Four-Day Cross Connection Specialist Course - 3.2 CEUs

19600 Molalla Avenue #t 104 Oregon City, OR 97045

Class meets in-person only T-F, 8:00 AM - 5:00 PM

Location
Clackamas Community College, Training Center B, Room T104
19600 Molalla Ave.
Oregon City, OR 97045

Description:
This course aims to equip individuals involved in safeguarding public water systems from contamination due to cross connections, with a focus on cross connection control specialists, plumbing inspectors, waterworks managers, and backflow device testers. Students will learn to set up and operate cross connection control programs, coordinate with other agencies, and draft cross connection ordinances. CEUs earned count towards inspector certification with the State of Oregon Health Authority.

URL: https://ccc-wet.eventbrite.com/

OESAC Four-Day APPLICATION

WORKSHOP OUTLINE

NAME OF WORKSHOP

Cross Connection Specialist Course Hours: 3.2 CEU

Institution: Clackamas Community College

Course Objectives: Designed to provide information to individuals involved in the protection of public water systems from contamination due to cross connections. This course should be of special interest to cross connection control specialists, plumbing inspectors, waterworks managers, and backflow device testers.

Learning Outcomes: Students will be able to set-up and operate a cross connection control program as well as coordinate cross connection control with other agencies. Students will be schooled in writing a cross connection ordinance.

The CEUs earned apply towards the inspector certification through the State of Oregon Health Authority.

4-Day Cross Connection Specialist Course
Schedule

Monday	
8:00 – 10:00	Lecture
10:00 – 10:15	*Break*
10:15 – 12:00	Lecture
12:00 – 1:00	*Lunch*
1:00 – 2:45	Lecture
2:45-3:00	*Break*
3:00 – 5:00	Lecture
Tuesday	
8:00 – 10:00	Lecture
10:00 – 10:15	*Break*
10:15 – 12:00	Lecture
12:00 – 1:00	*Lunch*
1:00 – 2:45	Lecture
2:45-3:00	*Break*
3:00 – 5:00	Lecture
Wednesday	
8:00 – 10:00	Lecture
10:00 – 10:15	*Break*
10:15 – 12:00	Lecture
12:00 – 1:00	*Lunch*
1:00 – 2:45	Lecture
2:45-3:00	*Break*
3:00 – 5:00	Lecture
Thursday	
8:00 – 10:00	Lecture
10:00 – 10:15	*Break*
10:15 – 12:00	Lecture
12:00 – 1:00	*Lunch*
1:00 – 2:45	Review of course content
2:45-3:00	*Break*
3:00 – 5:00	Written Exam

Cross Connection Control: 4-Day Certification

Clackamas Community College: Oregon Backflow Training (OBT)

James T. Nurmi, Ph.D.
Mathew LaForce, Ph.D.

Cross Connection Control

Sections

1. **History of Cross Connection Control**
2. **Working Together for Safe Water (video)**
3. **Hydraulics**
4. **Backflow Preventers**
5. **Facilities and their Cross Connections**
6. **Elements of a Program**
7. **Real World Examples of Problems/Incidents**
8. **Court Cases = CYA**
9. **Residential Plumbing Issues**
10. **Safety**
11. **What's new in Cross Connection Control?**

Definition of Cross-Connection

Definition of Cross-Connection

TCA 68-221-703. Definitions.

As used in this part, unless the context otherwise requires:

"Cross connection" means any physical arrangement whereby a public water supply is connected, directly or indirectly, with any other water supply system, sewer, drain, conduit, pool, storage reservoir, plumbing fixture or other device which contains, or may contain, contaminated water, sewage or other waste or liquid of unknown or unsafe quality which may be capable of imparting contamination to the public water supply as a result of backflow. Bypass arrangements, jumper connections, removable sections, swivel or change-over devices through which, or because of which, backflow could occur are considered to be cross-connections; [Acts 1983, ch. 324, § 4; 1988, ch. 583, § 2; T.C.A. § 68-13-703; Acts 1998, ch. 592, §§ 1-3.]

Requirements for a Cross Connection Specialist Training Course

- Definitions, identification of cross connection hazards, and the hydraulics of backflow
- Approved cross connection control methods, backflow prevention assembly specifications, and testing methods used for Authority approved backflow prevention assemblies
- Cross connection control requirements for public water systems, implementation of a cross connection control program, and writing a local cross connection control ordinance
- Public education and record keeping requirements for an effective cross connection control program
- Facility water use inspection techniques and hands on inspection of local facilities to identify actual or potential cross connections
- Cross connection control program enforcemnet and managing a backflow assembly tester program
- Review and discussion of cross connection specialist safety issues
- Minimum score of 70% on written exam

Section 1

History of X-Connection

History: Ancient Civilizations

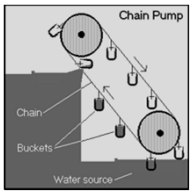
- Typically, civilizations started near water for drinking and irrigation
  - Clay jars were the earliest type of water distribution systems
  - Romans developed intricate network of aqueducts to carry water to their cities for drinking, bathing, fountains and finally to wash their waste away.

History: Ancient Civilizations

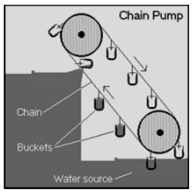
How did the Babylonians get water up to the garden?

History: Ancient Civilizations

Buckets brought water from the Euphrates…..HOW?

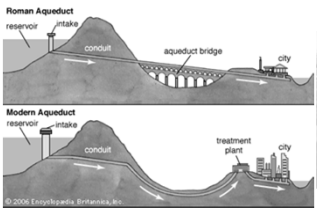


History: Ancient Civilizations



+ Slave Power

History: Ancient Civilizations



History: Ancient Civilizations

- The final destruction of Rome occurred in 537 AD during a siege on Rome by the Goths.
  - The aqueducts which supplied Rome with water were destroyed. The people of Rome could not survive without water and the population of Rome fell by 90% because of lack of water and disease.
- This is because they relied on aqueducts so much. Imagine if someone turned off all of your water in your house and said “SURVIVE”.
  - It would be impossible.
  - So when an Aqueduct was destroyed it was catastrophic.

History: Modern Age

- Most early water systems were developed primarily for fire suppression in industrial areas
- First developed municipal water utility was established in Boston, MA in 1652
- Pipes were hollowed out to transport water
- If you needed water, firefighters drilled a hole in the wood and plug them when done. Call a

History: Modern Age

- Earliest insurance companies insisted that water would be available either from the distribution system or directly from the river, so the distribution lines were directly linked to the river with only a single check or gate valve. Guess what happened?

History: Modern Age

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CROSS CONNECTION!!!!

- "Secondary Water Supplies, Their Danger and Values" published in 1910 New England AWWA subsection
  - The check valve consisted of an iron body with cast iron swing checks of clappers = metal to metal seating

History: Modern Age

- Earliest insurance companies insisted that water would be available either from the distribution system or directly from the river, so the distribution lines were directly linked to the river with only a single check or gate valve. Guess what happened?

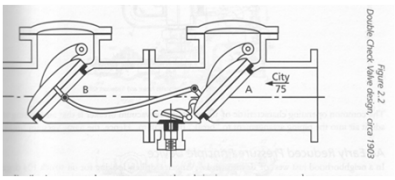
BACKFLOW INCIDENTS!!!!

- "Secondary Water Supplies, Their Danger and Values" published in 1910 New England AWWA subsection
  - The check valve consisted of an iron body with cast iron swing checks of clappers = metal to metal seating
  - RUST = limited BACKFLOW PROTECTION
  - Solution = multiple checks

History: Modern Age

First Check Valve designed in 1903

- Both checks (A and B) connected so that if one opens, both opens
- When there is flow, the Drain (C) closes
- Flow stops, checks close and drain (C) will open
- All of the components are linked together



Double Check Valve design, circa 1903 Figure 2.2

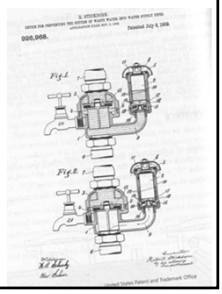
Frank P. Cotter developed a "simple self sealing check valve, adapted to be connected in the pipe connections without requiring special fittings and which may be readily opened for inspection or repair" 1907 (U.S. patent #865,631).

Nikola Tesla invented a deceptively simple one-way valve for fluids in 1916, called a Tesla valve. It was patented in 1920 (U.S. patent 1,329,559).

History: Modern Age

Vacuum Breakers

- 1909, first patent approved for "Device for Preventing The Return of Waste Water into Water Supply Pipes" = first atmospheric vacuum breaker
- Opening will admit air into the piping in order to break the vacuum



History: Modern Age

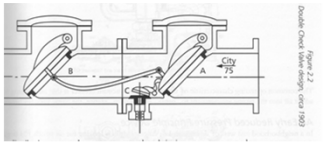
Early Reduced Principle Device

- West of LA, Oil drillers struck 104^0C sodium rich water = Bimini Water Company (supplied local water until 1915
- Thermal springs were fed to local swimming pools
- Created an obvious cross-connection!
- Required to install a double check assembly
- This particular Double Check had a relief valve that opened when the inlet shutoff valve was closed = first type of reduced pressure backflow assembly.

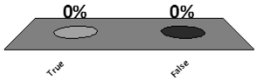
This is a picture of one of the first Check Valves?

A. True

B. False



Note how the checks and drain are physically connected.



Section 2

Working Together for Safe Water (15 min. video)

Section 3

Hydraulics

Outline

- **Hydraulics Review**
- **Definitions**
- **Backflow Preventers**
- **Applications**
- **Summary**

Water Height (ft) to Pressure (psi)

A container that is 1 ft by 1 ft by 1 ft (a cubic foot container) is filled with water. What is the pressure on the square foot bottom of the container.

Water density = 62.4 lb/ft^2

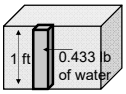
Convert = 62.4 lb/ft^2 = 62.4 lb/ (1 ft) (1 ft)

= 62.4 lb/(12 in) (12 in)

= 62.4 lb/(144 in^2)

= 0.433 lb/in^2

= 0.433 psi

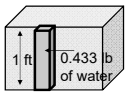


A foot high column of water over a square inch surface area weighs 0.433 lb which equals 0.433 psi.

