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CROSS-CONNECTION CONTROL & BACKFLOW PREVENTION MANUAL





The Indiana Department of Environmental Management

In conjunction with:

Cross-Connection Control Committee, City and County of Denver, Colorado;
Department of Natural Resources, State of Wisconsin;
United States Environmental Protection Agency, Water Supply Division; and,
R.W. Muckleroy, Houston, Texas.

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Table of Contents

Abstract	4
Introduction.....	4
What is a Cross Connection?	4
Protection of Water Supply Systems	4
State of Indiana Cross Connection Regulations.....	5
170 IAC 6-1-20 Water Quality Standards(ISDH Rule)	5
327 IAC 8-10 Cross Connections; Control; Operation	5
675 IAC 16-1.3-64; Unlawful Connections (Excerpt: Indiana Plumbing Code).....	14
Additional and Expanded Definitions.....	16
Responsibility for Cross-Connection Control.....	18
Water Purveyor	18
Indiana Department of Environmental Management.....	18
Domestic Plumbing Inspection (Internal Water System).....	19
Consumer	19
Legal Liability.....	19
Guidelines for Developing a Cross-Connection Control (CCC) Program.....	20
Local Ordinance.....	20
Outreach and Education.....	21
Inspection.....	21
Record Keeping	21
The Role of IDEM in a Cross-Connection Control Program.....	22
Suggested Model Ordinance for Cross-Connection Control	23
Potential Hazards	26
Pipe Color Coding.....	30
Fire Protection Systems	30
Water Loading Stations.....	30
Water Trucks.....	30
Training Provider of Cross-Connection Device Inspectors and Testers.....	31
Backflow and Backsiphonage.....	31
Single Check Valve.....	31
Changeover Devices	32
Approved Types of Backflow Prevention Assemblies	33
Air-Gap Separation (AG).....	33
Atmospheric Vacuum Breaker (AVB).....	34
Pressure Vacuum Breaker (PVB)	34
Double-Check Valve (DCV).....	34
Reduced-Pressure Principle Backflow Preventer (RP).....	35
Test Results for RP Backflow Preventers.....	36
Proper Selection of Backflow Prevention Devices.....	37
Thermal Expansion.....	37
Reported Backflow Incidents Past and Present.....	37
In Indiana	37
American Water Works Association Conference.....	38
Summary	38
Appendix A: Sample Test Report Form	40
Appendix B: Works Cited.....	42

Abstract

This document has been generated by the Indiana Department of Environmental Management (IDEM) to provide general guidelines regarding cross-connection control and backflow prevention in the State of Indiana. This manual is intended to serve as an informative and useful introductory reference for backflow prevention, to be used in conjunction with reference texts for more detail. One extremely important text is the “**Manual of Cross-Connection Control, Tenth Edition**” by the University of Southern California, October, 2009, available from the University of Southern California bookstore.

Included in this manual are the Indiana Administrative Codes governing cross-connection control and backflow, including codes administered by the Indiana State Department of Health (ISDH) and IDEM, as well as the Indiana Plumbing Code. Guidelines for developing a cross-connection control program are also included. A section explaining the legal liability associated with cross connections and backflow is additionally provided for reference. The technical aspects of some common cross-connection control devices and backflow prevention devices are also presented. The mention of trade names and commercial products in this manual are for illustrative purposes, and does not constitute endorsement or specific recommendation of use.

Introduction

What is a Cross Connection?

For use in this manual, a **cross connection** is: any physical arrangement whereby a public water supply is connected, directly or indirectly, with any secondary water supply system, sewer drain, conduit, pool, storage reservoir, plumbing fixture, or other device which contains or may contain any water, contaminated liquid, or other waste of unknown or unsafe quality that could impart a contaminant to the drinking water as a result of backflow or backsiphonage.

Protection of Water Supply Systems

In order to protect the public water supply system from cross connections:

- No installation of public water supply piping or part thereof shall be made in such a manner that it will be possible for used, unclean, polluted or contaminated water, mixtures or substances to enter any portion of such piping from any tank, receptacle, equipment or plumbing fixture by reason of backsiphonage or any other cause, either during normal use and operation thereof or when any such tank, receptacle, equipment or plumbing fixture is flooded or subject to pressure in excess of the pressure in the hot-or-cold-water piping;
- No person shall make a connection or allow one to exist between pipes or conduits carrying domestic water supplied by any public or private water service system, and any pipes, conduits or fixtures containing or carrying water from any other source or containing or carrying water which has been used for any purpose whatsoever, or any piping carrying chemicals, liquids, gases, or any substance, unless there is provided an approved backflow prevention device. IDEM’s approval must be obtained before any connection is made between the domestic supply and any contaminated, polluted, or auxiliary water system; and,

- No plumbing fixture, device or construction shall be installed or maintained or shall be connected to any domestic water supply when such installation or connection may provide a possibility of polluting such water supply or may provide a cross connection between a distributing system of water for drinking and domestic purposes and water which may become contaminated by such plumbing fixture devices or construction unless there is provided an approved backflow prevention device.

State of Indiana Cross Connection Regulations

The following are sections from the Indiana Administrative Code containing the regulations governing cross connections.

Indiana State Department of Health:

170 IAC 6-1-20 WATER QUALITY STANDARDS

Authority: IC 8-1-1-3; IC 8-1-1-12; IC 8-1-2-4

Affected: IC 8-1-2-33

Sec. 20. Quality. (A) Water furnished by any water utility for human consumption or for domestic use shall be of such quality as will have the approval, or comply with the requirements, of the Indiana State Department of Health.

(B)(1) Public water supplies within the distribution pipe systems shall be adequately protected against pollution from backsiphonage or cross connections with other systems on customer's property by proper installation of protective devices in accordance with the rules of the Indiana State Department of Health. Such protective devices shall be installed and maintained at the cost and expense of the customer, subject however, to the inspection test and approval of the utility before being placed in service, and at such times thereafter as recommended by the Indiana State Department of Health.

(2) Public water supplies shall also be adequately protected against any unnecessary and avoidable pollution at their own sources, and at all times after being taken there from, until delivery to the customer, to conform in all cases to the requirements of the Indiana State Department of Health.

(Indiana Utility Regulatory Commission; No. 34805: Standards of Service For Water Utilities Rule 18; filed Nov 28, 1977, 3:00 pm: Rules and Regs. 1978, p. 693)

Indiana Department of Environmental Management (IDEM):

327 IAC 8-10 CROSS CONNECTIONS; CONTROL; OPERATION

Cited in: 327 IAC 8-10-1; 327 IAC 8-10-8; 327 IAC 8-10-10; 675 IAC 16-1.2-35; 860 IAC 1-5-9.

327 IAC 8-10-1 Definitions

Authority: IC 13-7-7-5; IC 13-7-14-5

Affected: IC 13-1-3-1.5; IC 13-7-1; IC 13-7-7-5; IC 13-7-14-5

Sec. 1. In addition to the definitions contained in IC 13-7-1, IC 13-1-3-1.5, and in 327 IAC 8-10-1, the following definitions apply:

(1) "Air gap" means an unobstructed vertical distance through atmosphere between the discharge end of a pipeline supplied from a public water supply, and the overflow rim of the receiving portion of the customer water system.

- (2) "Backflow" means the flow or contaminants into the public water supply distribution system from a source other than the public water supply.
- (3) "Booster pump" means a pump installed on a pipeline to increase water pressure and flow.
- (4) "Commissioner" means the commissioner of the Indiana Department of Environmental Management, or his or her authorized representative.
- (5) "Cross connection" means any physical arrangement, including cross-connection control devices not in working order, whereby a public water supply distribution system is directly connected, either continuously or intermittently, with any secondary source of supply, sewer, drain, conduit, pool, piping, storage reservoir, plumbing fixture, or other device which contains, or may contain, and is capable of imparting to the public water supply, contaminants, contaminated water, sewage, or other waste or liquid of unknown or unsafe quality.
- (6) "Cross-connection control device" means any device or assembly, approved by the commissioner for construction on or installation in water supply piping, which is capable of preventing contaminants from entering the public water supply distribution system.
- (7) "Cross-connection control device inspector" means a person who has successfully completed training in testing and inspection of cross-connection control devices from a training provider approved by the commissioner, has received a registration number from the commissioner, and who has not been notified by the commissioner the registration number has been revoked in accordance with section 11(b) of this rule.
- (8) "Cross-connection hazard " means any customer facility which, because of the nature and extent of activities on the premises or the materials used in connection with the activities or stored on the premises, would present an immediate or potential danger or health hazard to customers of the public water supply should backflow occur.
- (9) "Customer" means any person who receives water from a public water supply.
- (10) "Customer service line" means the pipeline from the public water supply to the first tap, fixture, receptacle, or other point of customer water use; or to the first secondary source of supply, or pipeline branch in a building.
- (11) "Customer water system" means all piping, fixtures, and appurtenances, including secondary sources of supply, used by a customer to convey water on his premises.
- (12) "Double check valve assembly" means a device or assembly composed of two (2) tightly closing shut-off valves surrounding two (2) independently acting check valves, with four (4) test cocks, one (1) upstream of the four (4) valves and one (1) between each of the four (4) check and shut-off valves.
- (13) "Downstream" means the direction of flow when only the public water supply is supplying water through the customer water system and backflow is not occurring.
- (14) "Pressure type vacuum breaker" means a device or assembly containing an independently operating internally loaded check valve and an independently operating loaded air inlet valve located on the downstream side of the check valve with a spring-loaded air inlet, for relieving a vacuum or partial vacuum in a pipeline.
- (15) "Public water supply" means any wells, reservoirs, lakes, rivers, sources of supply, pumps, mains, pipes, facilities, and structures through which water is obtained, treated as may be required, and supplied through a water distribution system to at least twenty-five (25) persons per day or fifteen (15) service connections for drinking, domestic, or other purposes, including state-owned facilities.
- (16) "Reduced pressure principle backflow preventer" means a device composed of two (2) tightly closing shut-off valves surrounding two (2) independently acting pressure reducing check valves that in turn surround an automatic pressure differential relief valve, and four (4) test cocks, one (1) upstream of the five (5) valves and one (1) between each of the four (4) check and shut-off valves. The check valves effectively divide the structure into three (3) chambers; pressure is reduced in each downstream chamber allowing the pressure differential relief valve to vent the center chamber to atmosphere should either or both check valves malfunction.
- (17) "Registration number" means a unique number assigned to a person by the commissioner demonstrating that the person has fulfilled the education and examination requirements as described in section 11 of this rule and is recognized by the state as a cross-connection control device inspector.

(18) "Secondary source of supply" means any well, spring, cistern, lake, stream, or other water source, intake structure, pumps, piping, treatment units, tanks and appurtenances used, either continuously or intermittently, to supply water other than that from the public water supply to the customer, including tanks used to store water to be used only for fire fighting, even though the water contained therein is supplied from the public water supply.

(19) "Supplier of water" means any person who owns and/or operates a public water supply.

(20) "Training provider" means an organization who conducts or presents a cross-connection control device inspector course approved by the commissioner in conformance with section 12 of this rule.

(21) "Upstream" means the direction of flow opposite to downstream.

(Water Pollution Control Board; 327 IAC 8-10-1; filed Sep 24, 1987, 3:00 pm: 11 IR 714; filed March 31, 1999, 1:50 p.m.: 22 IR 2515).

327 IAC 8-10-2 Cross connection prohibited; bypass

Authority: IC 13-7-7-5; IC 13-7-14-5

Affected: IC 13-7-7-5; IC 13-7-14-5

Sec. 2. No customer shall cause or allow the construction or maintenance of a cross connection. Piping installed to bypass a cross-connection control device constitutes a cross connection unless the bypass piping is also fitted with a similar cross-connection control device.

(Water Pollution Control Board; 327 IAC 8-10-2; filed Sep 24, 1987, 3:00 pm: 11 IR 715)

327 IAC 8-10-3 Booster pump connection

Authority: IC 13-7-7-5; IC 13-7-14-5

Affected: IC 13-7-7-5; IC 13-7-14-5

Sec. 3. No customer shall cause or allow the installation or maintenance of a booster pump in a public water system unless a device is installed to control operation of the booster pump when pressure to pump suction drops as follows:

(1) Wherever a fire suppression system has a booster pump installed only for fire suppression, it shall have an audible or visual alarm to provide warning when flow occurs and a control valve shall be installed on the booster pump discharge to automatically throttle the flow as necessary to maintain ten (10) pounds per square inch, pump suction pressure.

