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Protect Your Water Supply from Agricultural Chemical Backflow

Michigan State University Extension Service

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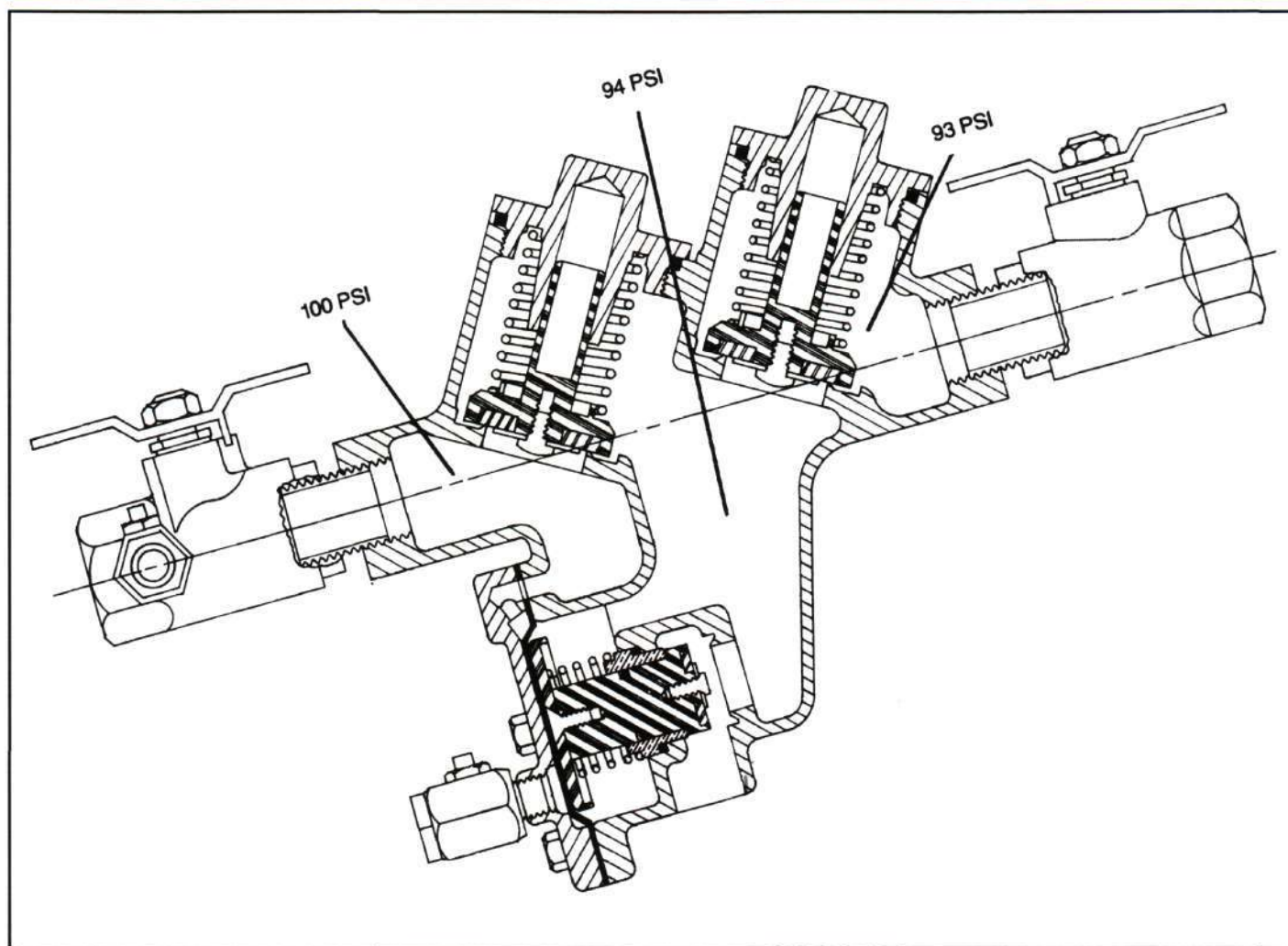
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PROTECT YOUR WATER SUPPLY FROM AGRICULTURAL CHEMICAL BACKFLOW

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and Julie Stachecki, Pesticide Education



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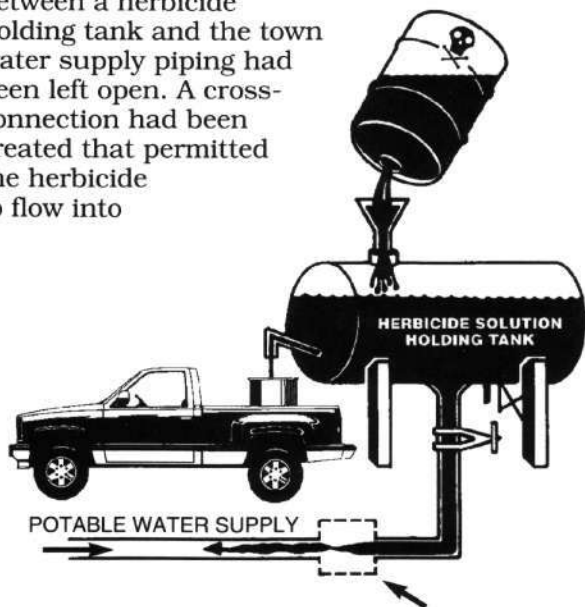
EXTENSION BULLETIN E-2349 • (NEW) FEBRUARY 1993

Preventing contamination and pollution of water (drinking water, surface water and groundwater) is everyone's responsibility. Water contamination can occur from presumably innocent actions. **Backflow** from a polluted or contaminated source into a water supply system by way of a cross-connection is one way contamination can occur. A **cross-connection** is a connection or arrangement of piping through which backflow could occur. The following events actually happened.

