



## Residential Water Supply & Distribution

Based on the 2009 IRC

January 2013

Office of Education and Data Management  
Department of Construction Services  
State of Connecticut

Spring 2013 Career Development

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### Overview / Introduction

- Facility orientation
  - Exits, restrooms, refreshments
- Registration
  - Tracking card scanning, email updates, other notes
- Chronological plan
  - Coffee break, restart & stop time
- Instructor introduction
  - Name, background, credentialing

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### Topic Introduction & Orientation

- Topic Introduction
  - Chapter 29 'grew' in the 2009 IRC
  - Water supply portion essentially unchanged
    - Emphasis on protection of potable water
    - Some change in marking of non-potable water
    - Minor addition / amending by CT
  - Residential sprinkler addition
    - Intention is to provide NFPA13d equivalent – 'EZ system'
    - Some resultant concerns with adoption

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## The Big Change!

- P2904 Dwelling Unit Sprinkler Systems

- We will discuss:

- CT Code amendments
- CT Restrictions
- System requirements
- Sprinkler coverage
- Piping / valves
- Water Supply
- Pipe sizing
  - Prescriptive
  - Calculated
- Instructions
- Post-installation inspections




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## Major CT Amendments

- 2009 ICC Language

- R313.1 An automatic residential sprinkler system shall be installed in townhouses
- R313.2 Effective January 1, 2011; an automatic residential sprinkler system shall be installed in one and two family dwellings.
  - Exception: additions and alterations to existing buildings.

- CT Language

- R313.1 WHEN an automatic residential sprinkler system is to be installed in townhouses, it shall be designed and installed in accordance with P2904 or NFPA 13D.
- R313.2 WHEN....., it shall be designed and installed in accordance with Section P2904 or NFPA 13D

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## Major CT Amendments

- 2009 ICC Language

- Intent is to mandate AS in single family, two family, and townhouses
- Intent is to permit design and installation by plumbers and homeowners

- CT Language

- Effectively permits installation per P2904
- Does NOT require AS installation




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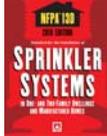
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## Dwelling Unit Sprinkler Systems

- P2904 Dwelling Unit Sprinkler Systems
  - “Where installed, residential sprinklers systems, or portions thereof, shall be in accordance with NFPA 13D or IRC Section P2904.
    - AS not required
    - Installed systems shall meet either 13D or P2904



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## Section P2904 Dwelling Unit Sprinkler Systems

- This code does **NOT** require a sprinkler system in dwelling units
- ICC Intentions:
  - Provide protection equivalent to NFPA 13D
  - Eliminate need for hydraulic calculations
  - Permit homeowner to install system
  - Permit residential plumbing contractor to install
  - Permit combination AS / domestic water systems



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## Dwelling Unit Sprinkler Systems



- Dwelling Unit Sprinkler Standards
  - NFPA 13D
    - Hydraulic calculations
    - Sprinkler contractor design installation
  - IRC P2904
    - Simple calculations
    - Plumbing contractor installation intended

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Connecticut Department of Consumer Protection  
--License Required for AS Installation?--

- [Connecticut General Statutes](#) > [Title 20](#) > [Chapter 393](#) > [§ 20-334 - License or card of registration. Requirements. Suspension or revocation](#)
- (a) No person shall engage in, practice or offer to perform the work of any occupation subject to this chapter in this state unless such person has first obtained a license as provided in section 20-333, or possesses a card of registration from the Labor Department or the board and is subject to all of the regulations adopted under this chapter for the purpose of governing apprenticeship training, or has been issued a license for such particular work under this chapter prior to July 6, 1967.

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[Connecticut General Statutes](#) > [Title 20](#)  
> [Chapter 393](#) > [§ 20-334a - Types of licenses](#)

- (c) The following licenses for fire protection sprinkler systems work may be issued by the department: (1) A fire protection sprinkler contractor's license may be issued to a person who provides satisfactory evidence of education and experience in fire protection sprinkler systems work, as defined in subdivision (9) of section 20-330, and who has passed an examination which has demonstrated competence in all aspects of such trade. Applicants for such license shall complete a form provided by the commissioner; and (2) a journeyman sprinkler fitter's license may be issued to a person who has completed a bona fide apprenticeship program pursuant to section 20-334c, and who has not less than four years experience in fire protection sprinkler systems work, as defined in subdivision (9) of section 20-330, or who has been licensed under this section, and has passed an examination which has demonstrated competence in all aspects of such trade. Applicants for such license shall complete a form provided by the department.

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[Connecticut General Statutes](#) > [Title 20](#) > [Chapter 393](#) > [§ 20-338a - Work required to be performed by licensed persons](#)

- Any contractor who applies for a building permit from a local building official for any work required to be performed by a person licensed under the provisions of this chapter, shall cause such work to be performed by a person licensed under the provisions of this chapter.

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## Dwelling Unit Sprinkler Systems

- 2 General 'types' covered by P2904
  - "Stand-alone" system
    - Considered equivalent to NFPA 13D
    - Separate from the domestic water system
      - Requires backflow prevention
  - Multipurpose wet pipe system
    - Domestic & fire protection water
      - Fire protection water & domestic water combined
      - Ignore fixture calculations found in other portions of Chapter 29
        - » Assumption is that sprinkler flow is adequate for fixture flow needs




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## Dwelling Unit Sprinkler Systems

- P2904.1.1 Required Sprinkler Locations
  - If installed; systems must cover all areas of a dwelling unit
    - Specific exceptions:
      - » Attics
      - » Crawlspace w/o fuel fired appliances
      - » Closets <24 feet<sup>2</sup> with smallest dimension not greater than 3'
      - » Small bathrooms (less than 55 feet<sup>2</sup>)
      - » Garages, carports
      - » Unheated areas
  - A sprinkler shall also be installed above fuel-fired appliances in normally unoccupied spaces.
  - In general: Unoccupied, unconditioned, and minor areas do not require AS protection.

