

2021 Uniform Plumbing Code Part 3

Wisdom and Associates, Inc.

Chapter 6 - Water Supply & Distribution

Cross Contamination

- No connection between potable water piping and any other system
- Each fixture or supply must be protected (602.2)
- Cross-connections are links where contaminants can enter the water supply
- Pressure at the polluted source exceeds the pressure of the potable supply
- Backsiphon - vacuum is created upstream of the fixture
- Backflow - Reversed flow from backpressure

Hazard Levels

- Low Hazard - Pollution, undesirable taste or color, but not unfit for consumption and will not cause sickness
- High Hazard - Contamination, not safe for human consumption, may cause sickness or death
- Hazard level dictates which type of backflow prevention is necessary

Direct Cross Connection

- Physical connection between potable and non-potable system
- Example: boiler connection to potable water system

Indirect Cross Connection

- Under-rim connection - water supply is below rim level
- Over-rim connection - fixture has hose or connection which places outlet below rim level
- Example: hose in a bucket

Air Gap

- A physical separation between the a potable water outlet and a receiving vessel
- Minimum air gap per Table 603.3.1

Minimum Air Gaps		
Fixture	Where Not Affected By Sidewalls	Where Affected By Sidewalls
Effective openings not greater than 1/2 inch diameter	1 inch	1-1/2 inches
Effective openings not greater than 3/4 inch diameter	1-1/2 inches	1-1/2 inches
Effective openings not greater than 1 inch diameter	2 inches	3 inches
Effective openings greater than 1 inch diameter	Two times diameter of opening	Three times diameter of opening

Atmospheric Vacuum Breakers

- Simplest design, must be installed at each outlet
- Protects against backsiphon only
- Provides high hazard protection
- Installed a minimum 6" above highest downstream usage
- Not subject to "continuous" pressure (12hrs out of 24)
- No valves downstream (may cause continuous pressure) (603.3.2)

Hose Connection Backflow Preventer

- Installed on each faucet or hose bibb
- Installed 6" above ground surface
- Does not provide freeze protection (603.3.3)

Double Check Valve Assemblies

- Protects against backsiphon and backpressure
- Not approved for backflow for water system containing hazardous substances (low hazard only)
- Grey area for irrigation systems due to potential chemicals
- Installed 12" above ground (603.3.4)

Pressure Vacuum Breaker Assemblies

- Allows continuous water pressure and valves downstream
- Minimum 12" above highest outlet
- May eject water, provisions must be made for indoor installation (603.3.5)

Spill Resistant Pressure Vacuum Breaker Assemblies

- Same as pressure vacuum breaker but resists spills (603.3.6)

Reduced Pressure Zone Assembly

- Highest level of protection (low and high hazard acceptable)
- Protects against backflow and backsiphon (603.3.7)

Dual Check Backflow Preventer

- Low hazard backflow protection
- Coffee machines, non-carbonated drink machines (603.3.10)

Backflow Preventer w/ Intermediate Atmospheric Vent

- Low hazard protection from backsiphon and backflow (603.3.12)

Backflow Preventer w/ Intermediate Atmospheric Vent & Pressure Reducing Valve

- Addition of pressure reducing valve

Laboratory faucet Backflow Preventer

- Designed for laboratory faucets where hoses can be attached. (603.3.11)



Atmospheric vacuum breakers are commonly used for sprinkler systems.



Hose connection backflow preventers have a set screw that prevents easy removal with a garden hose.

Testing

- Backflow assemblies must be tested when installed, moved, repaired and annually
- Building owner of superintendent responsible (603.4.2)

Connections

- Direct connection between potable water piping and sewer not permitted
- Air gap twice outlet pipe diameter, no less than 1"
- Direct connection to inlet side of trap allowed if vacuum breaker above flood rim level is installed (Dishwasher air gap) (603.4.4)

Integral Backflow Preventers

- Fixtures, appliance with integral backflow or air gap can be installed as listed
- Some dishwashers have integral backflow, but are specifically covered in a later chapter (603.4.6)

Heat Exchangers

- Heat exchangers for heat transfer, heat recovery, or solar shall protect the potable system from contamination
- *Open direct heating systems not allowed* (603.5.4)

