 13D 8.2.2.1
- Residential sidewall sprinkler heads which have been listed with specific positioning criteria must be installed in accordance with their listings. NFPA 13D 8.2.2.2

# Sprinkler Installation

- When residential sprinklers are installed in an unfinished basement, the sprinkler heads may be installed in a manner that anticipates the future installation of a finished ceiling. NFPA 13D – 8.2.4

# Obstructions

- Listed below are several different types of obstruction changes that can effect the fire sprinkler spray pattern without the sprinkler designer's knowledge.
  - Ceiling Fans
  - Fixtures that hang/protrude from the ceiling i.e. ceiling fans, chandeliers, suspended lights, hanging racks
  - Cabinets
  - Shelving
  - Soffits
  - Large horizontal beam ceilings
  - Sloped ceilings with beams
  - Steeply sloped ceilings
  - Box/Bay windows



# Obstructions

- It is important to be able to identify potential obstructions to fire sprinkler spray patterns. NFPA 13D – A.8.2.5
  - Having a good understanding of potential obstructions is an important role of the inspector to ensure that the response time and discharge spray pattern are not affected.
  - Some obstructions may require additional residential sprinklers while others may require a higher flow rate than normal. Obtain guidance from the installer/designer if there are any concerns or potential obstructions found during the installation.

# Obstructions

- Sprinklers are allowed to be installed, at the discretion of the designer, at the highest ceiling level in closets less than 400 cubic feet in size without regard to obstructions. NFPA 13D - 8.2.5.1
- All distances are measured from the center of the sprinkler deflector to the nearest edge of the obstruction. NFPA 13D – 8.2.5.2.2

# Obstructions

- Pendant sprinkler heads must be at least 3 feet away from obstructions such as light fixtures, ceiling fans, etc. unless they meet other spacing requirements described in NFPA 13D. NFPA 13D – 8.2.5.2.1
- When residential sprinkler heads cannot be placed at the correct design dimension from an obstruction the installer shall contact the designer before proceeding with the installation.

# Obstructions

- In some cases an obstruction, such as fan blades, may encompass more than 50 percent of the area (in plan view). In these cases the installer shall contact the designer before proceeding with the installation. NFPA 13D – 8.2.5.2.4
- Residential pendant and upright sprinkler heads must be positioned in accordance with NFPA 13D – 8.2.5.4 when continuous obstructions are present. NFPA 13D – 8.2.5.4.1

# Obstructions

- Residential sidewall sprinkler heads must be installed a minimum of 5 feet away from obstructions, such as fan blades, unless other requirements of NFPA 13D are met. NFPA 13D – 8.2.5.3.1
- When measuring the distance to obstructions for residential sidewall sprinkler heads as well as residential pendant and upright sprinkler heads, the distance is measured from the center of the sprinkler deflector to the nearest edge of the obstruction. NFPA 13D – 8.2.5.3.2

# Obstructions

- When it is not possible to locate a residential sidewall sprinkler the minimum of 5 feet away from the obstruction an additional sprinkler is required on the opposite side of the obstruction. NFPA 13D – 8.2.5.3.3. The installer shall contact the designer before proceeding with the installation if this situation occurs after the initial design.
- When the area of the obstruction encompasses more than 50 percent of the area (in plan view) the sprinklers must be positioned in accordance with NFPA 13D – 8.2.5.5. NFPA 13D – 8.2.5.3.4

**Table 8.2.5.5.2(a) Positioning of Sprinklers to Avoid Obstructions (Residential Sidewall Sprinklers)**

<b>Distance from Sidewall Sprinkler to Side of Obstruction (A)</b>	<b>Maximum Allowable Distance of Deflector Above Bottom of Obstruction (in.) (B)</b>
Less than 8 ft	Not allowed
8 ft to less than 10 ft	1
10 ft to less than 11 ft	2
11 ft to less than 12 ft	3
12 ft to less than 13 ft	4
13 ft to less than 14 ft	6
14 ft to less than 15 ft	7
15 ft to less than 16 ft	9
16 ft to less than 17 ft	11
17 ft or greater	14

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

Note: For A and B, refer to Figure 8.2.5.5.2(a).

