



CPVC Fire Sprinkler Systems

Learning Objectives

- Listings and Approvals necessary for installation of CPVC fire sprinkler systems
- Various design parameters for CPVC Fire Sprinkler systems
- Concealed versus exposed systems
- Correct joining methods of CPVC pipe and fittings
- Options for freeze protection

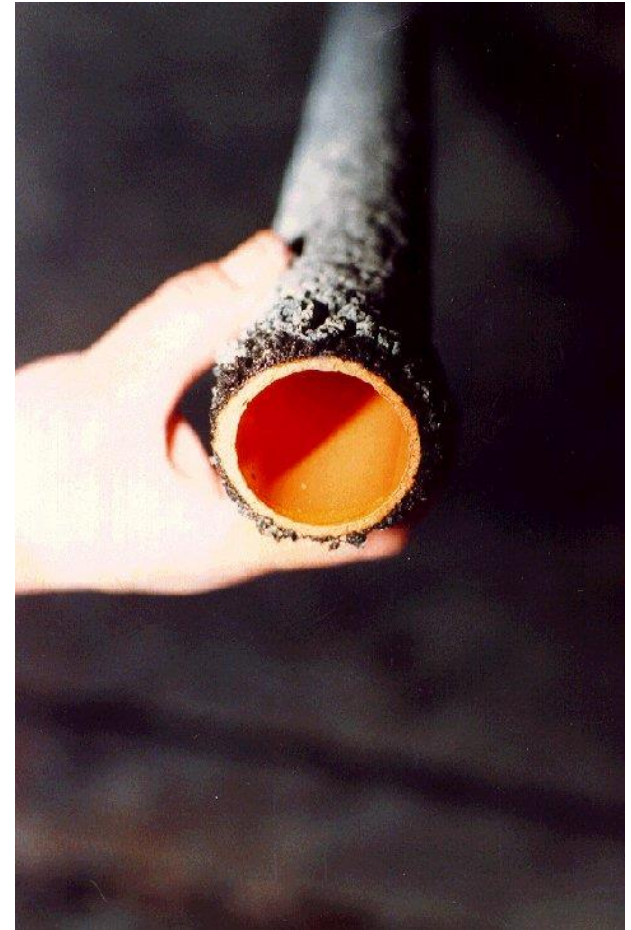
Specially Listed for fire protection systems

- CPVC pipe/fittings system must be listed by a third party to the UL 1821 standard
 - To ensure use of correct CPVC systems, specify a UL 1821 listing for CPVC fire sprinkler systems
- UL 1821 Test
 - Fire reaches 1,600°F
 - Pipe is in direct contact with the fire for 10 minutes
 - 700° F - 900°F
 - After the test, pipe and fittings are pressure tested to 175psi



UL 1821 Test – CPVC Performance

- Inside Pipe Properties remain unchanged
- Does not burn by itself
 - Requires more oxygen than is in the atmosphere to sustain a flame
- Chars instead of burning
- Charring becomes a thermal barrier
 - restricts the flow of heat into pipe wall
 - reduces the rate of burning



Listings and Approvals

- Listed by UL, UL of Canada and Loss Prevention Certification Board
 - NFPA 13 – Light Hazard
 - NFPA 13R
 - NFPA 13D
 - NFPA 24
 - – Underground Water Service
 - Air plenums as defined in NFPA 90A
- Factory Mutual (FM) Approved
- Listed by NSF for potable water usage
- Meets the requirements of Major Model Building Codes
- CPVC may be listed for “wet” and/or “dry” applications
 - Confirm listings for specific manufacturers

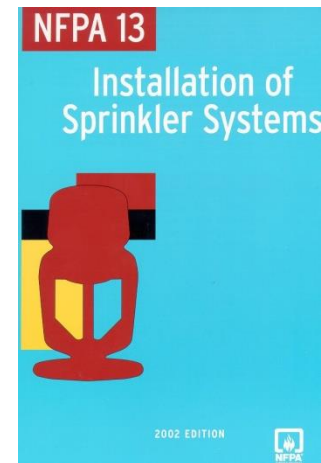


UL Listed

- UL, C-UL, and ULC
- UL 1821 – Thermoplastic Sprinkler Pipe and Fittings for Fire Protection Service
- UL 1887 - Standard for Safety Fire Test of Plastic Sprinkler Pipe for Visible Flame and Smoke Characteristics
- ULC / ORD - C199 - Combustible Piping for Sprinkler Systems

Occupancy Classifications

- NFPA 13 – Light Hazard
 - Churches
 - Clubs
 - Educational (Schools / Universities)
 - Hospitals
 - Institutional
 - Libraries
 - Museums
 - Nursing Homes
 - Offices
 - Restaurant Seating Areas
 - Theatres / Auditoriums