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## Dwelling Unit Sprinkler Systems

- Sprinkler Head Requirements
  - Listed
  - Installed "in accordance with manufacturer's instructions"
  - Standard rating 135°F to 170°F
  - 175°F to 225°F rating for specific areas
    - Sunlight exposure through skylights
    - Attics
    - Concealed spaces under roofs
    - Table P2904.2.2 specific heat sources
      - » Fireplace, solid fuel stoves
      - » Kitchen appliances
      - » Central heating components
      - » Luminaries
  - P2904.2.3 Protected from freezing
    - Pipe & heads installed in non-freezing areas
    - Dry sidewall or dry pendant heads permitted




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### Dwelling Unit Sprinkler Systems

- P2904.2.4 Sprinkler coverage
  - Single head - 400 ft<sup>2</sup> maximum
  - Not blocked by obstructions
  - Ceiling fan considerations
    - Pendant head spacing requirements
    - Sidewall head distance requirements



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### Dwelling Unit Sprinkler Systems

- P2904.2 Piping / valves
  - Solvent cement precautions
    - Verification of excess cement blockage issues
  - Head modifications prohibited
    - Paint, caulk, or any other modification



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### Dwelling Unit Sprinkler Systems

- P2904.3 Piping / valves
  - AS pipe support same as distribution pipe support
  - Nonmetallic (listed CPVC & PEX) pipe must be protected from the living space by minimum 3/8" gypsum or 1/2" plywood or 15 min. rated protection.
    - Exceptions:
      - No protection in non- sprinklered areas
        - » Closets, small baths, crawl spaces
      - No protection for pipe listed as needing no protection



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### Dwelling Unit Sprinkler Systems

- P2904.3 Piping / valves
  - Shut –off valves prohibited
    - No isolation of the AS system from distribution system
    - Valve for entire distribution system permitted
  - Single dwelling unit limitation
    - Piping beyond service valve limited to single dwelling
  - Sprinkler drain valve required
    - Maintenance drain



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### Dwelling Unit Sprinkler Systems

- P2904.4 Determining Design Flow for each Head
  - Minimum head flow based on manufacturer's data
    - Factors will include:
      - Coverage area
      - Ceiling configuration
      - Head temperature rating
      - Type of sprinkler head
      - Additional manufacturer's conditions



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### Dwelling Unit Sprinkler Systems

- P2904.4.2 Determining Design Flow Rate
  - System flow based on the premise of a single head activation
    - Design flow for area with 1 sprinkler based on flow from that head
    - Design flow from area with more than 1 head is based on the head with greatest demand, multiplied by two
    - Flow for non-standard room configurations will be based on manufacturer's instructions
    - System design flow is based on the area with greatest flow demand
    - Area flow demand may be reduced by division of areas
      - Walls
      - Openings between areas must have minimum 8" lintel

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## Dwelling Unit Sprinkler Systems

- P2904.5 Water Supply
  - Must satisfy system demand as calculated
  - Must satisfy pressure as we will calculate
  - Must consider low cut-out pressure of private supply
  - Must provide minimum supply duration
    - 7 min for single story dwelling, <2000 ft<sup>2</sup>
    - 10 min. for two, or more, stories
    - 10 min for dwelling 2000+ ft<sup>2</sup>
      - NOTE: A well, storage tank or combination of both, may be used to meet capacity. Utility supplied water must provide sufficient pressure / volume
- Will impact size of AS supply pipe
  - ¾" nominal minimum regardless of results




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## Dwelling Unit Sprinkler Systems

- P2904.6.1 Options for sizing supply pipe
  - NFPA 13D
    - Hydraulic calculations
  - IRC P2904.6.2
    - Prescriptive method
- Regardless of method: ¾' minimum pipe from source to sprinkler head with minimum ½" threaded reducer fittings on head.




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## Dwelling Unit Sprinkler Systems

- The prescriptive pipe sizing method
  - Essentially matching available pressure to sprinkler system demand
    - Permits manipulation of friction loss inducing items to permit proper system design
  - P2904.6.2.1 Available pressure equation
    - Will determine minimum diameter /maximum length of pipe from service valve to most remote AS head

$$P_r = P_{sup} - PL_{svc} - PL_m - PL_d - PL_e - P_{sp}$$



- P<sub>r</sub> Pressure applied to tables P2904.6.2
- P<sub>sup</sub> Pressure available from water supply
- PL<sub>svc</sub> Pressure loss in water service pipe
- PL<sub>m</sub> Pressure loss in water meter
- PL<sub>d</sub> Pressure loss due to other devices
- PL<sub>e</sub> Pressure loss due to elevation
- P<sub>sp</sub> Maximum pressure required by a sprinkler

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## Dwelling Unit Sprinkler Systems

- The prescriptive method
  - P2904.6.2.1 Available pressure equation
    - $P_t = P_{sup} - PL_{svc} - PL_m - PL_d - PL_e - P_{sp}$
  - $P_{sup}$  Pressure available from water supply
    - “worst case” pressure used
      - » Public Water System – Seasonally & time-of-day adjusted
        - “worst case” pressure used
      - » Private Water System – Minimum “cut-on” pressure




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## Dwelling Unit Sprinkler Systems

- The prescriptive method
  - P2904.6.2.1 Available pressure equation
    - $P_t = P_{sup} - PL_{svc} - PL_m - PL_d - PL_e - P_{sp}$
  - $PL_{svc}$  Pressure loss in water service pipe
    - Table 2904.6.2(1)
      - » Based on GPM, pipe diameter, and length of service run
      - » Private well systems are measured from pressure switch location
        - This value would be “0” based on the photo below




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## Dwelling Unit Sprinkler Systems

- The prescriptive method
  - P2904.6.2.1 Available pressure equation
    - $P_t = P_{sup} - PL_{svc} - PL_m - PL_d - PL_e - P_{sp}$
  - $PL_m$  Pressure loss in water meter
    - Table P2904.6.2(2)
      - » Based on GPM and size of meter




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### Dwelling Unit Sprinkler Systems

- The prescriptive method
  - P2904.6.2.1 Available pressure equation
    - $P_t = P_{sup} - PL_{svc} - PL_m - PL_d - PL_e - P_{sp}$
  - $PL_d$  Pressure loss due to other devices
    - Based on manufacturer supplied data
    - » An automatic bypass valve may negate this value



