PLUMBING & CROSS-CONNECTION CONTROL

MODULE 3

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VI. Mechanical Backflow Assemblies & Devices
- Hose Bibb Vacuum Breaker
- Atmospheric Vacuum Breaker
- Pressure Vacuum Breaker
- Backflow Preventer with an Intermediate Atmospheric Vent
- Reduced Pressure Zone Backflow Prevention Assembly
- Double Check Valves

This module is presented primarily for information and future reference; BETC participants are not expected to know the various device types EXCEPT the general principles of hose bibb, atmospheric, and pressure. There are no detailed plumbing device questions on the BETC test.

VI. MECHANICAL BACKFLOW ASSEMBLIES & DEVICES

The type of mechanical assembly or device selected must be appropriate for the degree of hazard and specific application relevant to the potential backflow possibilities. Mechanical backflow preventers consist of single or multiple check valves that open from the flow pressure of the potable water. These valves are fabricated to seat tightly on a machined surface and when closed, prevent any flow in the wrong direction. Also, some devices have air inlets or ports that are vented to the atmosphere to relieve any vacuum or negative pressure developed in the system. All backflow devices must be installed so they are accessible for inspection, service and repair.

NOTE:

The specific use and installation of a backflow prevention assembly or device must be clarified by the manufacturer and comply with the plumbing codes governing the jurisdiction in which the unit is installed.

AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)

ASSE is a consensus, voluntary ANSI (American National Standards Institute) accredited association that develops and maintains product performance standards for component parts of the plumbing systems and professional qualifications standards. Eighteen standards are for backflow devices/assemblies. On the following pages, examples of various devices are cited with the number for the ASSE standard under "Installation & Use."

FOOD PROCESSING & RETAIL FOOD CODE PLUMB ING REGULATIONS

FDA Food Code
Chapter 5. The following section is from the Food and Drug Administration's 1997 Food Code (food establishments) pertaining to: 5-202.14 Backflow Prevention Device, Design Standard.

> A backflow or backsiphonage prevention device installed on a water supply system shall meet American Society of Sanitary Engineering (A.S.S.E.) Standards for construction, installation, maintenance, inspection, and testing for that specific application and type of device.

Grade A Pasteurized Milk Ordinance (PMO), Current Edition
Item 8r, 7p, and Appendix D, Standards for Water Sources.

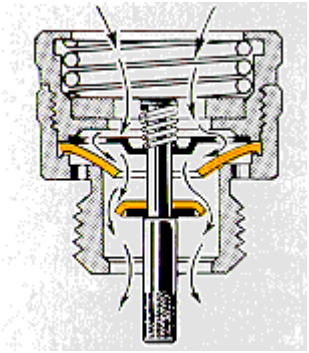
National Shellfish Sanitation Program Manual of Operations, Part II, 1995 Revision
Section D, Part 8 and 9.

HOSE BIBB VACUUM BREAKER (HBVB)

A hose bibb vacuum breaker contains one spring loaded valve and an atmospheric vent that is controlled by a diaphragm seal. The HBVB is installed on the end of a hose bibb (sill cock or boiler drain inlet) for a garden hose, slop/mop sink hose etc., or anywhere else a hose can be connected. Internally, the valve is spring loaded to be in a closed position and opens with flow in the proper direction. As the water flow begins (dynamic, water flow in the desired direction), the valve opens and allows the diaphragm seal to close off the atmospheric vent (the flow pressure is what moves & holds the diaphragm against the vent ports). When zero pressure or back-siphonage (negative pressure) conditions exist, the spring pulls the valve closed and simultaneously pushes the diaphragm (thus, opening the vent to relieve any vacuum) into position to form a tight seal between the valve and valve

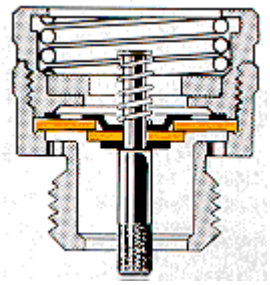
seat. Under static conditions (no flow) with the HBVB, the check valve may or may not be closed. (The HBVB is not approved for continuous pressure but there may be time periods when water pressure exists on both sides of the device)

open



closed

Vent/air inlet



HBVB INSTALLATION & USE:

1. Shut off valves must be located up stream from the vacuum breaker, and spring-loaded pistol- grip shutoff valves are not to remain on the hose with the water left on, when not being actively used.