Per NFPA 13 2010 Edition, Section A.5.2

Ordinary Hazard Exception

- NFPA 13 – Ordinary Hazard Exception:
 - Pipe or tube Listed for light hazard occupancies shall be permitted to be installed in ordinary hazard rooms of otherwise light hazard occupancies where the room does not exceed 400 ft² (13m²)



Per NFPA 13 2010 Edition, Section 6.3.6.2

Occupancy Classifications

- NFPA 13R – Residential (Up to and including 4 stories)
 - Multi-Family/ Multi-Story Units
 - Hotel / Motel
 - Apartments
 - Condominiums / Townhouses
 - Student housing



Occupancy Classifications

- NFPA 13D - Residential
 - One / Two Family Dwellings
 - Mobile / Manufactured Homes



Air Plenums

- Listed by UL for use in Return Air Plenums as defined by NFPA 90A and UL 1887
- Some CPVC may be installed adjacent to ceiling openings, however the pipe cannot cross the opening



Factory Mutual Approved

- CPVC pipe and fittings have performed successfully when installed exposed in fire testing by FM Research per FM 1635
- CPVC pipe and fittings is the only approved non-metallic piping system for exposed use in FM insured buildings
- This also includes use behind “drop-in” ceiling tiles



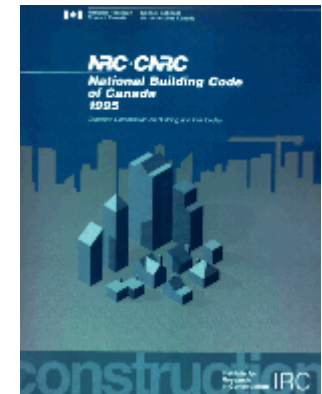
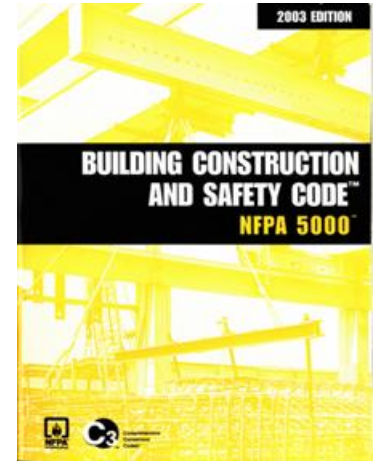
NSF International

- NSF Certified for potable water conveyance per Standard 61



Building Codes

- National Codes
 - ICC (International Code Council)
 - NFPA 5000
 - National Building Code of Canada
- Local Codes
 - City of Los Angeles (RR 5218)
 - New York City (MEA 434-88-M)
 - Chicago



New UL listing for CPVC*

- Composite Wood Joist
 - Primarily one- and two-family homes
 - Allows exposed installation in unfinished basements



* Not all CPVC fire protection systems have been listed by UL for these applications, verify with piping manufacturer

CPVC Advantages

- Used in fire protection systems since 1984
- Corrosion resistance
- Increased hydraulic capabilities allows for pipe downsizing (Hazen Williams C-factor = 150)
- Faster scheduling – No pre-fabrication
- Design savings – CAD Advantages
- Light-weight
- Overall cost savings
 - More economical than steel
 - Quicker to install

Product Advantages

- Immune to Corrosion
 - No pinhole leaks
- No Scale buildup ("tuberculation") inside the piping
 - Can impact the hydraulic characteristics of the pipe and break off into pieces that could plug a sprinkler



MIC - Microbiologically Influenced Corrosion

Design / Engineering Advantages

- Fewer design hours compared to steel
- Less field coordination required
- New BIM family of objects
- Tested for 50 year life expectancy at 175 psi and 150°F with a safety factor of 2
 - Most CPVC Fire Sprinkler System manufacturers meet or exceed this level
 - Performance is based on the quality of the CPVC compound/resin used – verify results with manufacturer

Design Parameters

- CPVC pipe and fittings standards
- Availability
- Temperature / pressure ratings
- Expansion and contraction
- Hanging and supports
- Riser supports

Pipe and Fittings Standards and Dimensions

Pipe

- ASTM Standards
 - ASTM F442
- Pipe Dimensions
 - 3/4" to 3"
 - SDR 13.5



Fittings

- ASTM Standards
 - ASTM F437
 - ASTM F438
 - ASTM F439 or
 - ASTM F1970
- Fitting Dimensions
 - 3/4" to 1 1/4"
 - Sch. 40 or 80
 - 1 1/2" to 3"
 - Sch. 80

Temperature / Pressure Rating

- CPVC fire sprinkler pipe & fittings are rated for continuous service of 175 psi @ 150°F (1210 kPa @ 65°C)
- Pressure rating is the same for ¾” through 3” at a given temperature
- UL requires a burst pressure test of 5 times the working pressure, or 875psi
 - Some CPVC has been tested to a burst pressure of approximately 1500psi