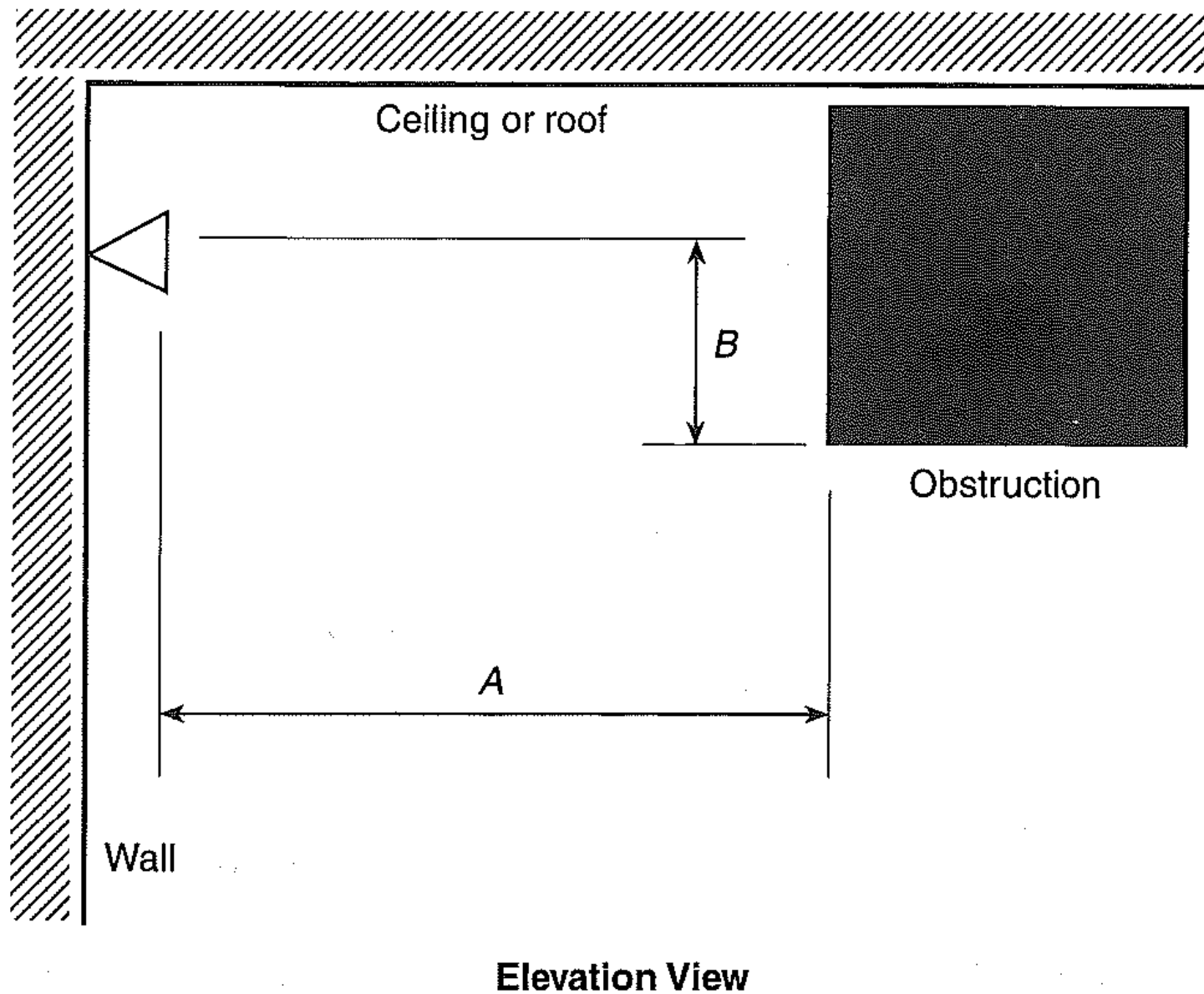
**Table 8.2.5.5.2(b) Positioning of Sprinklers to Avoid Obstructions Along the Wall (Residential Sidewall Sprinklers)**

<b>Distance from Sidewall Sprinkler to Side of Obstruction (<i>A</i>)</b>	<b>Maximum Allowable Distance of Deflector Above Bottom of Obstruction (in.) (<i>B</i>)</b>
Less than 1 ft 6 in.	0
1 ft 6 in. to less than 3 ft	1
3 ft to less than 4 ft	3
4 ft to less than 4 ft 6 in.	5
4 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