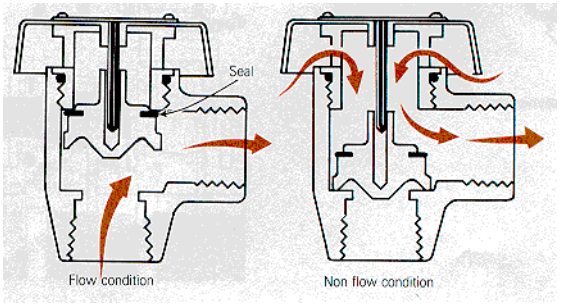
2. Each hose connected to a manifold or "Y" must be provided with its own HBVB, i.e., county fair, special events where several vendors may share one hose spigot

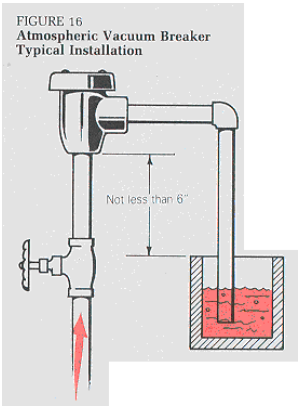
3. Approved for **HIGH HAZARDS, NON-CONTINUOUS PRESSURE & NO POTENTIAL BACKPRESSURE.** ASSE standard #1011

NOTE: HBVB's cannot be used under continuous pressure conditions (defined as water pressure on both sides of the unit for more than 12 hours), because the spring loaded valve may stick or freeze in the open position, thus making the water supply vulnerable to backflow. Remember, you must evaluate the HBVB in its setting and determine the use and time. If the use period extends over 12 hours, then an approved continuous pressure backflow device must be installed.

ATMOSPHERIC VACUUM BREAKER (AVB)

This device has an internal polyethylene or metal float valve that moves up and down on a shaft (not spring loaded). Water moving in the normal direction of flow lifts the float, and causes the atmospheric vent to close (an opening on the top of the unit is open to the air). The normal water pressure keeps the float valve in the upward closed position. Shutting off the water causes the float to drop; the supply valve to close; and results in the atmospheric vent being open. With the water off, the down stream piping of the AVB is open to the atmosphere, creating an air gap, and thus preventing any back-siphonage. When a negative pressure occurs on the supply side, the float valve drops, closing off the supply, and opening the atmospheric vent. Thus, any down stream contamination will not be siphoned into the potable supply. The atmospheric vacuum breaker provides **excellent protection against "back-siphonage" only**. Exposing the AVB to backpressure can cause the atmospheric valve to modulate up and down, thus permitting a potential contaminant, via backpressure, to enter the water supply.





AVB INSTALLATION & USE:

1. The mushroom shaped device must be installed vertically (upright position), with the atmospheric opening at the top and the elevation of the unit must be at least 6 inches above the highest inlet, "down stream" of the AVB.

2. All shutoff devices must be located "up stream" from the AVB (supply side). This unit cannot be tested after installation.

3. Approved for **HIGH HAZARDS, NON-CONTINUOUS PRESSURE & NO POTENTIAL BACKPRESSURE**. ASSE standard #1001

NOTE: AVB's cannot be used under continuous pressure conditions (defined as water pressure on both sides of the unit for more than 12 hours), because the float valve may stick or freeze in the up position, thus making the water supply vulnerable to potential back-siphonage. Remember, you must evaluate the AVB in its setting and determine the use and time. If the use period extends over 12 hours, then an approved continuous pressure backflow device must be installed.

PRESSURE VACUUM BREAKER (PVB)

The PVB is similar to the atmospheric vacuum breaker (AVB), except that it has two test cocks and two gate valves (new units use ball valves) for testing the unit, and it also has two positive seating (spring loaded) valves. The first check valve (supply side) is spring loaded for a closed position and "guards" the potable water supply side; when the water supply is turned on, the flow pushes it in the open position. The second check valve or air inlet valve (down stream side) is spring loaded for an open position to the atmosphere and only closes when the supply water is turned on. When the supply pressure drops to or below atmospheric pressure (below 0 gauge pressure), the second check valve opens to the atmosphere and the first check valve closes. As with the AVB, the PVB only provides protection for back-siphonage.