Thus, 0.433 converts pressure from feet of water to pressure in pounds per square inch. **

Pressure (psi) to Water Height (ft)

Can use a ratio to determine feet of water are equivalent to psi



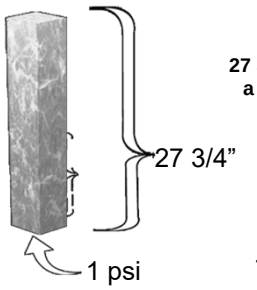
$$\frac{1ft}{0.433\,psi} = \frac{(x)ft}{1psi}$$

$$\frac{(1ft)(1ft)}{0.433\,psi} = x$$

2.31 ft = x

1 psi is equivalent to the pressure created by a column of water 2.31 ft high

PSI = pounds of pressure per square inch

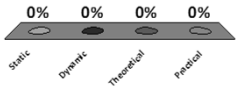


27 3/4" of water generates a pressure of one pound per square inch (psi)

1 PSI = 2.31 ft

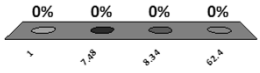
The pressure exerted by a column of water one inch square when at rest, is the _____ pressure. It is usually measured in psi.

A. Static
B. Dynamic
C. Theoretical
D. Practical



A pound of water weighs _____lbs.

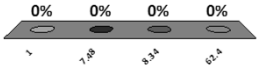
A. 1
B. 7.48
C. 8.34
D. 62.4



A pound of water weighs _____lbs.

GOTCHA!!!

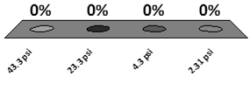
A. 1
B. 7.48
C. 8.34
D. 62.4



At a wastewater treatment plant a RP device is installed 100 ft below some elevated piping containing raw sewage. If a backflow incident occurs what is the backpressure that could be exerted on the RP assembly?

Given Elevation = 100 ft
Formula For 1 ft of water =0.433 psi
Solve: 100 ft X 0.433psi = 43.3 psi

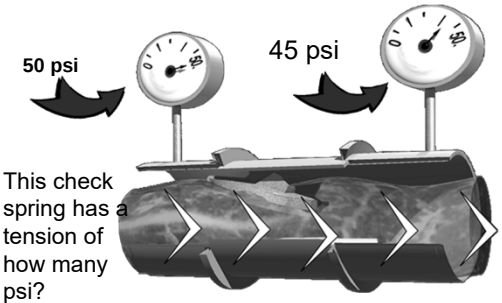
A. 43.3 psi
B. 23.3 psi
C. 4.3 psi
D. 2.31 psi



Water pressure naturally tends to equalize.

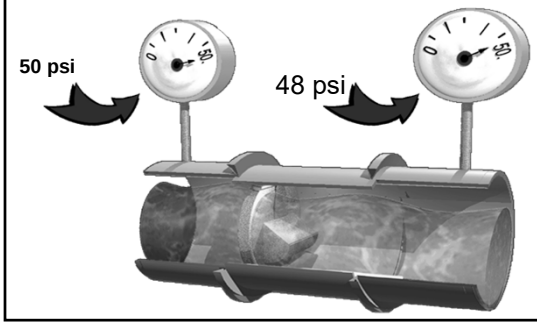
Therefore, water flows from high pressure regions to low pressure regions

Normal Flow

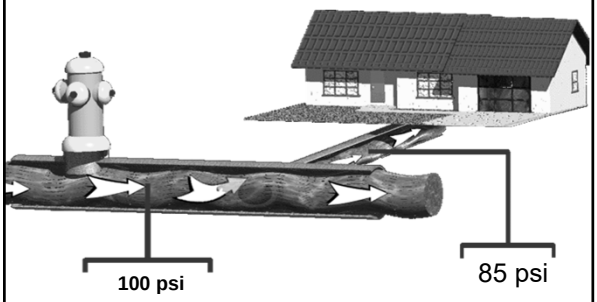


This check spring has a tension of how many psi?

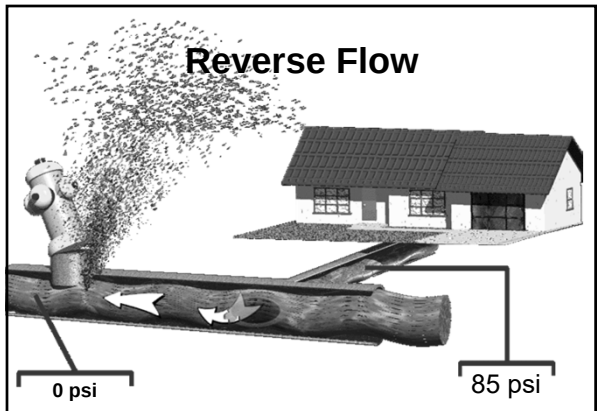
No Flow



Normal Flow



Reverse Flow



Backflow

The undesirable reversal of flow of water or other substances into the potable water distribution supply

Backflow

Backflow is caused by either:

- **Backpressure**
- **Backsiphonage**

Backflow: Backpressure

Pressure in Downstream Piping Greater than Supply Pressure

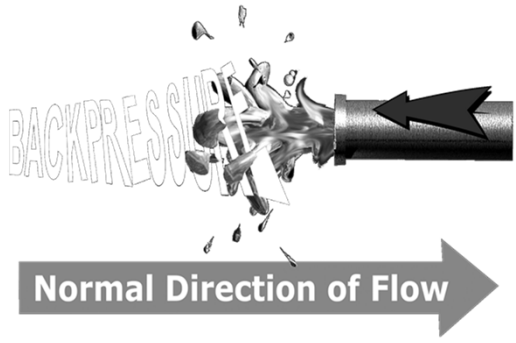
<u>Backpressure Caused By:</u>

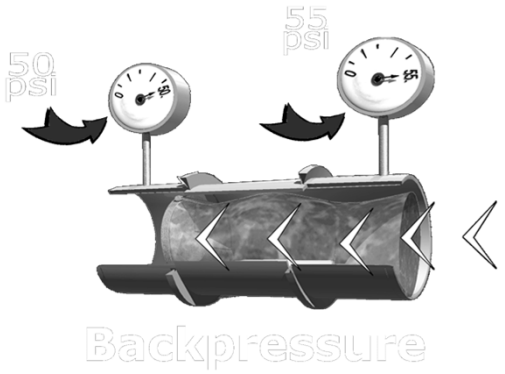
Backflow: Backpressure

Pressure in Downstream Piping Greater than Supply Pressure

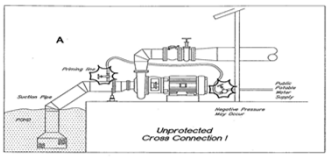
<u>Backpressure Caused By:</u>

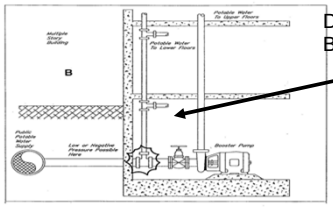
- Elevated Piping
- Potable water connections to pumps: Discharge side of pump
- Thermal Expansion-Boilers.





Priming Line = Cross Connection



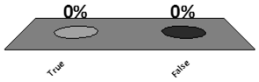


Discharge Side = Backpressure

Figure 6. Both of these installations can produce the potential for negative pressure in the potable water supply line.

Backpressure can be caused by elevated piping, the discharge side of a pump and thermal expansion?

A. True
B. False



Backsiphonage

Sub-Atmospheric Pressure in the Water System

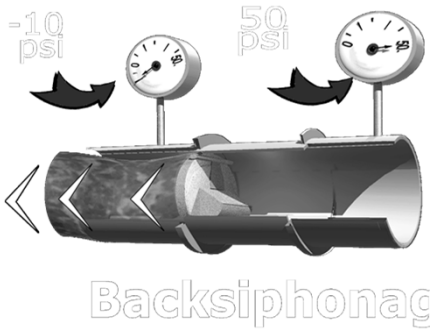
Backflow: Backsipohonage

Backsiphonage Caused By:

Backflow: Backsipohonage

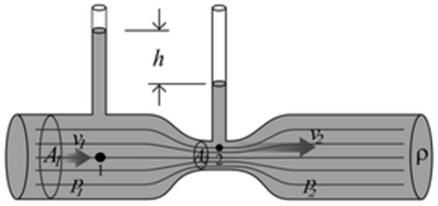
Backsiphonage Caused By:

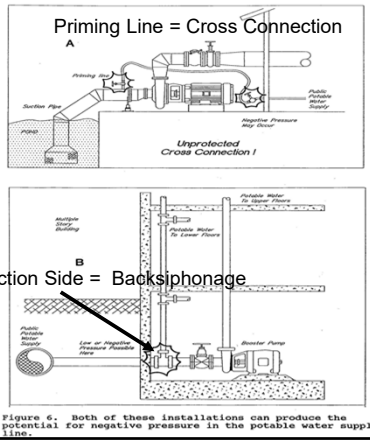
- Elevated Piping - water main break, Fire Fighters
- Potable Water connections to pumps: Suction side of pump
- Venturi Effect



Venturi Effect

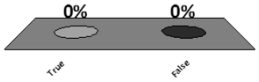
- **The Venturi effect is a special case of Bernoulli's principle, in the case of fluid or air flow through a tube or pipe with a constriction in it.**
- **This can occur when water distribution pipes break or have leaks!!!**





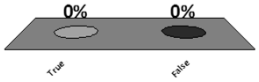
Backsiphonage can be caused by elevated piping, the suction side of a pump or the Venturi effect?

A. True
B. False



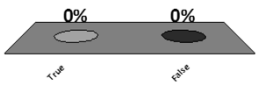
Backpressure occurs when elevated pressure in a system causes water to flow opposite of its intended direction?

A. True
B. False



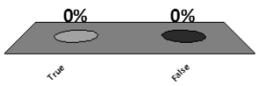
Backsiphonage means a drop in distribution system pressure below atmospheric pressure (partial vacuum), that would cause, or tend to cause, water to flow opposite of its intended direction.

A. True
B. False



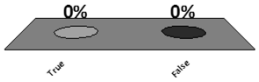
Backpressure and backsiphonage are forces contributing to the reverse flow of water in pipelines

A. True
B. False



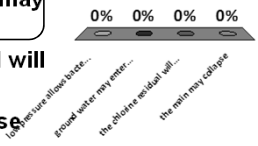
A positive pressure in the distribution system is desirable to keep toxic substances out of the system.

