What Is a Cross-Connection?

A cross-connection is a direct arrangement of piping that allows the potable (safe drinking) water pipe to be connected to a pipe supply that contains a contaminant or pollutant. An example of a cross-connection is a common garden hose attached to your home outside faucet with the hose outlet end lying in a pool or inserted into a sewer clean out. Other examples include a garden hose inserted in a car's radiator for flushing that contains anti-freeze or a hose attached to a chemical sprayer for weed killing. Again, a cross-connection would be any drinking water supply connected to any non-drinking water supply.

Ironically, the most common cross-connection is the garden hose. The weekend warrior (the "fix-it" person) either is unaware of the potential danger or makes plumbing changes without understanding local plumbing codes which address cross-connections. If you are making plumbing changes and are not familiar with backflow and cross-connections, please use a licensed plumber. These cross-connections are potentially dangerous to the internal plumbing of our homes and the water utility supply system.

What Is Backflow Prevention?

Backflow prevention is the control of cross-connections, stopping the reverse flow of contaminated water from its source to the utility's water supply system. There are several ways to accomplish backflow prevention. The steps to cross-connection control include learning to understand cross-connections through articles and websites, formal training in cross-connection control, the use of backflow prevention devices, and eliminating the contaminated sources.

What Is Backflow?

Backflow is the undesirable reversal of non-potable fluids or other substances connected through a cross-connection to the public drinking water system or to the consumer's potable water system. Two types of backflow components may cause the undesirable fluids to mix with drinking water in the event of a cross-connection. These backflow components are backpressure and back-siphonage. Both of these backflow conditions are hydraulic properties that are unseen within piping systems.
What Is Backpressure Backflow?

Backpressure backflow is when a cross-connection of a non-potable fluid has a greater pressure than the public water supply system. A cross-connection between the consumer's water service and the public water system could push these unwanted contaminants or pollutants into the drinking water supply. An auxiliary water source (reclaimed water, fire suppression system, lake, canal, or well) fitted with a pump could create backpressure onto the drinking water side. Backpressure may occur when the County's water supply pressure is 60 pounds per square inch (60 psi), and it is connected through a cross-connection to higher temperature water in a boiler or high-rise building at 80 psi. The greater pressure of 80 psi will force its way into the public water system. As stated, a backpressure hazard may include a cross-connection with a pump to a private well, reclaimed water, or lake water used for irrigation. The consumer is normally unaware of these dangerous cross-connections.

What Is Back-Siphonage?

Back-siphonage is a condition caused by negative pressure (vacuum) within the utility water system. Back-siphonage can be caused by a broken water main. A water outage reduces water pressure within a building and the water distribution system, often causing a reversal of water flow. Fighting a fire may also cause reversal of flow in water mains by withdrawing large amounts of water very quickly. It causes low pressure to be seen in other parts of the system. Remember that liquids will flow toward the lowest pressure, so if the lowest pressure is the broken water main, all cross-connection waters will try to reach that point and create a vacuum.

Why Is Backflow Prevention Important?

With the ongoing articles about backflow prevention and cross-connection control, you have seen that the water supplier needs to protect the public water supply against backflow contamination or pollution.

Backflow of water can make the water system unusable or unsafe to drink. Each water supplier has a responsibility to provide water that is safe to drink under all foreseeable circumstances. Furthermore, consumers generally have absolute faith that the water delivered to them through a public water system is always
safe to drink. For these reasons, each water supplier must take reasonable precaution to protect its drinking water supply against backflow.

The water supplier usually does not have the authority or capability to repeatedly inspect every water service for cross-connections and backflow. Each water supplier should ensure that a backflow preventer is installed and maintained at the water service connection to each premise that poses a significant health hazard. This includes dedicated fire lines, irrigation systems, reclaimed water users, auxiliary waters (lakes/ponds/canals), and commercial customers.

Local plumbing codes require backflow preventers to every water outlet (Air-Gap or Hose Connection Vacuum Breakers). These backflow devices are within the internal plumbing system on every building or home. Because these internal devices are not always installed correctly or even tested, the water supplier will require a containment device to be placed at the water meter to contain any backflow within the property or building and in return protect the community water supply system.

**What Are the Methods or Mechanisms Used to Prevent Backflow?**

The basic method is the Air-Gap. This Air-Gap provides a physical vertical air barrier, a physical separation between the end of a water supply outlet (pipe) and the flood rim of a receiving tank or vessel. This separation must be at least twice the diameter of the pipe supply line but never less than one inch. An Air-Gap is considered the maximum protection against backpressure backflow, back-siphonage backflow, and toxic conditions because there are no mechanical components to break down. This Air-Gap should be inspected annually because it can be easily bypassed. We see this Air-Gap used every day in the kitchen sink and our utility water hauling vehicles. The Air-Gap is not always practical because it will not supply water pressure, only water.

**What Is a Reduced Pressure Principle Backflow Assembly (RPZ)?**

A mechanical backflow preventer that can be used for backpressure backflow, back-siphonage backflow, and toxic conditions is the Reduced Pressure Principle Backflow Assembly (RPZ). This RPZ has two independent spring-loaded check valves and a pressure differential relief valve between the check valves. The RPZ device includes shutoff valves and is equipped with test ports for annual testing.
FAQ and Device/Usage Chart

The relief valve will open if either check valve fails and will harmlessly dump any backflow water to the ground, thus, backflow water or contaminated fluids never reach the public water supply system. This device is subject to failure as with anything mechanical, so annual testing is required. Installation is normally on commercial accounts at the water meter and must be installed 12 inches above ground or flood level.

