

**CROSS-CONNECTION CONTROL MANUAL  
AND  
DESIGN CRITERIA FOR CROSS-CONNECTION CONTROL  
PLANS, ORDINANCES, AND POLICIES**



**DIVISION OF WATER SUPPLY  
TENNESSEE DEPARTMENT OF ENVIRONMENT AND CONSERVATION  
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**TENNESSEE DEPARTMENT OF ENVIRONMENT AND CONSERVATION  
DIVISION OF WATER SUPPLY**

**SUBJECT: CROSS-CONNECTION CONTROL PROGRAM**

To assist public water systems in establishing an effective program to control cross-connections, the Division of Water Supply of the Tennessee Department of Environment and Conservation has prepared the following criteria.

1. Each public water supply shall develop a comprehensive, ongoing program for the detection, elimination, and prevention of cross-connections. A policy or ordinance and a plan for the program shall be submitted to the Director of the Division of Water Supply, Tennessee Department of Environment and Conservation, for review and approval. Upon approval of the plan, the water purveyor shall implement the program.
2. Any backflow prevention assemblies, required should be of a model and construction approved by the Division of Water Supply and the water purveyor.
3. Any backflow prevention assemblies, required to protect the public water supply, should be installed at a location and in a manner approved by the water purveyor. It is logical that the customer who needs cross-connection protection bears the expense of providing backflow protection. The installation of all such backflow prevention assemblies should meet or exceed the minimum standards established by the Tennessee Department of Environment and Conservation.
4. It should be the duty of the water purveyor to see that backflow prevention assemblies are properly installed where required, tested for proper functioning upon completion of installation, and to see that the assemblies are inspected and tested at least annually or more frequently as required by the water purveyor or the Division of Water Supply of the Tennessee Department of Environment and Conservation to determine if the assemblies meet applicable performance standards. Testing of such units should be performed by the water purveyor or by a person approved by the water purveyor. Testing and repairing of backflow prevention assemblies should be by qualified personnel. The person receiving a certificate of competency in the testing of backflow assemblies as evaluated and issued by the Department of Environment and Conservation or its successor should perform the testing of such units. These assemblies should be repaired, overhauled, or replaced with approved units whenever they are found to be defective. Records of inspections, tests, repairs, and overhauling, shall be evaluated by the public water purveyor and made part of the system's permanent records.
5. A customer of the public water system should notify the water purveyor of any installations, repairs, changes or proposed corrective actions on protective assemblies.
6. When cross-connections, actual or potential, exist, the water purveyor should establish a time for completion of the necessary corrections, taking into consideration the degree of hazard involved, and the time required to obtain and install the needed corrections. The water purveyor should use every means at his disposal to obtain the cooperation of the customer; however, if proper protection has not been provided after a reasonable period of time (following legal notification), the water utility should physically separate the public water supply from the on-site piping system in such a manner that the two systems cannot again be connected by an unauthorized person.
7. The water purveyor shall maintain up-to-date records on cross-connection control activities and the status of the program for their control, and should be ready at any time to supply such information as may be requested by the Department or others.
8. Where there is a secondary water source or other piping system which could be cross- connected with the potable water supply, the public water supply should be protected by reduced pressure backflow prevention assembly on the incoming service line at the service connection in a manner acceptable to the water purveyor. Exposed piping should be identified by distinguishing colors, labels, or tags, and be maintained so that each pipe can be readily traced in its entirety.
9. A private water storage tank supplied by a public water supply system shall be deemed a secondary (or auxiliary) water supply unless its design meets the minimum design standards required for

distribution system storage tanks for public water supplies. In addition, the tank must be constructed, maintained, and used so that the water circulates through the tank on a continual basis, and the quality of water consistently meets Drinking Water Standards.

10. The water purveyor should deny water service to any premises where cross-connections exist until corrective action is taken. If necessary, water service should be discontinued for failure to test or maintain backflow prevention assemblies in a manner acceptable to the water purveyor. If it is found that the backflow prevention assemblies have been removed or bypassed or otherwise rendered ineffective, water service should be discontinued unless corrections are made immediately. Water service to such premises should not be restored until the customer has corrected or eliminated such conditions or defects to the satisfaction of the water purveyor.
11. No person should install or maintain a water service connection to any premises where a booster pump has been installed unless the booster pump is equipped with either an approved suction pressure sustaining valve or a low pressure cutoff mechanism designed to cut off the booster pump when the pressure on the suction side of the pump drops to 20 psi gauge or less. The suction pressure-sustaining valve has a distinct advantage over the low pressure cut off assembly in that it will not stop the pump because of low pressure in the suction valve. In the event that insufficient water is being supplied to the pump to maintain a head of 20 psi, the suction pressure-sustaining valve, located on the discharge side of the pump, will smoothly throttle only to the event necessary to maintain a preset suction pressure. In the case of a fire service line, the suction pressure sustaining valve or low-pressure cutoff assembly should be Factory Mutual Approved or UL listed. It should be the duty of the water customer to maintain the low-pressure cutoff device and pressure sustaining valve assembly in proper working order and to certify to the water purveyor at least once a year that the device is operating correctly. Such booster pumps should be installed in a manner that prevents backflow into the public water system.

Pumping stations within the public water supply distribution system should be equipped with low-pressure cutoff devices or a suction pressure-sustaining valve in accordance with the requirements set forth in the "Design Criteria for Public Water Supplies". The devices should be maintained in good working condition and tested at least once a year. Records should be kept showing the results of the tests on the cutoff or pressure sustaining devices.

12. All mortuaries utilizing a public water supply in the preparation of bodies should have a properly installed reduced pressure backflow preventer assembly for the protection of the public water supply.
13. A reduced pressure backflow preventer assembly should be installed at each service connection from a public water supply to any premises on which there is a wastewater treatment plant or a sewage lift station. This recommendation applies to all premises publicly or privately owned.

## DEFINITION OF TERMS

**Air Gap:** A physical separation between the free flowing discharge end of a potable water supply line and an open or non-pressurized receiving vessel.

**Approved Air Gap:** An air gap separation with a minimum distance of at least twice the diameter of the supply line when measured vertically above the overflow rim of the vessel, but in no case less than one (1) inch.

**Approved:** Any condition, method, device, procedure accepted by the Tennessee Department of Environment and Conservation, Division of Water Supply, and Water Provider.

**Auxiliary Intake:** Any piping connection or other device whereby water may be secured from any sources other than from the public water system.

**Auxiliary Water Supply:** Any water supply on or available to the premises other than water supplied by the public water system.

**Backflow:** The reversal of the intended direction of flow of water or mixtures of water and other liquids, gases, or other substances into the distribution pipes of a potable water system from any source.

**Backpressure:** A pressure in the downstream piping that is higher than the supply pressure.

**Backsiphonage:** Negative or Sub-atmospheric pressure in the supply piping.

**Backflow Prevention Assembly:** An approved assembly designed to prevent backflow.

**Bypass:** Any system of piping or other arrangement whereby water may be diverted around a backflow prevention assembly, meter, or any other public water system controlled device.

**Contamination:** The introduction or admission of any foreign substances that causes illness or death.

**Contaminant:** Any substance introduced into the public water system that will cause illness or death

**Cross-Connection:** Any physical arrangement whereby public water supply is connected, directly or indirectly, with any other water supply system, sewer, drain, conduit, pool, storage reservoir, plumbing fixture or other device which contains, or may contain, contaminated water, sewage, or other waste or liquid of unknown or unsafe quality which may be capable of contaminating the public water supply as result of backflow caused by the manipulation of valves, because of ineffective check valves or backpressure valves or because of any other arrangement.

**Cross-Connection Control Coordinator/Manager:** The person who is vested with the authority and responsibility for the implementation of the Cross-Connection Control Program and for the provision of this ordinance/policy.

**Customer:** Any natural or artificial person, business, industry, or governmental entity that obtains water, by purchase or without charge, from the water provider.

**Direct Cross-Connection:** An actual or potential cross-connection subject to backsiphonage and backpressure.

**Double Check Detector Assembly:** A specially designed assembly composed of line size approved double check valve assembly, with a bypass containing a water meter and approved double check valve assembly specifically designed for such application. The meter shall register accurately for very low rates of flow up to 3 gallons per minute and shall show a registration for all rates of flow. This assembly shall only be used to protect against non-health hazards and is designed primarily for use on fire sprinkler systems.

**Double Check Valve Assembly:** An assembly of two internally loaded check valves, either spring loaded or internally weighted, installed as a unit between tightly closing resilient seated shutoff valves and fitted with properly located resilient seated test cocks. This type of device shall only be used to protect against non-health hazard pollutants.

**Failed:** The status of a backflow prevention assembly determined by a performance evaluation based on the failure to meet all minimums set forth by the approved testing procedure.

**Fire System Classifications Protection:** The classes of fire protection systems, as designated by the American Water Works Association "M14" for cross-connection control purposes based on water supply source and the arrangement of supplies, are as follows:

**Class 1:** Direct connection to the public water main only; non pumps, tanks, or reservoirs; no physical connection from other water supplies; no antifreeze or other additives of any kind; all sprinkler drains discharging to the atmosphere, dry well or other safe outlets.

**Class 2:** Same as Class 1, except booster pumps may be installed in connection from the street mains.

**Class 3:** Direct connection to public water supply mains in addition to any one or more of the following: elevated storage tanks; fire pumps taking suction from above ground covered reservoirs or tanks; and pressure tanks.

**Class 4:** Directly supplied from public water supply mains, similar to Class 1 and Class 2, with an auxiliary water supply dedicated to fire department use and available to premises, such as an auxiliary supply located within 1700 feet of the pumper connection.

**Class 5:** Directly supplied from public water supply mains and interconnection with auxiliary supplies such as pumps taking suction from reservoirs exposed to contamination, or from rivers, ponds, wells or industrial water systems; where antifreeze or other additives are used.

**Class 6:** Combined industrial and fire protection systems supplied from the public water mains only, with or without gravity storage or pump suction tanks.

**Hazard, Degree of:** A term derived from evaluation of the potential risk to public health and the adverse effect of the hazard upon the public water system.

**Hazard, Health:** A cross-connection or potential cross-connection involving any substance that could, if introduced in the public water supply, caused death, illness, and spread disease also known as a **High Hazard**.

**Hazard, Plumbing:** A cross-connection in a customer's potable water system plumbing that is not properly protected by an approved air gap or backflow prevention assembly.

**Hazard, Non-health:** A cross-connection or potential cross-connection involving any substance that would not be a health hazard but would constitute a nuisance or be aesthetically objectionable if introduced into the public water supply also known as **Low Hazard**.

**Indirect Cross-Connection:** An actual or potential cross-connection subject to backsiphonage only.

**Industrial Fluid:** Any fluid or solution that may be chemically, biologically, or otherwise contaminated or polluted in a form or concentration that could constitute a health, system, pollution, or plumbing hazard if introduced into the public water supply. This shall include, but is not limited to: polluted or contaminated water; all type of process water or used water originating from the public water system and that may have deteriorated in sanitary quality; chemicals; plating acids and alkalis; circulating cooling water connected to an open cooling tower; cooling towers that are chemically or biologically treated or stabilized with toxic substance; contaminated natural water systems; oil, gases, glycerin, paraffin, caustic, and acid solutions, and other liquids or gases used in industrial processes, or for fire purposes.

**Inspection:** An on-site evaluation of an establishment to determine if backflow prevention assemblies are needed by the customer to protect the public water system from actual or potential cross-connections.

**Interconnection:** Any system of piping or other arrangement whereby a public water supply is connected directly with a sewer, drain, conduit, or other device, which does, or may carry sewage or not.

**Passed:** The status of a backflow prevention assembly determined by a performance evaluation in which the assembly meets all minimums set forth by the approved testing procedure.

**Performance Evaluation:** An evaluation of an approved Double Check Valve Assembly or Reduced Pressure Principle Assembly (including approved Detector Assemblies) using the latest approved testing procedures in determining the status of the assembly.

**Pollutant:** A substance in the public water system that would constitute a non-health hazard and would be aesthetically objectionable if introduced into the public water supply.

**Pollution:** The presence of a pollutant or substance in the public water system that degrades its quality so as to constitute a non-health hazard.

**Potable Water:** Water that is safe for human consumption as prescribed by Tennessee Department of Environment and Conservation, Division of Water Supply.

**Public Water Supply:** An entity that furnishes potable water for general use and which is recognized as the public water supply by Tennessee Department of Environment and Conservation, Division of Water Supply.

**Pressure Vacuum Breaker Assembly:** An assembly consisting of one or two independently operating spring loaded check valve(s) and an independently operating spring loaded air inlet valve located on the discharge side of the check valve(s), with tightly closing shutoff valve(s) on each side of the check valves and properly located test cocks for testing valves. This assembly is approved for internal use only and is not approved for premise isolation by the State of Tennessee.

**Public Water System:** A water system furnishing water to the public for general use which is recognized as a public water supply by the State of Tennessee.

**Reduced Pressure Principle Assembly:** An assembly consisting of two independently acting approved check valves together with hydraulically operating, mechanically independent, pressure differential relief valve located between the check valves and below the first check valve. These units shall be located between two tightly closing resilient seated shutoff valves as an assembly and equipped with properly located resilient seated test cocks.

**Reduced Pressure Principle Detector Assembly:** A specially designed assembly composed of a line-size approved reduced pressure principle backflow prevention assembly with a bypass containing a water meter and approved reduced pressure principle backflow prevention assembly specifically designed for such application. The meter shall register accurately for very low flow rates of flows up to 3 gallons per minute and shall show registration for all flow rates. This assembly shall be used to protect against non-health and health hazards and used for internal protection.

**Service Connection:** The point of delivery to the customer's water system; the terminal end of a service connection from the public water system where the water department loses jurisdiction and control over the water. "Service Connection" shall include connections to fire hydrants and all other temporary or emergency water service connections made to the public water system.

**State:** The State of Tennessee, Tennessee Department of Environment and Conservation, Division of Water Supply.

**Survey:** An evaluation of a premise by a water system performed for the determination of actual or potential cross-connection hazards and the appropriate backflow prevention needed.

**Water System:** The water system operated, whether located inside or outside, the corporate limits thereof, shall be considered as made up of two (2) parts, the Utility System and the Customer System.

- A. The utility system shall consist of the facilities for the production, treatment, storage, and distribution of water, and shall include all those facilities of the water system under the complete control of the water department, up to the point where the customer's system begins (i.e. downstream of the water meter);
- B. The customer system shall include those parts of the facilities beyond the termination of the water department distribution system that are utilized in conveying water to the point of use.



## CHAPTER I

### INTRODUCTION TO BACKFLOW PREVENTION

#### 1.1 INTRODUCTION

The waterworks industry has the technology to make it possible to deliver a safe and high quality drinking water to the distribution systems of public water supplies. It is not enough to be assured that a safe water leaves the treatment plant. The important question is "Does the customer receive a safe water at all times?" It is, therefore, imperative that everything possible be done to protect against the degradation of water quality within the distribution system. It is of utmost importance to:

- A. Monitor the bacteriological and chemical quality of water being distributed.
- B. Maintain adequate pressure throughout the distribution system.
- C. Eliminate or protect all physical connections within both the distribution system and private plumbing systems that could permit the backflow of contaminants.

The possibility of backflow due to the improper use of water within the customer's premises is especially significant, because when backflow occurs, the potable water supply may become a transmitter of disease, toxic materials, or other hazardous substances.

The customer's water tap (plumbing fixtures or water-using equipment) is actually the end of the water system and the overflow rim of the fixture or receiving vessel is the beginning of the sewage system. Many ordinary and, seemingly, insignificant plumbing fixtures have been installed in such a way as to pose a serious threat to the health and safety of the entire community. The way they are installed will permit the backflow of contaminants into the water supply line that may spread disease, or toxic substances, resulting in illness or death, or otherwise degrade the quality of water being distributed. The interconnection of secondary, unsafe, or questionable water supplies whereby backflow into the public water supply may occur has long been recognized as a high risk high hazard. All physical connections or situations that will permit backflow or unsafe or questionable water or other substances are commonly referred to as cross-connections.

Public health and water supply officials have long been concerned about cross-connections and interconnections in both private plumbing systems and public water supplies. Appendix H provides case histories of cross-connections that resulted in backflow of contaminants and pollutants. Connections that make possible the contamination of potable water are ever present within the water distribution system and are extremely dangerous. The probability of a single plumbing system contaminating the public water system through cross-connections may seem remote, but when an untold number of similar plumbing systems are considered, the probability is great. The only acceptable protection is to eliminate or protect all possible links whereby such pollution or contamination of the water system may occur.

The Division of Water Supply is dedicated to having an effective ongoing cross-connection control program actively pursued by each public water system. This is the only way that the public water system can faithfully discharge its responsibility to see that the customer receives a safe water under all foreseeable circumstances. The Division of Water Supply will assist the water system in every way possible in this respect.

There are three essential parts of an effective program for the control of cross-connections. They are outlined below:

- A. Clear local authority for the control of cross-connection hazards in the form of an ordinance or official policy statement adopted by the governing body (i.e. City Council, Board of Commissioners, Utility Board, owners, etc.).

- B. A detailed written plan outlining a realistic program of action designed to effectively identify and control cross-connection hazards within the area served by the water system.
- C. The implementation of the plan by establishing an effective ongoing program for cross-connection control. A well-organized work program to identify cross-connection hazards and to discourage the creation of new hazards is essential to protect the quality of drinking water being distributed to the ultimate user. On-site visits, correspondence, follow-up inspections, evaluations of protective measures, testing, routine resurveys, customer education and assistance, and record keeping are important steps in the water system properly discharging its responsibility to deliver a safe water to each customer under all foreseeable circumstances.

The above items will be discussed in more detail in this manual.

## 1.2 OBJECTIVE

The objective of the water supplier is to assure the safety and potability of water delivered to all users. To fall short of this may allow some consumers to drink contaminated water. An active, ongoing effort to control cross-connections is necessary if a safe water is to be delivered to each customer under all foreseeable circumstances. To accomplish this objective, the following program goals are suggested:

- A. To protect the health of the community by protecting the public water supply from possible contamination by isolating within the customer's private water (plumbing) system any contaminants or pollutants that could, under adverse conditions, backflow through uncontrolled cross-connections into the public water distribution system.
- B. To maintain a continuing program of cross-connection control designed to systematically and effectively control all actual and potential cross-connections which may be created in the future.

## 1.3 CAUSES OF BACKFLOW

Whenever there is a physical connection between a potable water supply system and a nonpotable system, backflow may occur either by "backsiphonage" or by "backpressure". Backflow means any reversal in the flow of water from its intended direction of flow. When conditions are such that the water ceases to flow toward the customer's various fixtures and outlets and begins to flow from the intended outlets toward the source of supply, the water supply can easily become contaminated through unprotected cross-connections.

### 1.3.1 BACKSIPHONAGE

Backsiphonage is caused by a reduced or negative pressure being created in the supply piping. One of the major causes of backsiphonage is undersized piping. Another cause is the interruption of the supply pressure. This will allow negative pressures to be created by water trying to flow to a lower point in the system. If water is withdrawn from a pipe at a very high velocity, the pressure at certain locations within the piping system may be reduced and cause a foreign substance to flow into the pipe. The entire potable water supply can thus become contaminated due to backsiphonage of contaminants into the potable water supply.

Common examples that may cause backsiphonage include:

- A. Undersized piping.
- B. High velocity flow (when coupled with undersized piping to create the **aspirator effect**)
- C. Line repair or break at a lower elevation.
- D. Lowered pressure in the water main due to a high water withdrawal rate, such as fire fighting, a line break or water main flushing.
- E. Reduced supply main pressure on suction side of a booster or fire pump.

- F. The closing of a valve on the supply line and the draining of water to a low point in the system.

### 1.3.2 BACKPRESSURE

Backpressure may cause backflow to occur where a potable water system is connected to a nonpotable system of piping, and the pressure in the nonpotable system exceeds that in the potable system. High pressures may be created by means of pumps, boilers, etc. There is a high risk of nonpotable water being forced into the potable water system whenever backpressure conditions exist.

Common examples that may cause backpressure include:

- A. Pumping systems without backflow prevention assemblies. This includes booster and fire pump systems.
- B. Potable water connections to boilers and other pressure systems without backflow prevention assemblies.
- C. Connections with another piping system that may, at times, have a higher pressure.
- D. Water stored in tanks or plumbing systems that by virtue of their elevation would create head sufficient to cause backflow if pressure were lowered in the public system.

## CHAPTER II

### RESPONSIBILITY AND AUTHORITY FOR CROSS-CONNECTION CONTROL

#### 2.1 RESPONSIBILITY

Water works officials, the water customer, public health personnel, plumbing inspectors, plumbing installers, building managers, and maintenance personnel all share, to some degree, a responsibility for safeguarding the health and safety of those who obtain water from a public water system. All of these have a moral responsibility and several clearly have a legal responsibility to protect the water being distributed against contamination through cross-connections. Careful attention must be given to the proper design and installation of water piping systems, fixtures and equipment and to see that these facilities are properly operated and maintained. The effective control of cross-connections requires cooperation between the water purveyor, the plumbing inspection officials, public health officials, plumbing installers, and the customer. Each have responsibilities and each must carry out these responsibilities in order to properly safeguard the potable water supply from pollution or contamination.

As outlined in another section of this manual, authority for Tennessee public water supplies to control cross-connection hazards is contained in Sections 68-221-701 through 68-221-720 of the Tennessee Code Annotated (TCA). It must be remembered that this law places the major responsibility on the water system for supplying safe water to each customer and for controlling cross-connection hazards. Sharing in this responsibility is the owner or the customer and the Tennessee Department of Environment and Conservation. The responsibilities of each are outlined below. In addition to these legal responsibilities, we must keep in mind that it is the moral responsibility of all involved with the treatment, distribution and use of water from a public water system to see that the quality of our drinking water is not jeopardized by allowing it to be degraded or contaminated.

##### 2.1.1. THE WATER PURVEYOR

Under Sections 68-221-701 through 68-221-720 of the Tennessee Code Annotated, the water purveyor has primary responsibility to prevent water from unapproved sources, or any other foreign substance from entering the public water supply system. The water purveyor is prohibited by this law and the regulations authorized therein from installing or maintaining a water service connection to a customer's private water system where cross-connection or backflow hazard exists or will probably exist, unless the public water supply system is properly protected against backflow.

The water purveyor's responsibility begins at the source and includes treatment, pumping, storage and distribution facilities, including the consumer's service connection. Many water purveyors consider their responsibility ending at the point of delivery to the customer's private water lines. TCA Sections 68-221-701 through 68-221-720 and the Federal Safe Drinking Water Act holds the water system responsible for the quality of water delivered to the free flowing outlet of the ultimate user. The only exception involves situations where the customer alters water quality within his private water distribution system. The water purveyor is responsible for documenting that the water delivered to the free flowing outlet of the ultimate user meets certain standards of quality.

The water purveyor has the responsibility of providing its customers with water that is safe under all foreseeable circumstances. Thus, in fulfilling this responsibility, the water purveyor must protect the water distribution mains from hazards within the customer's premises that have the potential of degrading the quality of water in the community system. The water system retains the authority to adopt requirements that meet or exceed minimum requirements set forth by the state or federal agencies.

The water purveyor has the responsibility to:

- A. Conduct surveys to determine if the customer's water use practices pose a danger of contaminating the water system.

- B. See that cross-connection problems are corrected or that adequate protection against backflow is provided.
- C. Make regular visits to determine if protection remains adequate.
- D. Maintain records regarding efforts to protect the water system.

In summary, the water system must have an effective ongoing program consisting of informing the public, routine investigations, enforcement, testing, and record keeping if they are to fulfill their responsibility to provide a safe water to each customer under all foreseeable circumstances and to minimize the potential of legal liability.

#### 2.1.2 THE CUSTOMER

The customer has the dual responsibility for protecting the water being distributed within his premises as well as protecting the public water supply system against contamination through cross-connections. The customer has responsibility starting at the point of delivery from the public water supply and continuing throughout the private water distribution system.

Protection of the community water supply often necessitates the installation and maintenance of approved backflow prevention assemblies at the water service connection. The customer is responsible for the installation, operation, and maintenance of such backflow prevention assemblies as may be necessary for the protection of the community water system.

The customer should provide internal cross-connection protection for the health and safety of those within the premises. The Occupational Safety and Health Standards Section 1910-141(b)(2)(ii) requires employers to provide a safe water for the occupants of the premises and specifically states that, "... the construction of nonpotable water systems or systems carrying other nonpotable substances shall be such as to prevent backflow or backsiphonage into the potable water system".

#### 2.1.3 PLUMBING INSPECTION AGENCIES

Tennessee has recently adopted statutes and regulations regarding the licensing of plumbers. The state of Tennessee under the Rules of Tennessee Department of Commerce and Insurance, Division of Fire Protection, Chapter 0780-2-2 Codes and Standards has adopted the Standard Building Code as a minimum.

Where plumbing inspection officials exist, they have the responsibility to require plumbing to be installed in accordance with the applicable codes and should require protection against backflow consistent with the code and as necessary for the proper protection of the public water system. Plumbing codes should be amended as needed to be up-to-date with new developments and revisions in nationally recognized model codes.

The plumbing code should be diligently enforced. All new construction and modifications of existing plumbing should be inspected for compliance with the plumbing code.

#### 2.1.4 INSTALLERS AND MAINTENANCE PERSONNEL

Plumbing installers, maintenance personnel, and lawn irrigation installers should observe good plumbing principles and should see that the possibility of cross-connections and backflow is avoided or eliminated from the plumbing system. They should be diligent in adhering to local plumbing codes and ordinances. It is recommended and encouraged that the water purveyors contact and educate local plumbers, lawn irrigation installers, and others about cross-connections and details of the water purveyor's policy or ordinance.

#### 2.1.5 TENNESSEE DEPARTMENT OF ENVIRONMENT and CONSERVATION

Under Sections 68-221-701 through 68-221-720 of the Tennessee Code Annotated, the Tennessee Department of Environment and Conservation has the general responsibility to see that water

treatment and distribution are designed, installed, operated and maintained so as to best protect the health of the public. This responsibility includes enforcing laws, rules, regulations, and policies to insure that water suppliers establish and carry out an effective cross-connection control program to protect the quality of water being distributed. The Department provides technical assistance and aids in establishing and supporting effective, ongoing cross-connection control programs.

The Department has the responsibility for insuring that the water purveyor operates and maintains the public water system free of actual or potential cross-connection hazards. Furthermore, this Department has the responsibility of seeing that the water purveyor provide a safe water to the customer and that the water system requires the customer to install and properly maintain an approved backflow prevention assembly.

#### 2.1.6 LEGAL CONSIDERATIONS

Court decisions have held the water purveyor liable for distributing contaminated water through the public distribution system even though the contamination was introduced through backflow from the premises of one of its customers. It seems that the courts follow the reasoning that the water system officials know, or should have known, that hazardous cross-connections normally exist within many of its customers' premises and the failure to take appropriate measures to protect the water system from such hazards constitutes negligence on the part of the water purveyor.

The water purveyor is responsible for delivering safe water to the customer's service connection under all foreseeable circumstances. To discharge this responsibility, the water purveyor must take every reasonable precaution to protect the community distribution system from hazards. The water purveyor must determine if cross-connection hazards exist within a customer's premises. Where such cross-connection hazards exist, they must be removed or properly isolated from the distribution system so as to eliminate the possibility of backflow. Such action would include the installation of an acceptable backflow prevention assembly on the service line, the elimination of the hazard, or the discontinuance of water service.

All public water supplies must have an active ongoing cross-connection control program if they are to fulfill their responsibility to see that each customer receives safe water under all foreseeable circumstances. Such a program would include periodic inspections of all premises where cross-connections are likely to exist and prompt action to systematically correct all cross-connections found. Detailed records concerning inspections, reinspections, recommended protection, a list of all protective assemblies within the system, data on routine tests and repairs, and correspondence records are invaluable in demonstrating that the water purveyor is taking reasonable precaution to protect the quality of water being distributed. Such records would likely be the chief source of defense on behalf of the water system in any legal proceeding concerning this matter.

## 2.2 AUTHORITY

### 2.2.1 GENERAL DISCUSSION

One of the first questions which is likely to be asked when initiating a program of cross-connection control is "What authority do you have for coming into my business and making an inspection?". If modifications in the plumbing are necessary or if a backflow prevention assembly is required, the customer will certainly want to know "by what authority are these corrective measures required?" It is essential, therefore, that authority for cross connection control measures be clearly defined. Persons engaged in cross-connection control activities should be ready to answer such questions. Municipal officials, water system officials, and related agencies should all have a clear understanding of the authority for controlling cross-connections.

### 2.2.2 LOCAL AUTHORITY

The authority for cross-connection control activities must be well defined at the local level. The governing body which controls the water system must adopt adequate legislation, regulations, rules, etc., which clearly prohibits cross-connections and declares their intent that the water system be operated free of such hazards. Authority for the control of cross-connections can be clearly

established by the adoption of appropriate ordinances, official policy statements and plumbing codes.

It is vital that the water system's governing body not only make a clear statement in the form of an ordinance or official policy statement, but they must stand behind the water system operating personnel when enforcement action is necessary. Little can be accomplished without a real commitment by the governing body to safeguard the quality of water being distributed. The governing body should insist the water system's operation personnel work aggressively to control cross-connections and fully support any necessary and reasonable enforcement action. When the potential health and safety problems are fully appreciated, the members of the governing body will be able to give an informed and satisfactory explanation to those who complain about being asked to provide protective measures.