(2) For all booster pumps other than those described in subdivision (1), a control device shall be installed to either prevent operation of the booster pump, or else to automatically throttle flow to or from the booster pump as necessary to maintain a minimum of twenty (20) pounds per square inch, gauge, pump suction pressure. The supplier of water may require that the control device be calibrated to maintain a higher than twenty (20) pounds per square inch, gauge, pump suction pressure, where necessary to provide a minimum pressure of twenty (20) pounds per square inch, gauge, throughout the pressure zone of the public water system distribution system to which the customer is connected.

(Water Pollution Control Board; 327 IAC 8-10-3; filed Sep 24, 1987, 3:00 pm: 11 IR 715; filed Mar. 31, 1999, 1:50 p.m.: 22 IR 2516)

327 IAC 8-10-4 Cross-connection hazards; notice; exemptions

Authority: IC 13-7-7-5; IC 13-7-14-5

Affected: IC 13-7-7-5; IC 13-7-14-5

Sec. 4. (a) Where a cross-connection hazard as specified by subsection (c) is designated:

(1) An air gap shall be constructed or a reduced pressure principle backflow preventer shall be installed, in accordance with section 7 of this rule, on the customer service line for:

(A) any new facility;

- (B) any modified customer service line; or
- (C) any existing facility where a higher capacity meter is installed; and
- (2) neither an air gap nor a reduced pressure principle backflow preventer shall be required to be incorporated into customer service lines that both are utilized solely for fire suppression and are fitted with an audible alarm that will activate when water is detected to be flowing in the customer service line.
- (b) Customers who have a cross connection that has resulted in a contaminant being introduced into a public water system or a customer water system:
 - (1) shall immediately construct an air gap or install a reduced pressure principle backflow preventer on the customer service line in accordance with section 7 of this rule; or
 - (2) is exempt from the requirements of subdivision (1) because the affected customer service line is both utilized solely for fire suppression and is fitted with an audible alarm that will activate when water is detected to be flowing in the line.
- (c) The following customer facilities are designated cross-connection hazards:
 - (1) Aircraft and missile manufacturing plants.
 - (2) Automotive plants including those plants that manufacture motorcycles, automobiles, trucks, recreational vehicles, and construction and agricultural equipment.
 - (3) Beverage bottling plants, including dairies and breweries.
 - (4) Canneries, packing houses, and reduction plants.
 - (5) Car washes.
 - (6) Chemical, biological, and radiological laboratories including those in high schools, trade schools, colleges, universities, and research institutions.
 - (7) Hospitals, clinics, medical buildings, autopsy facilities, morgues, other medical facilities, and mortuaries.
 - (8) Metal and plastic manufacturing, fabricating, cleaning, plating, and processing facilities.
 - (9) Plants manufacturing paper and paper products.
 - (10) Plants manufacturing, refining, compounding or processing fertilizer, film, herbicides, natural or synthetic rubber, pesticides, petroleum or petroleum products, pharmaceuticals, radiological materials, or any chemical which could be a contaminant to the public water supply.
 - (11) Commercial facilities that use herbicides, pesticides, fertilizers or any chemical which could be a contaminant to the public water supply.
 - (12) Plants processing, blending or refining animal, vegetable or mineral oils.
 - (13) Commercial laundries and dye works, excluding coin operated Laundromats.
 - (14) Sewage, storm water, and industrial waste treatment plans and pumping stations.
 - (15) Water front facilities including piers, docks, marinas, and shipyards.
 - (16) Industrial facilities which recycle water
 - (17) Restricted or classified facilities (federal government defense or military installations), or other facilities closed to the supplier of water or to the commissioner.
- (d) Customer facilities not designated as a cross-connection hazard by subsection (c) may be designated a cross-connection hazard by written notification from the commissioner to the customer and to the customer's public water system. The notice shall specify the nature of the customer activity that necessitates designation of the customer's facility as a cross-connection hazard , and the date by which the customer shall install a cross-connection control device in accordance with section 7 of this rule, on the customer service line to the facility so designated.
- (e) The commissioner may issue a letter exempting a customer from the requirements of subsection (a) if the customer can show to the satisfaction of the commissioner that the activities taking place at the customer's facility, and the materials used in connection with these activities or stored on the premises, cannot endanger the health of customers of the public water system should backflow occur. An exemption shall remain valid for no more than three (3) years from the date of issuance. If the commissioner finds that the customer facility has become a cross-connection hazard, the commissioner will void the exemption and so notify the customer.

(Water Pollution Control Board; 327 IAC 8-10-4; filed Sep 24, 1987, 3:00 pm: 11 IR 716; filed Mar 31, 1999, 1:50 p.m.:22 IR 2516)

327 IAC 8-10-5 Secondary source of installation of supply; installation of air gaps or other devices

Authority: IC 13-7-7-5; IC 13-7-14-5

Affected: IC 13-7-7-5; IC 13-7-14-5

Sec. 5.(a) Customers shall construct an air gap or install a reduced pressure principle backflow preventer or a double check valve assembly in accordance with section 7 of this rule, on the customer service line to:

(1) tanks used only to store water from the public water supply for fire suppression that are constructed to maintain the bacteriological quality of the water, in compliance with 327 IAC 8-2; or

(2) secondary sources of supply that:

(A) use well water as the only private source of supply;

(B) are constructed to maintain the bacteriological quality of the water, in compliance with 327 IAC 8-2; and,

(C) produce, without treatment, water meeting the drinking water quality standards enumerated in 327 IAC 8-2.

(b) Customers shall construct an air gap or install a reduced pressure principle backflow preventer in accordance with section 7 of this rule on the customer service line to or into a facility having a secondary source of supply of a type other than those enumerated in subsection (a), that is used only for fire suppression.

(c) No secondary source of supply of a type other than those enumerated in subsections (a) and (b) shall be physically connected on the customer service line to or into the facility.

(Water Pollution Control Board; 327 IAC 8-10-5; filed Sep 24, 1987, 3:00 pm: 11 IR 716; filed Mar 31, 1999, 1:50 p.m.: 22 IR 2517)

327 IAC 8-10-6 Land irrigation facility buried below ground; installation of air gaps or other devices

Authority: IC 13-7-7-5; IC 13-7-14-5

Affected: IC 13-7-7-5; IC 13-7-14-5

Sec. 6. Customers shall construct an air gap or install a reduced pressure principle backflow preventer or pressure type vacuum breaker in accordance with section 7(2)(b) of this rule, on the water line connecting the public water supply to any land irrigation facility buried below ground that has a sprinkler outlet located less than six (6) inches above grade, and is constructed after July 19, 1985.

(Water Pollution Control Board; 327 IAC 8-10-6; filed Sep 24, 1987, 3:00 pm: 11 IR 717; Mar 31, 1999,1:50 pm: 22 IR 2518)

327 IAC 8-10-7 Construction and installation requirements for air gaps or other devices

Authority: IC 13-7-7-5; IC 13-7-14-5

Affected: IC 13-7-7-5; IC 13-7-14-5

Sec. 7.(a) The discharge pipe of an air gap shall terminate:

(1) a minimum of two pipe diameters of the discharge pipe or six inches, whichever is the lesser, above the maximum recorded flood level or above the flood level rim of the receiving vessel, whichever is higher.

(2) a minimum of three (3) pipe diameters of the discharge pipe or six (6) inches, whichever is the lesser, above the maximum recorded flood level or above the flood level rim of the receiving vessel, whichever is higher where:

(A) a sidewall, rib, or similar obstruction is spaced closer than three (3) diameters from the piping affecting the air gap; or

(B) two (2) intersecting walls are located closer than four (4) pipe diameters from the piping affecting the air gap.

(b) Only those models of double check valve assemblies, reduced pressure principle backflow preventers, and pressure type vacuum breakers which have been listed by the

Foundation for Cross-Connection Control and Hydraulic Research of the University of Southern California (August 27, 1997), or those acceptable under the Indiana plumbing rules at 675 IAC 16-1.2 shall be installed.

(c) Reduced pressure principle backflow preventers shall be installed horizontally, with: (1) no plug or additional piping affixed to the pressure differential relief valve port; and, (2) the pressure differential relief valve port a minimum of twelve (12) inches above floor level.

Additionally, the device must be installed at a location where any leakage from the pressure differential relief valve port will be noticed, and that allows access to the valve for maintenance and testing from floor level, without use of a ladder or other similar temporary apparatus, and that will not subject the device to flooding, excessive heat or freezing.

(d) All double check valve assemblies shall be installed at a location that allows access to the device for maintenance and testing from floor level, without use of a ladder or other similar temporary apparatus, and that will not subject the device to flooding excessive heat or freezing.

(e) Pressure type vacuum breakers shall be installed as near as possible to the irrigation facility, at a location that allows access to the device for maintenance and testing from floor or ground level, without use of a ladder or other similar temporary apparatus, that will not subject the device to flooding, excessive heat or freezing. Additionally, the device must be installed between two (2) tightly closing shut-off valves, with its center line or datum point a minimum of twelve (12) inches above:

- (1) floor level;
- (2) the highest downstream shut-off valve; and
- (3) the highest downstream overflow rim or discharge point.

(Water Pollution Control Board; 327 IAC 8-10-7; filed Sep 24, 1987, 3:00 pm: 11 IR 717; filed Mar 31, 1999, 1:50 pm: 22 IR 2518)

327 IAC 8-10-8 Inspection of devices; time limits

Authority: IC 13-7-7-5; IC 13-7-14-5

Affected: IC 13-7-7-5; IC 13-7-14-5

Sec. 8. (a) The customer shall install and maintain in working order at all times any cross-connection control device or booster pump control device required by this rule. .

(b) To ensure that each cross-connection control device required by this rule is in working order, the customer shall have each device inspected or tested by a cross-connection control device inspector at the time of construction or installation, and at the following intervals, in the following manner:

- (1) Air gaps shall be inspected at intervals not exceeding one year to ensure that they continue to meet the requirements of section 7 of this rule.
- (2) Reduced pressure principle backflow preventers shall be tested at intervals not exceeding six (6) months to ensure that:
 - (A) both check valves are drip-tight under all pressure differentials; and,
 - (B) the pressure differential relief valve will maintain pressure in the center chamber at least two (2) pounds per square inch below that of the inlet chamber.
- (3) Double check valve assemblies shall be tested at intervals not exceeding one (1) year to ensure that both check valves are drip-tight under all pressure differentials.
- (4) Pressure type vacuum breakers shall be tested at intervals not exceeding one (1) year to ensure that the air inlet opens fully when water pressure is at or below atmospheric.

(A) The customer shall permit access to the customer's premises by the inspector, the customer's public water system, or the commissioner, at reasonable times, and upon presentation of identification, for inspection of the customer's water system or testing of cross-connection control devices installed in accordance with this rule.

(B) Those customers granted an exemption in accordance with section 4(e) of this rule shall report to the commissioner and to the supplier of water any proposed change in process, plumbing or in materials used or stored at the

exempted facility at least fourteen (14) days prior to making the change. Failure to do so shall void the exemption.

(Water Pollution Control Board; 327 IAC 8-10-8; filed Sep 24, 1987, 3:00 pm: 11 IR 717; filed Mar 31, 1999, 1:50 pm: 22 IR 2519).

327 IAC 8-10-9 Inspectors; reports of inspection or test

Authority: IC 13-7-7-5; IC 13-7-14-5

Affected: IC 13-7-7-5; IC 13-7-14-5

Sec. 9.(a) All cross-connection control device inspectors shall:

- (1) be registered with the commissioner in accordance with section 11 of this rule;
- and,
- (2) shall submit reports of all inspections as required by subsection (b).

(b) The inspector shall report to the public water system, the customer and, if requested, the commissioner, on a form provided by the commissioner, the results of inspections or tests conducted pursuant to section 8(b) of this rule on air gaps, reduced pressure principle back-flow preventers, double check valve assemblies, and pressure type vacuum breakers. Reports shall be submitted to the public water system and to the customer within thirty (30) days of the inspection or test.

