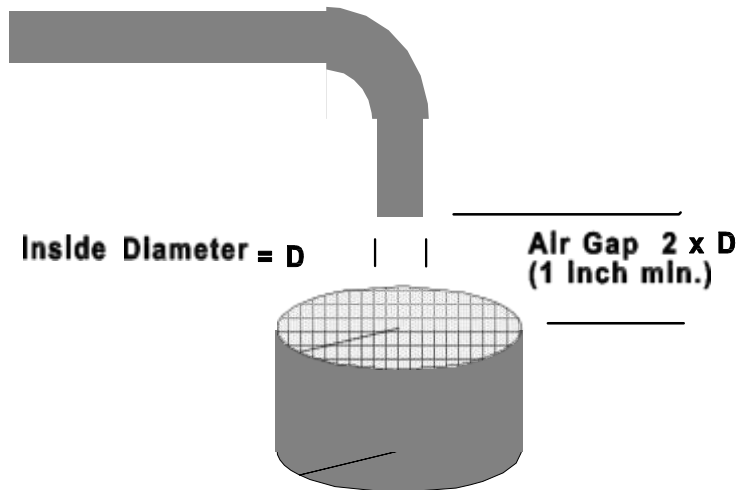


Approved types of Backflow Prevention Assemblies

Most backflow preventers fall into one of three classes: the vacuum breaker, the double-check valve, or the reduced-pressure principle valve. Both prevent backflow due to



superior pressure, or back pressure on the downstream side of a system, which will overcome the pressure on the supply side. They are installed in the main supply system where there is a possibility of backflow.

Air-Gap Separation

Air-gap separation (AG) is probably the oldest method of preventing cross connections that result in backflow due to either back pressure or backsiphonage. In many states, it is still the only method approved for preventing this type of backflow. Air-gap separation is the unobstructed vertical distance through free atmosphere between the lowest opening from any pipe or faucet supplying water to a tank, plumbing fixture or other device and the flood-level rim of the receptacle.

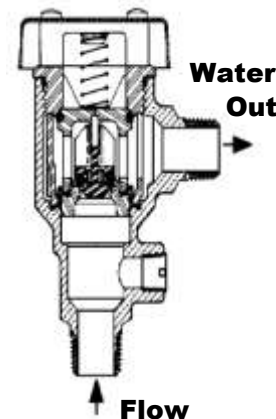
Although an air gap generally affords maximum protection, it can be bypassed easily, its effectiveness thus being entirely destroyed. It is also not reliable if the gap is too small. As defined in American National Standard A112.1.2-1042 (R1973), an air gap should be twice the diameter of the effective opening of the supply pipe. In no case shall the gap be less than one inch, or 25.4 mm. "The Recommended Standards for Water Works: 2007 edition" by the Great Lakes - Upper Mississippi River Board of Public Health and Environmental Managers recommends that for water treatment facility design of chemical addition to drinking water that:

no direct connection exists between any sewer and a drain or overflow from the feeder, solution chamber or tank by providing that at all drains terminate at maximum six inches or two pipe diameters, whichever is lesser, above the overflow rim of a receiving sump, conduit or waste receptacle.

Atmospheric Vacuum Breaker

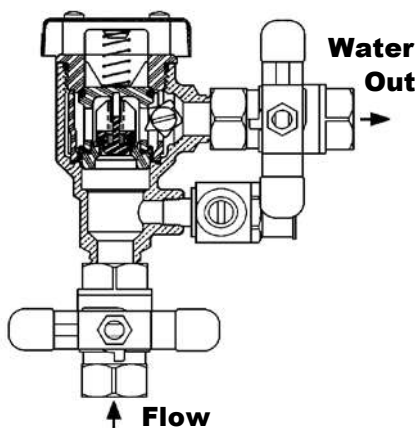
The atmospheric vacuum breaker (AVB) assembly is one of the most simple and least expensive types of backflow preventers. The AVB contains an air inlet valve, check seat and an air inlet port. Water flowing through the AVB causes the air inlet valve to close against the air inlet port. When normal water flow is stopped, the air inlet valve falls to form a block for backsiphonage. The AVB protects against non-health hazards or health hazards under backsiphonage only. The atmospheric vacuum breaker is not designed to protect against back pressure. Based on the design and operation of AVB, the following criteria must be implemented:

1. Absolutely no shut-off valves are allowed on the discharge side of the AVB;
2. A minimum of six inches of clearance above all downstream piping of the AVB or any overflow rim is required; and,
3. The AVB shall not be under continuous pressure for more than 12 hours.



