



Vents and Venting

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Note: In determining your answers to the CE questions, use only the material presented in the corresponding continuing education article. Using information from other materials may result in a wrong answer.

Venting, a component of a gravity drainage system, is a parallel arrangement of piping that limits the air pressure within the drain. By definition, venting is a separate piping system joined to the drainage system at certain connection points and is sized to keep the air pressure in the drain from disturbing the water seals of fixture traps. Generally, the air pressure limit is 1 inch (25.4 millimeters) of water column (wc) above or below atmospheric pressure. When the vent piping is a sufficient diameter or limited in length, the permissible air pressure can be achieved.

Venting also allows air circulation, which prevents the accumulation of volatile substances in a drainage system. Such circulation is necessary for the installation of an interceptor, and some municipalities that have sewer problems warranting a house trap for each building require it.

Venting is not limited to sanitary drainage systems. Venting design principles are applicable to other drainage systems such as those for chemical waste, graywater waste, and clear-water waste.

The design of a venting system is closely tied to the design of the drainage system. That is, the permissible velocities in the drainage system and its peak flow rates affect the diameters in the venting system. If sink drains are nonstandard or if the vertical distance between a fixture outlet and its trap outlet is excessive, then velocities in the entire drainage system will be greater than those assumed in vent sizing tables.

Because they have no moving parts, vent systems are quiet, and they generally operate flawlessly for decades. However, these two virtues can disguise a fault in a drain and vent system if particular errors in the venting are unknown. These errors typically are related to the elevation of the horizontal portion of the venting.

A variety of interpretations exist regarding the details of venting, and the venting portions of plumbing codes vary greatly across the country. Typically, vent sizing requirements are expressed as ratios of a vent diameter to the drain diameter. This handbook, however, presents the engineering basis for venting, as well as the sizing tables of some of the model plumbing codes commonly enforced in the United States. Nonetheless, local plumbing codes should be consulted for the minimum requirements of a vent system design.

TRAP DESIGN

A fixture trap provides a water seal without significantly impairing flow. Figure 3-1 illustrates a sink trap with three pressure levels within a drain system, with no drainage occurring from the sinks and a fully open sink outlet. The principles of this trap design can apply to most other fixtures, except those with an intentional siphon action, such as a water closet.

In the first trap in Figure 3-1, the water level is even on both sides of the trap. That is, the air above the water on the drain system side has an atmospheric pressure identical to the air inside the room. The next trap shows the effect on the water levels if the atmospheric pressure on the drain system side increases by an amount that displaces the water downward by $\frac{1}{2}$ inch (12.5 mm). The water level rises on the room side by an equal amount, giving a 1-inch (25-mm) pressure difference. The pressure difference that causes a 1-inch (25.4-mm) deflection of water is 0.0361 pounds per square inch (psi) (0.249 kilopascals [kPa]). If the pressure increases to more than 2 inches (50.8 mm), air and other sewer gases will pass into the room.

The last trap in the figure shows the effect of negative pressure in the drainage system, which allows the atmospheric pressure of the room side of the trap to depress the water level by 1 inch (25 mm). The 1 inch (25 mm) of water on the other side is lost down the drain. When the pressure in the drainage system returns to neutral, the water levels will be

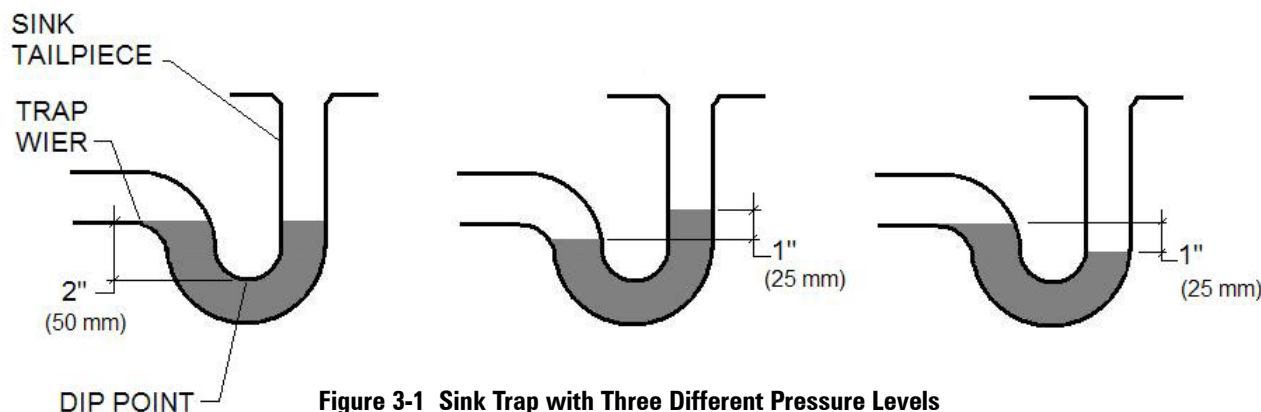


Figure 3-1 Sink Trap with Three Different Pressure Levels

1½ inches (38 mm) above the dip point. If the negative pressure is subsequently more than 1½ inches (38 mm), air will be pulled from the room.

