Tech Brief

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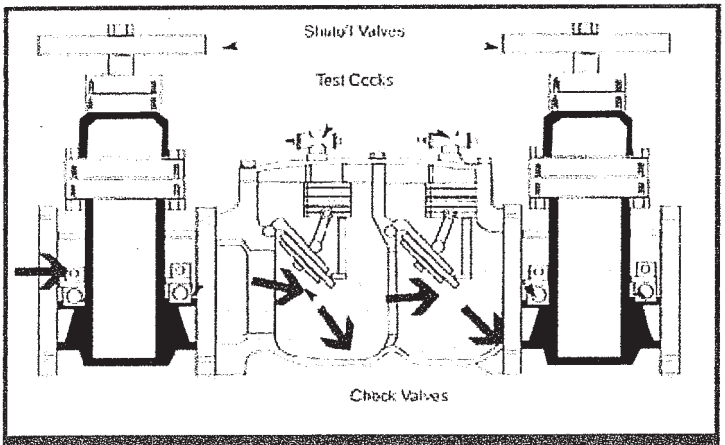
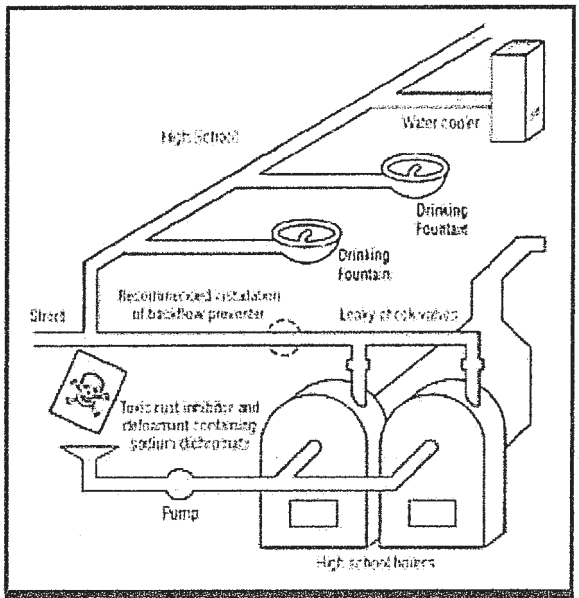
Cross Connection and Backflow Prevention

By **Zane Satterfield, P. E.**, NESC Engineering Scientist

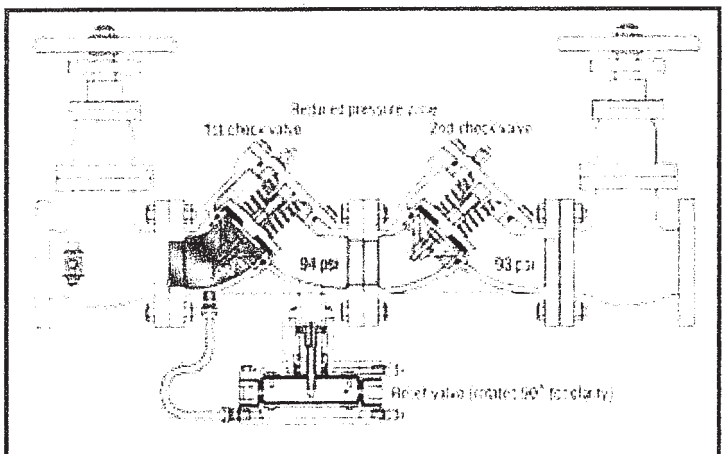
Plumbing cross connections can link a potable water supply to a contamination source, causing a serious public health hazard. Cross connections can be controlled, but it takes vigilance and knowledge to carry out a good cross-connection control program. This poster illustrates some mechanical devices and methods used to control cross connections in commercial and industrial applications as well as for homeowners.



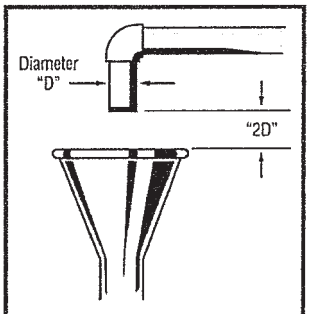
A double check valve or double check assembly consists of two check valves assembled in series usually with a ball valve or gate valve installed at each end for isolation and testing. Test cocks (very small ball valves) are in place to attach test equipment for evaluating whether the double check assembly is still functional (in most states it is important to have the test cocks to be approved backflow devices).



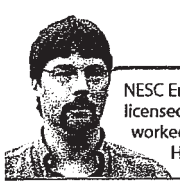
This is a typical situation in public buildings where prevention devices like RPBP should be used.



A reduced pressure zone backflow preventer (RCBP) has two spring check valves with a pressure-relief valve located between them that can be vented to the atmosphere.



An air gap is the most effective way to prevent cross connection and backflow. An air gap can be thought of as a no-fail check valve that doesn't have an internal seat or any moving parts. However, air gaps are not possible for all situations. Therefore, other devices to prevent backflow and backsiphonage must be available.