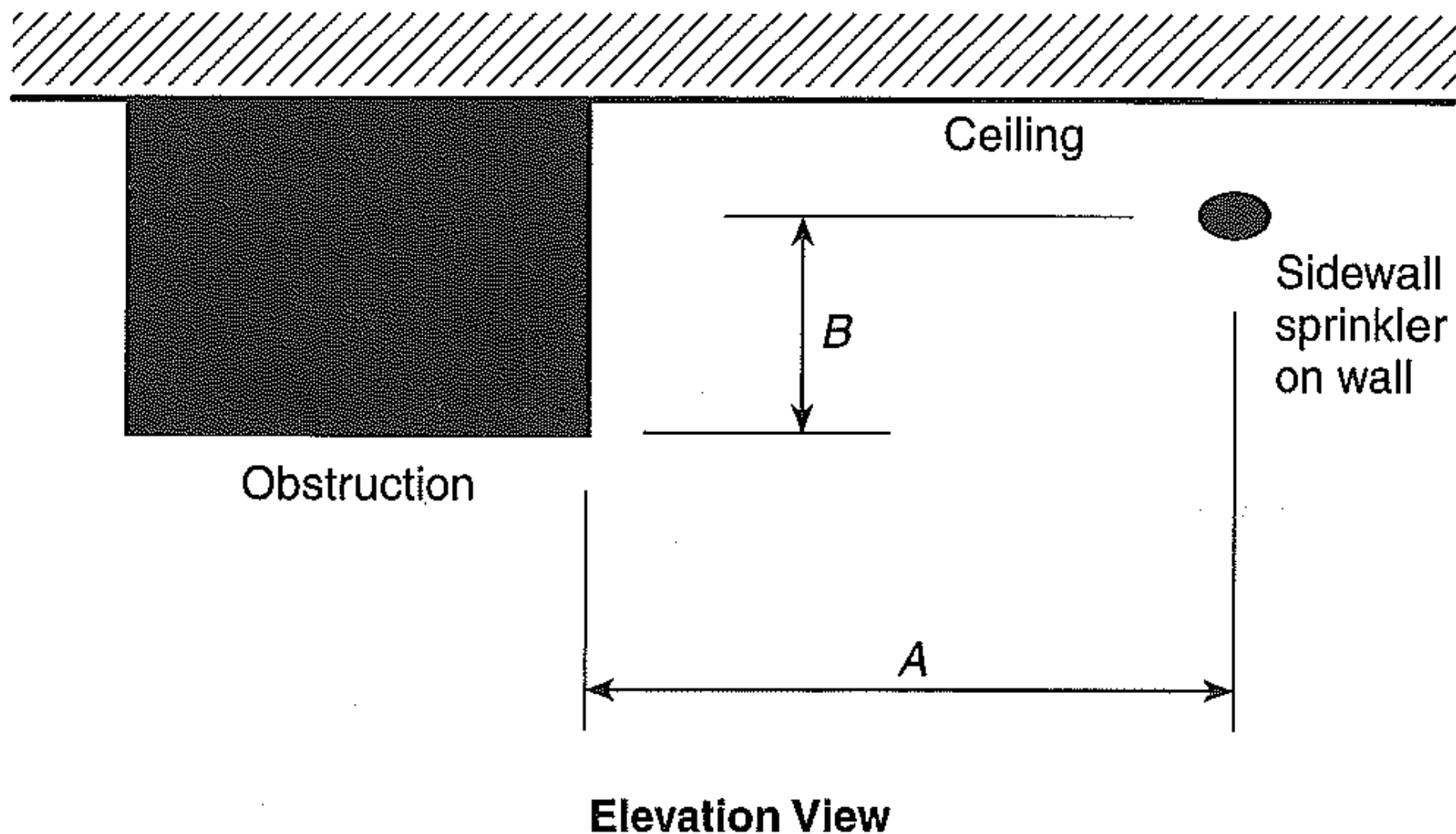
For SI units, 1 in. = 25.4 mm; 1 ft = 0.3048 m.

Note: For *A* and *B*, refer to Figure 8.2.5.5.2(b).





**FIGURE 8.2.5.5.2(a) Positioning of Sprinklers to Avoid Obstructions (Residential Sidewall Sprinklers).**



**FIGURE 8.2.5.5.2(b) Positioning of Sprinklers to Avoid Obstructions Along the Wall (Residential Sidewall Sprinklers).**

# Obstructions

- Continuous obstructions to residential sidewall sprinklers require that a sprinkler head shall be installed on the opposite side the obstruction. NFPA 13D – 8.2.5.5.3 The installer shall contact the designer before proceeding with the installation if this situation occurs after the initial design.
- When residential sidewall sprinklers are installed they must follow the requirements of NFPA 13D. NFPA 13D – 8.2.5.6

# Obstructions

- Soffits extending more than 8 inches in width or projection from the wall shall require that sprinkler heads be installed under the soffit. NFPA 13D – 8.2.5.6.1
  - Sidewall sprinklers may be installed on soffits directly over cabinets without requiring additional sprinklers below the soffit or cabinets where the soffit does not project more than 12 inches from the wall. NFPA 13D – 8.2.5.6.2
  - Sidewall sprinklers more than 3 feet above the top of cabinets are permitted to be installed on the wall above the cabinets when the cabinets project no more than 12 inches from the wall. NFPA 13D – 8.2.5.6.3

# Safety Factor / Design Adjustments

- If the designer provides additional safety factors for minor piping adjustments during the installation, those adjustments are limited to the specific parameters stated on the design drawings.
- Contact the installer / designer for any design changes to the piping layout that deviate from those shown on the design drawings.

# Pipe Sizing

- The minimum pipe size of piping must be at least  $\frac{3}{4}$  inches unless otherwise permitted by NFPA 13D. NFPA 13D – 8.4.3.2

# Pipe Sizing

- Nonmetallic piping ½ inch in diameter, including special listed fittings, is allowed to be installed only in network systems provided the following conditions are met. NFPA 13D – 8.4.3.3
  - Each sprinkler is supplied by a minimum of three separate paths.
  - The calculations clearly indicate the pipes that create paths to the sprinklers.
  - No dead ends are allowed on piping that supplies water to a sprinkler.