Another trap issue occurs when the momentum of water flowing from the sink causes most of the water to evacuate from the trap. When the pressure in the drain returns to neutral, the water level may be below the dip point, and sewer gases will move freely from the drain system into the room. The loss of a trap seal is prevented by providing a fixture vent.

TYPES OF FIXTURE VENTS

Individual fixture vents and various alternative vent designs are commonly employed in plumbing systems. Some are mechanical; others use larger-than-normal drain diameters; and one recognizes the use pattern of private bathrooms. Still another addresses the vent connection limitations of island sinks. Traditional alternative vent designs are generally part of most plumbing codes, while other alternative vent designs require a technical submission to the authority having jurisdiction (AHJ).

In a good vent system design, the orientation of the vent pipe at its connection to a fixture drain is generally vertical or, at most, 45 degrees from vertical.

Common Vent

Figure 3-2 shows a common vent. It is suitable for two lavatories, sinks, or floor drains. A similar design may serve water closets. The two fixtures connect at the same elevation with a vertical double wye fitting. Some codes permit a double sanitary tee, and others permit a horizontal branch with a horizontal double wye, whereby the vent connects downstream of the double wye.

The vent is sized for the combined drainage fixture units of both fixtures. If two wall-outlet fixtures connect at different elevations, rather than what is shown in Figure 3-2, venting of the lower fixture is compromised. However, some codes permit this design, called a vertical wet vent, if the diameter between the two fixture connections is increased.

Private Fixture Group Wet Venting

Another wet vent design recognizes the usage of private fixture groups (see Figure 3-3). That is, compared to a public restroom, a private bathroom is less likely to have two or three fixtures discharging into the drainage system simultaneously. This design is restricted to a water closet, a lavatory, and a bathtub or shower. The fixture branch of the water closet is downstream of the other fixtures and upstream of a stack or fixtures unrelated to the wet venting. An individual vent is connected only to the lavatory, and its drain is the vent for the other fixtures.

Various codes regulate the size of the wet vent, and some codes permit two bathroom groups with back-to-back lavatories connected with a common vent. Some codes permit a sink connection to the group, while others require a relief vent downstream of two bathroom groups.

Circuit Venting

Through a horizontal branch, many fixtures can be vented by one or two vents as shown in Figure 3-4. Various names are used for such venting, including circuit venting, loop venting, and battery venting. The branch is a uniform size along the distance between the connected fixture drains. Public toilet rooms typically use this design for venting floor-outlet water closets and floor drains. Typically, one vent connects between the two upstream fixtures, and the other vent connects downstream of the last fixture.

Codes vary in the details of the permissible design, usually with a limit of eight floor-outlet fixtures. Some codes permit a lavatory fixture branch to serve as either or both of the vent connections;

