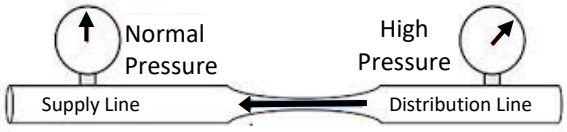
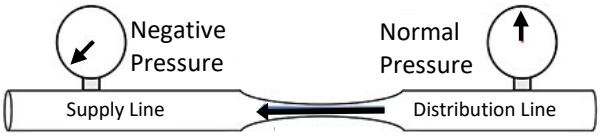
Guidance Document – Backflow Devices
Irrigation Pipeline and Livestock Pipeline (Codes 430 and 516)

## Introduction

The installation of some conservation practices including irrigation systems, livestock watering pipelines and facilities, agricultural chemical handling facilities, and sprinkler systems may involve the connection to a water supply. Water contamination can occur whenever there is a cross-connection between a water supply and any other water distribution system. Users of the water supply could be exposed to bacteria such as *E. coli* from manure, and chemicals such as fertilizers and pesticides that may be present in pipelines used in agriculture.

Cross-connection is defined by the State of Wisconsin as "a connection or potential connection between any part of a water supply system and another environment containing substances in a manner that, under any circumstances, would allow the substances to enter the water supply system by means of back siphonage or back pressure". Cross-connections can allow the flow of water to reverse direction and flow back into, and potentially contaminate, a water distribution system unless a backflow prevention device is installed. Backflow can occur because of back pressure or back siphonage as described in Figure 1. Back siphonage is assumed to always be able to occur. Therefore, backflow prevention is always needed.

Figure 1. Definitions of backflow conditions: back pressure and back siphonage

| Back Pressure | Back Siphonage |
|---|---|
| Occurs when the distribution pipeline is at a higher pressure than the supply line, allowing undesirable substances to be "pushed" back into the supply line.<br><br>Common conditions are booster pumps or chemical injectors with a higher pressure than the supply line or a distribution pipeline is at a higher elevation than the supply line. | Occurs when negative or reduced pressure occurs in the distribution pipeline, allowing undesirable substances to be "pulled" back into the supply line.<br><br>Common causes are undersized supply piping, supply line breaks, and sudden high demand upstream. |
| Back Pressure<br>  <br><br>Water is "PUSHED" back into supply line. | Back Siphonage<br>  <br><br>Water is "PULLED" back into supply line. |
| Informational video: | |

State and local laws regulate plumbing, well drilling, and pump installation. Well drilling and pump installation, including the initial pressure tank, are regulated by the Wisconsin Department of Natural Resources (DNR). A Licensed Well Driller and a Licensed Pump Installer are required for well drilling, well pump installation, pressure tank, and piping to the pressure tank.

Plumbing upstream of and including the initial pressure tank must be installed by a Department of Natural Resources (DNR) licensed water well driller or DNR licensed pump installer. Plumbing downstream of the initial pressure tank is regulated by the Department of Safety and Professional Services (DSPS) and is typically required to be installed by a DSPS licensed plumber or DSPS licensed utility contractor. However, a property owner may install plumbing within the *perimeter* of a one-family home or farm building owned and/or occupied by the property owner, unless required otherwise by local ordinance. The system owner or operator is responsible for certifying, in writing, the plumbing meets State regulations and is responsible for hiring licensed personnel as needed.

When providing technical and/or financial assistance, conservation personnel are responsible for reviewing and accepting the installed backflow prevention device. This document provides evaluation and installation information on several common backflow prevention devices to assist in determining if the selected device is appropriate.

Several different types of backflow prevention devices are commercially available. Table 1 provides information on the Air-Gap method and five devices commonly used in Wisconsin.