Revision to ASTM F442

- CPVC fire sprinkler pipe is certified to ASTM F442 through NSF
- The revision to ASTM F442 was approved in April, 2013
- The revised standard specifies two material classifications
 - CPVC 4120-05: CPVC compounds having an HDS of 500 psi at 180°F
 - CPVC 4120-06: CPVC compounds having an HDS of 625 psi at 180°F

Revision to ASTM F442

- In addition to the markings that are currently required on the pipe, the revised standard also requires the following markings:
- Type of plastic pipe material in accordance with the material designation code for example, CPVC 4120-06.
- Pressure rating in pounds-force per square inch for water at both 73°F [23°C] and 180°F [82°C], shown as the number followed by psi and the temperature (for example, “320 psi at 73°F, 100 psi at 180°F”).
- The marking changes are required by January 1, 2014

Revision to ASTM F442

- **CPVC 4120-05 sprinkler pipe will be marked**

CPVC 4120-05 320 PSI @ 73°F 80 PSI @ 180°F

CPVC 4120-05 320 PSI @ 73°F 80 PSI @ 180°F

CPVC 4120-05 320 PSI @

- CPVC 4120-05
- 320 psi at 73°F
- 80 psi at 180 ° F

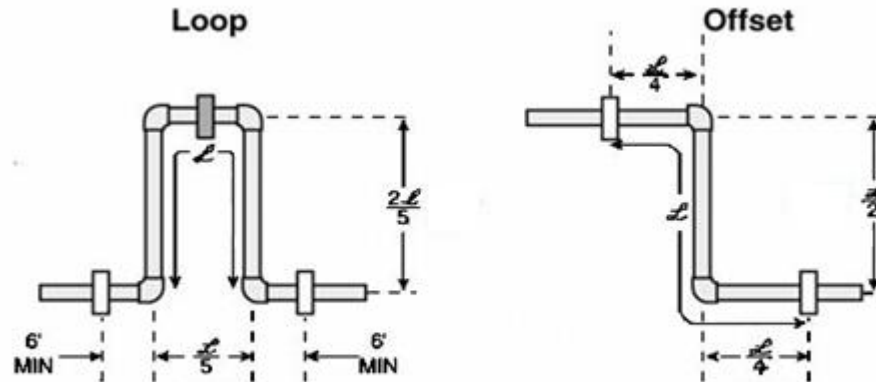
- **CPVC 4120-06 fire sprinkler pipe will be marked**

CPVC 4120-06 320 PSI @ 73°F 100 PSI @ 180°F

CPVC 4120-06 320 PSI @ 73°F 100 PSI @ 180°F

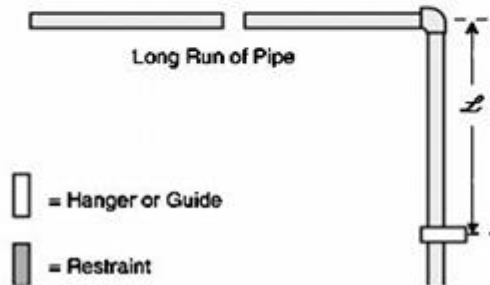
- CPVC 4120-06
- 320 psi at 73°F
- 100 psi at 180°F

Thermal Expansion and Contraction



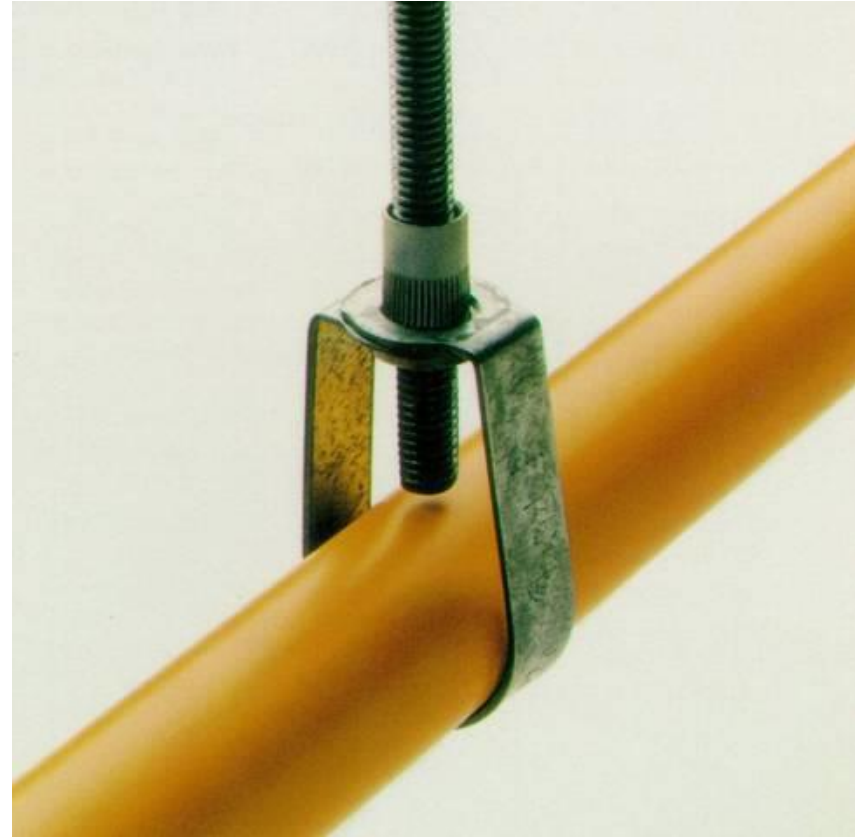
Do not butt-up against fixed structure (joist, stud or wall)