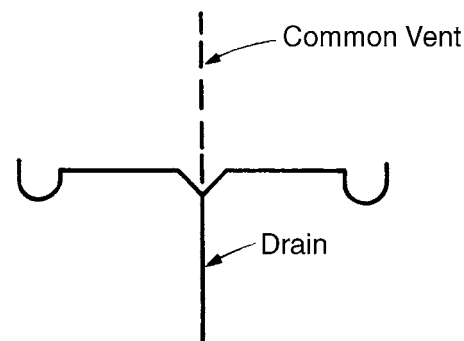


Figure 3-2 Common Vent for Two Sinks or Lavatories

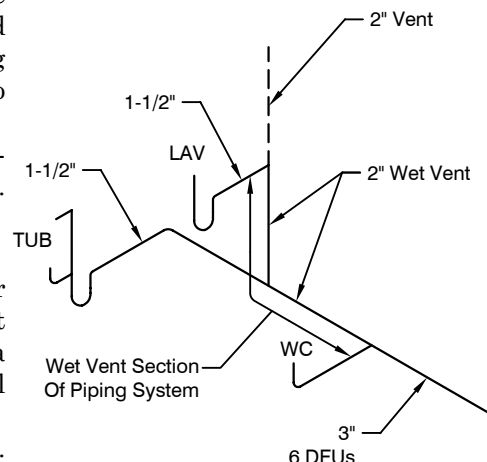


Figure 3-3 Horizontal Wet Vent

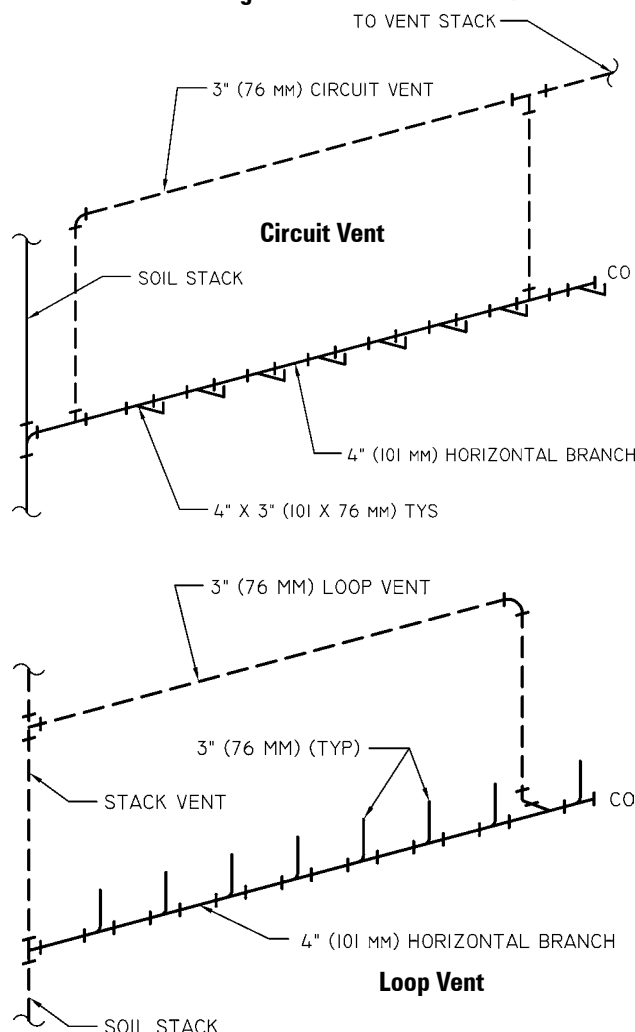


Figure 3-4 Circuit Vent Designs

hence, the fixtures of the circuit vent are also wet vented. With a generous diameter, the upper half of the cross-sectional area of the common horizontal branch is sufficient to prevent excessive pressures from affecting the trap seal of any non-flowing fixture in the group.

Waste Stack

For circumstances with limited walls or little opportunity to provide a vertical vent pipe, other traditional venting designs are devised by employing a larger drain diameter. Called a waste stack, in this design a vent is required only at the top of the drain stack. However, the advantages of a larger stack diameter, which limits air pressure within the core of air inside the stack, are not possible if the stack contains horizontal offsets.

The waste stack serves building designs that have identical wall layouts on multiple floors, but it does not accommodate varying wall locations between floors. Codes usually require each fixture to connect individually to the stack and the diameter to be constant from the base to the stack vent. Codes usually prohibit a water closet from being connected to a waste stack.

Combination Drain and Vent

Another design employed for circumstances with limited walls is called the combination drain and vent. Vent pipes at the upstream end of a building drain are the only requirement. Unlike a drainage system served by individual vents, the building drain diameter in the combination waste and vent generally is increased by one commercial pipe size. Depending on the code, the vent pipe may be a drain stack, a single wall-outlet fixture, or a vent stack as a vertical extension from the building drain. The design is ideal for a column-free warehouse and for a basement that has only floor drains. The design also is commonly used for venting the basement floor drain in residential construction.

Diameters, connection points, floor drain branch lengths, and possible downstream relief vents are prescribed in the plumbing codes. Some codes permit a combination drain and vent in systems other than the building drain; other codes limit the types of fixtures connected to it, but some permit a limited number of water closets.

Island Vent

Similarly, a sink in casework that is not located near a wall requires an island sink vent (see Figure 3-5). Unlike an individual vent that rises above the sink rim level before turning horizontal, an island vent turns horizontal just below the rim and drops below the floor. Depending on the code, it connects to a building drain that serves the sink, or it connects to the horizontal drain branch that serves the sink and to a vent stack in the nearest wall. Codes usually prescribe cleanouts and a pipe slope in the vent piping.

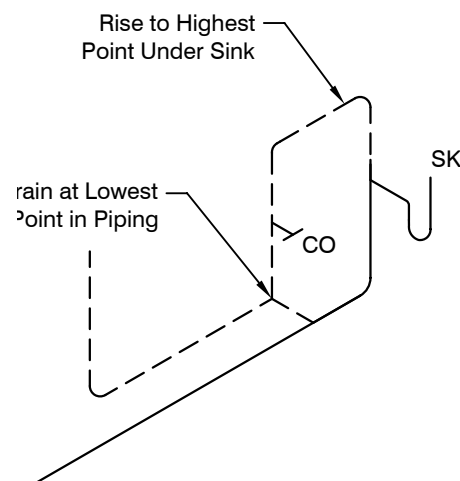


Figure 3-5 Island Fixture Venting

VENT SYSTEMS

The connection of a vent to a fixture drain should not be so close as to become clogged with debris washed through the trap, and it should not be so far away that it becomes blocked by water that will accumulate if downstream piping is obstructed. The vent is not blocked, for various connection orientations, if the location of the vent connection is less than the distances listed in Table 3-1.

From the vent connection, the vent pipe in a conventional system extends to the outdoors generally through a network of vent pipes. The open end of the pipe at the outdoor location, called a vent terminal, is generally above the roof, about 1 foot (0.3 meters) from its surface, and its diameter is of a generous size to prevent closure caused by frost buildup. A vent terminal generally is not permitted to be located near air intakes, doors, windows, and promenades. In addition, provision must be made for expansion and contraction of the vent terminal relative to the roof membrane.

Where two vent pipes are connected, the horizontal pipes joining them are called vent headers or vent branches. The connection of two or more stack vents is called a vent header, while the connection of two or more fixture vents is called a branch vent.