Protection of Lawn Sprinklers and Irrigation Systems

- No pumps and no chemicals, any of four types of backflow prevention devices allowed
- A pumped or chemical system, must use reduced pressure principle backflow prevention assemblies (603.5.6)

Outlets With Hose Attachments

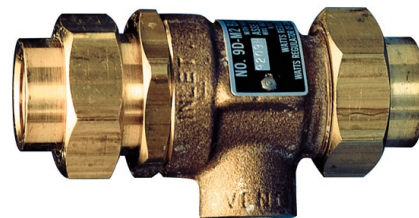
- Must have non-removable hose bibb backflow preventer, vacuum breaker, or atmospheric vacuum breaker installed
- Freezing climates must be self draining
- Exception: water heater, boiler, and clothes washer connections (603.5.7)

Steam or Hot Water Boilers

- Must be protected from potable water supply with double check valve or reduced pressure principle backflow prevention assembly
- If chemicals in the system, must use reduced pressure principle backflow prevention assembly (603.5.10)



Direct connections between water filtration systems and sewers are not uncommon and pose a cross-contamination hazard.



Double Check Valve W/ Atmospheric Port



Reduced Pressure Zone Assembly

Lead Content

- Potable water for human consumption
- No more than 0.25% of the wetted surface of the piping, fittings, etc.
- Solder and flux no more than 0.2%
- Exceptions: not for human consumption, flush valves, fill valves, flushometer valves tub fillers, shower valves, water main gate valves greater than 2 inches (604.2)
- No more than 8% content for water supply systems for non-drinking water application (604.2.1)

Tracer Wire

- Plastic piping permitted for water service as long as grounding is maintained (604.10)
- Plastic piping for water supply outside underground must have a blue insulated copper trace wire or other approved conductor
- Tracer must terminate above ground
- Electrically continuous (604.10.1)

Check Valve Required

- All systems that circulate water must have a check valve to ensure direction of flow (606.8)

Potable Water Tank Venting

- Vents required per manufacturers specifications
- Vent termination must be screened with #24 mesh (.0342" openings) (607.3)

Potable Water Tank Overflow

- Minimum 16 square inch overflow (minimum 4.5" ID)
- Termination must be screened with #24 mesh (607.4)

Water Pressure

- Minimum 15 PSI at main or source, or minimum required at any fixture
- 80 PSI Max (608.1)

Expansion Tanks

- Water systems with check valve or backflow prevention must have expansion tank
- Regardless of type of water heater used
- Instantaneous water heaters with less than 3" internal diameter exempt (608.3)



Water systems with a check valve or backflow prevention must have expansion tank, which is used to take up the increase in volume when water expands when heated. Lack of expansion tanks is a common cause of water heater pressure relief valve leakage. Expansion tanks are typically installed on the cold water supply line to the water heater. They have a diaphragm or bladder inside that separates the water from a compressed air cushion, which absorbs the force of the expanding water and maintains proper system pressure

Pressure Relief Valve

- All water heaters must have a pressure relief valve (608.4)

T&P Valve Discharge Piping

- Must be equal to size of valve outlet
- Must point down
- Must be rated to the temperature of the system
- Must discharge through an air gap to drainage systems
- Discharge between 6" and 24"
- Discharge cannot cause personal injury or structural damage (608.5)

Pipe Insulation

- Domestic hot water piping must be insulated
- Minimum insulation thickness equal to the diameter of the pipe or 2" maximum
- Not required to be insulated through (inside) framing members
- Not required to be insulated between control valve and outlet (609.11)

Installation

- Potable water piping more than 12" below grade
- More than 12" below frost depth
- Juneau: 32"
- Kodiak: 36"
- Kenai: 42"
- Anchorage: 60"
- Palmer: 42"
- Fairbanks: 42" (609.1)

Testing

- Potable water tested at 50 psi for 15 minutes (609.4)

Water Hammer

- Caused by quick acting valves
- Arrestors required where damage may occur (609.11)

The code calls for all domestic hot water piping to be insulated, this was a big change from the 2012 to 2015 versions of the code. Insulation helps maintain the water temperature in the pipes, reducing the energy needed to heat water in hot water supply systems or to cool it in cold water systems. For hot water pipes, insulation minimizes the heat loss as the water travels from the heater to the faucet, ensuring that the water arrives at the tap at the desired temperature. For cold water pipes, it prevents the water from warming up due to ambient temperatures, especially important in warm climates or during summer months.