# Network Systems

- Only one insert tee is allowed in each piping section between sprinklers and can only serve domestic fixtures.
- When inserted fittings are installed each sprinkler must have a minimum of four separate paths from the water supply.
- Piping serving domestic fixtures only shall be installed in accordance with the NCSPC.

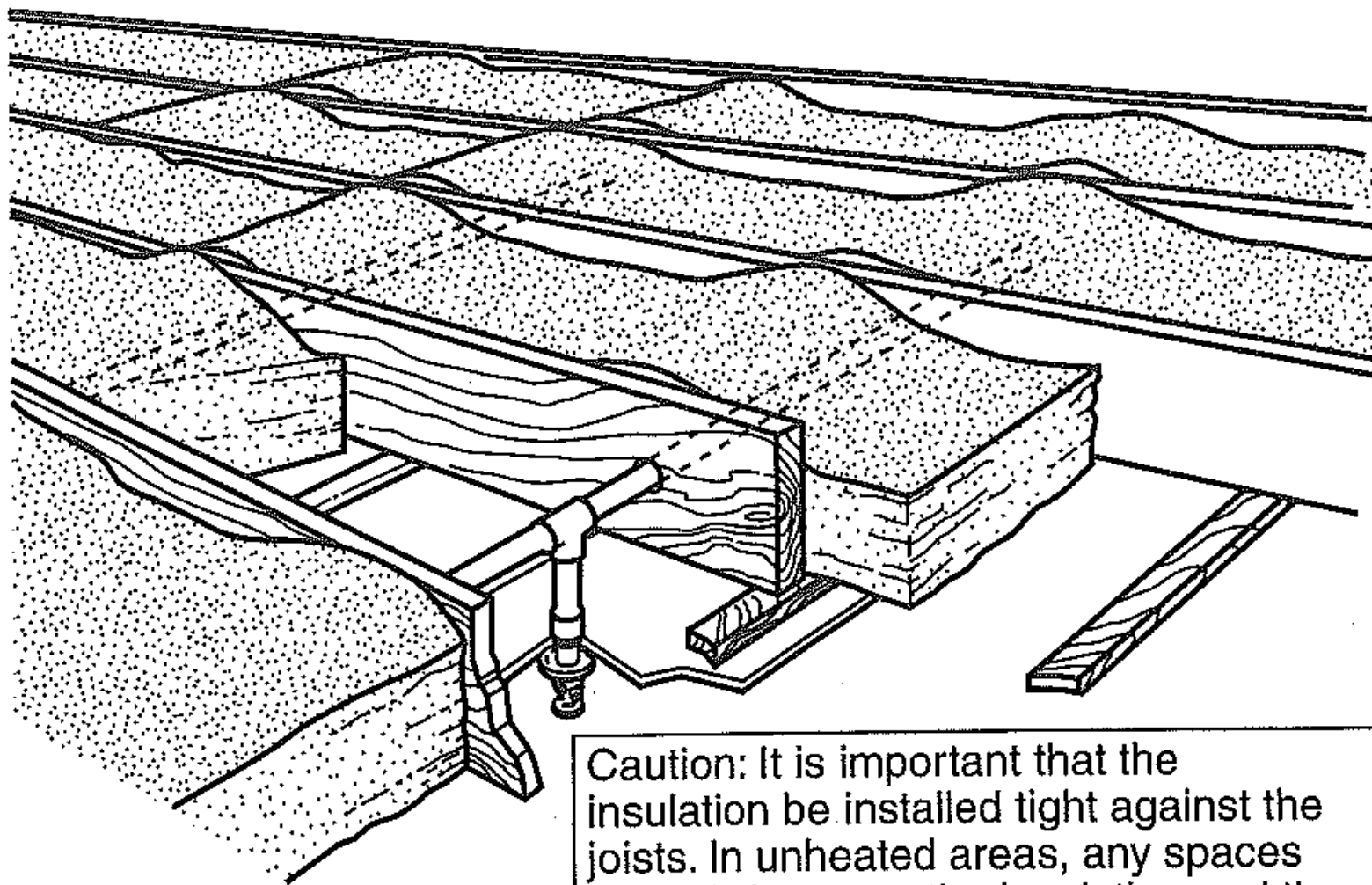


# Piping, fitting and material changes

- Any changes, additions or deletion of pipe, fittings or materials, that deviate from the approved design drawings must be reported to the designer of record for review.