(Water Pollution Control Board; 327 IAC 8-10-9; filed Sep 24, 1987, 3:00 pm: 11 IR 718 filed Mar 31, 1999, 1:50 p.m. 22 IR 2519).

327 IAC 8-10-10 Noncompliance; retention of reports; access

Authority: IC 13-7-7-5; IC 13-7-14-5

Affected: IC 13-7-7-5; IC 13-7-14-5

Sec. 10.(a) Because cross connections may cause disease through transmission of contaminants via the public water supply, the commissioner shall order the supplier of water to remove the customer service meter or otherwise sever the public water supply connection to any customer which the commissioner finds or has reason to believe is in violation of any provision of this rule.

(b) The supplier of water shall retain the three (3) most recent reports of test conducted on air gaps, reduced pressure principle backflow preventers, double check valve assemblies, and pressure type vacuum breakers installed in accordance with this rule. The supplier of water shall permit access to these files at reasonable times and upon presentation of identification by the commissioner.

(c) If so requested, the public water shall submit to the commissioner copies of any report required to be retained by subsection (b).

(Water Pollution Control Board; 327 IAC 8-10-10; filed Sep 24, 1987, 3:00 pm: 11 IR 718; filed Mar 31, 1999, 1:50 p.m.: 22 IR 2519)

327 IAC 8-10-11 Registration of inspector; list of registered inspectors; list of approved devices

Authority: IC 13-7-7-5; IC 13-7-14-5

Affected: IC 13-7-7-5; IC 13-7-14-5

Sec. 11. (a) Upon reviewing and finding the information certified by the training provider acceptable, the commissioner shall issue a registration number to each person whose training provider has certified that the applicant has met the following requirements of education and examination:

(1) The information supplied by the applicant must be reviewed and acceptable to the training provider.

(2) Each applicant must attend forty (40) hours of education and successfully complete a written and oral examination for cross connection device inspectors administered by a training provider.

(b) The commissioner may revoke the registration number of any cross-connection control inspector, following a hearing pursuant to IC 4-21.5, when it is found that the inspector has violated any of the provisions set out in this rule or IC 13-18-11-8.

(c) The commissioner shall maintain a list entitled "Indiana Registered cross-connection control Device Inspectors, All Inspectors", that is comprised of cross-connection control device inspectors registered in Indiana.

(d) The commissioner shall maintain a list entitled "Indiana Registered cross-connection control Device Inspectors, Active Inspectors", that is comprised of cross-connection control device inspectors that are registered in Indiana in accordance with subsection (a) and who have requested their inclusion on this list in writing to the commissioner during the previous two (2) years.

(e) The commissioner shall maintain a list entitled "List of Approved Backflow Prevention Assemblies, August 27, 1997, Foundation for cross-connection control and Hydraulic Research, University of Southern California" that is comprised of a listing of cross-connection control devices from the Foundation for cross-connection control and Hydraulic Research of the University of Southern California.

(f) The commissioner shall make the following lists as described in this section available to the public upon request:

(1) Indiana Registered cross-connection control Device Inspectors. All Inspectors.

(2) Indiana Registered cross-connection control Device Inspectors, Active Inspectors.

(3) List of Approved Backflow Prevention Assemblies, August 27, 1997, Foundation for cross-connection control and Hydraulic Research, University of Southern California.

(Water Pollution Control Board; 327 IAC 8-10-11; filed Sep 24, 1987, 3:00 pm: 11 IR 718, filed Mar 31, 1999, 1:50 p.m.: 22 IR 2519)

327 IAC 8-10-12 Approval of an organization as a training provider of cross-connection control device inspectors: record keeping

Authority: IC 13-13-5-1; IC 13-14-8; IC 13-14-9; IC 13-15-1-2; IC 13-15-2-1; IC 13-18-2; IC 13-18-3-1; IC 13-18-4-1

Affected: IC 4-21.5; IC 13-11-2; IC 13-18-11-8

Sec 12. (a) The commissioner shall approve an organization as a training provider of cross-connection control device inspectors if the training provider's proposed course meets the following requirements:

(1) The proposed course instruction and examination have a total duration of at least Forty (40) hours.

(2) The proposed course deals with matters directly related to the cross-connection control devices that include, but are not limited to, the following:

(A) Cross connection identification, degree of hazard, prevention, control devices, and practices.

(B) Backflow prevention assembly field test procedures and gauge accuracy verification, Section 9 from the "Manual of Cross Connection Control", ninth edition, 1993, from the Foundation for cross-connection control and Hydraulic

Research, University of Southern California.

(C) Cross-connection control device inspection, repair, and maintenance.

(D) Content, intent, and related policy of this rule.

(E) Responsibilities of the customer, public water system, and cross-connection control device inspector.

(3) Each instructor of the proposed course must be recognized by Indiana as a cross connection control device inspector to teach the assigned subject.

(4) Includes both a written and oral examination proctored by different instructors and meet the following requirements:

(A) Written examination which tests the student's comprehension of the material discussed in subdivision (2).

(B) An oral examination which tests the student's ability and competency to perform inspections, test procedures specified under subdivision (2)(B) and troubleshooting on cross-connection control devices.

(5) The organization submits a written request to the commissioner for approval as a training provider of cross-connection control device inspectors. The request shall contain the following:

(A) The name, address, and telephone number of the organization, name of course, specific topic on which there are to be presentations, time devoted to each topic, and dates and locations where the course will be offered.

(B) All instructors names, registration numbers, educational backgrounds, professional experiences, and current professional affiliations.

(C) Information to demonstrate fulfillment of the requirements of subdivision (2) to the satisfaction of the commissioner.

(D) A written class outline.

(b) The commissioner's approval of an organization as a training provider of cross-connection control device inspectors shall be valid for a duration of five (5) years.

(c) All training providers must maintain records on the date of all courses, the names of all individuals attending the course, duration of the course, all instructor's names, and the program content. These records shall be maintained for five (5) years.

(d) Training providers must submit to the commissioner a record of individuals attending courses within thirty (30) days of the conclusion of the course. These records shall be maintained for a five (5) year period. The record shall contain the following:

(1) Name of course.

(2) Name, address, and current phone number of individual attending course.

(3) Date of course.

(4) Performance on the written and oral examinations required by subsection (a)(4).

(e) The commissioner may revoke the approval of a training provider, following a hearing pursuant to IC 4-21.5, when it is found that the training provider has violated any of the provisions set out in the approval of the training provider's cross-connection control device inspectors course, in this rule or IC 13-18-11-8.

(Water Pollution Control Board; 327 IAC 8-10-11; filed Sep 24, 1987, 3:00 pm: 11 IR 718, filed Mar 31, 1999, 1:50 p.m.: 22 IR 2520)

327 IAC 8-10-13 Incorporation by reference

Authority: IC 13-14-8; IC 13-14-9; IC 13-15-1-2; IC 13-15-2-1; IC 13-18-3-1; IC 13-18-4-1

Affected: IC 13-11-2; IC 13-13-5-1; IC 13-18-2

Sec. 13.(a) The following materials, including titles and names and addresses of where they may be located for inspection and copying, are incorporated by reference into this rule:

(1) "List of Approved Backflow Prevention Assemblies, August 27, 1997, Foundation for cross-connection control and Hydraulic Research, University of Southern California", Foundation for cross-connection control and Hydraulic Research, University of Southern California, Kaprielian Hall 200, Los Angeles, California 90089-2531 or from the Indiana Department of Environmental Management, Office of Water Management, Indiana Government Center-North, 100 North Senate Avenue, Room

1255, Indianapolis, Indiana 46206

(2) Backflow Prevention Assembly Field Test Procedure and Gauge Accuracy Verification, Section 9 from the "Manual of Cross Connection Control", ninth edition, 1993, Foundation for cross-connection control and Hydraulic Research, University of Southern California, Kaprielian Hall 200, Los Angeles, California 90089-2531 or from the Indiana Department of Environmental Management, Office of Water Management, Indiana Government Center North, 100 North Senate Avenue, Room 1255, Indianapolis, Indiana 46206

(b) The commissioner must commence rulemaking efforts to update this section before the conclusion of twenty-four (24) months from the previous update.

(Water Pollution Control Board; 327 IAC 8-10-11; filed Sep 24, 1987, 3:00 pm: 11 IR 718, filed Mar 31, 1999, 1:50 p.m.: 22 IR 2521)

Excerpt: Indiana Plumbing Code

(Indiana Department of Homeland Security, Division of Fire and Building Services):

675 IAC 16-1.3-64 Section 602.1; unlawful connections

Authority: IC 22-13-2-2

Affected: IC 22-12; IC 22-13; IC 22-14; IC 22-15; IC 36-7-2-9

Sec. 64. Change section 602.1 to read as follows: No installation of potable water supply piping or part thereof shall be made in such a manner that it will be possible for water or substances that do not comply with the requirements for potable water to enter any portion of such piping from any tank, receptacle, equipment, or plumbing fixture by reason of back-siphoning, by suction, or any other cause, either during normal use and operation thereof or when any such tank, receptacle, equipment, or plumbing fixture is flooded or subject to pressure in excess of the operating pressure in the hot-or-cold-water piping.

(Fire Prevention and Building Safety Commission; 675 IAC 16-1.3-64; filed Jun 30, 1999, 2:53 p.m.: 22 IR 3391; readopted filed Nov 1, 2005, 3:00 p.m.: 29 IR 896)

675 IAC 16-1.3-66 Section 603.0; cross-connection control

Authority: IC 22-13-2-2

Affected: IC 22-12; IC 22-13; IC 22-14; IC 22-15; IC 36-7-2-9

Sec. 66. Change section 603.0 to read as follows: Cross-connection control shall be provided in accordance with the provisions of this chapter and TABLE 6-2. No person shall install any water operated equipment or mechanism, or use any water treating chemical, or substance, if it is found that such equipment, mechanism, chemical, or substance may cause the potable water system not to comply with the PLUMBING CODE Indiana Administrative Code Page 15 requirements to be considered potable water. Such equipment or mechanism may be permitted only when equipped with an approved backflow prevention device or assembly.

(Fire Prevention and Building Safety Commission; 675 IAC 16-1.3-66; filed Jun 30, 1999, 2:53 p.m.: 22 IR 3391; readopted filed Nov 1, 2005, 3:00 p.m.: 29 IR 896)

675 IAC 16-1.3-68 Section 603.1; approval of devices or assemblies

Authority: IC 22-13-2-2

Affected: IC 22-12; IC 22-13; IC 22-14; IC 22-15; IC 36-7-2-9

Sec. 68. Delete section 603.1 and substitute to read as follows: Before any device or assembly is installed for the prevention of backflow, it shall have first been approved by the administrative authority.

(Fire Prevention and Building Safety Commission; 675 IAC 16-1.3-68; filed Jun 30, 1999, 2:53 p.m.: 22 IR 3392; readopted filed Nov 1, 2005, 3:00 p.m.: 29 IR 896)

675 IAC 16-1.3-74 Section 603.4.4.1; heat exchangers

Authority: IC 22-13-2-2

Affected: IC 22-12; IC 22-13; IC 22-14; IC 22-15; IC 36-7-2-9

Sec. 74. Change section 603.4.4.1 to read as follows: The potable water system shall be protected from the heat transfer medium used in heat exchangers when required by section 603.0. Double-wall heat exchangers shall separate the potable water from the heat transfer medium by providing a space between the two (2) walls which is vented to the atmosphere.

(Fire Prevention and Building Safety Commission; 675 IAC 16-1.3-74; filed Jun 30, 1999, 2:53 p.m.: 22 IR 3392; readopted filed Nov 1, 2005, 3:00 p.m.: 29 IR 896)

675 IAC 16-1.3-76 Section 603.4.5; inlets to tanks, vats, sumps, and swimming pools

Authority: IC 22-13-2-2

Affected: IC 22-12; IC 22-13; IC 22-14; IC 22-15; IC 36-7-2-9

Sec. 76. Change the third sentence of section 603.4.5 to read as follows: Where atmospheric vacuum breakers or airgaps are not installed, other approved backflow preventers may be installed in accordance with the requirements for that type of device or assembly as set forth in this chapter.

