Backflow Prevention: The Forefront of Responsible Irrigation

As the demand for potable water exceeds supply, the responsibility of the irrigation contractor grows. The contractor must protect public water supplies from contamination.

Backflow prevention is a subject about which every irrigation contractor should be completely informed. Whether you do business in a state or locality that permits you to install certain types of backflow devices, or are required by law to have a licensed plumber install them, you should be able to recognize errors in installation, operation or maintenance.

When the flow of water is reversed from an irrigation system back into the potable system, a backflow condition is created. If contaminants are allowed to flow back into the potable water system, even in minuscule quantities, the population is at risk of consuming fertilizers, pesticides and animal residues.

Any connection between the potable water supply and a source of contamination is called a cross-connection. Irrigation systems, bypass arrangements, jumper connections, swivel or changeover arrangements or other temporary arrangements through which backflow can occur are considered to be cross-connections.

Irrigation systems might begin with potable water, but they are subject to contamination from submerged sprinklers, auxiliary water supplies, ponds, reservoirs, swimming pools and other sources of nonpotable water.

Because irrigation systems may be equipped with pumps, injectors or pressurized tanks, many jurisdictions declare them high-hazard cross connections, but in others they are classified low-hazard. For any irrigation system, an approved backflow preventer must be installed at the cross-connection point to avert backflow. The backflow prevention apparatus
must match the specific hydraulic conditions at the site and be capable of protecting against the degree of hazard present.

Check with your local agency or municipality for codified construction requirements. This may include the state or local health department, the plumbing inspection or building permit department or the city planning department. All backflow preventers should be inspected after installation and retested annually to ensure their proper operation.

**What Causes Backflow?**

Backflow, the unwanted reverse flow of liquids in a piping system, is created by two basic conditions -- backpressure or backsiphonage.

Backpressure is the flow from a pressurized system through an unprotected cross-connection into the potable water supply. This occurs when a superior pressure is generated in a nonpotable water system by a pump or by elevation differences.

The primary causes of backpressure are:

- Booster pump designed without backflow prevention devices.
- Interconnection with another system operated at a high pressure, like a fertilizer injector system.
- When a change of system pressure causes the pressure at the supply point to become lower than the pressure at the point of use, the nonpotable water can be backsiphoned into the main supply line.

The primary causes of back-siphonage are:

- Undersized piping.
- Line repairs or breaks that are lower than a service point.
- Lower main pressure from high water-withdrawal rates.
- Reduced supply main pressure on suction side of a booster pump.

The type of backflow preventer needed is based on the degree of hazard of any substance which can flow into the potable water supply. A pollutant is considered to be any substance that affects the color or odor of the water, but doesn't pose a health factor. A contaminant is a health hazard that can cause illness or death when ingested. Contaminants must be controlled by either an air gap or a reduced pressure principle backflow prevention assembly.

**Backflow Preventers**

An air gap is a physical separation between the discharge end of a potable water supply line and the top of an open or nonpressure receptacle. These vertical separations must be at least twice the diameter of the inlet pipe and never less than 1 inch.

Pollutants can be controlled at the cross-connection by one of several mechanical backflow preventers, including vacuum breakers -- atmospheric or pressurized -- double check-valve assemblies and a reduced pressure principle assembly.
Atmospheric vacuum breakers (AVBs) are designed to prevent backsiphonage and are not effective against backpressure. The device uses a disc-float assembly to seal off the atmospheric vent area when the system is pressurized. When the water supply is shut off or if the line pressure drops to the atmospheric level, the float falls, opening the atmospheric vent, and allows air to enter the piping system, thus interrupting the possible backsiphoning action.

These backflow preventers should be installed at least 6 inches above all downstream piping and outlets. If piping is run to a point of higher elevation, the pressure created by the elevated water will cause backpressure to keep the air-inlet valve closed, and the assembly loses its intended protection.

Never place shutoff valves or obstructions downstream from AVBs. A shut-off valve will keep the assembly under pressure and allow the float check to seal against the air-inlet port. The result is simply an elbow in the piping system and not a backflow preventer. For that same reason, an atmospheric vacuum breaker must not be used for more than 12 hours in a 24-hour period.