Pipe insulation is particularly important under slabs in Alaska where the ground temperature is cold year-round.

Potable Water Table 610.4 Method

- Must use 610.3 fixture unit chart
- Developed length from meter to most remote point
- Difference in elevation from meter to highest point
- Size to the minimum pressure available (610.7)
- Systems that fall outside Table 610.4 must use Appendix A
- 3 pressure ranges; 30-15 psi, 46-60 psi, over 60 psi
- Minimum ¾" building supply

Table 610.4 Sizing Steps

1. Determine pressure available at the source
2. Add or subtract ½ pound of pressure for each foot of elevation difference between source and highest fixture
3. Use appropriate pressure range group
4. Select the length column that is equal to or longer than the required length
5. Follow down to a fixture unit value equal to or greater than the number of fixture units required
6. Once the proper fixture unit value for the length is found, sizes of meter and building supply pipe can be found in the two left hand columns.

Branch Sizing

- Minimum size of each branch based:
- Number of fixture units in that branch
- Total developed length of the system
- Meter size
- No branch has to be larger than the building supply (commonly applies to cold water lines serving water heaters)

Table 610.4

Fixture Unit Table for Determining Water Pipe and Meter Sizes																
Pressure Range - 30 to 45 psi (207 to 310 kPa)**																
Meter and Street Service, Inches	Building Supply and Branches, Inches	Maximum Allowable Length in Feet														
		40	60	80	100	150	200	250	300	400	500	600	700	800	900	1000
¾	1½***	6	5	4	3	2	1	1	1	0	0	0	0	0	0	0
¾	¾	16	16	14	12	9	6	5	5	4	4	3	2	2	2	1
¾	1	29	25	23	21	17	15	13	12	10	8	6	6	6	6	6
1	1	36	31	27	25	20	17	15	13	12	10	8	6	6	6	6
¾	1 ¼	36	33	31	28	24	23	21	19	17	16	13	12	12	11	11
1	1 ¼	54	47	42	38	32	28	25	23	19	17	14	12	12	11	11
1 ½	1 ¼	78	68	57	48	38	32	28	25	21	18	15	12	12	11	11
1	1 ½	85	84	79	65	56	48	43	38	32	28	26	22	21	20	20
1 ½	1 ½	150	124	105	91	70	57	49	45	36	31	26	23	21	20	20
2	1 ½	151	129	129	110	80	64	53	46	38	32	27	23	21	20	20
1	2	85	85	85	85	85	85	82	80	66	61	57	52	49	46	43
1 ½	2	220	205	190	176	155	138	127	120	104	85	70	61	57	54	51
2	2	370	327	292	265	217	185	164	147	124	96	70	61	57	54	51
2	2 ½	445	418	390	370	330	300	280	265	240	220	198	175	158	143	133