(Fire Prevention and Building Safety Commission; 675 IAC 16-1.3-76; filed Jun 30, 1999, 2:53p.m.: 22 IR 3392; readopted filed Nov 1, 2005, 3:00 p.m.: 29 IR 896)

675 IAC 16-1.3-80 Section 603.4.12; nonpotable water piping

Authority: IC 22-13-2-2

Affected: IC 22-12; IC 22-13; IC 22-14; IC 22-15; IC 36-7-2-9

Sec. 80. Change section 603.4.12 to read as follows: No drinking or domestic water outlets shall be connected to the nonpotable water line. Whenever possible, all portions of the nonpotable water line shall be exposed and all exposed portions shall be identified as approved by the administrative authority. Each outlet on the nonpotable water line, which may be used for drinking or domestic purposes, shall be posted "CAUTION: NONPOTABLE WATER, DO NOT DRINK".

(Fire Prevention and Building Safety Commission; 675 IAC 16-1.3-80; filed Jun 30, 1999, 2:53 p.m.: 22 IR 3393; readopted filed Nov 1, 2005, 3:00 p.m.: 29 IR 896)

675 IAC 16-1.3-81 Section 603.4.13; potable water supply to carbonators

Authority: IC 22-13-2-2

Affected: IC 22-12; IC 22-13; IC 22-14; IC 22-15; IC 36-7-2-9

Sec. 81. Add a sentence to the end of section 603.4.13 to read as follows: Copper shall not be used downstream from the backflow preventer or backflow device.

(Fire Prevention and Building Safety Commission; 675 IAC 16-1.3-81; filed Jun 30, 1999, 2:53 p.m.: 22 IR 3393; readopted filed Nov 1, 2005, 3:00 p.m.: 29 IR 896)

675 IAC 16-1.3-84 Sections 603.4.18.2 and 603.4.18.3; protection from fire systems

Authority: IC 22-13-2-2

Affected: IC 22-12; IC 22-13; IC 22-14; IC 22-15; IC 36-7-2-9

Sec. 84. Delete items 1 and 2 in sections 603.4.18.2 and 603.4.18.3 and substitute as follows:

1. Double check valve assembly.
2. Double check detector assembly.

(Fire Prevention and Building Safety Commission; 675 IAC 16-1.3-84; filed Jun 30, 1999, 2:53 p.m.: 22 IR 3393; readopted filed Nov 1, 2005, 3:00 p.m.: 29 IR 896)

675 IAC 16-1.3-85 Section 603.4.20; portable cleaning equipment, dental vacuum pumps

Authority: IC 22-13-2-2

Affected: IC 22-12; IC 22-13; IC 22-14; IC 22-15; IC 36-7-2-9

Sec. 85. Change the title and text of section 603.4.20 to read as follows: Portable cleaning equipment, dental vacuum pumps, and chemical dispensers. Portable cleaning equipment, dental vacuum pumps, and chemical dispensers shall be protected from backflow by an air gap, an atmospheric vacuum breaker, a spill-proof vacuum breaker, or a reduced pressure principle backflow preventer, or pressure vacuum breaker.

(Fire Prevention and Building Safety Commission; 675 IAC 16-1.3-85; filed Jun 30, 1999, 2:53 p.m.: 22 IR 3393; readopted filed Nov 1, 2005, 3:00 p.m.: 29 IR 896)

Additional and Expanded Definitions

Air-gap separation - the unobstructed vertical distance through the free atmosphere between the lowest opening from any pipe or faucet supplying water to a tank, plumbing fixture or other device and the flood level rim of the receptacle. An “approved air-gap separation” shall be at least double the inside diameter of the supply pipe or six inches, whichever is less as measured vertically above the top rim of the vessel; in no case shall the gap be less than one inch. However, in some cases a different measurement is necessary. In cases where: (A) a side wall, rib, or similar obstruction is spaced closer than three diameters from the piping affecting the air gap; or (B) two intersecting walls are located closer than four pipe diameters from the piping affecting the air gap; a minimum of three times the diameter of the discharge pipe or six inches, whichever is less, is required above the maximum recorded flood level or above the flood level rim of the receiving vessel, whichever is higher.

Approved - the term “approved” is used in reference to a water supply system or backflow prevention device or method. It shall mean a prevention strategy that is considered acceptable by the appropriate regulatory agency.

Auxiliary supply - any water source or system other than the public water supply that may be available in the building or premises.

Backflow - the flow of any foreign liquid, gas, or substance into the distributing pipe lines of a potable supply of water. Backflow may occur under two conditions: pressure greater than atmospheric (see **back pressure**), and pressure that is subatmospheric (see **backsiphonage**).

Backflow prevention device, approved - a device that has been investigated and approved by IDEM and the water purveyor having jurisdiction. Approval of the device may be left solely to the water purveyor at the discretion of the regulatory agencies.

Backflow prevention device tester, certified - a person in good standing who is qualified to test backflow prevention devices and has proven their competency to the satisfaction of the appropriate regulatory agencies.

Back pressure - backflow caused by a pump, elevated tank, boiler or other means that could create pressure within the system greater than the supply pressure.

Backsiphonage - a form of backflow due to a negative or subatmospheric pressure within a water system.

Consumer - the owner or operator of a private potable water system served by a public water supply.

Contamination - an impairment of a public water supply’s quality caused by the presence of any foreign substance (organic, inorganic, radiological or biological) to a degree which creates a hazard to public health through poisoning or through the spread of disease (see **pollution**) or creates a nuisance condition such as discoloration, staining, tastes or odors.

Cross connection, point of - a specific point or location in a public or a consumer's potable water system where a cross connection exists.

Hazard, degree of - expresses the results of an evaluation of a health, system or plumbing hazard.

Hazard, health - any condition, device or practice in a water supply system and its operation that creates, or may create, a danger to the health and well-being of a consumer.

Hazard, high (contamination) - a physical or toxic hazard which could be detrimental to human health.

Hazard, low (pollution) - a hazard which could cause aesthetic problems or have a detrimental effect on the quality of water in a potable water system.

Hazard, plumbing - a cross connection in a consumer's potable water system that may permit backsiphonage in the event of a negative pressure in the supply line or due to back pressure in which the downstream piping pressure is greater than the supply line pressure. Unprotected plumbing-type cross-connections are considered to be health hazards. They include, but are not limited to, faulty connections to fixtures such as toilets, sinks, tubs, lavatories, wash trays and domestic washing machines.

Hazard, system - a threat to the physical quality of the public water or the consumer's potable water system. Also included is the introduction of a material not dangerous to health but aesthetically objectionable that would have a degrading effect on the quality of the potable water in the system.

Industrial fluid - any fluid or solution that may chemically, biologically or physically degrade the approved water supply.

Industrial line - a separate water piping system serving water-using devices, with a backflow preventer or air-gap separation on the line where the water is taken from the potable water line, also known as the point of takeoff.

Industrial piping system, consumers - a system used by a consumer for the transmission or storage of anything other than a water supply intended or used for human consumption or food processing. Such a system would include all pipes, conduits, tanks, receptacles, mixtures, equipment and appurtenances used to produce, convey or store substances that are or may be polluted.

Isolation - installation of a backflow prevention device at the point of a service connection on the downstream side of the water meter.

Nonpotable water - water not safe for drinking, personal or culinary use.

Operator - the person in direct or responsible charge and supervising the operation of a wastewater or water treatment plant or a water distribution system.

Person - any person, firm, organization, partnership, trust or association of persons, joint venture, corporation or company. The United States, the State of Indiana and any officer or agent thereof are also included in this definition.

Points of delivery - see **Service connection**.

Pollution - the presence of any foreign substance in water that tends to degrade water quality so as to constitute a hazard or to impair its potability or usefulness. The substance can be organic, inorganic, radiologic or biologic.

Potable water - water that is safe for drinking, personal or culinary use.

Premises - an integrated land area, including improvements, undivided by public thoroughfares or water distribution mains where all parts of the land area are operated under the same management and for the same purpose.

Protection device - any of the following devices: 1) air-gap separation; 2) approved double-check valve assembly; 3) approved reduced-pressure principle backflow prevention assembly, or 4) atmospheric or pressure vacuum breaker.

Service connection - the terminal end of a service from the public water supply where the water purveyor surrenders jurisdiction and sanitary control over the water at its point of delivery to the consumer's water system. If a meter is installed at the end of the service connection then the service connection would be the downstream terminus of the meter.

Water delivered (or delivered water) - any water supplied by a water purveyor from a public water supply to a consumer's water system after it has passed the point of delivery and is no longer under the sanitary control of the water purveyor.

Water purveyor - the owner or operator of a public water supply.

Water supply, approved - any public or consumer's potable water supply that has been investigated and approved by IDEM. IDEM shall have the final judgment as to safety and potability, in determining what constitutes an approved water supply.

Water system, consumer's - any potable or nonpotable water system located on a consumer's premises, whether supplied by a public water supply or an auxiliary water system.

Responsibility for Cross-Connection Control

Water Purveyor

The water purveyor's responsibility begins at the source of supply, and include adequate treatment facilities, public water distribution systems and service piping, and end at the point of delivery to the consumer's water system. In addition, all public water supplies shall be continuously operated and maintained so that water is safe in quality, clean and adequate in quantity, and chemically satisfactory for ordinary domestic consumption. To ensure that the proper precautions are taken, the purveyor shall:

- Exercise reasonable vigilance to insure that the customer has taken the proper steps to protect the public water system. When it is determined that a backflow prevention assembly is required, the water purveyor shall require the customer to install an approved backflow preventer device with respect to the degree of hazard. The customer will be responsible for installation at their own expense, testing immediately upon installation, proper repair and maintenance of the assembly and keeping adequate records of each test.

Indiana Department of Environmental Management (IDEM)

As a regulatory agency, IDEM has the following responsibilities:

- To establish reasonable guidelines and regulations to ensure the public water supplies that people use are safe and provide an adequate drinking water supply. The commissioner uses agency staff to enforce the rules, regulations and policies to be followed in carrying out an effective cross-connection control program.
- To recommend that the extent of cross-connection control protection must be commensurate with the degree of hazard present. The best known protection is the properly maintained air-gap separation or the reduced pressure principal backflow assembly, since both offer a high degree of reliability.
- To verify that all IDEM-approved, cross-connection control assemblies meet the specifications set forth in the University of Southern California "Manual of Cross-Connection Control: Tenth Edition," and are fully tested in a laboratory and in the field. Several recognized testing laboratories are available to perform this testing and can provide the necessary certification on the reliability of the device. A list of approved

devices has been established and can be furnished upon request. Installation maintenance and gauge accuracy verification of the backflow prevention devices must meet the standards provided in the Indiana Administrative Code at 327 IAC 8-10.

- To revoke or suspend the registration or certification number of a cross-connection control device inspector for improper testing, maintenance, reporting, or other unethical practices in accordance with 327 IAC 8-10 of the Indiana Administrative Code. A hearing is required, as laid out in Indiana Statute under in IC 4-21.5 or IC-18-11-8.

Domestic Plumbing Inspection (Internal Water System)

The Indiana Department of Homeland Security's (IDHS) Fire Prevention and Building Safety Commission enforces laws, rules, regulations and policies to be followed by plumbers or other persons when installing, modifying or adding to any piping system used to carry potable water. It is the direct responsibility of IDHS to ensure a safe water carrying system after the point of delivery from the water purveyor's mains. The regulation of workmanship, materials, sizing and safety are the responsibility of the Indiana Fire Prevention and Safety Commission of IDHS .

Consumer

The consumer has the primary responsibility of preventing pollutants and contaminants from entering their potable water system or the public potable water system. The consumer's responsibility starts at the point of delivery from the public water supply and includes all water conditioning equipment and piping. When it is determined that a backflow prevention device is required for the protection of the public water system, the consumer shall be required to install an approved backflow prevention device at each service connection at their own expense, , to properly repair and maintain the device or devices and to keep adequate records of each test and subsequent maintenance and repair.