Local codes will detail installation requirements, however the following are usually minimum standards:

- Install in an accessible location for inspection and servicing.
- Flush pipelines thoroughly prior to installing AVBs.
- Install downstream of the last shutoff valve.
- Install a minimum of 6 inches above the highest outlet it serves.
- Never install in a situation where it will be under continuous operating pressure for more than 12 hours in a 24-hour period.
- Protect the assembly from freezing by draining it in the winter months when the system is not in use.

Pressure vacuum breakers (PVBs) also are designed to prevent backsiphonage and, too, are ineffective against backpressure. Pressure vacuum breakers use a check valve designed to close with the aid of a spring when water flow stops. Its air inlet valve opens when the internal pressure is one psi above atmospheric pressure, preventing nonpotable water from being siphoned back into the potable system. The assembly includes resilient, seated shutoff valves and testcocks.

Being spring-loaded, PVBs don't rely on gravity like AVBs, and can be installed on the pressure side of a shutoff valve. Pressure vacuum breakers must be installed at least 12 inches above all downstream piping and outlets and can be used to protect against a pollutant or contaminant.

Local codes will detail installation requirements, however the following are usually minimum standards:

- Install in an accessible location for inspection and servicing.
- Flush pipelines thoroughly prior to installing PVBs.
- Install on the mainline to the irrigation system upstream of the shutoff valves.
- Install a minimum of 12 inches above the highest outlet it serves.
- Protect the assembly from freezing by draining it in the winter months when the system is not in use.
Double check valve assemblies are effective against backflow caused by backpressure and backsiphonage and are used to protect the potable water system from low-hazard substances. Double-checks consist of two positive-seating check valves installed as a unit between two tightly closing shutoff valves and are fitted with testcocks.

Elevation differences are inconsequential with double checks. However, they are more cumbersome and, if installed below grade, can be difficult to drain for freeze protection.

Local codes will detail installation requirements, however the following are usually minimum standards:

Install in an accessible location for inspection and servicing.
Flush pipelines thoroughly prior to installing double check assemblies.
Protect the assembly from freezing by properly installing it in a utility building or shelter and draining it in the winter months when the system is not in use.

Dual check valve assemblies are effective against backflow caused by backpressure or backsiphonage. They protect the potable water system from substances that are not health hazards.

Dual checks consist of two independent inline check-valve modules. They also should be installed in an accessible location for inspection and servicing. Local codes will detail installation requirements.

Reduced Pressure Principle Assemblies (RPs) protect against backpressure and backsiphonage of pollutants and contaminants. The assembly is comprised of two internally loaded, independently operating check valves with a mechanically independent, hydraulically dependent relief valve between.

During normal operation, the pressure in the zone between the two check valves is maintained lower than the supply pressure. If the zone pressure approaches the supply pressure, the relief valve will automatically maintain a differential of not less than two psi between the supply pressure and the zone between the two check valves by discharging to the atmosphere.

The RP also contains tightly closing, resilient-seated shutoff valves upstream and downstream of the check valves, along with resilient-seated testcocks. This backflow prevention assembly is used to protect against high-hazard contaminants and should always be the choice of backflow prevention when applying fertilizers and chemicals via the irrigation system.

Local codes will detail installation requirements, however the following are usually minimum standards:

Install in an accessible location for inspection and servicing.
Flush pipelines thoroughly prior to installing RP assemblies.
Protect the assembly from freezing by properly installing it in a utility building or shelter and draining it in the winter months when the system is not in use.
When located inside a building, the relief-valve port should be piped through an air gap to a drain to prevent water damage.
The device should not be installed in pits where any part of the device could become
submerged in standing water. The device should be installed a minimum of 12 inches above grade.

Understand all local codes before proceeding with backflow prevention. It is imperative, both legally and ethically, that the proper backflow preventer for each individual project be correctly selected and installed. Always investigate through the municipality, county and water agency in whose jurisdiction you are designing or installing irrigation. These agencies and offices will lead you to the personnel qualified to specify, install and regularly test your backflow prevention device.