PVB INSTALLATION & USE:

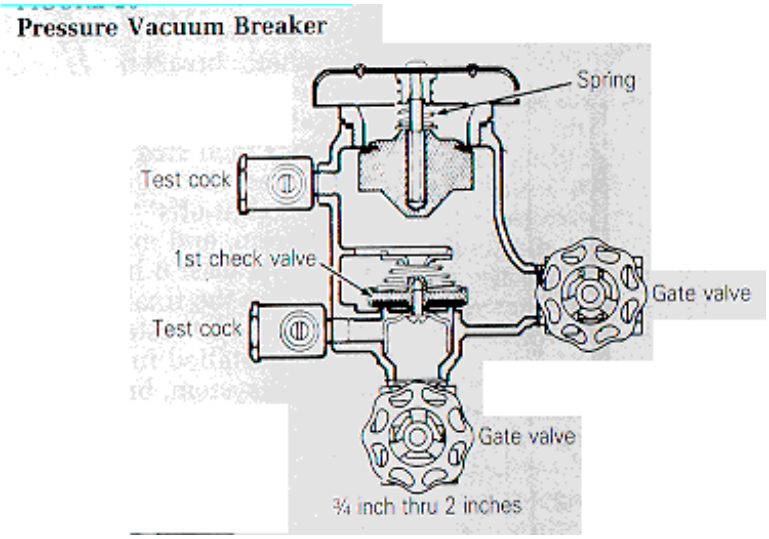
1. The unit is generally used in agricultural, irrigation, and industrial applications.

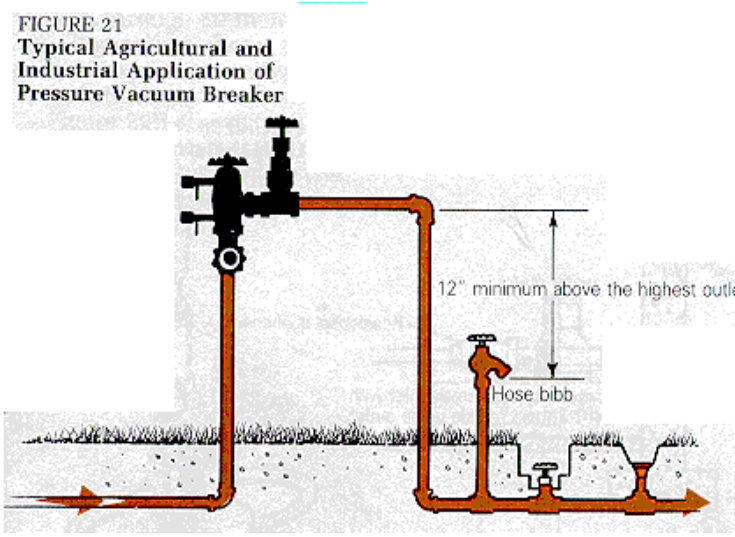
2. The PVB must be installed at least 12 inches above the highest elevated inlet or fixture on its down stream side. Also, the unit must have a shut off valve on each side and two test cocks for testing.

3. The device must be located in an accessible area for testing and servicing. Also, it is permissible to install shut off devices down stream of this unit.

4. Lines should be thoroughly flushed prior to installation in order to prevent any debris from lodging in the valve seats and preventing a tight seal.

The PVB is approved for **HIGH HAZARD, CONTINUOUS PRESSURE & NO POTENTIAL BACKPRESSURE.** ASSE standard #1020





BACKFLOW PREVENTERS WITH INTERMEDIATE ATMOSPHERIC VENT

1. SPECIALTY UNITS FOR 1/2 & 3/4 INCH SUPPLY LINES

This device contains an atmospheric vent between two spring loaded check valves, and these valves are spring loaded for automatic closure under static (no water flow) conditions. The atmospheric vent is controlled by a diaphragm seal that directly responds to the movement of the supply side (primary) check valve. As the water flow begins (dynamic), the primary check opens and simultaneously frees the diaphragm seal to close off the atmospheric vent and then proceeds to open the secondary check valve (down stream side). The positive supply pressure holds the diaphragm seal in place to close off the atmospheric vent under static (there is no flow, but supply pressure exits in the device) or dynamic conditions. Under back-siphonage conditions, the diaphragm seal is able to open the atmospheric vent independent of the primary check valve (to relieve any vacuum on the supply side). To further understand how an atmospheric vent satisfies a vacuum, put a hole in a soda straw, keeping the hole out of the soda and try to drink the soda. When a zero pressure or back-siphonage condition exits on

the supply side, the primary check valve closes under spring pressure and simultaneously pushes the diaphragm seal into position to form a tight seal between the valve and valve seat - opening the atmospheric vent and closing the secondary check valve.

Under back-pressure conditions, the secondary check valve would close first. If the secondary check valve were to foul in the closed position, the primary check valve would close and the backpressure leakage would drain out through the atmospheric vent (air break chamber). (Note: Backflow preventers with atmospheric vents should be located so that water leakage will not cause a nuisance.)