Change of Direction



Hangers

- Most UL Listed pipe hangers are suitable for CPVC pipe and fittings
- Listed hangers are required for NFPA 13 and 13R systems
- NFPA13D allows all locally approved hangers



UL Listed Pipe Hangers

- UL Listed steel hangers are approved for use with CPVC pipe if:
 - Hangers do not bind the CPVC pipe from movement (unless specifically UL Listed to do so)
 - Hangers do not have a rough or sharp edges that come in contact with the CPVC pipe
- Pipe hangers must comply with the requirements of NFPA 13 and 13R
- Restraining clips are recommended but not required
- Hangers must prevent kick back from sprinkler heads

Hanger Support Requirements

- Hanger supports are required at
 - Regular intervals on standard pipe runs
 - “In-Line” sprinkler head drops (unique to CPVC systems)
 - End of line sprinkler head drop and Armover supports

Hanger Support Spacing Standard Pipe Runs for all Pressures

Nominal Size		Maximum Support Space	
inches	mm	feet	meters
¾"	20.0	5½	1.7
1"	25.0	6	1.8
1¼"	32.0	6½	2.0
1½"	40.0	7	2.1
2"	50.0	8	2.4
2½"	65.0	9	2.7
3"	80.0	10	3.0

CPVC "In-Line" Hanger Support

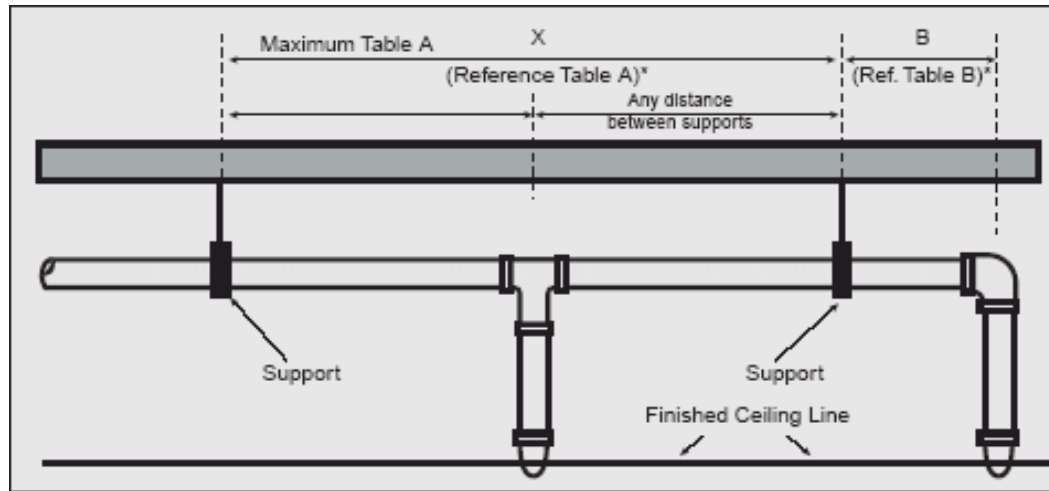
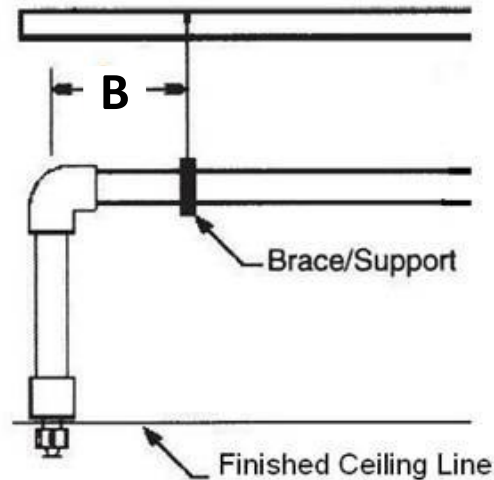