A. True
B. False



From a sanitary standpoint, the pressure in a distribution system should never be allowed to fall to zero because

A. low pressure allows bacteria to multiply
B. ground water may enter and backsiphonage may occur
C. the chlorine residual will drop faster
D. the main may collapse



Cross-Connection

An actual or potential connection between a potable water supply and any non-potable substance or source

Key Words Backflow

Cross connection- cross-connection is the link or channel connecting a source of pollution with a potable water supply.

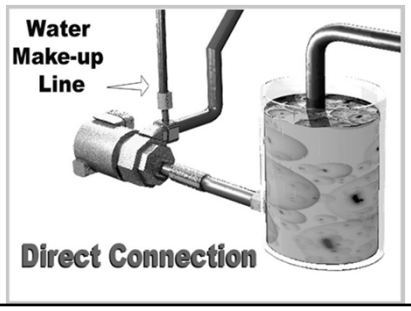
Direct "ACTUAL" cross connection = physically connected plumbing = subject to either backpressure or backsiphonage

Indirect "POTENTIAL" cross connection = something has to happen = only subject to backsiphonage (ex. Garden fertilizer)

Service Connection- means the piping connection by means of which water is conveyed from a distribution main of a public water system to a user's premise. *For a community water system, the portion of the service connection that conveys water from the distribution main to the user's property line, or to the service meter, where provided, is under the jurisdiction of the water supplier*.

Direct "ACTUAL" cross connection

- physically connected plumbing = subject to either backpressure or backsiphonage



Indirect Cross-Connection

- **Indirect "POTENTIAL" cross connection = something has to happen = only subject to backsiphonage (ex. Garden fertilizer)**

Submerged Inlet

Indirect Cross Connection: Why?

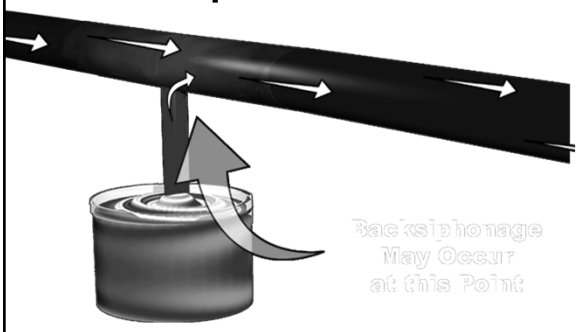
Low Inlet

Direct Cross Connection: Why?

Low Inlet

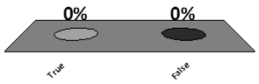
Direct Cross-Connection?

Indirect X-Connection: Aspirator Effect



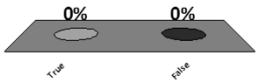
In a cross connection control plan the service connection is typically located at the property line or service meter of a home?

A. True
B. False



An Auxiliary Water Supply is any supply of water used to augment the supply obtained from the public water system, which serves the premise in question (groundwater well).

A. True
B. False



Direct or Indirect Cross-connection?

A. Direct
B. Indirect

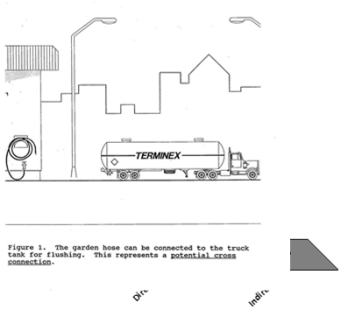


Figure 1. The garden hose can be connected to the truck tank for flushing. This represents a potential cross connection.

dir. indir.

Degree of Hazard

- **Non-Health Hazard**
- **Health Hazard**

Pollutant

- **Non-Health Hazard: aesthetically objectionable (smells, tastes bad, looks bad) but does not hurt the consumer.**
- **Give some examples?**

Contaminant

- **Health Hazard: a substance that has either a acute or chronic effect on the consumers health**
- **Give Examples?**
- **How do we protect the community from these CONTAMINANTS?**

Section 4

Backflow Preventers

Backflow Assemblies

Backflow Preventer- means a device, assembly or method to prevent backflow into the potable water system.

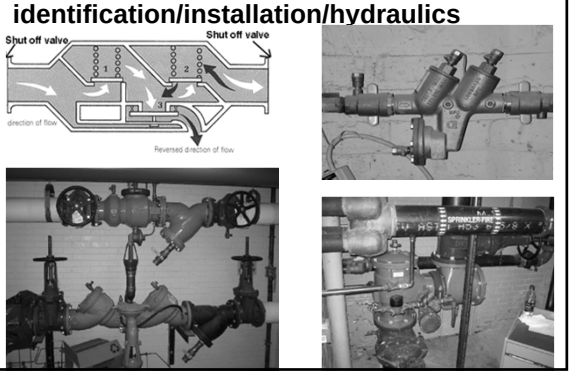
Approved Backflow Prevention Assembly- means a Reduced Pressure Principle Backflow Prevention Assembly, Reduced Pressure Principle-Detector Backflow Prevention Assembly, Double Check Valve Backflow Prevention Assembly, Double Check-Detector Backflow Prevention Assembly, Pressure Vacuum Breaker Backsiphonage Prevention Assembly, or Spill-Resistant Pressure Vacuum Breaker Backsiphonage Prevention Assembly, of a make, model, orientation, and size approved by the Department.

Assemblies listed in the currently approved backflow prevention assemblies list developed by the University of Southern California, Foundation for Cross-Connection Control and Hydraulic Research

Five Means of Preventing Backflow

- Air Gap Separation
- Reduced Pressure Principle Assembly
- Double Check Valve Assembly
- Pressure Vacuum Breaker/ Spill-Resistant Vacuum Breaker
- Atmospheric Vacuum Breaker

Backflow prevention assemblies identification/installation/hydraulics



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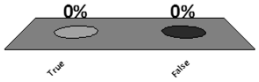

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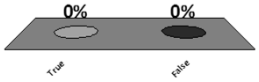
A. True

B. False

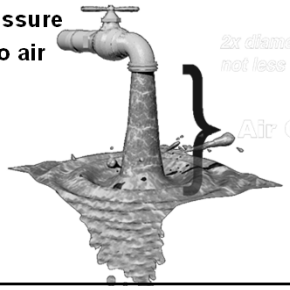


Air Gap: Highest Level of Protection But????

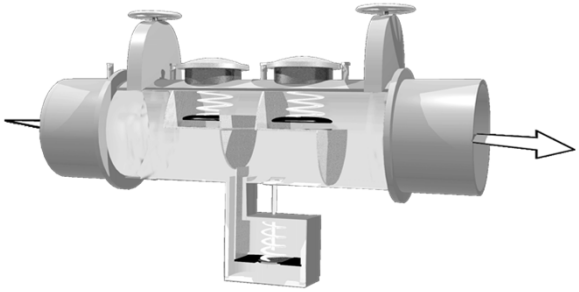
- Air Gap = 2 x diameter (2d) but never less than 1 inch
- Why can't these be used in many applications?

Air Gap: Highest Level of Protection But????

- Air Gap = 2 x diameter (2d) but never less than 1 inch
- Why can't these be used in many applications?
  - Loss of pressure
  - Exposure to air

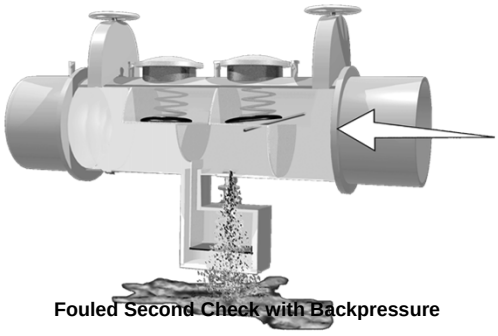


Reduced Pressure Principle Assembly (RP)



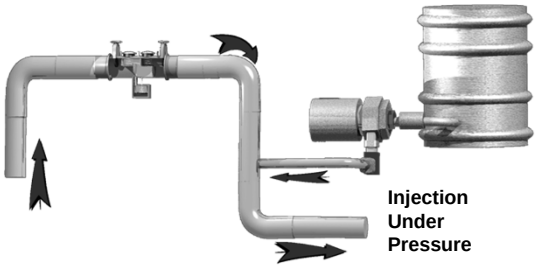
Normal Flow

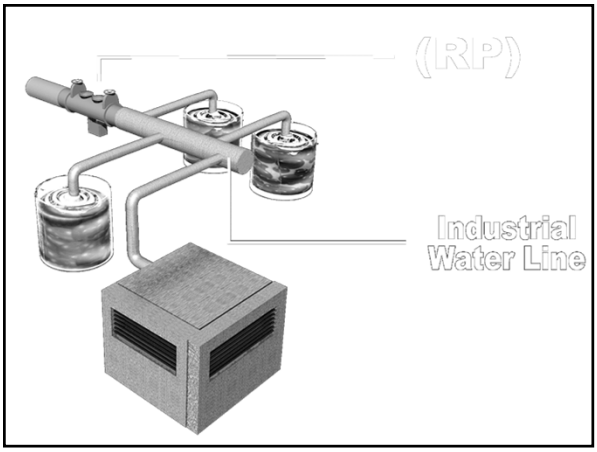
Reduced Pressure Principle Assembly (RP)

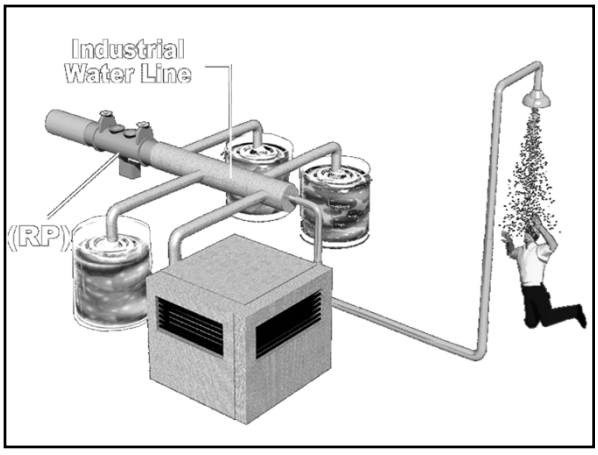


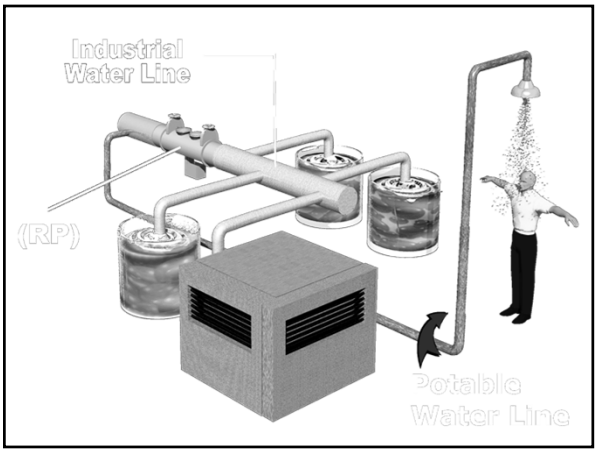
Fouled Second Check with Backpressure

Reduced Pressure Principle Assembly (RP)