Herbicide in the Water System

"Yellow, gushy stuff" poured from faucets in a small Maryland town. The state banned drinking, cooking, bathing or using the water for any purpose except for flushing toilets. Pesticides had contaminated the water supply, and among the contaminants was a commonly used, potent agricultural herbicide.

Investigation of the problem revealed that water pressure in the town water main was temporarily reduced because of a water pump failure. Coincidentally, a gate valve between a herbicide holding tank and the town water supply piping had been left open. A cross-connection had been created that permitted the herbicide to flow into



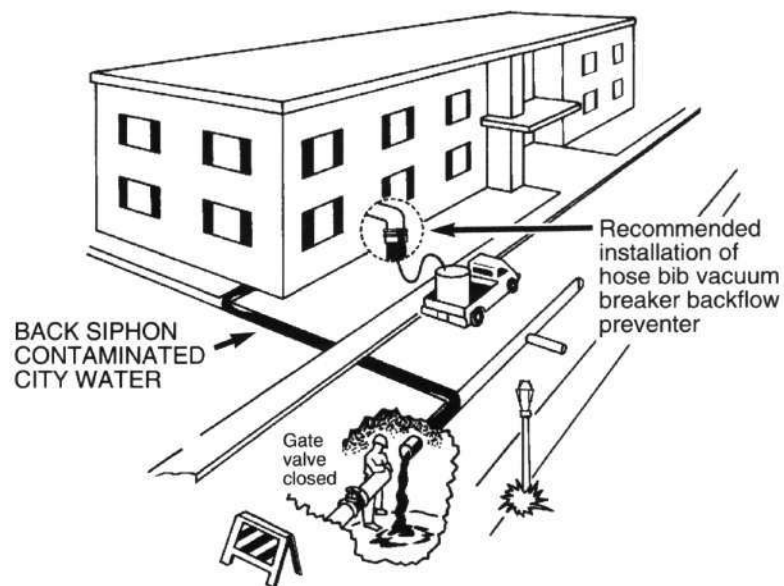
WITHOUT A BACKFLOW PREVENTION DEVICE HERE - REVERSE FLOW CAUSES CONTAMINATION.

the potable water supply system. Upon restoration of water pressure, the herbicide flowed to faucets and other outlets throughout the town.

Insecticide Contaminates Water Supply

Insecticides entered the water pipes of a large apartment complex in Pennsylvania when a pest control operator used a garden hose from one of the apartment buildings to dilute an insecticide in a tank truck. At the same time, a city worker was cutting a 6-inch main line to install a valve.

The end of the garden hose was submerged in the tank containing the insecticide when water to the area was shut off and lines were partially drained prior to the valve installation. When the 6-inch water line was cut, water started to drain out of the cut. The insecticide was siphoned out of the exterminator's truck through the garden hose and into the water system, contaminating the water supply. Repeated efforts to clean and flush the lines were not satisfactory and the entire plumbing system had to be replaced. Fortunately, these situations were discovered and corrected before they caused permanent human injury or death. The prevention of such cross-connections is the focus of this bulletin.



One particular cross-connection requires special attention: filling a chemical spray tank with a hose from a potable water system. As illustrated in the Pennsylvania case study, if the end of the hose can extend into the liquid inside the tank, it is possible for back-siphonage backflow to occur if pressure in the water system is lost for any reason. Back-siphonage backflow could result in the spray tank chemical solution being drawn back into the water system or well, with disastrous results.

This back-siphonage backflow example can be prevented by using a technique as simple as an "air gap." That is, do not let the hose come into contact with the tank solution. Or use an approved backflow prevention device. Several of these devices and their use are discussed in the following pages.

Pesticides can present human health hazards. Therefore, **pesticides are classified as high-hazard materials when working with and around water supply sources.**

Common Questions about Cross-Connection and Backflow Prevention

1 What is *back-siphonage backflow* and what can cause it?

Back-siphonage backflow is the reversal of normal flow in a system caused by negative pressure (a vacuum or partial vacuum) in the supply piping.

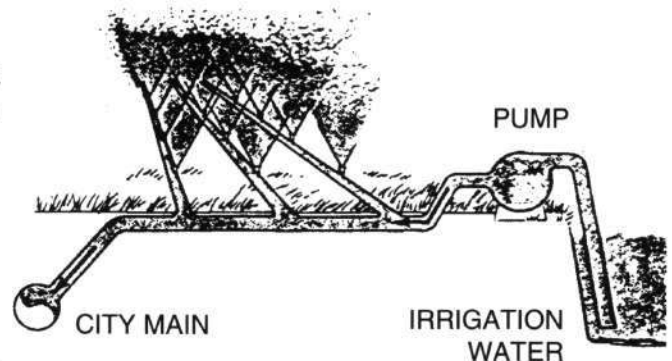
Back-siphonage backflow can be created when a stoppage occurs in the water supply. This may happen in a public water system because of nearby fire fighting, repairs or breaks in the main water supply line. The effect is similar to the sipping of an ice cream soda through a straw. The liquid is drawn into the low pressure (suction) area.