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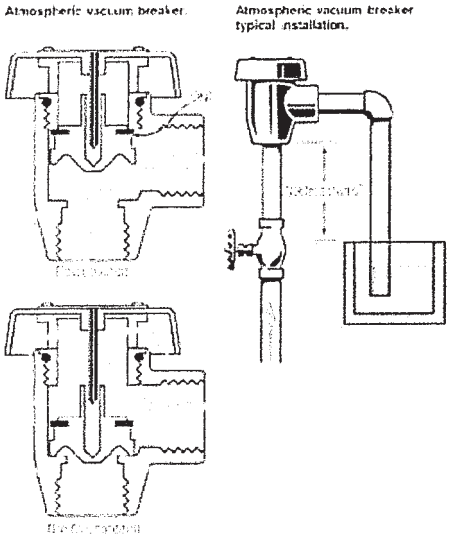
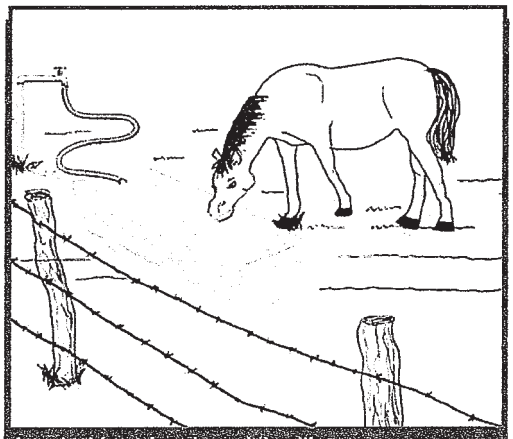
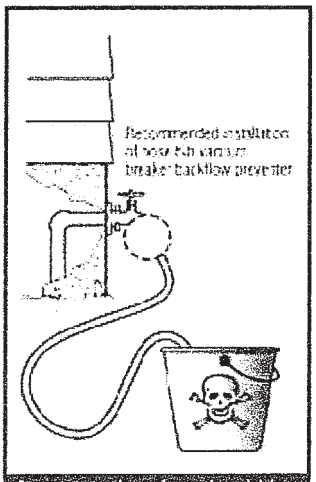


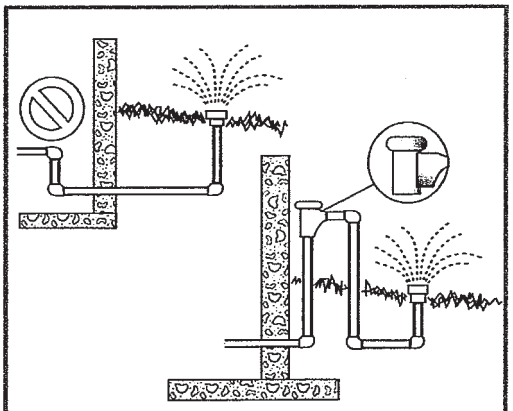
A properly installed vacuum breaker (atmospheric vacuum breaker) provides excellent protection against backsiphonage. For example, if the flow in the pipe is stopped, a vacuum breaker valve drops down, closes the water supply entry, opens an air vent, and prevents contaminants from being siphoned into the water supply. Vacuum breakers do not protect against backpressure.



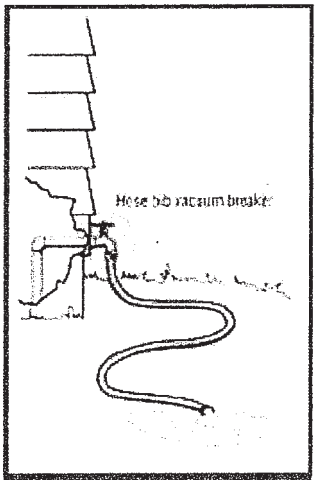
A typical frost-free hose bib with no vacuum breaker—a common situation where a vacuum breaker should be installed.



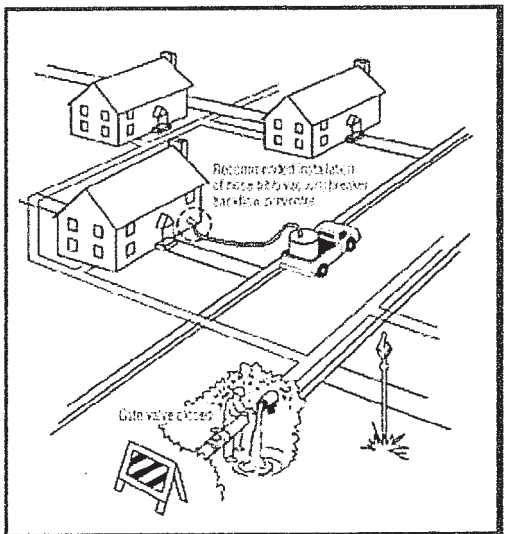
A vacuum breaker should be installed on all hose bibs.



Lawn irrigation systems need a vacuum breaker backflow preventer to protect against lawn chemicals being drawn into the drinking water supply.



Typical hose bib with no built-in vacuum breaker—a simple screw-on vacuum breaker can be installed.