Table 3-1 Maximum Distance of Fixture Trap from Vent

International Plumbing Code		
Size of Trap, in.	Slope, in./ft	Distance from Trap, ft
1¼	¼	5
1½	¼	6
2	¼	8
3	1/8	12
4	1/8	16
Uniform Plumbing Code		
1¼	¼	2.5
1½	¼	3.5
2	¼	5
3	¼	6
4 and larger	¼	10

For SI: 1 in. = 25.4 mm; 1 ft = 304.9 mm; 1 in./ft = 83.3 mm/m
Source: 2012 International Plumbing Code Table 909.1 and 2010 Uniform Plumbing Code Table 10-1

Drainage basins that are pumped of their contents require a vent to replenish the lost volume with air that is at atmospheric pressure. This vent pipe allows the basin to be sealed from the building's air. Interceptors also may require an individual vent. These vents may be connected to the other vents unless the interceptor requires isolation, such as with chemical wastes.

All parts of a vent system, including the vent terminal, are independent of similar vent system types. That is, the sanitary vent system does not share its parts with the vent system of a chemical waste system, clear-water system, graywater system, or steam vent system.

The piping material for vent systems can be identical to the drain system. The pressure test for the drain system often is applied to the vent system at the same time, with a few differences. Insulation that may be applied on drain piping that is prone to condensation is not applied to the vent piping, and the radii of elbows and tees are usually sharper than on drainage fittings.

For a fixture drain, the elevation of the horizontal portion of its vent is generally 2 to 6 inches (50.8 to 152 mm) above the rim of the fixture. Similarly, the elevation of a branch vent is 2 to 6 inches (50.8 to 152 mm) above the rim elevation of the highest connected fixture (see Figure 3-6). This elevation restriction prevents the fixture from functioning correctly when an obstruction occurs downstream of its vent connection. If the vent branch were at or below the fixture rim, drainage flow would divert to the vent of the lower fixture, and the obstruction would continue to be unnoticed.

A horizontal vent pipe is installed with its slope, if any, favoring the drain stack so water is never trapped within the vent. Various restrictions on the horizontal length were based on an earlier belief that continuous airflow was required in venting to maintain trap seals. However, this has been disproved. Continuous airflow is required only if volatile substances are present, such as with certain interceptors or in city sewers.

VENT STACK DESIGN

The flow in a vertical drain stack consists of solids, a film of water around its interior surface, and a hollow core of air in the center. In approximately 50 feet (15 m), the velocity reaches a maximum and remains constant for the remaining descent. At the base, the film transitions into an open channel flow in the lower half of the building drain, and air occupies the upper half of the building drain pipe. The major portion of the transition consists of a rapid shallow channel that abruptly converts to a deeper channel. This abrupt elevation change is called a hydraulic jump. Before the jump, the film dropping from the inside portion of the pipe bend creates a curtain that isolates the core of air in the stack from the air in the building drain. The hydraulic jump also may isolate the core of air. Hence, air pressure builds up in the core unless it's relieved.

In plumbing, the distance between floors can be regarded as an interval between branches connected to the drain stack. Such branch intervals are used as the basis for venting requirements, and the term allows some liberty regarding floors not having a connection to the stack.

For buildings with four branch intervals or less, a vent is connected at the top of each drain stack and extends upward to a vent terminal or a vent header (see Figure 3-7). This top connection is sufficient to relieve the air pressure in the core.

In a high-rise building with five or more branch intervals, a vent pipe is placed parallel to each drain stack to relieve the core air pressure. It connects at the base of the drain stack before the drain sweeps to a horizontal plane. The top end of the vent stack joins the vent that extends from the drain stack (see Figure 3-8). For buildings with 10 branch intervals or more, intermediate vent connections (called yoke vents) are made at every 10 branch intervals.