2 What is *back-pressure backflow* and why does it occur?

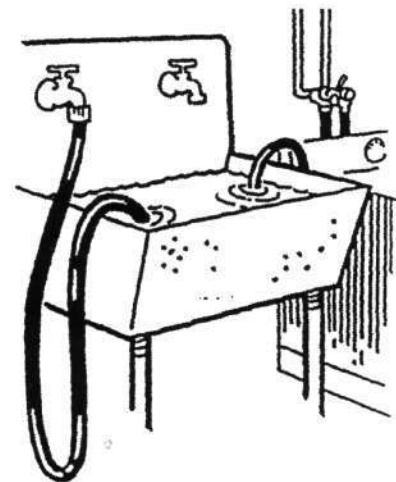
Back-pressure backflow is the reversal of normal flow in a system because downstream pressure is greater than the supply pressure.

Back-pressure backflow occurs when the higher pressure in the user system pushes undesirable substances back into the water supply system. Causes can be booster pumps, the backflow from an elevated irrigation system back to the well head when the pump is shut down, or the siphonage from a spray tank back through the fill hose to the supply line when the water supply pressure is lost or the pump is turned off.



3 What is a *cross-connection*?

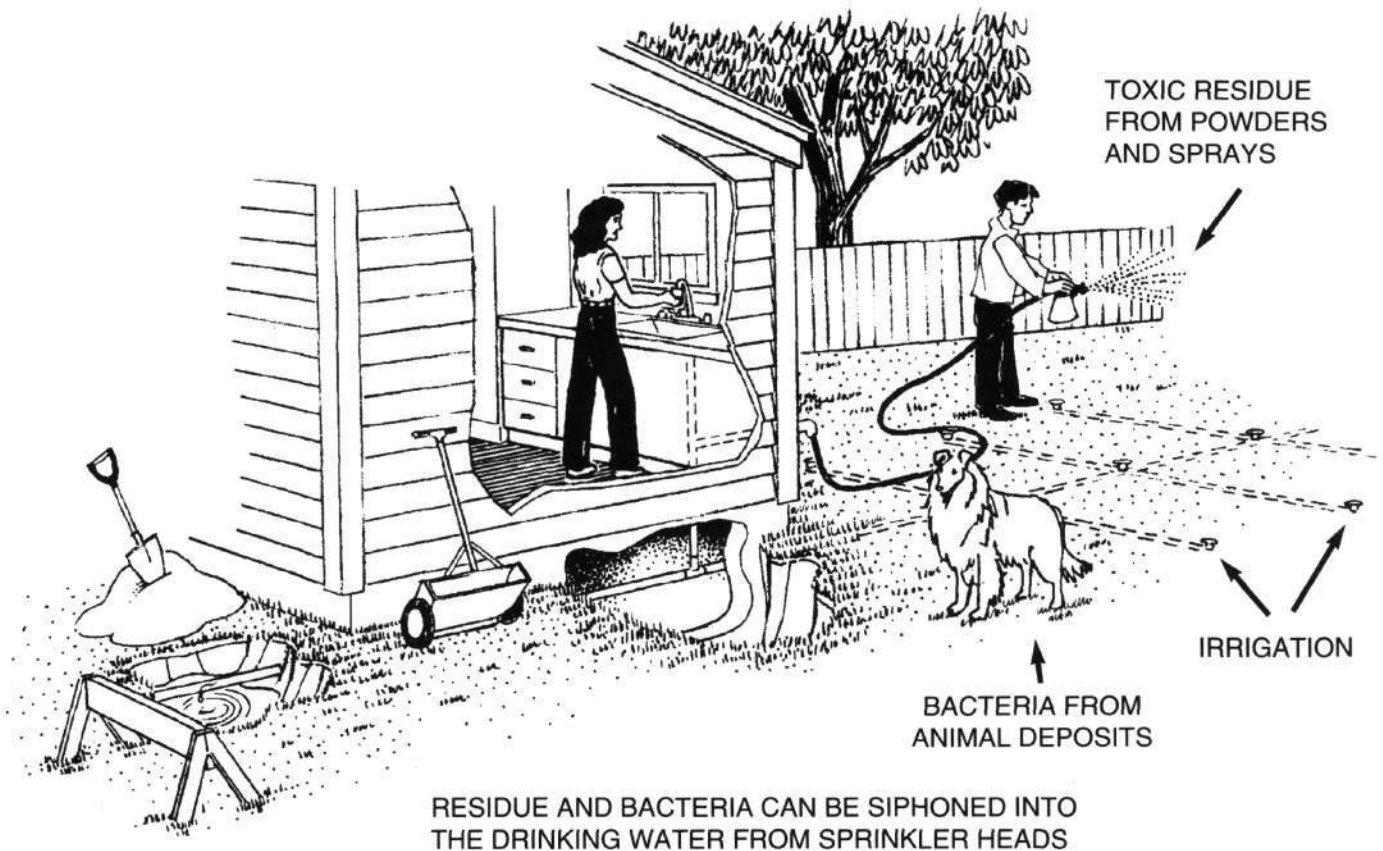
A cross-connection is a direct or indirect arrangement of piping that allows the potable water supply to be connected to piping that contains a contaminant. An example is the common garden hose attached to a water spigot with the end of the hose lying in a puddle of water. Other examples are a hose attached to a service sink with the end of the hose submerged in a tub full of detergent, supply lines connected to bottom-fed tanks (such as pesticide spray tanks or fermentation tanks) and supply lines to boilers.