TABLE A Maximum Support Spacing Distance In Line Sprinkler Head Drop Tee		
Nominal Pipe Size	Less than 100 psi (690 kPa)	More than 100 psi (690 kPa)
3/4" (20mm)	4' (1.22m)	3' (0.91 m)
1" (25mm)	5' (1.52 m)	4' (1.22 m)
1 1/4" (32 mm)	6' (1.83 m)	5' (1.52 m)
1 1/2" - 3" (40 - 80 mm)	7' (2.13 m)	7' (2.13 m)

End of Line and Armover Hanger Support

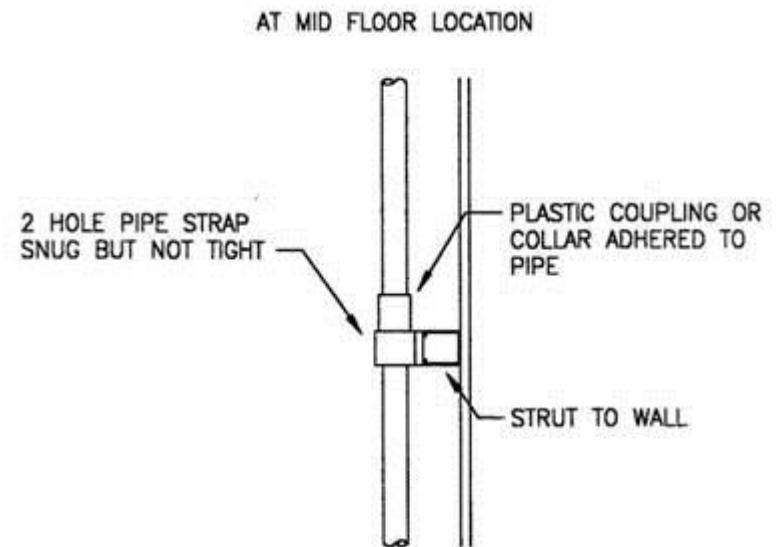
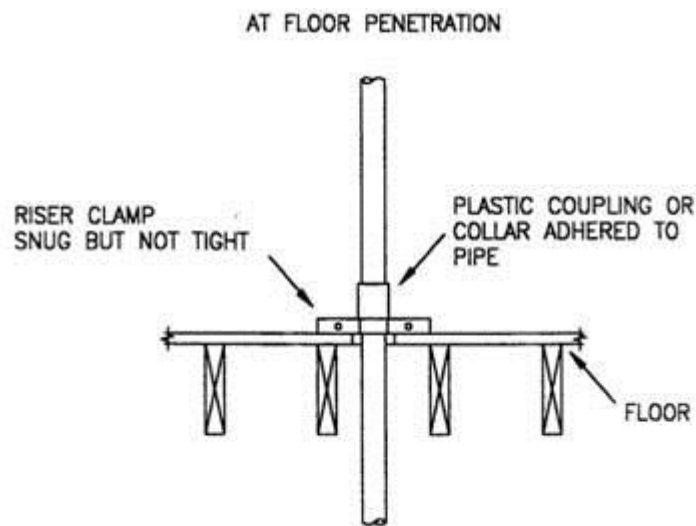


Per NFPA 13 2010 Edition 9.2.3.5

TABLE B Maximum Support Spacing Distance End Line Sprinkler Head Drop Elbow		
Nominal Pipe Size	Less Than 100psi (690kPa)	More Than 100 psi (690kPa)
¾" (20mm)	9" (229m)	6" (152m)
1" (25mm)	12" (305m)	9" (229m)
1¼" (32mm)	16" (406m)	12" (305m)
1½"-3" (40 -80mm)	24" (610m)	12" (305m)

Riser Supports

- Maintain vertical piping in straight alignment with supports at each floor or at 10' intervals, whichever is less



Concealed vs. Exposed

- Concealed installations
- Exposed installations
- Combustible concealed spaces
- System risers
- Garages
- Attic spaces

Concealed or Exposed

- Concealed installations
 - UL, LPCB, VdS require material that is used for concealment to be fire resistant for 30 min.
 - Majority of CPVC installations are concealed
- Exposed installations (UL, FM, LPCB)
 - Quick response sprinklers
 - Smooth flat horizontal ceiling
 - Refer to manufacturer's instructions

Concealed Installations

- No additional parameters besides CPVC pipe and fittings shall be used in a concealed system application employing sprinkler heads rated at 225 °F (107 °C) or lower
- Minimum concealed protection shall consist of
 - A layer of 3/8” thick gypsum wallboard (sheetrock) or a
 - suspended membrane ceiling with lay in panels or tiles having a weight of not less than 0.35 lbs per square foot when installed with metallic support grids or a
 - 1/2” plywood soffit

