CROSS CONNECTION

A cross connection is a direct arrangement of a piping line which allows the potable water supply to be connected to a line which contains a contaminant. An example is the common garden hose attached to a sill cock with the end of the hose lying in a cesspool. Other examples are a garden hose submerged in a tub full of detergent, supply lines connected to bottom-fed tanks, lawn sprinkler and supply lines to boilers.

DEFINITIONS:

BACKFLOW - The unwanted reverse flow of water, gases or other substances into the distribution system of potable water supply. A potential for backflow exists any time there is an actual or potential cross connection between the potable water supply and any source of contamination or pollution.

BACK SIPHONAGE - Reduced pressures resulting from a difference in water levels at two separated points within a continuous fluid system. The effect is similar to sipping fluid through a straw.

BACK PRESSURE - Reversed flow due to pressures other than siphonic action. Interconnected fluid systems in which the pressure of one exceeds the pressures of the other.

CODES:

The items below were taken from the 1986 Illinois Plumbing code and are to only show the engineer what to expect when designing a system. Code research should be done on each project.

890.1540 c. The water distribution system shall be protected against back siphonage and backflow. Each water outlet shall be protected from backflow and/or back siphonage, preferably by having the outlet end for which the water flows spaced a distance above the flood-level rim of the receptacle into which the water flows sufficient to provide a "minimum fixed air gap." Where it is not possible to provide a minimum fixed air gap, the water outlet shall be equipped with an accessibly located backflow/ back siphonage preventer complying with applicable standards.

890.1540 c.2. Fire Safety System. The installation of a fire safety system involving the potable water supply system shall be in accordance with NFPA Standard no. 13, and the potable water supply system shall be protected against backflow or back siphonage by a minimum of a single check valve approved under NFPA no. 13. If a fire department connection is part of the fire safety system, the potable water supply system must be protected by an approved backflow device (check with local authorities).

890.1540 d. Prohibited Connections. Chemical or Petroleum Pressure Vessels. No person shall connect any pressure vessel, i.e., storage tank, tank car, tank truck or trailer or other miscellaneous pressurized tank or cylinder containing or having contained liquified gaseous petroleum products or other liquified gaseous chemicals to any potable water supply. Water for flushing or cooling, or otherwise to be installed into such a vessel shall be obtained by gravity through a minimum fixed air gap.

890.1540 e. Devices for the protection of the potable water supply. Approved backflow preventers or vacuum breakers shall be installed with all plumbing fixtures and equipment, the potable water supply outlet of which may be submerged and which is not protected by a minimum fixed air gap. Connection to the potable water supply system, for the following fixtures or equipment, shall be protected against backflow with any one or more of the devices as indicated below:

1. Low inlet to receptacles containing toxic substances:
   - A. an approved fixed air gap fitting.
   - B. reduced pressure unit.
   - C. pressure vacuum breaker unit.
   - D. atmospheric vacuum breaker unit.

2. Low inlet to receptacles containing non-toxic substances:
   - A. approved fixed air gap fitting
   - B. reduced pressure unit
   - C. pressure vacuum breaker unit
   - D. atmospheric vacuum breaker unit
   - E. approved double check valve assembly
   - F. double check with atmospheric vent

3. Outlets with hose attachments which may constitute a cross connection:
   - A. approved fixed air gap fitting
   - B. reduced pressure unit
   - C. pressure vacuum breaker unit
   - D. atmospheric vacuum breaker unit

4. Coils or jackets used as heat exchangers in compressors, degreasers, and other such equipment involving toxic substances:
   - A. approved fixed air gap fitting
   - B. reduced pressure unit
   - C. pressure vacuum breaker unit

5. Direct connections - subject to back pressure:
   - A. non-toxic substances
     - i. approved fixed air gap fitting
     - ii. reduced pressure unit
     - iii. approved double check valve assembly
     - iv. double check with atmospheric vent

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B. toxic substances
   i. approved air gap fitting
   ii. reduced pressure unit
C. sewage and lethal substances
   i. approved fixed air gap fitting.

890.1650 a.3. Heat exchangers using a nontoxic transfer fluid with no conditioning chemicals in the system may be of single wall construction.

890.1650 a.4. Heat exchangers using a toxic transfer fluid and/or having conditioning chemicals in the system shall be separated from the potable water by a double wall construction. There shall be an open air gap to the atmosphere between the two walls. The boiler must be of low pressure (below 15 psi).