#### 2.2.2.1 ORDINANCES

A well written ordinance that clearly prohibits cross-connections is necessary for the water system that is operated by a municipality (or county government) to effectively control cross-connection hazards. Each municipally operated water system is required by the Tennessee "Rules for Public Water Systems" to submit to the Division of Water Supply of the Tennessee Department of Environment and Conservation, an approved ordinance for controlling cross-connections. The ordinance should clearly:

- A. Prohibit cross-connections
- B. Authorize and direct the water system's operating personnel to monitor the water use practices of its customers to determine if a potential for backflow exists
- C. To require appropriate corrective measures for the protection of water quality and public health
- D. Provide for enforcement by authorizing the water system to discontinue water service, where necessary, for the protection of public health and safety.

A careful study should be made of any related existing ordinances, policies and regulations that might have a bearing on the water system's efforts to conduct an effective ongoing cross-connection control program. It should be determined if there are any provisions of existing ordinances and rules that might be a hindrance to the program and if the position of the water purveyor could be strengthened by modifications.

#### 2.2.2.2 POLICY STATEMENTS

Utility Districts, Water Co-ops, Investor Owned Water Companies, and Utility Boards are not empowered to adopt and enforce ordinances. They can, however, accomplish the same objective through the adoption of an official policy statement or resolution. The policy, when properly adopted and recorded in the minutes of the Board of Directors, can be administered and enforced just as well as an ordinance. Those water systems not operating directly under the management of a municipality or county government are required to submit to the Division of Water Supply an approved policy statement or resolution adopted by the governing body or owners. Such a policy is designed to accomplish the same objective as an ordinance and is enforceable.

#### 2.2.2.3 PLUMBING CODES

A strong plumbing code that is actively enforced is needed to control the plumbing practices within the community. Active enforcement of plumbing codes could prevent the creation of most plumbing type cross-connections. Without strict enforcement of adequate up-to-date plumbing codes, cross-connections will likely continue to be installed faster than the cross-connection control team can find and eliminate them.

A close working relationship with the local plumbing inspection agency will strengthen the water system's cross-connection control program. In localities where there is no active plumbing inspection or plumbing code, it would be in the water system's interest to work toward the adoption and active enforcement of an effective code.

Model plumbing codes such as the Standard, International, and BOCA (Building Officials and Code Administrators) Plumbing Codes all contain a number of specific requirements designed to safeguard against the possibility of backflow of contaminants into potable water lines. Water system personnel should become familiar and cite where applicable the portions of these codes that deal specifically with protection against backflow. Chapter 6, in particular, of the International Plumbing Code 2000 may be used to good advantage even in areas that do not have a plumbing code in force.

### 2.2.3 STATEWIDE AUTHORITY

There is ample authority for the water purveyor to make investigations necessary to determine if the customer's water use practices endanger the purity and safety of the water being distributed and to require appropriate corrective measures to protect the water system against the hazards of backflow. The following outlines the authority established on the state level for such activities.

#### 2.2.3.1 Tennessee Code Annotated

Section 68-221-711 of the Tennessee Code Annotated specifically prohibits certain acts that may adversely affect a public water system. One of the prohibited acts is "the installation, allowing the installation, or maintenance of any cross-connection, auxiliary intake, or bypass, unless the source and quality of water from the auxiliary supply, the method of connection, and the use and operation of such cross-connection, auxiliary intake, or bypass as been approved by the department". Section 68-221-703 defines a cross-connection as follows: "Cross-connection means the physical arrangement whereby a public water supply is connected, directly or indirectly, with any other water supply system, sewer, drain, conduit, pool, storage reservoir, plumbing fixture, or other device which contains or may contain, contaminated water, sewage, other waste or liquid of unknown or unsafe quality which may be capable of imparting contamination to the public water supply as a result of backflow. Bypass arrangements, jumper connections, removable sections, swivel or changeover devices through which, or because of which, backflow could occur are considered to be cross-connections".

The legislation prohibits all of the various hazardous connections or conditions that may allow the backflow of unsafe substances or liquids of unknown quality into potable water supply systems. Section 68-221-702 states "Recognizing that the waters of the state are the property of the state and are held in public trust for the benefit of its citizens, it is declared that the people of the state are beneficiaries of this trust and have a right to both an adequate quantity and quality of drinking water".

The regulations for implementation of the Tennessee Safe Drinking Act requires public water systems to demonstrate that the water distributor meets certain health related standards of quality at the ultimate users free flowing outlet. This clearly implies that the water system has authority for on-site surveys and for requiring protective measures.

### 2.2.4 FEDERAL AUTHORITY

The Federal Safe Drinking Water Act and regulations adopted for its implementation have the same requirements as outlined above. The above-mentioned state regulations mirror the requirements and language of the Federal Safe Drinking Water Act (and regulations) that applies to each public water supply in the USA. Therefore, these regulations can also be cited as authority for on-site visits of the customer's water distribution lines for the purpose of safeguarding against the degradation or contamination of water through cross-connections.



## CHAPTER III

### DEVELOPING AND IMPLEMENTING A CROSS CONNECTION CONTROL PROGRAM

#### 3.1 INTRODUCTION

A comprehensive control program for the elimination and prevention of cross connections is required of each public water supply under the Rules and Regulations for Public Water Supplies. The written plan can be regarded as an agreement between the water system and the Division of Water Supply of the particular aspects of the cross-connection control program. A written plan shall be developed and implemented that will include the following functions:

- A. Permits review and general acceptance of the practices and procedures to be followed in controlling cross connections.
- B. Assures that established practices and policies will be followed uniformly throughout the water system.
- C. Gives local officials and agencies opportunity to have input to the program prior to adoption and serves as a reference following adoption.
- D. Assures continuity of cross connection surveillance activities following changes in management personnel, elected officials, personnel within the water system, plumbing and building inspection agencies, etc.
- E. Provides outline and guidelines for the policy or ordinance.

#### 3.2 OUTLINE FOR PREPARING A PLAN

The following is a summary of sections that are to be included in a cross-connection control plan and a general description of each. For more specifics on requirements and design of an approved plan refer to section entitled *Design Criteria for Cross-Connection Control Plans, Policies, and Ordinances* in this manual.

- I. Introduction** – General statement of problem and what needs to be done.  
The Who, What, When, Where, and How of effectively controlling cross connections are to be defined in the plan.
- II. Authority for Cross-Connection Control** – Detail local, state, and federal authority for controlling cross connections  
The ordinance or policy should be included in the plan
- III. Program To Be Pursued**
  - 1. Staffing
  - 2. Cross-Connection Control Surveys and Inspections
  - 3. Public Education and Awareness Efforts
  - 4. Customer's Responsibility
  - 5. Enforcement
- IV. Procedures for Inspection**
  - 1. Field Visit Procedures
  - 2. Reports
  - 3. Follow-up Visits and Reinspections
  - 4. Installation of Backflow Prevention Assemblies
  - 5. Technical Assistance

**V. Premises Requiring Reduced Pressure Principle Assemblies or Air Gap Separation**

1. High Risk High Hazards
2. High Hazards

**VI. Premises Allowing Double Check Valve Assemblies (If Allowed)**

**VII. Inspection and Testing of Backflow Prevention Assemblies**

1. Approval of New Installations
2. Routine Inspection and Testing of Assemblies
3. Accepted Test Procedure
4. Official Tests
5. Prior Arrangements for Testing
6. Repairs
4. Annual testing and inspection of protective assemblies

**VIII. Parallel Units**

**IX. Records**

**X. Backflow Contamination Procedures**

**XI. Modifications to Plans**

**XII. Approval Signatures**

3.3 DISCUSSION OF LOCAL CROSS CONNECTION CONTROL PLAN

Rules promulgated under the Tennessee Safe Drinking Water Act require each public water system to develop a comprehensive, ongoing program for the elimination and prevention of cross connections. A plan for controlling cross connections must be developed and submitted to the Division of Water Supply for review and approval. The regulations require the water system to fully implement the program plan promptly after its approval.

A. Staffing and Time Requirements

The plan should designate the local inspection and enforcement agency or agencies. The local authority for implementation of the program should be indicated in the plan by the inclusion of an ordinance or official policy statement. The plan should effectively control cross connections. To conduct an effective cross connection control program, a definite allotment of time and personnel should be committed to such activities. In addition, office support of those making field investigations is essential.

B. Scheduling On-Site Visits of Customer's Premises

A time schedule should be proposed for the inspection of all premises considered likely to have cross connection problems. The initial schedule for inspection should be arranged so that, the most critical establishments will be inspected first. Where protection is needed, a time table for correction is to be given to the customer, giving consideration to the degree of hazard and the time required to make corrections, etc. Follow-up inspections are essential to see that:

1. Problems are corrected promptly
2. All protective measures are installed properly
3. Backflow assemblies are tested to determine if they are functioning properly.
4. Periodic reinspections should be completed of all inspected facilities for the purpose of detecting facility changes that may require backflow prevention assemblies.

C. Premises Reinspections

A schedule of reinspection of premises where hazards are likely to occur must be established.

#### Reinspection and Testing of Backflow Prevention Assemblies

Backflow prevention assemblies are to be tested upon completion of installation and at least annually thereafter. The installation of protective assemblies or correction of plumbing problems should not be considered complete or acceptable until the work has been inspected and tested by the water system or their approved representative. Any backflow assemblies taken out of service for cleaning and/or repairs should be tested when placed back into service.

Field testing should be conducted in accordance with the procedures in Appendices D-G. These testing procedures are to be followed in detail and must be performed by State certified personnel.

### 3.4 IMPLEMENTATION OF A CROSS CONNECTION CONTROL PLAN

In implementing an organized plan for cross connection control the following items should be accomplished:

- A. The existing city ordinances or policies pertaining to cross connections should be reviewed every five years (minimum) and updated as required.
- B. Authorized personnel should be given the general responsibility of organizing and supervising the cross connection control plan.
- C. All premises where cross connections are considered likely to exist should be listed and given a priority ranking for scheduling onsite inspections.
- D. All applications for new water service or change of occupancy should be reviewed by the authorized personnel of the cross connection control plan.
- E. All new plans for commercial/industrial water usage should be submitted and reviewed before construction is initiated. Irrigation and fire sprinkler system plans should be submitted for approval.
- F. All new plans for residential lines that are constructed in areas where residents exist are reviewed for existing wells on establishments where water service is requested.
- G. A list of backflow prevention assemblies that are approved by the division of Water Supply and the water system shall be provided to the customer. The customer should also be supplied with a list of installation criteria and sketches of typical installations.
- H. All corrective measures should be inspected immediately upon completion to see that the work is adequate and tested, where applicable, to verify that all backflow prevention assemblies meet accepted performance standards.
- I. The customer should be informed that backflow prevention units are to be tested routinely at least once for each 12 months in service. In addition, the customer shall be informed that they are responsible for keeping backflow control assemblies in good repair.
- J. Adequate records such as: details of all inspections, tests and maintenance reports, and all correspondence between the water purveyor, the customer, the health departments, plumbing inspection agency, etc., should be kept on file for ready reference.
- K. Periodic reinspection should be conducted.
- L. If a high risk health hazard is located, the cross connection is to be eliminated promptly or water service to the premises should be discontinued depending on assessment until the cross-connection problem has been corrected.
- M. The customer should be informed that failure to cooperate in the installation, maintenance, and testing of backflow prevention assemblies is considered grounds for termination of water service to the premises.

- N. The water purveyor should recognize its responsibility for correction of all cross connections within the distribution system.
- O. Water system personnel, administrators and/or testers, within the cross connection control program, should obtain State certificate of competency for testing backflow prevention assemblies.

### 3.5 ESTABLISHING PRIORITIES FOR INSPECTIONS

Existing commercial or nonresidential premises are to be initially inspected for cross connection hazards. Those customers suspected of having a high risk high hazard condition should be of the highest priority to be inspected. Nonresidential establishments with high hazards would be of second priority followed by establishments with low hazards.

Residential establishments should be inspected in the same manner as the nonresidential customers after survey questionnaires have been received.

A suggested list of hazards is included in Appendix A.

#### High Risk High Hazard Premises

1. Mortuaries, morgues, or autopsy facilities
2. Hospitals, medical buildings, animal hospitals, doctor clinics, and dental offices
3. Sewage treatment, water treatment, and pumping facilities
4. Premises with auxiliary water supplies or industrial piping systems
5. Chemical plants (manufacturing, processing, compounding, or treatment)
6. Laboratories and research facilities (industrial, commercial, medical research school)
7. Packing houses and rendering plants
8. Manufacturing plants
9. Food and beverage processing plants
10. Automated car wash facilities
11. Exterminating companies
12. Airports, railroads, bus terminals, piers, boat docks, and truck terminals
13. Bulk distributors and users of pesticides, herbicides, liquid fertilizers, etc.
14. Metal plating, pickling, and anodizing operations
15. Greenhouses, nurseries, agricultural irrigators, and lawn irrigation systems
16. Commercial laundries and dry cleaners
17. Film laboratories
18. Petroleum processing and storage plants
19. Restricted establishments
20. Others (as found present)
21. Penal Institutions and Jails

22. Schools with laboratories, pools, spas, athletic facilities
23. Nursing or convalescent homes, sanitariums
24. Coin operated laundries
25. Restaurants and food handlers
26. Hotels and motels
27. Major office buildings (over 3 stories)
28. Apartment houses, condominiums
29. Service stations, auto garages, and truck repair
30. Beauty parlors, barber shops, beauty and barber schools
31. Shopping centers
32. Mobile home parks, recreational vehicle parks, campgrounds
33. Swimming pools, recreational areas, parks
34. Farms, dairies, feedlot operations
35. Churches with baptismal pools
36. Buildings with harmful additives in the fire sprinkler lines

### 3.6 OUTLINE FOR PREPARING A CROSS-CONNECTION CONTROL ORDINANCE OR POLICY

The following is a summary of sections that are to be included in a cross-connection control policy or ordinance. For more specifics on requirements and design of an approved policy or ordinance refer to section entitled *Design Criteria for Cross-Connection Control Plans, Policies, and Ordinances* in this manual.

1. Definitions:
2. Compliance with TCA:
3. Regulated:
4. Statement Required:
5. Applicability:
6. Inspections/Surveys:
7. Backflow Prevention Determination (listed as Required Assemblies and Methods):
8. Approved Backflow Prevention Assemblies:
9. Backflow Prevention Assembly Installation Requirements:
10. Existing Backflow Prevention Assemblies:
11. Assembly Performance Evaluations and Testing:
12. Corrections of Violations:
13. Non-Potable Supplies:
14. Conflicting Provisions:
15. Penalties:
16. Effective Date:
17. Approval Signatures

## CHAPTER IV

### RECOMMENDED PRACTICES

#### 4.1 BASIC CONSIDERATIONS

In providing protection against cross connections, there are two separate and distinct areas of concern, which closely relate to one another. They are:

- A. Protection of distribution system by “**premises isolation**”.
- B. Protect the occupants or users of the water supply within a customer’s premises by “**in-house isolation**”.

The Division of Water Supply’s scope of protection concerns the water treatment plant and distribution system. The Division of Water Supply regulations concerning cross-connections and cross-connection control are designed to protect the distribution system. However, the distribution can protected from cross-connections by an assembly and within a premises or establishment a cross-connection can occur. Regulations, restrictions, and codes concerning internal cross-connections are usually promulgated through the Health Department, occupational health officer, or other similar group. In-house isolation is **not recommended or allowed** in-lieu of premises isolation due to lack of control of activities within a premises by the water system.

Since the water system is responsible for seeing that each customer receives safe water under all foreseeable circumstances, the water purveyor is primarily concerned with preventing backflow from entering the public water supply lines and being distributed to other customers. The water customer, on the other hand, is primarily concerned with the protection of the in-house piping system and the occupants of the premises from contamination.

#### 4.2 PREMISES ISOLATION

The theory of premises isolation is utilized to provide protection to the general public where cross connections (actual or potential) exist. Under this philosophy, a premise is isolated from the public water supply by means of a backflow prevention assembly. Premises isolation is the only sure or practical way of protecting the public water supply in cases where industrial, institutional, and commercial complexes subject the water system to a high hazard. Such customers may make frequent plumbing changes, restrict access to portions of premises, and/or utilize hazardous materials in such a way as to threaten the water system. Under such conditions, isolation of the entire premises is the only way a water system can adequately fulfill its responsibility of protecting its other customers from the hazards located within the customer’s premises. It is pointed out that this method does not offer protection to the on-premises personnel from internal cross connection hazards.

#### 4.3 SITUATIONS REQUIRING MAXIMUM PROTECTION

The history of cross-connection control has provided sufficient evidence to enable us to predict rather reliably that certain types of situations or devices will almost always have serious cross-connection problems. These types of installations require the most reliable protection available. An approved air-gap separation or a reduced pressure backflow prevention assembly is required under the following circumstances:

- A. To isolate auxiliary water sources that pose a high cross-connection risk including:
  - 1. Private wells, springs, etc.
  - 2. Surface water sources
  - 3. Recirculated waters, processed fluids, gases, etc.

4. Water from public systems stored in unapproved facilities, or from facilities that may not receive adequate circulation to maintain the desired free chlorine residual, or be degraded in any other manner
- B. To protect against submerged outlets or connections to tanks or piping systems including:
1. Vessels containing or possibly containing substances, which could be a source of contamination (chemical, bacteriological, radiological, etc.)
  2. Heating or cooling coils submerged in a contaminant or substances that could become contaminated
  3. Treated water for boilers, fire systems, chilled water systems, etc.
  4. Commercial boilers with or without treatment
  5. Processing or water treatment facilities, pumping station
  6. Facilities for direct flushing of waste hoppers, sewers, etc.
  7. Industrial or other piping systems
- C. Other situations or conditions that pose a significant risk of contamination:
1. The degree of hazard involved
  2. The likelihood of frequent and/or unapproved plumbing changes
  3. The probability of frequent modification of water using equipment
  4. The complexity of the internal piping system
  5. The difficulty in making frequent inspections to verify that the internal protection provided is being adequately maintained
  6. The likelihood of protective assemblies being rendered ineffective
  7. The ease of access to premises
  8. The time necessary to inspect all water outlets not protected by a backflow prevention assembly
  9. The time needed to inspect the facility at least annually to determine if new cross connections have been created.

An expanded list of situations and water-using devices allowing or potentially allowing a cross-connection to occur can be found in Appendix A.

#### 4.4 ESTABLISHMENTS REQUIRING MAXIMUM PROTECTION

The Division of Water Supply recommends that the following types of establishments (but should not be limited to this list) be isolated from the water system by approved reduced pressure backflow prevention assembly or an approved air-gap separation. Numerous cross-connections have occurred in the following establishments that have resulted in sickness or death and are considered significant risks. The backflow prevention assembly or air-gap separation should be installed on the customer's side of the meter and before the first water use.

- A. Premises with high risk auxiliary water supplies
- B. Premises where inspection is restricted or limited

- C. Hospitals, mortuaries, clinics, animal hospitals, and buildings with similar hazards
- D. Water and Wastewater treatment plants and pumping stations
- E. Chemical plants
- F. Metal plating plants
- G. Manufacturing plants
- H. Processing plants (food, beverage, petroleum, or other)
- I. Radioactive material processing plants or nuclear reactors
- J. Laboratories
- K. Processing facilities for sand, gravel, concrete, etc.
- L. Establishments that store, distribute, dilute or apply liquid fertilizers, pesticides, herbicides, etc.
- M. Automated car wash facilities
- N. Greenhouses and nurseries
- O. Dry cleaners and laundries

An expanded list establishments and facilities allowing or potentially allowing a cross-connection to occur can be found in Appendix A.

#### 4.5 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. To help prevent the possibility of the two systems being interconnected, applicable plumbing code regulations requiring color-coding should be required at such locations. Pipes should be identified accurately by labeling and by color coding, based on the ASME (American Society of Mechanical Engineers) standard or the plumbing/building code adopted by the local administrative authority having jurisdiction. It is recommended that charts be posted throughout the plant to identify personnel of the code in use. Piping systems carrying potable water should be appropriately color-coded and clearly labeled (potable water). It is recommended that piping systems be appropriately labeled for easy identification.

#### 4.6 RECORD KEEPING

Adequate records are to be maintained by the water purveyor to document all efforts made to determine where backflow hazards exist and efforts to protect the water system against these hazards. Complete detailed records showing that every effort has been made to protect the quality of water against contamination by backflow is essential in demonstrating that the water system has faithfully fulfilled its responsibility to see that each customer receives safe water under all foreseeable circumstances.

Records are to include, but are not limited to:

- A. Reports of inspections, recommendations, re-inspections, and corrective action taken
- B. Correspondence between purveyor, customer, health agency, plumbing inspection agency, etc., concerning investigations, corrective action, etc.
- C. A master list of all backflow protection assemblies installed for the protection of the water system



- D. Vital data on each protective assembly. (Manufacturer, Model, Size, Serial No., date installed, etc.)
- E. Test and maintenance reports on each protective assembly. Appendix P contains a sample test report with all minimum required data
- F. Filing systems to indicate when testing is due and/or when repeat inspections of premises are needed

Optional:

- G. Systems using computerized billing and having computer capability should give consideration to incorporating codes for cross connection potential, protective assemblies, inspection period, etc., for each service account

Good records will prove invaluable in demonstrating that the purveyor has been actively pursuing an ongoing cross connection program and has taken every reasonable precaution to protect the community water system against cross connection which may degrade the quality of water in the community distribution system.

The records of cross connection control activities are to be kept assembled in a fashion that would facilitate evaluation of the overall program. The records should permit a ready review of the history of the conditions and progress at any particular premises.

#### 4.7 PUBLIC AWARENESS REQUIREMENT

For a comprehensive effective cross connection control program the water purveyor is encouraged to establish a public education program. Public education is absolutely vital in helping to control cross-connections at residential establishments. The Division of Water Supply requests that the water system provide public education to all customers of the water system in the form of an article in the Consumer Confidence Report or a brochure sent out at least once annually. Public education should stress that in order to further safeguard the quality of water delivered to the customer, it is necessary for an active cross connection control program to be aggressively pursued. Some suggested means of providing public education are as follows:

- A. An article in the Consumer Confidence Report
- B. Purchase advertising space in local newspaper.
- C. Education material is distributed at request of water service.
- D. Public service announcements over local radio and/or television.
- E. See if the editor of the local paper will run an article on cross connection control.
- F. Cross connection brochures conveniently located at bill payment, permit locations and plumbing supply warehouses.
- G. Presentations to various government agencies, Civic Clubs, PTA (Parent/Teacher Association), PTO (Parent/Teacher Organization), Schools, local businesses, etc.,

## CHAPTER V

### EQUIPMENT, INSTALLATION, AND TESTING

#### 5.1 INTRODUCTION

The refusal of water service to high-risk premises would be the ultimate in protecting the water system against contamination through cross connections. In theory, the next best protection would be a properly constructed air-gap separation, however, there are many situations where this is not a practical solution for either the water system or the water customer. Even though an approved air-gap separation is practical in some cases, water systems have long ago found it to be self-defeating to follow a policy that the only acceptable protection against cross connections is to “plumb them out” (or to provide air-gap separation at all points where backflow could occur). This policy presents operational problems for water customers needing water under pressure. The reluctance of the customer to maintain air-gap separations where needed and the impracticality of the water system monitoring them results in very little improvement in the protection against backflow. Several mechanical type protective assemblies have been developed which when used properly, can be used to provide reliable protection. The proper use of the more common mechanical type protective assemblies and the air-gap separation is discussed in more detail later in this chapter.

#### 5.2 SITE SELECTION FOR LOCATING BACKFLOW PREVENTION ASSEMBLIES

The selection of a suitable site and proper installation of backflow prevention units is essential if the desired protection is to be obtained. Units should not be installed in locations where the assembly is exposed to corrosive fumes, grit, sticky, corrosive, or abrasive substances. These assemblies should be protected against mechanical abuse and freezing. Units should not be located near electrical components. All assemblies should be installed so that they will be easily accessible for testing and repair. Backflow prevention assemblies should be installed so that they are not subject to flooding. If assembly is installed outside, an acceptable enclosure should also be installed. Enclosure should provide freeze and vandalism protection, plus allow for easy access to the device for testing and repair. See Appendices B-E for installation recommendations. The backflow assembly should be sized for adequate flow requirements.

#### 5.3 INSTALLATIONS REQUIRING CONTINUOUS SERVICE

Where a customer requires continuous uninterrupted service and where it is not possible or practical to provide water service from two separate service lines entering the premises, provisions should be made for the installation of two backflow prevention assemblies in parallel. Care must be made when installing parallel units to ensure continuous services. Service to hospitals is an example where this type of installation is recommended.

Multi-story buildings that have a number of flushometer toilets should be equipped with parallel assemblies. Experience has shown that if the water supply is cut off to this type of building, the flushometer toilets may have to be manually reset.

Resistance to providing dual or parallel backflow prevention assemblies at some installations where they are needed is likely to be strong. It would be wise for the water purveyor to either insist upon the installation of dual assemblies or to obtain a written agreement signed by the owner or occupant of the premises agreeing that water service may be interrupted as necessary for testing and repair of the assemblies at reasonable and mutually agreeable times. From the water system's standpoint, it is reasonable to expect the occupant of the premises to make the necessary arrangements for interrupting water service to allow for testing or repairs during normal working hours no later than two (2) weeks following receipt of written notification by the water system.

Two smaller units that will handle the rated capacity of a larger unit will usually compare favorably with the cost of the larger units. In some cases, the cost of two (2) small units will be less than one large unit. If it is difficult for the occupant of the premises to be without water when testing or repairs are necessary, then it is definitely advantageous to the customer to have dual or parallel units regardless of the cost. Don't forget to make it clear to the customer that two units in parallel should result in essentially the same head loss as

using a single larger unit. The customer often mistakenly thinks that parallel units result in twice the head loss of a single unit.

## 5.4 AIR-GAP SEPARATION

An air-gap separation is the vertical separation between the water supply line outlet and the overflow rim of the non-pressurized receiving fixture or tank. An "approved air-gap separation" must have a vertical unobstructed distance of at least twice the internal diameter of the outlet pipe but never less than one inch. Air-gap separations should comply with the latest revision of ASA (American Standards Association) Standard 10.4.

In theory, a properly designed and maintained air-gap is the best means available to protect against backflow. An air-gap is not always practical and is vulnerable to being altered to nullify its effectiveness. In certain high risk, health hazard installations, an air-gap separation is highly recommended. Particular attention should be given to monitoring air-gap separation installations to see that they are not altered.

The minimum vertical separation should be increased to at least 3 diameters if the outlet pipe is near (within 3 diameters) a vertical wall. In lieu of an engineering evaluation, use the following. If it is near two vertical walls, this distance should be increased to 4 diameters. The vertical distance is measured between the lowest part of the outlet and the flood rim of the fixture or tank into which it discharges. Measuring to a lower overflow outlet is not acceptable.

Approved air-gap separations are frequently used at sinks, showers, bathtubs, drinking fountains, etc., however, the practicality of their use elsewhere is very limited. The two main limitations to using an approved air-gap separation are briefly outlined below.

- A. The protection for the water system is frequently destroyed due to modifications or being bypassed.
- B. The distribution system pressure, needed by the customer for many intended water uses, is dissipated through an air-gap separation. The cost and maintenance of equipment for re-pumping or an elevated storage tank would be a financial burden on the customer.

## 5.5 REDUCED PRESSURE TYPE BACKFLOW PREVENTION ASSEMBLIES

The reduced pressure zone type backflow prevention assembly contains two spring loaded resilient seat check valves with a relief valve mechanism that will automatically discharge to the atmosphere any leakage past either check valve, which might otherwise allow contamination to flow back into the water supply lines. The check valves and relief valve function mechanically independent. An approved reduced pressure backflow prevention assembly should have the necessary test cocks to permit the unit to be field-tested.

The relief valve ensures that the pressure in the zone between the two check valves is always at least 2 psi lower than the pressure on the inlet side of the unit. This reduced pressure in the zone is always maintained regardless of fluctuations in the supply pressure and flow through the assembly. Any leakage past either check valve could allow the pressure in the zone (between the check valves) to rise. The relief valve, however, will automatically discharge to the atmosphere insuring that the pressure in the zone is always at least 2 psi lower than the pressure at the inlet to the first check valve. Any leakage through either or both check valves will not result in a reversal of flow.

The reduced pressure backflow preventer assembly is normally used in locations where an air-gap separation is impractical or where there is a tendency to modify an air-gap separation. This assembly effectively protects against backflow caused by either backpressure or backsiphonage condition and is used for protection against backflow of substances that may be hazardous to health. If the backflow preventer is to be installed on a hot water line, care must be taken to see that the unit is designed and approved for hot water use.

### 5.5.1 APPROVED UNITS

All new units being installed in Tennessee for the protection of a public water system should be included on the latest listing of "Approved Backflow Prevention Assemblies" maintained by the University of Southern California Standards. This list is available through the Division of Water

Supply or the Fleming Training Center. The contact numbers to receive an approved list are 615-532-9199 (Division of Water Supply) or 615-898-8090 (Fleming Training Center).