Table 610.4

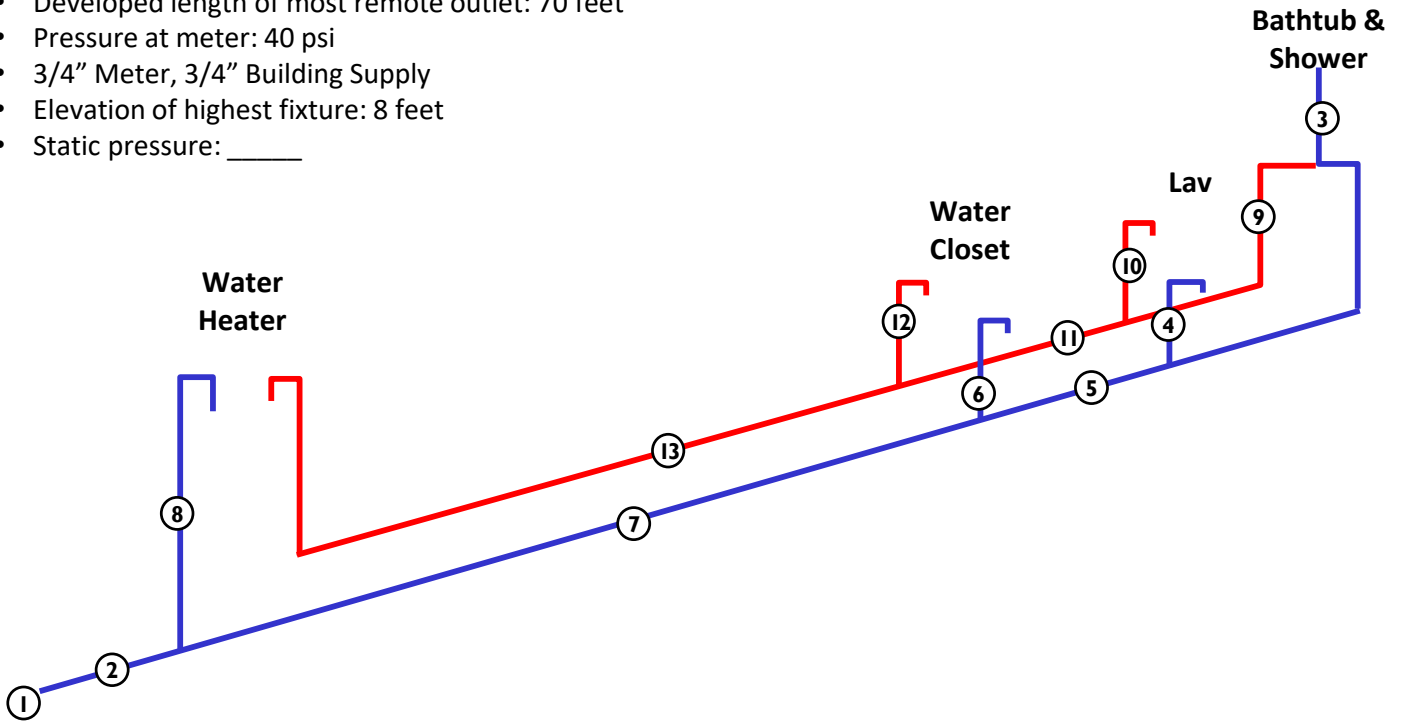
Fixture Unit Table for Determining Water Pipe and Meter Sizes																
Pressure Range – 46 to 60 psi (317 to 414 kPa)**																
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3/4	1/2***	7	7	6	5	4	3	2	2	1	1	1	0	0	0	0
3/4	3/4	20	20	19	17	14	11	9	8	6	5	4	4	3	3	3
3/4	1	39	39	36	33	28	23	21	19	17	14	12	10	9	8	8
1	1	39	39	39	36	30	25	23	20	18	15	12	10	9	8	8
3/4	1 1/4	39	39	39	39	39	39	34	32	27	25	22	19	19	17	16
1	1 1/4	78	78	76	67	52	44	39	36	30	27	24	20	19	17	16
1 1/2	1 1/4	78	78	78	78	66	52	44	39	33	29	24	20	19	17	16
1	1 1/2	85	85	85	85	85	85	80	67	55	49	41	37	34	32	30
1 1/2	1 1/2	151	151	151	151	128	105	90	78	62	52	42	38	35	32	30
2	1 1/2	151	151	151	151	150	117	98	84	67	55	42	38	35	32	30
1	2	85	85	85	85	85	85	85	85	85	85	85	85	85	83	80
1 1/2	2	370	370	340	318	272	240	220	198	170	150	135	123	110	102	94
2	2	370	370	370	370	368	318	280	250	205	165	142	123	110	102	94
2	2 1/2	654	640	610	580	535	500	470	440	400	365	335	315	285	267	250

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1 1/2	1 1/2	151	151	151	151	128	105	90	78	62	52	42	38	35	32	30
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1	2	85	85	85	85	85	85	85	85	85	85	85	85	85	83	80
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2	2 1/2	654	640	610	580	535	500	470	440	400	365	335	315	285	267	250

Water System Sizing

- 1.6 GPF gravity water closets
- Developed length of most remote outlet: 70 feet
- Pressure at meter: 40 psi
- 3/4" Meter, 3/4" Building Supply
- Elevation of highest fixture: 8 feet
- Static pressure: _____