890.1650 a.5. No heat exchanger will be permitted on any high pressure boiler unless:

A. the heat exchanger is double walled;
B. the heat exchanger has an air gap open to atmosphere between the two walls;
C. a pressure reducing valve is installed between the boiler and heat exchanger with the setting 30 psi lower than the water service pressure.
   A pressure relief valve shall be installed downstream of the pressure reducing valve at a setting of five (5) pounds above the pressure reducing valve.

CLASSIFICATIONS OF CROSS CONNECTIONS:

LOW HAZARD - Aesthetically effected, objectional taste, odor and appearance. Non-hazardous to a persons health.

HIGH HAZARD - Hazard to health resulting in sickness or death.

(Illinois classification - Toxic is something to make someone sick. Lethal will kill someone. There is no scientific explanation for what is toxic and lethal. It is up to the interpretation of the inspector. Toxic requires a backflow preventer. Lethal requires an air gap).

TYPES OF BACKFLOW PREVENTERS:

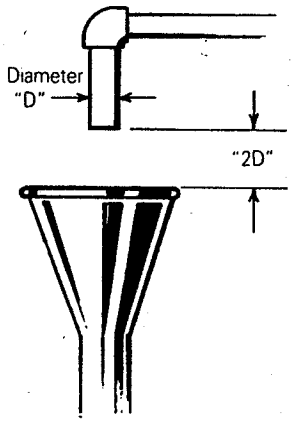
There are six basic types of backflow prevention devices available to correct cross connections: air gap, barometric loop, vacuum breakers (atmospheric and pressure), double check with intermediate atmospheric vent, double check valve assemblies and reduced pressure principal devices.

There are three major industry standards for these devices. They are: American Society of Sanitary Engineers (ASSE), American Water Works Association (AWWA), and The University of California Foundation for Cross Connection Control and Hydraulic Research.

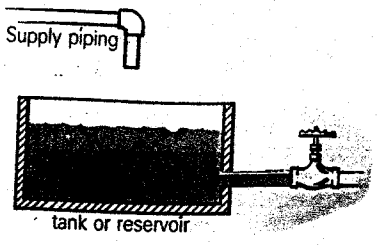
AIR GAP - Exactly what it sounds like. They are primarily used at end of the line service where reservoirs and storage tanks are used. In a continuous piping system, each air gap requires the added expense of reservoirs and secondary pumping system.

A. Back siphonage and back pressure.
B. Cheap when water only needs to be supplied at atmospheric pressure. Expensive when water needs to be under pressure.
C. All types of hazards.
D. All pipe sizes.

Air Gap



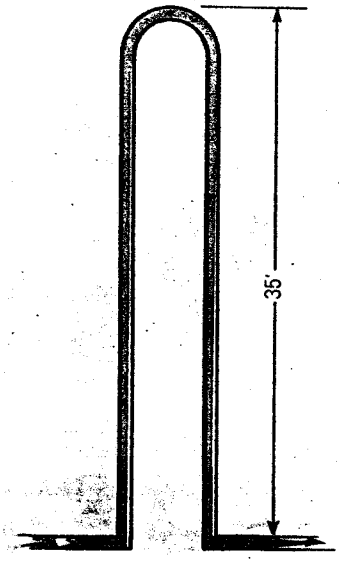
Air Gap in a Piping System



BAROMETRIC LOOP - Consists of a continuous section of piping that rises to a height of 35 ft and back down to the original level. It is based on the principal that a water column can not be siphoned over 33.9 ft at sea level.

A. Back siphonage only.
B. Impractical and expensive in most cases.
C. All pipe sizes.
D. Low and moderate hazards.

Barometric Loop



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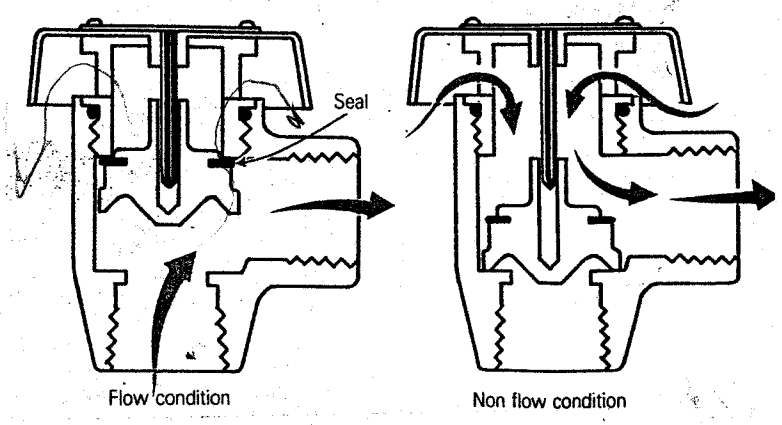
ATMOSPHERIC VACUUM BREAKER - They contain a free floating, elastomeric disk. Water flow lifts the float, which then causes the disk to seal. Termination of the water supply will cause the disk to drop down venting the unit to atmosphere. They can not have a shut off valve down stream which could subject them to continuous pressure. Vacuum breakers have a tendency to leak.