## 5.5.2 INSTALLATION

- **Access to Unit:** The reduced pressure backflow preventer should be installed with adequate space to facilitate maintenance and testing. The water line should be thoroughly flushed to expel all debris prior to installing a reduced pressure backflow prevention assembly. A strainer is recommended upstream of all backflow prevention assemblies (except on fire lines). Debris lodging under one of the check valves is one of the most common causes of trouble with these assemblies. All materials used in installation of a backflow assembly should be of a non-corrosive nature, this will also help with limited the amount of debris that enters an assembly.
- **Prevention of Flooding:** The effectiveness of the assembly is nullified if the relief port is subject to flooding. Therefore, reduced pressure backflow prevention assemblies should never be installed below ground level or in other locations subject to flooding. Under no circumstances, should the relief discharge opening be plugged. The assembly depends upon an open relief port for safe operation. Care must also be taken to protect the assembly from freezing.
- **Discharge Drainage:** A reduced pressure backflow preventer will spill or discharge water under certain normal and most abnormal operating conditions. When the assembly is located inside a building, there must be a suitable means of taking care of any discharge without creating a safety, nuisance or flooding problem. The drain should be designed to handle the maximum discharge flow from the assembly. If the discharge from the relief valve is to be piped away from the unit, an approved fixed air-gap funnel must be provided at the relief port.

A listing of installation criteria suitable for installation is given in Appendix B.

## 5.6 DOUBLE CHECK VALVE ASSEMBLY

An approved double check valve assembly has two internally loaded, independently acting, resilient seat valves in series. The unit includes tightly closing shutoff valves located on each end of the assembly and suitable connections for testing the water-tightness of each check valve. A double check valve assembly does not provide the same degree of protection as the reduced pressure backflow preventer.

The unit will function under pressure for extended periods and, when functioning properly, will protect against backpressure and backsiphonage conditions. Unlike the reduced pressure backflow preventer, protection against backflow is not provided when both check valves leak.

Double check valves must be located with adequate space for testing and maintenance. Pit installations must be avoided due to flooding possibilities and confined space entry requirements. The assembly must be protected from freezing. The water supply lines should be thoroughly flushed prior to installation of the assembly. A strainer must be installed, unless the assembly is installed on a fire protection line. Only non-corrosive materials must be used in installing all backflow assemblies. After the installation has been completed, the assembly must be checked immediately for proper operation. A more complete listing of approved installation criteria is given in Appendix C.

## 5.7 DOUBLE CHECK-DETECTOR CHECK VALVE ASSEMBLY

A double check-detector check valve assembly contains a main line double check valve assembly with a smaller factory installed double check valve assembly and meter in a bypass configuration to detect leakage or unauthorized usage. The check valves in the main line double check valve assembly is heavier loaded than the small bypass unit to ensure that if there is flow in the line, at least part of the flow registers on the bypass meter. The bypass does not interfere with flow through the main line assembly, but if the meter is read routinely, leakage, unauthorized use, or theft can be detected. It is important from a fire protection standpoint that the private fire lines be kept free of leaks and it is very important to the water system that there be no unauthorized usage of water from unmetered fire lines. The degree of protection against backflow is identical in the double check valve assembly and in the double check-detector check valve assemblies.

Attempts to modify a double check valve assembly by adding a bypass line containing a meter and a small double check valve assembly usually results in a unit that will not function properly. The University of Southern California Foundation for Cross Connection Control and Hydraulic Research cautions against attempts to convert a double check valve assembly to a double check-detector check valve assembly. The Foundation carefully evaluates each make, model, and size before approving the units.

The installation requirements for the double check-detector check valve are the same as for a standard double check valve assembly. However, the unit may require greater horizontal clearance to allow adequate room for testing and maintenance of both the main line and the bypass double check valve assemblies.

Caution:

Several manufacturers utilize a stronger first check valve spring in the main line assembly than is utilized in a regular double check valve assembly to insure that low flows will pass through the bypass meter. Therefore, the number one check valve spring may not be interchangeable with the number two check valve spring, contrary to the normal practice for regular double check valve assemblies.

## 5.8 SPECIAL APPLICATIONS PROTECTIVE MEASURES

### 5.8.1 GENERAL

The following is a brief description of several assemblies that are available today for additional preventative measures for establishments that do not require premise isolation, but may be required by the water system as precautionary.

Under no circumstances shall they be used in place of a required Reduced Pressure Backflow Preventer (RPBP) or Double Check Valve Assembly (DCVA). In all cases, their use should be limited to establishments and situations that have no hazards present and a low risk of backflow.

Various standards and listings from AWWA, Canadian Standards Association (CSA), International Association of Plumbing and Mechanical Officials (IAPMO), and Foundation for Cross Connection Control and Hydraulic Research (FCCCHR) apply to some of these assemblies (consult manufacturer's specifications). The water system is urged to give serious thought to the use of such assemblies and establish a policy or guidelines as to where and under what circumstances they can approve using such assemblies.

### 5.8.2 RESIDENTIAL SINGLE OR DUAL CHECKS

These consist of one or two spring loaded, soft seated check valves installed in a single body, designed for  $\frac{3}{4}$  and 1 inch residential line service. The use of dual checks at the meter setting can be regarded as preventative measures against the occasional misuses of water in residential premises, such as careless use of hoses. They are not acceptable for premises isolation and should not be relied upon if there is a persistent cross connection problem, such as a cross connection with a private auxiliary water supply; not where a high hazard exists such as where an exterminator or where a farmer frequently mixes sprays at the premises. In such cases, a reduced pressure backflow preventer should be installed on the customer's service line for premises isolation.

When using these units, careful records should be kept on where and when the units are installed. It is recommended that they be regarded as part of the meter setting and the water system be responsible for their installation and maintenance. A schedule should be established for routinely checking the unit for effectiveness and to rebuild it. It is recommended that these units not be left in service longer than three to five years before they are rebuilt. Performance checks of the unit may indicate the need for more frequent renewal of expendable parts of the units. If dual or single checks are used, effort by the water purveyor should be made to inform customers of possible problems caused by thermal expansion.

### 5.8.3 INTERMEDIATE ATMOSPHERIC VENT BACKFLOW PREVENTER

Similar to a residential dual check, this unit has the additional feature of a vent opening to the atmosphere that allows either air to enter the unit or leakage to be vented to the atmosphere. This

unit must be used in heated areas above floor level with the vent terminating a minimum of six (6) inches above drain or maximum flood level.

#### 5.8.4 VENDING MACHINE BACKFLOW PREVENTER

This is a dual check with a vent to the atmosphere, designed for use in preventing carbon dioxide gas and/or carbonated water from vending machines from entering the water supply system. Carbon dioxide in water lowers the pH to the point that an appreciable amount of copper may be dissolved in water that is standing in copper pipe. Copper concentrations sufficient to cause copper poisoning may result.

#### 5.8.5 HOSE BIBB VACUUM BREAKERS

These units, which are quite common, are used in hose bibb outlets and laboratory fittings where a hose can be attached. They are designed to prevent against backsiphonage situations only where the hose may be immersed in nonpotable solutions.

**Caution: Vacuum breakers on frost free hose bibbs must be of a design that can be drained in cold weather to prevent freezing.**

A number of manufacturers have developed frost-free hose bibbs with built-in vacuum breakers that automatically drain the hydrant when it is shut off. Many of these can be purchased as cheap as a regular frost-free hose bibb and hose bibb vacuum breaker. The use of self-draining hose bibb with a built-in vacuum breaker is highly recommended. This effectively eliminates the problem of the regular wall frost free hydrant equipped with a hose bibb vacuum breaker being destroyed in a hard freeze because someone failed to properly drain the unit.

#### 5.8.6 BOOSTER PUMPS

Booster pumps are often required in high-rise buildings. Such booster pumps are often connected directly to the city water main or water service lines. Under such conditions, there is always a possibility of creating a negative pressure in the water supply line. This condition is conducive to backflow contaminating the water system through cross connections or from leaks within the distribution system lines.

If booster pumps are required within the customer's premises, plans and specifications for their installation should be approved by the local water utility before installation. Booster pumps should not be allowed in locations where there is not a satisfactory supply of water to maintain a minimum residual pressure of at least 20 psi at peak demand. Booster pumps should only be used to boost the pressure and should never be installed to increase the flow of water in the line supplying the pump. If a larger flow rate is needed, it should be obtained by installing larger mains supplying the area, additional supply mains, additional storage, on-site storage, etc. All booster stations, unless supplied directly from a storage tank, should have automatic controls to prevent the suction pressure from being lowered below 20 psi. The water purveyor is to test or require the owner to submit test data to document that these assemblies are working satisfactorily at least annually.

Booster stations within the water distribution system should, likewise, have appropriate controls to assure that a minimum pressure of at least 20 psi is maintained on the suction side of the pumps. The Division of Water Supply of the Department of Environment and Conservation must approve plans for all such booster stations prior to construction, as required by Section 68-13-706 of the Tennessee Code Annotated.

The installation of uncontrolled high capacity fire pumps exceeding the carrying capacities of the supply mains cannot be tolerated. When fighting fires, it is critical that water pressure on the water supply main be monitored and care taken to see that acceptable residual pressures are maintained at all times in the water mains.

### 5.9 TESTING OF BACKFLOW PREVENTION ASSEMBLIES

When mechanical devices are relied upon to provide protection against backflow, it is necessary to inspect, test, and repair the assemblies on an annual basis. It must be realized that all mechanical devices are

subject to fouling and to wear or deterioration, which can render them ineffective and prevent their meeting the performance standard set up for these assemblies. Only individuals who have demonstrated proficiencies and have obtained a Certificate of Competency for Testing and Evaluation of Backflow Prevention Assemblies obtained from the Division of Water Supply and any other requirements set forth by the water system should be utilized.

- A. Since the water purveyor has the primary responsibility for the quality of the water that they are distributing, it is the water systems responsibility to verify that all premise isolation assemblies are inspected and tested. This does not mean that the water purveyor could not use other qualified backflow testers for inspection and testing. If the inspection, testing, and/or repair are delegated to others, it is absolutely essential that the purveyor exercise general control over these activities and be certain beyond any doubt that the work is being done in an acceptable manner.
- B. Test Kit Certification and Calibration
  - 1. Test gauges are certified on an annual basis by a lab approved (or certified) by the manufacturer of the test kit.
  - 2. Test gauge are re-tested for accuracy more often if it has been mishandled, such as dropped, frozen or overheated.
  - 3. Certification and/or calibration records for each test gauge are documented and on file with the water purveyor.

#### 5.10 TESTING FREQUENCY AND REPAIR

All backflow prevention assemblies should be tested on at least a 12 month basis. A full report giving pertinent test data and indicating what, if any, repairs were made and signed by the tester are to be maintained as a part of the water system's cross connection files. The test report in Appendix P contains the minimum data required for each backflow prevention devices. All assemblies failing test procedures established by the Division of Water Supply should be repaired or replaced, and re-tested promptly.

#### 5.11 NON-COMPLIANCE

It is the water purveyor's responsibility to see that all cross connection hazards are protected and that all testing and repairs are completed in a timely manner. The ordinance or policy of the water purveyor must contain language to allow for a timetable for installation, testing and repair completion and for actions to be taken in the event that the customer is non-compliant.

- A. Day 0-Letter for non-protected site, untested assembly or a failed backflow test

***Optional, but highly suggested***

- B. *Day 30-Second Notice, installation or repair not completed*
- C. *Day 60-Certified Letter-Non Compliance, Action may be taken*
- D. Day 90-Water Service is discontinued

Exceptions should be made for premises that present a high risk of contamination and should be required to correct the problem promptly.

## **APPENDICES**



## APPENDIX A

### TYPICAL CROSS CONNECTION HAZARDS

Actual or potential cross connection hazards may be present within almost every water using premises. To better understand and become aware of these hazards, the following examples are provided.

#### A. Common Facilities and Systems Likely to have Cross Connection Hazards:

1. Auxiliary Water Systems

Any premises or facility with an alternate water supply on or available to the premises. Water stored in reservoirs that are not properly protected or circulated is considered an auxiliary supply.

2. Food Processing

Pressure cookers, autoclaves, retorts, and other steam connected facilities.

3. Cooling Systems Single Pass

Compressors, heat exchangers, air-conditioning equipment, and other water-cooled equipment that may be sewer connected

4. Farming Operations

Poultry houses, chicken houses with automatic proportioning pumps or feeder barrels for supplying water with live virus or other medication, livestock watering troughs with below the rim filling outlet, diluting and mixing of pesticides and insecticides, mixing and spray equipment, greenhouses, dilution of liquid fertilizers, dairies, unprotected hose bibbs.

5. Fire Protection Systems

Piping systems and storage reservoirs that may be treated for prevention of scale formation, corrosion, algae, or slime.

Piping systems that contain non-potable plumbing materials.

Booster pumps without suction pressure sustaining valves or low suction pressure cutoff switches.

Sprinkler systems filled with antifreeze solutions Piping systems filled with chemical compounds used in fighting fires.

Fire systems with an auxiliary source of supply or which are located within 1700 ft. of streams, lakes, ponds, reservoirs, or other non-potable waters that could be utilized in emergencies.

6. Film Processing

Automatic film processing machines, tanks, vats, and other facilities used in processing film.

7. Hydraulic Test Facilities

Hydraulic test equipment using pumps, rams, pressure cylinders, or other hydraulic principles, which may force liquids back into the public water system.

Piping systems, tanks, and other equipment where the public water system pressure is used directly and which may be subject to backpressure.

8. Industrial Piping Systems

Industrial piping systems containing chemicals, gases, cutting or hydraulic fluids, coolants, antifreeze, hydrocarbon products, glycerin, paraffin, caustic or acid solutions and other substances.

9. Industrial Systems – Chemical Contamination

Tanks, can and bottle washing machines, and piping systems where caustics, acids detergents, and other compounds are used in cleaning, sterilizing, and flushing.

10. Residential or Commercial lawn irrigation systems.

Irrigation systems equipped with pumps, injectors, pressurized tanks, or other facilities for injecting agricultural chemicals, such as, fungicides, pesticides, herbicides, and other toxic or objectionable substances, require immediate protection.

11. Laundry and Dyeing Facilities

Laundry machines having under rim or bottom inlets, dry cleaning equipment, solvent reclaim facilities.

Wash water storage tanks equipped with re-circulating pumps.

Dye vats in which toxic chemicals and dyes are used.

Shrinking, bluing, and dyeing machines directly connected to re-circulating systems.

Boilers, steam lines, and heat exchangers.

12. Paper Processing

Pulp, bleaching, dyeing, and processing facilities that may be contaminated with toxic chemicals.

13. Petroleum Processing

Steam boilers, steam lines, mud pumps and mud tanks, oil well casing used for dampening gas pressures, dehydration tanks, oil and gas tanks in which hydraulic pressures are used to raise oil and gas levels, gas and oil lines used for testing, excavating, and slugging.

14. Plating Facilities

Plating facilities using highly toxic cyanides, heavy metals, such as, copper, cadmium, chrome, acids, and caustic solutions.

Plating solution filtering equipment with pumps and circulating lines.

Tanks, vats, or other vessels used in painting, descaling, anodizing, cleaning, stripping, oxidizing, etching, pickling, dipping, and rinsing operations and lines used for transferring fluids.

15. Storage Tanks, Cooling Towers, and Circulating Systems

Storage tanks, cooling towers, reservoirs, and circulatory systems contaminated with bird droppings, algae, slimes, or with water treatment compounds, such as copper, chromate, phenols, and mercury.

16. Sewerage Systems

Cross connections to sewage pumps for priming, water seal lubrication, cleaning, flushing, or unclogging.

Water-operated sewage pump ejectors.

Sewer lines used for disposing of filter or softener backwash, water from cooling systems, or for providing a quick drain for building lines and lines used for flushing or blowing out obstructions in sewer lines.

17. Steam Generation Facilities

Steam generating facilities and lines which may be contaminated with boiler compounds, heat exchangers, single wall steam heated water heating equipment.

18. Hospital-Medical Facilities

Unprotected connections to bedpan washers, hydrotherapy tubs, toilets, urinals, autopsy and mortuary equipment, aspirators, x-ray and photo processing equipment, vacuum pump seals.

Unprotected connections to laboratory equipment which may be chemically or bacteriologically contaminated, such as, steam sterilizers, autoclaves, specimen tanks, and pipette washers.

B. Equipment posing significant risk of creating cross-connections.

Establishments with equipment list will normally require premise isolation with a Reduced Pressure Principle Assembly or Double Check Valve Assembly depending on hazard unless otherwise found to have an appropriate air gap.

Many devices or equipment below may be designed and constructed with approved air gaps that would adequately protect the water system. However, the cross-connection control inspector should consider and make judgments on the amount risk that the establishment poses to the distribution and not solely on the presence or absence of the devices, situations, or equipment listed below.

The following is an incomplete list of equipment normally requiring backflow prevention assemblies, it is to be noted that any connection with piping, equipment, or devices that contain or may contain substances that are pollutants or contaminants will require premises isolation.

Air-conditioning systems (using water for processing)

Aspirators

Air lines

Autoclaves and sterilizers

Auxiliary systems

Baptismal tanks

Bathtubs (Hard Piped)

Bedpan washers

Bidets

Booster pumps

Brine tanks, softeners

Boilers

Car wash equipment

Chemical feeders

Chillers

Chlorination equipment

Coffee urns

Commercial cookers

Condensers

Compressors

Cooling systems

Cooling towers

Culture vats

Cuspidor, dental

Developing equipment

Dishwashers

Display fountains

Drinking fountains

Ejectors, steam or water

Extractors

Fire protection systems, standpipes, sprinkler systems and drain lines

Fish tanks, ponds

Floor drains

Food mixing tanks

Frost-free toilets, hydrants, and fountains

Garbage grinders

Garbage can washers

Garden sprayers

Heat exchangers

Humidity controls

Hydraulic equipment

Hydraulic insecticide or fertilizer applicators

Hydraulic lifts

Ice makers

Irrigation systems, lawn sprinklers

Kitchen equipment

Laboratory equipment

Laundry equipment

Lavatories  
 Lawn sprinklers  
 Liquid handling systems  
 Lubrication, pump bearings  
 Medical equipment  
 Pest control equipment  
 Photo laboratory sinks  
 Potato peelers  
 Pressure cookers  
 Process water circulation systems  
 Pump, priming systems  
 Sewer flush tanks  
 Shampoo sinks, basins  
 Showers, telephone type shower heads  
 Sinks, slop sinks  
 Soda fountains  
 Solar water and space heating equipment  
 Steam boilers  
 Steam tables  
 Stop and waste vales  
 Swimming pools, ponds, fountains  
 Tank and vats  
 Therapeutic tanks, spas, and hot tubs  
 Threaded hose bibbs  
 Toilets, flushometer, flush tank, ballcock, flush valve siphon jet  
 Vegetable peelers  
 Vacuum systems  
 Urinals (siphon set blowout)  
 Vacuum systems (water operated with water seals)  
 Water treatment devices  
 Water troughs  
 Water-using mechanical equipment  
 Water Jacketed tanks, vats, cookers

C. **Premises, facilities or establishments that pose a significant risk of cross-connection –**

Reduced Pressure Backflow Prevention Assemblies are **strongly** recommended.

Agricultural processing facilities  
 Aircraft and missile plants  
 Amusement parks  
 Animal hospitals and clinics  
 Automotive plants  
 Auxiliary water systems  
 Autopsy facilities  
 Beverage bottling plants  
 Breweries  
 Buildings (multistory) – hotels, apartment houses, public and private buildings, or structures having unprotected cross connections  
 Campgrounds  
 Canneries  
 Car washes  
 Chemical plants – manufacturing, processing, compounding, treatment, packing, storage  
 Chemically contaminated water systems  
 Civil works  
 Clinics  
 Cold storage plants  
 Dairies, creameries  
 Dry cleaners  
 Dental buildings  
 Dye works

Extermination Companies  
Fertilizer plants  
Fertilizer (liquid) and spray distributors  
Film laboratories  
Fire sprinkler systems  
Funeral homes  
Hospitals  
Laboratories  
Laundries and dye works  
Lawn irrigation systems  
Medical buildings  
Metal manufacturing, cleaning, processing, and fabricating plant  
Mortuaries  
Morgues  
Motion picture studio  
Nursing home or convalescent homes  
Greenhouses, plant nurseries  
Oil and gas production, storage, or transmission facilities  
Oil refineries  
Packing houses  
Paper and paper product plants  
Plating plants  
Power plants  
Private wells  
Radioactive materials or substances – plants or facilities that process or use radioactive materials  
Reduction plants  
Restricted, classified, or other closed facilities  
Rubber plants  
Sand and gravel plants  
Schools and colleges  
Sewage pumping stations  
Storm water pumping stations  
Hard plumbed swimming pools, ponds, and fountains  
Tanneries of all kinds  
Therapeutic tanks, spas, and hot tubs  
Vegetable and food processing facilities  
Waterfront facilities and industries  
Water treatment plants  
Wastewater treatment plants  
Water using recreational facilities (swimming pools, water slides)

**APPENDIX B**  
**INSTALLATION CRITERIA**  
**FOR**  
**REDUCED PRESSURE PRINCIPLE BACKFLOW PREVENTION ASSEMBLY**

General:

All backflow prevention assemblies will be inspected to verify that the units meet the following requirements and tested to verify that the installed units meet the performance requirements as set forth in the latest Edition of the “Manual for Cross Connection Control” published by the Foundation for Cross Connection Control and Hydraulic Research – University of Southern California

MINIMUM INSTALLATION REQUIREMENTS (RPBP):

- A. The assemblies should never be subject to flooding; therefore should:
1. Never be located in a pit or other area subject to flooding
  2. Avoid piped drains for enclosures housing the units. Provision should be made for discharging water (maximum design discharge) directly through the wall of the enclosure housing the unit at a slightly higher elevation than surrounding ground level or maximum flood level.
  3. The lowest part of the relief valve discharge port should be a minimum of 12 inches plus the nominal size of the discharge opening of the assembly above either:
    1. The ground
    2. Top of the opening(s) in enclosure wall
    3. Maximum flood levelWhichever is highest, in order to prevent any part of the assembly from becoming submerged.
- B. Reduced Pressure backflow prevention assemblies being installed in Tennessee for the protection of a public water system should be included on the latest listing of “Approved Backflow Prevention Assemblies” maintained by The Foundation for Cross-Connection Control and Hydraulic Research. This list is available through Tennessee Department of Environment and Conservation, Division of Water Supply.
- C. The assemblies should be installed where the units can be easily tested and repaired. Assemblies should be installed in accordance with manufacturer’s installations.
1. Installation of assemblies 2” and less there must be a minimum of six inch clearance from all walls. Assemblies over 2” must be a minimum of twelve inches from all walls.
  2. Assemblies installed in stationary enclosures should have at least a 2 ft. clearance on each side of the assembly to facilitate testing and servicing. Adequate drainage must be provided.
  3. Assemblies should not be installed higher than 5 ft. from the floor/ground to the center line of the assembly unless safe permanent access is provided for testing and servicing
- D. The pipelines should be thoroughly flushed to remove foreign material and debris. A strainer should be added on the inlet side of the assembly before installation except for fire protection service lines.

- E. Reduced Pressure Backflow Preventers should be installed with unions and isolation valves on both ends of the assembly to allow removal of the assembly for repair or replacement.
- F. Provisions should be made to protect the assemblies from freezing. Insulating materials should not restrict the relief valve discharge or accessibility to test cocks or name plate of the unit. All enclosures should be designed to provide for adequate draining for the relief valve.
- G. The relief valve should never be plugged, restricted, or solidly piped to a drain, ditch or pump. Rigidly secured air-gap funnels may be used to direct discharges away from the unit provided an approved air-gap separation is provided at the relief valve discharge and again at the discharge end of the drainpipe. An adequate area drain is recommended to handle the maximum relief valve flow to prevent flooding.
- H. The test cocks, valve stems, or name plates should not be painted and their accessibility, operation or legibility should not be hampered nor the relief valve discharge passage be restricted by insulation or other coverings.
- I. The assemblies should be placed in the upright position in a horizontal run of the pipe and special supports added if needed, unless the assemblies are approved for other orientations.
- J. For applications where water temperatures exceed 110°F (43°C) only approved hot water devices are to be used.
- K. Prior to the installation of an assembly, ensure that the temperature-pressure relief valves on heating vessels are properly installed and are in good working condition. It is recommended that the customer install thermal expansion tanks or other devices used to relieve pressure buildup instead of relying on the temperature-pressure valve on the heating vessel.
- L. The assembly should be adequately supported to prevent the unit from sagging. Special supports are needed for units in the 4" to 10" size range

**APPENDIX C**  
**INSTALLATION CRITERIA**  
**FOR**  
**DOUBLE CHECK VALVE BACKFLOW PREVENTION ASSEMBLY**

General:

All backflow prevention assemblies should meet the following requirements and recommendations as set forth in the latest Edition of the Manual for Cross-Connection Control published by the Foundation for Cross-Connection Control and Hydraulic Research-University of Southern California. It is the responsibility of the water system to ensure that establishment meets all installation requirements as set forth in the policy or ordinance.

Note:

Double check-detector check and double check valve assemblies have only been approved by the Division of Water Supply for fire service lines, Residential and Commercial, that are Classes 1-3 and do not contain any contaminants. The customer or installer is cautioned to obtain prior approval from the water system before purchasing and installing double check-detector check and double check valve assemblies for each intended application.

- A. A Double Check Valve Assembly (DCVA) should be installed in an accessible location with adequate space to facilitate maintenance and testing.
- B. Above ground installations are highly preferred. Where above ground installation is not practical prior approval should be obtained from the water system on details of installation. The following general requirements are to be followed for pit or vault installations:
  - Pit or vaults are to be of watertight construction.
  - Constructed so that it will not flood.
  - Must be well drained. Drains should be discharged to the atmosphere above the flood plain.
  - Design with a sump and pump if subject to ground water accumulation.
  - Provided with access ladder and adequate natural or artificial lighting to permit maintenance, inspection and testing.
  - Test cocks should be protected with watertight plugs.
  - All safety practices should be followed when entering confined spaces. Consult with a safety professional before entering any confined space
- C. A strainer may be required ahead of the assembly in some localities. No strainer should ever be installed until approval is received by the fire official having jurisdiction and/or the Insurance Underwriters.
- D. Pipelines should be thoroughly flushed to remove foreign material and debris before installing the assembly.
- E. Prior to the installation of a DCVA, insure that the temperature-pressure relief valves on heating vessels are properly installed and are in good working condition. It is recommended that the customer install thermal expansion tanks or other devices used to relieve pressure buildup instead of relying on the temperature-pressure valve on the heating vessel.
- F. Double Check Valve Assemblies should be installed with unions and isolation valves on both ends of the assembly to allow removal of the assembly for repair or replacement.
- G. Prior to the installation of DCVA, ensure that the temperature-pressure relief valves on heating vessels are properly installed and are in good working condition.
- H. All DCVA's should be installed in a horizontal position unless otherwise approved for other orientations.
- I. The assembly should be installed at least 12 inches above ground or maximum flood level, whichever is highest, in order to prevent any part of the assembly from becoming submerged.



- J. Assemblies 2" and less should be a minimum of six inch clearance from all walls. Assemblies over 2" should be a minimum of twelve inches from all walls.
- K. Assemblies installed in stationary enclosures should have at least a 2 ft. clearance on each side of the assembly to facilitate testing and servicing.
- L. The assembly should be adequately supported to prevent the assembly from sagging. Special supports are usually needed for 4" to 10" assemblies.
- M. Assemblies to be installed should be on the latest Approved List and installed in the approved orientation.
- N. Prior to installation, refer to the Manufacturer's literature for temperature ranges. DCVA must be protected from freezing temperatures. For temperatures in excess of 43°C (110°F), consult manufacturer's literature for recommendations. For the above condition only approved hot water devices may be used.

## APPENDIX D

### Reduced Pressure Principle Assembly Test Procedure 3 Valve Test Kit

#### A. Initial Setup

1. Flush test cocks by:
  - a. opening test cock #4 to establish flow through the assembly. (Leave this test cock open until others are flushed)
  - b. open test cock #1, flush and close
  - c. open test cock #2, flush and close
  - d. open test cock #3, flush and close
  - e. close test cock #4
2. Install test kit adapters into the test cocks.
3. All test kit valves should be in CLOSED position before connecting the test kit
4. Connect high side hose of the test kit to test cock #2
5. Connect low side hose of the test kit to test cock #3
6. Open test cock #3
7. Open the low side valve and the bypass valve to purge air from the test kit.
8. Open test cock #2 **SLOWLY** (If this test cock is opened too quickly, it may cause the relief valve to open. To achieve accurate test measurements, it is important NOT to open the relief valve until the appropriate time)
9. Open the high side valve to purge air from the test kit.
10. Close the high side valve.
11. After the gauge reaches the upper end of the scale, close the low side valve and the bypass valve.
12. Close shutoff valve #2.
  - a. If the relief valve begins to discharge when closing the shutoff valve, end the test at this point, complete the test report indicating a failed assembly and that check valve #1 is leaking.

#### Response:

Observe the gauge reading.

NOTE: The reading on the test kit reflects the APPARANT static drop across check valve #1 (setup pressure). DO NOT record this number at this time. This number can not be correctly determined until other unit functions have been evaluated. The test kit and unit are now ready to begin the test.