Cross-Connection Control Device Inspector or Tester

A backflow inspector or tester is a person who has successfully completed training in the testing and inspection of cross-connection control devices from a training provider approved by IDEM. The backflow inspector or tester is responsible for the following:

- Performing accurate field tests and repairs to ensure that the backflow prevention device is operating properly in order to protect the drinking water supply against contamination due to cross connection hazards;
- Conducting gauge accuracy verification and backflow testing procedures following Section 9 from the "Manual of Cross-Connection Control: Tenth edition," to ensure accurate test results (ref. the Indiana Administrative Code under 327 IAC 8-10-12b(a)(2)(B));
- Reporting the results of each inspection or test conducted pursuant to the Indiana Administrative Code under 327 IAC 8-10-8(b) and submitting the report to the public water system and customer within 30 days of the inspection or test; and,
- Obtaining appropriate continuing education courses (i.e. video, CD-ROM, e-learning, publication, classroom instruction, etc.) to maintain competency, increase knowledge, improve skills and keep abreast of current standards.

Legal Liability

The duty to install protective devices and inspect was set out by the Indiana Appellate Court in the Lincoln Trust cross connection case of 1929: *Pennsylvania Railroad Company vs. Lincoln Trust Company*, Admr., 167 NE 721, or 91 Ind. App 28.

In this case, the Fort Wayne city water utility was held liable for the death of a customer. The customer had consumed tap water polluted with river water introduced into the city main through a cross connection with the railroad's main. The railroad main was carrying polluted water from the river as a secondary source. This case charged a water utility with a special duty in cases where cross connections are in existence. The court said:

“The City having permitted the railroad company to connect its water main with the water main of the City, was duty-bound to exercise reasonable care to see that no polluted and impure water was allowed to enter its mains through the water main of the railroad.”

Note that the court established a duty to inspect and the use of reasonable preventive devices. Specifically, it said that the duty of inspection does not end with installation, but continues during use. With regard to devices, the court said the water company should use every reasonable effort to adopt and use all proper means readily known to science for the prevention of accidents.

Guidelines for Developing a Cross-Connection Control Program

Local Ordinances

Utilities are not required to develop a local ordinance to create and operate a cross-connection control program. Existing state regulations and utility policies often provide all the authority a utility needs to initiate and operate a cross connection control program. The purpose of a local ordinance or policy is to compliment or enhance the state statutes and regulations. The local ordinance must be at least as stringent as the applicable state regulations. If the utility decides that a local ordinance is desirable, the process of enacting this local ordinance is an important part of the public education role of the utility. A local ordinance must provide the water supplier with the enforcement authority needed to implement an effective cross-connection control program. The local ordinance should also give the water supplier the right of entry for the purposes of inspection and investigation, as well as the authority to take enforcement action, such as the termination of water service. Additional functionality the local ordinance may provide is as follows:

- In addition to the seventeen facilities identified in the 327 IAC 8-10 of the Indiana Administrative Code as cross-connection hazards, the utility may designate additional facilities as cross-connection hazards.
- A utility may want to require that all existing facilities (including those constructed prior to July 19, 1985), identified in the state Rule 327 IAC 8-10 of the Indiana Administrative Code as cross connection hazards, install air gaps or a reduced-pressure principle devices.
- A utility may want to designate residential irrigation systems that are permanently attached to the potable water system as hazards. This would require the owners of residential irrigation systems to install backflow prevention devices.
- A utility may want to require that all test reports from backflow prevention device

inspections be submitted to the utility.

Outreach and Education

The most practical way to run an effective cross-connection control program is to provide public education for both technical and lay people who must work with the program. Some important education and outreach steps include:

- Developing and maintaining the cooperation of the county health agencies, the water customers and the local government officials.
- Informing the customers of the potential public health risks that can result from a cross connection. The local water utility may educate the public through bill inserts, special mailings or maintain internet sites to explain cross connection and backflow prevention to its residential and commercial customers.
- Explaining the necessity of a “right of entry” to customers. According to the Indiana Statute, under IC 13-2-22-7, IDEM employees have the right of entry upon lands or water for the purpose of investigation. Utility personnel may need similar access.
- Locating the manufacturers of different backflow prevention devices and local distributors. Get to know the certified backflow prevention device inspectors in your area.
- Identifying customers with potential cross-connection hazards.
- Categorizing hazards as high or low-risk.
- Developing policies concerning new construction and existing facilities.

Inspection

It is important to conduct site surveys or inspections where cross connections are likely to occur. An inspection for potential cross-connection hazards can be conducted by anyone authorized by the utility. IDEM recommends that the inspection be performed by an individual certified in the state of Indiana as a backflow prevention inspector or tester, or someone familiar with plumbing and backflow hazards. Some important items to remember are:

- Inspectors should get to know their customers and the water-using processes within facilities that are inspected.
- Inspections should begin at the point of service and continue downstream the length of the customer’s drinking water system.
- When installing new connections, customers with potential cross-connection hazards should be identified.
- When a cross-connection hazard is discovered, the cross-connection hazard must be eliminated or an approved backflow prevention device must be installed within ten days.
- The degree of hazard and the hydraulic demands must be considered when selecting a backflow preventer assembly.
- The installation of backflow devices must be in accordance with Rule 327 IAC 8-10 and manufacturer’s specifications. The assembly shall be accessible for maintenance and testing from floor level without use of a ladder or similar temporary apparatus.

Record Keeping

Records are vital information that assure cross-connection control devices are in working order and protect utilities from legal liability. The importance of keeping accurate and complete

records cannot be overstated.

- The water supplier shall retain the three most recent test reports for air gaps, atmospheric vacuum breakers, reduced-pressure principle backflow preventers, pressure vacuum breakers, spill-resistant pressure vacuum breakers and double-check valve assemblies.
- Copies of test reports must be retained by the water purveyor, the customer, the backflow inspector or tester and be available if requested by IDEM. The inspector is responsible for distributing the test report to the appropriate entities.
- The test report should include the location, date of inspection and the water meter reading to ensure that each device has been inspected and tested.
- The inspector is responsible for distributing the test report to the public water system and customer within 30 days of the inspection or test (Appendix A has a test report example).
- The inspector should install an inspection tag on air gaps, reduced-pressure principle backflow preventers, double-check valve assemblies, pressure vacuum breakers, spill-resistant pressure vacuum breakers, and atmospheric vacuum breakers. The inspection tag should contain at least the following information:
 - (1) Manufacturer's name and model type,
 - (2) Date of inspection,
 - (3) Due date for re-inspection; and,
 - (4) The name of the inspector with registration number.

Off-the-shelf computer programs are available for tracking the cross-control devices existing on a customer's premises to ensure that these devices are operating properly and have been inspected in accordance with Rule 327 IAC 8-10.

The Role of IDEM in a Cross-Connection Control Program

The Cross-Connection Control Rule found in the Indiana Administrative Code under 327 IAC 8-10 provides an extremely important tool for the water purveyors of Indiana to ensure that the public water supply is protected against contamination through either backflow or backsiphonage conditions existing on their customers' premises. This rule may be strengthened at the local level by a water utility adopting an ordinance or a set of operating policies more stringent than the rule. Supporting activities are important to maintain an active cross-connection control program.

IDEM provides the following:

- Assistance and guidance to public water supplies in the development of their own cross-connection control programs;
- Maintenance of a list of backflow preventer devices from the Foundation of Cross-Connection Control and Hydraulic Research, University of Southern California;
- Maintenance of a list of cross-connection control device inspectors or testers registered in Indiana. The Indiana Professional Licensing Agency provides a list on its Web site at www.IN.gov/pla (click on the link to "Search and Verify License;")
- Cross connection program surveys of water utilities to ensure cross-connection programs are being implemented adequately to protect the drinking water supply against cross-connection hazards existing in water utility plants and on customer premises;
- Enforcement for violations of regulations found under 327 IAC 8-10 of the Indiana Administrative Code.

IDEM will assist water utilities in bringing persons into compliance with cross connection regulations. If a utility feels that a facility is a cross-connection hazard, and is unable to obtain cooperation regarding the utility's cross-connection policies, the utility can contact IDEM's Office of Water Quality, Drinking Water Branch for assistance. If circumstances warrant, the IDEM Drinking Water Branch will contact the persons involved and work toward a resolution.

In extreme cases, the IDEM Drinking Water Branch will refer persons for enforcement to ensure compliance with Indiana's regulations. According to Indiana statute, found under IC 13-2-22-7, IDEM employees have the right of entry upon lands or water for the purpose of investigation.

Suggested Model Ordinance for Cross-Connection Control

ORDINANCE NO. _____ (*number*)

TO PROVIDE A PROGRAM FOR PROTECTING THE PUBLIC WATER SYSTEM FROM CONTAMINATION DUE TO BACKFLOW OF CONTAMINANTS THROUGH THE WATER SERVICE CONNECTION INTO THE PUBLIC WATER SYSTEM

WHEREAS 675 IAC, Article 16, Rule 1.2, of the Indiana Plumbing Code, as adopted by the Indiana Fire Prevention and Building Safety Commission, requires protection of the public water supply from contaminants due to backflow through connections to fire protection and standpipe systems; and,

WHEREAS the Indiana Department of Environmental Management authorizes the maintenance of a continuing program of cross-connection control which will systematically and effectively prevent the contamination of all potable water systems;

NOW, THEREFORE, BE IT ORDAINED by the (*council or board*) of the (*City or Town*) of the State of Indiana:

SECTION 1. That a cross connection shall be defined as any physical connection or arrangement between two otherwise separate systems, one of which contains potable water from the (*City or Town*) water system, and the other, water from a private source, water of unknown or questionable safety, or steam, gases, or chemicals, whereby there may be a flow from one system to the other, the direction of flow depending on the pressure differential between the two systems.

SECTION 2. That no person, firm, or corporation shall establish or permit to be established or maintain or permit to be maintained any cross connection. No interconnection shall be established whereby potable water from a private, auxiliary, or emergency water supply other than the regular public water supply of (*City or Town*) may enter the supply or distribution system of said municipality, unless such private, auxiliary, or emergency water supply and the method of connection and use of such supply shall have been approved by the (*name of water utility*) and by the Indiana Department of Environmental Management in accordance with 327 IAC 8-10.

SECTION 3. That it shall be the duty of the (*name of local agency*) to cause inspections to be made of all properties served by the public water system where cross connections with the public water system is deemed possible. The frequency of inspections and re-inspections based on potential health hazards involved shall be established by the (*name of local agency*).

SECTION 4. That upon presentation of credentials, the representative of the (*name*

of local agency) shall have the right to request entry at any reasonable time to examine the property served by a connection to the public water system of **(City or Town)** for cross connections. On request, the owner, lessee, or occupant of any property so served shall furnish to the inspection agency any pertinent information regarding the piping system or systems on such property. The refusal of access or refusal of requested pertinent information shall be deemed evidence of the presence of cross connections.

SECTION 5. That the **(name of water utility)** is hereby authorized and directed to discontinue water service to any property wherein any connection in violation of this ordinance exists, and to take such other precautionary measures deemed necessary to eliminate any danger of contamination of the public water system. Water service shall be discontinued only after reasonable notice is served on the owner, lessee, or occupants of the property or premises where a violation is found or suspected to exist. Water service to such property shall not be restored until the cross connection(s) has been eliminated in compliance with the provisions of this ordinance.

SECTION 6. That, if it is deemed by the **(name of water utility)** that a cross connection or an emergency endangers public health, safety, or welfare and requires immediate action, and a written finding to that effect is filed with the clerk of the **(City or Town)** and delivered to the consumer's premises, service may be immediately discontinued. The consumer shall have an opportunity for hearing within 10 days of such emergency discontinuance.

SECTION 7. That all consumers using toxic or hazardous liquids, all hospitals, mortuaries, wastewater treatment plants, laboratories, and all other hazardous users install and maintain a reduced pressure principal backflow preventer in the main water line serving each building on the premises. The backflow preventer must be installed in an easily accessible location not subject to flooding or freezing.

SECTION 8. The reduced pressure principle backflow preventers shall not be installed below ground level.

SECTION 9. That this ordinance does not supersede the Indiana Plumbing Code, the IDEM Rule 327IAC 8-10 or the **(City or Town)** plumbing ordinance No. **(number)**, but is supplementary to them.