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### Dwelling Unit Sprinkler Systems

- The prescriptive method
  - P2904.6.2.1 Available pressure equation
    - $P_t = P_{sup} - PL_{svc} - PL_m - PL_d - PL_e - P_{sp}$
  - $PL_e$  Pressure loss due to elevation
    - Head loss between the water source and highest sprinkler head.
    - » Table 2904.6.2(3)



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### Dwelling Unit Sprinkler Systems

- The prescriptive method
  - P2904.6.2.1 Available pressure equation
    - $P_t = P_{sup} - PL_{svc} - PL_m - PL_d - PL_e - P_{sp}$
  - $P_{sp}$  Maximum pressure required by a sprinkler
    - » Based on flow rate determined by P2904.4.1



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## Dwelling Unit Sprinkler Systems

- Let's design a Sprinkler System
  - Based on Sample Problem #1, 2009 IRC Commentary
    - Water service line - 100'
    - Minimum public main tap pressure – 105 psi
    - 30' elevation increase to floor elevation
    - 5/8" water meter
    - Water service pipe enters 4' below first floor elevation
    - Flat ceilings
    - Electric HVAC Unit
    - CPVC Distribution pipe material



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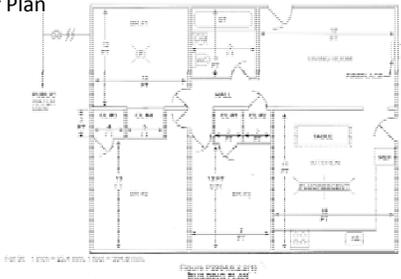
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## Dwelling Unit Sprinkler Systems

- Let's design a Sprinkler System
  - Floor Plan



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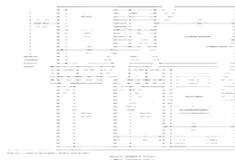
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## Dwelling Unit Sprinkler Systems

- Let's design a Sprinkler System
  - Sprinkler locations selected based on 2904.1.1
    - All closets <3' smallest dimension, <24 feet<sup>2</sup> – no head required
    - Bath <55 feet<sup>2</sup> – no head required
    - Electric HVAC – no head required
    - No AS permitted in unconditioned attic – sidewall heads required
      - (P2904.2.3 Freezing areas)



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## Dwelling Unit Sprinkler Systems

- Sprinkler head considerations;
  - Bedroom 3
    - Unconditioned attic prohibits pendant wet head
    - Non-metallic pipe requires fire protection
    - Freezing concern requires interior wall
      - » Economical solution uses wall common to BR 2
    - Model C or D head may be selected
      - » 14 ft by 14 ft coverage
        - 12 gpm @ 9 psi




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- Manufacturer Supplied Sample Data Sheet

COVERAGE	MINIMUM WATER SUPPLY REQUIREMENTS
12 feet by 12 feet	9 gpm @ 8.4 psi
14 feet by 14 feet	10 gpm @ 10.4 psi

Sprinkler Model B, Pendant, K = 4.3

COVERAGE	MINIMUM WATER SUPPLY REQUIREMENTS
12 feet by 12 feet	12 gpm @ 7.8 psi
14 feet by 14 feet	13 gpm @ 9.1 psi
16 feet by 16 feet	13 gpm @ 9.1 psi
18 feet by 18 feet	17 gpm @ 15.6 psi
20 feet by 20 feet	21 gpm @ 23.9 psi

Sprinkler Model C, Horizontal Sidewall, Deflector 4-6 inches from ceiling, K = 4.0

COVERAGES	MINIMUM WATER SUPPLY REQUIREMENTS
12 feet by 12 feet	11 gpm @ 7.6 psi
14 feet by 14 feet	12 gpm @ 9 psi
16 feet by 16 feet	15 gpm @ 14.1 psi

Sprinkler Model D, Horizontal Sidewall, Deflector 4-6 inches from ceiling, K = 4.9

COVERAGE	MINIMUM WATER SUPPLY REQUIREMENTS
12 feet by 12 feet	11 gpm @ 7.6 psi
14 feet by 14 feet	12 gpm @ 9 psi
16 feet by 16 feet	16 gpm @ 18 psi
16 feet by 16 feet	16 gpm @ 18 psi
16 feet by 20 feet	23 gpm @ 33.1 psi
18 feet by 18 feet	19 gpm @ 22.6 psi
18 feet by 20 feet	24 gpm @ 36 psi
20 feet by 20 feet	25 gpm @ 39 psi

For SF: 1 foot = 304.8 mm, 1 pound per square inch = 6.895 kPa, 1 gallon per minute = 3.785 L/min.

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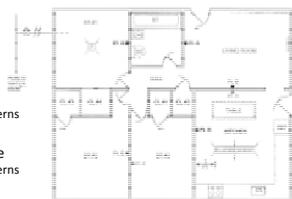
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## Dwelling Unit Sprinkler Systems

- Sprinkler head considerations;
  - Bedroom 1
    - Ceiling fan
      - Special head placement concerns
  - Bedroom 2
    - Alcove entry area
      - Spray pattern concerns
  - Bedroom 3
    - No special concerns
  - Living room
    - Fireplace
      - Head temperature concerns
  - Kitchen
    - Surface luminaire & range
      - Head temperature concerns




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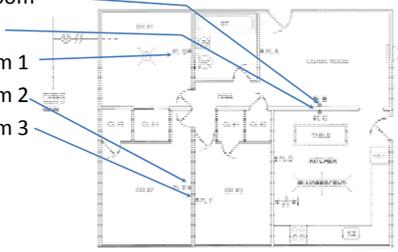
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### Dwelling Unit Sprinkler Systems

- Sprinkler head demand
  - Living room
  - Kitchen
  - Bedroom 1
  - Bedroom 2
  - Bedroom 3



FOR IBC 1502.4.3.2.1.1.1  
FIGURE 7.2054.6.2.1.1  
CONSTRUCTION OF SPRINKLER HEAD

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### Dwelling Unit Sprinkler Systems