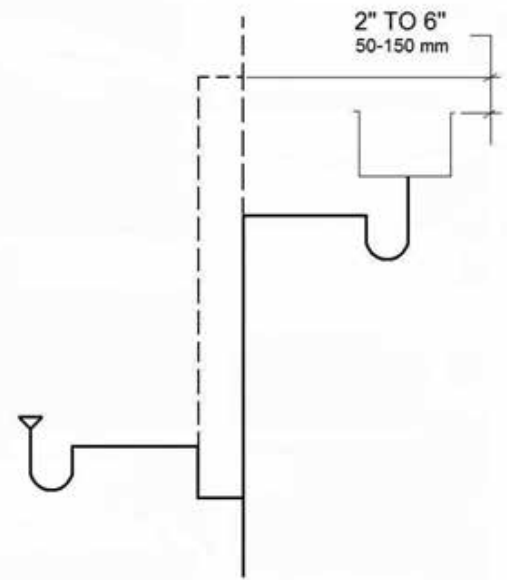


Figure 3-6 Two Vent Pipes Joined Above the Sink Rim

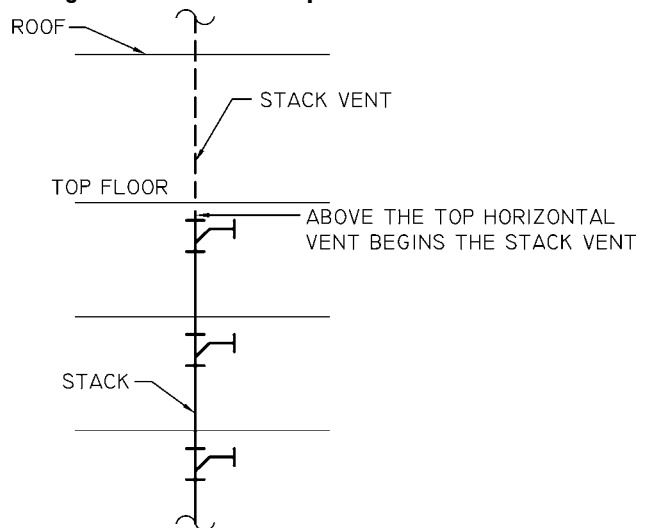


Figure 3-7 Stack Vent Joined to a Drain Stack

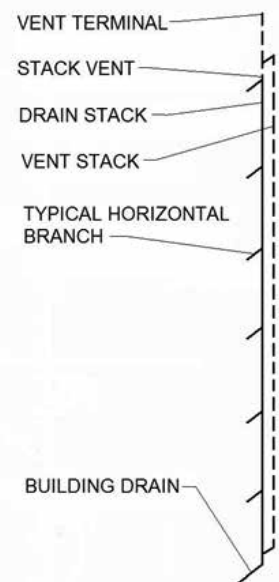


Figure 3-8 Vent Stack Joined to a Drain Stack

Sizing a Vent Stack

To size a vent stack, the vent diameter and length are determined from the maximum flow rate of the water and air flowing in the drain stack and passing toward its base. The downward-moving air velocity in the core is equal to the terminal velocity of the water film. From the ratio of the cross-sectional area of the water to the entire pipe diameter, the flow rate of the air passing into and up the vent stack can be determined. When the vent stack is of a sufficient diameter, the pressure change due to friction along its length is no more than 1 inch (25.4 mm) of water column.

A vent stack is sized based on the conservation of energy of the air circulating in a drain stack and a vent stack. Recall the following from Bernoulli's equation for an ideal flow between any two points along a flow stream, applicable in any consistent units of measurement:

Equation 3-1

$$\frac{P_1}{d} + h_1 + \frac{v_1^2}{2g} = \frac{P_2}{d} + h_2 + \frac{v_2^2}{2g}$$

where

P = Pressure

d = Specific weight

h = Height

v = Velocity

g = Gravitational acceleration

In an actual flow stream, a friction term, h_f , is added to the right side of the equation to represent the friction between the two points. For Point 1 of a vent stack being at the lower connection of a drain stack and Point 2 being at the top of the vent stack, the equation can be revised as follows:

Equation 3-2

$$\frac{P_1}{d} + \frac{v_1^2}{2g} = h_2 + \frac{v_2^2}{2g} + h_f$$

If the vent diameter is unchanged along the length of the vent stack, the velocity terms can be omitted. For the friction term expressed as $h_f = f \times ([v^2 \div 2g] \times [L \div D])$, the equation is:

Equation 3-3

$$\frac{P_1}{d} = h_2 + f \times \left(\frac{v^2}{2g} \times \frac{L}{D} \right)$$

where

f = Darcy-Weisbach friction factor

L = Pipe length, Point 1 to Point 2

D = Diameter of the vent stack

Rearranging the terms to find the maximum length of a vent stack for a given diameter, we find Equation 3-4, which is for an adequate pipe length and diameter for the given air velocity and the permissible pressure drop.

Equation 3-4

$$L = \frac{(P_1/d - h_2) \times D}{fv^2/2g}$$

This general equation is applicable in U.S. customary units and SI units.

Alternatively, Equation 3-4 may be expressed in terms of the flow rate of air, q . Recall that $v = q \div (D^2\pi \div 4)$. Thus, for $h_2 = 0$, we have:

Equation 3-5

$$L = \frac{(P_1/d) \times D}{f \times (q/D^2\pi/4)^2/2g}$$

Simplify this equation by recalling that the density of standard air is 0.000044 pounds per cubic inch (0.0119 Newton per liter), 231 cubic inches = 1 gallon, and $P_1 = 0.0361$ psi (248.8 pascals). Thus,

$$L = (0.0361 \div 0.000044) \times 2 \times 32.2 \times D^5 \times (\pi \div 4)^2 \times (60 \div 231)^2 \div (fq^2)$$

$$[L = (248.8 \div 0.0119) \times 2 \times 9.824 \times D^5 \times (\pi \div 4)^2 \times (1,000) \div (fq^2)]$$

or

Equation 3-6

$$L = \frac{2,226 D^5}{fq^2} \quad [L = \frac{2.53 \times 10^8 D^5}{fq^2}]$$

The unit for length is feet (meters), for diameter is inches (millimeters), for airflow is gpm (liters per second), and f is dimensionless.