4

What is the most common form of *cross-connection*?

The ordinary garden hose is the most common offender. It can easily be connected to potable water supplies and used for a variety of potentially dangerous applications, including mixing, diluting, and spraying pesticides and fertilizers.

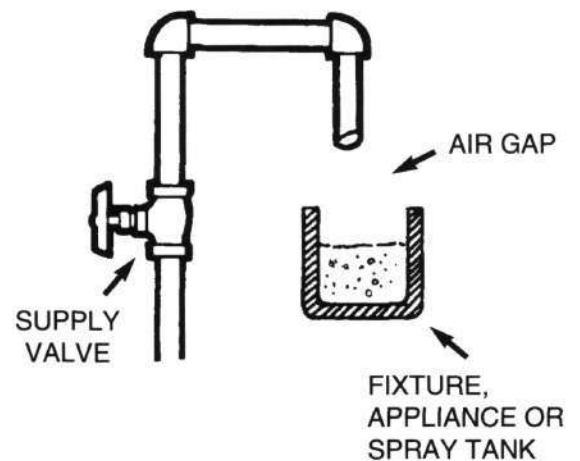


5

What are some basic devices commonly used for protection against *cross-connections*?

Common devices are:

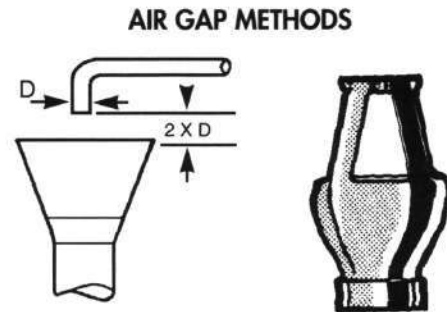
1. Air gap.
2. Atmospheric vacuum breakers (AVB), including hose connection vacuum breakers.
3. Pressure-type vacuum breakers (PVB).
4. Double-check valves (various arrangements).
5. Reduced pressure zone assembly.



6

What is an *air gap* device and where can it be used?

An air gap is the physical separation of the potable and non-potable water supply systems by an air space. This is usually the easiest and least expensive backflow prevention method. The vertical distance between the supply pipe and the flood rim should be two times the diameter of the supply pipe, but never less than 1 inch. The air gap can be used on a direct pipe connection or a tank inlet connection, and for all toxic substances.



7

What is an *atmospheric-type vacuum breaker (AVB)* and where is it typically used?

The most commonly used atmospheric-type vacuum breaker incorporates an atmospheric vent in combination with a check valve. Its operation depends on the water supply pressure to open the check valve and seal off the atmospheric vent. This permits the water to flow to downstream equipment. A loss of pressure in the supply line permits the check valve to drop and seals the orifice while, at the same time, the vent opens, admitting air into the system to break the vacuum.

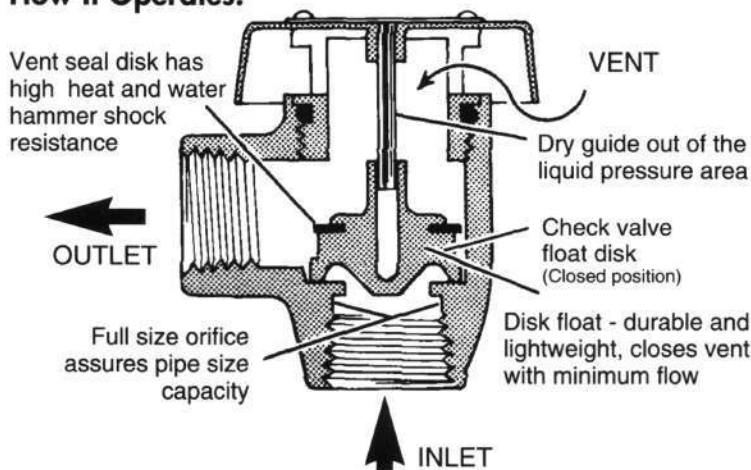
An atmospheric vacuum breaker cannot be subject to continuous pressure. That is, there can be no shut-off valves downstream of its location. Nor can it be subjected to more than 12 hours of continuous pressure.

Both AVBs and PVBs must be properly elevated and sized for the application. An AVB must be 6 inches above the highest use point; a PVB, 12 inches above the highest use point (per state plumbing code).

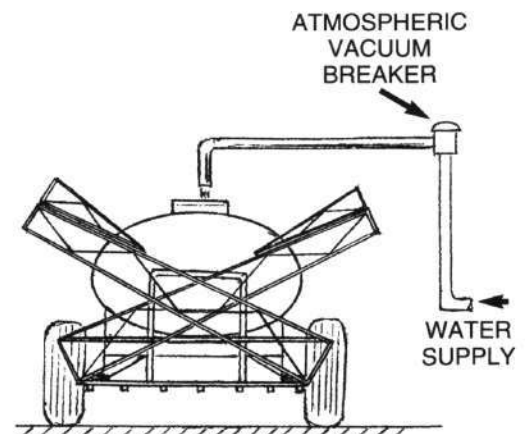


ATMOSPHERIC VACUUM BREAKER

How It Operates:



Atmospheric-type vacuum breakers can be used on most inlet-type water connections that are not subject to back-pressure, such as low inlet feeds to receptacles containing toxic and non-toxic substances, valve outlets or fixtures with hose attachments, single-zone lawn sprinkler systems and commercial dishwashers.

