

PLUMBING & CROSS-CONNECTION CONTROL

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BETC PLUMBING INFORMATION MANUAL

I. PLUMBING SYSTEMS

Once a potable water system (also referred to as “safe drinking water” or just “drinking water”) has been contaminated by the inadvertent actions of the user or installer, the foreign or toxic material can be distributed throughout the facility's potable plumbing system and adjacent premises on the same supply. The contaminated water, if undetected and utilized, may subsequently cause illness or death. Therefore each business, institution, residence, or other user has the ultimate responsibility to protect its potable water from any actual or potential introduction of contaminants or pollutants. The entire piping network for a water system, from the point of origin to the point of use, is divided into two categories: PRIMARY (containment) and SECONDARY (isolation) systems.

PRIMARY SYSTEM or CONTAINMENT

The primary system is composed of the water mains used by the water purveyor to deliver water to the various buildings (or service connections) on the system. The water purveyor is responsible for delivering safe drinking water to the point of delivery for the customer's or user's water system (secondary system). To protect the system from foreign or toxic materials being introduced via the customer, a backflow prevention assembly or device is installed at the water service entrance for “containment” on the premises.

SECONDARY SYSTEM or ISOLATION

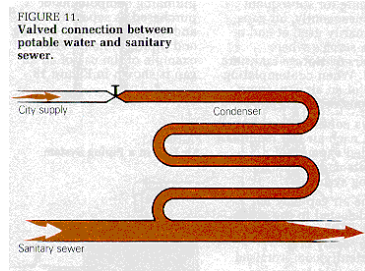
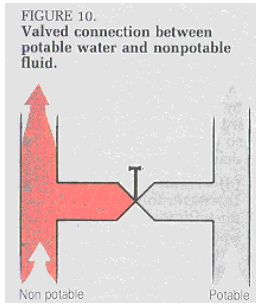
The secondary system is the plumbing network that distributes potable water from the down stream side of the water meter or service connection to the points of use throughout the facility and/or premises. Remember, few people are aware of what is occurring inside the building and/or premises (secondary system). The determination of cross-connections is, in part, the function of the inspector, however, it is the ultimate responsibility of the owner to comply with state and local plumbing codes specific for that jurisdiction. Safeguarding the system is met by “isolation,” providing backflow protection at each actual or potential cross-connection on the premises.

II. CROSS-CONNECTIONS

A cross-connection is an ACTUAL or POTENTIAL link between the potable water supply and a source of contamination (sewage, chemicals, gas, etc.). This link can be envisioned as a conduit or hose permitting the transfer of foreign material into a safe drinking water system. A cross-connection can be any temporary or permanent direct connection (hard plumbed), by-pass arrangement, jumper connection, removable section, swivel or change-over device, etc. that could connect a potable system to a non-potable source. Ideally, it is best not to have any cross-connections, but in certain situations they may be unavoidable. When an installation requires a cross-connection (as a last resort or unavoidable situation i.e., boiler, injector units, chemical aspirators), it must be properly protected with an acceptable backflow prevention assembly or device to eliminate any potential for a reverse flow back into the potable supply. An unprotected cross-connection threatens the health and safety of individuals and food or beverage products utilizing water from that system.

TWO TYPES OF CROSS-CONNECTIONS

1. DIRECT CONNECTION

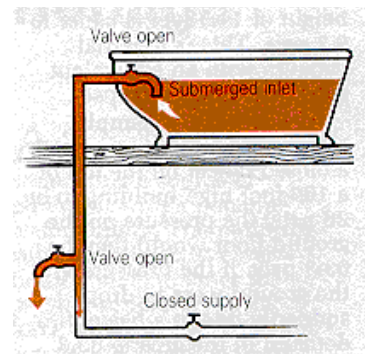
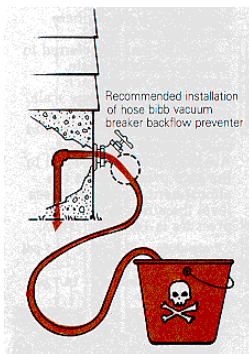


A direct connection is a physical connection between a potable and non-potable system. An example of this would be a water supply line connected directly to a boiler, sewage line, or other nonpotable auxiliary water source. A direct pathway exists between the two separate systems for contamination to be transferred into the potable system as shown in the diagrams below. A direct connection is subject to both back-siphonage and backpressure (see next page).

2. INDIRECT CONNECTION

An indirect connection between a potable and nonpotable supply does not exist under "normal" conditions; however, under "unique" circumstances a pathway for contamination can occur. Usually the source of contamination may back-up, be blown across, siphoned, pushed or diverted into a potable water supply. An indirect connection is only subject to back-siphonage (see next page).

Example scenario, the end of a faucet terminates below the flood level of a sink, (referred to as a "submerged inlet" because it does not provide the required air gap), and the waste backs up or the sink becomes clogged to the point that the water inlet becomes submerged. If a vacuum or negative pressure should develop in the potable supply, the contaminant could be siphoned into the water supply.



III. FORCES ACTING ON CROSS-CONNECTIONS

Some cross-connections are immediately obvious, but others can be subtle and difficult to find. Contamination or pollution occurs when the pressure differentials between the water supply and another system, via some connection, are sufficient to transfer the contaminant or pollutant into the potable supply. The temporary reversal of pressures or momentary vacuums in the water supplies can be freakish and unpredictable. These hydraulic forces can either **PUSH** (forced by higher pressure than the potable supply) or **PULL** (vacuum/siphon, the potable supply drops below normal levels) the contaminant into the drinking water system.