- If the gauge stabilizes at point above the relief valve opening point, proceed to Section B.
- If the pressure drops to relief valve opening point, end the test at this point, complete the test report indicating a failed assembly.

#### B. Evaluate the Opening Point of the Relief Valve

**Purpose:** To determine that the relief valve opens at 2 psid or greater and holding tight in other conditions.

1. Open the high side valve one turn.
2. Open the low side valve SLOWLY! Stop opening the valve when the gauge begins to drop. (The low side valve should not require opening more than one-quarter turn to exercise the relief valve. If it does require opening more than one-quarter turn, then it is possible that the shutoff valve #2 is leaking. Or, if the relief valve does not open, it may be stuck or the pressure passage may be clogged)
3. As the gauge drops, observe the relief valve discharge opening. When water begins to drip from the discharge opening, record the reading on the gauge. This reading is the relief valve opening point.
4. Close the low side valve.

#### Response:

- If the relief valve opens at or above 2 psid, record the opening point on the test report and proceed to Section C.

- If the relief valve opened at a pressure less than 2 psid or did not open, end the test at this point, complete the test report indicating a failed assembly.

### C. Test #2 Check For Leakage Against Backpressure

**Purpose:** To determine that check valve #2 is holding tight in backpressure conditions.

1. Open the bypass valve to purge air from the bypass line. Then close.
2. Connect the bypass hose to test cock #4, then open test cock #4.
3. Loosen the low side hose connection at test cock #3 allowing leakage to reestablish setup pressure in the zone between the two checks.
4. Tighten the low side hose connection.
5. Open the bypass valve. (This will allow supply pressure to be routed to the zone between check valve #2 and shutoff valve #2).
6. Observe the gauge reading.
  - a. No movement in the gauge indicates that check valve #2 is holding tight against backpressure.
  - b. A slight drop in gauge pressure, then stability above the relief valve opening point, indicates check valve #2 disc compression. But the check valve is holding tight.
  - c. A drop in gauge pressure to relief valve opening point indicates a leaking check valve #2.

**Response:**

- If the check valve is holding tight, record this on the test report and proceed to Section D.
- If the check valve is NOT holding tight, end the test at this point, complete the test report indicating a failed assembly and a leaking check valve #2.

### D. Evaluate the Drop Across #1 Check in Direction of Flow

**Purpose:** To determine that the static pressure drop across check valve #1 is 3 psid or greater than the opening of the relief valve. (A reading less than 3 psid is does not mean that the unit is inadequate protection against backflow but does indicate that “spitting” may occur from the relief valve during line pressure fluctuations.)

1. Loosen the low side hose connection at test cock #3 allowing leakage to reestablish setup pressure in the zone between the two checks.
2. Tighten the low side hose connection.

**Response:**

- Observe the gauge reading.
  - a. A stable gauge pressure reading 3 psid or above the relief valve opening point indicates that check valve #1 is holding tight with an adequate pressure differential to minimize spitting. Record this on the test report and proceed to Part E.
  - b. If the gauge pressure is less than 3 psid above the relief valve or drops to relief valve opening point, end the test at this point, complete the test report indicating a failed assembly and a leaking check valve #1.

### E. Test the #2 Shutoff Valve for Leakage

**Purpose:** To determine that shutoff valve #2 is holding tight.

1. Close test cock #2.

**Response:**

- No movement in the gauge indicates that shutoff valve #2 is holding tight. Record this on the test report.
  - A drop in gauge pressure indicates that shutoff valve #2 is leaking. Record this on the test report indicating a failed assembly, make the owner aware that repair MUST occur.
2. Close all test cocks. Disconnect all hoses. Close the high side and bypass valve. Proceed to Section F.

### F. Evaluate the Drop Across #2 Check in Direction of Flow

**Purpose:** To determine that the pressure drop across check valve #2 is 1 psid or greater.

1. Connect high side hose of the test kit to test cock #3
2. Connect low side hose of the test kit to test cock #4
3. Open test cock #4
4. Open test cock #3
5. Open the low side valve and the bypass valve to purge air from the test kit.
6. Open the high side valve to purge air from the test kit.
7. Close the high side valve.
8. Close the low side valve and the bypass valve.

Or tester may use the following variation:

1. Connect high side hose of the test kit to test cock #3.
2. Connect low side hose of the test kit to test cock #4.
3. Open test cock #4.
4. Open the low side valve and the bypass valve to purge air from the test kit.
5. Open test cock #3.
6. Open the high side valve to purge air from the test kit.
7. Close the high side valve.
8. Close the low side valve and the bypass valve.

**Response:**

- Observe the gauge reading.
  - a. A stable gauge pressure reading 1 psid or above indicates that check valve #2 is holding tight.
  - b. If the pressure drops below 1 psid, complete the test report indicating a failed assembly and that repairs **MUST** be made to check valve #2.
- 9. Close all test cocks, disconnect all hoses, open shutoff valve #2, remove fittings and drain test kit.

## APPENDIX E

### Reduced Pressure Principle Assembly Test Procedure 5 Valve Test Kit

#### A. Initial Setup

1. Flush test cocks by:
  - a. opening test cock #4 to establish flow through the assembly. (Leave this test cock open until others are flushed)
  - b. open test cock #1, flush and close
  - c. open test cock #2, flush and close
  - d. open test cock #3, flush and close
  - e. close test cock #4
2. If not already in place, install test kit adapters into the test cocks
3. All test kit valves should be in CLOSED position before connecting the test kit
4. Connect high side hose of the test kit to test cock #2
5. Connect low side hose of the test kit to test cock #3
6. Open test cock #3
7. Open the low side bleed valve to purge air from the test kit.
8. Open test cock #2 **SLOWLY** (If this test cock is opened too quickly, it may cause the relief valve to open. To achieve accurate test measurements, it is important NOT to open the relief valve until the appropriate time)
9. Open the high side bleed valve to purge air from the test kit.
10. Close the high side bleed valve.
11. After the gauge reaches the upper end of the scale, close the low side bleed valve.
12. Close shutoff valve #2.
  - a. If the relief valve begins to discharge when closing the shutoff valve, end the test at this point, complete the test report indicating a failed assembly and that check valve #1 is leaking.

#### Response:

Observe the gauge reading.

NOTE: The reading on the test kit reflects the APPARANT static drop across check valve #1 (setup pressure). DO NOT record this number at this time. This number cannot be correctly determined until other unit functions have been evaluated. The test kit and unit are now ready to begin the test.

- If the gauge stabilizes at point above the relief valve opening point, proceed to Section B.
- If the pressure drops to relief valve opening point, end the test at this point, complete the test report indicating a failed assembly.

#### B. Evaluate the Opening Point of the Relief Valve

**Purpose:** To determine that the relief valve is opening when the pressure in the zone is 2 psid or greater of supply pressure and holding tight in other conditions.

1. Open the high side valve one turn.
2. Open the low side valve SLOWLY! Stop opening the valve when the gauge begins to drop. (The low side valve should not require opening more than one-quarter turn to exercise the relief valve. If it does require opening more than one-quarter turn, then it is possible that the shutoff valve #2 is leaking. Or, if the relief valve does not open, it may be stuck or the pressure passage may be clogged)
3. As the gauge drops, observe the relief valve discharge opening. When water begins to drip from the discharge opening, record the reading on the gauge. This reading is the relief valve opening point.
4. Close the low side valve.

#### Response:

- If the relief valve opened at or above 2 psid, record the opening point on the test report and proceed to Section C.
- If the relief valve opened at a pressure less than 2 psid or did not open, end the test at this point, complete the test report indicating a failed assembly.

### C. Test #2 Check For Leakage Against Backpressure

**Purpose:** To determine that check valve #2 is holding tight in backpressure conditions.

1. Open the bypass valve to purge air from the bypass line. Then close.
2. Connect the bypass hose to test cock #4, then open test cock #4.
3. Open low side bleed valve to reestablish setup pressure in the zone between the 2 checks. Then close low side bleed valve.
4. Open the bypass valve. (This will allow supply pressure to be routed to the zone between check valve #2 and shutoff valve #2).
5. Observe the gauge reading.
  - a. No movement in the gauge indicates that check valve #2 is holding tight against backpressure.
  - b. A slight drop in gauge pressure, then stability above the relief valve opening point, indicates check valve #2 disc compression. But the check valve is holding tight.
  - c. A drop in gauge pressure to relief valve opening point indicates a leaking check valve #2. Reestablish set up pressure and evaluate again. if deemed necessary.

**Response:**

- If the check valve is holding tight, record this on the test report and proceed to Section D.
- If the check valve is NOT holding tight, end the test at this point, complete the test report indicating a failed assembly and a leaking check valve #2.

### D. Evaluate the Drop Across #1 Check in Direction of Flow

**Purpose:** To determine that the static pressure drop across check valve #1 is 3 psid or greater than the opening of the relief valve. (A reading less than 3 psi is does not mean that the unit is inadequate protection against backflow but does indicate that “spitting” may occur from the relief valve during line pressure fluctuations.)

1. Open the low side bleed valve to reestablish setup pressure in the zone.
2. Close the low side bleed valve.

**Response:**

- Observe the gauge reading.
  - a. A stable gauge pressure reading 3 psid or above the relief valve opening point indicates that check valve one is holding tight with an adequate pressure differential to minimize spitting. Record this on the test report and proceed to Part E.
  - b. If the gauge pressure drops to relief valve opening point, end the test at this point, complete the test report indicating a failed assembly and a leaking check valve #1.

### E. Test the #2 Shutoff Valve for Leakage

**Purpose:** To determine that shutoff valve #2 is holding tight.

1. Close test cock #2.

**Response:**

- No movement in the gauge indicates that shutoff valve #2 is holding tight. Record this on the test report.
  - A drop in gauge pressure indicates that shutoff valve #2 is leaking. Record this on the test report indicating a failed assembly, make the owner aware that repairs MUST occur.
2. Close all test cocks. Disconnect all hoses. Close the high side and bypass valves. Proceed to Section F.

### F. Evaluate the Drop Across #2 Check in Direction of Flow

**Purpose:** To determine that the pressure drop across check valve #2 is 1 psid or greater.

1. Connect high side hose of the test kit to test cock #3
2. Connect low side hose of the test kit to test cock #4
3. Open test cock #4
4. Open test cock #3
5. Open the low side bleed valve to purge air from the test kit.
6. Open the high side bleed valve to purge air from the test kit.
7. Close the high side bleed valve.

8. Close the low side bleed valve.

Or tester may use the following variation:

1. Connect high side hose of the test kit to test cock #3.
2. Connect low side hose of the test kit to test cock #4.
3. Open test cock #4.
4. Open the low side bleed valve to purge air from the test kit.
5. Open test cock #3.
6. Open the high side bleed valve to purge air from the test kit.
7. Close the high side bleed valve.
8. Close the low side bleed valve.

**Response:**

- Observe the gauge reading.
  - a. A stable gauge pressure reading 1 psid or above indicates that check valve #2 is holding tight with an adequate pressure differential. Record this on the test report form.
  - b. If the pressure drops below 1 psid, complete the test report indicating a failed assembly and that repairs **MUST** be made to check valve #2.
- 9. Close all test cocks, disconnect all hoses, remove fittings and drain test kit, open shutoff valve #2.

## APPENDIX F

### Double Check Valve Assembly Test Procedure 3 Valve Test Kit

#### A. Initial Setup

1. Flush test cocks by:
  - a. opening test cock #4 to establish flow through the assembly. (Leave this test cock open until others are flushed)
  - b. open test cock #1, flush and close
  - c. open test cock #2, flush and close
  - d. open test cock #3, flush and close
  - e. close test cock #4
2. If not already in place, install test kit adapters into the test cocks
3. All test kit valves should be in CLOSED position before connecting the test kit
4. Connect high side hose of the test kit to test cock #2
5. Connect low side hose of the test kit to test cock #3
6. Open test cock #3
7. Open the low side valve and the bypass valve to purge air from the test kit
8. Open test cock #2
9. Open the high side valve to purge air from the test kit
10. Close the high side valve
11. After the gauge reaches the upper end of the scale, close the low side valve. The reading on the gauge is the "setup pressure".
12. Close shutoff valve #2. The test kit and unit are now ready to begin the test.

**The Double Check Valve Procedure can be performed by using one of the following options:**

**Option I. (This option will be no longer by available after the year 2011)**

#### B. Evaluate the Drop Across #1 Check in Direction of Flow

**Purpose:** To determine that the static pressure drop across check valve #1 is 1 psid or greater.

1. Open the low side valve to reestablish pressure in the zone between the checks.
2. Close the low side valve.

**Response:**

- Observe the gauge reading.
  - a. A stable gauge pressure reading 1 psid or greater indicates that check valve #1 is holding tight with an adequate pressure differential. Record this on the test report and proceed to Section C.
  - b. If the gauge pressure drops below 1 psid, end the test at this point, complete the test report indicating a failed assembly.

#### C. Test #2 Check For Leakage Against Backpressure

**Purpose:** To determine that check valve #2 is holding tight in backpressure conditions.

1. Open the high side valve to purge air from the bypass line. Then close.
2. Connect the bypass hose to test cock #4, then open test cock #4.
3. Loosen the low side hose connection at test cock #3 allowing leakage to reestablish setup pressure in the zone between the two checks.
4. Tighten the low side hose connection.



5. Open the high side valve. (This will allow supply pressure to be routed to the zone between check valve #2 and shutoff valve #2).
6. Observe the gauge reading.
  - a. No movement in the gauge indicates that check valve #2 is holding tight against backpressure.
  - b. A slight drop in gauge pressure, then stability, indicates check valve #2 disc compression. But the check valve is holding tight.
  - c. A constant drop in gauge pressure to 0 psid indicates a leaking check valve #2.

**Response:**

- If the check valve is holding tight, record this on the test report and proceed to Section D.
- If the check valve is NOT holding tight, end the test at this point, complete the test report indicating a failed assembly and a leaking check valve #2.

## **D. Test the #2 Shutoff Valve for Leakage**

**Purpose:** To determine that shutoff valve #2 is holding tight.

1. Close test cock #2.
  - a. No movement in the gauge indicates that shutoff valve #2 is holding tight.
  - b. A drop in gauge pressure indicates that shutoff valve #2 is leaking.

**Response:**

- If the shutoff valve holds tight, record this on the test report.
  - If the shutoff valve leaks, record this on the test report indicating a failed assembly make the owner aware that repair MUST occur.
2. Close all test cocks, disconnect all hoses, close all test kit valves.

## **E. Evaluate the Drop Across #2 Check in Direction of Flow**

**Purpose:** To determine that the pressure drop across check valve #2 is 1 psid or greater.

1. Connect high side hose of the test kit to test cock #3
2. Connect low side hose of the test kit to test cock #4
3. Open test cock #4
4. Open test cock #3
5. Open the low side valve and the bypass valve to purge air from the test kit.
6. Open the high side valve to purge air from the test kit.
7. Close the high side valve.
8. Close the low side valve.

Or tester may use the following variation:

1. Connect high side hose of the test kit to test cock #3.
2. Connect low side hose of the test kit to test cock #4.
3. Open test cock #4.
4. Open the low side valve and the bypass valve to purge air from the test kit.
5. Open test cock #3.
6. Open the high side valve to purge air from the test kit.
7. Close the high side valve.
8. Close the low side valve and the bypass valve.

**Response:**

- Observe the gauge reading.

- a. A stable gauge pressure reading 1 psid or above indicates that check valve #2 is holding tight with an adequate pressure differential. Record this on the test report form.
  - b. If the pressure drops below 1 psid, complete the test report indicating a failed assembly and that repairs MUST be made to check valve #2.
9. Open shutoff valve #2, close all test cocks, disconnect all hoses, remove fittings and drain test kit.

## Option II. (This option will take the place of Option I by the year 2011)

### B. Test #2 Check For Leakage Against Backpressure

**Purpose:** To determine that check valve #2 is holding tight in backpressure conditions.

1. Open the high side valve to purge air from the bypass line. Then close.
2. Connect the bypass hose to test cock #4, then open test cock #4.
3. Loosen the low side hose connection at test cock #3 allowing leakage to reestablish setup pressure in the zone between the two checks.
4. Tighten the low side hose connection.
5. Open the high side valve. (This will allow supply pressure to be routed to the zone between check valve #2 and shutoff valve #2).
6. Observe the gauge reading.
  - a. No movement in the gauge indicates that check valve #2 is holding tight against backpressure.
  - b. A slight drop in gauge pressure, then stability, indicates check valve #2 disc compression. But the check valve is holding tight.
  - c. A constant drop in gauge pressure to 0 psid indicates a leaking check valve #2.

**Response:**

- If the check valve is holding tight, record this on the test report and proceed to Section D.
- If the check valve is NOT holding tight, end the test at this point, complete the test report indicating a failed assembly and a leaking check valve #2.

### C. Evaluate the Drop Across #1 Check in Direction of Flow

**Purpose:** To determine that the static pressure drop across check valve #1 is 1 psid or greater.

1. Open the low side valve to reestablish pressure in the zone between the checks.
2. Close the low side valve.

**Response:**

- Observe the gauge reading.
  - a. A stable gauge pressure reading 1 psid or greater indicates that check valve #1 is holding tight with an adequate pressure differential. Record this on the test report and proceed to Section C.
  - b. If the gauge pressure drops below 1 psid, end the test at this point, complete the test report indicating a failed assembly.

### D. Test the #2 Shutoff Valve for Leakage

**Purpose:** To determine that shutoff valve #2 is holding tight.

2. Close test cock #2.
  - a. No movement in the gauge indicates that shutoff valve #2 is holding tight.
  - b. A drop in gauge pressure indicates that shutoff valve #2 is leaking.

**Response:**

- If the shutoff valve holds tight, record this on the test report.
  - If the shutoff valve leaks, record this on the test report indicating a failed assembly make the owner aware that repair MUST occur.
2. Close all test cocks, disconnect all hoses, close all test kit valves.

## **E. Evaluate the Drop Across #2 Check in Direction of Flow**

**Purpose:** To determine that the pressure drop across check valve #2 is 1 psid or greater.

1. Connect high side hose of the test kit to test cock #3
2. Connect low side hose of the test kit to test cock #4
3. Open test cock #4
4. Open test cock #3
5. Open the low side valve and the bypass valve to purge air from the test kit.
6. Open the high side valve to purge air from the test kit.
7. Close the high side valve.
8. Close the low side valve.

Or tester may use the following variation:

1. Connect high side hose of the test kit to test cock #3.
2. Connect low side hose of the test kit to test cock #4.
3. Open test cock #4.
4. Open the low side valve and the bypass valve to purge air from the test kit.
5. Open test cock #3.
6. Open the high side valve to purge air from the test kit.
7. Close the high side valve.
8. Close the low side valve and the bypass valve.

**Response:**

- Observe the gauge reading.
    - a. A stable gauge pressure reading 1 psid or above indicates that check valve #2 is holding tight with an adequate pressure differential. Record this on the test report form.
    - b. If the pressure drops below 1 psid, complete the test report indicating a failed assembly and that repairs MUST be made to check valve #2.
9. Open shutoff valve #2, close all test cocks, disconnect all hoses, remove fittings and drain test kit.

## APPENDIX G

### Double Check Valve Assembly Test Procedure 5 Valve Test Kit

#### A. Initial Setup

1. Flush test cocks by:
  - a. opening test cock #4 to establish flow through the assembly. (Leave this test cock open until others are flushed)
  - b. open test cock #1, flush and close
  - c. open test cock #2, flush and close
  - d. open test cock #3, flush and close
  - e. close test cock #4
2. If not already in place, install test kit adapters into the test cocks
3. All test kit valves should be in CLOSED position before connecting the test kit
4. Connect high side hose of the test kit to test cock #2
5. Connect low side hose of the test kit to test cock #3
6. Open test cock #3
7. Open the low side bleed valve to purge air from the test kit
8. Open test cock #2
9. Open the high side bleed valve to purge air from the test kit
10. Close the high side bleed valve
11. After the gauge reaches the upper end of the scale, close the low side bleed valve. The reading on the gauge is the "setup pressure".
12. Close shutoff valve #2. The test kit and unit are now ready to begin the test

**The Double Check Valve Procedure can be performed by using one of the following options:**

**Option I. (This option will be no longer by available after the year 2011)**

#### B. Evaluate the Drop Across #1 Check in Direction of Flow

**Purpose:** To determine that the static pressure drop across check valve #1 is 1 psid or greater.

1. Open the low side bleed valve to reestablish pressure in the zone between the checks.
2. Close the low side bleed valve.

**Response:**

- Observe the gauge reading.
  - a. A stable gauge pressure reading 1 psid or greater indicates that check valve #1 is holding tight with an adequate pressure differential. Record this on the test report.
  - b. If the gauge pressure drops below 1 psid, end the test at this point, complete the test report indicating a failed assembly.

#### C. Test #2 Check For Leakage Against Backpressure

**Purpose:** To determine that check valve #2 is holding tight in backpressure conditions.

1. Open the high side valve
2. Open the bypass valve to purge air from the bypass line. Then close.
3. Connect the bypass hose to test cock #4, then open test cock #4.
4. Open low side bleed valve to reestablish setup pressure in the zone between the two checks. Then close low side bleed valve.
5. Open the bypass valve. (This will allow supply pressure to be routed to the zone between check valve #2 and shutoff valve #2).
6. Observe the gauge reading.

- a. No movement in the gauge indicates that check valve #2 is holding tight against backpressure.
- b. A slight drop in gauge pressure, then stability, indicates check valve #2 disc compression. But the check valve is holding tight.
- c. A constant drop in gauge pressure to 0 psid indicates a leaking check valve #2.

**Response:**

- If the check valve is holding tight, record this on the test report and proceed to Section D.
- If the check valve is NOT holding tight, end the test at this point, complete the test report indicating a failed assembly and a leaking check valve #2.

## **D. Test the #2 Shutoff Valve for Leakage**

**Purpose:** To determine that shutoff valve #2 is holding tight.

1. Close test cock #2.
  - a. No movement in the gauge indicates that shutoff valve #2 is holding tight.
  - b. A drop in gauge pressure indicates that shutoff valve #2 is leaking.

**Response:**

- If the shutoff valve holds tight, record this on the test report.
  - If the shutoff valve leaks, record this on the test report indicating a failed assembly, make the owner aware that repair MUST occur.
2. Close all test cocks, disconnect all hoses, close all test kit valves.

## **E. Evaluate the Drop Across #2 Check in Direction of Flow**

**Purpose:** To determine that the pressure drop across check valve #2 is 1 psid or greater.

1. Connect high side hose of the test kit to test cock #3
2. Connect low side hose of the test kit to test cock #4
3. Open test cock #4
4. Open test cock #3
5. Open the low side bleed valve to purge air from the test kit.
6. Open the high side bleed valve to purge air from the test kit.
7. Close the high side bleed valve.
8. Close the low side bleed valve.

Or tester may use the following variation:

1. Connect high side hose of the test kit to test cock #3.
2. Connect low side hose of the test kit to test cock #4.
3. Open test cock #4.
4. Open the low side bleed valve to purge air from the test kit.
5. Open test cock #3.
6. Open the high side bleed valve to purge air from the test kit.
7. Close the high side bleed valve.
8. Close the low side bleed valve.

**Response:**

- Observe the gauge reading.
  - a. A stable gauge pressure reading 1 psid or above indicates that check valve #2 is holding tight with an adequate pressure differential. Record this on the test report form.

- b. If the pressure drops below 1 psid, complete the test report indicating a failed assembly and that repairs **MUST** be made to check valve #2.
9. Open shutoff valve #2, close all test cocks, disconnect all hoses, remove fittings and drain test kit.

## **Option II. (This option will take the place of Option I by the year 2011)**

### **B. Test #2 Check For Leakage Against Backpressure**

**Purpose:** To determine that check valve #2 is holding tight in backpressure conditions.

3. Open the high side valve
4. Open the bypass valve to purge air from the bypass line. Then close.
7. Connect the bypass hose to test cock #4, then open test cock #4.
8. Open low side bleed valve to reestablish setup pressure in the zone between the two checks. Then close low side bleed valve.
9. Open the bypass valve. (This will allow supply pressure to be routed to the zone between check valve #2 and shutoff valve #2).
10. Observe the gauge reading.
  - d. No movement in the gauge indicates that check valve #2 is holding tight against backpressure.
  - e. A slight drop in gauge pressure, then stability, indicates check valve #2 disc compression. But the check valve is holding tight.
  - f. A constant drop in gauge pressure to 0 psid indicates a leaking check valve #2.

**Response:**

- If the check valve is holding tight, record this on the test report and proceed to Section D.
- If the check valve is **NOT** holding tight, end the test at this point, complete the test report indicating a failed assembly and a leaking check valve #2.

### **D. Evaluate the Drop Across #1 Check in Direction of Flow**

**Purpose:** To determine that the static pressure drop across check valve #1 is 1 psid or greater.

1. Open the low side bleed valve to reestablish pressure in the zone between the checks.
2. Close the low side bleed valve.

**Response:**

- Observe the gauge reading.
  - c. A stable gauge pressure reading 1 psid or greater indicates that check valve #1 is holding tight with an adequate pressure differential. Record this on the test report.
  - d. If the gauge pressure drops below 1 psid, end the test at this point, complete the test report indicating a failed assembly.

### **E. Test the #2 Shutoff Valve for Leakage**

**Purpose:** To determine that shutoff valve #2 is holding tight.

2. Close test cock #2.
  - a. No movement in the gauge indicates that shutoff valve #2 is holding tight.
  - b. A drop in gauge pressure indicates that shutoff valve #2 is leaking.

**Response:**

- If the shutoff valve holds tight, record this on the test report.

- If the shutoff valve leaks, record this on the test report indicating a failed assembly, make the owner aware that repair MUST occur.
2. Close all test cocks, disconnect all hoses, close all test kit valves.

## **F. Evaluate the Drop Across #2 Check in Direction of Flow**

**Purpose:** To determine that the pressure drop across check valve #2 is 1 psid or greater.

1. Connect high side hose of the test kit to test cock #3
2. Connect low side hose of the test kit to test cock #4
3. Open test cock #4
4. Open test cock #3
5. Open the low side bleed valve to purge air from the test kit.
6. Open the high side bleed valve to purge air from the test kit.
7. Close the high side bleed valve.
8. Close the low side bleed valve.

Or tester may use the following variation:

1. Connect high side hose of the test kit to test cock #3.
2. Connect low side hose of the test kit to test cock #4.
3. Open test cock #4.
4. Open the low side bleed valve to purge air from the test kit.
5. Open test cock #3.
6. Open the high side bleed valve to purge air from the test kit.
7. Close the high side bleed valve.
8. Close the low side bleed valve.

**Response:**

- Observe the gauge reading.
    - a. A stable gauge pressure reading 1 psid or above indicates that check valve #2 is holding tight with an adequate pressure differential. Record this on the test report form.
    - b. If the pressure drops below 1 psid, complete the test report indicating a failed assembly and that repairs MUST be made to check valve #2.
9. Open shutoff valve #2, close all test cocks, disconnect all hoses, remove fittings and drain test kit.

## Appendix H

### Case Histories

#### CASE HISTORIES OF CROSS CONNECTION PROBLEMS

Outlined below are a few backflow incidences that have occurred in Tennessee in recent years. These are given as examples of contamination problems both to those within the customers' premises and the public depending upon the public supply. Many other examples can be found in the newspapers and in technical publications. Those interested in other case histories are referred to various AWWA publications, EPA Cross Connection Control Manual, USC Foundation for Cross Connection Control and Hydraulic Research Manual, and to the publications distributed by various vendors of backflow prevention assemblies.

##### Lead Poisoning

In Memphis in 1983, several employees at a battery plant suffered lead poisoning and were unable to work for an extended period of time after drinking water from the plant's drinking fountains. Investigations revealed that a small line had been connected between the plant's potable water line and a slurry wash-down pump for priming the pump. This line was installed around and over-the-top (air gap separation) to a tank used in priming the pump because of operational problems of the controls. The plant's entire potable water system was contaminated with lead but a reduced pressure backflow preventer on the service line prevented the contamination from entering the Memphis Light Gas and Water supply mains. This establishment has been previously visited and been required to install a reduced pressure backflow preventer (RP) assembly on the service line entering the premises, as well as internal protective measures.

After this instance, the Memphis cross connection inspectors required a RP on the internal line serving the plant's manufacturing areas for the protection of the plant's potable water supply. All of the internal water lines and water fixtures were required to be replaced.

The Memphis program operates under the supervision of a Cross Connection Board with close coordination of the Memphis and Shelby County Plumbing Inspection Agency. Internal protective measures, which they consider to be the first line of defense, are required as well as an RP on the service lines as a secondary defense where certain internal hazards exist.

##### Backflow at Roane State Community College

In January 1977, several students at Roane State Community College located at Rockwood, Tennessee complained of bad taste and a burning sensation after drinking water from the school's drinking fountains. Some of the students required medical attention. An investigation revealed that a valve on a ½ inch water supply line cross connected with the chilled water system had apparently been accidentally left opened allowing chemically treated water to enter the potable water lines. After the cross connection was corrected, the school's entire water supply system was flushed extensively. It was found, however, that within less than an hour after flushing, all chlorine residual would be dissipated. After it became obvious that the school's efforts to clean the water line of the residual effects of the corrosion control inhibitor were ineffective, State Health Department personnel assisted in feeding a strong chlorine solution to the water entering the school's internal piping system. Each fixture was systematically flush with a strong chlorine solution between 100-200 ppm throughout the plumbing system and was allowed to stand several hours before it was expelled. This disinfection procedure was successful in burning out the chemical residuals adhering to the pipe lines and no more trouble was encountered in maintaining a free chlorine residual approximately equal to that supplied by the public water throughout the facility.