In most circumstances, homeowners should install a hose bib vacuum breaker backflow preventer. A hose bib, also called a bibcock or sillcock, is typically used to provide hose connections outside of buildings. The downstream side of the valve (faucet) is threaded to match standard garden hoses. A typical situation that could cause backsiphonage is when a break occurs in a waterline that requires workers to shut off valves in the surrounding area to make repairs. Water can then drain out of the lines and siphon contaminants

A typical screw-on vacuum breaker for a hose bib.

References:

Bhardwaj, Vipin. 2004. "Tech Brief: Cross Connection and Backflow Prevention," *On Tap*. National Drinking Water Clearinghouse: Morgantown, WV.

U.S. Environmental Protection Agency. 2003. *Cross-Connection Control Manual*. Washington DC: EPA (Available as a product from NDWC, item #DWBKDM03)

Resort Municipality of Whistler. *http://www.whistler.ca/content/view/237/*

Watts Water Technologies, Inc. Canada. 2006. Backflow Prevention/Learn About. Educational Resources to Keep You Informed. *www.wattscanada.ca/pro/divisions/backflowprevention/learnabout/learnabout_usc.asp*. Accessed on May 22, 2007.

http://encyclopedia.thefreedictionary.com/Hose+bib Accessed on November 27, 2007.

http://en.wikipedia.org/wiki/Double_check_valve. Accessed on November 27, 2007.

The Source About Air. 2007. A Quick Word About Air Gaps. *www.airgap.com/about_airgaps.htm*. Accessed on November 27, 2007.

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High Hazard Cross Connections in Minnesota

In response to the federal Safe Drinking Water Act Ground Water Rule and recent incidents in Minnesota, the Minnesota Department of Health (MDH) has adopted high-hazard cross connections that are not adequately protected as a Significant Deficiency for all Community Public Water Systems (CPWSs).

For the purposes of CPWS Unit program implementation, SDs will be defined as high-hazard cross connections that need a Reduced Pressure Zone (RPZ) backflow preventer or air gap to meet the Minnesota Plumbing Code. However, CPWSs can adopt a more comprehensive approach, addressing all cross connections as part of a cross connection control program.

Plumbing cross connection contamination incidents occur throughout Minnesota, in both large and small communities. Below is a sample of cross-connection contamination events at CPWSs identified during MDH Drinking Water Emergency Responses:

June 2009	**Metro area**
Population 85,000	**Ethylene glycol**
April 2011	**Metro area**
Population 390,000	**Ethyl ether**

Incidents have also occurred in small to medium-sized communities in Minnesota.

As of July 1, 2011, MDH District Engineers are working with CPWSs to start identifying high-hazard cross connections that are not adequately protected. These Significant Deficiencies have the potential to cause introduction of contamination into finished drinking water, and are not allowed under the Minnesota Plumbing Code.

Many CPWSs already have established programs for monitoring high-hazard cross connections in their water distribution system. MDH is working with the Minnesota Department of Labor and Industry (DLI), League of Minnesota Cities (LMC), Minnesota Section of American Water Works Association (MNAWWA), Minnesota Rural Water Association (MRWA), local plumbing code authorities, and the plumbing industry to establish resources and rule language to help all CPWSs in addressing inadequately protected high-hazard cross connections.

These organizations are available to provide the following resources:

1) Provide information for elected officials regarding the threats and liabilities (public health and economic) associated with drinking water contamination due to inadequately protected high-hazard cross connections, i.e. fact sheets, website resources, workshops [LMC, AWWA, MRWA, MDH, DLI, and local plumbing code authority];

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2) Provide municipalities guidance for writing and adopting cross connection control ordinances [LMC, AWWA, MRWA, MDH, DLI, and local plumbing code authority];

3) Provide licensed boiler operators with training and spring/fall reminder letters regarding the importance of cross connection control during boiler maintenance [DLI and MDH];

4) Require local plumbing code authorities to forward received copies of all RPZ backflow preventer installation and maintenance records to the PWS [local plumbing code authority and DLI];

5) Provide CPWSs with templates for tracking high-hazard cross connections with RPZ installation and maintenance records, i.e. spreadsheet and postcard notices [MRWA and LMC]; and

6) Provide CPWSs with enforcement resources to address high-hazard cross connections that are not adequately protected including:
   a) ordinance language for enforcement and adopting any necessary fines [MRWA and LMC];
   b) fact sheet listing responsible authorities [MDH];
   c) assistance from enforcement authorities [regulatory authorities for licensed businesses; local plumbing code authority, DLI, and MDH].

You can find additional resources at http://www.lmc.org (ordinances), http://www.mrwa.com (templates and helpful hints for implementing cross-connection control programs), http://www.mnawwa.org, http://www.abpa.org, http://www.dli.state.mn.us, and http://www.health.state.mn.us for information on High-Hazard Cross Connections - Significant Deficiencies and High-Hazard Cross Connections – Responsible Authorities.

For more information, contact:
Environmental Health Division
Drinking Water Protection Section
http://health.state.mn.us/water
651-201-4700

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