Pipe Section	Fixture Units	Pipe Size
1 - Meter	7.5	3/4
2	7.5	3/4
3	4	1/2
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		

Demand Table			
Fixture	WSFU Per Fixture	# of Fixtures	WSFU Total
WC	2.5	1	2.5
Lav	1.0	1	1
Bathtub & Shower	4.0	1	4.0
Total			7.5

Table 610.4

Fixture Unit Table for Determining Water Pipe and Meter Sizes

Pressure Range - 30 to 45 psi (207 to 310 kPa)**

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1	2	85	85	85	85	85	85	82	80	66	61	57	52	49	46	43
1 1/2	2	220	205	190	176	155	138	127	120	104	85	70	61	57	54	51
2	2	370	327	292	265	217	185	164	147	124	96	70	61	57	54	51
2	2 1/2	445	418	390	370	330	300	280	265	240	220	198	175	158	143	133

Partial Table 610.3

Fixture	Minimum branch pipe size _{1,3}	Units
Combination Bath/Shower	1/2"	4 units
Clothes Washer	1/2"	4 units
3/4" Bathtub fill valve	3/4"	10 units
Dishwasher, Domestic	1/2"	1.5 units
Hose bibb ⁷	1/2"	2.5 units, each additional 1 unit
Lavatory	1/2"	1 Units
Kitchen sink, Domestic	1/2"	1.5 units
Laundry sink	1/2"	1.5 units
Shower, per head	1/2"	2 units
Gravity tank toilet, 1.6gpf	1/2"	2.5 units
Clothes Washer	1/2"	4 units
Flushometer tank, 1.6gpf	1/2"	2.5 units

Notes:

- Size of the cold branch pipe, or both the hot and cold branches.
- The listed minimum supply branch pipe sizes for individual fixtures are the nominal (I.D.) pipe size.
- Reduced fixture unit loading for additional hose bibbs as used is to be used only when sizing total building demand and for pipe sizing when more than one hose bibb is supplied by a segment of water distributing pipe. The fixture branch to each hose bibb shall be sized on the basis of 2.5 fixture units.

Flushometer Systems

- Must use 610.3 fixture unit chart
- Developed length from meter to most remote point
- Difference in elevation from meter to highest point
- Size to the minimum pressure available (610.10)
- Flushometer fixture demands are greater than typical plumbing fixtures
- A flushometer WC is given an initial value of 40 fixture units
- An additional flushometer WC is given a fixture value of 30 fixture units, for a total of 70 fixture units
- If another WC was added, for a total of three on the same branch, it would be given a fixture value of 20. The cumulative total of all three WCs would equal 90. (40+30+20)
- After the fifth WC, each additional WC receives a fixture unit value of 10
- The same principals apply to flushometer urinals