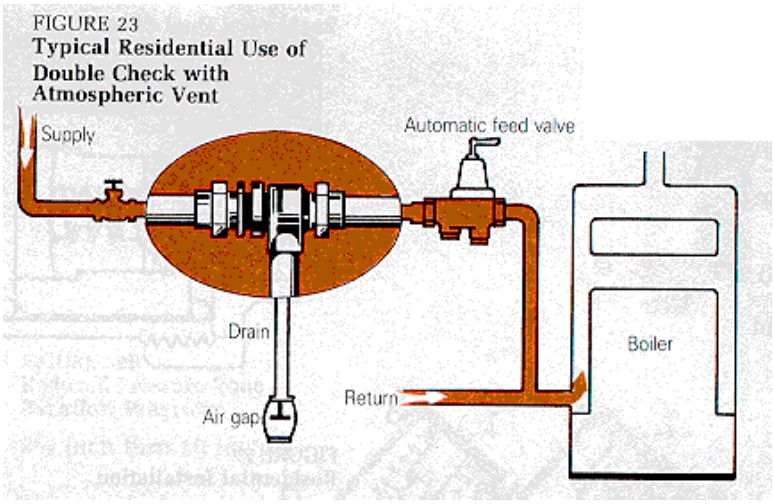


FIGURE 23
Typical Residential Use of Double Check with Atmospheric Vent

SPECIALTY UNITS WITH AN INTERMEDIATE ATMOSPHERIC VENT FOR 1/2 & 3/4 INCH SUPPLY LINES, continued

INSTALLATION & USE:

1. The unit can be installed horizontally or vertically and must not be located in a pit or a location subject to standing water. Under no circumstances should plugging of the relief port or vent be permitted.

2. Generally, the unit may be installed on water supply lines for laboratory equipment, food processing tanks, sterilizers, dairy equipment, livestock drinking fountains, residential boilers, or in other situations where cross-connection control is needed.

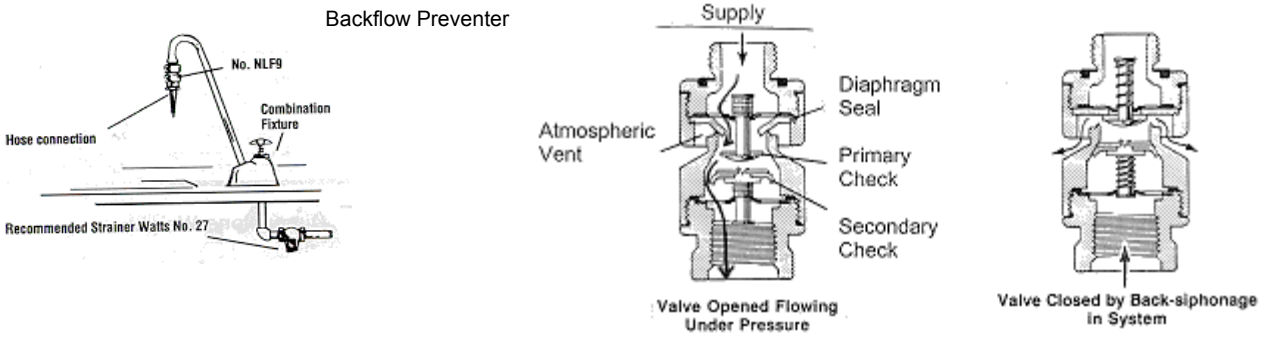
3. Approved for **LOW HAZARD, CONTINUOUS PRESSURE & BACKPRESSURE OR BACK-SIPHONAGE**. ASSE standard #1012

Note: Some plumbing codes or jurisdictions place application limitations on this device, because the unit cannot be tested.

INTERMEDIATE ATMOSPHERIC VENTS CONTINUED

2. SPECIALTY IN-LINE APPLICATIONS/LAB FAUCETS

These types of backflow preventers operate on the same principle as the backflow preventer with an intermediate atmospheric vent for 1/2 and 3/4 inch supply lines. There are several types of these units and not all of them are approved for continuous pressure.



INSTALLATION & USE:

1. Units that are approved for continuous pressure can be used in supply lines for low water volume needs such as coffee and tea urns or ice makers. (Not approved for soda carbonators.)

Units that are only approved for non-continuous pressure applications such as those installed on the supply side of an aspirator for a laboratory faucet or on a barber shop/ beauty parlor sink.

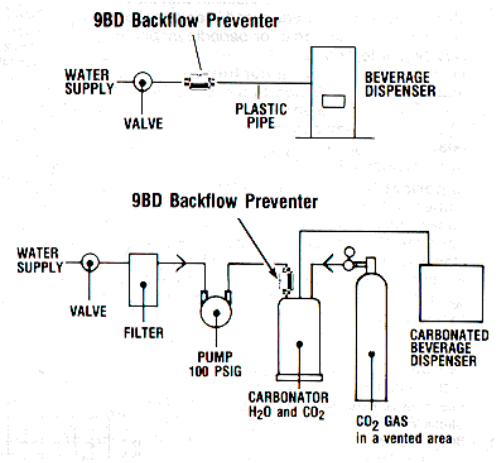
Whether a particular unit is APPROVED FOR CONTINUOUS PRESSURE OR NOT WILL NEED TO BE CLARIFIED BY THE MANUFACTURER.