## Table 1 – Backflow Prevention - Definitions, Specifications, and Installation Notes

| Backflow Prevention Devices | Abbreviation | Definition | Specifications | Installation Notes[1,2] | Cost |
|---|---|---|---|---|---|
| Reduced Pressure Principle Assembly | RPP | Two independently acting check valves, together with an automatically operating pressure differential relief valve located between the two check valves. | ASSE 1013, CAN/CSA B64.4 | The minimum clearance is 12" above the floor or grade to ensure an air gap between the relief valve and any water that might puddle beneath the device. Must be installed by a licensed plumber. | $$$$ |
| Double Check Valve Assembly | DC | Two independently acting check valves with two shutoff valves. Note: Two single check valves in series do not function as a Double Check Valve Assembly | ASSE 1015, CAN/CSA B64.5 | The minimum clearance is the same as for the RPP device. | $$$ |
| Pressure Vacuum Breaker | PVB | Contains within a single body, a check valve and a valve which opens to vent to the atmosphere whenever the pressure at the device approaches atmospheric. The device has two shut-off valves and is fitted with test cocks for field testing | ASSE 1020, CAN/CSA B64.1.2 | Can have shutoff valves downstream of it. Must be installed at least 12" above the highest outlet or, at least 12" above the highest overflow rim of a tank. | $$ |
| Atmospheric Vacuum Breaker | AVB | Has a moving element inside, which during normal flow prevents water from spilling from the device and during cessation of flow, drops down to provide a vent to the atmosphere. | ASSE 1001, CAN/CSA B64.1.1 | Cannot have any shutoff valves downstream of it. Must be installed at least 6" above the highest outlet or, at least 6" above the highest overflow rim of a tank. | $ |
| Hose Connection Backflow Preventer | HC | Force loaded check valve with an atmospheric vent open to vent when the device is not under pressure. | ASSE 1011, 1052, CAN/CSA B64.2 | The maximum allowable water height above the vacuum breaker is 10 feet | $ |
| Air-Gap | | An Air-Gap is a physical separation between the free-flowing discharge end of a potable pipeline and an open or nonpressure receiving vessel. | -- | The end of the discharge pipe must be at least twice the diameter of the valve opening diameter above the topmost rim of the receiving vessel (1 inch minimum). | - |

[1]Backflow preventers cannot be buried in a pit or located in spaces susceptible to flooding (DSPS 382)

[2]Mechanical backflow devices shall be tested in accordance with manufacturer's requirements unless otherwise specified.

The conditions under which the planned water distribution system will be operating must be considered before the appropriate backflow prevention device or method can be determined. Table 2 provides information on the conditions to be evaluated.

**Table 2 – Water Distribution System Conditions**

| | TOXIC | BACK PRESSURE | CONTINUOUS PRESSURE |
|---|---|---|---|
| *Definition* | • Any part of the distribution pipeline will be exposed to fertilizers, pesticides, or pathogens (manure). | • Distribution pipeline pressure is higher pressure than the supply line pressure on a continuous basis. | • Pressure from the supply line will be applied continuously for more than 12 hours. |
| *Example* | • System connected to a livestock water tank.<br>• Chemical injection system | • Booster pump or chemical injector operates at a higher pressure than the supply line.<br>• Distribution pipeline is at a higher elevation than the supply even if the normal supply pressure is greater than the distribution pipeline pressure. | • A hydrant is connected to a water supply line with a pressure tank and the hydrant is left on for more than 12 continuous hours. |

Table 3 can be used to assist in selecting a backflow prevention device or method that meets the water distribution system conditions and planned operation. If the water supply system is NOT owned and operated by the population at risk, RPP and Air Gap are the only options. Reference Table 3 for additional requirements and conditions for the Air Gap method.

**Table 3 – Backflow Prevention Use Conditions**

| | AIR-GAP [5] | RPP [2] | DC [2] | PVB [2] | AVB | HC |
|---|---|---|---|---|---|---|
| CONTINUOUS PRESSURE | See Note 1 | X | X | X | | |
| BACK PRESSURE | X | X | X | | | See Note 3 |
| TOXIC | X | X | | X [4] | X [4] | X [4] |

Notes:

1. Air-Gap may be used in a continuous pressure situation IF the outlet with the Air-Gap is float controlled and the float is designed for the outlet pressure. This design is commonly used in commercially available automatic waterers.
2. Must be tested by a DSPS licensed cross connection control tester at the time of installation, after repairs or alterations, and at least annually, at a minimum.
3. Maximum allowable water height above device is 10 feet.
4. An RPP or Air Gap is recommended for chemical injection systems (ex. fertilizer, pesticides, etc.).
5. If an Air-Gap is the only method of backflow prevention, except for commercially available automatic waterers, the following statement shall be boldly affixed on the plan drawings so the water supply owner acknowledges the necessity and function of the Air-Gap separation with a signature.

   **"An Air-Gap of at least (insert two times the pipe diameter of the valve opening, one inch minimum) inches is required between the supply line outlet and the top of tank to isolate health hazards from the water supply."**

   Signature_____

If the system is operated year-round, frost protection is required and shall be installed according to the manufacturer's requirements and applicable state codes. Wisconsin DSPS 382, for example, states that a backflow device may not be in a space susceptible to flooding nor in a well pit below ground. An insulated housing is an example of aboveground frost protection. Consult a licensed plumber for further details. If frost protection is not provided, the system should be drained during the winter.