Offsets

If the drain stack is not vertical from its top branch to the building drain, other air pressure-restricting conditions will occur where the stack changes direction. Figure 3-9 illustrates several types of drain stack offsets. At the upstream end of each offset, the air is blocked in the same way it is blocked at the base of a drain stack. Hence, a vent connection point, called a relief vent, is added to the drain stack if any drain branch connections are below the offset.

For 90-degree offsets, a relief vent is provided upstream and downstream of the horizontal portion of the offset as shown in Figure 3-10. For 30- and 45-degree offsets, a vent relief is provided upstream of the offset. The diameter of the relief vent matches the vent stack. The connection of the upper end of the two reliefs generally is prescribed to be a certain distance above the floor.

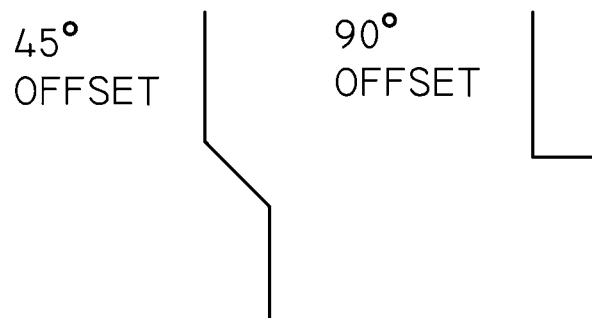


Figure 3-9 Drain Stack Offsets

Suds Pressure Zones

Another air restriction in plumbing occurs from detergents whose suds collect at the base of a drain stack, in a stack offset, and in a bend of the building drain. The affected areas are called suds pressure zones as shown with double lines over the pipes in Figure 3-11. The suds are displaced by water and solids, but not by air. Hence, for stacks loaded with laundry discharges, branches should not be connected to these zones, and an additional vent connection is required at the base of the stack above the suds-pressure zone.

Main Vent

A vent for the building drain is referred to as the main vent. Connecting from the building drain to a vent terminal or vent header, it relieves any pressure variation in the building drain. In some codes, a drain stack or vent stack qualifies as the main vent.

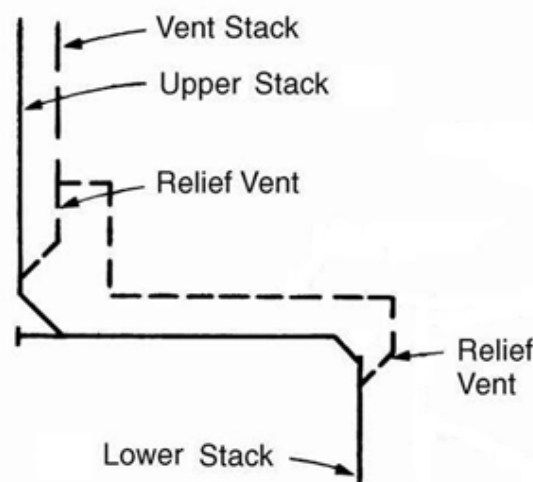


Figure 3-10 Relief Vents at a Drain Stack Offset

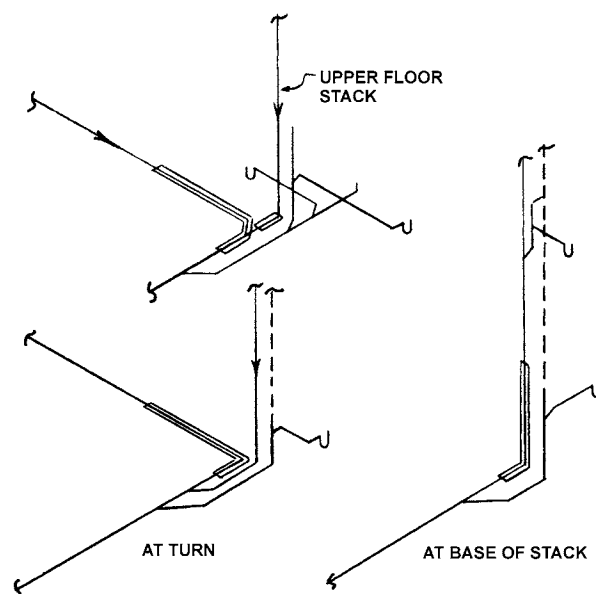
FIXTURE VENT DESIGN

The nature of water flow in a drain system is transient regarding which fixtures are flowing and the pattern of the flow with respect to time. However, the concern of the designer is the maximum flow rate, which generally occurs at the start of a fixture discharge.

At each fixture, air pressure at the vent connection increases as a discharge of water and solids approaches the connection. When the bulk of the water passes, air pressure drops below ambient and the airflow rate matches that of the water flow rate. This behavior pattern of the water and air is recognized especially in long horizontal branches. The water flow stabilizes into a steady flow occupying the lower half of the drain pipe. The upper half is occupied with air moving at the same velocity. Hence, the flow rates are identical.

As in vent stack sizing, the size of an individual fixture vent is determined from the airflow rate, the vent pipe diameter, and the vent pipe length to the vent terminal. For venting with changes in direction, equivalent lengths of straight pipe are added for each vent fitting. Hence, the actual length plus the equivalent lengths is the developed length.