A. Back siphonage only (not back pressure)
B. Cheap and very simple to install.
C. Moderate to high hazard connection.
D. 1/4" to 3" pipe sizes.

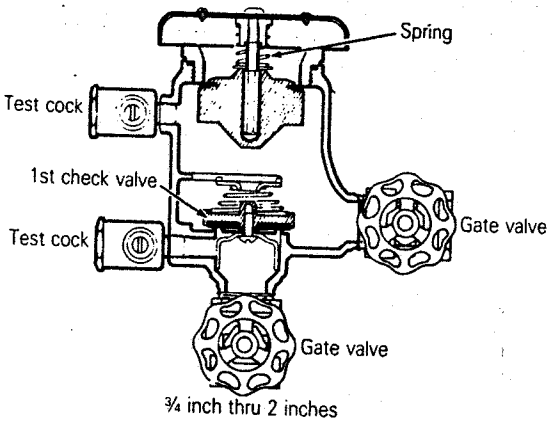
Atmospheric Vacuum Breaker

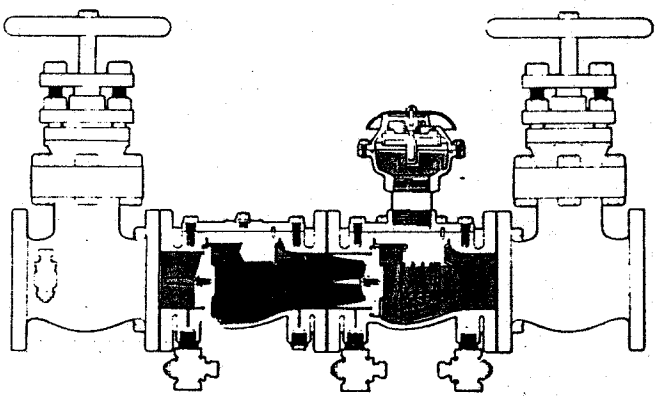


PRESSURE VACUUM BREAKERS - Very similar to an atmospheric vacuum breaker except a spring is placed above the disk.

A. Back siphonage only where there is a chance of continuous pressure.
B. Moderate to high hazard.
C. 1/2" to 2" pipe sizes.

Pressure Vacuum Breaker





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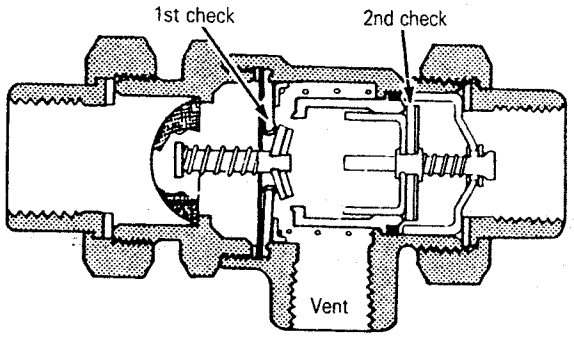
DOUBLE CHECK WITH INTERMEDIATE ATMOSPHERIC VENT - Basically a double check with an atmospheric vent located between the two checks.

A. Back siphonage, back pressure and continuous pressure usage.
B. Moderate to low hazard.
C. Moderate price.
D. 1/2" to 3/4" pipe sizes.

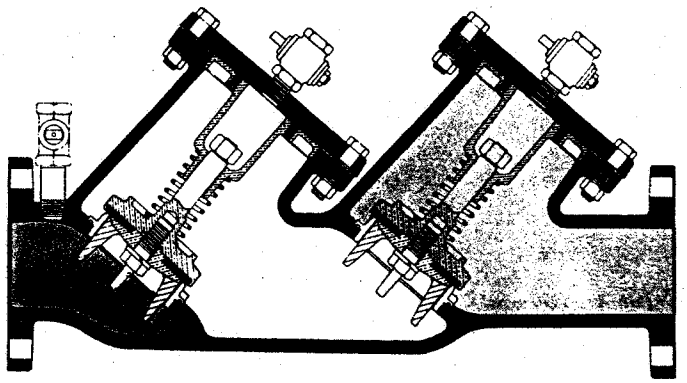
Double Check Valve with Atmospheric Vent



DOUBLE CHECK VALVE - It is two check valves coupled within one body, two gate valves furnished with test cocks. It can be readily tested to determine if either or both check valves are inoperative or fouled by debris. Each check is spring loaded closed and requires approximately one psi of differentialpressure to open.