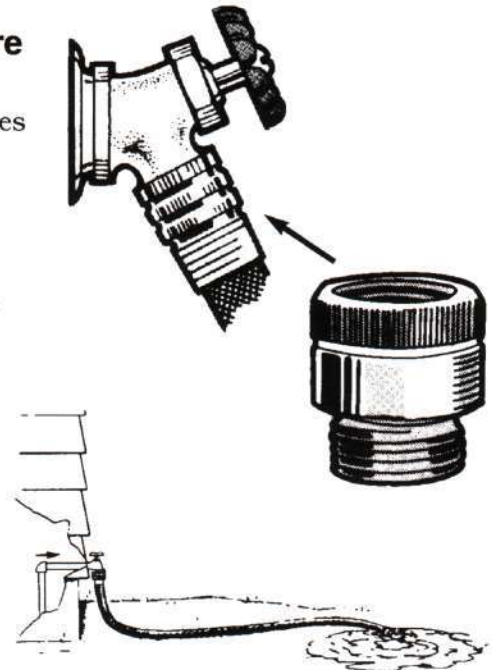
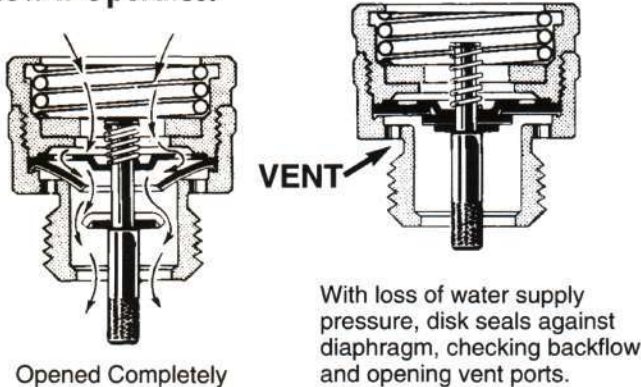


8

What are *hose bibb vacuum breakers* and where are they used?

Hose bibb vacuum breakers are small, inexpensive devices with hose connections that simply attach to water spigots, threaded faucets or other fixtures where a hose could be attached that could be introduced to a contaminant. Like the atmospheric-type vacuum breaker, they should not be used under continuous pressure (i.e., with a downstream valve) nor be subject to back-pressure backflow conditions.

How It Operates:



9

What is a *pressure-type vacuum breaker (PVB)* and where can it be used?

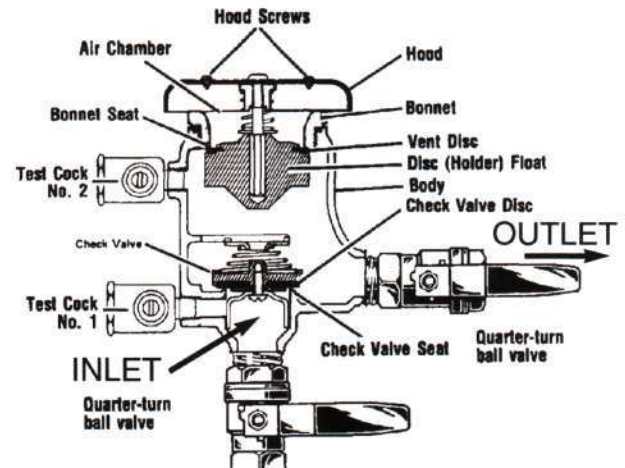
A pressure-type vacuum breaker (PVB) is a backflow prevention device designed to operate under continuous supply pressure, so a shut-off valve may be located downstream of the device.

“Continuous” is defined as 12 hours or longer. A device not designed for continuous supply pressure may “freeze” in one position and become inoperative. Like the AVB, the PVB cannot be subject to back-pressure backflow conditions.



How It Operates:

The pressure-type vacuum breaker has a spring-loaded vent float valve and a check valve. When line pressure drops to 1 psi (pounds per square inch) or less, the float valve opens the vent and the check valve closes the inlet, preventing backflow. The



PVB is equipped with two test cocks and shut-off valves for testing purposes.

Typical uses are: livestock water systems, photo developing tanks, large toilet facilities and swimming pools.

10

What is a double-check valve with intermediate atmospheric vent and where is it used?

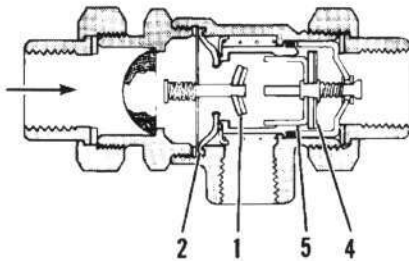
These devices are also pressure-type vacuum breakers, but they are designed with an intermediate atmospheric vent to ensure a break in the vacuum. They are intended for low health hazard cross-connections and are made for 1/2-inch and 3/4-inch lines. They are used on cattle drinking fountains, trailer park water

supply connections, boiler feed lines and similar low flow, low hazard applications. They will protect against both back-siphonage and back-pressure and can be used under continuous pressure.



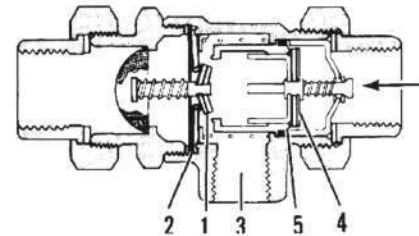
These devices are NOT appropriate for use with agrichemicals.