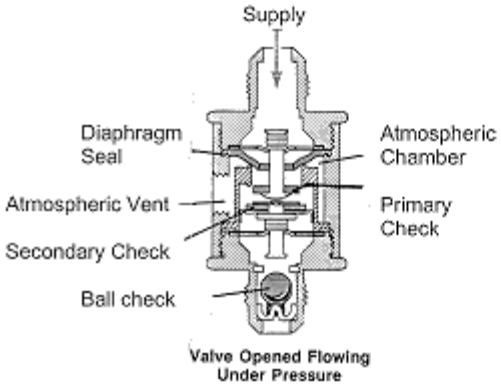
All types are approved for LOW TO MODERATE HAZARDS AND BACKPRESSURE OR BACK-SIPHONAGE. ASSE standard #1035

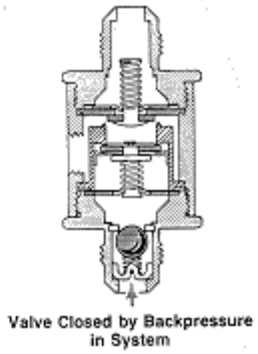
INTERMEDIATE ATMOSPHERIC VENTS CONTINUED

3. SPECIALTY UNITS FOR BEVERAGE VENDING MACHINES

This backflow preventer is very similar internally to the specialty units for 1/2 & 3/4 inch, and 1/4 & 3/8 inch supplies, except that it has an added ball check valve (after the secondary check valve). The ball check is an extra precaution to prevent carbon dioxide (CO_2) from backflowing (via backpressure) out of a soda carbonator and into any copper supply lines. The CO_2 gas reacts with water to form carbonic acid, which in turn will dissolve the copper lines and thus create possible copper toxicities in those ingesting the water. Any carbon dioxide leaking past the ball check valve and the secondary disc valve would be vented into the atmosphere via the atmospheric vent/air inlet.







INSTALLATION & USE:

1. The backflow preventer and carbonator system must be located in a well ventilated area. Installation may be horizontal or vertical.

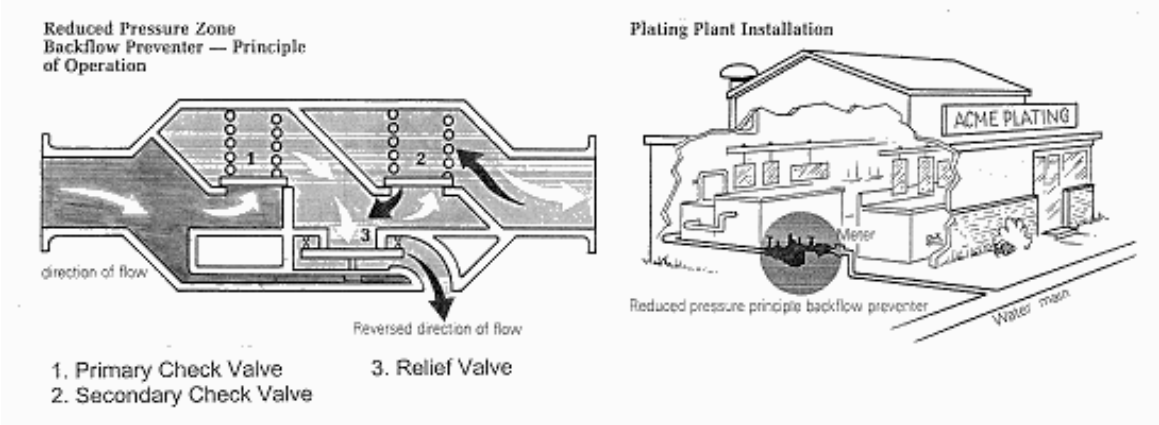
2. The unit may also be used for other beverage equipment such as coffee, tea, and hot chocolate.