SECTION 10. In addition to IDEM Rule 327 IAC 8-10-4(c), the following customer facilities need a backflow prevention device:

(provide a list of facilities)

SECTION 11. That if, in the judgment of the Superintendent of Water, an approved backflow prevention device is necessary for the safety of the public water system, the Superintendent of Water will give notice to the water consumer to install such an approved device immediately. The water consumer shall, at his own expenses, install such an approved device at a location and in a manner approved by the Superintendent of Water and shall have inspections and tests made of such

approved devices as required by the Superintendent of Water and in accordance with the IDEM Rule 327 IAC 8-10.

SECTION 12. This ordinance shall become effective ten (10) days after adoption on second reading, the welfare of the (*City or Town*) requiring it.

APPROVED AS TO FORM AND LEGALITY:

City Attorney

Mayor or Town Board President

First Reading: _____

Second Reading: _____

Effective Date: _____

City Clerk

Distributed to Council: _____

Potential Hazards

Almost all water-using facilities may have actual or potential cross-connection hazards. The following is a partial list of facilities where cross connections are likely to be found and the recommended device for backflow prevention. The type of device or method of protection required should be commensurate with the degree of hazard.

Facility	Device
Aircraft and missile plants	RP
Automotive plants	RP
Beverage bottling plants	RP
Breweries	RP
Car washes	RP
Canneries, packing houses and reduction plants	DC
Chemical plants	RP
Commercial laundries and dye works	RP
Dairies and cold storage plants	DC
Fertilizer manufacturing plants	RP
Film laboratories	RP
Fountains	AG/RP/PVB/ SPVB/DC
Medical buildings, hospitals, mortuaries, morgues, sanitariums and nursing homes	RP
Laboratories	RP
Metal manufacturing, cleaning, plating, processing and fabricating plants	RP
Motion picture studios	RP
Oil and gas production plants	RP
Paper and paper products plants	RP
Photo labs	RP
Power plants	RP
Rubber plants	RP
Schools and colleges with laboratories	RP
Swimming pools	AG/RP/PVB/DC
Wastewater treatment plants, and wastewater and storm water pumping stations	RP
Waterfront facilities and industries	RP
Water treatment plants	RP

Any fixture with a submerged inlet could be a cross-connection hazard. Potential cross connections exist between the consumer's water system and the following fixtures. The devices listed are only recommendations. The type of device or method of protection required should be commensurate with the degree of hazard.

Fixture	Device
Air-conditioning equipment with dual safe and unsafe water supplies or with direct sewer connection for wastewater	RP
Aquariums with a below-the-rim water inlet	AG/RP
Aspirator on surgical, dental or industrial equipment operated by water ejector	AVB
Aspirators on chemical sprayers	AVB
Automatic device for filling tanks, boilers and vats which have overflow connections to a sewer	AG/AVB
Automatic soap dispenser	AG/AVB
Any direct connection between water pipes and sewers, even though gate valves are used	RP
Any individual vat, tank, etc., which has an inverted water supply connection or a water supply connection below the top of the spill rim	RP
Baptistery with below-the-rim water connection	AG/AVB
Bath with below-the-rim water connection	not allowed
Bedpan washer and sterilizer with below-the-rim water connection, or with inverted water supply subject to direct contamination	AVB
Bidet with submerged inlet	AVB
Boilers	AG/RP
Bird bath with submerged inlet	AG/RP
Cellar drains of the water ejector type	AG
Cistern supply in private home, cross connected with the city supply	RP
Coffee urn with direct water supply and sewer connections	AVB
Combination faucet with one safe and one unsafe supply	AVB
Condenser on medical and industrial equipment	AG/RP
Cuspidor with water supply connection	RP
Commercial dishwashing machines	AVB
Dual water supplies, such as hot water supply from an unsafe source	AG/RP
Dental cuspidor and saliva ejector with unprotected water supply connection	RP
Drinking fountain with submerged water inlet or with the water supply line passing through the drain	not allowed
Dishwasher with water inlet below the rim	AVB

Dual water supplies cross connected in factories, etc.	RP
Egg boiler having direct water supply and sewer connections	AVB
Ejector actuated by direct water connection	RP
Filter with waste connected direct to sewer	AG
Fish pond with submerged water inlet	AG/RP
Floor drain with flushing connection, often used in operating rooms	AVB
Flushometer valve not protected with siphon breaker	AVB
Foot tub with submerged water inlet	not allowed
Floor drain having automatic device for sealing	AG
Frost-proof hydrant, whether or not the valve drains to the sewer or to the ground surrounding the sewer	AVB
Fire hydrant with drain connection to sewer or weephole to the sewer or to the ground surrounding the sewer	RP
Garbage can washers	AVB/PVBA
Gas-type chlorinator with dual feed to mixing basin and clear well	AG/RP
Grease trap with water supply connection for flushing	AG
Hose for sink, laundry tray, soap kettles, etc.	AVB
Hose outlets for washing down industrial, commercial or other equipment	AVB
Hydraulic elevator with waste connection direct to sewer	AG
Hospital equipment such as autoclave, instrument sterilizer, utensil sterilizer, etc., with submerged inlets and with direct connections to the sewer	RP
Industrial processes requiring direct water connections	RP
Industrial water supplies process appliances with direct water supply connections not having adequate air gaps	RP
Kitchen fixtures with common waste and supply lines	not allowed
Kitchen sink garbage disposal or grinder	AG/AVB
Lawn sprinkling systems	SPVB/PVB/DCV
Lawn sprinkling systems with automatic chemical dispenser	SPVB/PVB/RP
Leaky water main or service near sewer	RP
Make-up water tank at swimming pool with below-water inlet	AG
Ordinary home and store-type evaporative air cooling units, with a float valve to maintain water at a constant level	RP
Pump used for dual purposes, with one safe and one unsafe supply	AG/RP
Pump used for unsafe material having a direct water connection for priming	AG/RP
Pump pit with drain connection to sump or sewer line	AG
Rubber hose with hand control or self-closing faucets attached, as used in	

connection with baths, industrial vats, containers, etc.	AVB
Refrigeration equipment with water cooling	AG/RP
Rubber hose connection extending water line to below the overflow rim of sinks, lavatories, tanks, tubs, laboratory apparatus, etc.	AVB
Sealing ring on sewage pump with direct water connection	AG/RP
Sewage lift with direct water connection	AG/RP
Sinks with below-the-rim water inlets	Not allowed
Sludge line with direct water connection for flushing	AG/RP
Sterilizers of all kinds, both medical and dental, with submerged inlets	RP
Still with direct water connection	RP
Steam table with water supply connection entering the bottom of the table	AVB
Seat-action water closet with pressure tank having a flush valve in or attached to the bowl	AVB
Swimming pool with direct water connection	AG/RP
Siphon flush tank with water connection below the overflow rim	AG
Therapeutic bath with submerged inlet	AG
Toilet equipped with flushometer valve attached to the bowl	AVB
Tumbler washer in beverage sink having submerged inlet	AG/AVB
Tank with inverted supply or below-the-rim supply	AG
Urinal having direct flushing device	AG
Vat with inverted supply or below-the-rim supply	AG/RP
Water softener waste discharge or overflow pipe	AG
Water cooler improperly designed and using toxic refrigerant which may pollute the water supply	RP
Watering troughs (dairies, hog farms and horse stables)	AG/AVB
Water-operated aspirator on a suction flask in laboratories, etc.	AVB
Water-operated aspirator in undertaking establishments, hospitals, etc.	AVB
Water closet of the hopper type with pressure tank having a flush valve in or attached to the bowl	AVB
X-ray developing tank with submerged water supply inlet	RP
Yard hydrant having drip openings below ground surface that may allow polluted ground water to drain into the water supply pipes	RP

Pipe Color Coding

When two or more piping systems are used for water in a building or industrial plant, extreme care should be taken not to interconnect the systems. There may be a potable water system in addition to systems carrying lesser quality water, such as fire protection. To help prevent the possibility of the two systems being interconnected, pipes should be identified adequately by legends and color coding based on the “Recommended Standards for Water Works: 2007 Edition” (ten states standard) or the American Standards Association “Scheme for Identification of Piping Systems” (ASA A13.1-1956).

Color coding should not be used solely to identify the contents of the pipes but should be used to supplement the use of legends. Potable water lines should be painted dark blue or with the bands of dark blue and the words “potable water” stenciled on the pipe at appropriate intervals. Pipes carrying water for fire protection should be painted red and be stenciled. Piping systems carrying other material or water for other purposes should also be clearly identified with appropriate legends and color coding.

Fire Protection Systems

Facilities with fire protection systems are often cross-connection hazards. Fire protection systems are sometimes connected to auxiliary, nonpotable water sources. Chemical additives or frost inhibitors are sometimes used in fire protection systems. Fire protection systems are not required to be disinfected and sanitized to the same standards as potable water systems. Due to the infrequency with which fire protection systems are used, water standing in the system becomes “stale” or discolored due to iron or manganese and should not be allowed to enter the potable system.

Fire protection systems must comply with the Fire Protection and Building Safety Commission Rule, found under 675 IAC 16-1.2-35.1 of the Indiana Administrative Code.

Water Loading Stations

Potable water loading stations used for overhead filling of tanks through a hatch opening at the top are often used to fill potable vessels and other tanks or contaminated vessels. These stations follow specific standards:

1. The filling spout must not be allowed to intrude into the tank further than two (2) pipe diameters of the filling pipe above the flood level rim of the receiving vessel.
2. There shall be no backflow to the public water supply.
3. Hoses shall not be contaminated by contact with the ground.

Water Trucks

Water trucks for swimming pools, garden ponds, cisterns, street cleaning, landscaping, ornamental fountains, etc., can be cross-connection hazards if proper precautions are not

taken when filling the truck from a potable water source. Many water trucks are equipped with an air gap or a reduced-pressure principle backflow prevention assembly on the water intake. If a backflow prevention device is not an integral part of the water truck, a reduced-pressure principle backflow prevention assembly should be installed on the water supply downstream of the water meter, if a meter is required.

Training Providers of Cross-Connection Device Inspectors and Testers

At the time of printing there are four organizations qualified in Indiana to certify backflow prevention device inspectors:

1. The Indiana chapter of the American Backflow Prevention Association: (765) 220-5570;
2. The Indiana Pipe Trades Association: (260) 490-5896;
3. The Indiana School of Backflow and Cross Connection: (317) 966-2962, (317) 966-2955 or (317) 867-3388; and,
4. The Industrial Cross Connection Prevention: (317) 299-8266.

Reciprocity with other states is not automatic. An individual should contact IDEM's Drinking Water Branch with questions about reciprocity.

Backflow and Backsiphonage

Backflow is generally defined as the flow of any foreign liquid, gas or other substance into the distributing pipelines of a potable supply of water from any source or sources other than the intended one. For backflow to occur, two conditions must be present:

1. A link must exist between the potable and the nonpotable system; and,
2. The resultant flow produced by the differential pressure must be toward the potable system. If both systems are at pressures greater than atmospheric (positive pressure), backflow due to back pressure can occur. A pump, elevated tank or boiler can create a back pressure that is greater than the pressure in the potable system.

If the potable system is at a pressure less than atmospheric (negative pressure), the atmospheric pressure on the foreign liquid will force it toward the partial vacuum and backsiphonage occurs. A more explicit term for backflow when subatmospheric pressure exists, backsiphonage is the backing up, or siphoning, of a foreign liquid into a potable water system. Backflow due to back pressure is well illustrated by an accident that occurred during World War II at an East Coast shipyard. The water supply for the firefighting system was drawn from the harbor and supplied at a pressure higher than that used in the potable water system. A temporary cross connection between the two systems, made by someone unfamiliar with the systems, caused the polluted harbor water to be pumped back into the potable water system. This accident resulted in approximately 700 cases of gastroenteritis. A similar incident, reported on the West Coast in 1960, was discovered before anyone became sick.

