Note: The following example only provides a small portion of the course created for Certus. The information has been placed in a knowledge and learning management system for instructors to use. Visuals and practice example were also provided and placed in the system for classes.

Backsiphonage & Backflow Prevention

Backflow is a term in plumbing for an unwanted flow of water in the reverse direction. It can be a serious health risk for the contamination of potable (drinking) water supplies that come out of faucets. It is so important that the topic is extensively covered in the Inform Plumbing Code (UPC). There are federal and state regulations that mandate the regular testing of water quality along with systems and pipelines that transport or store drinking water.

Therefore, any tradesperson, including plumbers, needs to have a clear understanding and good working knowledge of backflow and its prevention. This includes all related regulations, requirements, and standards from governing organizations, including:

- U.S. Environmental Protection Agency's National Primary Drinking Water Regulations
- Occupational Safety and Health Administration's Sanitation Standards
- International Code Council's (ICCs) International Building Codes (IBC)
- International Association of Plumbing and Mechanical Official's (IAPMOs) Uniform Plumbing Code (UPC)
- American Water Works Association (AWWA) Standards
- American Society of Mechanical Engineers (ASME) Standards

There are also regulations, standards, and rules on the state and local level that must be followed.

In this lesson, you will learn regarding backflow and its prevention: basic terminology; what, how, why, when, and where; backflow devices and assemblies; codes and regulations; installation; and maintenance.

A. Common Terms & Definitions

Backflow: The flow of water or other liquids, mixtures, or substances into the distributing pipes of a potable supply of water from sources other than its intended source.

Backflow Connection: An arrangement whereby backflow can occur.

Backflow Preventer. A backflow prevention device, an assembly, or another method to prevent backflow into the potable water system.

Backflow Protection. The protection of the water is supplied to a bathtub, whirlpool, bathtub, dishwasher, hand washers, food waste disposers, faucets, fixtures, fittings, cross connections, hoses, (connected), devices, etc.

Backpressure Backflow. Backflow due to an increased pressure above the supply pressure, which may be due to pumps, boilers, gravity, or other sources of pressure.

Backsiphonage: The flowing back of used, contaminated, or polluted water from a plumbing fixture or vessel into a water supply pipe due to a pressure less than atmospheric in such pipe.

Cross Connection: An actual or potential connection between a potable water plumbing system and nonpotable water plumbing system that can allow pollutants or contaminants to flow into the potable water system.

Cross Contamination: the occurrence of water from a nonpotable water system flowing into a potable water system to which it is or could be connected.

Nonpotable Water: It is a lower quality water that is not approved for human consumption. It is approved and used for toilet flushing, dust control, soil compaction, fire protection, commercial laundry, vehicle washing, street cleaning, and snowmaking.

Potable Water: This is the highest quality of water approved safe for drinking, washing (a person, food, or utensils), and cooking.

Water Supply System: The building supply pipe, the water distribution pipes, and the necessary connecting pipes, fittings, control valves, backflow prevention devices, and all appurtenances carrying or supplying potable water in or adjacent to the building or premises.

B. Frequency

Backflow in public and private water systems is a well-known problem by federal and state government agencies, companies, and trade professionals. Despite many regulations, standards, codes, and rules in areas including backflow and potable water systems, several organizations' issues remain. The EPA reported the following statistics for 2022.

- The number of active Public Water Systems (PWS) in the U.S. was 154,106.
- Seventy-three percent (112,544) of the PWSs active in that year had no reported violations of drinking water standards.
- Twenty-seven percent (41,561) were reported to have violated at least one drinking water standard.
- Nearly twenty percent (31,542) of PWSs failed to meet at least one monitoring or reporting requirement.
- For that year, the EPA and other primacy agencies initiated at least one formal enforcement action at 2,429 PWSs and at least one informal enforcement action at 25,923 PWSs in response to drinking water violations at PWSs within their jurisdictions.

From this data, it emerges there is a clear need for everyone involved with water systems to do a better job of addressing backflow and its prevention.

C. Causes of Backflow

There are two main causes of backflow occurrence called "back pressure" and 'backsiphonage".