Exposed Installations

Additional Parameters Apply:

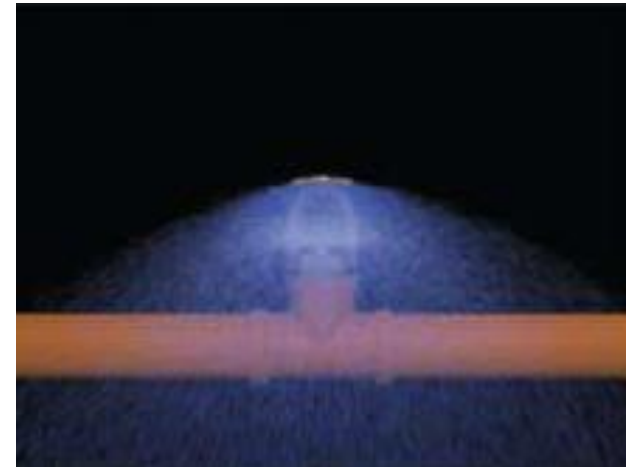
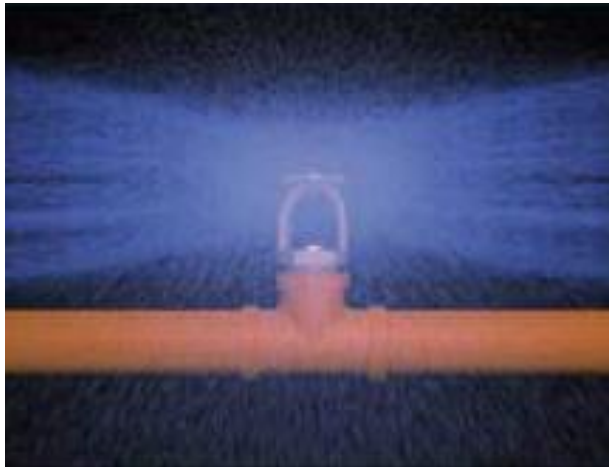
- Smooth, flat, horizontal ceiling construction parameter applies to all exposed applications
- Pendants
 - Piping shall be mounted directly to the ceiling
 - Deflector distance installed within 8” from ceiling
- Horizontal sidewalls
 - Piping shall be mounted directly to the wall
 - Deflector distance installed within 6” from sidewalls and 12” from the ceiling
- Uprights
 - Piping center line distance installed within 7 ½” from ceiling
 - Sprinklers installed within 4” from the ceiling
- Decorative covering can be installed over exposed CPVC pipe and fittings per manufacturer instructions

Combustible Concealed Spaces

- CPVC pipe and fittings are not approved for installation in combustible concealed spaces requiring sprinklers, as referenced in NFPA 13, unless protected in some cases by sprinklers specifically UL Listed for this application
- NFPA 13R and 13D permit the omission of sprinklers from combustible concealed spaces and CPVC pipe and fittings may be installed in these areas

UL Listed Sprinklers

- Sprinklers listed for use in combustibile concealed spaces have a different spray pattern than standard sprinklers
- Only used UL Listed sprinklers when using CPVC in a combustibile concealed space