During this instance, school was dismissed for at least one day. The school, having no resident facilities, managed to operate with water being available only for the bathrooms during the cleanup period. All food available on campus was provided by catered sandwiches and snacks and only bottled drinks were available until the cleanup was finalized.

##### Chlordane Contamination in Chattanooga

In 1976, a dead-end water line serving about forty-seven homes in a middle class residential neighborhood distributed water containing as high as 1,200 mg/l of chlordane. The Tennessee American Water Co.



promptly disconnected those customers in the area served by the affected line and began warning the customers of the contamination problem and assisting them until cleanup efforts were completed. Tests revealed that only the customers on a dead-end line downstream of a pressure-reducing valve were affected. Cleanup required the replacement of about 4,700 feet of water main, meters and customer service lines, replacement of the customer's hot water heaters with new ones, and, in some cases, replacement of internal water lines. After installation of temporary meters and reduced pressure backflow preventers, the water company flushed the internal plumbing for about eight hours each day. Flushing continued until chlordane levels of less than 3 ppb were obtained after water stood in the lines overnight. Service to some of the customers could not be restored for about four to five weeks. The chlordane apparently entered the system through a hose used to fill a 2.5-gallon garden type sprayer. The Tennessee American Water Company handled the cleanup well from a public relations standpoint. Fortunately, the water company came through this instance without being involved in any legal suits. Cleanup operations cost several hundred thousand dollars. The Chattanooga Basin Office of the Division of Public Health, as well as the personnel of the Central Division of Laboratories, devoted themselves full time on this problem for some four to six weeks.

The fact that this backflow instance occurred within a water system where an excellent cross connection control program was in place does not minimize the importance of an ongoing program. This occurred in a strictly residential area in spite of the water system's efforts to prevent such occurrences. The Tennessee American Water Company would have been in a precarious situation if they had not had an effective program and acted responsibly to safeguard their customers from backflow hazards so common in industries, institutions and commercial customers. This instance made the headlines, but the water system was not taken to task because they had recognized the need of an active cross connection control program and they were actively at work trying to prevent backflow from occurring.

#### Mill Water in Drinking Fountains

Employees at a blast furnace in Rockwood, Tennessee complained about bad tasting water. Investigation revealed that several new drinking fountains had been installed a month or so earlier and that they were mistakenly tapped into the plant's "mill water" system supplied from open cooling ponds.

#### Copper Poisoning

In Morristown, Tennessee, some of the workers involved in remodeling a movie theater became sick after drinking soft drinks from the soda fountain. A malfunctioning control valve on the drink dispenser allowed CO<sub>2</sub> to backflow into copper water supply lines. The water from these lines used in the drinks contained sufficient copper to cause copper poisoning.

#### Anti-Freeze

A maintenance worker at a shop located behind the Tracy City Elementary School was using a garden hose with an adapter to add water to a tractor tire to which five gallons of ethylene glycol (regular automotive anti-freeze) had been added. The worker left the tire unattended for a short period of time while the water was still running into the tire and returned to find the tire deflated. Fortunately, school was not in session or else the school's water supply would likely have been contaminated with heavy doses of ethylene glycol. A booster station located on the school property has apparently created a negative pressure drawing the glycol into a six-inch line.

In the winter of 1984-85, a cross connection in a cooling tower using ethylene glycol resulted in the drinking water within a foundry located in Camden, Tennessee, becoming contaminated. This apparently only affected the plant's internal water lines without backflow entering the water system's lines

## APPENDIX I

### State Guidance for Approved Backflow Prevention Assemblies

All assemblies, used to protect the public water supply, must be approved by the Division of Water Supply. New installation and replacement assemblies required by a public water system must be included on the latest listing of the Approved List maintained by the Division of Water Supply. A backflow prevention device will qualify as an assembly, if it is consistent with the following definitions:

#### **DOUBLE CHECK-DETECTOR CHECK VALVE ASSEMBLY (DCDA)**

A specially designed unit composed of a line size approved double check valve assembly with a specific bypass line equipped with a small water meter and a ¾ inch approved double check valve assembly. The meter shall register accurately for only very low rates of flow and shall show a registration for all rates of flow. The meter will detect small leakage or theft of water for unmetered fire lines. This assembly is designed for fire service lines and is recommended for unmetered fire lines. This assembly is designed to protect against a low hazard or pollutant.

#### **DOUBLE CHECK VALVE ASSEMBLY (DCVA)**

An assembly composed of two independently acting, approved check valves, including tightly closing shutoff valves located at each end of the assembly and fitted with properly located test cocks. This assembly is designed to protect against a low hazard or pollutant.

#### **REDUCED PRESSURE PRINCIPLE BACKFLOW PREVENTION ASSEMBLY (RPBP)**

An assembly containing two independently acting approved check valves together with a hydraulically operating, mechanically independent pressure differential relief valve located between the check valves and at the same time below the first check valve. The unit shall include properly located test cocks and tightly closing shutoff valves at each end of the assembly. This assembly is designed to protect against a health hazard (i.e. contaminant).

#### **REDUCED PRESSURE PRINCIPLE-DETECTOR BACKFLOW PREVENTION ASSEMBLY (RPDA)**

A specially designed assembly composed of a line-size approved pressure principle backflow prevention assembly with a bypass containing a specific water meter and an approved reduced pressure principle backflow prevention assembly. The meter shall register accurately for only very low rates of flow up to 3 gpm and shall show a registration for all rates of flow. This assembly shall be used to protect against a non-health hazard or a health hazard. The RPDA is primarily used on fire sprinkler systems. This assembly is designed to protect against a health hazard (i.e. contaminant).

The following assemblies will meet recommendations and requirement for protection of the water system:

1. **Reduced Pressure Principle Assembly**
2. **Reduced Pressure Principle Detector Assembly**
3. **Double Check Valve Assembly\***
4. **Double Check Valve Detector Assembly\***

\* Double Check Valve Assemblies and Double Check Valve Detector Assemblies are permissible on non-chemical fire lines Class 1-3 only. Use of these assemblies is at discretion of the water purveyor.

Atmospheric Vacuum Breakers, Pressure Vacuum Breakers, and Spill-Resistant Pressure Vacuum Breakers are not approved by the Division of Water Supply for premise isolation.

#### **Existing Assemblies not on Approved List**

Assemblies not listed on the Approved List may be accepted by the Division of Water Supply as an approved assembly under very strict guidelines. The water purveyor may elect, at their discretion, to accept only assemblies listed on the Approved List in order to establish the utmost confidence in backflow protection and prevention.

The Division of Water Supply highly recommends the use of assemblies listed only on the Approved List. Approval of assemblies not listed on the Approved List will be considered on a case-by case basis by the water system with fulfillment of these requirements:

1. Approved Ordinance and Policy of water purveyor at the time of installation did not address or require assemblies from Approved List. Ordinance or policy must be amended and approved, if needed, to allow unapproved existing assemblies that meet the following requirements.
2. Assembly must meet installation criteria required by the water provider.
3. Must meet the definition of assembly and is annually tested. The assembly must be deemed **Passed** to remain as an acceptable and approved backflow prevention assembly for the protection of the water system.
4. Installation, operation, and maintenance of the assembly will provide adequate protection against backflow.
5. Assembly must be repaired using manufacturer-specified parts in accordance to procedures outlined by manufacturer.
6. A written plan must be reported by the water provider concerning the assembly not shown on the latest Approved List. The plan will specify all conditions and information concerning the assembly including manufacturer, model, serial number, installation, repair information (if available), time line of replacement (depending on type of hazard and risk of contamination) if assembly cannot be repaired in accordance with manufacturer procedures. All plans and worksheets must be completed and kept on file by the water system.
7. If assembly cannot be repaired according to the manufacturer-specified procedures, it must be replaced with an assembly listed on the latest Approved List. The replacement assembly will be installed, operated, and maintained in accordance to the approved policy/ordinance of the water purveyor.

## APPENDIX J

### State Guidance for Backflow Prevention Assembly Performance Evaluations

Performance evaluations are needed to demonstrate that all parts of the assemblies are performing as designed and as approved.

1. Performance evaluations must be performed on every assembly at least every 12 months.
2. Each backflow prevention assembly must be deemed **Passed** to remain approved and acceptable protection for the public water system.

**Passed:** The status of a backflow prevention assembly determined by a performance evaluation in which the assembly meets all minimum standards set forth by the approved testing procedure.

**Reduced Pressure Principle Assembly:**

- a. Relief Valve must be have an opening point of 2.0 psid or greater
- b. Backpressure on Check Valve #2 must hold tight.
- c. Static Pressure Drop across Check Valve #1 must be 3.0 psid or greater than relief valve opening point.
- d. Shutoff Valve #2 must hold tight.
- e. Static Pressure Drop across Check Valve #2 must be 1.0 psid or greater.

**Double Check Valve Assembly:**

- a. Static Pressure Drop across Check Valve #1 must be 1.0 psid or greater.
- b. Backpressure on Check Valve #2 must hold tight.
- c. Shutoff Valve #2 must hold tight.
- d. Static Pressure Drop across Check Valve #2 must be 1.0 psid or greater.

3. The Backflow Prevention Assembly Tester must have, at minimum, a valid Certificate of Competency in Testing and Evaluation Backflow Prevention Assemblies and a valid test kit certification by a manufacturer-approved entity.
4. Backflow Prevention Assembly Testers must test and evaluate according to the latest Division of Water Supply's approved procedures.
5. Test kits must be certified annually and the water provider and tester must show proof of certification from manufacturer-approved entities.
6. Proof of annual test kit certification and Certificate of Competency must be current and kept on file for each tester by water provider for five years.
7. Test reports must be completely and accurately documented and the appropriate evaluation determined from testing procedure.
8. All correspondence and documentation pertaining to each backflow prevention assembly will be kept on file by the water provider for at least five years. This includes, but not limited to, test reports, repair reports and installation records.
9. Each location requiring an assembly will have a documented backflow prevention assembly, if the assembly at the address cannot be identified or is not the correct assembly, the water provider will be notified.
10. Every assembly must pass each part of the Performance Evaluation. If any test does not meet the minimum requirements set forth in the testing procedure, the assembly is deemed **Failed**. If conditions around the assembly do not allow the assembly to be tested, the assembly fails the assembly performance evaluation. (Examples would include assembly is submerged, test cocks missing or plugged, relief valve continually discharging)

**Failed:** The status of a backflow prevention assembly determined by a performance evaluation based on the failure to meet all minimum standards set forth by the approved testing procedure.

11. Assemblies must be tested when installed and after every repair. Backflow prevention assemblies on lawn irrigation systems must be tested when assemblies are placed in service. If lawn irrigation backflow assemblies are taken out of service to winterize the system, upon startup of the system, the assemblies must be retested.
12. Water systems may elect to place additional requirements on assembly testers as long as there is no conflict with State statute or regulation.

## APPENDIX K

### State Guidance for Certificate of Competency for Testing and Evaluating Backflow Prevention Assemblies

The information listed below is guidance concerning Certificate of Competencies:

- Anyone testing backflow prevention assemblies for the purposes outlined in the water system's Cross-Connection Control Ordinance or Policy must have a **valid** Certificate of Competency in Testing and Evaluation of Backflow Prevention Assemblies issued by the Division of Water Supply.
- A valid certificate is defined as a Certificate (Basic or Renewal) issued by the state of Tennessee that has not surpassed the three-year time limit from issuance. After certificates have been granted by the State of Tennessee, a Certificate No. is assigned to the applicant. Certificates are valid for three (3) years after certificates are granted. All Certificates are no longer valid, if the Renewal Certificate is not attained within three (3) years from the date the certificate was issued. A 1 year grace period is allowed to attend the renewal class however, the person must not be allowed to test after the 3 year expiration.
- The applicant must complete and satisfy all requirements set forth by the Division of Water Supply to attain and renew the Certificate of Competency.
- Applicant must successfully complete a State-approved Basic Cross-Connection Control training session, written exam, and practical exam to attain an initial Certificate of Competency. The student must successfully complete a State-approved Renewal Cross-Connection Control training session and practical exam to renew the Certificate of Competency.
- Certificate of Competency must be valid in order to perform assembly evaluations.
- In order to renew the Certificate of Competency, a Renewal Course and Exam must be taken within three years after the issuance date to remain valid.
- If the Certificate of Competency is not renewed three years after issuance, the certificate is no longer valid, but does not expire.
- A one year grace period to renew the Certificate of Competency is allowed once the three year time limit has passed.
- Water providers will not accept a test report from a tester whose certificate is in the grace period or has expired.
- If the tester does not renew during the one year grace period, the certificate expires and the tester must take the Basic Course and Basic Exam in order to attain the Certificate of Competency.
- The Certificate of Competency is not transferable and no one may work "under" the certificate.
- A Plumber Certificate in Testing and Evaluating Backflow Prevention Devices issued by Division of Water Supply cannot be substituted and will not be accepted in place of the Certificate of Competency.
- Certificates of Competency in Testing and Evaluation of Backflow Prevention Assemblies from other states or entities will only be accepted if approved by the Division of Water Supply. No entities or states presently have an approved Certificate of Competency.
- Water providers may elect to impose additional restrictions on testers within their systems, as long as the State's statutes, regulations, and policies are met.

#### Minimum Requirements in Policy/Ordinance:

Anyone testing backflow prevention assemblies for the purposes outlined in the water system's Cross-Connection Control Ordinance or Policy must possess a **valid** Certificate of Competency in Testing and Evaluation of Backflow Prevention Assemblies issued only by the Division of Water Supply.

## APPENDIX L

### State Guidance Concerning Lawn Irrigation Systems on Public Water Systems and Well Systems

Lawn irrigation systems, both commercial and residential, are recognized by the State of Tennessee, Division of Water Supply as an actual and potential cross-connection to a public water system. The contact between the sprinkler heads and the soil or submergence of sprinkler heads allows a connection between the potable water system and water of unknown or unsafe quality.

Soil and standing water in contact with the sprinkler heads poses a significant risk of containing E.coli, Cryptosporidium, Giardia, other pathogens, and hazardous chemicals used for lawn care. Many lawn irrigation systems use toxic chemicals injected in the piping to fertilize and eliminate undesired plants.

#### **Required Protection for Lawn Irrigation Systems on Public Water Systems:**

- For public water systems to protect their distribution lines, lawn irrigation systems are protected by a **Reduced Pressure Principle Assembly** or **Reduced Pressure Principle Detector Assembly**.
- Double Check Valves cannot be used for premise isolation on lawn irrigation systems. Double Check Valves may be used for non-health hazards only. Water which contains or may contain pathogens or harmful chemicals is considered a health hazard and must be protected by a **Reduced Pressure Principle Assembly** or **Reduced Pressure Principle Detector Assembly** only.
- Pressure vacuum breakers, Spill-resistant vacuum breaker, and atmospheric vacuum breakers may not be used to protect the public water system's main-line piping or distribution system. These devices are point-of-use devices and may not be used for premise isolation.
- Assemblies must be tested annually.
- Assemblies on lawn irrigation systems must be tested during the start-up period (typical maximum time limit is within 90 days). Annual testing immediately prior to winterization or seasonal shutdown is not acceptable. Testing may also be initially staggered in order to reduce problems with scheduling tests.

#### **Required Protection for Lawn Irrigation Systems on Well Systems:**

- Lawn irrigation systems on well systems with chemical additional systems are protected by a **Reduced Pressure Principle Assembly** or **Reduced Pressure Principle Detector Assembly**.
- Double Check Valves cannot be used on lawn irrigation systems. Double Check Valves may be used for non-health hazards only. Water which contains or may contain pathogens or harmful chemicals is considered a health hazard and must be protected by a **Reduced Pressure Principle Assembly** or **Reduced Pressure Principle Detector Assembly** only.
- Pressure vacuum breakers, Spill-resistant vacuum breaker, and atmospheric vacuum breakers may not be used to protect the well system. These devices are point-of-use devices and may not be used for premise isolation.
- Assemblies should be tested periodically.
- The assembly is placed immediately after the pressure tank.
- The number 1 test cock may be used as a sampling port.



## APPENDIX M

### State Guidance for Residential and Commercial Fire Sprinkler Systems

Public water systems must protect their distribution system from cross-connections with residential and commercial fire sprinkler systems. Level of protection is determined by the degree of hazard.

#### **Degree of Hazard:**

**Non-health Hazard:** Pollutants that will not cause illness or death.

- Commercial fire sprinkler systems: Classes 1-3 (Systems with no hazardous chemical additives)
- Residential fire sprinkler systems: Closed Fire Protection Systems (Systems that do not circulate fresh water through system, lines that dead end without connecting to domestic supply)

#### **Minimum Protection for Non-Health Hazards Required by Public Water System:**

Double Check Valve or Double Check Valve Detector Assembly

The following **Residential Fire Protection Systems** do not require backflow prevention assemblies due to circulation of fresh, potable water throughout the system:

- **Flow-Through Protection Systems-** Domestic and Fire System split after meter and reconnect at the end to a clothes washer, dishwasher, toilet or other fixture to prevent water from becoming stagnant.
- **Protection Systems-**Domestic and Fire System are all on one line. Use of Domestic water prevents system from becoming stagnant.

**Health Hazard:** Contaminants that cause illness or death.

- Commercial fire sprinkler systems: Classes 4-6 (Systems with chemical additives-ethylene glycol, MIC (Microbiologically Influenced Corrosion) inhibitors, anti-foaming agents)
- Residential fire sprinkler systems: Any residential fire sprinkler system with harmful chemical additives or connections to hazardous chemicals.

#### **Minimum Protection for Health Hazards Required by Public Water System:**

Reduced Pressure Principle or Reduced Pressure Principle Detector Assembly

#### **Note of Importance:**

Testing fire sprinkler system backflow prevention assemblies may be restricted and regulated by other State departments or divisions. **All** backflow prevention assemblies required by the public water supply to protect the distribution system must be tested annually. If backflow prevention assemblies on fire sprinkler systems cannot be tested by the public water system, amendments to the policy or ordinance may be needed to allow the testers with appropriate licenses or certifications required by other entities to perform assembly evaluations.

## APPENDIX N

### State Guidance for Cross-Connection Control Public Awareness

Cross-Connection programs must provide education and public awareness on cross-connections and the dangers of backflow. Public awareness also informs the customers of the cross-connection control policies and ordinances of the public water system. The following would meet minimum requirements for public awareness and education in a public water system cross-connection control plan:

- 1. All new customers will be given information on cross-connection control and backflow prevention at request of water service. This information will cover the fundamental causes of backflow, the dangers involved, and protection against cross-connections.**
- 2. A minimum of one annual correspondence to all customers regarding cross-connection control or related issues:**

**These examples would meet satisfy this requirement:**

- Reminders with water bills or pamphlets mailed to all customers concerning cross-connections and/ or backflow prevention at least once per year.
- An article in the public water system's Consumer Confidence Report on cross-connection control or related issue.

**The following suggestions are not required but highly recommended:**

- Posters at the water system office displayed one month out of each quarter.
- Personal visits to commercial, industrial, institutional, and agricultural customers to explain the need for cross-connection control.
- Contact made with developers to explain cross-connection control requirements as early as possible in the planning or construction stage.
- Website articles
- Local newspaper article
- TV announcement

## APPENDIX O

### Frost Proof Hydrant – Installation Criteria

Frost proof hydrants prevent damage to hydrants during cold weather. Properly installed hydrants pose virtually no hazard to the distribution system. However, frost proof hydrants, if not properly installed, may constitute a hazard not only to the water system, but also to those who may consume water from the hydrant. The freeze proof hydrants and drinking fountains utilize drains to subsurface pits. When the hydrant is closed, a drain at the bottom of the hydrant is opened. This could allow contaminated water to run back into the barrel of the hydrant if the surrounding ground becomes saturated because of heavy rainfall, heavy hydrant usage, and poor soil percolation. If frost proof hydrants cannot be installed without the high risk of contamination, the following recommendations may need to be considered.

#### Acceptable Means of Protection:

- A. Where conditions permit, a conventional frost free hydrant can be fitted with a watertight pipe sloped to drain to the atmosphere. Such a drain must extend above ground level and not be subject to flooding.
- B. The use of hydrants of a design which do not use subsurface drains, such as:
  1. Murdock “Ejecto-San” style Post water hydrant/jug filler, Models ESH-65, ESH-65LB, and ESHSC-65
  2. Murdock trimline, push button, fountain/hydrant, Model TLFH-60, Note: This unit is not a freeze proof design.
  3. Murdock “Ejecto-San style drinking fountain/jug filler combination Model ESHD-3565
  4. Murdock “Expelo” hydrant – The Murdock Mfg. & Supply Co.  
2488 River Rd.  
Cincinnati, Ohio 45204
  5. American No. 126 – American Foundry & Mfg. Co.  
920 Palm Street  
St. Louis, MO 63160
  6. KenRay Brass Model 841 – KenRay Brass Products, Inc.  
Vermont, IL
  7. Josam No. 1445 – Josam Mfg. Co.  
Michigan City, Indiana
  8. White Water Model 256 – White Water Mfg. Co.  
Whitewater, WI 53190

## **APPENDIX P**

### **Useful Forms and Sample Letters**

# BACKFLOW ASSEMBLY TEST REPORT

Service Address \_\_\_\_\_

Name of Premises \_\_\_\_\_

Location of device \_\_\_\_\_

Device \_\_\_\_\_

Number

Manufacturer

Model

Size

Serial

Test Kit \_\_\_\_\_

Manufacturer

Serial Number

Date Certified

RP

DC

DCDA

RPDA

## Reduced Pressure Principle Assembly

Relief Valve Opening Point	Check Valve # 2 Backpressure Test	Check Valve #1	No. 2 Shutoff Valve	Check Valve #2
Opened at _____ psid Did not open <input type="checkbox"/>	Closed Tight <input type="checkbox"/> Leaked <input type="checkbox"/>	Held at _____ psid Leaked <input type="checkbox"/>	Closed Tight <input type="checkbox"/> Leaked <input type="checkbox"/>	Held at _____ psid Leaked <input type="checkbox"/>

## Double Check Valve Assembly

Check Valve #1	Check Valve # 2 Backpressure Test	No. 2 Shutoff Valve	Check Valve #2	Backflow Assembly Status
Held at _____ psid Leaked <input type="checkbox"/>	Closed Tight <input type="checkbox"/> Leaked <input type="checkbox"/>	Closed Tight <input type="checkbox"/> Leaked <input type="checkbox"/>	Held at _____ psid Leaked <input type="checkbox"/>	Passed <input type="checkbox"/> Failed <input type="checkbox"/>

Date \_\_\_\_\_ Time \_\_\_\_\_ Certified Tester # \_\_\_\_\_

Test by (Signature) \_\_\_\_\_ Print Name \_\_\_\_\_

Your signature certifies that all information provided on this section is correct.

Comments: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

# BACKFLOW ASSEMBLY REPAIR REPORT

<b>R E P A I R S</b>	Cleaned <input type="checkbox"/>  Replaced: (List all parts replaced)   List any additional repair items not previously addressed:
Date _____ Time _____ Certified Tester # _____ Repair by (Signature) _____ Print Name _____ Your signature certifies that all information provided on this section is correct.	

<b>Reduced Pressure Principle Assembly</b>				
Relief Valve Opening Point	Check Valve # 2 Backpressure Test	Check Valve #1	No. 2 Shutoff Valve	Check Valve #2
Opened at _____ psid	Closed Tight <input type="checkbox"/>	Held at _____ psid	Closed Tight <input type="checkbox"/>	Held at _____ psid
Did not open <input type="checkbox"/>	Leaked <input type="checkbox"/>	Leaked <input type="checkbox"/>	Leaked <input type="checkbox"/>	Leaked <input type="checkbox"/>

<b>Double Check Valve Assembly</b>				<b>Backflow Assembly Status</b>
Check Valve #1	Check Valve # 2 Backpressure Test	No. 2 Shutoff Valve	Check Valve #2	
Held at _____ psid	Closed Tight <input type="checkbox"/>	Closed Tight <input type="checkbox"/>	Held at _____ psid	<b>Passed</b> <input type="checkbox"/>
Leaked <input type="checkbox"/>	Leaked <input type="checkbox"/>	Leaked <input type="checkbox"/>	Leaked <input type="checkbox"/>	<b>Failed</b> <input type="checkbox"/>
Date _____ Time _____ Certified Tester # _____ Test by (Signature) _____ Print Name _____ Your signature certifies that all information provided on this section is correct.				

Comments: \_\_\_\_\_

**Water System**  
**Cross-Connection Questionnaire Survey**  
**Residential**

Occupant Name \_\_\_\_\_

Occupant Address \_\_\_\_\_

1. Occupancy: \_\_\_\_\_Own      \_\_\_\_\_Rent
2. Meter serves:   Homes                      How Many? \_\_\_\_\_  
                          Buildings                      How Many? \_\_\_\_\_
3. Do you have? (Please Check all that apply):  
Hot Tub \_\_\_\_\_      Swimming Pool \_\_\_\_\_      Jacuzzi \_\_\_\_\_  
Waterbed \_\_\_\_\_      Solar System \_\_\_\_\_      Green House \_\_\_\_\_  
Underground Sprinkler System \_\_\_\_\_      Darkroom Equipment \_\_\_\_\_  
Drip/Soaker/Irrigation System \_\_\_\_\_      Portable Dialysis Machine \_\_\_\_\_  
Insecticide Sprayers (That attach to garden hose also) \_\_\_\_\_  
Utility sink w/threaded faucet \_\_\_\_\_  
Wood burning hot water heater \_\_\_\_\_      Ghost pipes (unidentified) \_\_\_\_\_
4. Do you have bathtub that fills from the bottom? Yes \_\_\_\_\_ No \_\_\_\_\_
5. Do you have a water softener or any extra water treatment system? Yes \_\_\_\_\_ No \_\_\_\_\_
6. Do you have an auxiliary water supply on your premises? Yes \_\_\_\_\_ No \_\_\_\_\_
7. Do you have livestock and use a water trough or water system connected to by public water?  
Yes \_\_\_\_\_ No \_\_\_\_\_
8. Is your home or building elevated above your water meter? Yes \_\_\_\_\_ No \_\_\_\_\_
9. Does a creek, river, or spring water run near or on your property? Yes \_\_\_\_\_ No \_\_\_\_\_
10. Do you have a booster pump, well pump, or any other type water pump? Yes \_\_\_\_\_ No \_\_\_\_\_
11. Do you receive irrigation water from a different source? Yes \_\_\_\_\_ No \_\_\_\_\_
12. Do you have a backflow protection device on your property now? Yes \_\_\_\_\_ No \_\_\_\_\_
13. Do you have any situation that you are aware of that could create a cross-connection?  
Yes \_\_\_\_\_ No \_\_\_\_\_
14. Do you have any other water-using equipment on your property not mentioned above?  
Yes \_\_\_\_\_ No \_\_\_\_\_

If yes, please list below:

---

---

\_\_\_\_\_  
Print Name

\_\_\_\_\_  
Phone #

\_\_\_\_\_  
Signature

\_\_\_\_\_  
Date

**Please notify this office if any of the above conditions change.**

DATE:

RE: Smith Industries, Inc.  
First Street Facility

Mr. John Smith  
President – Smith Industries, Inc.  
123 South First Street  
Anywhere, TN 0000

Dear Mr. Smith:

On \_\_\_\_\_ 20\_\_\_\_, a survey of water use practices was completed by \_\_\_\_\_, at the above referenced facility. The assistance provided by \_\_\_\_\_ is greatly appreciated.

This survey revealed several serious cross connections that could result in the contamination of the water supply lines and the public water system. A summary of cross connection problems found is listed on the attached sheet.

Ordinance (or Policy) No. \_\_\_\_\_ and the Tennessee Code Annotated and rules for public water systems prohibit such cross connection hazards in public water systems.

You are being notified that you must install a reduced pressure principle backflow prevention assembly on the water service line between the meter and the first point of use by \_\_\_\_\_ 20\_\_\_\_. This requirement is the result of our efforts to protect the public water system from the backflow of dangerous substances. We are trying to see that each customer is furnished safe water and must receive the cooperation of all our customers to accomplish this objective.

Enclosed is a list of reduced pressure principle backflow prevention assemblies approved for use in Tennessee and the minimum installation criteria. As soon as you notify us that the installation is completed, our cross connection control representative will verify that the unit is properly installed and tested.

The installation of a reduced pressure principle backflow prevention assembly on your water service line does not afford protection for those within your facility from internal cross connection hazards.

We will be glad to assist you in locating all cross connections hazards and in designing effective control measures.

Your prompt attention to this important matter is appreciated. Please contact \_\_\_\_\_ at \_\_\_\_\_ for any additional information or assistance you need.

