

Backflow Prevention for the Fire Protection Industry

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An Overview of Backflow Protection

There are two ways for backflow to occur. The first way that backflow can occur is by backpressure. What is backpressure? It is when the pressure in the downstream piping rises above the supply pressure of the system. This can potentially cause a reversal of flow in the water system. Some common causes of back pressure include thermal expansion, pump systems, elevated tanks, etc. The second cause of backflow is back siphonage. Backsiphonage is the reversal of water flow due to a drop in the water pressure on the supply side. The most common cause of back siphonage is a water main break.

There are two levels of hazard. The cross connection community defines them as low hazard and high hazard. Low hazard is a non-health hazard pollution. It may distort the color, taste, or smell of the water, but is not a health hazard. A high hazard is defined as a health hazard.

There are five means of protecting against backflow, including an air gap, an atmospheric vacuum breaker (AVB), a reduced pressure valve assembly (RP), a double check valve assembly (DC), and a pressure vacuum breaker (PVB). An air gap is defined as a physical, unobstructed distance of two times the diameter of the outlet. An air gap is the best, and safest, way to prevent backflow caused by both backsiphonage and backpressure.

An AVB protects against low hazard and high hazards. It protects against back siphonage only. It must be installed a minimum of six (6) inches above the highest pipe downstream of the device, and for equipment/deck-mounted applications a minimum of one (1) inch above the highest point of use. Some of the device's installation limitations include that control valves are not permitted downstream of the device, and it cannot be subjected to continuous pressure. When a back siphonage condition occurs, the AVB will seal the inlet against the water flow, and allow air to enter the device to protect against backflow.

The PVB also protects against low hazard and high hazards. It also protects against back siphonage only. Unlike the AVB, the PVB can be subjected to continuous pressure conditions. The PVB must be installed a minimum of twelve (12) inches above the highest point downstream of the device. Control valves are permitted downstream of the device. A PVB must be installed as a complete assembly; and unlike the AVB, it is field testable. One other difference between a PVB and an AVB is that the PVB is spring loaded.

The DC protects against low hazard conditions only. It protects against both back pressure and back siphonage. It is installed as an assembly, meaning that the device includes two check valves and two valves. It is a field testable device.

The RP protects against both low and high hazard conditions. It protects against both back pressure and back siphonage. It is installed as an assembly, meaning that the device includes two check valves, two valves, and an intermediate zone. It is field testable; and is the highest form of mechanical protection against backflow.

Selecting a Backflow Preventer

How do we select the proper device for an application? There are twelve questions that will enable you to determine the proper device for your application.

1. Is the application a high or low hazard situation?
2. Is the application subject to back pressure, back siphonage, or both?
3. Is there danger of water damage?
4. Is the application subject to a freezing location?
5. Does the application require continuous service?

Selecting a Backflow Preventer

- A Dozen Questions to Ask -

- 1) Is the application a low or high hazard?
- 2) Is the application subject to backpressure?
- 3) Is there a danger of water damage?
- 4) Is the application subject to freezing?
- 5) Does the application require continuous service?
- 6) Will there be control valves downstream of the device?
- 7) Is the device located near electrical equipment?
- 8) Is there sufficient drainage for the application?
- 9) What will the pressure loss be through the device?
- 10) Is the device to be used as a point of use installation?
- 11) Is there acceptable room for maintenance and testing?
- 12) Can a remote location be utilized?

6. Can there be control valves downstream of the device?
7. Will the device be located near electrical equipment?
8. Is there sufficient drainage for the application?
9. What will the pressure be throughout the device?
10. Is the device used at the point of use?
11. Is there sufficient room at the location for maintenance and field testing?
12. Can a remote location be used?

Some other items you must consider prior to installing a backflow prevention device is whether the device is approved or listed by ASSE, FM, UL, USC, or another listing agency; and is the device in compliance with local codes or jurisdictions?

Backflow preventers are used in a variety of industrial facility applications. Some of the industrial applications that require cross connection control include cooling towers, process tanks, humidifiers, fire protection systems, restrooms, paint booths, car washes, and slop sinks.

Fire Protection Systems

There are four basic types of fire protection systems used in the industry. The number one type, and probably the most prevalent, is the wet pipe system. An antifreeze loop can be tied into or fed from the wet pipe system. The other three types are: a dry pipe system, a pre-action system, and a deluge system. As the name implies, a wet pipe system has water in the fire protection system. The system is charged when a fire develops, and the individual sprinkler heads closest to the fire are discharged. The antifreeze system is similar to the wet pipe system; however, it is used in large applications which include sprinkler heads that may be located outside of the building, such as in a loading dock area. Instead of installing a dry pipe system, engineers will design an antifreeze loop as part of the wet pipe system for these applications. The dry pipe system's design is similar to a wet pipe system; however, the water from the supply main is kept out of the piping due to air pressure. The valve is usually a six to one (6:1) differential type of valve where the air pressure in the sprinkler system actually maintains the valve in the closed position.