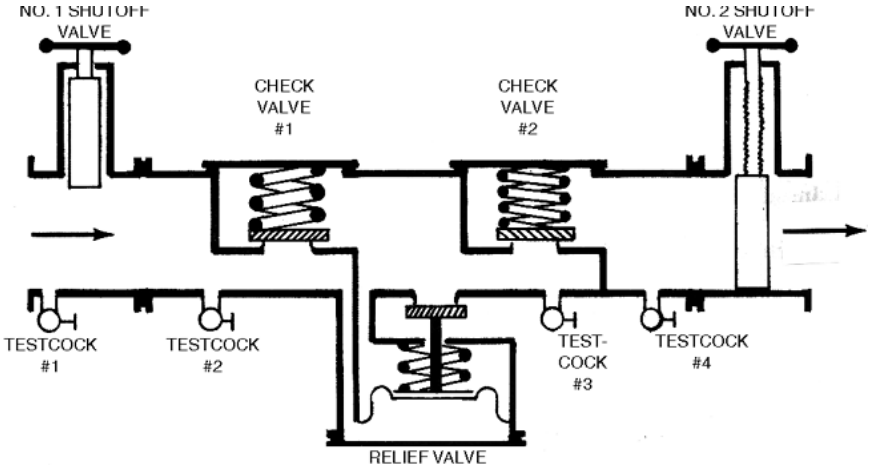
The Operation and Maintenance (O&M) plan shall include the inspection/testing frequency and maintenance recommended by the backflow prevention device manufacturer, at a minimum. Reference Table 3 for additional DSPS testing requirements.

# Examples of Backflow Prevention Devices

(Informational YouTube links also provided)

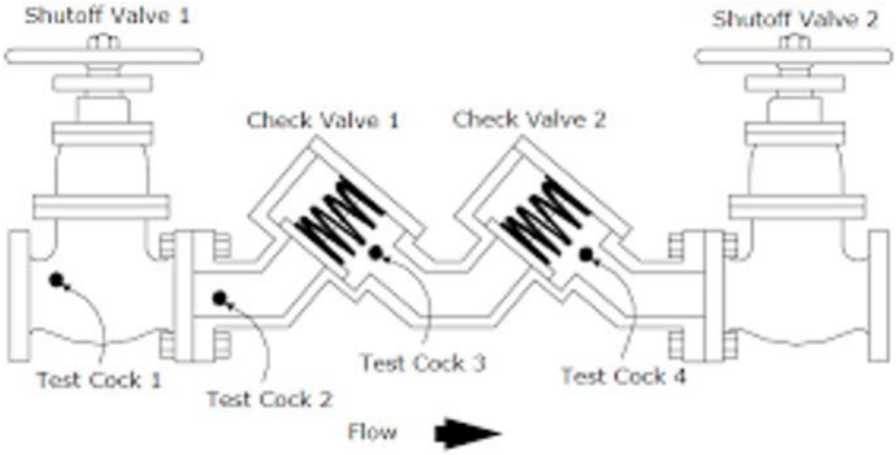
## Reduced Pressure Principle Assembly (RPP)

https://www.youtube.com/watch?v=W3wg11mMfb8



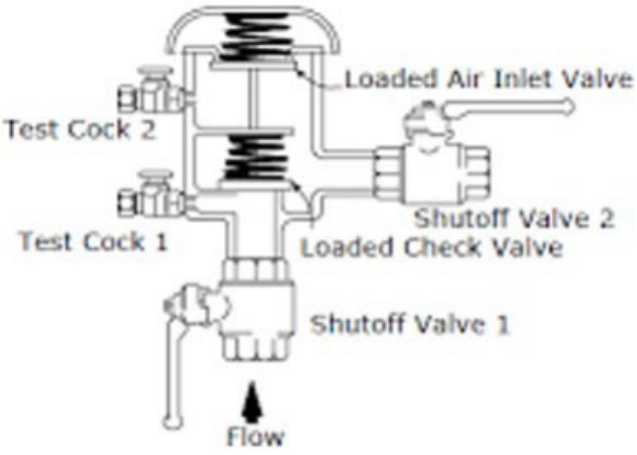
## Double Check Valve Assembly (DC)

https://www.youtube.com/watch?v=VnYo7LBjHaY

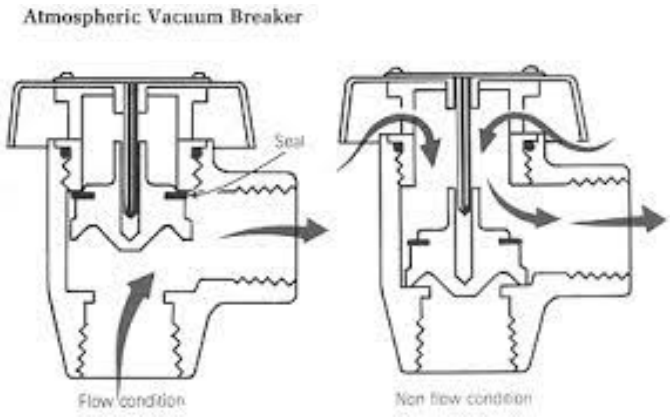

## Pressure Vacuum Breaker (PVB)

https://www.youtube.com/watch?v=IdASRPrJKq8

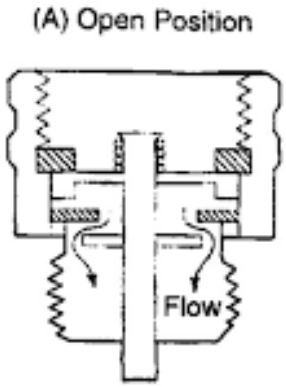
## Atmospheric Vacuum Breaker (AVB)