Pressure Vacuum Breaker

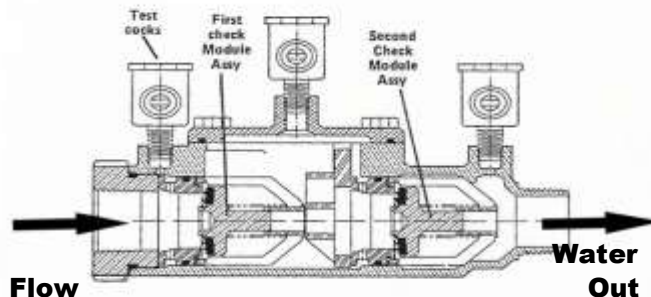
The pressure vacuum breaker (PVB) assembly evolved from the need to have a testable atmospheric vacuum breaker. The PVB contains an internally loaded check valve and an internally loaded air inlet valve. The valves independently act with the air inlet valve located downstream of the check valve. Shut-off valves and test cocks are located at each end of the assembly. The PVB, unlike the atmospheric vacuum breaker, can be tested. The PVB protects against non-health hazards or health hazards under backsiphonage only. The pressure vacuum breaker is not designed to protect against back pressure. Based on the design and operation of PVB, the following criteria must be implemented:



1. Shut-off valves may be installed on the downstream of PVB; and,
2. A minimum clearance of 12 inches above all downstream piping must be established.

Double-Check Valve

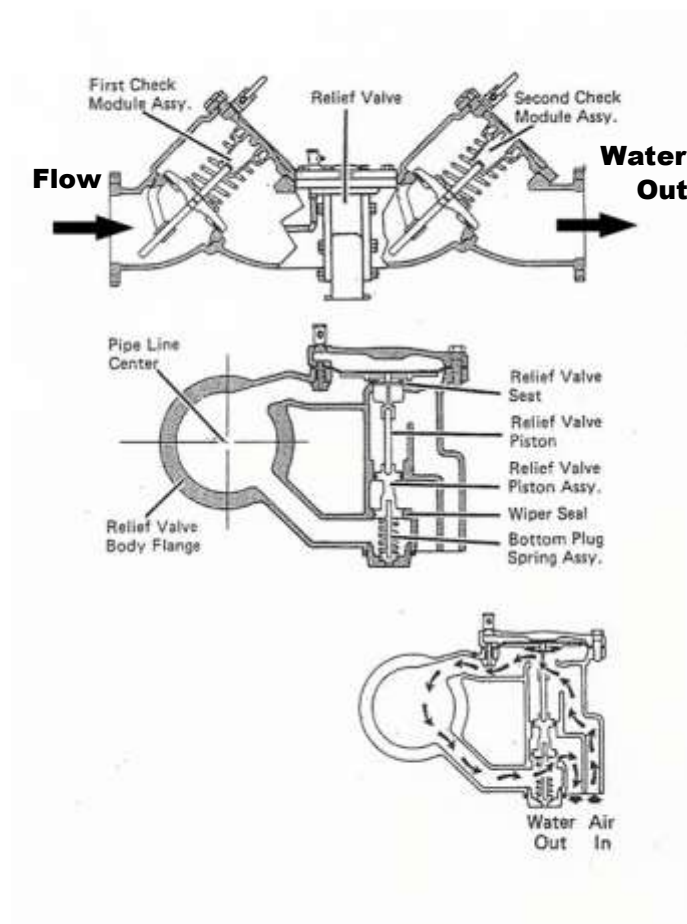
The double-check valve (DCV) consists of two independently acting, resilient seat check valves located between two tightly closing shut-off valves, together with suitable test cocks, and stop valves arranged so that the main check valves can



be tested for water tightness.

This device is one of the oldest types of backflow preventers, dating back to the late 19th century. An approved double-check valve device is regarded as an assembly that meets the requirements of American Water Works Association (AWWA) Standard for Double-Check Valve Backflow Prevention Assembly (AWWA C510-92) or an assembly that has been approved by a testing laboratory sanctioned by the Conference of State Sanitary Engineers.

Reduced-Pressure Principle Backflow-Preventer



An approved Reduced-Pressure Principle device (RP) is regarded as an assembly that meets the requirements of the AWWA Standard for Reduced-Pressure Principle Backflow Prevention Assembly (AWWA C511-92) or an assembly that has been approved by a laboratory sanctioned by the Conference of State Sanitary Engineers. The reduced-pressure principle backflow preventer, introduced to the water supply industry about 1942, is safer than the double-check valve. The device consists of an automatic differential-pressure valve located between two or more independently acting, spring-loaded, resilient seat-check valves. These seat-check valves are, in turn, located between two tightly closing shut-off valves. Suitable test cocks are provided for testing the tightness of the main check valves. Since this device discharges to the atmosphere, it can be used where codes call for an air gap. Backflow assemblies installed in a confined space are not recommended. For example, the RP cannot be installed in pits.

The RP operates on the hydraulic principle that water will not flow from a zone of lower pressure to a zone of higher pressure. As a differential-pressure valve, the relief valve is held in a closed position when the pressure on the supply side is higher by a prescribed amount than that in the zone between the two main check valves. When the pressure on the supply side of the unit falls below a set value, the relief valve opens, and the intermediate zone discharges to atmosphere. If the pressure on the discharge side of the device becomes higher than the supply pressure and the second-check valve malfunctions, the intermediate zone also discharges to atmosphere. An outstanding advantage that the reduced-pressure principle backflow preventer has over the double-check valve is the visible indication of malfunctioning

long before a danger of backflow exists. Hence, repairs can be made while the device is still effectively acting as a backflow preventer.