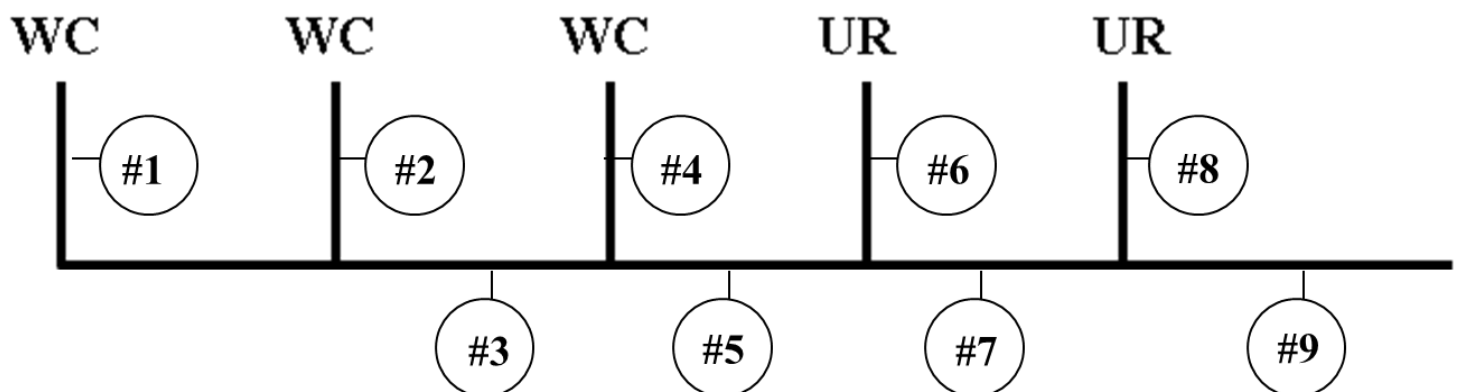
Example 1

- What would be the fixture unit count for 7 WCs?
- $40+30+20+15+10 +10+10 = 135$
- 7 WCs equal 135 fixture units

Example 2

- What would be the fixture unit count for 7 Urinals?
- $20+15+10+8+5 +5+5 = 68$
- 7 urinals equal 68 fixture units

Flushometer Exercise



Flushometer Fixture Units for Water Sizing

Water Closet w/ Flushometer Valves		
Number of Flushometer Valves	Individual Fixture Units	Cumulative Fixture Units Assigned for Water Closets
1	40	40
2	30	70
3	20	90
4	15	105
5 or more	10 each	115 + 10 each
Urinals w/ Flushometer Valves		
Number of Flushometer Valves	Individual Fixture Units	Cumulative Fixture Units Assigned for Urinals
1	20	20
2	15	35
3	10	45
4	8	53
5 or more	5 each	58 + 5 each

Other Sizing Methods

- Parallel of Home Run Method
- Listed systems installed according to their listings
- Cannot exceed velocity requirements of the code (610.12)
-

Appendix A

- Based on friction loss charts per 100 feet of piping
- Fittings given an equivalent length
- Velocity cannot exceed 10 FPS
- For large, intricate systems

Appendix C

- Allows reduced WSFU, DFU counts in bathroom groups
- Assumes that only one fixture in a bathroom group is used at a time in a private bathroom
- Copper tubing: 8 fps cold water / 5 fps hot water
- Also applies to copper fittings used in other tubing types

Chapter 7 - Sanitary Drainage

Horizontal to Vertical

- Horizontal drain lines entering a vertical stack:
- 45° wyes
- 60 ° wyes
- Combination wyes
- Sanitary tee
- Sanitary tapped tee
- Or equivalent
- Not more than one fitting on the same level unless discharge cannot travel across
- Double san tee may be used is largest inlet is 2 pipe sizes smaller than the barrel (706.2)

Horizontal to Horizontal

- Horizontal drain lines entering horizontal drain lines must use:
- 45° wye
- 45° wye and 1/8 bend combinations
- Or other fittings of equivalent sweep (706.3)

Vertical to Horizontal

- Vertical drain lines connecting with horizontal drain lines
- 45° wye
- 45° wye and 1/8 bend combinations
- Or other fittings of equivalent sweep (706.4)

Cleanout Locations

- Required at:
- Upper terminal of each horizontal drainage pipe
- Each run of more than 100 feet
- Changes in direction exceeding 135°
- Above the fixture connection fitting at each urinal (707.4)

Cleanout Exceptions

- Drain lines less than 5 feet
- Horizontal drain piping sloped 72° or less
- Above floor level of the lowest floor
- Approved two way cleanout (707.4)

Cleanout Access

- Must be readily accessible
- 18" clearance in front for 2" pipe or smaller
- 24" clearance in front for larger than 2" pipe
- No underfloor cleanout more than 5 feet from access (formerly 20 feet)
- Crawlspace less than 18" must extend above the floor level
- 30" wide access path (707.8-9)

Grade of Horizontal Piping

- Uniform slope of $\frac{1}{4}$ inch per foot
- 4" or larger may have $\frac{1}{8}$ inch per foot if $\frac{1}{4}$ inch per foot not practical (708.1)