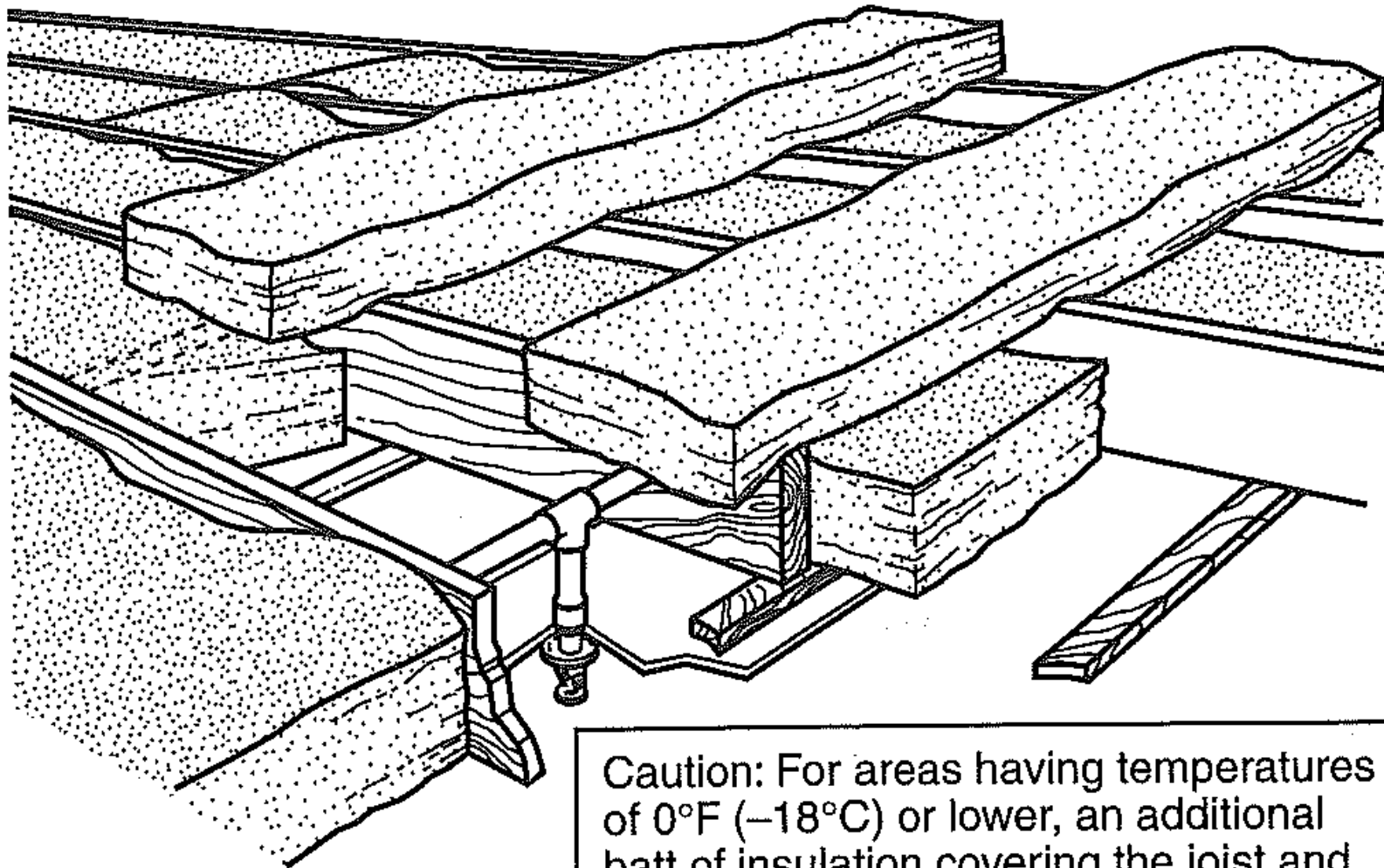
# Freeze Protection

- Multipurpose residential sprinkler systems shall follow the insulation procedures prescribed in the North Carolina State Plumbing Code.
- Multipurpose residential sprinkler systems are wet pipe systems and must be installed in areas that can maintain a minimum of 40°F. NFPA 13D – 8.3.1
- In areas that are subject to freezing extra care must be taken to ensure wet pipe systems are properly insulated. Insulation should be installed with regards to the insulation manufactures installations instructions. NFPA 13D – A.8.3.1