How It Operates:



NORMAL FLOW - CHECKS OPEN - VENT CLOSED

With flow through valve, primary check (1) opens away from diaphragm seal (2). Atmospheric vent remains closed by deflection of diaphragm seal (2). Secondary check (4) opens away from downstream seat (5), permitting flow of water through valve.



NEGATIVE SUPPLY PRESSURE - CHECKS CLOSED - VENT OPEN

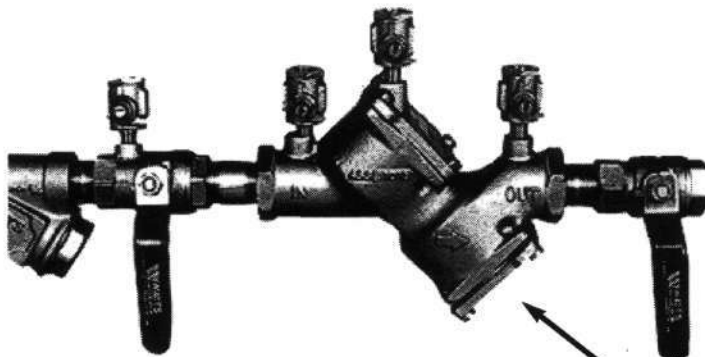
With a back-siphonage condition created, secondary check (4) seals tightly against downstream seat (5). Primary check (1) seals tightly against diaphragm (2). Atmospheric vent (3) is now open, permitting air to enter air break chamber. In the event of fouling of downstream check valve, leakage would be vented to atmosphere through the vent port, thereby safeguarding the safe drinking water system from contamination.

11

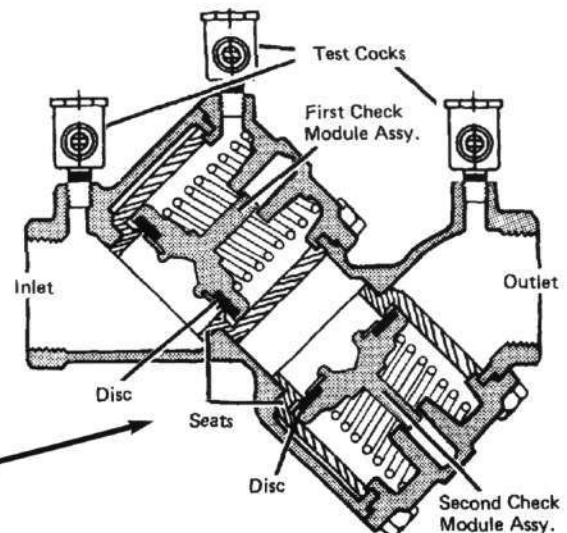
What is a double-check backflow prevention assembly and where is it used?

A double-check backflow prevention assembly consists of two independently operating check valves with inlet and outlet shut-off valves and four test cocks. It is designed to prevent reverse flow in water lines. It is used in a variety of low health hazard situations. It will prevent back-pressure backflow, will function under

continuous pressure and is available in sizes from 1/2 inch to 10 inches. Typical uses are main supply lines, food cookers, lawn sprinklers and fire sprinklers.



First and second check modules are interchangeable.



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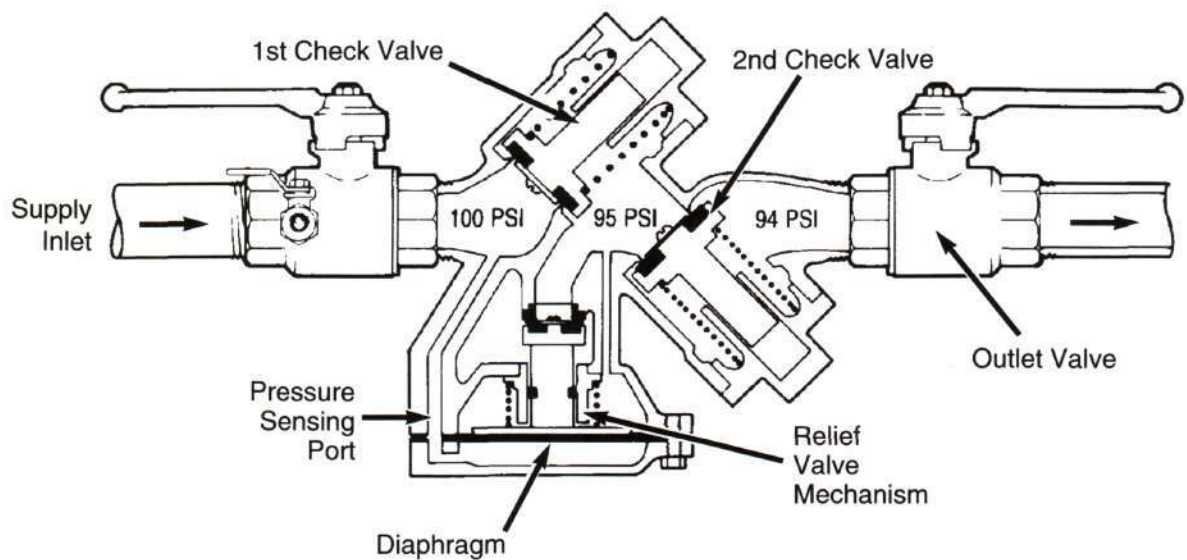
What is a *reduced-pressure zone* backflow prevention device and where is it used?