3. Approved for **LOW HAZARD, CONTINUOUS PRESSURE & BACKPRESSURE OR BACK-SIPHONAGE**. ASSE standard #1032

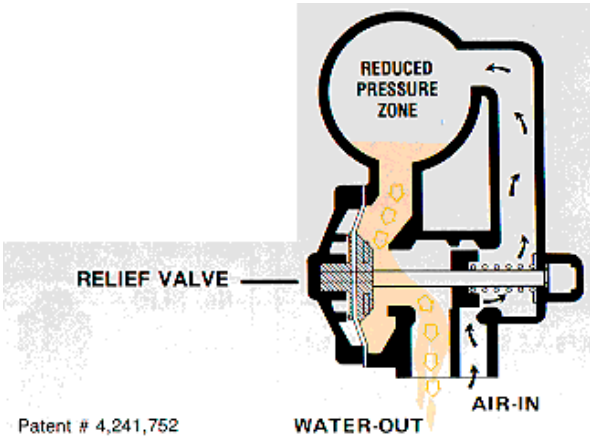
REDUCED PRESSURE ZONE BACKFLOW PREVENTION ASSEMBLY (RPZ)

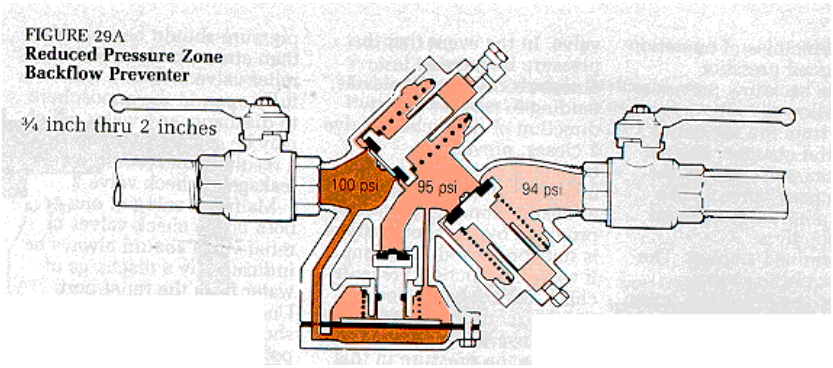
This type of mechanical backflow prevention assembly provides the maximum protection against both back-siphonage and backpressure. Construction of the RPZ consists of two very sensitive, independent, spring loaded check valves with a reduced pressure "zone" between them (at least a 2 psi pressure differential between the “supply pressure” and the “reduced pressure zone”). These check valves are spring loaded to automatically close unless they are held open with flow in the proper direction. As the water passes through the primary check valve, the water pressure will drop (predetermined friction loss/resistance) at least 2 psi in the "reduced" pressure zone or central chamber. Under normal conditions the water will continue through the secondary check valve (only requires 1 psi to open) to the point of usage.

The reduced pressure zone contains a relief valve that drains to the atmosphere and is spring loaded for an automatic open position. The relief valve has the RP zone water pressure on one side and the water supply pressure on the other side. To keep the relief valve closed, the supply pressure must exceed the RP zone pres sure. Thus , it will spring open under any conditions causing the water pres sure in the “RP zone ” to approach or exceed the supply pressure. Also, when the relief valve opens, an



air passage from the atmospheric vent to the RP zone is opened to satisfy any back-siphonage conditions. So, even if both check valves are fouled, the relief valve will continue to protect the supply.

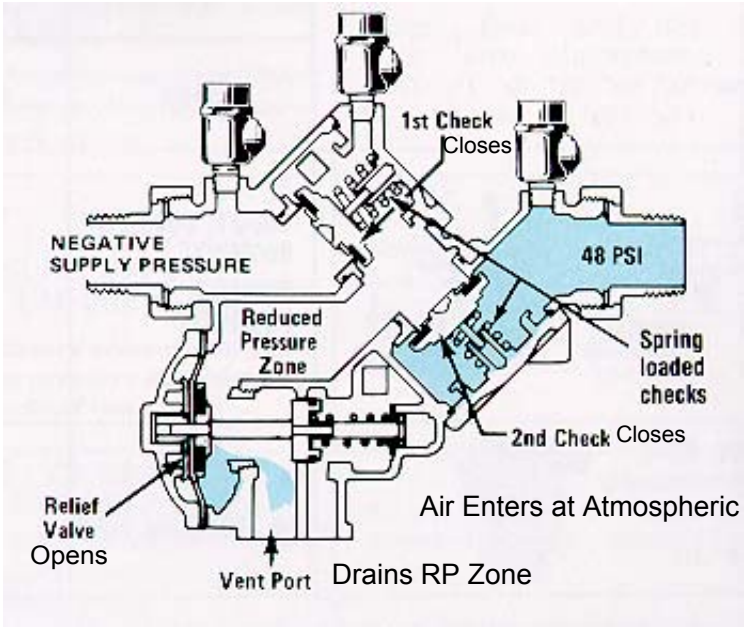




RPZ WATER FLOW AND RELIEF VALVE ACTION WITH VARIOUS SCENARIOS:

1. BACKPRESSURE - pressure increases downstream from the backflow preventer.
   As the downstream pressure approaches the pressure of the "reduced pressure zone", the secondary check valve will close. (Water pressure in the "RP zone" must exceed the downstream pressure in order to hold the secondary check valve open.)