What Is a Double Check Valve Assembly (DC)?

The Double Check Valve Assembly backflow preventer is a mechanical device that consists of two independently acting, spring-loaded check valves. This device includes shutoff valves at each end of the assembly and is equipped with test ports. The Double Check Valve Assembly does not include a relief valve as with the Reduced Pressure Principle device. On the Double Check Valve Assembly, if the second check valve fails, the first check valve is a backup. The Double Check Valve Assembly is effective against backpressure and backsiphonage but should be used only to isolate pollutant (non-health/non-toxic) conditions. The Double Check Valve Assembly can be used to protect against aesthetically objectionable hazard locations, such as non-chemical businesses, non-chemical irrigation injection systems, commercial and residential accounts with a low risk hazard, reclaimed water areas, and clothing, food, or steam facilities. The Double Check Valve Assembly is normally installed 12 inches above the ground level or below ground in a separate box with test ports plugged. This device is subject to failure, as with anything mechanical, so annual testing is required by the utility to ensure the drinking water system is protected.

What Is a Pressure Vacuum Breaker (PVB)?

A Pressure Vacuum Breaker (PVB) backflow preventer is a mechanical device that consists of one independently acting, spring-loaded check valve and an independently acting spring-loaded air inlet valve on the discharge side of the device. This device includes shutoff valves at each end of the assembly and is equipped with test ports. A PVB may be used to isolate health or non-health hazards but is only effective on back-siphonage conditions. Backpressure applications should be avoided. Normal applications would include isolation protection to an irrigation system and located at or near the exterior of a building. The PVB shall be installed 12 inches above the highest water outlet. During a back-siphonage condition (vacuum) the PVB will close the bottom check
valve and the air inlet will open to let air enter the device to break the vacuum. This device is subject to failure as with anything mechanical, so annual testing is required.

**What Is a Hose Connection Vacuum Breaker, Backflow Through Back-Siphonage?**

Hose Connection Vacuum Breaker, Backflow through Back-Siphonage is a form of backflow that is the reversal of normal water flow to your home or business caused by a negative pressure (vacuum) in the water supply system. Back-siphonage can be created when the water supply piping is cut (main break) or during periods of high velocity water flow due to nearby fire fighting. If our homes lack the required backflow prevention devices (hose bibb vacuum breakers) or irrigation protection, contaminants can be back-siphoned into either the house plumbing or the utility's water supply system.

A situation common to most homeowners involves chemical aspirators, which are used to spray fertilizer or pesticides on yards or flower gardens. These are often attached to garden hoses, which may not have hose bibb vacuum breakers for protection. A back-siphonage condition could cause chemicals from the aspirators to be pulled into the house plumbing, thus, hose bibb vacuum breakers are required by all plumbing codes within the United States. Without the use of containment devices, hose bibb vacuum breakers are the utility and homeowner's first line of defense in prevention of backflow prevention.

Plumbing and water utility inspectors survey for these inexpensive devices, which are simply attached to threaded faucets, sill cocks or any pipe threaded for hose attachment. Similar to atmospheric vacuum breakers, hose bibb vacuum breakers should not be used in situations where backpressure could occur. In the past, some hose bibb vacuum breakers manufactured in foreign countries have not met nationally approved standards, such as ASSE 1011, CSA B64.2 and IAPMO.

Freezing conditions may require hose bibb vacuum breaker models made with a drainage stem, which permit drainage during winter months. Removable-type hose bibb vacuum breakers have a potential problem, because they may not be reinstalled after winter. To prevent removal of these vacuum breakers, lock tight setscrew or twist lock devices provide for permanent installation. Cross-connections, either back-siphonage (vacuum) or backpressure (higher pressure
than the distribution pressure, caused by an auxiliary pump) are possible. It is imperative that each water service connection is in compliance with all plumbing codes. Hose connection vacuum breakers meeting ASSE 1011 standards are required by plumbing codes on all threaded hose connections.

### How Do I Select the Proper Device?

<table>
<thead>
<tr>
<th>CONDITION</th>
<th>Double Check Valve Assembly (DCVA ASSE 1015)</th>
<th>Reduced Pressure Principle (RP) ASSE 1013</th>
<th>Pressure Vacuum Breaker (PVB) ASSE 1020</th>
<th>Atmospheric Vacuum Breaker (AVB) ASSE 1001</th>
<th>Air Gap (AG)</th>
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<tbody>
<tr>
<td>BACK PRESSURE</td>
<td>x</td>
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<td>BACK SIPHONAGE</td>
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<td>NON TOXIC (low hazard)</td>
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<tr>
<td>CONTINUOUS SUPPLY PRESSURE</td>
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<tr>
<td>INSTALL LEVEL</td>
<td>12&quot; above grade</td>
<td>Relief valve 12&quot; above grade</td>
<td>12&quot; above highest water outlet</td>
<td>6&quot; above highest water outlet</td>
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- Install level: 12" above grade
- Relief valve: 12" above grade
- 12" above highest water outlet
- 6" above highest water outlet
- No more than 12 hours
- 2x pipe diameter. Not less than 1"