- Sprinkler Head Selection
  - Based on Manufacturer's Data
- Living room
  - Model D Head - 18 ft by 18 ft coverage
    - 19 gpm @ 22.6 psi (HIGHEST DEMAND)
- Kitchen
  - Model C Head - 16 ft by 16 ft coverage
    - 15 gpm @ 14.6 psi
- Bedroom 1
  - Model C Head - 12 ft by 12 ft coverage
    - 11 gpm @ 7.6 psi
- Bedroom 2
  - Model C Head - 16 ft by 16 ft coverage
    - 15 gpm @ 14.1 psi
- Bedroom 3
  - Model C or D - 14 ft by 14 ft coverage
    - 12 gpm @ 9 psi




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### Dwelling Unit Sprinkler Systems

- $P_t = P_{sup} - PL_{svc} - PL_m - PL_d - PL_e - P_{sp}$
- $P_t = 105$
- $P_{sup} = 105$  psi, based on utility provided data
  - Worst case scenario




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### Dwelling Unit Sprinkler Systems

- $P_t = P_{sup} - PL_{svc} - PL_m - PL_d - PL_e - P_{sp}$
- $P_t = 105 - 18.7 - 11 - 22 - 17.4$



- $PL_e = 17.4 \text{ psi}$ , due to elevation loss based on table 2904.6.2(3)  
 - 30' to floor level + 7.5' to sprinkler = 37.5 of elevation loss

ADD TABLE 2904.6.2(3)

Elevation Loss (ft)	Pressure Loss (psi)
5	2.2
10	4.4
15	6.6
20	8.8
25	11.0
30	13.2
35	15.4
40	17.6
45	19.8
50	22.0

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### Dwelling Unit Sprinkler Systems

- $P_t = P_{sup} - PL_{svc} - PL_m - PL_d - PL_e - P_{sp}$
- $P_t = 105 - 18.7 - 11 - 22 - 17.4 - 22.6$



- $P_{sp} = 22.6 \text{ psi}$ , based on highest demand sprinkler

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### Dwelling Unit Sprinkler Systems

- $P_t = P_{sup} - PL_{svc} - PL_m - PL_d - PL_e - P_{sp}$
- $P_t = 105 - 18.7 - 11 - 22 - 17.4 - 22.6$
- $P_t = 13.3 \text{ psi}$



- $P_{sup} = 105 \text{ psi}$ , based on utility data
- $PL_{svc} = 18.7 \text{ psi}$ , based on Table 2904.6.2(1)
  - NOTE: 1" minimum pipe diameter from table
- $PL_m = 11 \text{ psi}$ , based on Table 2904.6.2(2)
  - Based on the supplied meter size
- $PL_d = 22 \text{ psi}$ , PRV friction loss at 19 gpm
  - FL acquired from PRV data sheet
- $PL_e = 17.4 \text{ psi}$ , due to elevation loss based on table 2904.6.2(3)
  - 30' to floor level + 7.5' to sprinkler = 37.5 of elevation loss
- $P_{sp} = 22.6 \text{ psi}$ , based on highest demand sprinkler

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## Dwelling Unit Sprinkler Systems

- $P_t = 13.3$  psi
  - Pressure available for FL from water service entry to the most remote sprinkler
    - » This pressure is insufficient
      - Tables P2904.6.2(4) through P2904.6.2(9) require at least 15 psi
  - Remedy:
    - » Reduce FL in PRV
      - Select a 1" PRV with a FL of 16 psi
    - » Reduce FL in Water Service Line
      - Increase line to 1-1/4" with a FL of 7 psi




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## Dwelling Unit Sprinkler Systems

- $P_t = P_{sup} - PL_{svc} - PL_m - PL_d - PL_e - P_{sp}$
- $P_t = 105 - 7 - 11 - 16 - 17.4 - 22.6$
- $P_t = 31$ psi
  - $P_{sup} = 105$  psi, based on utility data
  - $PL_{svc} = 7$  psi, based on Table 2904.6.2(1)
    - 1-1/4" Pipe diameter
  - $PL_m = 11$  psi, based on Table 2904.6.2(2)
    - Based on the supplied meter size
  - $PL_d = 16$  psi, based on a larger PRV
    - FL acquired from PRV data sheet
  - $PL_e = 17.4$  psi, due to elevation loss based on table 2904.6.2(3)
    - 30' to floor level + 7.5' to sprinkler = 37.5 of elevation loss
  - $P_{sp} = 22.6$  psi, based on highest demand sprinkler




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## Dwelling Unit Sprinkler Systems

- Selecting sprinkler pipe size
  - Determine length of pipe run
    - Point of service entry to most remote sprinkler
  - Use Table P2904.6.2(6) to determine if 3/4" pipe will suffice
    - 19 gpm flow rate (greatest demand sprinkler)
    - 31 psi available pressure
      - 141 feet of run permissible
      - 3/4" pipe will be required for supplying all sprinkler heads

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### Dwelling Unit Sprinkler Systems

- Inspection Items
  - P2904.8 Inspections
    - Water distribution system inspected to P2904.8.1 & P2904.8.2
    - Pre concealment inspection required
      - AS in specified areas
      - Spray pattern considerations
      - Correct temperature heads
      - Proper size pipe
      - Pipe length not excessive
      - Non-metallic pipe listed for fire sprinkler use
      - Proper pipe support
      - Pipe system testing according to P2503.7

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### Dwelling Unit Sprinkler Systems

- Inspection Items
  - P2904.8. 2 Final Inspection
    - Final Inspection required
      - Sprinkler heads not painted, damaged, hindered
      - Pump (if required) automatically starts upon activation of system
      - No additions or modification to calculated / hydraulic system
      - Signage or tag on main shut-off valve (P2904.7)
      - Owner's manual present
      - Water supply duration and rate

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### General Requirements P2901

- Pressure
- Quantity
- Identification



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### Water Required

- P2901.1 Potable water required
  - Pressure
    - As specified within the code body
      - 40 psi minimum
      - 80 psi maximum
  - Quantity
    - As specified within the code body
      - Sufficient for installed fixtures
      - Sufficient for sprinkler system
        - » If installed