2. BACK-SIPHONAGE - approaching zero or negative pressure on the supply side.
   When the supply pressure approaches zero or negative values, the primary check valve will close; the relief valve will spring open (draining the reduced pressure zone); the atmospheric vent passage to the reduced pressure zone will open; and the secondary check valve will close.



3. BACKPRES SURE & BACK- SIPHONAGE SIMULTANEOUSLY
The primary and secondary check valves would close, and the relief valve and atmospheric vent port would open.

4. CHECK VALVES OR RELIEF VALVE MALFUNCTION

Malfunctioning of one or more of the three valves in the RPZ backflow preventer would not compromise the safety of the water supply (but there may be water discharging from the relief port until unit is repaired).

Secondary Check Valve

Backpressure: If some obstruction or wear prevents the secondary check valve from closing tightly, backpressure leakage would increase the central chamber pressure and thus open the relief valve and atmospheric vent port. (As chamber pressure approaches supply pressure, the relief valve springs open.)

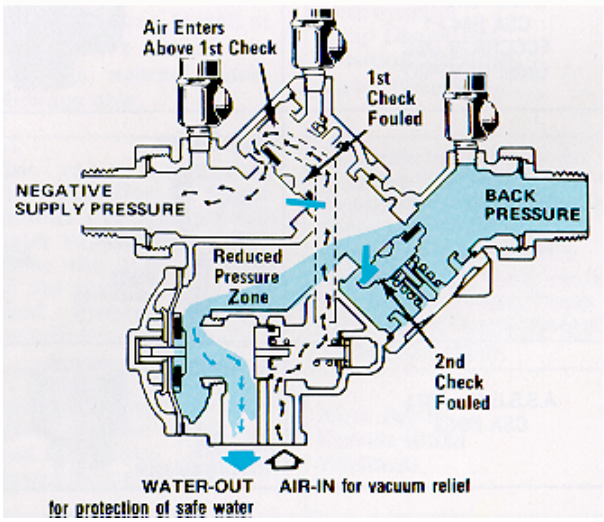
Primary Check Valve

Back-siphonage: If the primary check valve were to foul, then simultaneously the relief valve would open, and the air passage from the atmospheric vent port would deliver air to an area just above the primary check valve. The air would satisfy any vacuum caused by back-siphonage. The air flowing to the primary check valve does not use the same passage in the relief valve used for draining water.

Backpressure: If the primary and secondary check valves were to fail simultaneously, then the water leaking back into the central chamber would exit through the relief valve.

Relief Valve/Port

A malfunctioning relief valve will not close; it will remain open, discharging water through the port until repaired. Even when fouled, the supply remains protected.



RPZ INSTALLATION & USE:

1. Under no circumstances should plugging of the relief port be permitted.

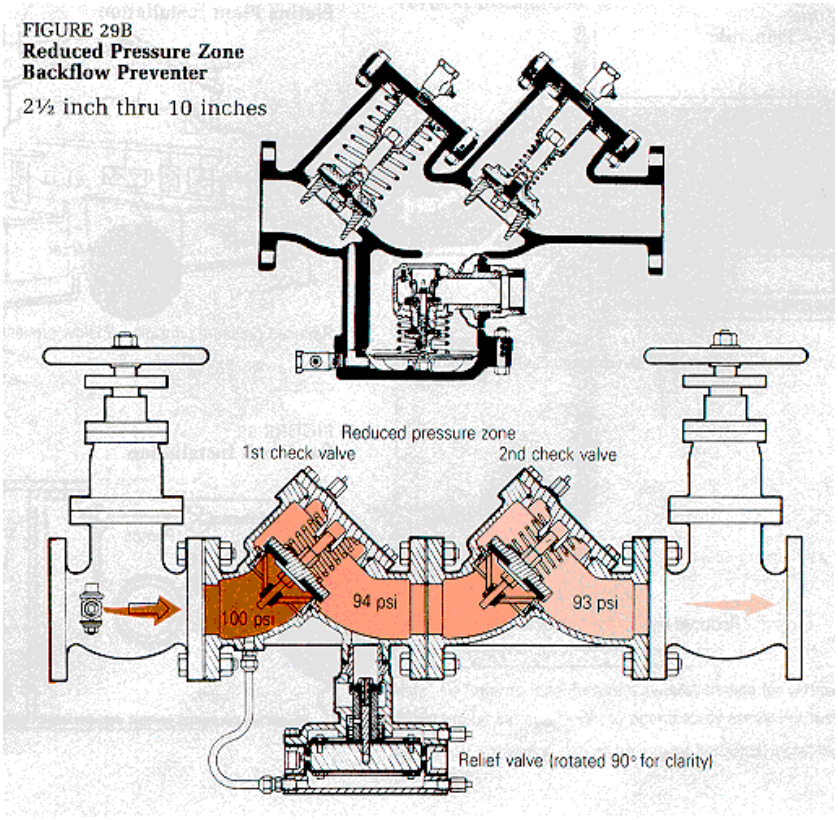
2. The RPZ is equipped with test cocks and gate valves to enable required unit testing.