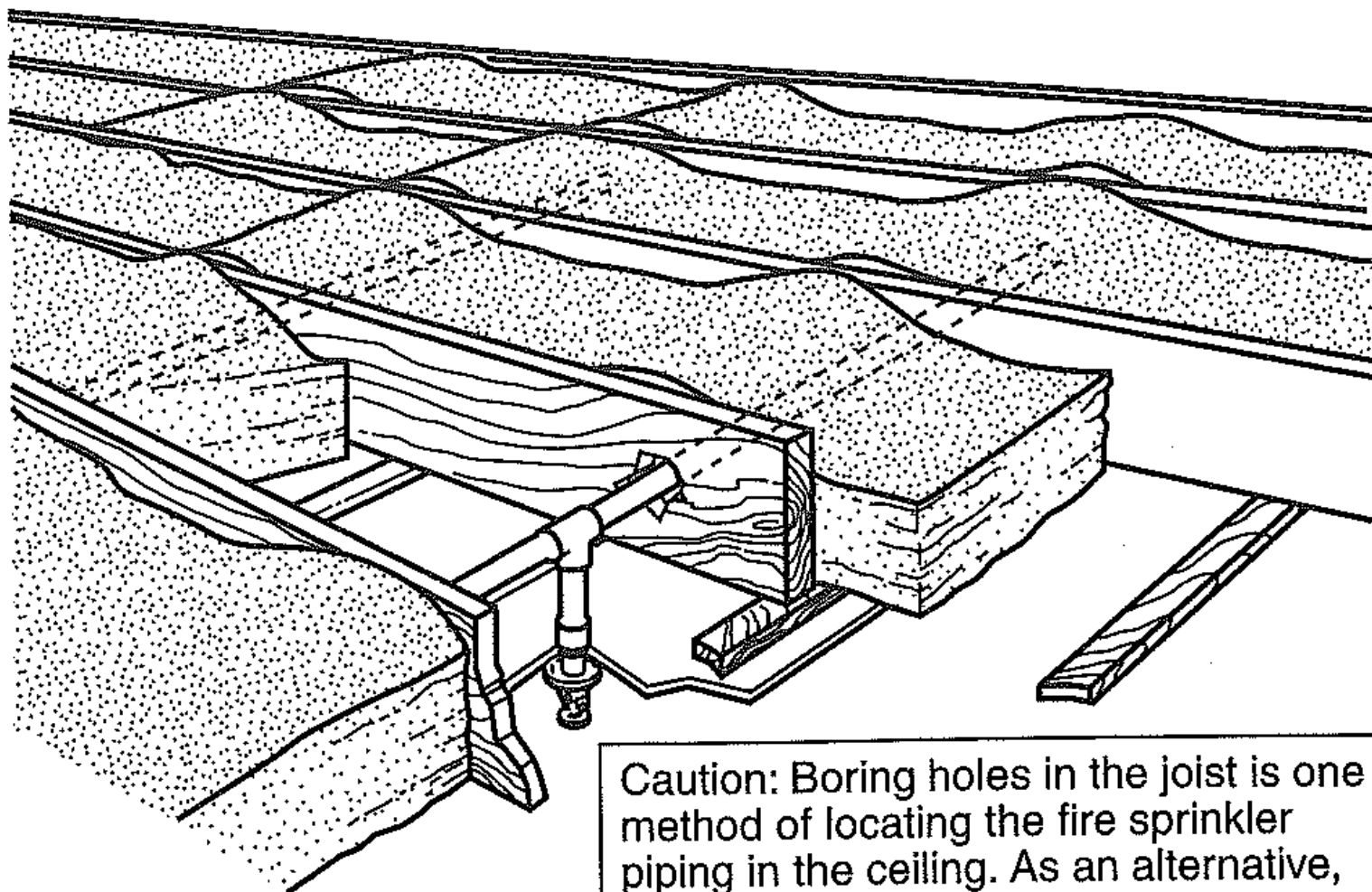
Caution: It is important that the insulation be installed tight against the joists. In unheated areas, any spaces or voids between the insulation and the joists causes the water in the fire sprinkler piping to freeze.