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### Identification

- P2901.1
  - Marking required for non-potable water systems
    - Color
      - Purple for 'gray' water systems
    - Metal tags
    - Other appropriate method



Non-potable water outlets must be identified



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### Potable water Supply Protection P2902

- Cross connections
- Contamination
- Specific backflow devices



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### Cross Connections

- P2902 Protection of Potable Water Supply
  - Safeguards to prevent contamination
    - Private / potable public supply connection prohibited



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### Backflow

- P2902.2 Supply lines & fittings for every plumbing fixture shall be installed to prevent backflow
- P2902.3 Protection of Potable Water Outlets
  - Backflow prevention required where contamination hazard exists
    - Air gaps
    - Reduced pressure backflow prevention device
    - Check valve(s)
    - Vacuum breaker hardware



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Table P2902.3

- General application guide for backflow prevention

DEVICE	HAZARD OF BACKFLOW	APPLICATION <sup>a</sup>	APPLICABLE STANDARDS
Air gap	High or low hazard	Backsiphonage or backpressure	ASSE 1012.1.2
Air gap fittings for use with plumbing fixtures, high or low hazard	High or low hazard	Backsiphonage or backpressure	ASSE 1012.1.3
Antisiphon-type air valves for gravity water closets, flush valves	High hazard	Backsiphonage only	ASSE 1029, CSA B125
Backflow preventer with intermediate intermediate valve	Low hazard	Backsiphonage or backsiphonage	ASSE 1012, CSA B125
Foot-candle check float protection backflow prevention assembly	Low hazard	Backsiphonage or backsiphonage	ASSE 1012, AWWA C206, CSA B125, CSA B64.2.1
Double check detector fire protection backflow prevention assembly	Low hazard	Backsiphonage or backsiphonage	ASSE 1048
Double check valve-type backflow preventer	Low hazard	Backsiphonage or backsiphonage	ASSE 1024, CSA B64.0, CSA B125
House connection backflow preventer	High or low hazard	Low head backsiphonage, vented siphoning, gravity backsiphonage or backsiphonage	ASSE 1022, CSA B64.2.1
House connection vacuum breaker	High or low hazard	Low head backsiphonage or backsiphonage	ASSE 1011, CSA B64.2, CSA B64.2.1
Laboratory fume hood backflow preventer	High or low hazard	Low head backsiphonage and backsiphonage	ASSE 1035, CSA B64.7
Pipe-applied atmospheric-type vacuum breaker	High or low hazard	Backsiphonage only	ASSE 1001, CSA B64.1.1
Pressure vacuum breaker assembly	High or low hazard	Backsiphonage only	ASSE 1002, CSA B64.1.2
Reduction pressure detection fire protection backflow prevention assembly	High or low hazard	Backsiphonage or backsiphonage	ASSE 1007
Reduction pressure detection backflow preventer	High or low hazard	Backsiphonage or backsiphonage	ASSE 1013, CSA B64.2, CSA B64.1.1
Retention vacuum breaker	High or low hazard	Backsiphonage only	ASSE 1005
Vacuum breaker wall hydrants, frost-resistant, intermediate shutoff air gap	High or low hazard	Low head backsiphonage or backsiphonage	ASSE 1010, CSA B64.2.2

Table P2902.3.1

- Minimum Air Gap Criteria

FIXTURE	MINIMUM AIR GAP	
	Away from a wall <sup>a</sup> (inches)	Close to a wall (inches)
Effective openings greater than 1 inch	Two times the diameter of the effective opening	Three times the diameter of the effective opening
Lavatories and other fixtures with effective opening not greater than 1/2 inch in diameter	1	1.5
Over-rim bath fillers and other fixtures with effective openings not greater than 1 inch in diameter	2	3
Sink, laundry trays, goose-neck back faucets and other fixtures with effective openings not greater than 1/2 inch in diameter	1.5	2.5

For SI: 1 inch = 25.4 mm.  
 a. Applicable where walls or obstructions are spaced from the nearest inside edge of the spout opening a distance greater than three times the diameter of the effective opening for a single wall, or a distance greater than four times the diameter of the effective opening for two intersecting walls.

Backflow Prevention

- P2902.4.1 Specifics
  - Flush tanks require anti-siphon fill valve
    - ASSE 1002 or CSA B125 conforming



### Backflow Prevention

- P2902.4.2 Specifics
  - Vacuum breaker faucets & equipment
    - Installation compliant with instructions
    - Not less than 1" above flood level
  - May be found on bathtubs, whirlpools, bidets, or sinks



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### Backflow Prevention

- P2902.4.3 Specifics
  - Hose connections require vacuum breaker
    - Exception for boiler / water heater drains
    - Exception for laundry equipment connection
      - Machine or external backflow protection required



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### Cross Connection Requirements

- Specification language for connection of:
  - Boilers
  - Heat exchangers
  - Lawn Irrigation Systems
  - Fire Sprinkler Systems
  - Solar Systems



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### Cross Connection Requirements

- P2902.5.1 Boiler connection
  - Backflow preventer with intermediate atmospheric vent
    - ASSE 1012 or CSA CAN / CSA B64.3
  - Conditioning chemical additives require one of the following protective:
    - air gap
    - ASSE 1013 reduced pressure principle backflow device
    - CSA CAN/CSA B64.3 device
    - AWWA C511 device



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### Cross Connection Requirements

- P2902.4.2 Heat exchanger connection
  - “Essentially toxic transfer fluids” require:
    - Double wall separation from potable water
    - Open air gap between walls vented to atmosphere
  - “Essentially non-toxic transfer fluids” require:
    - Single wall separation
  - R201 - ‘Essentially toxic transfer fluids’
    - Grey water, glycol, oils, ammonia, hydrazine
  - R201 – ‘Essentially non-toxic transfer fluids’
    - Propylene glycol, mineral oil, some refrigerants

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### Cross Connection Requirements

- P2902.5.3 Lawn Irrigation System connection
  - Required protection consists of one of the following:
    - Atmospheric type vacuum breaker
      - Valve prohibited downstream of device
    - Pressure type vacuum breaker
    - Reduced pressure principle backflow preventer
      - This device required for systems containing chemical additive capability