Vent pipes on fixtures connected to the building drain are not different than those connected to a horizontal branch. Like the horizontal



Note: Double lines represent suds pressure zones. Shown are connections outside the pressure zones.

Figure 3-11 Suds Pressure Zones

branch, the water flow in the building drain branch stabilizes into a uniform pattern occupying the lower half of the pipe. Air in the upper half flows at the same velocity as the water in the lower half.

For two fixtures with individual vents, the airflow in the vent branch serving them is determined from combining the airflow rates of each fixture. The vent length is selected for the fixture furthest from the vent terminal.

The composite effect of multiple fixtures for any part of the drain system generally is decided on a 99 percent probability, assuming such a rare event is random. The tabulation of drainage fixture units from each connected fixture provides an easy determination of drain loading. It can be applied to any grouping of fixtures or the entire building.

A corresponding load on the vent system is determined in the same way. That is, drainage fixture units can be noted at each section of vent piping from the accumulation of fixture units served by that section of vent piping. A capacity table for fixture venting can be formulated with drainage fixture units, vent diameters, and vent lengths. Equation 3-6 provides the relationship between airflow, vent diameter, and vent length. Building drain pipe diameters are selected based on drainage fixture units. Drain capacities, in gpm (L/s), are calculated by the Manning formula. Hence, for each commercial pipe diameter, drainage fixture units can be matched to the gpm (L/s) values of water flow and equal amounts of airflow.

For example, a 5-inch (12-mm) building drain sloped at 1 percent is permitted no more than 390 drainage fixture units. The Manning formula, with $n = 0.013$, determines the stabilized water flow rate and airflow rate to be 77 gpm (4.86 L/s). Thus, the vent branch for all of the fixtures contributing to the 390 drainage fixture units can be sized at 77 gpm (4.86 L/s) using Equation 3-6.

ALTERNATIVE VENT SYSTEMS

Nonstandard alternative vent designs require a technical submission to the AHJ. The submission may be a one-time submission of a product, or it may be a submission of each building using the alternative design. The submission includes all of the technical engineering requirements that are necessary for the intent of the code to be recognized by the authority.

Air-Admittance Valves

A design method employing a special check valve at an individual vent connection and a pressure attenuator near the base of a drain stack is an alternative vent system. The check valve, or air-admittance valve, allows air into the drain branch when negative pressure conditions occur. When positive or neutral pressure occurs, the check valve closes. The location of an air-admittance valve is at each fixture or group of fixtures, similar to traditional venting. The vent can be located within casework but not within a wall without a louver. Manufacturers and code officials have various other specific installation limitations.

When positive pressure occurs at the base of a drain stack, a pressure attenuator momentarily absorbs the pressure increase before any nearby fixture trap is affected. A butylene bladder expands inside the device up to 1 gallon (3.78 L), which effectively relieves the pressure surge. Pressure attenuators also are installed every three to five floors for buildings with more than 10 floors.

For vent systems using air-admittance valves, a main vent with a vent terminal and a connection to the building drain are required to relieve positive vent pressure. Drainage sumps also require traditional venting. Otherwise, individual vents are eliminated from the design. A stack vent with a vent terminal also is eliminated for stacks of six branch intervals or less.

For chemical waste systems, the compatibility of the chemicals must be within the recommendations of the air-admittance valve manufacturer.

Sovent Systems

The high velocity in a drain stack is prevented significantly in the Sovent design through special fittings. This proprietary design is suitable for a multistory building. The fittings eliminate the vent stack and many of the individual vents. The aerator fitting, spaced at each floor, prevents the occurrence of a terminal velocity and allows a water closet flow stream to join the stack flow without disrupting the air core. A deaerator fitting at the bottom allows the air core pressure to be relieved into the building drain. A deaerator fitting also is installed at the upstream end of a horizontal offset. Where a water closet is not connected to a stack, the terminal velocity is controlled at that floor level by installing two 45-degree stack offsets or an inline offset.

Fixtures connected to the building drain require individual vents, and fixtures on horizontal branches require individual vents if they are beyond the limits of the Sovent design guidelines. However, these individual vents can connect to the Sovent drain stack rather than a vent stack. Other requirements including fixture unit assignments, stack capacities, branch capacities, vent header sizing, and building drain sizing can be obtained from the manufacturer.

Single Stack

The design of the single stack, or Philadelphia stack, provides an installation economy and saves space in multistory buildings. Vent stacks and many individual vents are eliminated. Through larger stack diameters, the air core is relieved inside the stack and, through larger branches and traps, fixture trap seals are maintained. Other features include fixture fittings that replenish water in the trap.

CODE REQUIREMENTS

Vent requirements vary geographically depending on the AHJ. Sizing guidelines can be found in the International Plumbing Code (IPC) published by the International Code Council and the Uniform Plumbing Code (UPC) published by the International Association of Plumbing and Mechanical Officials.

For ease of sizing a vent for an individual fixture or a branch vent for a group of fixtures, Table 3-2 provides a convenient reference. It was created by relating drainage fixture units to drain diameters and the IPC requirement for vent diameters to be one-half of the drain diameter but no less than 1.25 inches (32 mm). The third column shows a one-increment pipe size increase, per IPC, when the developed length is greater than 40 feet (12 m).