The pre-action system is also similar to the dry pipe system. The difference is that there must be two conditions in order for the system to discharge. First, you must have some type of detector on the system, whether it is a heat detector or a smoke detector, that trips a solenoid valve on the system which allows water to enter the system. Now that the piping is filled with water (similar to a wet pipe system), you need the individual sprinklers to discharge.

A deluge system has a heat detector that goes off, trips the solenoid valve on the deluge valve allowing water to enter the system, and water exits every sprinkler head on the system.

According to the AWWA M14 Manual, there are six classes of systems. A Class I system is a system that is directly connected to the city water main. There are no pumps, tanks or reservoirs. There are no antifreeze or other additives in the water. Sprinkler drains must discharge to the atmosphere or a safe outlet. Class II systems are designed the same as a Class I; however, there is a booster pump added to the system. Class III systems have a direct connection to the water mains plus at least one of the following components - an elevated tank(s), or pumps taking suction from above ground tanks or covered reservoir. A Class IV system is directly supplied by public mains. It may or may not have a pump; and it has an auxiliary water supply available. If the auxiliary water supply (pond, lake, reservoir, etc.) is within 1700 feet of the fire department connection, then the system becomes a Class IV. The Class V system is directly supplied by the public water mains, and is interconnected with the auxiliary water supply. The pumps are taking suction from an exposed reservoir or other secondary water supply automatically without assistance from the fire department. Finally, a Class VI system is essentially where there are chemicals added into the system. This is the most severe type of protection, and the biggest concern for the industry.

The Basic Components of a Fire Protection System

There are several different components of a basic fire protection systems. There is a water supply, whether it is a tank or city water mains. There is both above and below ground piping. Usually, the underground piping is potable water piping. All of the above ground piping, typically, is black steel piping. Some may be galvanized piping, but that is a very small portion. There are gate valves, check valves, and alarm check valves. There is a fire department connection where the firemen connect their hoses to boost the water pressure in the system. In addition, there are sprinklers, inspectors test connections, hangers and sway bracing.

What Type of Backflow Protection is Required?

According to the AWWA M14 Manual, a Class I and a Class II system do not require backflow protection on the fire protection system if it is installed with approved potable water piping and components. Class III systems require some form of backflow protection, whether it is an air gap or a double check valve assembly. Class IV and Class V require either an air gap or a reduced pressure assembly. Class VI systems requires a reduced pressure assembly.

There are several concerns that engineers need to contend with when designing fire protection system that include backflow protection. Typically, fire protection engineers will specify double check valve assemblies and reduced pressure assemblies. The reduced pressure assemblies are generally specified only for chemical systems. One of the main concerns that the industry is trying to address regarding RP devices is the friction loss across the device. Why is this so important? The systems of today are designed based upon a hydraulic calculation method. The calculation is based on a given area and a density. The density is the gallons per minute per square foot (this can range anywhere from 0.1 gallons to 0.4 gallons). When the sprinkler systems are designed, they are designed for a given square footage - not the entire building. Therefore, we take the density over the remote portion of a building based on the hazard. When the system pressure is reduced by the backflow protection device, the system piping and components must be sized larger to compensate for the pressure reduction, thus causing the system to be more expensive to design and install.

Where Should Backflow Protection Systems be Installed?

A backflow protection device should be installed on new and existing Class III, IV, V and VI systems. If you are using potable water piping in Class I and Class II systems, then backflow protection is not required per the AWWA M14 Manual. However, if non-potable water piping is used in the system, then a backflow protection device is required. There has been a lot of controversy between the fire protection industry and the cross connection control industry. "How many people have died?" has been asked; but that should not be the point. The point should be protecting the potable water supplies to ensure safe drinking water. And what about dry pipe, pre-action and deluge system? Should they have backflow protection? I personally don't think it is needed because there is no water in the system to backflow. These systems have air in the piping.

As an industry, we need to determine the level of hazard, and base the type of backflow protection required on the hazard. We should not require RP's on all installations - the fire protection industry could come back and say that no protection is needed, and we will lose the battle to protect the potable water supplies. ○

	Air Gap	AVB	PVB	DC	RP
High Hazard	X	X	X		X
Low Hazard	X	X	X	X	X
Backpressure	X			X	X
Backsiphonage	X	X	X	X	X
Significant Pressure Loss	X			X	X
Continuous Pressure Allowed			X	X	X
Vents to Atmosphere	X	X	X		X
Vertical Installations				X	X
Used as Isolation	X			X	X
Used as Containment	X			X	X
Parallel Installation Common				X	X