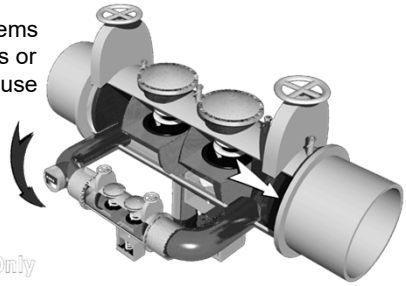






Reduced Pressure Principle Detector Assembly

Used on fire sprinkler systems to detect leaks or unauthorized use

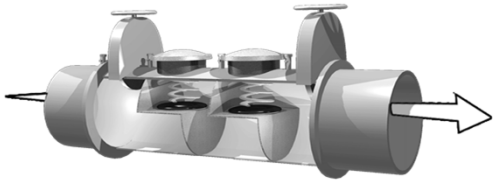


At Least 3 GPM Through Bypass Only

Reduced Pressure Principle Assembly (RP)

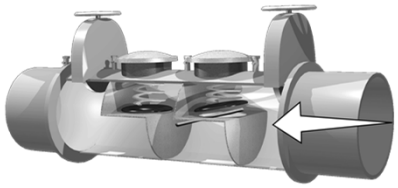
- **Backsiphonage**
- **Backpressure**
- **Pollutant**
- **Contaminant**

Double Check Valve Assembly (DC)



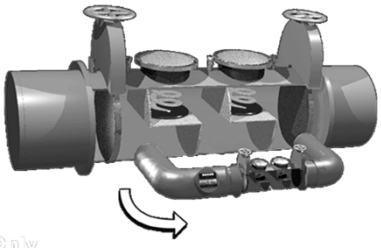
Normal Flow

Double Check Valve Assembly (DC)



Backpressure
Second Check Fouled

Double Check Detector Assembly



At least 3 GPM Through By Pass Only

Double Check Valve Assembly (DC)

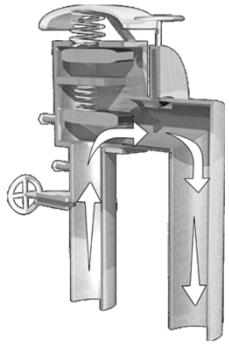
- **Backsiphonage**
- **Backpressure**
- **Pollutant**

Proper Installation for DC and RP

- **Minimum 12” above grade**
- **Maximum 36” above grade**
- **Accessibility for testing and repair**
- **Weather/vandalism protection (if needed) with adequate drainage**

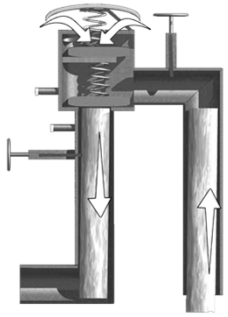
Proper Installation for DC and RP

Backflow Preventers should only be installed vertically, if they have been specifically approved for vertical orientation



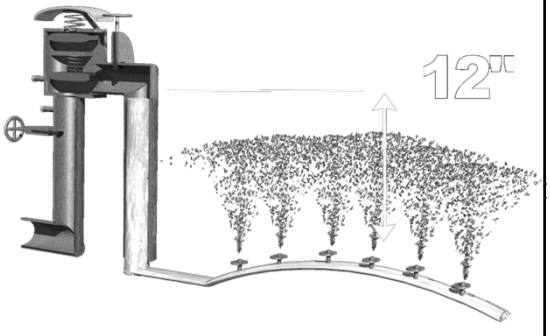
Pressure Vacuum Breaker (PVB)

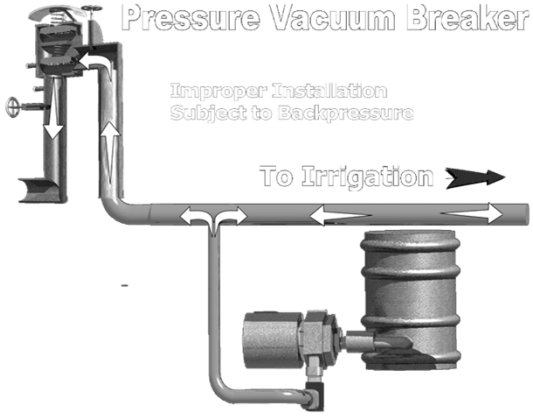
Normal Flow

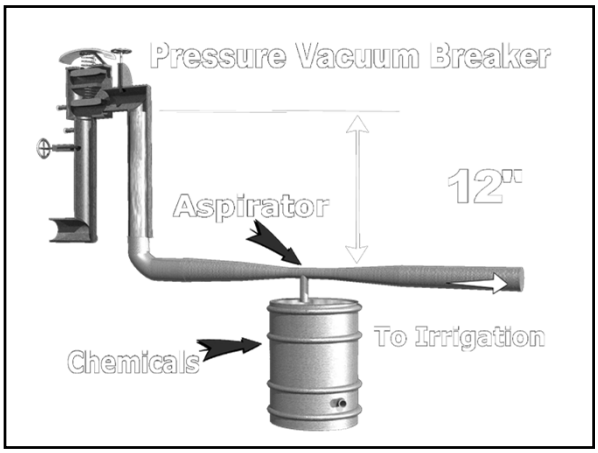


Pressure Vacuum Breaker (PVB)

Backsiphonage Condition

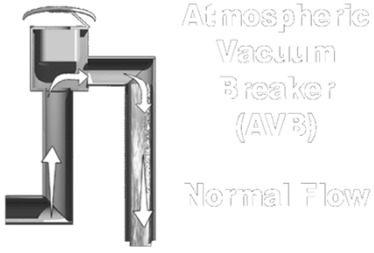






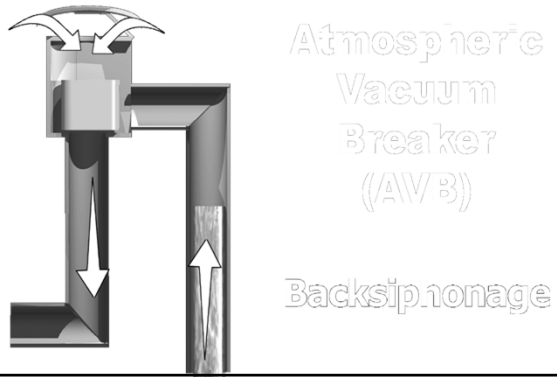
Pressure Vacuum Breaker

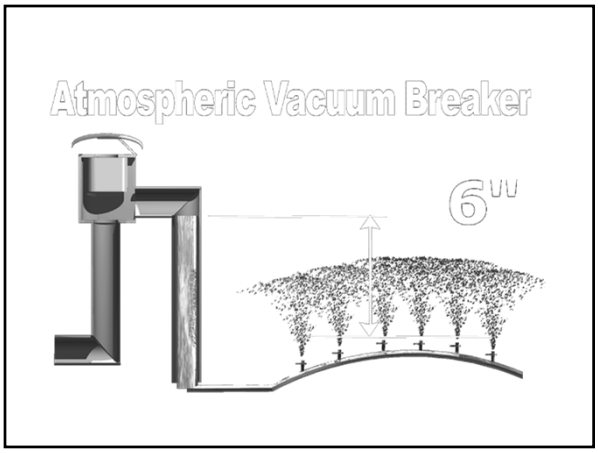
- **Backsiphonage Only**
- **Pollutant**
- **Contaminant**
- **Elevation - 12”**

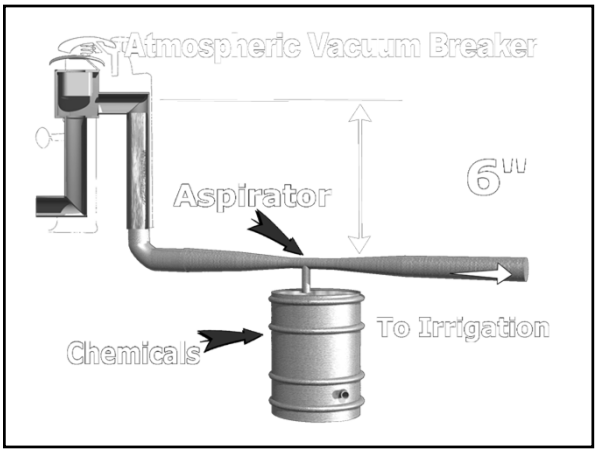


Can be used for pollutants or contaminants BUT only protects against backsiphonage.

These are what is installed on your hose bibs!



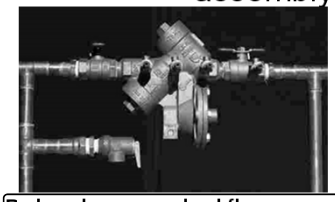




Atmospheric Vacuum Breaker

- Backsiphonage Only
- Pollutant
- Contaminant
- Elevation - 6”
- Non-Continuous Use
- No down stream shut-off valves

The following image is a _____ assembly?



A. Reduced pressure backflow assembly
B. Double check valve assembly
C. Pressure vacuum breaker assembly
D. Atmospheric vacuum breaker
E. Air gap

The following image is a _____ assembly?

A. Reduced pressure backflow assembly
B. Double check valve assembly
C. Pressure vacuum breaker assembly
D. Atmospheric vacuum breaker
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The following image is a _____ assembly?