The AWWA Standard for Reduced-Pressure Principle Backflow Prevention Assembly (C511-92) details the requirements for design, materials of construction, and operation of the devices in all sizes. AWWA Manual M14 provides guidelines for the operation of double-check valves and reduced-pressure principle devices.

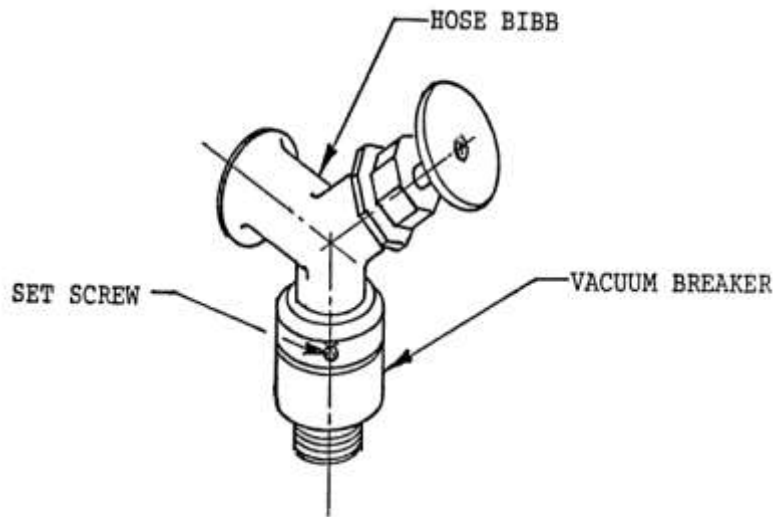
Test Results for Reduced-Pressure Backflow Preventers

In the Los Angeles area, the reduced-pressure principle device has been used since 1944 and has given excellent service. In more than 100,000 tests conducted at the University of Southern California by the Foundation for Cross-Connection Control Research, there has never been a case of backflow, as indicated by sickness or death, where this device has been used.

More than 200 of these devices are used at atomic energy installations. At the Oak Ridge National Laboratory, exhaustive tests were conducted in 1962 to determine whether the device would provide an adequate air-gap separation. The reduced-pressure principle device was tested under varying conditions, including ionic diffusion, lower pressure on the supply side, and water hammer on the discharge side. The report states, in part: "Using a solution of manganese and potassium nitrates as a non-radioactive tracer, backflow from the discharge side to the supply side was not detectable by activation and radiochemical analysis having a sensitivity of 0.2 ppb of manganese."

Hose Bibb Vacuum Breaker

The hose bibb vacuum breaker is designed specifically to be mounted on a faucet to prevent backsiphonage. It may be used on a wash basin or laboratory faucet or outside hose bibb. This unit can readily be subject to back pressure by simply having the hose outlet higher than the faucet. However, this device is better than no protection at all.



HOSE BIBB VACUUM BREAKER

Proper Selection of Backflow Prevention Devices

When selecting a backflow prevention device, whether it is used for a cross connection at the system connection or a cross connection at the point of use, the following questions will help determine which device will be most appropriate:

1. Is it an indirect or direct cross connection? An indirect cross connection is subject to backsiphonage only, while a direct cross connection is a connection which is subject to back pressure,
2. What is the degree of hazard? A “low hazard” shall mean a substance which is only aesthetically objectionable (i.e. bacteriological, unusual taste, odor, beverages, etc.). A “high hazard” shall mean a substance that could cause illness or death if ingested (i.e. toxic chemicals, radioactive materials, etc.).
3. Is the system under continuous use or pressure for more than 12 of any 24-hour period with no shut-off valves or obstructions downstream? The pressure vacuum breaker assembly may be used under continuous pressure, while the atmospheric vacuum breaker must not be used under continuous pressure.
4. What hydraulic conditions will the backflow prevention device experience at the point of connection? Backflow prevention assemblies are to be used within their rated operating conditions. A backflow prevention device which is over specified will increase the cost unnecessarily. Engineering data from the manufacturer should be consulted when selecting a backflow prevention device.

Thermal Expansion

When installing a backflow prevention device, attention must be paid to the thermal expansion of water downstream from the point of isolation. The thermal expansion of water confined in pipes and fixtures could increase the water pressure resulting in a catastrophic failure. Facilities with water heaters and double-check valves or reduced-pressure principle backflow

preventers should include a pressure relief valve, expansion tank or other device to accommodate thermal expansion. The smaller the isolated system, the less inherent tolerance to thermal expansion exists. Therefore, pressure relief devices are essential in residential facilities which are equipped with water heaters and backflow prevention devices.