This device is an assembly of two independently operating check valves with an intermediate hydraulically dependent differential relief valve. These units are intended to protect the potable water supply from reverse (back) flow when subjected to emergency conditions of combined back-siphonage and back-pressure, even if both check valves fail. They are suitable for high health hazard

conditions under continuous pressure. RPZ units have shut-off valves on the inlet and outlet pipes and test cocks. They are available in sizes from 1/2 inch to 10 inches.

Typical uses are in main supply lines, boilers, cooling towers, sewage treatment systems, and pesticide loading and handling facilities such as chemical feed lines to submerged inlet tanks.

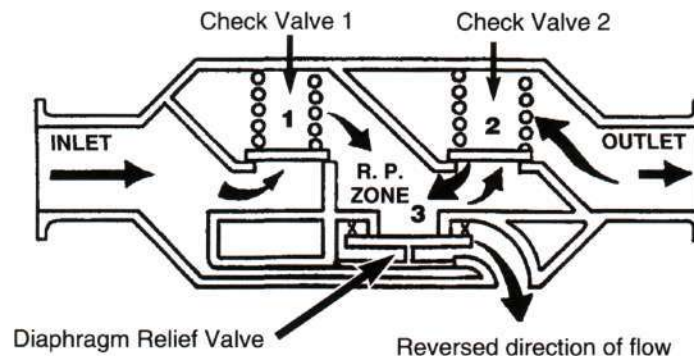
Reduced Pressure Zone Assembly



How It Operates:

The reduced-pressure zone assembly automatically reduces the pressure in the zone between the two check valves (1 & 2) to at least 5 psi below the inlet pressure. The diaphragm spring on the relief valve (3) is set so that if a pressure differential of 2 psi or less occurs across the diaphragm

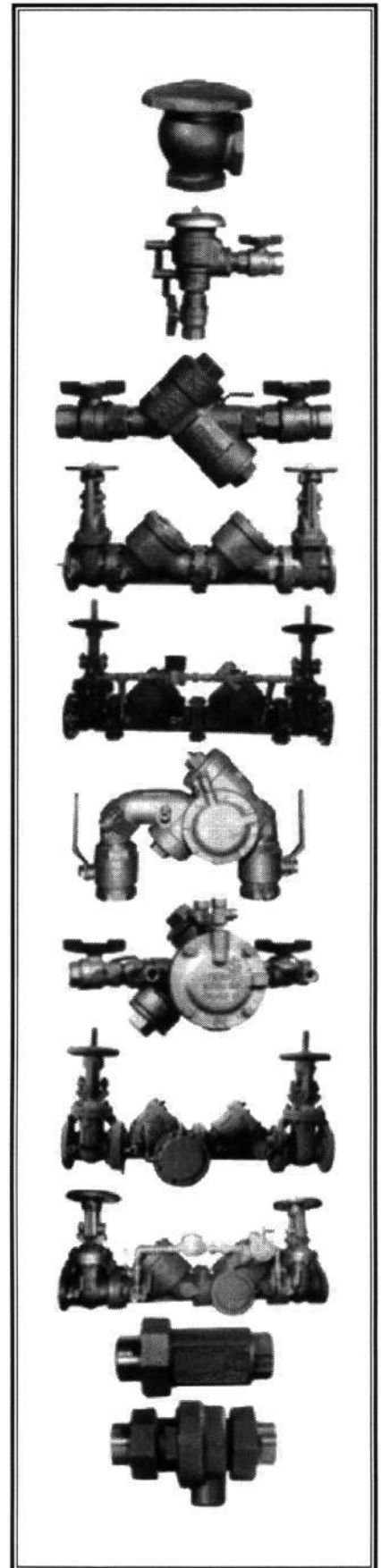
(between inlet and zone pressure), the relief valve will open and discharge zone water to the drain. If either or both check valves fail, the differential relief valve will open, letting water from the zone out to the drain, preventing backflow from back-pressure or back-siphonage.



SELECTING THE PROPER BACKFLOW PREVENTION DEVICE

Backflow prevention devices are available in a wide range of types and styles. They range from small, simple units to large, complex assemblies. The selection of the most appropriate device depends on the particular situation. Pesticides are considered a health hazard and require a device that will protect the water supply from high hazard conditions and materials. Exercise considerable care when selecting a device. Any device selected to protect the potable water supply from cross-connection backflow contamination must be approved for use by the state and meet local and state plumbing codes.

Additional help in developing suitable cross-connection controls is available from experienced licensed plumbers, representatives of the manufacturers of approved backflow prevention devices, your local supplier or the Agricultural Engineering Department at Michigan State University. Extension Bulletin E-2099, "Using Chemigation Safely and Effectively," available from MSU, discusses backflow prevention in chemigation. Also, the American Society of Agricultural Engineers (ASAE) has developed a standard for safety devices. "Safety Devices for Chemigation" addresses backflow prevention for chemical injection into irrigation and similar water systems. This publication, ASAE EP 409, can be obtained by calling the ASAE at (616) 429-0300, FAX (616) 429-3852, or writing ASAE, 2950 Niles Road, St. Joseph, MI 49085-9659.