A.
B. Double check valve assembly
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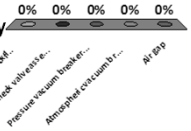

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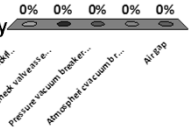

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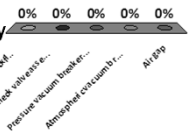

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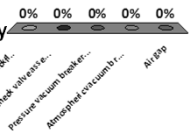

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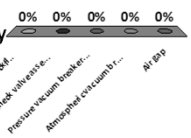
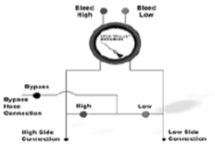
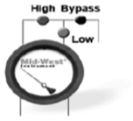


So, how do we test these assemblies?

Differential Pressure Gauge

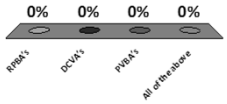


3 Valve Gauge



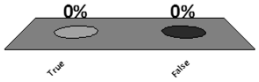
A differential pressure gauge is used to test the following Assemblies?

A. RPBA's
B. DCVA's
C. PVBA's
D. All of the above



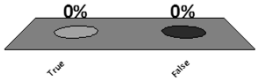
A backflow device can be tested?

A. True
B. False



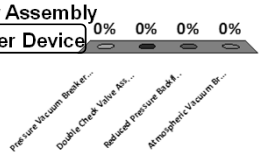
A backflow assembly is testable?

A. True
B. False



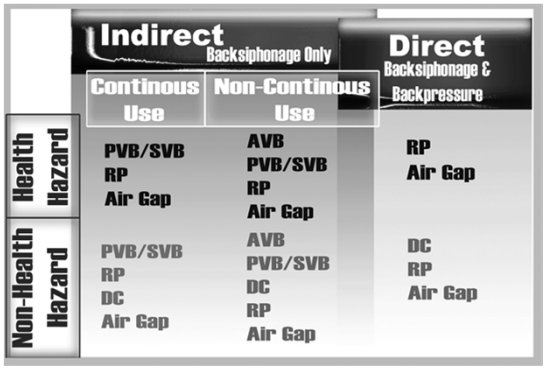
Which of the following is not testable?

A. Pressure Vacuum Breaker Assembly
B. Double Check Valve Assembly
C. Reduced Pressure Backflow Assembly
D. Atmospheric Vacuum Breaker Device

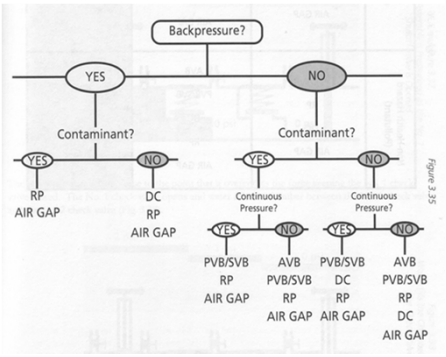


Three Questions

- What type of Cross-Connection is it?
  - Indirect?
  - Direct?
- What is the degree of Hazard?
  - Non-health hazard?
  - Health hazard?
- Is it under continuous use (or pressure)?



Three Questions:



Page 69 In-Class Assignment

Section

Facilities

- **5 Typical Facilities: useful in preparing for a site visit**

What are they?

Facilities

5 Typical Facilities: useful in preparing for a site visit

1. **Services**

Facilities

5 Typical Facilities: useful in preparing for a site visit

1. **Services**
2. **Manufacturing**

Facilities

5 Typical Facilities: useful in preparing for a site visit

1. **Services**
2. **Manufacturing**
3. **Food Processing**

Facilities

5 Typical Facilities: useful in preparing for a site visit

1. **Services**
2. **Manufacturing**
3. **Food Processing**
4. **Medical**

Facilities

5 Typical Facilities: useful in preparing for a site visit

1. **Services**
2. **Manufacturing**
3. **Food Processing**
4. **Medical**
5. **Restricted**

Facilities

5 Typical Facilities: useful in preparing for a site visit

1. **Services**
2. **Manufacturing**
3. **Food Processing**
4. **Medical**
5. **Restricted**

And then there are always the OTHERS???

Facilities

5 Typical Facilities: useful in preparing for a site visit

1. **Services**
   - Car Washes, Film Labs, and Laundry Facilities
     - Soap injection systems, recylcling/circulating systems
       - » May contain bird poop, vermin, algae, bacteria, toxic chemicals, copper sulfate, pentachlorophenol, chromates, mercury, ammonium compounds
     - Steam Generating Facilities
     - Water Cooled Equipment
     - Sewer connected plumbing fixtures (flush valve toilets)
     - Hydraulically-operated equipment
     - Tanks, automatic film processing machines (Walmarts)
     - Laundry Machines: under-rim or bottom inlets
     - Dye Vats
     - Water storage tanks

Facilities

5 Typical Facilities: useful in preparing for a site visit

2. **Manufacturing**
   - Aircraft, automotive, chemical, metal works, Oil/gas, plating, power, rubber, and sand/gravel facilities
     - Reservoirs, recirculating systems
     - Steam generating (often contain chemicals in water to increase steam production)
     - Plating fac. (contain toxic metals**)**
     - Sewer lines
     - Oil/gas tanks
     - Industrial fluid lines

Facilities

5 Typical Facilities: useful in preparing for a site visit

3. Food Processing

- Bakery, beverage manufacturing/bottling, brewery, cannery, dairy, frozen foods, packing, restaurants, slaughterhouses
  - Dishwashing equipment, food mixing tanks, reservoirs, fire fighting systems (antifreeze)
  - Laboratory equipment
  - Irrigation systems
  - Recycled water
  - Pasteurization equipment
  - Dehydration tanks

Facilities

5 Typical Facilities: useful in preparing for a site visit

4. Medical

- Nursing homes and assisted living, dentists, hospitals, kidney dialysis centers, medical labs, medical offices, veterinary offices
  - Lab equipment
  - Medical/dental equipment
  - Mortuary equipment
  - Whirlpools
  - All the others listed above

Facilities

5 Typical Facilities: useful in preparing for a site visit

5. Restricted

- Civil works, Classified, and Research facilties
  - Chemicals, alien parts, radioactive materials, etc.
  - All others listed above

Facilities

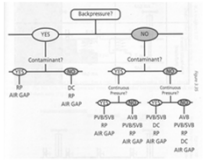
5 Typical Facilities: useful in preparing for a site visit

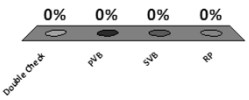
All of the OTHERS:

- Amusement parks, aquariums, hotels/motels, motion picture studios, schools/colelges, waterfront facilities, zoos, etc.

What type of assembly does a wastewater plant require?

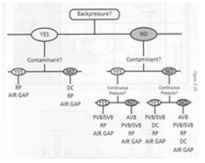
A. Double Check
B. PVB
C. SVB
D. RP

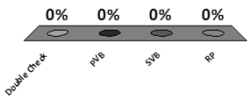




What type of assembly does a medical office require?

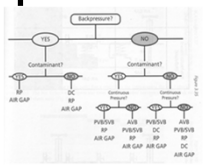
A. Double Check
B. PVB
C. SVB
D. RP

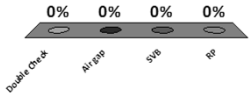




What type of assembly does a irrigation system without fertilizer line require?

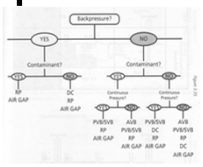
A. Double Check
B. Air gap
C. SVB
D. RP

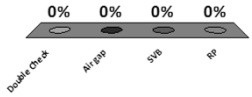




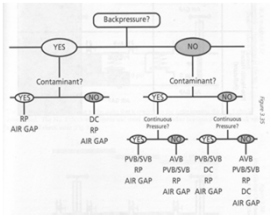
What type of assembly does a irrigation system with fertilizer line require?

A. Double Check
B. Air gap
C. SVB
D. RP





Three Questions:



Typical Cross Connections

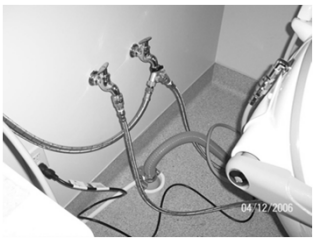
Give me some examples of where you might have a cross connection?

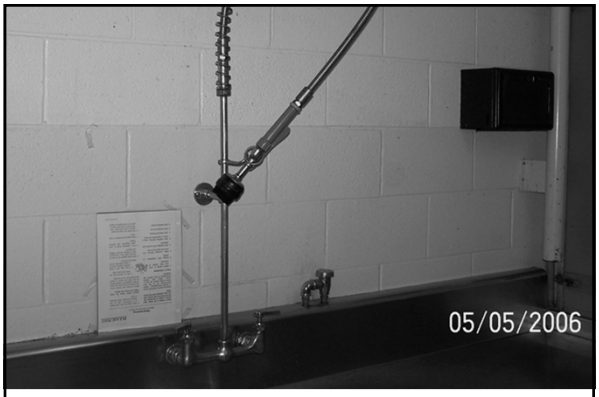
Hose Bib

Janitors Faucet

Laundry Tub Faucets

Hose Bibs: Medical Whirlpool





Hose and Spray

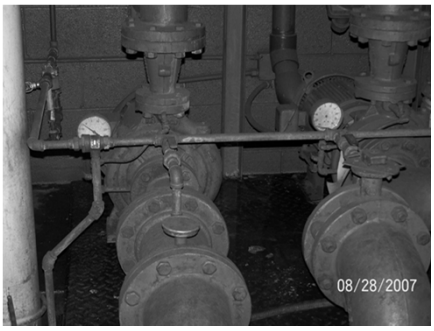
Fill Valve

Backflow Preventer

Boiler

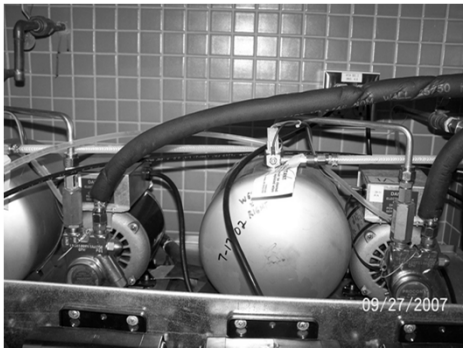
Electric Boiler

Cooling Towers



Coffee Makers

Carbonator



Carbonator

Soap Dispenser

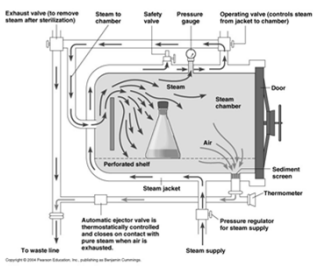
Commercial Dishwasher

Parts Washer

Chemical Dispenser

Mortuary Table

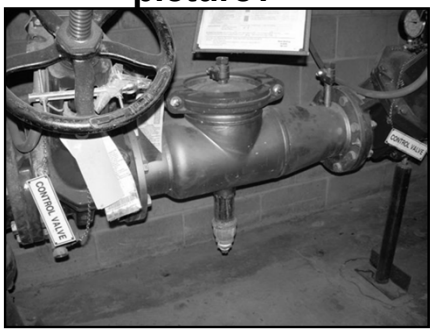
Autoclaves



Car Wash

- Hose thread vacuum breakers may be installed without a permit by anyone.
- A licensed plumber working under a permit is required for any other form of cross connection correction.