BACKFLOW

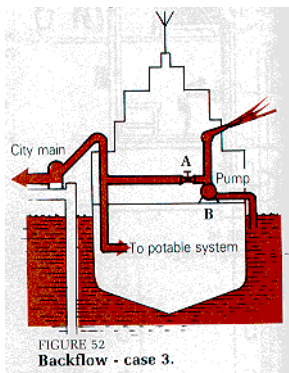
Backflow is a reverse flow in the primary or secondary system that is opposite to the expected or intended direction. This flow reversal is undesirable, however, a properly protected system can remain safe. There are two types of backflow, acting separately or in combination, that allow contaminants (high hazard) or pollutants (low hazard) to enter the water supply via a cross-connection: BACKPRESSURE and BACK-SIPHONAGE.

BACKPRESSURE (A PUSHING FORCE)

Backpressure occurs when both systems (potable & nonpotable) are under pressure (above atmospheric pressure or positive head pressure), but the nonpotable system has a greater pressure than the potable system. This pressure differential pushes the contaminant or pollutant into the potable supply. Pumps or thermal expansion from boilers connected to a supply are examples of how these pressure differentials can be created.

PRINCIPLE CAUSES OF BACKPRESSURE:

For backpressure to occur, a “direct connection” to another system must exist. This other system would actually or potentially be operated at a higher pressure than the potable supply, i.e., a fertilizer injector system, booster pump, boiler, fire sprinkler system or other auxiliary water source.

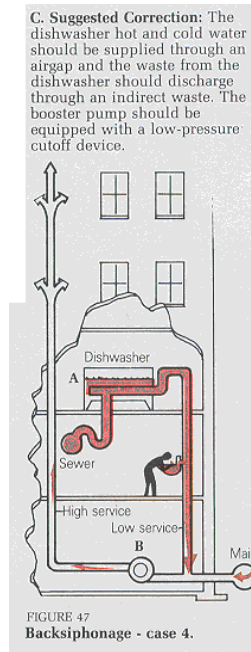
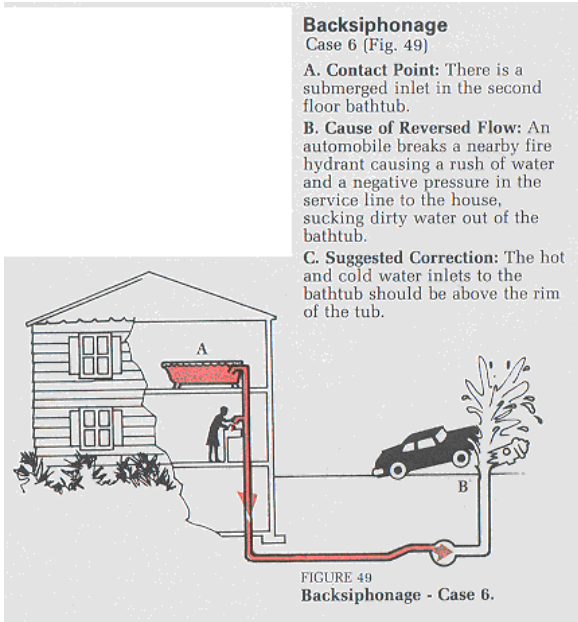


Potential Backpressure on City

- A. Contact Point: A valve connection exists between the potable and the nonpotable systems aboard the ship.
- B. Cause of Reversed Flow: While the ship is connected to the city supply system for the purpose of taking on or the potable system, the valve between the and nonpotable systems is opened permitting inated water to be pumped into the municipal

BACK-SIPHONAGE (VACUUM, PULLING FORCE)

Back-siphonage occurs when the pressure in the water supply drops below zero (less than atmospheric pressure or negative head pressure), and the adjacent nonpotable source is drawn or siphoned into the potable supply. NOTE: Back-siphonage can occur with either a “direct” or “indirect” connection, and the systems can be “opened” or “closed” - meaning exposed/open to the atmosphere, or not exposed/closed to the atmosphere.

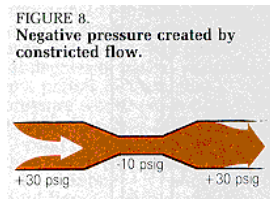


Backsiphonage

Case 4 (Fig. 47)

A. Contact Point: The water supply to the dishwasher is not protected by a vacuum breaker. Also, the dishwasher has a solid waste connection to the sewer.

B. Cause of Reversed Flow: The undersized main serving the building is subject to reduced pressures, and therefore only the first two floors of the building are supplied directly with city pressure. The upper floors are served from a booster pump drawing suction directly from the water service line. During periods of low city pressure, the booster pump suction creates negative pressures in the low system, thereby reversing the flow.



PRINCIPLE CAUSES OF BACK-SIPHONAGE:

1. Undersized sections of pipe can create an aspirator effect in the restricted area.
2. A break or repair in a supply line can create a vacuum or siphoning effect (as gravity drains the water out) on the elevated portions of the system above the effected area.
3. A high water withdrawal, such as fire fighting or water main flushing, can create a vacuum. This withdrawal is more likely to create stronger negative pressures at the higher elevations on the system.
4. A vacuum can be induced on the suction side of a booster pump, such as high-rise buildings and processing plants.