Unacceptable backflow preventer devices

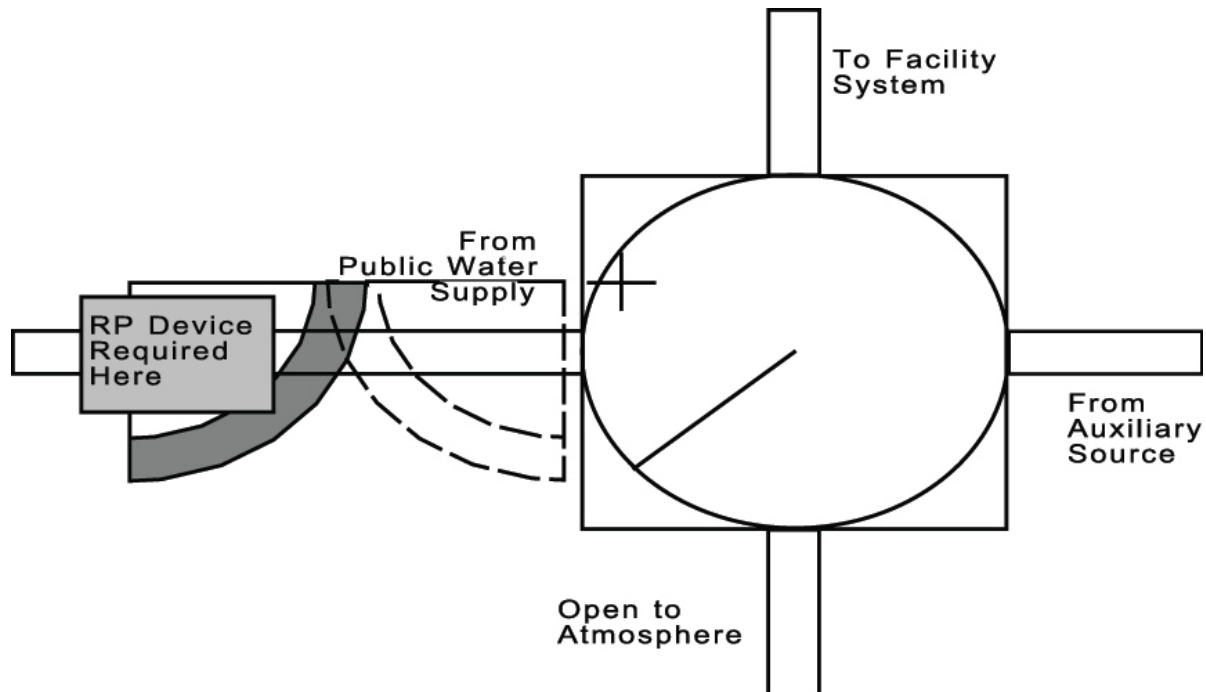
Single-Check Valve

The prevention of backflow in pipelines is a critical problem that requires the tight closing of valves under all conditions of service when flow ceases in the normal direction. Therefore, when a potable water system must be protected against contamination from backflow, it is essential that the preventive device be fully adequate, well constructed, properly installed and carefully maintained.

Currently IDEM recognizes only backflow prevention devices that have been approved by the Foundation for Cross-Connection Control and Hydraulic Research, University of Southern California.

Changeover Devices

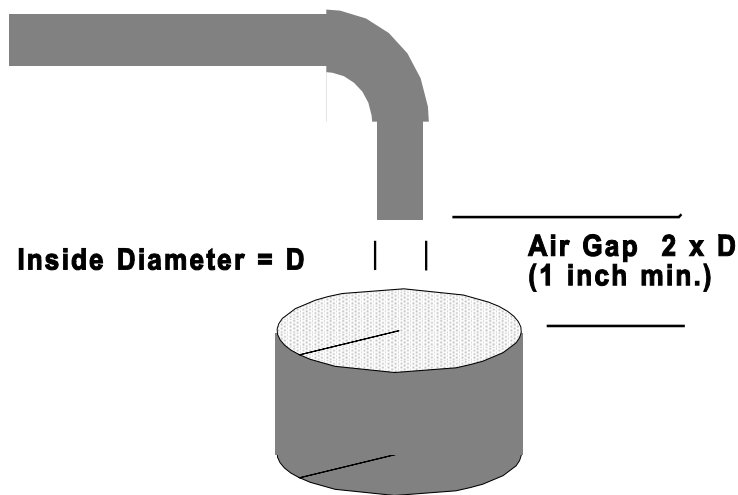
Changeover devices and four-way valves have been approved by some states under certain circumstances. A number have been used to quickly change over from one water supply source to another. These devices provide an alternate, but not simultaneous, supply to equipment from a potable domestic supply or a nonpotable auxiliary source. Changeovers include swing devices, swivel devices, four-way plug valves, sliding multi-port tubes (manually or hydraulically operated) and others.



None of these devices should be classified as backflow preventers because they fail to meet the requirements of an approved backflow preventer. For short periods after the swivel has been switched from a nonpotable source to a potable one, the flow of nonpotable water into an approved water system may occur if the system is not protected by a backflow prevention device

Approved types of Backflow Prevention Assemblies

Most backflow preventers fall into one of three classes: the vacuum breaker, the double-check valve, or the reduced-pressure principle valve. Both prevent backflow due to



superior pressure, or back pressure on the downstream side of a system, which will overcome the pressure on the supply side. They are installed in the main supply system where there is a possibility of backflow.

Air-Gap Separation

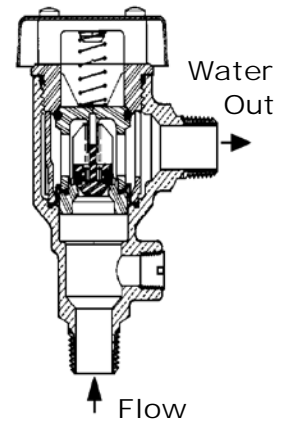
Air-gap separation (AG) is probably the oldest method of preventing cross connections that result in backflow due to either back pressure or backsiphonage. In many states, it is still the only method approved for preventing this type of backflow. Air-gap separation is the unobstructed vertical distance through free atmosphere between the lowest opening from any pipe or faucet supplying water to a tank, plumbing fixture or other device and the flood-level rim of the receptacle.

Although an air gap generally affords maximum protection, it can be bypassed easily, its effectiveness thus being entirely destroyed. It is also not reliable if the gap is too small. As defined in American National Standard A112.1.2-1042 (R1973), an air gap should be twice the diameter of the effective opening of the supply pipe. In no case shall the gap be less than one inch, or 25.4 mm. “The Recommended Standards for Water Works: 2007 edition” by the Great Lakes - Upper Mississippi River Board of Public Health and Environmental Managers recommends that for water treatment facility design of chemical addition to drinking water that:

no direct connection exists between any sewer and a drain or overflow from the feeder, solution chamber or tank by providing that at all drains terminate at maximum six inches or two pipe diameters, whichever is lesser, above the overflow rim of a receiving sump, conduit or waste receptacle.

Atmospheric Vacuum Breaker

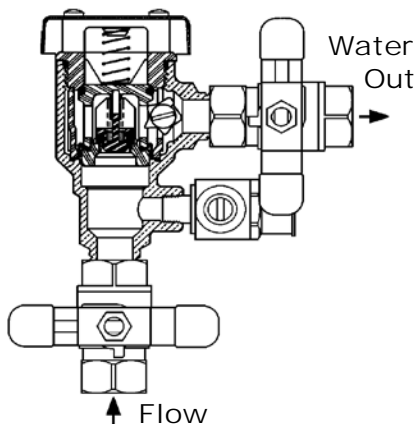
The atmospheric vacuum breaker (AVB) assembly is one of the most simple and least expensive types of backflow preventers. The AVB contains an air inlet valve, check seat and an air inlet port. Water flowing through the AVB causes the air inlet valve to close against the air inlet port. When normal water flow is stopped, the air inlet valve falls to form a block for backsiphonage. The AVB protects against non-health hazards or health hazards under backsiphonage only. The atmospheric vacuum breaker is not designed to protect against back pressure. Based on the design and operation of AVB, the following criteria must be implemented:



1. Absolutely no shut-off valves are allowed on the discharge side of the AVB;
2. A minimum of six inches of clearance above all downstream piping of the AVB or any overflow rim is required; and,
3. The AVB shall not be under continuous pressure for more than 12 hours.

Pressure Vacuum Breaker

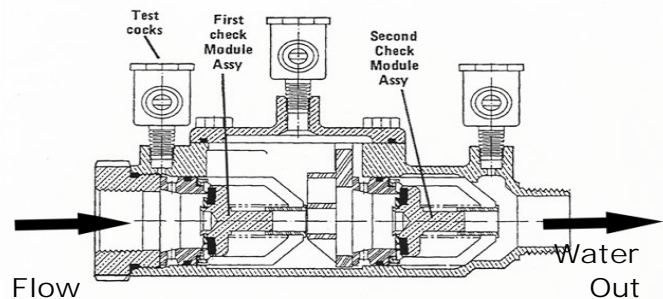
The pressure vacuum breaker (PVB) assembly evolved from the need to have a testable atmospheric vacuum breaker. The PVB contains an internally loaded check valve and an internally loaded air inlet valve. The valves independently act with the air inlet valve located downstream of the check valve. Shut-off valves and test cocks are located at each end of the assembly. The PVB, unlike the atmospheric vacuum breaker, can be tested. The PVB protects against non-health hazards or health hazards under backsiphonage only. The pressure vacuum breaker is not designed to protect against back pressure. Based on the design and operation of PVB, the following criteria must be implemented:



1. Shut-off valves may be installed on the downstream of PVB; and,
2. A minimum clearance of 12 inches above all downstream piping must be established.

Double-Check Valve

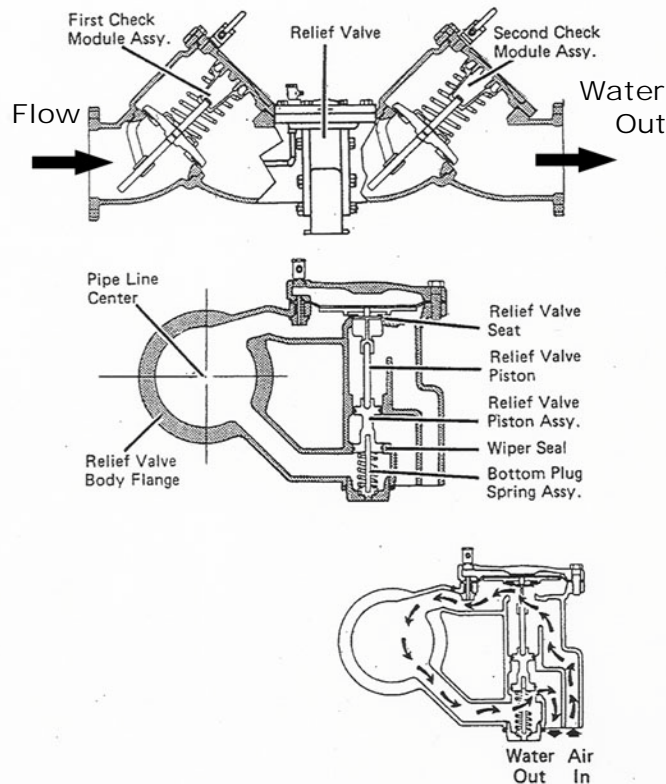
The double-check valve (DCV) consists of two independently acting, resilient seat check valves located between two tightly closing shut-off valves, together with suitable test cocks, and stop valves arranged so that the main check valves can



be tested for water tightness.

This device is one of the oldest types of backflow preventers, dating back to the late 19th century. An approved double-check valve device is regarded as an assembly that meets the requirements of American Water Works Association (AWWA) Standard for Double-Check Valve Backflow Prevention Assembly (AWWA C510-92) or an assembly that has been approved by a testing laboratory sanctioned by the Conference of State Sanitary Engineers.

Reduced-Pressure Principle Backflow-Preventer



An approved Reduced-Pressure Principle device (RP) is regarded as an assembly that meets the requirements of the AWWA Standard for Reduced-Pressure Principle Backflow Prevention Assembly (AWWA C511-92) or an assembly that has been approved by a laboratory sanctioned by the Conference of State Sanitary Engineers. The reduced-pressure principle backflow preventer, introduced to the water supply industry about 1942, is safer than the double-check valve. The device consists of an automatic differential-pressure valve located between two or more independently acting, spring-loaded, resilient seat-check valves. These seat-check valves are, in turn, located between two tightly closing shut-off valves. Suitable test cocks are provided for testing the tightness of the main check valves. Since this device discharges to the atmosphere, it can be used where codes call for an air gap. Backflow assemblies installed in a confined space are not recommended. For example, the RP cannot be installed in pits.