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### Lawn Irrigation Rain Sensor

- P2902.5.3.1 Connecticut code addition
  - Rain sensor override required




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### Cross Connection Requirements

- P2902.5.4 Fire Sprinkler System connection
  - Backflow protection must consist of either:
    - Double check valve assembly
    - Reduced pressure principle backflow device
  - Exception:
    - Separation of potable / sprinkler system not required where:
      - Where AS System is part of the water distribution system AND no FD connection is provided.
        - » NOTE: Portions of an AS system making use of anti-freeze additives must be isolated by specified devices (P2902.5.4.1)

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### Cross Connection Requirements

- P2902.5.5 Solar System connection
  - ASSE 1012 or ASSE 1013 device required
    - Exception: Solar system piping is listed for potable, part of the water distribution system, and conforms to requirements of the IPC
  - Chemical additives require 'Reduced pressure principle backflow preventer




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### Access to Backflow Equipment

- Access P2902.6
  - Hardware must be accessible for inspection & servicing
    - Per manufacturer's instructions



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### Installation

- P2905.1 Soil & groundwater issues
  - Pipe & fitting installation prohibited in soil and groundwater contaminated with materials which is likely to cause damage to the installation
  - P2905.1.1 BO may order analysis of the soil
  - P2905.1.2 Alternate materials or location may be required



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### Installation

- P2905.4.2 Water Service Installation
  - Underground installation per P2604
    - Backfill, protection, proximity to footings
  - Common trench with sewer OK, if:
    - Sewer pipe materials comply with P3002.1



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### Materials , Joints, Connections

- Materials
  - P2905.2 Lead content of pipe & fittings must not exceed 8%
    - EPA prompted requirement



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### Materials , Joints, Connections

- Materials
  - Polyethylene pipe must be:
    - Cut square
    - Cut with appropriate tool
    - Chamfered to remove sharp edges
    - Not kinked or bent beyond straight
    - Minimum radius of 30 diameters or coil radius
    - No bends within 10 diameters of fitting or valve
    - Joined with mechanical joints or heat-fusion process
      - P2905.3.1 Heat fusion joint specifics
      - P2905.3.2 Mechanical joint specifics



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### Materials , Joints, Connections P2905 & P2906

- Materials
  - Water service pipe must:
    - Conform to NSF 61 AND
    - One of the standards listed in table 2905.4
      - Various standards based on pipe material
    - Ductile Iron pipe must be lined per AWWA C104



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## Materials , Joints, Connections

- Materials

- P2905.4 Water Service Pipe

- Pressure rating
      - 160 psi minimum rating
      - Greater rating required where service pressure >160 psi
    - Water service piping materials which are not third-party certified for water distribution must shall terminate at, or before the full-open valve located at the entrance to the structure.




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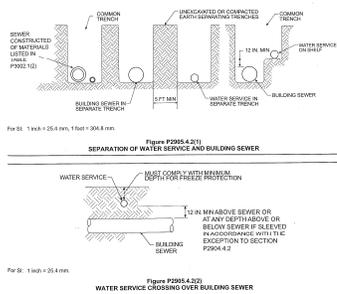
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## Water Service Installation




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## Materials , Joints, Connections

- Materials

- P2905.5 Water Distribution Pipe

- Meets NSF 61 standard
    - Conform to appropriate standard per table P2905.5
    - 100 psi minimum rating at 180 degrees for HW pipe




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### Materials , Joints, Connections

- Connections in distribution pipe
  - Pipe fittings must be approved for compatibility
  - Comply with applicable standards in table P2905.6
  - NFS 61 compliant
  - Flexible connections conform to ASME A112.18.6
  - Connections must be “gas tight”
  - Plastic joints must be made with approved fittings
    - As permitted by P2905.9



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### Materials , Joints, Connections

- Solvent cementing ABS (P2905.9.1.1)
  - Appropriate solvent cement
    - ASTM D 2235
  - Pipe & fittings at similar temperature
  - Clean, dry joints
  - Square cut with chamfering
  - Uniform solvent application to pipe & fitting
  - Avoid excessive solvent to eliminate interior bead
  - Installation twist & hold
  - Removal of exterior solvent bead
  - 24 hours to pressurization



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### Materials , Joints, Connections

- Solvent cementing CPVC (P2905.9.1.2)
  - Appropriate solvent cement
    - ASTM D 2846 or ASTM F 493
    - Orange color solvent cement
  - Primer required
    - Unless solvent cement conforms to ASTM F 493
    - Solvent cement is yellow in color
    - ½” through 2” CPVC pipe & fittings
    - Pipe & fittings meet ASTM D 2846
  - Proper preparation of pipe ends and connectors



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### Materials , Joints, Connections

- Solvent cementing PVC Plastic Pipe
  - Primer required
    - Purple in color (CT amendment)
    - ASTM F 656-02 compliant
  - Solvent cement
    - NOT purple in color (CT amendment)
    - Conforming to ASTM D 2564-04e01
  - Proper preparation of pipe ends and connectors



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### Materials , Joints, Connections

- Other Connections
  - Mechanical joints
    - Appropriate & installed per manufacturer's direction
  - Polypropylene pipe
    - Heat-fusion or mechanical per P2905.10
  - PEX
    - Mechanical joints per P2905.11
  - Stainless steel
    - Mechanical or welded per P2905.12



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### Materials , Joints, Connections

- Threaded Connections (P2905.13)
  - Requirements:
    - National Taper Pipe Thread
    - Pipe interior reamed after threading
    - Pipe ends deburred and cleaned
    - Compound on male threads only



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### Materials , Joints, Connections

- Copper tubing connections
  - Soldered joints
    - Proper fittings
      - ASTM B 828
    - Squared ends
    - Reamed interior burr removal
    - Cleaned bright
    - Fluxed
      - ASTM B 813
    - Appropriate solder
      - .2% maximum lead content



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### Materials , Joints, Connections

- Proper connections (P2905.15)
  - P 2905.15 Flared connections
    - Formed with proper tool
    - Made with approved fittings