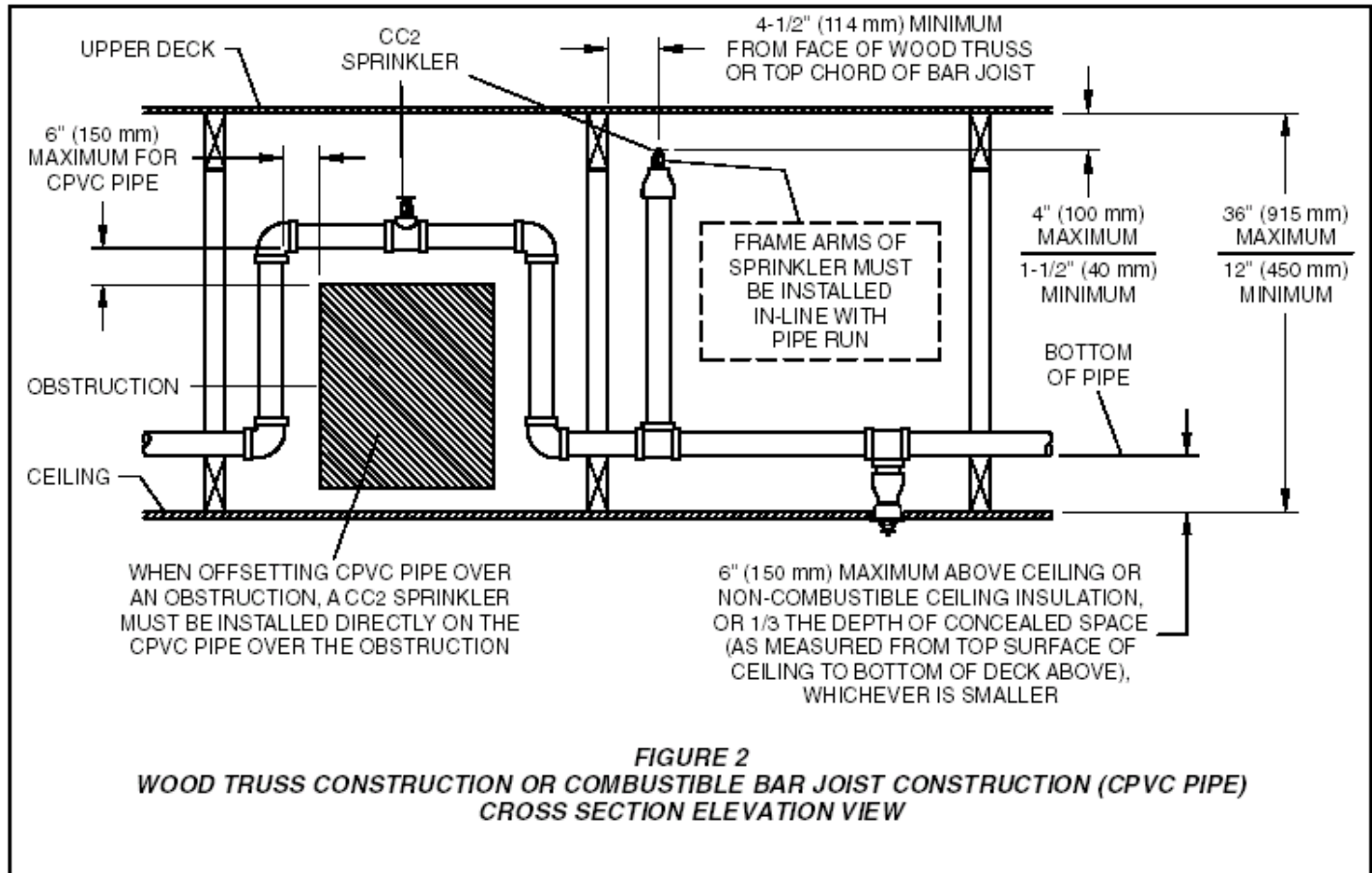


Combustible Concealed Spaces

- Wood truss construction
- Draft curtains at 1,000 sq. ft.
- Max. depth 36"
- Min. depth 12"
- Verify that specified pipe, fittings and sprinkler heads are UL Listed for this application



Combustible Concealed Spaces

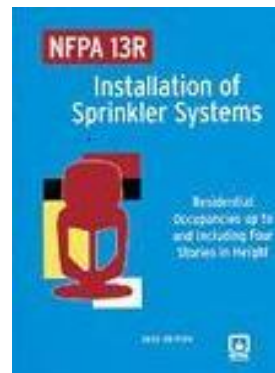


System Risers

- May be used as system risers in accordance with NFPA 13, 13R, and 13D when installed protected (concealed). The minimum protection shall consist of either one layer of 3/8" (9.5 mm) thick gypsum wallboard or 1/2" (12.7 mm) thick plywood
- When installed without protection (exposed) in accordance with NFPA 13D and 13R, additional limitations apply
- Refer to the manufacturer for design requirements

Garages

- NFPA 13R
 - CPVC pipe and fittings shall be installed concealed behind protection consisting of a minimum of one layer of 3/8" thick gypsum wallboard or 1/2" thick plywood
 - Sprinklers shall be UL Listed, quick response, standard coverage, pendent or sidewall sprinklers with a 225°F (107°C) maximum temperature rating shall be utilized



Attic Application

- Specifically listed CPVC pipe and fittings may be used to protect the attic when installed with specifically listed attic sprinklers heads
- CPVC pipe can be used to
 - Feed the wet system sprinklers in the floor below the attic
 - Note: 6 inches of non-combustible insulation must cover the CPVC pipe
 - Feed the wet system sprinklers to protect the attic
- Refer to manufacturer for specific design requirements, NFPA 13, and consult with the AHJ prior to the installation

Joining Pipe and Fittings

- Handling and storage
- Sprinkler head adapters
- Set and cure times
- Pressure testing
- Freeze protection

Handling and Storage of CPVC

- Keep in cartons and bags to protect from damage and maintain cleanliness
- Inspect pipe for splits, cuts, and gouges
- Handle pipe and fittings with care
- Cover pipe stored outside with an opaque tarp to protect from UV light
- Avoid contamination with petroleum based products such as cutting or packing oils