The RP operates on the hydraulic principle that water will not flow from a zone of lower pressure to a zone of higher pressure. As a differential-pressure valve, the relief valve is held in a closed position when the pressure on the supply side is higher by a prescribed amount than that in the zone between the two main check valves. When the pressure on the supply side of the unit falls below a set value, the relief valve opens, and the intermediate zone discharges to atmosphere. If the pressure on the discharge side of the device becomes higher than the supply pressure and the second-check valve malfunctions, the intermediate zone also discharges to atmosphere. An outstanding advantage that the reduced-pressure principle backflow preventer has over the double-check valve is the visible indication of malfunctioning

long before a danger of backflow exists. Hence, repairs can be made while the device is still effectively acting as a backflow preventer.

The AWWA Standard for Reduced-Pressure Principle Backflow Prevention Assembly (C511-92) details the requirements for design, materials of construction, and operation of the devices in all sizes. AWWA Manual M14 provides guidelines for the operation of double-check valves and reduced-pressure principle devices.

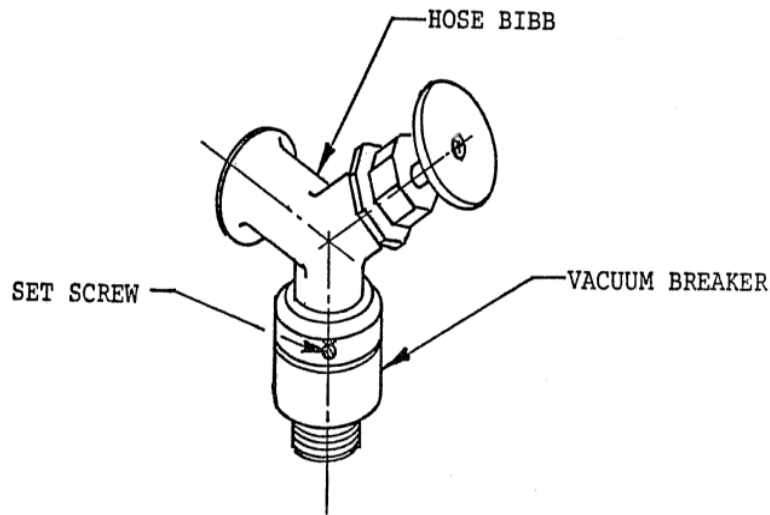
Test Results for Reduced-Pressure Backflow Preventers

In the Los Angeles area, the reduced-pressure principle device has been used since 1944 and has given excellent service. In more than 100,000 tests conducted at the University of Southern California by the Foundation for Cross-Connection Control Research, there has never been a case of backflow, as indicated by sickness or death, where this device has been used.

More than 200 of these devices are used at atomic energy installations. At the Oak Ridge National Laboratory, exhaustive tests were conducted in 1962 to determine whether the device would provide an adequate air-gap separation. The reduced-pressure principle device was tested under varying conditions, including ionic diffusion, lower pressure on the supply side, and water hammer on the discharge side. The report states, in part: "Using a solution of manganese and potassium nitrates as a non-radioactive tracer, backflow from the discharge side to the supply side was not detectable by activation and radiochemical analysis having a sensitivity of 0.2 ppb of manganese."

Hose Bibb Vacuum Breaker

The hose bibb vacuum breaker is designed specifically to be mounted on a faucet to prevent backsiphonage. It may be used on a wash basin or laboratory faucet or outside hose bibb. This unit can readily be subject to back pressure by simply having the hose outlet higher than the faucet. However, this device is better than no protection at all.



HOSE BIBB VACUUM BREAKER

Proper Selection of Backflow Prevention Devices

When selecting a backflow prevention device, whether it is used for a cross connection at the system connection or a cross connection at the point of use, the following questions will help determine which device will be most appropriate:

1. Is it an indirect or direct cross connection? An indirect cross connection is subject to backsiphonage only, while a direct cross connection is a connection which is subject to back pressure,
2. What is the degree of hazard? A “low hazard” shall mean a substance which is only aesthetically objectionable (i.e. bacteriological, unusual taste, odor, beverages, etc.). A “high hazard” shall mean a substance that could cause illness or death if ingested (i.e. toxic chemicals, radioactive materials, etc.).
3. Is the system under continuous use or pressure for more than 12 of any 24-hour period with no shut-off valves or obstructions downstream? The pressure vacuum breaker assembly may be used under continuous pressure, while the atmospheric vacuum breaker must not be used under continuous pressure.
4. What hydraulic conditions will the backflow prevention device experience at the point of connection? Backflow prevention assemblies are to be used within their rated operating conditions. A backflow prevention device which is over specified will increase the cost unnecessarily. Engineering data from the manufacturer should be consulted when selecting a backflow prevention device.

Thermal Expansion

When installing a backflow prevention device, attention must be paid to the thermal expansion of water downstream from the point of isolation. The thermal expansion of water confined in pipes and fixtures could increase the water pressure resulting in a catastrophic failure. Facilities with water heaters and double-check valves or reduced-pressure principle backflow

preventers should include a pressure relief valve, expansion tank or other device to accommodate thermal expansion. The smaller the isolated system, the less inherent tolerance to thermal expansion exists. Therefore, pressure relief devices are essential in residential facilities which are equipped with water heaters and backflow prevention devices.

Reported Backflow Incidents Past and Present in Indiana

- In 2005 the drinking water supply for an Indiana town was directly connected with pond water being utilized for a fire suppression system in a local facility. The interconnection was separated only by a single check valve.
- In 2004 the pressure relief valve for a residential water heater was removed and plugged, causing the water heater to explode. The meter for the service connection is equipped with a check valve.
- In 2002 Elementary School's domestic plumbing was contaminated with isopropyl alcohol.
- In 2001 an electric power and light company's ground water wells were directly connected to city water mains causing bacteriological contamination.
- In 2000 a rubber seal factory paint sprayer gun was directly connected to the drinking water supply for cleaning purposes.

- In 1996, following a water main flushing, a Huntington, Indiana resident complained of low water pressure. Upon removing the house meter, it was discovered that the meter had been clogged with resin that had backsiphoned from a water softener while the main was being flushed.
- In 1995 a chemical company was washing and flushing a tank when the flush water was backsiphoned into the potable water system inside the building. The backflow prevention device failed and was repaired immediately.
- In 1993 the potable water of an industrial facility became contaminated with soluble oil when an internal backflow device was bypassed. The bypass line was removed immediately and the backflow preventer was tested to ensure proper operation.
- In 1992 antifreeze backflowed into a university laboratory's potable water. A nearby water main break had caused the backsiphonage of antifreeze from a cooling system. The reduced-pressure principle device had failed. The backflow device was replaced.
- In 1992 a school found pink-colored water at the dishwashing station. A chemical treatment for the boiler had backsiphoned due to a faulty check valve. An approved backflow preventer was installed immediately.
- In 1990 a middle school experienced a backflow of antifreeze from the school's boiler make-up water and air-conditioning units. There was no backflow preventer on either water line at the time of the incident.
- In 1987 a government building experienced backsiphonage from a direct connection of laboratory equipment, dishwashing units, cooling towers, auxiliary wells, etc. into the potable water lines. All of this equipment was subsequently isolated with an approved backflow device.

American Water Works Association Conference

- In 1974, during an annual conference of the AWWA in Boston, thousands of people attending the conference noticed “yellow water” in the drinking water. Chromium had been added to the facility’s chilled water system. A manual shut-off valve was inadvertently left open and backflow occurred, distributing “yellow water” to the drinking fountains, soda fountains, and coffee makers in the auditorium. The problem was corrected by installing an approved backflow prevention device.

Summary

In closing, the following essential points should serve as a constant reminder to any jurisdiction maintaining a cross-connection control program:

1. Cross connections are a public health problem. Control is vital.
2. Separate piping systems for potable and nonpotable water, or wastewater, offer the optimum means to protect potable water systems from contamination. The maintenance of complete separation, when both types of systems are in the same building, is extremely difficult. It is a tremendous task to make a complete, detailed survey of a large industrial complex. Cross connections are sometimes hidden underground, in walls or in water-using equipment. Frequent piping changes often result in new cross connections. In addition, the cost of periodic cross connection inspections is thought to be considerable by many.
3. The responsibility for eliminating cross connections in public water systems has been placed squarely on the shoulders of the water purveyor. A water purveyor’s liability cannot be shifted to any other person or authority. They can be held responsible for another authority’s acts or lack of action should negligence be shown. The courts of the United States and Indiana have upheld this position.
4. It is important for local authorities to prioritize the protection of their community’s water supply. Local authorities must adopt a cooperative attitude, apply their enforcement powers vigorously and provide adequate ordinances, legal advice and assistance, definitive directives and lists of approved devices classified by use.
5. If local building ordinances fail to cope with in-plant, cross-connection problems, water purveyors have no alternative but to protect the public water supply from contamination originating in a customer’s water system. Water purveyors have adopted a control system called “cross-connection control by containment.” This simply means that the purveyor installs, or requires to be installed, a suitable backflow preventer at the customer’s service connection, on the downstream side of the meter. Responsibility for cross connections within a facility is thus placed on its owners, but the purveyor’s water supply is protected against any possibility of contamination so long as the backflow preventer is maintained and tested at the prescribed intervals. Because of the difficulty in tracing out the complexity of water lines in a plant, a containment approach is a necessity.

Appendix A: Sample Test Report Form

Backflow Prevention Device Test and Maintenance Report

The approved cross-connection control device detailed hereon has been tested and maintained as required by the IDEM Rule 327 IAC 8-10-7 and is certified to comply with the above rule.

Test for: DCV RP PVB SVB AVB DCDA

DCV = Double-Check Valve, RP = Reduced Pressure Principle, PVB = Pressure Vacuum Breaker, SVB = Spill-Resistant Vacuum Breaker, DCDA = Double-Check Detector Assembly, AVB = Atmospheric Vacuum Breaker

Reduced Pressure Principle					
Double Check Valve Assembly		Relief Valve	PVB/SVB	AVB	
Check Valve # 1	Check Valve # 2				
Initial Test	Held at ____ PSID Leaked <input type="checkbox"/>	Held at ____ PSID Leaked <input type="checkbox"/>	Opened at: ____ PSID Did not Open <input type="checkbox"/>	Air Inlet Opened at ____ PSID Did Not Open <input type="checkbox"/>	Free Movement of Air Inlet Valve Free Fall <input type="checkbox"/>
					Cleaned <input type="checkbox"/> Replaced AVB <input type="checkbox"/>
Repairs and Materials Used					
Test After Repair	____ PSID Closed Tight <input type="checkbox"/>	____ PSID Closed Tight <input type="checkbox"/>	Opened at: ____ PSID	Air Inlet Opened at: ____ PSID Check Valve: ____ PSID	
Installation	Improper <input type="checkbox"/> Comments:	Improper <input type="checkbox"/> Comments:	Improper <input type="checkbox"/> Comments:	Improper <input type="checkbox"/> Comments:	Improper <input type="checkbox"/> Comments:

The above test result is certified to be true.

Test by:

First and Last Name: _____

Address: _____

Repaired by:

First and Last Name: _____

Inspection tag installed?

Registration Number: _____

Date of Inspection: _____

Registration Number: _____

Address: _____

Date of Inspection/Repaired: _____

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Appendix B: Works Cited

- American Water Works Association. (1990). *Manual of Water Supply Practices, Recommended Practice for Backflow Prevention and Cross-Connection Control, AWWA M14. Second edition*. Denver: American Water Works Association.
- American Water Works Association. (1992). *AWWA Standard for Double Check Valve Backflow-Prevention Assembly (ANSI/AWWA C510-92)*. Denver: American Water Works Association.
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- Foundation for Cross-Connection Control and Hydraulic Research. (1993). *Manual of Cross-Connection Control, Ninth Edition*. Los Angeles: Foundation for Cross-Connection Control and Hydraulic Research.
- The Great Lakes-Upper Mississippi River Board of Public Health and Environmental Managers. (1992). *Recommended Standards for Water Works*. Albany: The Great Lakes-Upper Mississippi River Board of Public Health and Environmental Managers.
- United States Environmental Protection Agency, Office of Water, Office of Drinking Water. (1989). *Cross-Connection Control Manual*. Washington, D.C.: USEPA.