3. Several unit sizes are available for 3/4 to 10 inch supply lines. Approximate pressure losses across the unit are 10 to 20 psi, depending on the size and flow rate.

4. Install on each high hazard connection within a secondary system and/or at the service connection or water meter (for containment on the property) of car washes, autopsy and funeral parlors, commercial boilers, cooling towers, hospital and laboratory equipment, processing tanks, sewage treatment, etc.

5. The unit must be accessible for testing and service, and must be located above grade (not subject to flooding). The device must be installed at least 12 inches from any wall and between 12 to 30 inches above the floor.

6. Approved for HIGH HAZARDS, CONTINUOUS PRESSURE, BACKPRESSURE OR BACK-SIPHONAGE. ASSE standard #1013



DOUBLE CHECK VALVES

A double check valve backflow preventer consists of two check valves that are spring loaded in the closed position. These devices do not have the added protection of an atmospheric vent and therefore are limited to the amount of protection they offer and how they can be used. Some jurisdictions and codes do not permit double check valves to be used for backflow protection.

INSTALLATION & USE:

1. Double check valves can only be used where they are approved for limited use with low hazard, continuous pressure conditions.

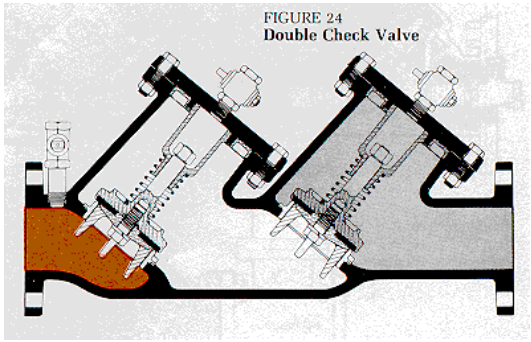
2. THREE TYPES OF DOUBLE CHECK VALVES:

   I. DOUBLE CHECK VALVE

   This type of device is designed for commercial applications for 3/4 to 10 inch supply lines and contains test cocks and gate valves for testing purposes.

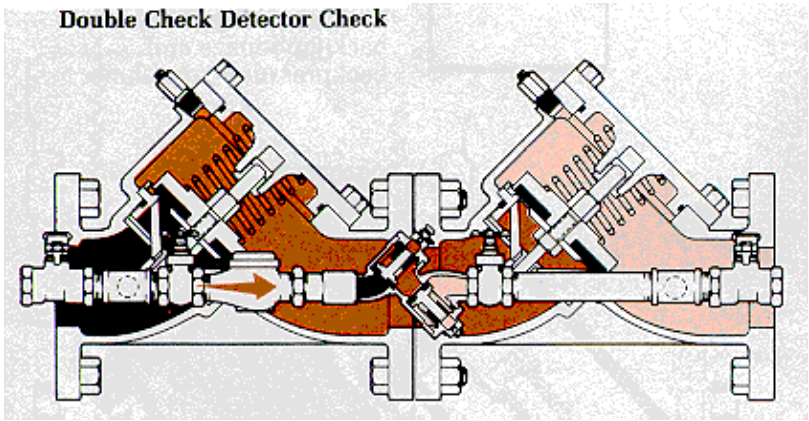
   ASSE standard #1015

Flow



II. DOUBLE CHECK DETECTOR CHECK VALVE

This device is similar to the "double check" unit except that it has a water meter added to detect down stream leaks and unauthorized withdrawals. The unit is commonly installed on fire protection supply mains. ASSE standard #1048



III. DUAL CHECK VALVE

The dual check valve is for residential applications only. When used, it is usually installed on the customer side of the water meter in an attempt to contain any pollutant (low hazard) within the resident's secondary system. The dual check valve is not equipped for in-line testing. ASSE standard #1024