Sincerely,

Name  
Title

Enclosures



**CROSS CONNECTION INVESTIGATION FORM**

Facility name \_\_\_\_\_

Address \_\_\_\_\_

Phone \_\_\_\_\_

Inspected by \_\_\_\_\_

NAME

POSITION

INTERVIEWED

CORRESPONDENCE


FINDINGS (Attach sketch if necessary)


RECOMMENDATIONS


Investigation Letter Written

ACTION TAKEN & DATES


## INSPECTION CHECK LIST

Name of Firm \_\_\_\_\_

Mailing Address \_\_\_\_\_

Time \_\_\_\_\_ Date \_\_\_\_\_ Water Pressure \_\_\_\_\_ pH \_\_\_\_\_ Chlorine Residual \_\_\_\_\_

<ul style="list-style-type: none"> <li><input type="checkbox"/> Air Conditioning</li> <li><input type="checkbox"/> Air Washers</li> <li><input type="checkbox"/> Air Conditioned Chillwater</li> <li><input type="checkbox"/> Air Conditioned Condenser Water</li> <li><input type="checkbox"/> Air Conditioned Cooling Towers</li> <li><input type="checkbox"/> Air Compressors</li> <li><input type="checkbox"/> Autopsy Tables</li> <li><input type="checkbox"/> Aspirator, Medical</li> <li><input type="checkbox"/> Aspirator, Weedicide and Root Feeders</li> <li><input type="checkbox"/> Autoclave &amp; Sterilizer</li> <li><input type="checkbox"/> Boiler Feed Line</li> <li><input type="checkbox"/> Baptismal Fount</li> <li><input type="checkbox"/> Bathtub Below Rim Filler</li> <li><input type="checkbox"/> Bedpan Washer, flushing Rim</li> <li><input type="checkbox"/> Bidet</li> <li><input type="checkbox"/> Brine Tank</li> <li><input type="checkbox"/> Bottle Washer</li> <li><input type="checkbox"/> Chemical Feeder Tanks</li> <li><input type="checkbox"/> Chlorinator</li> <li><input type="checkbox"/> Coffee Urn</li> <li><input type="checkbox"/> Cuspidor, Dental</li> <li><input type="checkbox"/> Chiller Tanks</li> <li><input type="checkbox"/> Cooking Kettles</li> <li><input type="checkbox"/> Condensate Tanks</li> <li><input type="checkbox"/> Demineralized System</li> <li><input type="checkbox"/> Digesters, Hospital</li> <li><input type="checkbox"/> Dishwater</li> <li><input type="checkbox"/> Drinking Fountain</li> <li><input type="checkbox"/> Degreasing Equipment</li> <li><input type="checkbox"/> Dye Vats and Tanks</li> <li><input type="checkbox"/> Developing Tanks</li> <li><input type="checkbox"/> Dairy Barn Equipment</li> <li><input type="checkbox"/> Etching Tanks</li> <li><input type="checkbox"/> Stills</li> <li><input type="checkbox"/> Starch Tanks</li> <li><input type="checkbox"/> Sitz Bath</li> <li><input type="checkbox"/> Sprinkler System, Fire Protection</li> <li><input type="checkbox"/> Shampoo Basin Hose Rinse, Beauty Shop</li> <li><input type="checkbox"/> Sinks, Wash-up</li> <li><input type="checkbox"/> Serrated Faucets</li> <li><input type="checkbox"/> Sizing Vats and Boxes</li> <li><input type="checkbox"/> Solution Tanks</li> <li><input type="checkbox"/> Urinal, Siphon Jet Blow-out</li> </ul>	<ul style="list-style-type: none"> <li><input type="checkbox"/> Urinal, Trough</li> <li><input type="checkbox"/> Fountain, Ornamental</li> <li><input type="checkbox"/> Detergent Dispenser</li> <li><input type="checkbox"/> Floor Drains Flushing</li> <li><input type="checkbox"/> Garbage Can Washer</li> <li><input type="checkbox"/> Garbage Disposals</li> <li><input type="checkbox"/> Hydro-Therapy Baths</li> <li><input type="checkbox"/> Humidifier Tank &amp; Boxes</li> <li><input type="checkbox"/> Hose Faucets</li> <li><input type="checkbox"/> Hot Water Heater &amp; Tanks</li> <li><input type="checkbox"/> Ice Maker</li> <li><input type="checkbox"/> Janitor Closets</li> <li><input type="checkbox"/> Lab Equipment</li> <li><input type="checkbox"/> Laundry Machine</li> <li><input type="checkbox"/> Lavatory</li> <li><input type="checkbox"/> Lawn Sprinkler</li> <li><input type="checkbox"/> Boat, Marina</li> <li><input type="checkbox"/> Make-up Tank</li> <li><input type="checkbox"/> Pump, Prime Lines</li> <li><input type="checkbox"/> Pump, Water Oper Eject</li> <li><input type="checkbox"/> Photo Lab Sinks</li> <li><input type="checkbox"/> Photostat Equipment</li> <li><input type="checkbox"/> Pump Pneumatic Eject</li> <li><input type="checkbox"/> Pipette Washer</li> <li><input type="checkbox"/> Potato Peeler</li> <li><input type="checkbox"/> Processing Tanks</li> <li><input type="checkbox"/> Re-circulated Water</li> <li><input type="checkbox"/> Sewer, Sanitary</li> <li><input type="checkbox"/> Sewer, Storm</li> <li><input type="checkbox"/> Swimming Pool</li> <li><input type="checkbox"/> Sewer, Flushing Manhole</li> <li><input type="checkbox"/> Steam Cleaner</li> <li><input type="checkbox"/> Steam Table</li> <li><input type="checkbox"/> Ultrasonic Baths</li> <li><input type="checkbox"/> Vats</li> <li><input type="checkbox"/> Telephone, Showers</li> <li><input type="checkbox"/> Water Closets, Tank</li> <li><input type="checkbox"/> Water Closets, Flush</li> <li><input type="checkbox"/> Water Oper Equipment</li> <li><input type="checkbox"/> Water Treatment Tanks</li> <li><input type="checkbox"/> Water Well Secondary System</li> <li><input type="checkbox"/> Wash Tanks</li> </ul>
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Remarks: \_\_\_\_\_

# WELL USER AGREEMENT OF NON-USE OR CONNECTION TO THE PUBLIC WATER SUPPLY

In accordance with Water System's Cross Connection Control program and state law, a private well or auxiliary water source may not be connected in any manner to the public water supply unless proper protection against cross connection is provided. Only a Reduced Pressure Backflow Preventer or an approved air gap (complete separation from public water supply) may be used for protection. These devices must have prior approval by Water System. Customers using the public water supply and not in compliance with this rule will have their water service discontinued.

**Check appropriate box:**

- This serves as notification that a well is located on the property at the following address:*
  
- This serves as notification that a well is not located on the property at the following address:*

\_\_\_\_\_

Please type or print

\_\_\_\_\_

\_\_\_\_\_

I (we) understand and agree that this system is, and shall remain totally segregated from the public water supply, and no unapproved or unauthorized cross connections, auxiliary intakes, bypasses, or interconnections with any type of irrigation systems or otherwise will be permitted without the proper cross connection control device and approval of the Water System.

I (we) further understand and agree that should an auxiliary water supply be connected to the public water system at the above address, maximum cross connection control equipment in the form of an approved air gap or reduced pressure backflow prevention device shall be installed to protect the public water supply.

Date: \_\_\_\_\_

Name: \_\_\_\_\_ Notary: \_\_\_\_\_

Signature: \_\_\_\_\_ Commission Expires: \_\_\_\_\_

# Backflow Incident Report Form

Reporting Agency: \_\_\_\_\_

Report Date: \_\_\_\_\_

Reported By: \_\_\_\_\_ Title: \_\_\_\_\_

Mail Address: \_\_\_\_\_ City: \_\_\_\_\_

State: \_\_\_\_\_ Zip Code: \_\_\_\_\_ Telephone: \_\_\_\_\_

Date of Incident: \_\_\_\_\_ Time of Occurrence: \_\_\_\_\_

General Location (Street, etc.): \_\_\_\_\_

Backflow Originated From:

Name of Premises: \_\_\_\_\_

Street Address: \_\_\_\_\_ City: \_\_\_\_\_

Contact Person: \_\_\_\_\_ Telephone: \_\_\_\_\_

Type of Business: \_\_\_\_\_

Description of Contaminants:  
(Attach Chemical Analysis or MSDS if available)

\_\_\_\_\_  
\_\_\_\_\_

Distribution of Contaminants:

Contained within customer's premises: Yes: \_\_\_\_\_ No: \_\_\_\_\_

Number of persons affected: \_\_\_\_\_

Effect of Contamination:

Illness Reported: \_\_\_\_\_

Physical irritation reported: \_\_\_\_\_

\_\_\_\_\_

Backflow Incident Report Form

Page 2 of 3

Cross-Connection Source of Contaminant (boiler, chemical pump, irrigation system, etc.):

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Cause of Backflow (main break, fire flow, etc.):

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Corrective Action Taken to Restore Water Quality (main flushing, disinfection, etc.):

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Corrective Action Ordered to Eliminate or Protect from Cross Connection (type of backflow preventer, location, etc.)

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Previous Cross-Connection Survey of Premises:

Date: \_\_\_\_\_ By: \_\_\_\_\_

Types of Backflow Preventer Isolating Premises:

RPBA: \_\_\_\_\_ RPDA: \_\_\_\_\_ DCVA: \_\_\_\_\_ DCDA: \_\_\_\_\_

Air Gap: \_\_\_\_\_ None: \_\_\_\_\_ Other Type: \_\_\_\_\_

Date of Latest Test of Assembly: \_\_\_\_\_

---

Backflow Incident Report Form  
Page 3 of 3

Notification of Division of Water Supply:

Date: \_\_\_\_\_ Time: \_\_\_\_\_ Person Notified: \_\_\_\_\_

Attach sheets with additional information, sketches, and/or media information, and mail to Local Environmental Field Office

## REFERENCES

1. (AWWA, 1992) "Recommended Practice for Backflow Prevention and Cross-Connection Control" Pacific Northwest Section American Water Works Association, Inc., 1992.
2. (EPA, 2005) United States Environmental Protection Agency, "Cross Connection Control Manual" U.S. Government Printing Office, Washington, 1973.
3. (FCCCHR, 1993) "Manual of Cross Connection control" Foundation for Cross Connection Control and hydraulic Research – University of Southern California, Ninth Edition, 1985.
4. (IAPMO) Uniform Plumbing Code. International Association of Plumbing and Mechanical Officials (IAPMO). Los Angeles, California
5. (IPC, 2000) International Plumbing Code. International Code Council. Falls Church, Virginia. 2000.

# DESIGN CRITERIA FOR CROSS-CONNECTION CONTROL PLANS, ORDINANCES, AND POLICIES



DIVISION OF WATER SUPPLY  
TENNESSEE DEPARTMENT OF ENVIRONMENT AND CONSERVATION  
2008



## Approved Cross-Connection Control Plan Criteria

In accordance to Division of Water Supply regulations, all community water systems must develop a plan to be reviewed and approved by the Division of Water Supply. Cross-Connection Control plans should describe how the distribution system will be protected from backflow and the steps the water system will take to detect and eliminate actual and significant potential cross-connections. The community water system by adhering to an approved plan and continuing an ongoing program based on the plan will have an effective means in controlling and prevention of backflow.

The scope of the plan is to describe the methods and actions that community water system will take to prevent backflow. The following template will represent an effective, approved plan. Plans should be developed by the water system based on observed conditions in the distribution, and the water system is encouraged to implement additional measures that would best protect their system from cross-connections. The water system's plan will contain a criteria list of establishments that require assemblies and the corresponding designation of hazard and assembly installation criteria. Any changes to Cross-Connection Control Plans are reviewed and approved by the Division of Water Supply.

The water system's plan will contain the following sections:

- I. Introduction** – General statement of problem and what needs to be done.
- II. Authority for Cross-Connection Control** – Detail local, state, and federal authority for controlling cross connections. The ordinance or policy should be included with the plan.
- III. Program To Be Pursued**
  1. Staffing
  2. Cross-Connection Control Surveys and Inspections
  3. Public Education and Awareness Efforts
  4. Customer's Responsibility
  5. Enforcement
- IV. Procedures for Inspection**
  1. Field Visit Procedures
  2. Reports
  3. Follow-up Visits and Reinspections
  4. Installation of Backflow Prevention Assemblies
  5. Technical Assistance
- V. Premises Requiring Reduced Pressure Principle Assemblies or Air Gap Separation**
  1. High Risk High Hazards
  2. High Hazards
- VI. Premises Allowing Double Check Valve Assemblies (*If Allowed by Water System*)**
- VII. Inspection and Testing of Backflow Prevention Assemblies**
  1. Approval of New Installations
  2. Routine Inspection and Testing of Assemblies
  3. Accepted Test Procedure
  4. Official Tests
  5. Prior Arrangements for Testing
  6. Repairs
  4. Annual testing and inspection of protective assemblies
- VIII. Parallel Units**
- IX. Records**
- X. Backflow Contamination Procedures**
- XI. Modifications to Plans**

## **XII. Approval Signatures**

# **Community Water System**

## **Cross-Connection Control Plan**

### **I. Introduction**

#### **A. Goal**

The goal of the Community Water System is to supply safe water to each and every customer under all foreseeable circumstances. Each instance where water is used improperly so as to create the possibility of backflow due to cross connections threatens the health and safety of customers and chances of realizing this goal. The possibility of backflow due to improper use of water within the customer's premises is especially significant because such cross connections may easily result in the contamination of our water supply mains. Such situations may result in the public water system becoming a transmitter of diseased organisms, toxic materials, or other hazardous substances that may adversely affect large numbers of people. The only protection against such occurrences is the elimination of such cross connections or the isolation of such hazards from the water supply lines by properly installed approved backflow prevention assemblies. The Community Water System must continue maintenance of a continuing program of cross connection control to systematically and effectively prevent the contamination or pollution of all potable water systems.

#### **B. Plan of Action**

The Community Water System is determined to take every reasonable precaution to ensure that cross connections are not allowed to contaminate the water being distributed to its customers. This cross connection plan outlines a course of action designed to control cross connection within the area served by the utility. This plan is intended to be a practical guide for safeguarding the quality of water distributed from becoming contaminated or polluted through backflow. By following the plan of action, the water provider will ensure that all aspects of the policy/ordinance on Cross Connection Control are being followed by customer.

### **II. Authority for Cross Connection Control**

A copy of the policy/ordinance, adopted date, Board of Directors is attached to this plan as Appendix 1. This policy/ordinance prohibits cross connections within water systems, authorizes the water system to make inspections of the customer's premises, requires that cross-connection hazards be corrected and provides for enforcement. This policy/ordinance expresses clear determination on the part of the Board of Directors that the water system is to be operated free of cross-connections that endanger the health and safety of those depending upon the public water supply. This policy/ordinance is considered to be a sound basis for the control of cross-connection hazards by the operating staff and management of the Community Water System. The provisions, contained within this policy/ordinance, are in keeping with the requirements set forth in Section 68-221-711 (6) of Tennessee Code Annotated and Section 1200-5-1-.17(6) of Tennessee Department of Environment and Conservation Rules governing Public Water Systems.

### **III. Program To Be Pursued**

The Community Water System will establish an active on-going cross-connection control program. This program is to be a continuing effort to locate and correct all existing cross-connection hazards and to discourage the creation of new problems. Safeguarding the quality of water being distributed to our customers is a high priority concern of the management of the Community Water System.

#### **A. Staffing**

Water provider has designated staffing to ensure that the program to control cross-connections is pursued in an aggressive and effective manner. It is proposed that a minimum of (number)

man at (number) days per month be allotted to the cross-connection control program initially. Depending on customer preference in scheduling, work related to the testing of devices may occur after hours or on weekends. A cross-connection control coordinator or manager and successor will be named. The cross-connection control coordinator is in charge of implementation of an effective cross-connection control program. The Cross-Connection Control Coordinator will ensure that the all aspects of the plan and policy/ordinance are followed.

XXXXXXX- Cross-Connection Control Coordinator

## **B. Cross-Connection Control Surveys/Inspections**

A representative of the water system will survey the distribution for all customers, both residential and nonresidential, for possible cross-connections. If it determined from the surveys that possible cross-connection may exist, the premise will be inspected. The need for backflow protection will be determined based on the results from the inspection. Notification of the type of backflow prevention assembly required and a date of compliance will be sent to the customer.

### **Non-Residential:**

All nonresidential and commercial establishments are required to have an approved backflow preventer installed that is in agreement to the actual or potential hazard present or inspections to determine that no assembly is needed based on criteria attached. The inspections will be performed on all new establishments before water service is established or within 90 days of connection. All nonresidential establishments not required to have assemblies will be inspected every five (5) years maximum. If there are existing establishments that have not been inspected, a list agreed upon by State (based on risk and public safety) and time line for inspection by the water provider will be generated. If establishment changes ownership (name listed on water bill), if plumbing permits are issued, irrigation systems installed, or a well is drilled within the establishment, then an inspection will need to be performed (suggested no later than 90 days). The need for backflow protection will be determined based on the results from the inspection. Notification of the type of backflow prevention assembly required and a date of compliance will be sent to the customer. **(Attach a list of criteria for requiring assemblies)**

### **Residential:**

For new residential customers, a written questionnaire will be given upon request for water service. If the survey reveals that a potential cross-connection may be present, an inspection is to be performed. The need for backflow protection will be determined based on the results from the inspection. Notification of the type of backflow prevention assembly required and a date of compliance will be sent to the customer. Each new residential customer will agree to not create cross-connections and a brochure is given to each new customer describing cross-connections and the responsibility of the customer in not creating one.

If the written questionnaire (See sample form in Appendix) reveals that the new customer may have any of the following, an inspection will be required:

1. Lawn irrigation systems
2. Residential fire protection systems (closed loop systems will require a double check valve minimum)
3. Pools, Saunas, Hot Tubs, Fountains
4. Auxiliary Intakes and Supplies-wells, cistern, ponds, streams, etc.
5. Home water treatment systems
6. Hobbies that require extensive amounts of toxic chemicals (taxidermy, metal plating, biodiesel, ethanol production, etc.)
7. Any other situations or conditions listed in the manual or conditions deemed a threat by the water system.

Written questionnaires will be sent to existing residential customers to determine if potential cross-connections exist. The distribution system will be divided into five segments and (a number agreed upon by the water system and the Division of Water Supply) will be surveyed

within five years. The distribution system will continue to be surveyed in this manner. Questionnaires that reveal potential cross-connections based on the criteria above will be inspected and a determination if backflow prevention assemblies are needed.

The system will be surveyed for residential lawn irrigation systems through questionnaires received and by secondary meters. All residential lawn irrigation systems will require a reduced pressure principle assembly. Residential customers with pools, saunas, hot tubs not filled by a hard pipe directly or indirectly connected may be allowed to use an air gap (and may be requested to use an atmospheric vacuum breaker at the hose bibb). However, if the pool or vessels is connected directly or indirectly by a hard line, an RP is required at minimum.

Residential customers required to have backflow prevention assemblies will be informed of possible thermal expansion problems within the establishment and correction of the condition.

### **Well System Inspections:**

Wells drilled on properties that are supplied by a public water system, particularly those designed for chemigation and fertigation, will need to be inspected to ensure separation from water system or the premises will require an approved assembly.

Wells that are drilled within the area of the distribution system within the last calendar year are inspected and a well user agreement is signed between the Community Water System and the customer. A list of existing wells that do not have a well user's agreement within the distribution area will be generated and (a number agreed upon by the water system and the Division of Water Supply) wells per year will be inspected until the entire list has been completed. Any well system that is connected directly or indirectly to the water system is required to disconnect or install a reduced pressure principle assembly. The customer will be required to sign a well user agreement if no assembly is required. It is recommended that inspections be performed on new listings within the year, and then perform inspections on existing, uninspected wells. The list is updated at the Local environmental field office and is available to the water system.

New lines that are constructed in areas where residential areas have been mainly supplied by well systems are surveyed and inspected.

## **C. Public Education and Awareness Efforts**

The Community Water System recognizes that it is important to inform its customers of the health hazards associated with cross-connections and to acquaint them with the program being pursued to safeguard the quality of water being distributed. The water system will seek to use every practical means available to acquaint the customers with the health hazards associated with cross-connections in an effort to get cooperation. Use of customer notification letters, annual consumer confidence report and local video and print media will be incorporated into the notification plan. Efforts will be made to have an employee, or employees, of the water system to appear before the civic clubs, PTAs, school groups, and other appropriate forums to discuss the problem of cross-connections and the program that is being pursued for their control.

Information will be provided to **all** customers about cross-connection control and backflow prevention by individual pamphlets or through an article in the Consumer Confidence Report (CCR) at least once per year. A brochure will be given to all new customers requesting water service describing cross-connections and prevention of backflow.

The following measures may also be used to inform customers about the need to control cross-connections:

1. Reminders with water bills.
2. Posters at the counter where the water bills are paid displayed one month out of the year
3. Annual consumer confidence report

4. a. Personal visits to commercial, industrial, institutional, and agricultural customers to explain the need for controlling cross-connections.
- b. Whenever possible, any such potential customer will be informed of needed cross-connection measures in the design or construction stage.

#### **D. Customer's Responsibility**

Cross-connections, created and maintained by the customer for his convenience endanger the health and safety of all who depend upon the public water supply. Therefore, the customer who creates a cross-connection problem shall bear the expense of providing necessary backflow protection and for keeping the protective measures in good working order. This includes repair, testing, installation, etc.

#### **E. Enforcement**

Where cross-connections are found to exist, the Community Water System will require the problem to be eliminated or isolated by a properly installed, approved backflow prevention assembly to prevent the possibility of backflow into the distribution system. Such protective measures will include a backflow prevention assembly on the customer's water service line ahead of any water outlets. Every effort will be made to secure the voluntary cooperation of the customer in correcting cross-connection hazards. If voluntary action cannot be obtained within the time set forth by written notice (**90 days maximum for high and low hazard, 14 days maximum for high risk high hazards**) to the customer, water service will be discontinued until conditions are in line with the water provider's policy/ordinance for the protection of the health and safety of the water distribution system.

After surveys or inspections have been completed, the establishments will be contacted by written correspondence outlining any correction (adding or repairing backflow prevention devices) needed and the time schedule allowed for correction of conditions. If the conditions have not been corrected by the time allotment (90 days maximum for high and low hazard, 14 days maximum for high risk high hazards), the water service will be discontinued to the establishment, along with any fines or other penalties deemed necessary by the Community Water System.

The Community Water System may give additional warnings of discontinuance and/or bring about penalties before the water service is discontinued. The time period for correction will be determined by the water provider, based on the seriousness of the hazard and risk of contamination, ranging from immediate correction or time period of up to 90 days. The maximum allowable time for correction will not exceed 90 days. Those sites deemed high risk high hazard are corrected within a maximum limit of 14 business days, preferably immediate correction. If the conditions do not satisfy the policy/ordinance or plan within 90 days, water service will be discontinued. In the case of backflow prevention devices on fire systems, it is recommended that the fire marshal be contacted before water service is discontinued, to prevent harm to anyone in case a fire occurred in a public building. The fire marshal can condemn the building, thus not allowing anyone to enter.

Water service will not be allowed to the establishment until all corrections have been made and all conditions of the policy/ordinance have been satisfied.

#### **IV. Procedures for Inspections:**

The Community Water System hopes that its efforts to acquaint its customers with the hazards of cross-connections will be successful to the point that the customer will try to maintain their internal water delivery system free of cross-connections. It is recognized that many customers may not recognize that they have a situation that would permit backflow into the water supply lines. Therefore, a thorough investigation will be made of all premises considered likely to have cross-connections. Such inspections will involve the customer's entire water using equipment, and other system components in an effort to locate all actual and potential cross-connections. The findings will be reported to the owner or occupant in writing along with a request for needed corrective action necessary to properly protect the public water system.

## **A. Field Visit Procedures:**

During the inspection, a field sheet will be completed showing details of significant findings. The hazards which cross-connections pose will be explained fully to the persons assisting the inspection. The customer will be informed that the information gathered during the survey will be reviewed by the Water System's management or engineering staff and that a written report containing any recommendations and requirements will be mailed to them as soon as possible.

## **B. Reports to Customers:**

The findings of the investigation will be summarized and a written report will be sent to the person assisting in the investigation, or the ranking management official of the establishment. Cross-connections found will be described briefly along with recommended method of correction. An effort will be made to keep the description of the findings and recommendations clear, concise and as brief as possible. The correspondence will indicate a willingness to assist the questions. The customer will be given a time limit for making the needed corrections depending (maximum of 90 days) upon the seriousness of the cross-connections involved and upon the complexity and difficulty of correcting the problems.

## **C. Follow-up Visits and Reinspections**

Follow-up visits will be made as needed to assist the customer and to assure that satisfactory progress has been made such visits will continue until all corrective action has been completed to the satisfaction of the water system.

## **D. Installation of Backflow Prevention Devices:**

Where the customer is asked to install a backflow prevention assembly, the customer will be supplied with a list of acceptable and approved assemblies. In addition, minimum acceptable installation criteria will be supplied (Installation Criteria will need to be attached to plan). It will be pointed out that a unit cannot be accepted until the water system has verified that the installation fully meets the installation criteria and has been tested to verify that the assembly has a status of Passed. Such backflow prevention assemblies must be of a make, model, and orientation currently listed as acceptable by both the water system and Tennessee Department of Environment and Conservation.

## **E. Technical Assistance:**

The customer will be urged to notify the water system when they are ready to begin installing either a reduced pressure or double check valve type backflow preventer assembly. The Water system cross-connection representative will visit the site to detail how the units must be installed to achieve the desired protection and to minimize maintenance and testing problems.

## **V. Premises Requiring Reduced Pressure Principle Assemblies or Air Gap Separation**

### **A. High Risk High Hazards**

Establishments which pose significant risk of contamination or may create conditions which pose an extreme hazard of immediate concern (High Risk High Hazards), the cross-connection control inspector shall require immediate or a short amount of time (14 days maximum), depending on conditions, for corrective action to be taken. In such cases, if corrections have not been made within the time limits set forth, water service will be discontinued.

High Risk High Hazards require a reduced pressure principle (or detector) assembly. The following list is establishments deemed high risk high hazard:

## High Risk High Hazards:

1. Mortuaries, morgues, autopsy facilities
2. Hospitals, medical buildings, animal hospitals and control centers, doctor and dental offices
3. Sewage treatment facilities, water treatment, sewage and water treatment pump stations
4. Premises with auxiliary water supplies or industrial piping systems
5. Chemical plants (manufacturing, processing, compounding, or treatment)
6. Laboratories (industrial, commercial, medical research, school)
7. Packing and rendering houses
8. Manufacturing plants
9. Food and beverage processing plants
10. Automated car wash facilities
11. Extermination companies
12. Airports, railroads, bus terminals, piers, boat docks
13. Bulk distributors and users of pesticides, herbicides, liquid fertilizer, etc.
14. Metal plating, pickling, and anodizing operations
15. Greenhouses and nurseries
16. Commercial laundries and dry cleaners
17. Film Laboratories
18. Petroleum processes and storage plants
19. Restricted establishments
20. Taxidermy facilities
21. Establishments which handle, process, or have extremely toxic or large amounts of toxic chemicals or use water of unknown or unsafe quality extensively.

## B. High Hazard

In cases where there is less risk of contamination, or less likelihood of cross-connections contaminating the system, a time period of (90 days maximum) will be allowed for corrections. High Hazard is a cross-connection or potential cross-connection involving any substance that could, if introduced in the public water supply, cause death, illness, and spread disease. (Provide criteria list, suggested to use Appendix A of manual)

## VI. Premises Allowing Double Check Valve Assemblies

### Low Hazard

Low hazard is a cross-connection or potential cross-connection involving any substance that would not be a health hazard but would constitute a nuisance or be aesthetically objectionable if introduced into the public water supply. Low Hazards are protected by double check valve assemblies at minimum. Double check valve (and detector) assemblies used for main line protection are allowed only on Classes 1-3 fire protection systems.

## VII. Inspection and Testing of Backflow Prevention Assemblies

### A. Approval of New Installations

The Water System will not consider the installation of assemblies to be complete until:

1. The installation has been inspected, and approved by the water system based installation criteria; and
2. Assembly is tested initially and has a status of Passed.

### B. Routine Inspection and Testing of Assemblies

To assure that all assemblies are functioning properly, assemblies will be tested within a 12 month period by backflow prevention assembly testers with a Certificate of Competency. If assembly is not tested within the 12 month period, enforcement action will be started. In



conjunction with testing the assembly, the water system representative or approved tester will investigate to determine:

1. That cross-connections, actual or potential, have not been added ahead of the protective assemblies,
2. The assembly meets all installation criteria; and
3. The assembly has not been bypassed or altered in some other way to compromise the backflow protection.

All reduced pressure and double check valve backflow prevention assemblies, including detector assemblies, utilized for the protection of the water system will be tested by a person possessing a valid Certificate of Competency from the State and approved by the water system in keeping with the following criteria:

1. Immediately following installation;
2. At least every 12 months;
3. Any time assemblies have been partially disassembled for cleaning and/or repair and;
4. Where there is indication that the unit may not be functioning properly (i.e. excessive or continuous discharges from relief valve, chatter, or vibration of internal parts).

### **C. Accepted Test Procedure**

Tests of assemblies will be made using a 3 or 5 valve test kit that has valid annual certification in accordance to the latest approved testing procedure from the Division of Water Supply.