BASIC TYPES OF BACKFLOW PREVENTION DEVICES

Device Type & Use	Description	Installed	Examples	Illustration
<p>AIR GAP</p> <p>High or low health hazard, back-siphon protection.</p>	Physical separation of potable and non-potable water systems - gap equal to 2 times diameter of supply line.	End of supply pipe.	Pesticide spray tanks, sinks, any non-pressurized receiver.	
<p>HOSE CONNECTION VACUUM BREAKERS</p> <p>Hose outlets, non-continuous pressure.</p>	Single check valve with atmospheric vacuum breaker vent. Typical size: 3/4 inch hose thread.	On hose bibbs and service sinks (no downstream valves).	Hose bibbs, service sinks, hydrants.	
<p>ATMOSPHERIC VACUUM BREAKER</p> <p>High hazard, non-continuous pressure or backpressure.</p>	Single float and disk with large atmospheric port. Typical sizes: 1/2 inch to 3 inches.	6 inches above fixture rim, not subject to back-pressure or continuous pressure (Back-siphon protection only.)	Pesticide spray tanks, single-zone lawn sprinklers, washing machines, dishwashers, processing tanks.	
<p>PRESSURE-TYPE VACUUM BREAKER</p> <p>High hazard continuous pressure.</p>	Spring-loaded single float with independent first check valve. Shut-off valves and test cocks. Typical sizes: 1/2 inch to 2 inches.	12 inches above overflow level of system being supplied and for continuous supply pressure. (Back-siphon protection only.)	Lawn sprinklers, livestock water systems, pesticide spray tanks and filling systems, swimming pools, laboratory equipment.	
<p>DOUBLE-CHECK WITH INTERMEDIATE VENT</p> <p>Low hazard, continuous pressure, small pipes.</p>	Two independent check valves with intermediate vacuum breaker and relief valve. Typical sizes: 1/4 inch to 3/4 inch.	Cross-connections with low health hazards, subject to back-pressure, back-siphonage, backflow and continuous pressure.	Small boilers, dairy equipment, residential small cooling towers.	
<p>DOUBLE-CHECK VALVE</p> <p>Low health hazard, continuous pressure.</p>	Two independent check valves with various arrangements. Typical sizes: 3/4 inch to 10 inches.	Cross-connections with low health hazards, subject to continuous pressure.	Fire protection sprinklers, tanks and vats, cookers, supply lines.	
<p>REDUCED-PRESSURE ZONE</p> <p>High hazard, continuous pressure and back pressure back-siphon protection.</p>	Two independent check valves with intermediate relief valve. Shut-off valves and test cocks. Typical sizes: 3/4 inch to 10 inches.	All cross-connections subject to back pressure or back-siphon and high health hazards; continuous pressure.	Main supply lines, commercial boilers, hospitals, process tanks, sewage treatment, pesticide handling.	

MANUFACTURERS OF BACKFLOW PREVENTION DEVICES - BY TYPE

MANUFACTURER	Atmospheric Vacuum Breaker	Pressure Vacuum Breaker	Double Check Valve	Reduced Pressure Zone
AMES COMPANY			X	X
ALSONS PRODUCTS CORPORATION	X			
AMERICAN COUPLING CORPORATION	X			
AQUAVAL SPECIALTIES, INC.	X			
AETNA PORCELAIN ENAMELING CO.	X			
BADGER METER, INC.				X
BELVEDERE PRODUCTS, INC.	X			
BIDORO MANUFACTURING COMPANY	X			
BISSEL		X		X
B & K INDUSTRIES	X			
BRAUKMANN CONTROLS CORPORATION			X	
A.W. CASH VALVE MFG. COMPANY	X			
CHAMPION BRASS MFG. COMPANY	X			
CHICAGO FAUCET COMPANY	X			
CAL-VAL COMPANY				X
CLEMAR MANUFACTURING CORPORATION	X			
C.M.B. INDUSTRIES			X	
CONBRACO INDUSTRIES	X		X	X
CRANE COMPANY				X
DELCOR	X			
FEBCO, INC.	X	X	X	X
FLUID DEVICES, INC.	X			
GARDEN AMERICA	X			
HAWS DRINKING FAUCET COMPANY	X			
HERSEY-SPARLING METER (BEECO)			X	X
JAYCO, INC.	X			
KOHLER COMPANY	X			
LAWLER I.T.T.			X	X
MICHIGAN SPRINKLER COMPANY	X			
MUELLER			X	X
NEPTUNE WATER METER COMPANY			X	X
NIDEL COMPANY	X			
OTTAWA VALVE COMPANY	X			
QUAKER RUBBER COMPANY	X			
RAIN BIRD BACKFLOW PREVENTION		X	X	X
RICHWELL VALVE COMPANY				X

MANUFACTURER	Atmospheric Vacuum Breaker	Pressure Vacuum Breaker	Double Check Valve	Reduced Pressure Zone
ROCKWELL INTERNATIONAL			X	X
ROYAL COACH BUCKNER		X	X	X
SINGER (Merrix Sales, Inc.)				X
SLOAN VALVE COMPANY	X			
SPEAKMAN COMPANY	X			
SURGICAL MECHANICAL RESEARCH, INC.		X		
TORO		X	X	X
T&S BRASS AND BRONZE WORKS, INC.	X			
TUBE TURNS PLASTICS, INC.	X			
WATER SAVER FAUCET COMPANY	X			
WATTS REGULATOR COMPANY	X	X	X	X
WILKINS REGULATOR		X	X	X
WOLVERINE BRASS	X			
ZURN INDUSTRIES INC.	X			

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