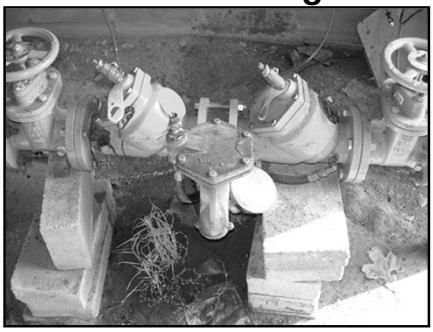
What's wrong with this picture?



What's Wrong?

What's Wrong?

What's Wrong?



What's Wrong?

What's Wrong?

Section 6

Elements of a Cross Connection Program

- Jurisdiction (who is responsible for what)
- Responsibilities
- ABCD and E's of a X-Connection Program

Jurisdiction (who is responsible for what)

- Water Supplier: responsible for water up to service connection
- Plumbing Code Enforcement Agency: have jurisdiction over internal plumbing (can issue permits etc at time of building or major renovations)
  - Typically do not require retroactive changes UNLESS it is determined to be UNSAFE, DANGEROUS, UNSANITARY OR A MENACE TO LIFE,HEALTH OR PROPERTY.
- International Plumbing Code: states same as above

Responsibilities

In order to protect our water, the water supplier, health agency, plumbing official and the consumer must work together!

Responsibilities

Health Agency: Promote and enforce laws, rules, regulations, and policies of an effective cross-connection control program

1. Public Potable Water System
   - Primary Responsibility: ensure water suppliers are operating potable water systems free of actual of potential sanitary hazards and cross connections
   - Meet federal and state standards
   - Require water suppliers to have a comprehensive cross connection control program

Responsibilities

Health Agency: Promote and enforce laws, rules, regulations, and policies of an effective cross-connection control program

2. Consumers Water System
   - Requires home owner (consumer) to install, test and properly maintain a approved backflow assembly when needed.
   - On site cross connection control and backflow requirements are addressed in State and Local Plumbing Codes

Responsibilities

Water Supplier (from Source to Consumer)

- Maintain their public water system in compliance with all Federal and State standards
- Should have a cross connection program in place
- Responsibility start at the source of the water and ends at the service connection
- Determine degree of hazard to the public water system
- If it is deemed that a backflow assembly is needed, can require the consumer to install at service connection

Responsibilities

Plumbing Official (point of service throughout users system)

- Starts at point of service and carries throughout the consumers water system.
- Review building plans and inspect plumbing as it is installed
- Explicit responsibility of preventing cross connections from being designed and built into structures
- In new plans, either eliminate cross connection or be provided a backflow assembly

Responsibilities

Consumer

- Starts at delivery site of water
- Prevent pollutants and contaminants from entering the water system
- If required to have a backflow assembly, required to install, operate, test and maintain
- Maintain accurate records of tests and repairs

Responsibilities

Certified Backflow Prevention Assembly Tester

- Perform accurate field tests
- Make reports for the consumer and the responsible authority

Responsibilities

Repair and Maintenance Technician

- Installing, repairing, overhauling and maintaining backflow prevention assemblies
- Make reports to consumer and the authority
  - Include list of all material and replacement parts
- Must use original manufactured replacement parts
- Do not change the design, material, or operational characteristics
- Technicians should have all state and local permits needed to repair, maintain, and overhaul backflow prevention assemblies.

ABCD and E's of X-Connection Control Program

A: Authority

B: Backflow Preventers

C: Certified Testers and Specialists

D: Defensible and Detailed Records

E: Education and Training

ABCD and E's of X-Connection Control Program

A: Authority: the administrative authority must have legal authority in place to implement policies, conduct site surveys and require back flow protection.

- Usually in the form of a local ordinance or law
- This legal document should include:
  - Accepted backflow assemblies
  - Field test procedures
  - Annual field test requirement
  - Maintenance
  - Installation
  - Certified testers
  - Certified specialists
  - Site surveys
  - Record keeping
  - Incident documentation
  - Public information
  - Non-compliance penalties

See Model Ordinance Handout!

ABCD and E's of X-Connection Control Program

B: Backflow Preventers

- A way to determine which list of Backflow preventers to use
  - Often it is written into the ordinance as Ex. "the most current List of Approved Backflow Prevention Assemblies"

ABCD and E's of X-Connection Control Program

B: Backflow Preventers
Approval/Listings

AWWA: Standards C510 and C511
- Cover DC and RP
- AWWA does NOT approve any assembly. The manufacturer claims that the assembly meets requirement of the AWWA

ASSE: develops standards for plumbing products including backflow assemblies
- To get ASSE stamped, requires lab evaluations by ASSE recognized labs

IAPMO: writes standards and codes
- Maintains standards for some plumbing products
- For others, they recognize standards of other organizations
- IAPMO has their own labs

ABCD and E's of X-Connection Control Program

Approval/Listings

Factory Mutual (FM): FM Global is a commercial and industrial insurance and risk management organization
- Maintains standards for DC's and RP's
- Requires assemblies to conform to either ASSE, AWWA, or USC
- Must also pass FM performance evaluation which include body strength and friction loss tests

Underwriters Laboratories (UL): independent, non-profit, product safety org.
- UL standard 1469 covers "backflow special check valves"?????
- RP's, DC's and detector assemblies
- Only test body strength and pressure loss

ABCD and E's of X-Connection Control Program

Approval/Listings

The Foundation for Cross Connection Control and Hydraulic Research at the University of Southern California (USC): in order for a backflow assembly to get approved, must meet the requirements in Chapter 10
- Extensive testing
- Includes a 1 year field evaluation of three assemblies under different conditions
- Field tested every 30-days
- All three have to pass or you start over

ABCD and E's of X-Connection Control Program

C: Certified Testers and Specialists

- Testers: Initial certification and recertification every two years
- Specialists: trained to administer a cross connection control program and to do site surveys to determine whether backflow assemblies are needed.
  - Need to understand degree of hazards, hydraulic conditions in which backflow can occur
  - All of this is needed in order to determine on a site survey whether a backflow assembly is needed

ABCD and E's of X-Connection Control Program

D: Defensible and Detailed Records

- Record keeping VERY important for CYA!!!!
- "defensible" means that the records should be sufficient to show that the administrative authority is meeting all of the requirements necessary to carry out their cross-control program.

ABCD and E's of X-Connection Control Program

E: Education

- General education regarding cross-connections of all personnel is important and reduces accidental cross-connections
  - The more people that are aware of what cross-connections are the better….you have more eyes out there!
- Also a good public relations tool.
  - Sometimes you need to convince a private owner that they need to install a backflow assembly….this can get difficult

ABCD and E's of X-Connection Control Program

To Summarize: 5 key elements of a Cross-Connection Control Program are?

What are they?

ABCD and E's of X-Connection Control Program

To Summarize: 5 key elements of a Cross-Connection Control Program are?

A. Authority (Rules)
B. Backflow Preventers (hardware)
C. Certified Testers and Specialists (Humans)
D. Defensible Records and Detailed Records (CYA!!)
E. Education and Training (Public)

Policies and Procedures

Ordinance's: All of the previous stuff (ordinances) gives the Authority the legal authority to carry out the cross-connection control program.

Policies and Procedures: these are needed to guide the administrative authority in the details of carrying out the program

- This document goes into the nitty-gritty on the operational details

Policies and Procedures

Several Options the Administrative Authority has for Implementation:

- Water supplier's program will be limited to system protection (containment) with all internal protection (isolation) problems handled by the local health agency and/or plumbing or building department
- Water supplier will contract with the **local** health agency for operation of its system protection program (health agency still responsible for internal protection)
- Water supplier will contract with the **private** health agency for operation of its system protection program (health agency still responsible for internal protection)
- Local health agency (County or City) can contract with a water supplier for the operation of the internal protection program along with the water supplier's system protection program
- State Health agency may have responsibility over the entire system and internal protection program
- Other combinations of responsibility unique to an area or jurisdiction

Specific Issues (Page 95 10 Ed.)

These should be covered by an administrative authority's Policies and Procedures Document:

1. Administration of the Program
   - give an office that will be responsible
   - A mechanism for handling appeals should be established
   - Where does the ultimate responsibility lie?

Specific Issues (Page 95 10 Ed.)

These should be covered by an administrative authority's Policies and Procedures Document:

2. Authority
   - Cite the legal authority that the agency has for the establishment of the cross-connection control program
   - Generally this starts with: Federal Safe Drinking Water Act Amendments of 1996
     - The any specific state rules
       - Then any county rules
   - Should also have a reference to the ability of the water supplier to terminate water service to the customer if the customer fails to provide required backflow prevention equipment, its maintenance, and its periodic testing

Specific Issues (Page 95 10 Ed.)

These should be covered by an administrative authority's Policies and Procedures Document:

3. Auxiliary Water Systems

- These Aux. Water Sytems are any other water sources other than your main potable water source
- Ex. Cisterns, another Water Utilities water, open containers used for fire protection
- Policy must be in place to protect the potable water from these alternative water sources

Specific Issues (Page 95 10 Ed.)

These should be covered by an administrative authority's Policies and Procedures Document:

4. Certified Backflow Prevention Assembly Testers

- Identify what basis will be used for the establishment of a List of Certified Backflow Prevention Assembly Testers

Specific Issues (Page 95 10 Ed.)