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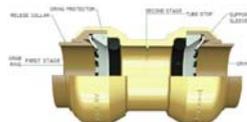
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### Materials , Joints, Connections

- Mechanical Connections
  - P2905.16 Push-in mechanical fittings
    - Approved pressure-lock fittings
    - Above ground only
    - Dissimilar materials OK
      - Outside pipe diameter must be compatible



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### Materials , Joints, Connections

- Connections
  - Dissimilar materials
    - Mechanical joint of appropriate material
      - ASTM D 1869 or ASTM F 477
    - P 2905.17 Specific requirements for:
      - Copper to galvanized
      - Plastic to other materials
      - Stainless to other materials




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### Materials , Joints, Connections

- Connections - P2905.18
  - Press Joints
    - Mechanical joint formed by motorized tool
      - Permanent joint
      - O ring fitting




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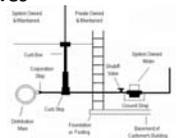
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### Valve Installation Requirements

- Specific valve requirements
  - P2903.9.1 Service valve
  - P2903.9.2 Water heater valve
  - P2903.9.3 Fixture valves
  - P2903.9.4 Valve requirements
  - P2903.9.5 Below grade valves
  - P2903.10 Hose Bibbs




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### Valve Installation Requirements

- Specific valve requirements
  - P2903.9.1 Service valve
    - Each dwelling unit must be provided with a shut-off
    - Valve must be accessible
    - “full – open” type with nominal resistance to flow
    - Provision for system drainage



– Dwelling units shall also be valved at the curb or property line in accordance with local utility requirements

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### Valve Installation Requirements

- Specific valve requirements
  - P2903.9.2 Water heater valve
    - “Full-open” valve on the cold water line to heater
    - Must be proximal and obvious as to function
    - Must be accessible



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### Valve Installation Requirements

- Specific valve requirements
  - P2903.9.3 Fixture valves
    - Required to all fixtures except:
      - Bathtubs
      - Showers
    - Must be accessible



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### Valve Installation Requirements

- Specific valve requirements
  - P2903.9.4 Valve requirements
    - Approved type
    - Compatible material
    - Potable water valves shall meet NSF 61 standards



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### Valve Installation Requirements

- Specific valve requirements
  - P2903.9.5 Below grade valves
    - Valves and outlets prohibited below grade
  - Freeze proof yard hydrants permitted if:
    - Backflow protected per Section P2902
    - Properly identified as “non-potable” water
    - Signage required
      - “ CAUTION, NONPOTABLE WATER DO NOT DRINK”
  - Sanitary yard hydrants are permitted
    - Drain reservoir does not drain sub-grade



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### Valve Installation Requirements

- Specific valve requirements
  - P2903.10 Hose Bibbs
    - Hose bibbs subject to freezing must equipped with an accessible stop-and-waste valve located inside the building
      - Exception for frostproof valves with the stem extending into conditioned or “semi conditioned” space.



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### Water Supply System Design P2903

- Required rate & pressure
- Maximum flow & consumption
- System pressure parameters
- Backflow issues
- Thermal Expansion
- Water hammer prevention
- Pipe size
- Valve requirements

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### Flow & Pressure Minimums

- P2903.1 Water system design criteria
  - System design must consider minimum flow and pressure under “peak demand” condition




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### Specific Water Flow & Pressure

TABLE 2903.1 Required capacities at Point of Outlet Discharge		
Fixture at Point of Outlet	Flow Rate (gpm)	Flow Pressure (psi)
Bathtub	4	8
Bidet	2	4
Dishwasher	2.75	8
Laundry Tub	4	8
Lavatory	2	8
Shower	3	8
Shower, temp. Controlled	3	20
Sillcock, hose bibb	5	8
Sink	2.5	8
Water closet, flushometer tank	1.6	15
Water closet, tank, close coupled	3	8
Water closet, tank, one-piece	6	20

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## Maximum Flow & Consumption

Table P2903.2 Maximum Flow Rates & Consumption for Fixtures	
Lavatory Faucet	2.2 gpm @ 60 psi
Shower Head (includes handheld)	2.5 gpm at 80 psi
Sink faucet	2.2 gpm at 60 psi
Water closet	1.6 gallons / flush cycle

- Establishes design criteria for manually controlled fixtures
- **MAXIMUM** consumption rate

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## Water System Pressure

- P2903.3 Minimum static pressure = 40 psi
  - Public & private supply
- P2903.3.1 Maximum static pressure = 80 psi
  - ASSE 1003 conformant pressure reduction device required when source pressure >80 psi

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## Thermal Expansion Protection

- P2903.4 Thermal expansion
  - Required with storage water heating equipment when supply pressure >pressure reducer setting
  - Approved device for thermal expansion control
  - Installed downstream of backflow devices
  - Properly sized based manufacturer’s instructions
- P2903.4.1 Pressure control
  - Required when thermal expansion may prompt greater than 80 psi system pressure as controlled by a PRV
  - Thermal expansion tank commonly used




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### Water Hammer Control

- P2903.5 Water Hammer
  - System flow velocity provides best control of ‘hammer’
  - System mechanical arrestors shall be installed in accordance with manufacturer’s instructions
    - NOTE: Previous code requirement for water hammer arresting device required with “quick-close” valves on system has been removed



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### Sizing of Water Piping System

- Considerations
  - Minimum flows and pressures
    - Previously mentioned table 2903.1
  - WSFU
    - Water supply fixture units
      - Table 2903.6
  - Appendix P
    - Adopted through R102.5
      - As amended by CT

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### Water Delivery Design Schemes

- 1) Empirical system design
  - Plumber designed based on experience
- 2) Engineered system design
  - Appendix P calculations
- 3) Manifold / gridded system design
  - Centralized distribution block(s)
- 4) Integration with automatic sprinkler system
  - Covered in section P2904

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### Empirical System Design

- P2903.6 Water Supply Fixture Units (w.s.f.u.)
  - Evolutionary assigned value for water use
  - Basis for sizing supply to fixtures / fixture groups
  - Directly related to gpm / pressure demands
  - Considers ‘groups’ of fixtures
    - e.g. : Bathroom group