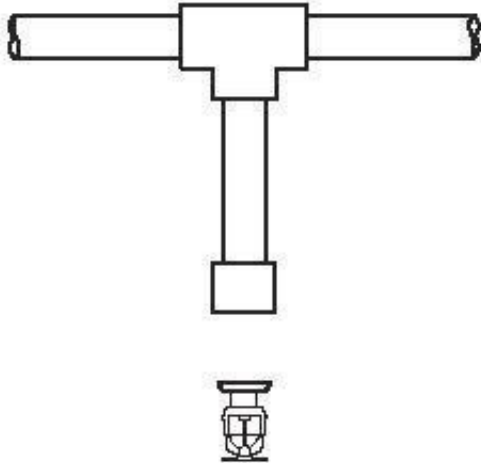
Sunlight Exposure

- Avoid prolonged direct sun light exposure
- Do not store unprotected outside
 - Without protection the pipe color may fade
 - The pipe may become more brittle
 - Note that the pressure bearing properties of CPVC pipe will not change due to sun light exposure
- The AHJ may have issues with the use of faded color CPVC pipe or fittings, we recommend not to use faded CPVC pipe or fittings

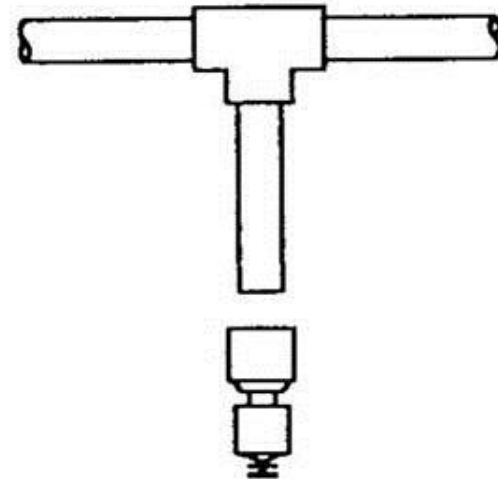
Sprinkler Head Adapters Installation

- NFPA 13 (2007) Section 8.3.1.4, where solvent cement is used as the pipe and fittings bonding agent, sprinklers shall not be installed in the fittings prior to the fittings being cemented in place

Right



Wrong



Set and Cure Times of Solvent Cement

- Set and cure times depend on pipe size, temperature, humidity and system pressure
- The assembly must be allowed to set without any stress on the joint for one (1) to five (5) minutes
- Only pressure test the system once the minimum cure times have been met
- Refer to solvent cement manufacturers for detailed cure time charts

Pressure Testing

- Do not pressure test with air or compressed gas
 - Gas is more compressible than water and may create a safety concern
 - Introduces the potential for contamination with oil from the compressor
- Refer to the manufacturer's installation instructions

Freeze Protection

- Design alternatives
- Insulation
 - Insulation is preferable to antifreeze
 - Use rolled or batt type insulation
 - Verify chemical compatibility
- Antifreeze
 - Do NOT use Glycol solutions
 - Glycerin (Factory Pre-Mix only)
- Refer to NFPA 13 Handbook and manufacturer's installation requirements

Chemical Compatibility

- CPVC can be damaged by contact with chemicals found in some construction products such as edible oils, petroleum- or solvent-based sealants, lubricants or firestop materials, and glycol-based antifreeze
- Verify chemical compatibility with the CPVC manufacturer or the manufacturer of the building product(s)
 - Most leading manufacturers provide chemical compatibility information specific to the CPVC compounds/resins used in their products

Painting of CPVC Pipe

- Use a water-based acrylic latex paint
 - Use of oil or solvent-based paints may be chemically incompatible with the CPVC
- Attain approval from the local AHJ prior to painting so not to cover the markings on the Listed pipe



All CPVC is Specially Listed

- All orange CPVC pipe and fittings are not the same
- Make sure CPVC is listed and approved for the intended purpose

Thank you for your time!

Questions?

Knowledge Assessment

- 1) What is the importance of a listing to UL 1821?
 - a) No relevance to CPVC fire sprinkler systems
 - b) Optional testing for CPVC fire sprinkler systems
 - c) Required for CPVC fire sprinkler systems
- 2) CPVC is listed by UL, ULC and LPCB for use under which standards:
 - a) NFPA 13 – Light Hazard
 - b) NFPA 13R
 - c) NFPA 13D
 - d) All of the above
- 3) True or False: CPVC fire sprinkler systems are permitted in concealed installations
 - a) True
 - b) False
- 4) What design element is used to accommodate thermal expansion and contraction in CPVC?
 - a) Solvent Cement Joining
 - b) Expansion Loops
 - c) Transition Fittings
 - d) All of the above
- 5) Which of the following is **NOT** acceptable freeze protection
 - a) Batt type insulation
 - b) Rolled insulation
 - c) Glycol antifreeze
 - d) Factory Pre-Mix Glycerin antifreeze