A. Back Pressure

Back pressure is a problem that occurs when pressure increases within a water supply distribution system beyond the level of its source. The rise in pressure adds resistance making it harder for the flow of water or other liquid to travel through a plumbing system whereby lowering efficiency and full range of functions. Backpressure can be caused by pumps, boilers, gravity, blocked drains, faulty fixtures, and high demand.

B. Backsiphonage

Backsiphonage occurs when potable water flowing through a potable water supply distribution system becomes exposure to contaminants, used or polluted water and then reverses its flow returning to from where it originated. The exposure turns the water into nonpotable and a reverse in flow contaminates all water within the water supply distribution system and the system itself.

The change in flow direction is caused by water movement being stopped. This creates a vacuum or partial vacuum that reverses the flow of water in the distribution system. The stoppage of water flow can be caused by pipes being too small to handle demand. This is especially the case when the need for water skyrockets for an event like a fire which pushes the system beyond capacity. Others cause include clogs, plumbing overhauling, cracks or brakes in a system, and failing devices, pipes, fixtures, or fittings.

C. Cross Contamination

There are several situations that can cause cross contamination of potable water supply systems. It can occur when the potable water supply system is connected to any of the following:

- Nonpotable water source
- Hose that is submerged in polluted water
- Boiler with chemical treated water
- Source of potable feed water to an industrial process, such as a cooling tower
- Irrigation systems
- Swimming pools and spas
- Water operated sump devices
- Water softeners
- Auxiliary water supply
- Fire sprinkler systems
- Sinks, toilets, and bathtubs
- Beverage dispensers

- Mechanical equipment

D. Repercussions of Backflow

Any occurrence of backflow is a serious problem for it facilitates the development of related problems. Some are relatively easy to solve, while others are hard and challenging. Examples of problems that can be cause by backflow have been provided in the following.

1. **Loss of Potable System & Water**

   When a public water supply system becomes contaminated, the provider loses their potable water system and the water that was within it. The residents no longer have a safe source of water for drinking, bathing, or cooking. The problem is not only inconvenient, but also very expensive. The water provider is forced to replace the system to provide potable water once again. For residents they now must buy bottles of water.

2. **Potential Health Implications**

   Until the backflow problem is discovered, nonpotable water flows through the supply and distribution system. Even after it is discovered, the system still contains contaminated water that is being distributed. This creates the risk of people drinking or using contaminated nonpotable water that may be hazardous. As a result, those who consume it may suffer short or long-term health problems.

E. Regulatory Governance

The problem of backflow is complex in regulatory governance because water quality, water systems, and backflow devices are all interconnected. However, the governance, regulations, rules, standards, codes, etc. come from several government agencies and organizations. It is the same situation regarding enforcement as well. The following chart provided a view of the big picture.

Application	Area of Governance	Agency/Organization	Standards | Codes
Water Supply Distribution Systems **Backflow Device or Assembly**	**Plumbing: Systems Devices Assemblies Installation**	International Code Council (ICC)	International Plumbing Codes (commercial only) International Building Codes
		International Association of Plumbing and Mechanical Officials (IAPMO)	National Standards Plumbing Code (residential and light commercial applications) form Plumbing Codes (residential and light commercial applications)
		erican Society of Mechanical Engineers (ASME)	formance Requirements of Backflow Devices A112.18.3 ety Requirements for Plumbing ANSI 40
		Occupational Safety and Health Administration (OSHA)	1910.141 – Sanitation 3432 Plumbing Fixture Fittings and Trim
		State Government	Codes vary by state
		City Government	Codes vary by city
Water	**Quality**	U.S. Environmental Protection Agency	e Safe Drinking Water Act ional Primary Drinking Water Regulations National Secondary Drinking Water Regulations
		Bureau of Ocean Energy Management	Federal Water Pollution Control Act Amendments/ Clean Water Act
		Occupational Safety and Health Administration	Sanitation Standards
		State Government	Codes vary by state
		City Government	Codes vary by city

For water quality (potable, nonpotable), the governing authority is the EPA. It is not at simple for the water systems and backflow preventer. In those areas rules are being written by the ICC, IAPMO, ASME, OSHA, states, and cities. As for enforcement, the EPA enforces its own regulations working with federal, state, and tribal regulatory partners.