These should be covered by an administrative authority's Policies and Procedures Document:

5. Change of Occupancy or Use

- On site water usages can change
- Talk to the building or plumbing enforcement agencies
- When they get a notice, ask them to forward any changes to you
- What could happen if a Pet Store goes out of business and a Dentist goes into that spot? Is there proper protection?
- Will need to do a follow up survey.
- This is another reason for the E in the ABCDE's. If your testers are aware of these changes, they might be the first one to notice a change of water use!

Specific Issues (Page 95 10 Ed.)

These should be covered by an administrative authority's Policies and Procedures Document:

6. Combined Services

- Anything that provides water to both domestic and other non-potable water uses (irrigtaion systems, industrial uses, fire sprinklers, etc.)
- Domestic water portion probably will not need backflow protection BUT the assessment of the degree of hazard for system protection needs to happen for the ENTIRE system

Specific Issues (Page 95 10 Ed.)

These should be covered by an administrative authority's Policies and Procedures Document:

7. Critical Services

- Anywhere the water cannot be shut-off
- Hospitals, industrial uses (INTEL)
- Emergency care facilities
- Film-processing labs
- Water supplier could require these places to have multiple services (all would need to be protected with same level of protection)
- If only a single service is available, then the water supplier could require multiple backflow assemblies on parallel lines so that one can be tested

Specific Issues (Page 95 10 Ed.)

These should be covered by an administrative authority's Policies and Procedures Document:

8. Equipment

- It is useful to include typical types of equipment that need backflow protection (See Equipment Handout!)

Specific Issues (Page 95 10 Ed.)

These should be covered by an administrative authority's Policies and Procedures Document:

9. Fire Sprinkler Systems

- Industrial systems could include sprinklers, fire hose connections and hydrants
- Couple of different systems:
  - Wet-pipe system – use black iron pipe (not approved for potable water = at least Double Check needed)
    - If the wet-pipe system contains chemicals (anti-freeze, foams, etc = RP needed)
  - Dry-pipe system
  - Deluge system
  - Pre-action system

Specific Issues (Page 95 10 Ed.)

These should be covered by an administrative authority's Policies and Procedures Document:

10. Incident Response

- Backflow incidents are going to happen even to the most comprehensive cross connection programs!
- HAVE a PLAN of action when something goes wrong!
- Should include details on how to respond to an incident
  - This Should Include:
    - **Source of the Backflow**: a water quality complaint is often the first indication of a backflow event. Trained personnel should respond ASAP.
    - **Isolate Source of Backflow:** source should be isolated asap and extent of contamination needs to be determined. Samples should be taken before any system is flushed to determine how bad the backflow incident was.
    - **Determine Extent of the Incident:** determine if the backflow event contaminated just the customers system or if it got into the distribution system = more sampling = isolate that portion of the distribution system

Specific Issues (Page 95 10 Ed.)

These should be covered by an administrative authority's Policies and Procedures Document:

10. Incident Response

- Notification
  - If limited to one facility = occupants and employees should be notified to not use the water until decontaminated
  - If distribution system contaminated = public must be notified!
- Decontamination
  - Depends on the contamination
  - Flushing is typical
- Documentation
  - Keep good records = CYA!

Specific Issues (Page 95 10 Ed.)

These should be covered by an administrative authority's Policies and Procedures Document:

11. Irrigation Systems

- Any use of water taken from potable water source used for anything that grows (lawns, gardens, landscaping, etc.)
- It is useful to describe the types of irrigation system and whether it has chemical additives or not)
- Also put down which backflow assembly is required

Specific Issues (Page 95 10 Ed.)

These should be covered by an administrative authority's Policies and Procedures Document:

11. Irrigation Systems

potable
landsca
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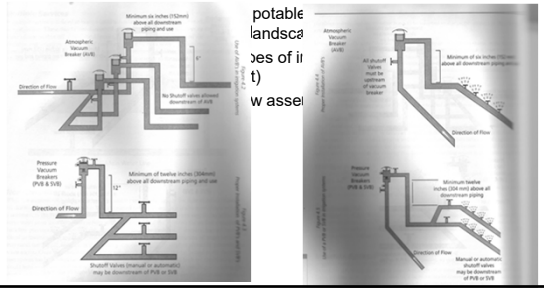


Specific Issues (Page 95 10 Ed.)

These should be covered by an administrative authority's Policies and Procedures Document:

12. Low Water Pressure

- Plumbing codes calls for at least 15 psi minimum at point of use
- Some customers may need a booster pump on-site = at least a double check = why? = BACKPRESSURE!

Specific Issues (Page 95 10 Ed.)

These should be covered by an administrative authority's Policies and Procedures Document:

13. Multiple Services

- Two or more water services are provided to a single site (Critical Care Purposes)
- Or domestic vs irrigation purposes

Specific Issues (Page 95 10 Ed.)

These should be covered by an administrative authority's Policies and Procedures Document:

14. Non-Compliance

- The ordinance should give the agency the right to refuse water service but you should also spell out the standard operating procedure here in the Policies and Procedures document
- SOP: turn off and lock the service connection (e.g. curb stop)
- Or physically removing the water meter
- Explain what the customer has to do to get their water turned back on
- Also include what happens to Backflow Certified testers if they fall out of compliance or to have been found falsifying documents

Specific Issues (Page 95 10 Ed.)

These should be covered by an administrative authority's Policies and Procedures Document:

15. Plumbing Codes

- Covers the water using equipment and applications of water use within a property. This document, in its latest form, should be adopted, by reference, as part of the Policies and Procedures

Specific Issues (Page 95 10 Ed.)

These should be covered by an administrative authority's Policies and Procedures Document:

16. Recycled Water Systems (Car Washes)

- The two systems must be separate without any interconnection
- Periodically test these systems by injecting a dye into the recycled water and seeing if it shows up in the potable water
- RP's usually required

Specific Issues (Page 95 10 Ed.)

These should be covered by an administrative authority's Policies and Procedures Document:

16. Restricted or Classified Services

- If you are refused permission (Defense Dept., National Labs, etc), you can either refuse water service or just require maximum backflow protection at the service connection (Air Gap or RP)

Specific Issues (Page 95 10 Ed.)

These should be covered by an administrative authority's Policies and Procedures Document:

17. Sump and Lift Stations

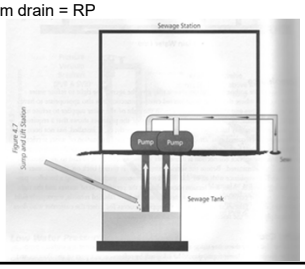
- Anytime drainage water or sanitary discharge is pumped up to a sewer or storm drain = RP

Specific Issues (Page 95 10 Ed.)

These should be covered by an administrative authority's Policies and Procedures Document:

17. Sump and Lift Stations

- Anytime drainage water or sanitary discharge is pumped up to a sewer or storm drain = RP



Specific Issues (Page 95 10 Ed.)

These should be covered by an administrative authority's Policies and Procedures Document:

17. Single and Multiple Family Dwellings

- Similar to the Multiple Services section
- The water purveyor typically does not want multiple service connections to a property = high risk of cross connection
- Solution = route multiple connections after the service connection

Specific Issues (Page 95 10 Ed.)

These should be covered by an administrative authority's Policies and Procedures Document:

18. Service across Political or Water Supplier Boundaries

- For those special occasions where the customer is on the boundary between two or more agencies
- Detail what to do in these cases

Specific Issues (Page 95 10 Ed.)

These should be covered by an administrative authority's Policies and Procedures Document:

19. Typical High Hazard Services

- Gives the typical services that constitute high hazards connection (see previous slides)
- Any list should not be considered all-inclusive

As the cross-connection control specialist continues to gain experience and knowledge in the field, more should be added to the policies and procedures!

Cross Connection Control Surveys

Preparing for Survey

- If people-power and $$$ is available for making initial inspections and for maintaining an adequate inspection and re-inspection program, you should evaluate the degrees of hazard, water uses and existing in-plant backflow protection.
- If not feasible to do because of lack of people-power and $$$, it is necessary to conduct an initial survey.
  - Depending on what is found, additional survey may be needed depending on the degrees of hazards found
  - Need to prioritize

Cross Connection Control Surveys

Preparing for Survey

- Try to get water service maps, plans, detailed drawings etc. This will help you identify whether or not a site survey is justified and will help you locate the major components of the water system
- Once you determine a survey is needed:
  - Owner of facility is notified
  - Ask that the site manager or some other knowledgeable on-site personel make time to help locate assemblies and cross-connections.

Cross Connection Control Surveys

Survey

- Tools of the trade: note pad, clipboard, safety equipment (hard hat, safety glasses, ear protection), flashlight, laser pointer to trace water piping, camera, video camera if allowed on-site would all be helpful in making defensible and detailed records.
- Start with surveying the water uses on-site.
- One method: Start at the service connection and floow the lines to points of use
  - Once experienced, the specialist will begin to know what to look for.
- If the facility is new to the specialist, learn as much as possible about what is done at the facility.

Cross Connection Control Surveys

Documentation

- Make a defensible and detailed report and should include
  - Water uses, cross-connections, degrees of hazard, any backflow protection, reference to any relevant codes and regulations
  - Should conclude stating what backflow is needed and where.
- Title: Name of the Facility, Date, and any on-site personnel that were present
- Document water uses
- List water systems, plumbing fixtures, and water using equipment (fire systems, irrigation etc)
- See Handout "Field Survey Form" go over the form

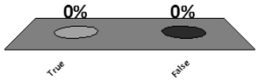
Cross Connection Control Surveys

Compliance

- Letter must be sent to the owner detailing the findings and possible requirements
- See example compliance letter in Chapter 8 of 10 ed.

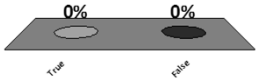
As a water purveyor, you can adopt an ordinance which is more stringent that the state regulations.

A. **True**
B. **False**



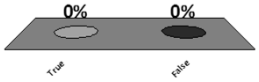
Single family residences do not have the kinds of hazards that would require backflow prevention assemblies.

A. **True**
B. **False**



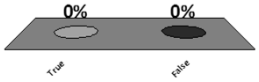
Only individuals with water certification can conduct a cross-connection control program.

A. **True**
B. **False**



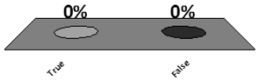
The person in charge of the cross connection control program should review plans on new construction.