**FIGURE A.8.3.1(a) Insulation Recommendations — Arrangement 1.**



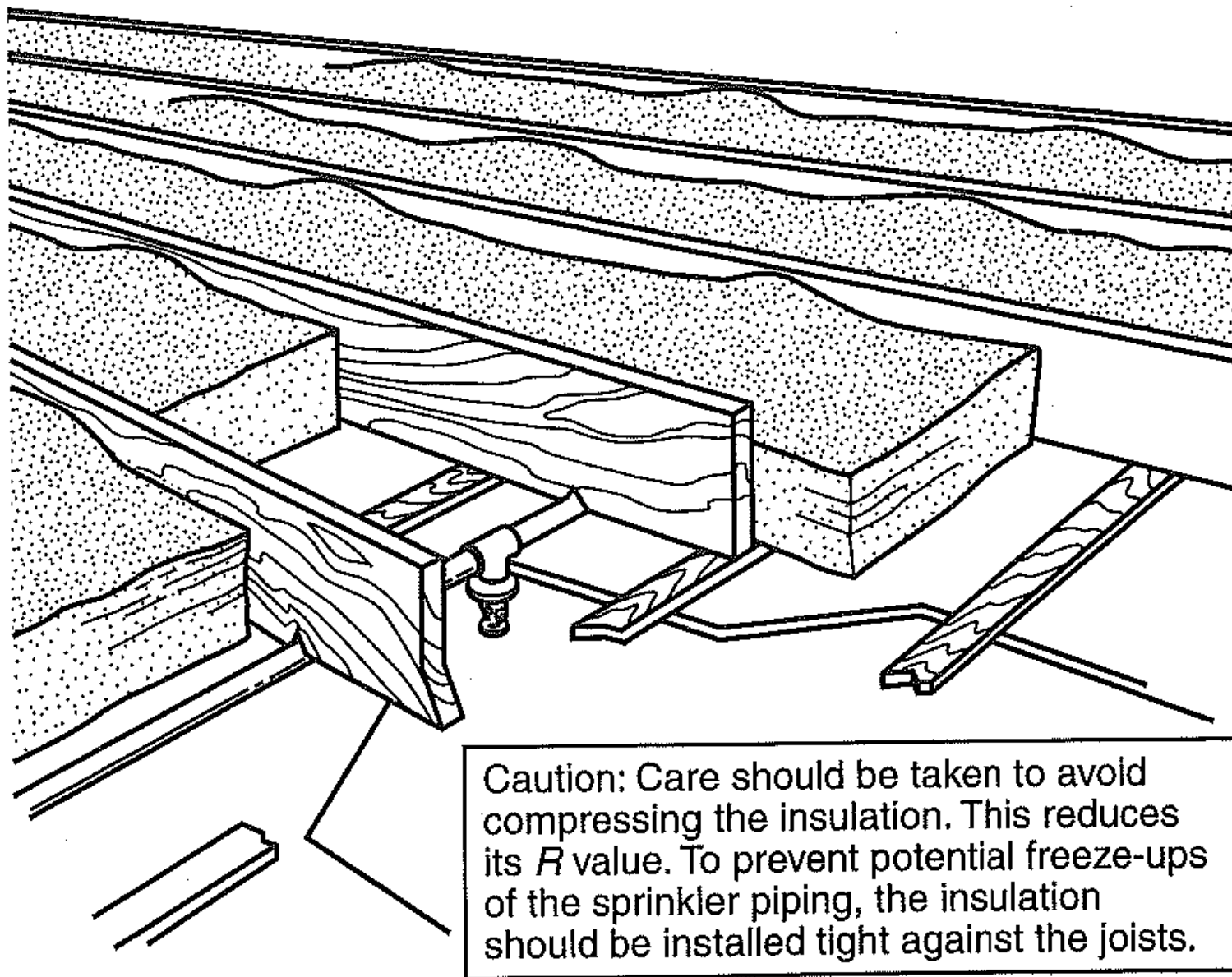
Caution: For areas having temperatures of 0°F (-18°C) or lower, an additional batt of insulation covering the joist and the fire sprinkler piping should be used. If this is not done, freeze-ups can occur in the sprinkler piping.