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### Empirical Design Table P2903.6

Type of Fixtures or Group of Fixtures	W.S.F.U.	Hot	Cold	Comb.
Bathtub		1.0	1.0	1.4
Clothes Washer		1.0	1.0	1.4
Dishwasher		1.4	---	1.4
Full-bath group with tub or shower stall		1.5	2.7	3.6
Half-bath group (water closet & lavatory)		0.5	2.5	2.6
Hose bibb		---	2.5	2.5
Kitchen group (dishwasher & sink w/o food grinder)		1.9	1.0	2.5
Kitchen sink		1.0	1.0	1.4
Laundry group (washer & tub)		1.8	1.8	2.5
Laundry tub		1.0	1.0	1.4
Lavatory		0.5	0.5	0.7
Shower stall		1.0	1.0	1.4
Water closet (tank type)		---	2.2	2.2

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### Engineered Hydraulic System Design Appendix P

- System hydraulic design steps
  - Not a mandatory portion of the code
    - Option for two methods of calculating piping system
      - AP103.3
      - AP201.1
    - Other sizing or design methodology acceptable
  - Inspectors are not responsible for calculation or interpretation of the design process
  - Performance inspection of the finished system will determine if code specific performance criteria has been satisfied!

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### Sizing Pipe Appendix P - Method I

- Based on:
  - Total water supply demand
    - AP103.3(3)
  - Determine minimum residual pressure
    - Table 2903.1
  - Elevation change
    - .433 psi per foot
  - Water meter FL
  - Loss due to:
    - Taps, filters, softeners, BPD, regulators, etc
  - Pipe & fitting FL
    - Feet of pipe
    - Equivalent feet loss of fittings
  - Very similar to our earlier AS example problem




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### Sizing Pipe Appendix P - Method II

- Based on:
  - Water supply demand
    - w.s.f.u.
    - adjustment made for 'groups' of fixtures
    - Conversion to GPM
  - Available head
    - Minimum daily psi at installation location
    - Adjustment for elevation change
      - ½ psi/ft
  - Adjustment for PRV
  - Special equipment losses
    - Backflow devices, water filters, softener
  - Water meter FL
  - Developed length of pipe & fittings
    - Most remote fixture
  - Another 'cookbook' exercise similar to the sprinkler system pipe calculation




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### Manifold System Design Specifics

- System design based on single of 'gridded' feeds to distribution manifolds
  - Individual hot & cold feeds to fixtures
- Designed based on P2903.8.1 through P2903.8.6
  - Manifold size
  - Distribution line size
  - Orientation of manifolds
  - Piping support
  - Valving
  - Bleed valve




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### Manifold System Design Specifics

- P2903.8.1 Manifolds properly sized
  - Table P2903.8.1 Manifold Sizing
    - Refers to table P2903.8.1
      - Converts W.S.F.U. into gpm equivalent



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### Manifold System Design Specifics

- P2903.8.2 For distribution line length <60'
  - 3/8" distribution lines OK if meter pressure >40 psi
  - Larger demand fixtures install per mfg. directions
  - Water heaters feed from manifold prompt increased manifold size



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### Manifold System Design Specifics

- P2903.8.3 Manifold orientation
  - May be mounted horizontally or vertically
    - In accordance with mfg. directions



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### Manifold System Design Specifics

- P2903.8.4 Support & protection
  - Plastic piping bundles supported per P2605
    - Prevent sagging
    - Proper hangers
    - Proper spacing
    - Prevention of chaffing



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### Manifold System Design Specifics

- P2903.8.5 Manifold Valving
  - Fixture valves may be installed at manifold or fixture
  - Manifold installed valves must be identified



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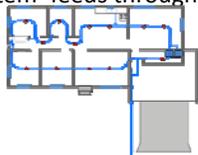
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### Integrated Sprinkler / Water Supply

- Flow for sprinklers calculated
  - As per earlier example
  - Fixture feed presumed to be adequate
  - Performance requirements for fixtures per code
- Multi-feed 'grid system' feeds through AS heads



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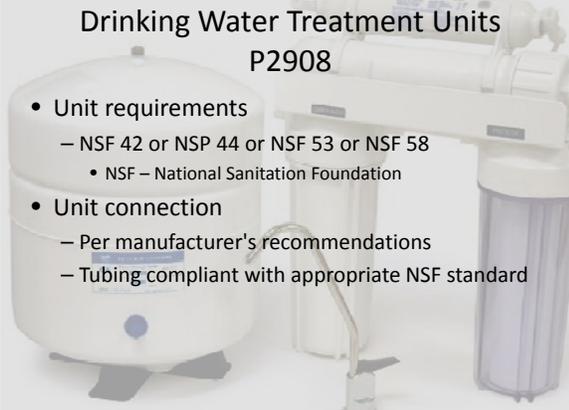
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### Drinking Water Treatment Units P2908

- Unit requirements
  - NSF 42 or NSP 44 or NSF 53 or NSF 58
    - NSF – National Sanitation Foundation
- Unit connection
  - Per manufacturer's recommendations
  - Tubing compliant with appropriate NSF standard



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### Inspection of Supply (And a good program review / summary)

- Chapter 29 Checklist
  - P2903.7 Water service pipe must be minimum ¾'
  - P2902.3 Backflow protection
  - P2902.1 Cross connections
  - P2903.1 Minimum capacity at fixtures
  - P2903.2 Maximum consumption
  - P2903.3 Minimum & maximum system pressure
  - P2903.4 Thermal expansion control
  - P2903.5 Water hammer control
  - P2903.9.1 Service valve locations
  - P2903.9.2 Water heater valve
  - P2903.9 Required valves & access
  - P2903.3 System pressure parameters



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### Thank-You!



**State of Connecticut**  
**Department of Construction Services**

- Office of the State Building Inspector
  - (860) 685 - 8310
- Office of the State Fire Marshal
  - (860) 685 - 8380
- Office of Education and Data Management
  - (860) 685 - 8330

Office of Education and Data Management 132

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