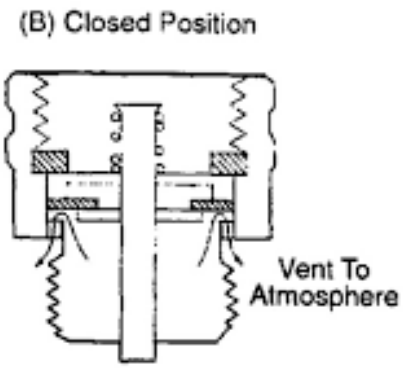
https://www.youtube.com/watch?v=QpSY79Todzk




## Hose Connection Backflow Preventer (HC)

https://www.youtube.com/watch?v=t6Kov7ymLcU



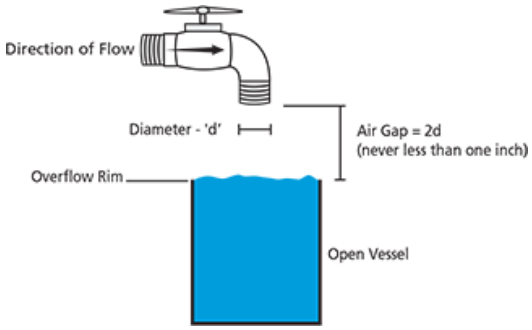



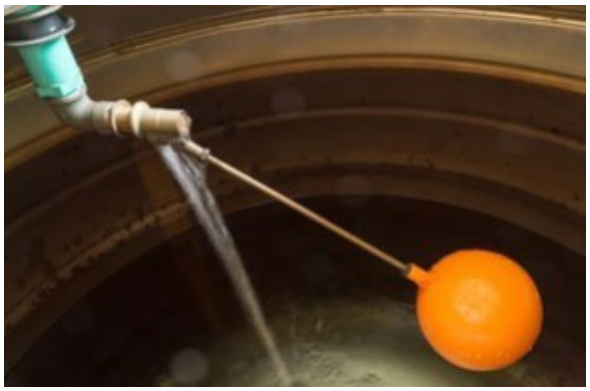
Guidance Document – Backflow Devices
Irrigation Pipeline and Livestock Pipeline (Codes 430 and 516)

## Air-Gap

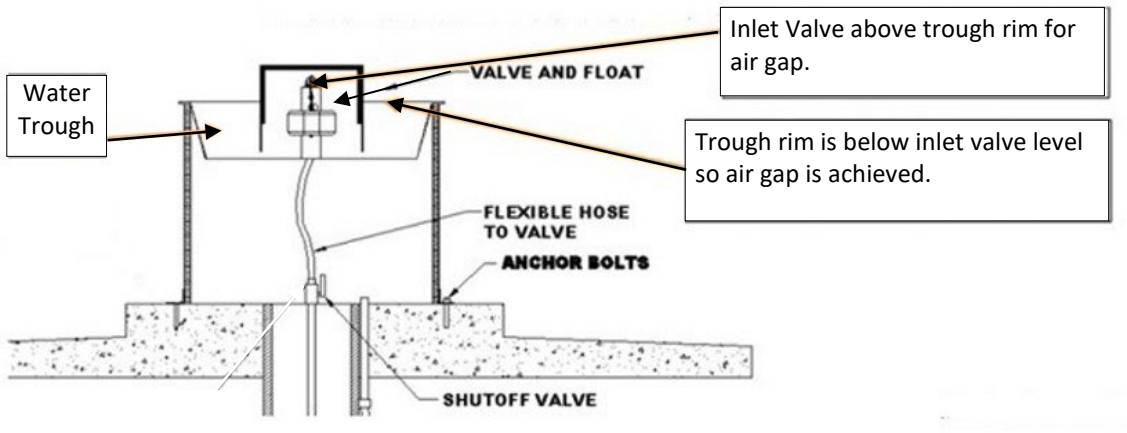
Water Tank Example:

**https://www.youtube.com/watch?v=WEh7pjY4HmU**



Automatic Waterer Example:




Detail of Inlet Valve & Float