### **D. Official Tests**

Only tests performed by persons possessing a valid Certificate of Competency will be considered official tests by the water systems. All test reports submitted must be of the type approved by the Division of Water Supply. All parts of testing procedure are recorded accurately on the test report with a determination of status (Passed or Failed). Certificates of Competency are not transferrable.

### **E. Prior Arrangements for Testing**

Prior arrangements will be made for a mutually agreeable time for testing the assemblies prior to performing the test. In all cases, the time which water services are interrupted will be held to a minimum in order to minimize the inconvenience to the customer. The customer, upon notification by the water system, has an obligation to work out a mutually agreeable time for testing assemblies within time allotted by the water system.

### **F. Repairs**

Should a protective assembly be found defective or have a status of Failed, the water system will require the assembly to be repaired promptly with manufacturer's specified parts, in accordance to manufacturer's suggested procedure, and placed in proper operating condition within a (specified) time limit (**maximum 90 days, 14 days for high risk high hazards**). Following repairs, the assembly is to be tested again to verify that it is meeting performance standards and have a status of Passed. The owner will be held responsible for maintaining protective measures in a good state of repairs. The owner of an assembly needing repairs or maintenance will be permitted to do the work, if such owner is properly qualified or the owner may elect to secure the services of someone else experienced in the repair of the assemblies.

## **VIII. Parallel Units**

The water system may require the installation of parallel assemblies if the customer cannot readily accommodated interruptions of water service for periodic testing and repairs of the assemblies or is unwilling to cooperate in scheduling a shutdown promptly for testing during normal hours worked by water system personnel.

## **IX. Records**

Good records are invaluable in the water system's efforts to safeguard the quality of water being distributed against degradation from backflow through cross-connections. Adequate records will be maintained as a part of the Water System's permanent files to:

- A.** Document the overall effort of the water system to properly discharge its responsibility to see that each customer receives a safe water under all foreseeable circumstances;
- B.** Give a complete picture as to the current status and history of the individual premises regarding the potential for backflow, corrections made, etc.;
- C.** To support enforcement action, whenever necessary, to obtain backflow protection; and
- D.** Document that assemblies have been properly installed, maintained, and tested routinely.

Records to be maintained by Water System will include, but not necessarily be limited to the following;

- A.** Master List of all Establishments with assemblies used for premise isolation, including location, assembly used, make, model, size, serial number etc.;
- B.** Correspondence between water system and its customers
- C.** Copy of Approved Plan
- D.** Copy of Approved Policy/ordinance
- E.** Test reports for each assembly
- F.** Copies of Certificates of Competency for each tester
- G.** Copies of test kit certifications
- H.** Site Inspection Reports
- I.** Residential written surveys
- J.** Backflow incident reports
- K.** Records on initial surveys, recommendations, follow-up, corrective action, routine reinspections, etc.
- L.** A file system designed to call to the attention of the cross-connection control personnel when testing and reinspections of premises are needed.
- M.** Public education pamphlets and information.

## **X. Backflow Contamination Procedures:**

If contamination is caused by backflow, the Community Water System will take the following actions to protect the health of the customer:

- A.** Isolate the lines containing any contaminant from the distribution system;
- B.** Inform customers with contaminated lines not to consume or use the water;
- C.** Report contamination to the Local Field Office;
- D.** Determine and separate the cross-connection allowing the backflow and contamination;
- E.** Remove contamination from lines;
- F.** Test and ensure that lines meet Division of Water Supply regulations for safe water;
- G.** Return service to customers affected customers once water is safe;
- H.** Document the details of the incident including cause, isolation, and correction, and send report to Local Field Office;
- I.** Continue to survey and inspect system for similar situations that may allow backflow.

## **XI. Modifications to Plan**

This plan may be modified from time to time to meet the needs of the utility and to meet the states requirements. The plan and policy/ordinance will be reviewed by the water system every five (5) years to determine if the existing plan meets requirements set forth by the Division of Water Supply and that it promotes an ongoing program. (**suggested:** The manager shall be authorized to modify, as needed this plan without the approval of the water system's governing body. The manager shall report any modifications to this plan to the board for their information, in a timely manner.) The

manager shall also advise the Local Field Office of any changes to this plan for their review and comments.

**XII. Approval Signatures**

**State Approval:** \_\_\_\_\_

**Date:** \_\_\_\_\_

**Board Approval** \_\_\_\_\_

**Date:** \_\_\_\_\_

**Board Chairman  
Signed:** \_\_\_\_\_

**Date:** \_\_\_\_\_

**Executive Director  
Signed:** \_\_\_\_\_

**Date:** \_\_\_\_\_

**INSTALLATION CRITERIA  
FOR  
REDUCED PRESSURE PRINCIPLE AND DOUBLE CHECK VALVE BACKFLOW  
PREVENTION ASSEMBLIES**

**MINIMUM INSTALLATION REQUIREMENTS are underlined**, all others are suggestions or items to consider:

- A. The RP assemblies should never be subject to flooding; therefore should:
1. Never be located in a pit or other area subject to flooding
  2. Avoid piped drains for enclosures housing the units. Provision should be made for discharging water (maximum design discharge) directly through the wall of the enclosure housing the unit at a slightly higher elevation than surrounding ground level or maximum flood level.
  3. The lowest part of the relief valve discharge port should be a minimum of 12 inches above either:
    1. The ground
    2. Top of the opening(s) in enclosure wall
    3. Maximum flood level

Whichever is highest, in order to prevent any part of the assembly from becoming submerged.
- B. All new backflow prevention assemblies being installed in Tennessee for the protection of a public water system should be included on the latest listing of "Approved Backflow Prevention Assemblies" maintained by the Division of Water Supply.
- C. The assemblies should be installed where the units can be easily tested and repaired.
1. Installation of assemblies 2" and less there must be a minimum of six inch clearance from all walls. Assemblies over 2" must be a minimum of twelve inches from all walls.
  2. Assemblies installed in stationery enclosures should have at least a 2 ft. clearance on each side of the assembly to facilitate testing and servicing. Adequate drainage must be provided.
  3. Assemblies should not be installed higher than 5 ft. from the floor/ground to the center line of the assembly unless safe permanent access is provided for testing and servicing
- D. The pipelines should be thoroughly flushed to remove foreign material and debris. A strainer should be added on the inlet side of the assembly before installation except for fire protection service lines.
- E. Installation of backflow prevention assemblies will not allow any unprotected or uninspected connections in front of the backflow prevention assembly.
- F. Backflow preventers should be installed with unions and isolation valves on both ends of the assembly to allow removal of the assembly for repair or replacement.
- G. Provisions should be made to protect the assemblies from freezing. Insulating materials should not restrict the relief valve discharge or accessibility to test cocks or name plate of the unit. All enclosures should be designed to provide for adequate draining for the relief valve.

- H. The relief valve of an RP should never be plugged, restricted, or solidly piped to a drain, ditch or pump. Rigidly secured air-gap funnels may be used to direct discharges away from the unit provided an approved air-gap separation is provided at the relief valve discharge and again at the discharge end of the drainpipe. An adequate area drain is recommended to handle the maximum relief valve flow to prevent flooding.
- I. The test cocks, valve stems, or name plates should not be painted and their accessibility, operation or legibility should not be hampered nor the relief valve discharge passage be restricted by insulation or other coverings.
- J. The assemblies should be installed in an approved position as listed in the Latest Approved List and special supports added if needed.
- K. For applications where water temperatures exceed 110°F (43°C) only approved hot water devices are to be used.
- L. Prior to completing the installation, temperature pressure relief valves on heating vessels should be properly installed and in good working condition. If needed, thermal expansion tanks should be installed.
- M. No unprotected bypasses or connections are made between the assembly and meter.

Existing assemblies not meeting the minimum requirements above, with the exception of being installed in an area that may allow flooding of the assembly, may be allowed variances by the water system. However, no variance may be allowed that will compromise the protection of the assembly or that will allow contaminants in the distribution system. All variances should be documented and kept on file for the life of the assembly. Please review the document entitled: Approved Backflow Prevention Assemblies

## APPENDIX A

### TYPICAL CROSS CONNECTION HAZARDS

Actual or potential cross connection hazards may be present within almost every water using premises. To better understand and become aware of these hazards, the following examples are provided.

#### **A. Common Facilities and Systems Likely to have Cross Connection Hazards:**

1. Auxiliary Water Systems

Any premises or facility with an alternate water supply on or available to the premises. Water stored in reservoirs that are not properly protected or circulated is considered an auxiliary supply.

2. Food Processing

Pressure cookers, autoclaves, retorts, and other steam connected facilities.

3. Cooling Systems Single Pass

Compressors, heat exchangers, air-conditioning equipment, and other water-cooled equipment that may be sewer connected

4. Farming Operations

Poultry houses, chicken houses with automatic proportioning pumps or feeder barrels for supplying water with live virus or other medication, livestock watering troughs with below the rim filling outlet, diluting and mixing of pesticides and insecticides, mixing and spray equipment, greenhouses, dilution of liquid fertilizers, dairies, unprotected hose bibbs.

5. Fire Protection Systems

Piping systems and storage reservoirs that may be treated for prevention of scale formation, corrosion, algae, or slime.

Piping systems that contain non-potable plumbing materials.

Booster pumps without suction pressure sustaining valves or low suction pressure cutoff switches.

Sprinkler systems filled with antifreeze solutions Piping systems filled with chemical compounds used in fighting fires.

Fire systems with an auxiliary source of supply or which are located within 1700 ft. of streams, lakes, ponds, reservoirs, or other non-potable waters that could be utilized in emergencies.

6. Film Processing

Automatic film processing machines, tanks, vats, and other facilities used in processing film.

7. Hydraulic Test Facilities

Hydraulic test equipment using pumps, rams, pressure cylinders, or other hydraulic principles, which may force liquids back into the public water system.

Piping systems, tanks, and other equipment where the public water system pressure is used directly and which may be subject to backpressure.

8. Industrial Piping Systems

Industrial piping systems containing chemicals, gases, cutting or hydraulic fluids, coolants, antifreeze, hydrocarbon products, glycerin, paraffin, caustic or acid solutions and other substances.

9. Industrial Systems – Chemical Contamination

Tanks, can and bottle washing machines, and piping systems where caustics, acids detergents, and other compounds are used in cleaning, sterilizing, and flushing.

10. Residential or Commercial lawn irrigation systems.  
Irrigation systems equipped with pumps, injectors, pressurized tanks, or other facilities for injecting agricultural chemicals, such as, fungicides, pesticides, herbicides, and other toxic or objectionable substances, require immediate protection.
11. Laundry and Dyeing Facilities  
Laundry machines having under rim or bottom inlets, dry cleaning equipment, solvent reclaim facilities.  
  
Wash water storage tanks equipped with re-circulating pumps.  
  
Dye vats in which toxic chemicals and dyes are used.  
  
Shrinking, bluing, and dyeing machines directly connected to re-circulating systems.  
  
Boilers, steam lines, and heat exchangers.
12. Paper Processing  
Pulp, bleaching, dyeing, and processing facilities that may be contaminated with toxic chemicals.
13. Petroleum Processing  
Steam boilers, steam lines, mud pumps and mud tanks, oil well casing used for dampening gas pressures, dehydration tanks, oil and gas tanks in which hydraulic pressures are used to raise oil and gas levels, gas and oil lines used for testing, excavating, and slugging.
14. Plating Facilities  
Plating facilities using highly toxic cyanides, heavy metals, such as, copper, cadmium, chrome, acids, and caustic solutions.  
  
Plating solution filtering equipment with pumps and circulating lines.  
  
Tanks, vats, or other vessels used in painting, descaling, anodizing, cleaning, stripping, oxidizing, etching, pickling, dipping, and rinsing operations and lines used for transferring fluids.
15. Storage Tanks, Cooling Towers, and Circulating Systems  
Storage tanks, cooling towers, reservoirs, and circulatory systems contaminated with bird droppings, algae, slimes, or with water treatment compounds, such as copper, chromate, phenols, and mercury.
16. Sewerage Systems  
Cross connections to sewage pumps for priming, water seal lubrication, cleaning, flushing, or unclogging.  
  
Water-operated sewage pump ejectors.  
  
Sewer lines used for disposing of filter or softener backwash, water from cooling systems, or for providing a quick drain for building lines and lines used for flushing or blowing out obstructions in sewer lines.
17. Steam Generation Facilities  
Steam generating facilities and lines which may be contaminated with boiler compounds, heat exchangers, single wall steam heated water heating equipment.
18. Hospital-Medical Facilities  
Unprotected connections to bedpan washers, hydrotherapy tubs, toilets, urinals, autopsy and mortuary equipment, aspirators, x-ray and photo processing equipment, vacuum pump seals.  
  
Unprotected connections to laboratory equipment which may be chemically or bacteriologically contaminated, such as, steam sterilizers, autoclaves, specimen tanks, and pipette washers.

## **B. Equipment posing significant risk of creating cross-connections.**

Establishments with equipment list will normally require premise isolation with a Reduced Pressure Principle Assembly or Double Check Valve Assembly depending on hazard unless otherwise found to have an appropriate air gap.

Many devices or equipment below may be designed and constructed with approved air gaps that would adequately protect the water system. However, the cross-connection control inspector should consider and make judgments on the amount risk that the establishment poses to the distribution and not solely on the presence or absence of the devices, situations, or equipment listed below.

The following is an incomplete list of equipment normally requiring backflow prevention assemblies, it is to be noted that any connection with piping, equipment, or devices that contain or may contain substances that are pollutants or contaminants will require premises isolation.

Air-conditioning systems (using water for processing)

Aspirators

Air lines

Autoclaves and sterilizers

Auxiliary systems

Baptismal tanks

Bathtubs (Hard Piped)

Bedpan washers

Bidets

Booster pumps

Brine tanks, softeners

Boilers

Car wash equipment

Chemical feeders

Chillers

Chlorination equipment

Coffee urns

Commercial cookers

Condensers

Compressors

Cooling systems

Cooling towers

Culture vats

Cuspidor, dental

Developing equipment

Dishwashers

Display fountains

Drinking fountains

Ejectors, steam or water

Extractors

Fire protection systems, standpipes, sprinkler systems and drain lines

Fish tanks, ponds

Floor drains

Food mixing tanks

Frost-free toilets, hydrants, and fountains

Garbage grinders

Garbage can washers

Garden sprayers

Heat exchangers

Humidity controls

Hydraulic equipment

Hydraulic insecticide or fertilizer applicators

Hydraulic lifts

Ice makers

Irrigation systems, lawn sprinklers



Kitchen equipment  
Laboratory equipment  
Laundry equipment  
Lavatories  
Lawn sprinklers  
Liquid handling systems  
Lubrication, pump bearings  
Medical equipment  
Pest control equipment  
Photo laboratory sinks  
Potato peelers  
Pressure cookers  
Process water circulation systems  
Pump, priming systems  
Sewer flush tanks  
Shampoo sinks, basins  
Showers, telephone type shower heads  
Sinks, slop sinks  
Soda fountains  
Solar water and space heating equipment  
Steam boilers  
Steam tables  
Stop and waste vales  
Swimming pools, ponds, fountains  
Tank and vats  
Therapeutic tanks, spas, and hot tubs  
Threaded hose bibbs  
Toilets, flushometer, flush tank, ballcock, flush valve siphon jet  
Vegetable peelers  
Vacuum systems  
Urinals (siphon set blowout)  
Vacuum systems (water operated with water seals)  
Water treatment devices  
Water troughs  
Water-using mechanical equipment  
Water Jacketed tanks, vats, cookers

**C. Premises, facilities or establishments that pose a significant risk of cross-connection**

Reduced Pressure Backflow Prevention Assemblies required for premises isolation

Agricultural processing facilities  
Aircraft and missile plants  
Amusement parks  
Animal hospitals and clinics  
Automotive plants  
Auxiliary water systems  
Autopsy facilities  
Beverage bottling plants  
Breweries  
Buildings (multistory) – hotels, apartment houses, public and private buildings, or structures having unprotected cross connections  
Campgrounds  
Canneries  
Car washes  
Chemical plants – manufacturing, processing, compounding, treatment, packing, storage  
Chemically contaminated water systems  
Civil works  
Clinics  
Cold storage plants

Dairies, creameries  
Dry cleaners  
Dental buildings  
Dye works  
Extermination Companies  
Fertilizer plants  
Fertilizer (liquid) and spray distributors  
Film laboratories  
Fire sprinkler systems  
Funeral homes  
Hospitals  
Laboratories  
Laundries and dye works  
Lawn irrigation systems  
Medical buildings  
Metal manufacturing, cleaning, processing, and fabricating plant  
Mortuaries  
Morgues  
Motion picture studio  
Nursing home or convalescent homes  
Greenhouses, plant nurseries  
Oil and gas production, storage, or transmission facilities  
Oil refineries  
Packing houses  
Paper and paper product plants  
Plating plants  
Power plants  
Private wells  
Radioactive materials or substances – plants or facilities that process or use radioactive materials  
Reduction plants  
Restricted, classified, or other closed facilities  
Rubber plants  
Sand and gravel plants  
Schools and colleges  
Sewage pumping stations  
Storm water pumping stations  
Hard plumbed swimming pools, ponds, and fountains  
Tanneries of all kinds  
Therapeutic tanks, spas, and hot tubs  
Vegetable and food processing facilities  
Waterfront facilities and industries  
Water treatment plants  
Wastewater treatment plants  
Water using recreational facilities (swimming pools, water slides)

**D. Other situations or conditions that pose a significant risk of contamination:**

1. The degree of hazard involved.
2. The likelihood of frequent and/or unapproved plumbing changes.
3. The probability of frequent modification of water using equipment.
4. The complexity of the internal piping system.
5. The difficulty in making frequent inspections to verify that the internal protection provided is being adequately maintained.
6. The likelihood of protective assemblies being rendered ineffective.

7. The ease of access to premises.
8. The time necessary to inspect all water outlets not protected by a backflow prevention assembly.
9. The time needed to inspect the facility at least annually to determine if new cross connections have been created.

**Water System  
Cross-Connection Survey  
Residential**

Occupant Name \_\_\_\_\_

Occupant  
Address \_\_\_\_\_

1. Occupancy: \_\_\_\_\_ Own \_\_\_\_\_ Rent
2. Meter serves: Homes \_\_\_\_\_ How Many? \_\_\_\_\_  
Buildings \_\_\_\_\_ How Many? \_\_\_\_\_
3. Do you have? (Please Check all that apply):  
Hot Tub \_\_\_\_\_ Swimming Pool \_\_\_\_\_ Jacuzzi \_\_\_\_\_  
Waterbed \_\_\_\_\_ Solar System \_\_\_\_\_ Green House \_\_\_\_\_  
Underground Sprinkler System \_\_\_\_\_ Darkroom Equipment \_\_\_\_\_  
Drip/Soaker/Irrigation System \_\_\_\_\_ Portable Dialysis Machine \_\_\_\_\_  
Insecticide Sprayers (That attach to garden hose also) \_\_\_\_\_  
Utility sink w/threaded faucet \_\_\_\_\_  
Wood burning hot water heater \_\_\_\_\_ Ghost pipes (unidentified) \_\_\_\_\_
4. Do you have bathtub that fills from the bottom? Yes \_\_\_\_\_ No \_\_\_\_\_
5. Do you have a water softener or any extra water treatment system? Yes \_\_\_\_\_ No \_\_\_\_\_
6. Do you have an auxiliary water supply on your premises? Yes \_\_\_\_\_ No \_\_\_\_\_
7. Do you have livestock and use a water trough or water system connected to by public water? Yes \_\_\_\_\_ No \_\_\_\_\_
8. Is your home or building elevated above your water meter? Yes \_\_\_\_\_ No \_\_\_\_\_
9. Does a creek, river, or spring water run near or on your property? Yes \_\_\_\_\_ No \_\_\_\_\_
10. Do you have a booster pump, well pump, or any other type water pump?  
Yes \_\_\_\_\_ No \_\_\_\_\_
11. Do you receive irrigation water from a different source? Yes \_\_\_\_\_ No \_\_\_\_\_
12. Do you have a backflow protection device on your property now? Yes \_\_\_\_\_ No \_\_\_\_\_
13. Do you have any situation that you are aware of that could create a cross-connection?  
Yes \_\_\_\_\_ No \_\_\_\_\_
14. Do you have any other water-using equipment on your property not mentioned above?  
Yes \_\_\_\_\_ No \_\_\_\_\_

If yes, please list below:

---

\_\_\_\_\_  
Print Name

\_\_\_\_\_  
Phone #

\_\_\_\_\_  
Signature

\_\_\_\_\_  
Date

**Please notify this office if any of the above conditions change.**

# Approved Cross-Connection Control Policy/Ordinance Criteria

The following sections are included in an approved Policy or Ordinance.

1. **Definitions:**
2. **Compliance with TCA:**
3. **Regulated:**
4. **Statement Required:**
5. **Applicability:**
6. **Inspections/Surveys:**
7. **Backflow Prevention Determination (listed as Required Assemblies and Methods):**
8. **Approved Backflow Prevention Assemblies:**
9. **Backflow Prevention Assembly Installation Requirements:**
10. **Existing Backflow Prevention Assemblies:**
11. **Assembly Performance Evaluations and Testing:**
12. **Corrections of Violations:**
13. **Non-Potable Supplies:**
14. **Conflicting Provisions:**
15. **Penalties:**
16. **Effective Date:**
17. **Approval Signatures:**  
The following are optional but recommended:
18. **Thermal Expansion Control:**
19. **Responsibility for Water System:**
20. **Inspection and Testing Fees (If Needed):**
21. **Water Heater Temperature-Pressure Relief Valves:**
22. **Safety Standards-Duplicate Equipment in Parallel Required:**

The information listed below under each section is examples and would meet basic recommendations as an approved policy or ordinance. Additional sections may be added to the policy or ordinance as determined by the water system and approved by the Division of Water Supply. The water system may elect to create an ordinance or policy more stringent than the following. All alterations to ordinances and policies must be approved by the Division of Water Supply. Please make alterations to this document for fluidity and agreement with the water system's approved cross-connection control plan.

Much of this document are recommendations and suggestions, however, the water system should include the following sections to have an adequate and effective policy/ordinance. The policy/ordinance is basically an agreement between the water system and customer of the policies or codes upheld by the water system.

# Community Water System Cross-Connection Control Policy/Ordinance

## Section 1. Definitions

**Air Gap:** A physical separation between the free flowing discharge end of a potable water supply line and an open or non-pressurized receiving vessel.

**Approved Air Gap:** An air gap separation with a minimum distance of at least twice the diameter of the supply line when measured vertically above the overflow rim of the vessel, but in no case less than one (1) inch.

**Approved:** Any condition, method, device, procedure accepted by the Tennessee Department of Environment and Conservation, Division of Water Supply, and Water Provider.

**Auxiliary Intake:** Any piping connection or other device whereby water may be secured from any sources other than from the public water system.

**Auxiliary Water Supply:** Any water supply on or available to the premises other than water supplied by the public water system.

**Backflow:** The reversal of the intended direction of flow of water or mixtures of water and other liquids, gases, or other substances into the distribution pipes of a potable water system from any source.

**Backpressure:** A pressure in the downstream piping that is higher than the supply pressure.

**Backsiphonage:** Negative or Sub-atmospheric pressure in the supply piping.

**Backflow Prevention Assembly:** An approved assembly designed to prevent backflow.

**Bypass:** Any system of piping or other arrangement whereby water may be diverted around a backflow prevention assembly, meter, or any other public water system controlled device.

**Contamination:** The introduction or admission of any foreign substances that causes illness or death.

**Contaminant:** Any substance introduced into the public water system that will cause illness or death

**Cross-Connection:** Any physical arrangement whereby public water supply is connected, directly or indirectly, with any other water supply system, sewer, drain, conduit, pool, storage reservoir, plumbing fixture or other device which contains, or may contain, contaminated water, sewage, or other waste or liquid of unknown or unsafe quality which may be capable of contaminating the public water supply as result of backflow caused by the manipulation of valves, because of ineffective check valves or backpressure valves or because of any other arrangement.

**Cross-Connection Control Coordinator/Manager:** The person who is vested with the authority and responsibility for the implementation of the Cross-Connection Control Program and for the provision of this ordinance/policy.

**Customer:** Any natural or artificial person, business, industry, or governmental entity that obtains water, by purchase or without charge, from the water provider.

**Direct Cross-Connection:** An actual or potential cross-connection subject to backsiphonage and backpressure.

**Double Check Detector Assembly:** A specially designed assembly composed of line size approved double check valve assembly, with a bypass containing a water meter and approved double check valve assembly specifically designed for such application. The meter shall register accurately for very low rates of flow up to 3 gallons per minute and shall show a registration for all rates of flow. This assembly shall only be used to protect against non-health hazards and is designed primarily for use on fire sprinkler systems.

**Double Check Valve Assembly:** An assembly of two internally loaded check valves, either spring loaded or internally weighted, installed as a unit between tightly closing resilient seated shutoff valves and fitted with properly located resilient seated test cocks. This type of device shall only be used to protect against non-health hazard pollutants.

**Failed:** The status of a backflow prevention assembly determined by a performance evaluation based on the failure to meet all minimums set forth by the approved testing procedure.

**Fire System Classifications Protection:** The classes of fire protection systems, as designated by the American Water Works Association "M14" for cross-connection control purposes based on water supply source and the arrangement of supplies, are as follows:

**Class 1:** Direct connection to the public water main only; non pumps, tanks, or reservoirs; no physical connection from other water supplies; no antifreeze or other additives of any kind; all sprinkler drains discharging to the atmosphere, dry well or other safe outlets.

**Class 2:** Same as Class 1, except booster pumps may be installed in connection from the street mains.

**Class 3:** Direct connection to public water supply mains in addition to any one or more of the following: elevated storage tanks; fire pumps taking suction from above ground covered reservoirs or tanks; and pressure tanks.

**Class 4:** Directly supplied from public water supply mains, similar to Class 1 and Class 2, with and auxiliary water supply dedicated to fire department use and available to premises, such as an auxiliary supply located within 1700 feet of the pumper connection.

**Class 5:** Directly supplied from public water supply mains and interconnection with auxiliary supplies such as pumps taking suction from reservoirs exposed to contamination, or from rivers, ponds, wells or industrial water systems; where antifreeze or other additives are used.

**Class 6:** Combined industrial and fire protection systems supplied from the public water mains only, with or without gravity storage or pump suction tanks.

**Hazard, Degree of:** A term derived from evaluation of the potential risk to public health and the adverse effect of the hazard upon the public water system.

**Hazard, Health:** A cross-connection or potential cross-connection involving any substance that could, if introduced in the public water supply, caused death, illness, and spread disease also known as a **High Hazard**.

**Hazard, Plumbing:** A cross-connection in a customer's potable water system plumbing that is not properly protected by an approved air gap or backflow prevention assembly.

**Hazard, Non-health:** A cross-connection or potential cross-connection involving any substance that would not be a health hazard but would constitute a nuisance or be aesthetically objectionable if introduced into the public water supply also known as **Low Hazard**.

**Indirect Cross-Connection:** An actual or potential cross-connection subject to backsiphonage only.

**Industrial Fluid:** Any fluid or solution that may be chemically, biologically, or otherwise contaminated or polluted in a form or concentration that could constitute a health, system, pollution, or plumbing hazard if introduced into the public water supply. This shall include, but is not limited to: polluted or contaminated water; all type of process water or used water originating from the public water system and that may have deteriorated in sanitary quality; chemicals; plating acids and alkalis; circulating cooling water connected to an open cooling tower; cooling towers that are chemically or biologically treated or stabilized with toxic substance; contaminated natural water systems; oil, gases, glycerin, paraffin, caustic, and acid solutions, and other liquids or gases used in industrial processes, or for fire purposes.

**Inspection:** An on-site evaluation of an establishment to determine if backflow prevention assemblies are needed by the customer to protect the public water system from actual or potential cross-connections.

**Interconnection:** Any system of piping or other arrangement whereby a public water supply is connected directly with a sewer, drain, conduit, or other device, which does, or may carry sewage or not.

**Passed:** The status of a backflow prevention assembly determined by a performance evaluation in which the assembly meets all minimums set forth by the approved testing procedure.

**Performance Evaluation:** An evaluation of an approved Double Check Valve Assembly or Reduced Pressure Principle Assembly (including approved Detector Assemblies) using the latest approved testing procedures in determining the status of the assembly.

**Pollutant:** A substance in the public water system that would constitute a non-health hazard and would be aesthetically objectionable if introduced into the public water supply.

**Pollution:** The presence of a pollutant or substance in the public water system that degrades its quality so as to constitute a non-health hazard.

**Potable Water:** Water that is safe for human consumption as prescribed by Tennessee Department of Environment and Conservation, Division of Water Supply.

**Public Water Supply:** An entity that furnishes potable water for general use and which is recognized as the public water supply by Tennessee Department of Environment and Conservation, Division of Water Supply.

**Pressure Vacuum Breaker Assembly:** An assembly consisting of one or two independently operating spring loaded check valve(s) and an independently operating spring loaded air inlet valve located on the discharge side of the check valve(s), with tightly closing shutoff valve(s) on each side of the check valves and properly located test cocks for testing valves. This assembly is approved for internal use only and is not approved for premise isolation by the State of Tennessee.

**Public Water System:** A water system furnishing water to the public for general use which is recognized as a public water supply by the State of Tennessee.