Testing

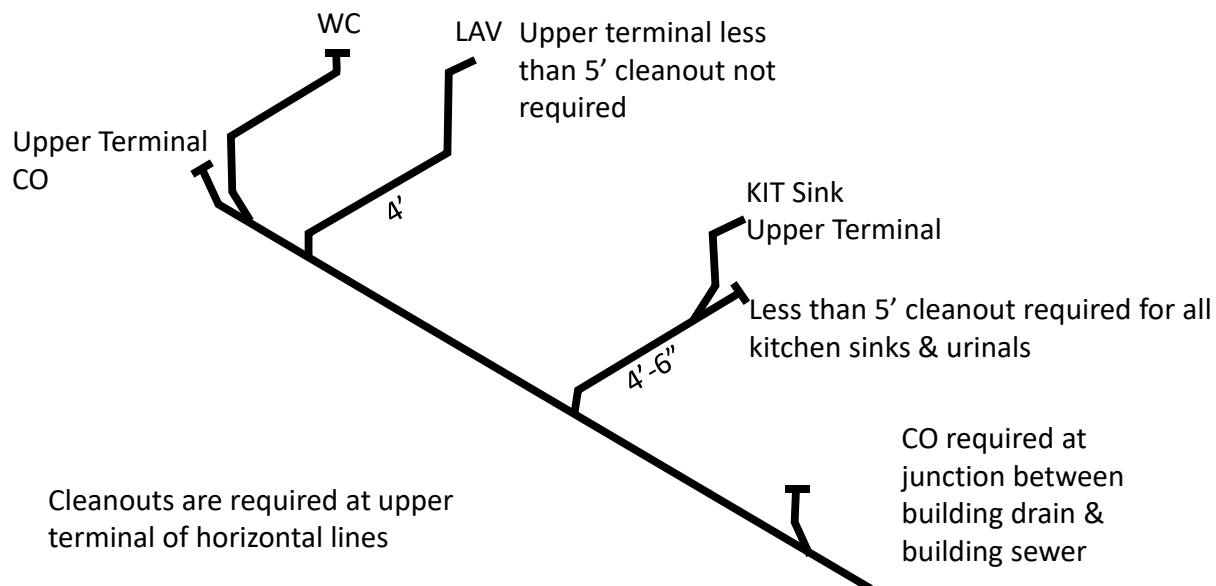
- Water test - 10' head of water for 15 minutes
- Air test - 5 psi for 15 minutes (712.2-3)

Table 702.1 Changes

- Water test - 10' head of water for 15 minutes
- Air test - 5 psi for 15 minutes (712.2-3)
- Nonwater Urinal with Drain Cleansing Action replaced Urinal, Hybrid
- DFUs & trap arm sizes stay the same

Table 703.2 Changes

- Maximum water closets on a 3 inch horizontal branch or drain increased from 3 to 5
- Maximum water closets on a 3 inch vertical pipe or stack increased from 4 to 5
- Up to 8 public lavs permitted on 1.5" vertical or horizontal branch sloped $\frac{1}{8}$ " per foot



This drawing shows many of the cleanout requirements. The upper terminal for each horizontal branch requires a cleanout, with the exception of the LAV sink drain line which is less than 5 feet in length. The kitchen sink drain line is also less than 5 feet in length, but a cleanout is required since it is a kitchen sink, the same rule would apply to a urinal. A cleanout is also required at the junction between the building drain and the building sewer.

Chapter 8 - Indirect Wastes

Air Gap or Air Break Required

- Indirect waste must discharge through air gap or air break (801.2)
- An Air Break is a physical separation between a waste pipe and a receptor

Standpipe Receptors

- 18"-30" above trap weir for clothes washers
- Clothes washer traps cannot be below floor level
- Indirect waste receptors not allowed in toilet rooms (unless clothes washer), store rooms, or cupboards (804.1)

Domestic Dishwashing Machine

- Must discharge through air gap
- Above floor rim level
- Air gap prevents pressurization of the disposal or tailpiece, something an integral backflow preventer does not do (807.3)

Condensate Disposal

- Condensate from condensing appliances discharged to approved plumbing fixture or disposal area
- Approved plumbing fixture discharge through air gap (814.1)

Condensate Control

- Where condensate overflow may damage the building (except for ceiling tiles) one of four methods must be used
1. Water level detecting device with appliance shutoff
 2. Additional pan with separate drain
 3. Additional drain line above the primary
 4. Additional drain pan with water level detecting device and appliance shutoff (814.2)

Condensate Cleanouts

- Cleanout required
- Condensate drain line blockages must be clearable without cutting pipe (814.3.1)