A. Back siphonage, back pressure and continuous pressure usage.
B. Low hazards.
C. 1/2" to 10" pipe sizes.

Double Check Valve



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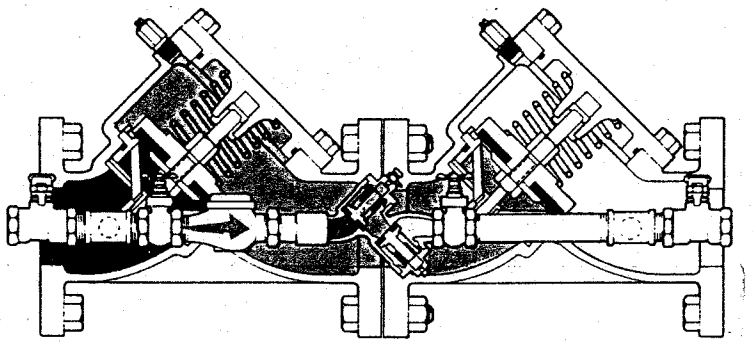
DOUBLE DETECTOR CHECK - It is similar to a double check with a small bypass pipe with meter and double check. In the event of water "theft" the lower pressure drop in the by-pass system permits the low flow of water to be metered. In high demand the main check valves open.

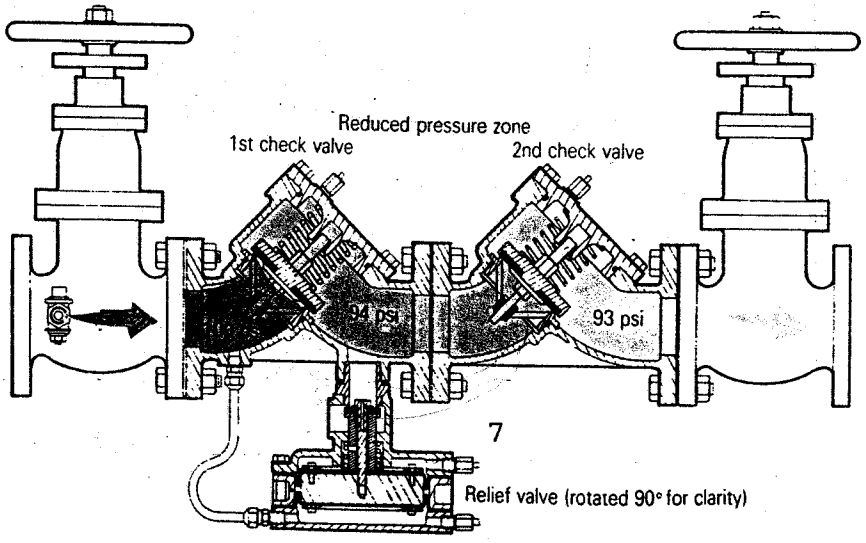
A. Back pressure, back siphonage and continuous pressure usage.
B. Low to high hazard (depending on the model).
C. 3" to 10" pipe sizes.
D. Good, when a system of metering low water usage is needed.

Double Check Detector Check



REDUCED PRESSURE PRINCIPLE - It is a double check valve with an atmospheric vent between the two checks. The reduced pressure zone is designed so that it is always kept at least two pounds less than the supply pressure. It can provide protection even if both the checks become fouled. It is effective protection for back pressure and back siphonage.

A. Back pressure, back siphonage and continuous pressure usage.
B. High hazard systems.
C. 3/4" to 10" pipe sizes.



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SELECTING BACKFLOW PREVENTERS:

A. City requirements
B. Governing code requirements
C. Engineering judgement
D. Select the unit based on pressure drop and GPM.

COMMENTS:

A. Devices to be set a minimum of 12" and a maximum of 30" from the floor and 12" from any wall.

B. Typically installed downstream of a water meter.

C. Generally mounted horizontally. Vertical mounting is possible but refer to manufacturers data.

D. All backflow preventers except double check assemblies have a tendency to leak (yes, even vacuum breakers). They should be placed where water flow is not a problem or measures should be provided to collect the water.