A. **True**
B. **False**



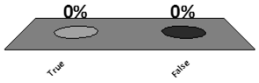
A good record system will include all correspondence, inspection reports, test reports, and related information.

A. **True**
B. **False**



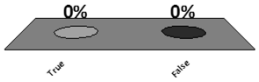
Only water systems with more than 1000 service connections are required to have a certified specialist to run their program.

A. **True**
B. **False**



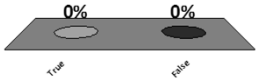
When requiring backflow prevention for new or existing facilities, it is important to require only approved assemblies.

A. True
B. False



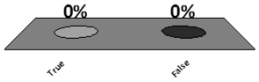
It is recommended that inspections be prioritized.

A. True
B. False



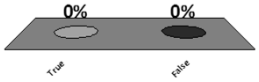
An air gap provides protection against backsiphonage and backpressure.

A. True
B. False



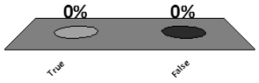
It is sometimes less expensive to require two smaller assemblies than one large assembly.

A. True
B. False



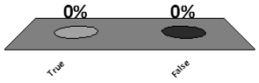
A community water system cross connection program does not require an ordinance or enabling authority.

A. True
B. False



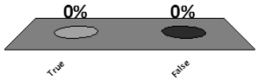
An RP and DC can only be installed at the property line.

A. True
B. False



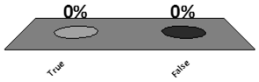
Water purveyors are excluded from liability suits that result from backflow incidences.

A. True
B. False



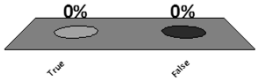
A community water system is one which serves people at places where they live.

A. True
B. False



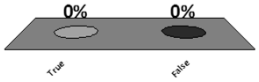
In community water systems, water suppliers are responsible for controlling and eliminating cross connections.

A. True
B. False



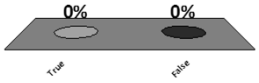
The type of backflow assembly required for a given situation must be commensurate with the degree of hazard.

A. True
B. False



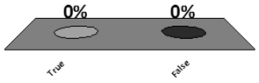
You should provide the owner with proper installation requirements for the assembly that is required.

A. True
B. False



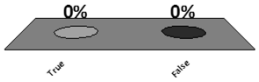
A solar water heating system can creat a cross connection hazard

A. True
B. False



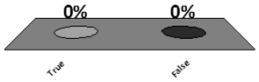
A medical facility may have potentially hazardous cross connections.

A. True
B. False



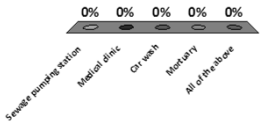
A RP should normally be installed on all boilers and similar pressure vessels.

A. True
B. False



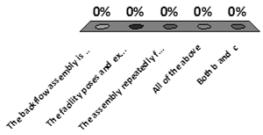
Which of the following require an air gap or RPBA to be installed at the water service connection.

A. Sewage pumping station
B. Medical clinic
C. Car wash
D. Mortuary
E. All of the above



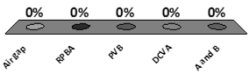
A water purveyor can require a more frequent than usual testing schedule for a backflow assembly, under the following conditions:

A. The backflow assembly is no longer approved
B. The facility poses and extreme health risk
C. The assembly repeatedly fails
D. All of the above
E. Both b and c



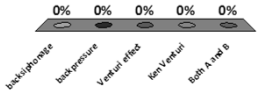
Which of the following meet requirements for in-plant protection on a boiler

A. Air gap
B. RPBA
C. PVB
D. DCVA
E. A and B



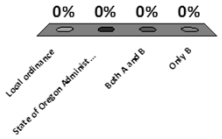
Elevated piping can produce backflow due to:

A. backsiphonage
B. backpressure
C. Venturi effect
D. Ken Venturi
E. Both A and B



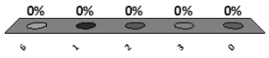
The authority to enforce a cross connection control program can come from which of the following?

A. Local ordinance
B. State of Oregon Administrative Rules
C. Both A and B
D. Only B



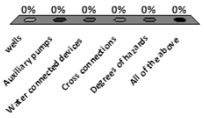
How many people should be delegated the responsibility for organizing and carrying out the cross connection control program.

A. 6
B. 1
C. 2
D. 3
E. 0



When doing a survey, what should you look for?

A. wells
B. Auxiliary pumps
C. Water connected devices
D. Cross connections
E. Degrees of hazards
F. All of the above



Instructor Biography:

Dr. James T. Nurmi, PhD.

Dr. James T. Nurmi, Ph.D. is a faculty instructor in the Engineering Science Department at Clackamas Community College. Jim has been teaching water related courses in the Water & Environmental Technology program for 12 years. He sits on several water related committees including the Oregon Health Authority Cross Connection Health Advisory Board and is a state certified instructor for both back-flow and cross connection specialist state certification courses. Jim has helped organize, schedule, participate and host the Pacific Northwest American Waterworks Association Water short school for the past 12 years, in which water industry professionals obtain continuing education units.

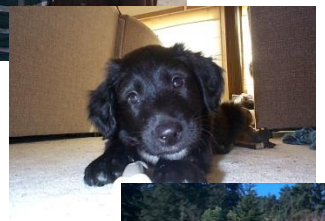
Jim previously worked as a senior research scientist and graduate faculty in the School of Medicine at Oregon Health & Science University. Dr. Nurmi received his B.A. from Gustavus Adolphus College in St. Peter, MN. After which, he worked at Argonne National lab on the physical and chemical immobilization of low-level mixed wastes. From there, he traveled to Oregon, where he completed his Ph.D. in Environmental Science & Engineering. Dr. Nurmi's doctoral dissertation was focused on the electrochemical properties of natural organic matter and of zero valent iron. Dr. Nurmi's research interests are broad, covering topics, such as: drinking water and wastewater, remediation of environmental contaminants, fundamental processes of material corrosion, and the use of electrochemical techniques for the detection and characterization of engineered nanoparticles.

Personal Background

B.A., Gustavus Adolphus College, 1997, Major: Biology

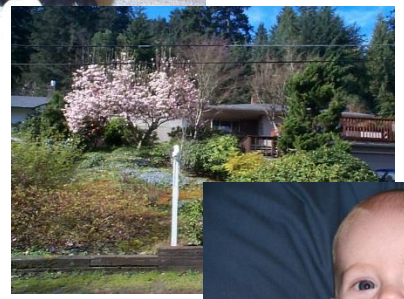
Argonne National Laboratory, Energy Technology Division (97-98)

Started at OGI in non-thesis Masters program, 1999



Got Married, 1999

Started PhD work at OGI, 2001



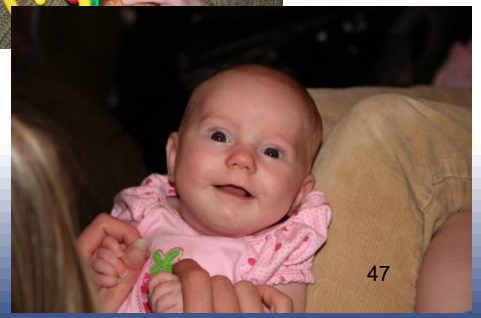
Adopted 2 blind cats, 2002

Bought a house and adopted a dog, 2004

James Daniel Nurmi born June 25, 2005

Received Ph.D. Nov. 2005

Anna Carmela Nurmi born March 7th, 2008

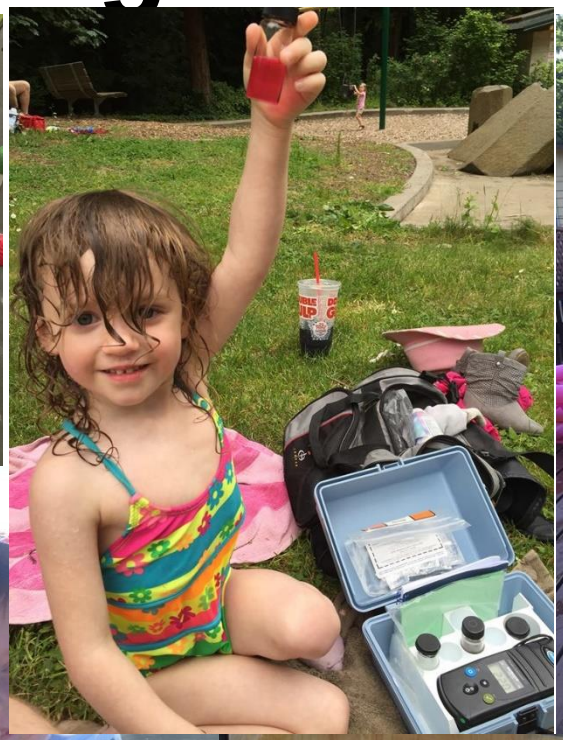


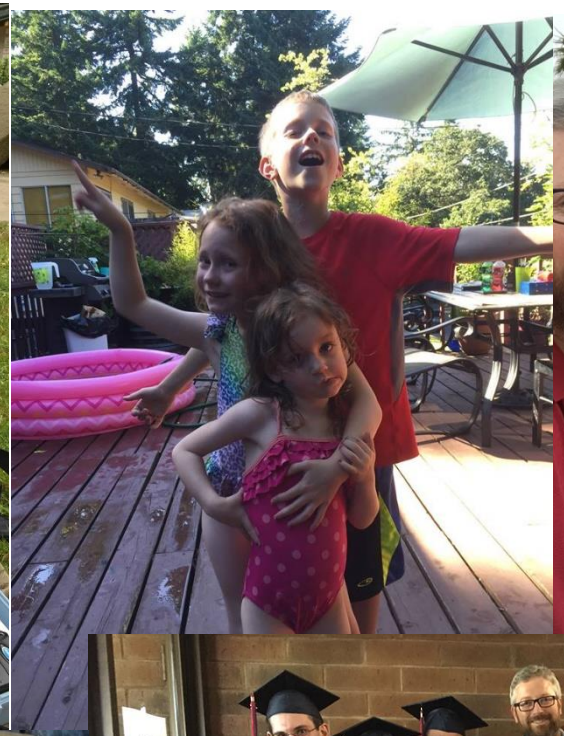
2011 Faculty at OHSU

Esmee Joan Nurmi born July 19th, 2011

2011 Faculty at CCC

Personal Background: Jim Nurmi





Personal Backgrounds