**FIGURE A.8.3.1(b) Insulation Recommendations — Arrangement 2.**

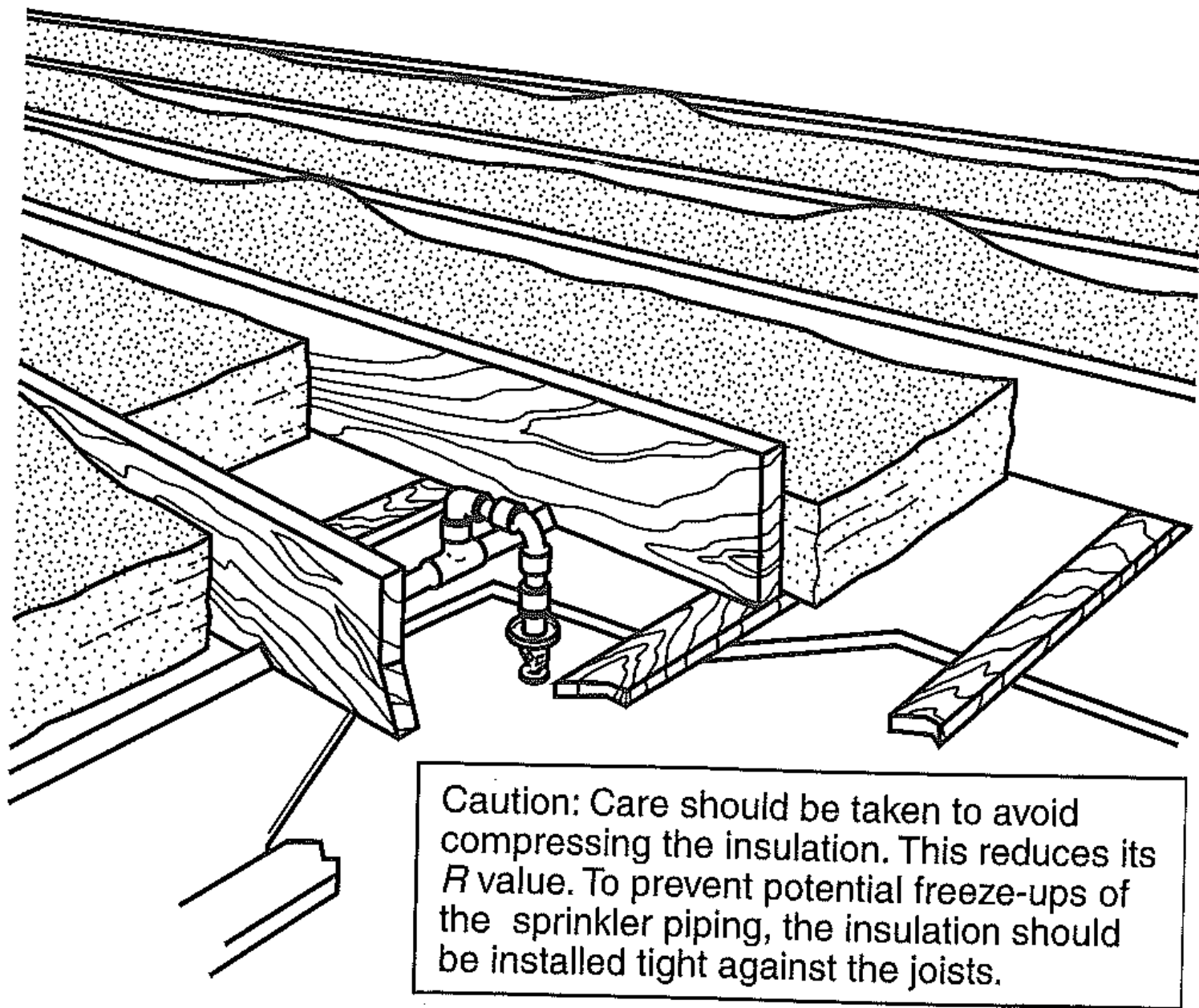


Caution: Boring holes in the joist is one method of locating the fire sprinkler piping in the ceiling. As an alternative, when temperatures are expected to be 0°F (−18°C) or lower, loose pieces of insulation should be stuffed in the bored holes around the piping.

**FIGURE A.8.3.1(c) Insulation Recommendations — Arrangement 3.**



**FIGURE A.8.3.1(d) Insulation Recommendations — Arrangement 4.**



**FIGURE A.8.3.1(e) Insulation Recommendations — Arrangement 5.**

# Piping in Unheated (attic) spaces

- North Carolina Plumbing Code requires an R – value of 6.5 for pipe in unheated spaces.
- NFPA 13D – addresses freezing through the use of a plastic “tent” sealed against the ceiling material to capture heat loss for pipe warmth
- 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. NFPA 13D 7.7
- The tenting method is approved and utilized in many jurisdictions – OSFM will provide documentation if requested





# Freeze Protection

- Insulation must be tight between the joists.
- Avoid compressing the insulation in any way, this lowers the R value.
- When there are holes bored in joist in attics, place insulation around the piping in the hole.
- Additional layer of insulation along the top of the joist and fire sprinkler piping in areas subject to temperatures of 0°F

# Freeze Protection

- Tenting of sprinkler pipe
- Keep the piping in the heat envelope
- Tenting of can lights
- Tenting around other obstructions

# Testing, Inspections, Modifications and Repairs

- Any modifications to a multipurpose fire sprinkler system other than replacing like for like sprinkler heads (identical Sprinkler Identification Number SIN) shall require a redesign from a NC Licensed Fire Sprinkler Contractor or NC Professional Engineer. NCGS 87-21, 21 NCAC 50.0516

# Approved Materials

- Only approved materials shall be installed.
- Devices and materials shall be listed and labeled for their intended use and shall be installed in accordance with their listing limitations. NFPA 13D – 4.5
- Materials used in a multipurpose sprinkler system shall be listed for Fire Protection.

# Approved Materials

- Multipurpose sprinkler systems shall be repaired with materials compatible to the original installation. NFPA 13D – 4.5
- Some manufactures have listed compatibility issues
- Refer to manufactures data sheets for compatible products



# Modifications

- Modifications to a system require a redesign from a North Carolina Licensed Fire Sprinkler Installation Contractor or Licensed Professional Engineer. NFPA 13D – 4.8

# Installer Responsibility

- It is the installer's responsibility to provide the owner/occupant with instructions on inspecting, testing and maintenance of the system. NFPA 13D – 4.1.1
- The system shall be hydrostatically tested to the system pressure. NFPA 13D – 4.2.1, A4.2
  - Fill the system with water.
  - Check each fitting visually for water leakage
  - In accordance with the manufacturer's recommendations.



# Bucket Testing – Acceptance Testing

- Test most remote area sprinkler heads as located on the design drawings.
- Perform test before flooring, painting other items are in place if at all possible
- Calibrated container test
  - Calibrated container placed at each flowing sprinkler head to record the volume of flow with in a specified time period also known as a bucket test.

# Sprinkler Replacement

- Any sprinkler head that has been painted outside of the factory shall be replaced with a new listed sprinkler. NFPA 13D – 4.1.3
- Any sprinkler that has been operated or damaged shall be replaced with sprinklers having the same characteristics as the original sprinkler. NFPA 13D – 4.1.2

Any Questions?