The EPA selects violators by prioritizing Safe Drinking Water Act (SDWA) enforcement responses using a methodology that assigns points to every violation based on the seriousness and duration of the violation. The violation points for each PWS are added together to produce a total score. A PWS with a

score of 11 or higher is designated as an enforcement priority until its violations are either returned to compliance or addressed with a formal enforcement action. Those selected as being violators must make changes so they are within compliance, or they will have to be fined for negligence violations under penalties.

The EPA reported for the year 2022 the following number for drinking water violations.

- At least one formal enforcement action at 2,429 Public Water Systems (PWS).
- At least one informal enforcement action at 25,923 PWS.

The majority (94%) of PWSs in enforcement priority status were small systems serving a population of 3,300 or less.

F. Backflow Prevention Devices, Methods & Assemblies

The risk posed by backflow can be mitigated by using preventive devices, methods and assemblies including the following.

- **Air Gap**
  An air gap is a separated vertical space *between the end of a pipe or faucet and the top of a* basin, sink or bathtub. That gap ensures water can flow from the faucet to the sink, but no contaminated water travels back into the faucet, even if the sink overflows. They are required in the UPC for certain plumbing fixtures, such as dishwashers, to prevent backflow.
- **Atmospheric Vacuum Breaker (AVB)**
  The atmospheric vacuum breaker is a device with an atmospheric air vent and check valve member. It prevents backsiphonage by allowing air into the piping systemin through its air vent.
- **Double Detector Check Valve Assembly (DDCVA)**
  The Double Detector Check Valve Assembly protects against back-pressure or back-siphonage with a cross-connection between potable

water systems and substances, in ‘medium hazard’ conditions. It is designed for use in fire service systems and allows monitoring of small draw-offs of water via the bypass.

- **Double Check Detector Assembly (DCDA)**
  The Double Check Detector Assembly (DCDA) is primarily used in fire applications. Its purpose is to provide protection from sprinkler systems, fire line booster pumps, fire district connections, and stagnant water that sits in fire system between uses. Components include two spring loaded check valves, a bypass assembly, meter, double check valve, and two tightly closing OS & Y gate valves.
- **Double Check Detector Fire Protection Assembly (DC)**
  The assembly has a double check valve backflow prevention assembly with a parallel detector assembly consisting of a water meter and a double check valve backflow prevention assembly.
- **Double Check Valve Assembly (DCVA)**
  The assembly has two independently acting internally loaded check valves, four properly located test cocks, and two isolation valves. It prevents backflow by closing one valve which reduces pressure differential across the other, allowing a more reliable seal and avoiding even minor leakage.
- **Hose Connector Backflow Preventer (HC)**
  A Hose Connector Backflow Preventer is a device with two independent check valves with an independent atmospheric vent between field testing and draining. It prevents backflow by opening to relieve the pressure buildup as soon as the pressure in the hose becomes greater than the supply pressure.
- **Pressure Vacuum Breaker Assembly (PVB)**
  The assembly consists of a loaded air inlet valve, an internally loaded check valve, two properly located test cocks, and two isolation valves. Regarding backflow prevention, this assembly allows water through and keeps the air inlet closed during normal conditions. But when air pressure is greater than the water pressure, the vented chamber

opens and breaks the suction effect from low pressure, thereby preventing the backflow of water.

- **Reduced Pressure Detector Fire Protection Assembly (RP)**
  The assembly has a parallel detector assembly consisting of a water meter and a reduced pressure principal backflow prevention assembly. If there is a backflow the check valves will close, and the relief valve will open, resulting in a reduced pressure zone and air gap between the check valves.
- **Reduced Pressure Zone Device (RPZD) Reduced-Pressure Principal Assembly (RP)**
  The assembly consists of one check valve (force loaded closed), and an air inlet vent valve (force loaded open to atmosphere) positioned downstream of the check valve and located between and including two tightly closing shutoff valves and test cocks.

  While water flows through the assembly's first check valve, it creates a pressure drop, then the relief valve determines if the supply pressure is greater and will remain closed. If the pressure difference between the supply and zone is reduced, the relief valve will open.
- **Spill-Resistant Pressure Vacuum Breaker (SVB)**
  A split-resistant pressure vacuum breaker has one check valve (force loaded closed) and an air inlet vent valve (force loaded open to atmosphere), positioned downstream of the check valve, and located between and including two tightly closing shutoff valves and test cocks.