Vent piping can be sized to UPC requirements using Table 3-3, given the drainage fixture units, developed length, and horizontal length. Columns four and five are derived from specific UPC requirements. The cross-sectional area of the pipes in column five are provided in column six as a convenience to meeting the additional UPC requirement that the sum of the area of all vents in a building shall not be less than the area of the sewer serving the building.

Table 3-2 IPC Sizes of Individual Vents and Vent Branches		
Drainage Fixture Units	Minimum Permitted Vent Diameter, in. (mm)	
	Developed Length Less than 40 ft (12 m)	Developed Length More than 40 ft (12 m)
1	1.25 (32)	1.5 (38)
2	1.25 (32)	1.5 (38)
3	1.25 (32)	1.5 (38)
6	1.25 (32)	1.5 (38)
12	1.25 (32)	1.5 (38)
20	1.5 (38)	2 (51)
160	2 (51)	2.5 (64)
360	2.5 (64)	3 (76)

Table 3-3 UPC Sizes of Any Vent					
Drainage Fixture Units	Vent Size with Length Restrictions			Minimum Vent Diameter Without Length Restrictions, in. (mm)	Cross-sectional Area of Pipe, in. ² (mm ²)
	Minimum Diameter, in. (mm)	Maximum Length, ft (m)	Maximum Horizontal Length, ft (m)		
1	1.25 (32)	45 (13.7)	15 (4.5)	1.5 (38)	1.77 (1,140)
8	1.5 (38)	60 (18.2)	20 (6.1)	2 (51)	3.14 (2,030)
24	2 (51)	120 (36.6)	40 (12.2)	2.5 (64)	4.91 (3,170)
48	2.5 (64)	180 (54.9)	60 (18.2)	3 (76)	7.07 (4,560)
84	3 (76)	212 (64.6)	70 (21.3)	4 (102)	12.57 (8,110)
256	4 (102)	300 (91.4)	100 (30.5)	5 (127)	19.6 (12,600)
600	5 (127)	390 (119)	130 (39.6)	6 (152)	28.3 (18,200)
1,380	6 (152)	510 (155)	170 (51.8)	8 (203)	50.3 (32,400)
3,600	8 (203)	750 (229)	250 (76.2)	10 (254)	78.6 (50,700)

ASPE Read, Learn, Earn Continuing Education

You may submit your answers to the following questions online at aspe.org/readlearnearn. If you score 90 percent or higher on the test, you will be notified that you have earned 0.1 CEU, which can be applied toward CPD renewal or numerous regulatory-agency CE programs. (Please note that it is your responsibility to determine the acceptance policy of a particular agency.) CEU information will be kept on file at the ASPE office for three years.

Notice for North Carolina Professional Engineers: State regulations for registered PEs in North Carolina now require you to complete ASPE's online CEU validation form to be eligible for continuing education credits. After successfully completing this quiz, just visit ASPE's CEU Validation Center at aspe.org/CEUValidationCenter.

Expiration date: Continuing education credit will be given for this examination through **September 30, 2017**.

CE Questions — "Vents and Venting" (CEU 239)

- Another name for circuit venting is _____.
 - loop venting
 - wet venting
 - battery venting
 - both a and c
- Per the UPC, what is the minimum vent diameter without length restrictions for 84 connected drainage fixture units?
 - 4 inches
 - 5 inches
 - 6 inches
 - 8 inches
- For buildings with 10 branch intervals or more, intermediate vent connections are made at every _____ branch intervals.
 - 5
 - 10
 - 15
 - 20
- What pressure difference will cause a 1-inch deflection of water in a sink trap?
 - 0.0361 psi
 - 0.361 psi
 - 3.61 psi
 - 30.61 psi
- For 12 connected drainage fixture units, what is the minimum permitted vent diameter if the developed length is more than 40 feet per the IPC?
 - 1.25 inches
 - 1.5 inches
 - 2 inches
 - 2.5 inches
- Which of the following is usually prohibited by code from being connected to a waste stack?
 - shower
 - bathtub
 - water closet
 - sink
- Venting is a parallel arrangement of piping that limits the _____ within a drain.
 - flow velocity
 - air pressure
 - water pressure
 - water hammer
- Per the UPC, what is the maximum distance a vent can be located from a 2-inch fixture trap at $\frac{1}{4}$ inch per foot slope?
 - 2.5 feet
 - 3.5 feet
 - 5 feet
 - 6 feet
- A vent for the building drain is referred to as the _____.
 - main vent
 - circuit vent
 - branch vent
 - relief vent
- Per the IPC, the vent diameter shall be _____ of the drain diameter.
 - one-quarter
 - one-half
 - three-quarters
 - the same size
- An air-admittance valve is a type of _____ valve.
 - ball
 - pressure-relief
 - gate
 - check
- In a private fixture group wet vent design, the drain of the _____ is the vent for the other fixtures.
 - water closet
 - bathtub
 - lavatory
 - shower