**Reduced Pressure Principle Assembly:** An assembly consisting of two independently acting approved check valves together with hydraulically operating, mechanically independent, pressure differential relief valve located between the check valves and below the first check valve. These units shall be located between two tightly closing resilient seated shutoff valves as an assembly and equipped with properly located resilient seated test cocks.

**Reduced Pressure Principle Detector Assembly:** A specially designed assembly composed of a line-size approved reduced pressure principle backflow prevention assembly with a bypass containing a water meter and approved reduced pressure principle backflow prevention assembly specifically designed for such application. The meter shall register accurately for very low flow rates of flows up to 3 gallons per minute and shall show registration for all flow rates. This assembly shall be used to protect against non-health and health hazards and used for internal protection.

**Service Connection:** The point of delivery to the customer's water system; the terminal end of a service connection from the public water system where the water department loses jurisdiction and control over the water. "Service Connection" shall include connections to fire hydrants and all other temporary or emergency water service connections made to the public water system.

**State:** The State of Tennessee, Tennessee Department of Environment and Conservation, Division of Water Supply.

**Survey:** An evaluation of a premise by a water system performed for the determination of actual or potential cross-connection hazards and the appropriate backflow prevention needed.

**Water System:** The water system operated, whether located inside or outside, the corporate limits thereof, shall be considered as made up of two (2) parts, the Utility System and the Customer System.

- A. The utility system shall consist of the facilities for the production, treatment, storage, and distribution of water, and shall include all those facilities of the water system under the complete control of the water department, up to the point where the customer's system begins (i.e. downstream of the water meter);
- B. The customer system shall include those parts of the facilities beyond the termination of the water department distribution system that are utilized in conveying water to the point of use.



## **Section 2. Compliance with TCA**

The Public Water System is to comply with Section 68-221-711 of the Tennessee Code Annotated, as well as the Rules of Public Water Systems, legally adopted in accordance with this policy/ordinance, which pertain to cross-connections, auxiliary intakes, bypasses, and interconnections, and establish an effective, ongoing program to control these undesirable water uses.

## **Section 3. Regulated**

No person shall cause a cross-connection, auxiliary intake, bypass, or interconnection to be made, or allow one to exist for any purpose whatsoever unless the construction and operation of same has been approved by the Tennessee Department of Environment and Conservation and the operation of such cross-connections, auxiliary intake, bypass, or interconnection is at all times under the direct supervision of the Cross-Connection Control Manager/Coordinator of the Public Water System.

### **Possible suggestions to add:**

- A. No water service connection to any premises shall be installed or maintained by Water System unless the water supply is protected as required by this policy/ordinance. Service of water to any premises shall be discontinued by the Water System if a backflow prevention assembly required by this policy is not properly installed, tested, and/or maintained; or if it is found that a backflow prevention assembly has been removed, bypassed, or if an unprotected cross-connection exists on the premises. Service shall not be restored until such conditions or defects are correct.
- B. Prior to execution any work order for a new customer, or for any change in service to an existing customer, notification shall be given to the office of the Cross-Connection Control. Inspectors from the Cross-Connection Control Office shall make immediate determination in writing to the customer of the type of backflow prevention assembly needed. Water service shall not be established or maintained until all necessary backflow prevention assemblies are installed.
- C. It shall be unlawful for any person to cause a cross-connection to made or allow one to exist for any purpose whatsoever unless the construction and operation of same have been approved by the Tennessee Department of Environment and Conservation, and the operation of such cross-connection is at all times under the direction of the manager of the Water System.
- D. If, in the judgment of the Cross-Connection Manager/Coordinator or designee, an approved backflow prevention assembly is required at the water service connection to a customer's premises, or at any point(s) within the premises, to protect the potable water supply, the manager shall compel the installation, testing, and maintenance of the required backflow prevention assembly(s) at the customer's expense.
- E. An approved backflow prevention assembly shall be installed on each water service line to a customer's premises at or near the property line or immediately inside the building being served; but in all cases before the first branch line leading off the service line.
- F. For new installations, the manager or his designee shall inspect the site and/or review plans in order to assess the degree of hazard and to determine the type of backflow prevention assembly, if any, that will be required, and to notify the owners in writing of the required assembly and installation criteria. All required assemblies shall be installed and operational prior to initiation of water service.
- G. For all existing premises, personnel from the Water System shall conduct inspections and evaluations, and shall require correction of violations in accordance with the provisions of this policy/ordinance.
- H. For existing installations, the Cross-Connection Manager/Coordinator may cause water service to be discontinued until such time as the customer complies with all requirements of state law and this policy/ordinance.

- I. For new commercial or industrial construction or renovation of a commercial or industrial property, the Cross-Connection Coordinator/Manager or inspector shall inspect the site and review plans in order to determine the type(s) of backflow prevention assembly and notify the owner(s) in writing the type of required assembly(s). Such assembly(s) shall be tested within \_\_\_\_\_ days upon connection to water system. ( **Time depends on hazard and risk**)
- J. The customer shall install approved assembly(s) at their expense. Failure, refusal, or inability on the part of the customer to install, and maintain such an assembly shall be cause for discontinuance of, or refusal of, water service to the premises until such requirements are satisfactorily met.
- K. No installation, alteration or change(s) shall be made to any backflow prevention assembly connected to the public water system without first securing permission from the Cross-Connection Manager/Coordinator.
- L. All backflow prevention assemblies will inspected after installation for compliance with all requirements of this policy. Failure to meet all installation and testing requirements shall be cause for discontinuance of, or refusal of, water service to the premises until such requirements are satisfactorily met.
- M. It shall be unlawful to install or allow any unprotected takeoffs from the water service line ahead of any meter or backflow prevention assembly located directly after the service connection to a customer's water system.

#### **Section 4. Statement Required**

That any person whose premises are supplied with water from public water system, and who also has on the same premises a separate source of water in an uncovered or unsanitary storage reservoir from which the water stored therein is circulated through a piping system, shall file with Public Water System a statement of the nonexistence of unapproved or unauthorized cross-connections, auxiliary intakes, bypasses, or interconnection. Such statement shall also contain an agreement that no cross-connection, auxiliary intake, bypass, or interconnection will be permitted upon the premises.

#### **Section 5. Applicability**

The requirements contained herein shall apply to all customers and premises the of Public Water System, and is hereby made a condition required to be met before water service is provided to any customer. This policy/ordinance shall be strictly enforced since it is essential for the protection of the public water supply against contamination and pollution.

#### **Section 6. Inspections/Surveys**

The Cross-Connection Manager/Coordinator shall inspect all properties served by the public water supply where cross-connections with the public water supply are deemed possible. The frequency of inspections and reinspections based on potential health hazards involved shall be established by the Cross-Connection Manager/Coordinator in accordance with guidelines acceptable to the Division of Water Supply.

#### **Other optional additions:**

##### **Right of Entry**

- A. The Cross-Connection Manager/Coordinator or designee shall have the right to enter at any reasonable time any property served by a connection to the Public Water System for the purpose of inspecting the piping system therein for cross-connections, auxiliary intakes, bypasses, or interconnections. On request, the owner, lessee, or occupant or any property so served shall furnish any pertinent information regarding the piping system on the property. The refusal of such information or refusal of access, when requested, shall be deemed as evidence of the presence of connections.
- B. When cross-connections, other structural or sanitary hazards, or any violation of this becomes known, the Cross-Connection Manager/Coordinator or designee may deny or discontinue service to the premises by providing for a physical break in the service line until the customer has corrected the conditions(s) in conformance with this policy/ordinance.

## Section 7. Backflow Prevention Determination

An approved backflow prevention assembly shall be installed on each service line to a customer's premises **(within \_\_\_\_ feet of the water meter)** and in all cases, before the first branch line leading off the service line, if it is impractical or easily altered to provide an effective air gap separation, when any of the following conditions exist **((Must include criteria list in policy/ordinance))**:

- A. All premises listed as High Risk High Hazard including industrial fluids, sewage, or any other non-potable substances are handled in such a manner as to create actual or potential health hazard to the water system.
- B. (All premises listed with actual or potential cross-connections listed in approved plan criteria list)
- C. Premises having auxiliary water supply, including but not limited to a well, cistern, spring, pond, river, or creek that is not, or may not be, of safe bacteriological or chemical quality and that is not acceptable as an additional source by the Cross-Connection Control Manager/Coordinator or designee.
- D. The plumbing from a private well or other water supply entering the building served by the public water supply, or is connected, directly or indirectly, to the public water supply.
- E. The owner or occupant of the premises cannot, or is not willing to demonstrate that the water use and protective features of the plumbing are such that frequent alterations are made to the plumbing.
- F. The nature and mode of operation within the premises is such that frequent alterations are made to the plumbing.
- G. The nature of the premises is such that the use of the structure may change to a use wherein backflow prevention is required.
- H. There is likelihood that protective measures may be subverted, altered, or disconnected.
- I. Any premises having service and fire flow connections, most commercial and educational buildings, construction sites, all industrial and medical facilities, lawn irrigation systems, public or private swimming pools, private fire hydrant connections used by any fire department in combating fires, photographic laboratories, standing ponds or other bodies of water, auxiliary water supplies, and wastewater treatment plants.
- J. Any premises having fountains, water softeners or other point of use treatment systems hot tubs or spas, or other type(s) of water using equipment.
- K. Premises otherwise determined by the Cross-Connection Control Manager/Coordinator or designee to create an actual or potential hazard to the public water system.
- L. In the case of any premises where there is any material dangerous to health that is handled in such a fashion as may create an actual or potential health hazard to public water system, the public water system shall be protected by an air gap separation (at the discretion of water provider to allow) or a reduced pressure principle backflow prevention assembly. The following premises, where such conditions may exist, include but are not limited to: sewage treatment plants, sewage pumping stations, chemical manufacturing plants, hospitals, mortuaries, funeral homes, and metal plating operations.
- M. In the case of any premises where, because of security requirements or other prohibitions or restriction it is impossible or impractical to make a complete cross-connection survey, the public water system shall be protected against backflow from the premises by either an air gap separation (at the discretion of the water provider) or reduced pressure principle assembly on each service line to the premises.

- N. A backflow prevention assembly shall be installed on each fire service line at the property line or immediately inside the building being served, but in all cases, before the first branch line leading off the service line wherever any of the following conditions exist:
1. Class 1,2, and 3 fire protection systems shall require at minimum a double check valve (detector) assembly; provided however, that a reduced pressure principle (detector) shall be required:
    - a. Underground fire sprinkler pipelines are parallel to and within (10') feet horizontally of pipelines carrying waste water or significantly toxic wastes; or
    - b. Premises having unusually complex piping systems;
    - c. The pumpers connecting to the system have corrosion inhibitors or other chemical added to the tanks of the fire trucks;
    - d. The piping system(s) has corrosion inhibitors or other chemical added to prevent freezing;
    - e. An auxiliary water supply exists with 1,700 feet of any likely pumper connection.
  2. Class 4, Class 5, Class 6 fire protection systems shall require an air gap, or a reduced pressure principle assembly (detector) as determined by the Cross –Connection Control Manager/Coordinator or designee.
  3. Where a fire sprinkler system is installed on the premises, a minimum of a double check valve assembly (detector) shall be required.
  4. Where a fire sprinkler system uses chemicals, such as liquid foam, to enhance fire suppression a reduced pressure principle detector assembly shall be required.
  5. The Cross-Connection Control Manager/Coordinator may require internal or additional backflow prevention devices where it is deemed necessary to protect potable water supplies within the premises.
- O. In the case of any premises with an auxiliary water supply as set out in Section 10. and not subject to any of the following rules, the public water system shall be protected by an air gap separation or a reduced pressure principle assembly.
- P. Double Check Valve Assemblies (and Detectors) may **only** be used for Class 1-3 fire protection systems (at the discretion of water provider to even allow)
- Q. In the case of any premises where there is any material dangerous to health that is handled in such a fashion as may create an actual or potential hazard to public water system, the public water system shall be protected by a reduced pressure principle backflow prevention assembly. The following premises, where such conditions may exist, include but are not limited to: sewage treatment plants, sewage pumping stations, chemical manufacturing plants, hospitals, mortuaries, funeral homes, and metal plating operations.
- R. In the case of any premises where there are uncontrolled cross-connections, either actual or potential, the public water system shall be protected by a reduced pressure principle assembly (detector) or air gap separation (at the discretion of water provider) assembly on each service line to the premises.
- S. In the case of any premises where, because of security requirements or other prohibitions or restriction it is impossible or impractical to make a complete cross-connection survey, the public water system shall be protected against backflow from the premises by either an air gap separation (at the discretion of the water provider) or reduced pressure principle assembly on each service line to the premises.
- T. In the case of any premises where toxic substances are present that could pose an undue health hazard, the Cross-Connection Control Manager/Coordinator or designee may require an air gap

separation or reduced pressure principle assembly at the service connection to protect the public water system. In making this determination, the Cross-Connection Control Manager/Coordinator or his designee shall consider the degree of hazard based on criteria list in approved plan **(Must include list in policy/ordinance)**.

## **Section 8. Approved Backflow Prevention Assemblies and Methods**

- A. All backflow prevention assemblies shall be fully approved and listed as acceptable by the State of Tennessee as to manufacture, model, size, application, orientation, and alterations. The assembly must have a status of Passed determined by performance evaluations to suffice as an approved backflow prevention assembly. The method of installation of backflow prevention devices shall comply with installation criteria set forth by this policy/ordinance and the State of Tennessee. Installation shall be at the sole expense of the owner of the owner or occupant of the premises.
- B. The type of protective assembly required by this Policy/Ordinance shall depend on the degree of hazard that exists. Reduced Pressure Principle Assemblies (Detector) may be used for health hazards and non-health hazards. Double Check Valve Assemblies (Detector) may **only** be used for non-health hazards and is limited to Class 1-3 fire systems only.
- C. Pressure vacuum breakers, spill-resistant vacuum breakers, and atmospheric vacuum breaker are not allowed for premise isolation and will not satisfy the requirements of this Policy/Ordinance for adequate backflow prevention due in part to the inability to protect against backpressure.

## **Section 9. Backflow Prevention Assembly Installation Requirements**

Minimum acceptable criteria for installation of backflow prevention assemblies shall include the following **(Include installation criteria listed in approved plan)**:

- A. All backflow prevention assemblies shall be installed at minimum in the approved orientation as indicated by the latest Approved List.
- B. All new assemblies installed must be on the Approved Assemblies List maintained by the Division of Water Supply and existing assemblies must have status of approved.
- C. Installation of assemblies shall be performed by person granted authority by the water provider. All backflow prevention assemblies installed fire protection systems must be performed by persons possessing a fire sprinkler contractor license. Evidence of current certifications/license must be on file with the Cross-Connection Control Manager/Coordinator before any installation or testing of the devices can be performed.
- D. All assemblies shall be installed in accordance with the manufacturer installation instructions and by the State of Tennessee installation guide, from the State Manual or policies on cross-connection control, unless such instructions are in conflict with this policy, in which case the policy/ordinance shall control, and shall possess all test cocks and fittings required for testing the assembly. All test cocks will be fitted with adapters and all fittings shall permit direct connection to test kits used by the department.
- E. The entire assembly including test cocks and valves shall be easily accessible for testing and repair and shall meet all confined space requirements of OSHA/TOSHA.
- F. Reduced Pressure Backflow Prevention Assemblies shall be located so that the relief valve discharge port is a minimum of twelve (12) inches, plus nominal diameter of the supply line, above the floor surface. The maximum height above the floor surface shall not exceed sixty (60) inches.
- G. Clearance of devices from wall surfaces or other obstructions shall be a minimum of six (6) inches; or if a person must enter the enclosure for repair or testing, the minimum distance shall be twenty-four inches.
- H. Devices shall be protected from freezing, vandalism, mechanical abuse, and from any corrosive, sticky, greasy, abrasive, or other damaging substance.

- I. Devices shall be positioned where discharge from a relief port will not create undesirable conditions. An approved air gap shall separate the relief port from any drainage system. Such air-gap shall not be altered without the specific approval of the department.
- J. Devices shall be located in an area free from submergence or flood potential and cannot be placed in a pit.
- K. All devices shall be adequately supported to prevent sagging.
- L. An approved strainer, fitted with a test cock, shall be installed immediately upstream of all backflow prevention assemblies or shut-off valve, except on fire lines, using only non-corrosive fittings (e.g. brass or bronze) in the device assembly.
- M. Gravity drainage is required on all installations. Below ground installations shall not be permitted for Reduced Pressure Principle Assemblies (detectors).
- N. Fire hydrants drains shall not be connected to the sanitary sewer, and fire hydrants shall not be installed in such manner that backsiphonage or backflow through the drain may occur.
- O. Where jockey (low volume-high pressure) pumps are utilized to maintain elevated pressure, as in fire protection system, the discharge of the pump shall be on the downstream side of any check valve or backflow prevention assembly. Where the supply for the jockey pump is taken from the upstream supply side of the check valve or backflow prevention assembly, a backflow prevention assembly of the same type(s) required on the main line shall be installed on the supply line.
- P. Fixed position, high volume fire pumps shall be equipped with suction limiting control to modulate the pump if the residual line pressure reaches 20 psi. If line pressure drops below 20 psi, the pump will shut off to protect the distribution system. This shut off system must be tested annually for proper operation and report of the test must be sent to the office of Cross-Connection Control.

## **Section 10. Existing Backflow Prevention Assemblies**

- A. All presently installed backflow prevention assemblies which were previously acceptable to the State of Tennessee that complies with installation, testing, and maintenance requirements of this policy/ordinance and in the sole discretion of the Cross-Connection Control Manager/Coordinator or designee adequately protect the public water system from backflow and that were approved assemblies for the purpose described herein at the time of installation may be retained in service.
- B. Location or space requirements shall not be cause for re-location or replacement of any backflow prevention assembly that is presently installed in a vertical run of pipe shall be replaced, reinstalled, in an approved manner in a horizontal run of pipe.
- C. Wherever an existing assembly is moved from the present location, or when the inspector finds that the conditions of the assembly constitutes a health hazard, the unit shall be replaced by the backflow prevention assembly meeting the requirements of this policy/ordinance.

## **Section 11. Assembly Performance Evaluations and Testing**

- A. All assemblies used to protect the public water system must be tested every 12 months. In those instances where the Cross-Connection Manager/Coordinator deems the hazard to be great enough (Criteria should be listed), performance evaluation may be required at more frequent intervals.
- B. Any assembly not tested with 12 month period will be deemed not approved and have a status of **Failed**. The customer will be sent notification of that the assembly is not in compliance with this ordinance or policy

- C. All assemblies must be deemed **Passed** for each initial and subsequent annual performance evaluations to satisfy as approved backflow prevention assembly.
- D. All assemblies will be tested by backflow prevention assembly tester possessing a **valid (see definition) Certificate of Competency in Testing and Evaluation Backflow Prevention Assemblies** issued by the State of Tennessee.
- E. All performance evaluation must be performed with an annually certified test kit.
- F. Certifications for test kits are valid for one year after certification is performed. If the test kit is not recertified after one year, it is deemed expired.
- G. Test kits must be certified annually and the backflow prevention assembly tester must show proof of certification from manufacturer-approved entities. No performance evaluations will be accepted from a backflow prevention assembly tester with an expired test kit certification.
- H. Proof of annual test kit certification and Certificate of Competency must be kept on file for each tester by water provider.
- I. Backflow Prevention Assembly Testers must test and evaluate according to the latest Division of Water Supply's latest approved procedures for Reduced Pressure Principle Assembly and the Double Check Valve Assembly.
- J. If any test does not meet the minimum requirements set forth in the approved testing procedure, the assembly is deemed **Failed** and does not suffice as an approved backflow prevention device. If conditions around the assembly do not allow the assembly to be tested, the assembly fails the assembly performance evaluation and is marked **Failed** on test report. (Examples would include assembly is submerged, test cocks missing or plugged, relief valve continually discharging).
- K. Backflow Prevention Assemblies are deemed **Passed** if all parts of the performance evaluation meet the minimum requirements in the approved testing procedure.
- L. Each location requiring an assembly will have a documented backflow prevention assembly, if the assembly at the address cannot be identified or is not the same, the water provider will be notified and a determination of which assembly is used for protection of the water system. (All areas that need protection will be listed by address and location along with the serial no. of device)
- M. Test reports must be completely and accurately documented and the appropriate evaluation (**Passed** or **Failed**) determined from testing procedure. Any test report that is not recorded completely in the sections pertinent to the results of the performance evaluation tests will not be accepted by the Public Water System.
- N. All performance evaluations on file will be recorded on an (State and Water System) approved test report.
- O. Assemblies must be tested when installed and after every repair. Backflow prevention assemblies on lawn irrigation systems must be tested when assemblies are placed in service after winterization (To prevent testing just prior to winterization). If lawn irrigation backflow assemblies are taken removed to winterize the system, upon startup of the system, the assemblies must be retested.
- P. Failure to maintain a backflow prevention assembly that is deemed **Passed** shall be grounds for discontinuance of water service. The removal, bypassing, or altering of a protective device or installation, without the approval of the Cross-Connection Control Manager/Coordinator or designee, thereof so as to render a device ineffective shall constitute grounds for discontinuance of water service. Water service to such premises shall not be restored until the customer has corrected or eliminated such conditions or defects to the satisfaction this ordinance/policy and the Cross-Connection Control Manager/Coordinator or designee.

- Q. The Water System shall require the occupant of the premises to keep the backflow prevention assembly working properly and a status of **Passed**. Repairs shall be made by qualified personnel acceptable to the Water System within the time limits set forth by this policy. Expense of such repairs shall be borne by the owner or occupant of the premises. The failure to maintain a backflow prevention assembly in proper working order and a status of Passed shall be grounds for discontinuance of water service.
- R. The backflow prevention assembly must be tested after every repair and have a status of **Passed** to be in compliance with this policy/ordinance.
- S. Cross-Connection Control Manager/Coordinator or designee shall have the right to inspect and test any assemblies whenever it is deemed necessary. Water service shall not be disrupted to the assembly without the knowledge of the occupant of the premises.

### **Recommendation and Suggestions**

- T. Provision should be made for fire sprinkler system testing; if third party testing is allowed, no problem, however if the utility or municipality should elect to test all assemblies, a allowance should be given for fire sprinkler contractors to test in accordance to Division of Fire Prevention regs. Those with fire sprinkler license will also be required to have a Valid Certificate of competency and all other requirements set forth by this policy/ordinance
- U. Any backflow prevention assembly tester found by the water system to be negligent in performing testing procedures or falsifying documentation in regards to a backflow prevention assembly will not be allowed continued approval to submit test reports. The water system may allow the backflow prevention assembly tester to perform testing at a later date, at the discretion of the Cross-Connection Control Manager/Coordinator or designee.
- V. Backflow prevention assembly testers must have approval from the \_\_\_\_\_ water system before any test reports are accepted. The \_\_\_\_\_ water system will issue a copy of the latest approved ordinance/policy from the \_\_\_\_\_ water system and require the signature of the tester acknowledging requirements and responsibilities before allowance of submittal of test reports.
- W. All performance evaluations, tests, and repairs shall be at the expense of the customer and shall be performed by backflow prevention assembly testers that satisfy all requirements of this ordinance/policy.
- X. Original records of evaluations and repairs shall be supplied to the Cross-Connection Control Manager/Coordinator or designee for retention.

## **Section 12. Corrections of Violations**

- A. Any customer having cross-connections, auxiliary intakes, bypasses, or interconnection(s) in violation of this ordinance/policy shall, after a thorough investigation of existing conditions and an appraisal of the time required, complete the work within the time designated by the Cross-Connection Control Manager/Coordinator or designee, but in no case shall the time for correction exceed ninety (90) days for High and Low Hazards or fourteen (14) days for High Risk High Hazards.
- B. Failure to comply with any order of the Cross-Connection Control Manager/Coordinator or designee within the time set out therein shall result in the termination of water service.
- C. Where cross-connections, auxiliary intakes, bypasses, or interconnections are found to constitute a high risk high hazard, the public water supply (criteria will be needed), the Cross-Connection Control Manager/Coordinator or designee shall require prompt corrective action (within 14 days) to be taken to eliminate the threat. Expeditious steps shall be taken to disconnect the public water system from the customer's piping systems unless the extreme hazard is corrected immediately.



- D. Failure to correct conditions threatening the safety of the public water system as prohibited by this ordinance or Tennessee Code Annotated 68-221-711 within the time limits set by the Cross-Connection Control Manager/Coordinator or designee or this ordinance/policy, shall be cause for denial or termination of water service. If proper protection is not provided after times set forth in this policy/ordinance, the Cross-Connection Control Manager/Coordinator or designee shall give the customer written notification that water service is to be discontinued, and thereafter physically separate the public water system from the customer's system in such a manner that the two systems cannot be connected by an unauthorized person.
- E. **(Direct language providing length of time for correction of violations for failed or nonexistent protection on extreme high hazard and high hazard and the letters sent- No more than 90 days.)**
- F. In the event that a backflow prevention assembly is deemed Failed (Initial or Annual Performance Evaluation), failure to install backflow prevention assemblies as requested by the Water System, or there are deficiencies in the installation from failure to conform to the installation criteria specified in this ordinance, or from deterioration, then the Cross-Connection Control Manager/Coordinator or designee shall issue a written notice of failure or deficiency (within \_\_\_\_\_ days). The time limit is dependent on risk of contamination and may not be greater than 90 days.

### **Section 13. Non-Potable Supplies**

- A. Any water outlet connected to auxiliary water sources, industrial fluid systems, or other piping containing non-potable liquids or gases, which could be used for potable or domestic purposes, shall be labeled in a conspicuous manner as:

#### **WATER UNSAFE FOR DRINKING**

- B. The minimum acceptable sign shall have black letters at least one inch (1") high on red background.
- C. Color coding of piping in accordance with Occupational Safety and Health Act guidelines may be required in locations where, in the judgment of the inspector, such color coding is necessary to identify and protect the potable water supply.

### **Section 14. Conflicting Provisions**

If any provision of this ordinance/policy is found to conflict with any provision of any other ordinance/policy, then the provision of this ordinance shall control. That should any part, or parts of this ordinance/policy be declared invalid for any reason, no other part, or parts, of this ordinance shall be affected thereby.

### **Section 15. Penalties**

**(Details of this section are at the discretion of the Water System)**

Any person responsible for a violation of this policy/ordinance may be subject to a civil penalty of not less than \_\_\_\_\_ nor more than \_\_\_\_\_. Each day a violation occurs shall constitute a separate offense. In addition to the foregoing fines and penalties, the Cross-Connection Control Manager/Coordinator or designee shall discontinue the public water service at any premises upon connection and service shall not be restored until such cross-connection, auxiliary intake, bypass, or interconnection has been discontinued.

Independent of and in addition to fines penalties imposed, the Cross-Connection Control Manager/Coordinator may discontinue the public water supply service to any premises upon which there is found to be a cross-connection, auxiliary intake, bypass, or interconnection; and service shall not be restored until such cross-connection, auxiliary intake, bypass, or interconnection has been eliminated.

### **Section 16. Effective Date**

This policy/ordinance shall take effect from and after its passage and publication as the law directs, the public welfare requiring it.

Approved this \_\_\_\_\_ day of \_\_\_\_\_, 2\_\_\_\_\_

### Section 17. Approval Signatures

State Approval: \_\_\_\_\_

Date: \_\_\_\_\_

Board Approval \_\_\_\_\_

Date: \_\_\_\_\_

Board Chairman  
Signed: \_\_\_\_\_

Date: \_\_\_\_\_

Executive Director  
Signed: \_\_\_\_\_

Date: \_\_\_\_\_

The following sections are highly recommended:

### Section 18. Responsibility for Water System

- A. Notwithstanding any provisions of a plumbing code adopted by units of local government having jurisdiction, the Cross-Connection Control Manager/Coordinator or designee shall be responsible for protecting the water system from contamination or pollution due to implementation and enforcement of this policy. Such authority shall extend beyond service connection to whatever extent is necessary to meet the requirements of this policy/ordinance.
- B. The authority to terminate water service for violation of any provision of this policy/ordinance shall rest solely with the Cross-Connection Control Coordinator/Manager, the assistant or designee shall have authority to take action to protect public health and safety.
- C. This section shall not be construed to prevent other officers or employees of the \_\_\_\_\_ Water System from terminating water service for failure to pay for water service, or for violation any other provision of \_\_\_\_\_ Water System policy/ordinance.

### Section 19. Inspection and Testing Fees

- A. Fees for initial or annual certification of a backflow prevention assembly may be published by the \_\_\_\_\_ of the \_\_\_\_\_ based on the recommendation of the Cross-Connection Control Manager/Coordinator to reflect the cost of processing such certification.
- B. In the event that a backflow prevention assembly is deemed Failed after the Initial and Annual Performance Evaluations, or there are deficiencies in the installation either from failure to conform to the installation criteria specified in this ordinance/policy, or from deterioration, then the Cross-Connection Control Manager/Coordinator or designee shall issue a written notice of failure or deficiency.

The Cross-Connection Control Manager/Coordinator may waiver any fees and/or cost that should be appropriately relieved.

## **Section 20. Thermal Expansion Control**

A device for the control of thermal expansion shall be installed on the customer's water system where the thermal expansion of the water in the system will cause the water pressure to exceed the pressure setting of the pressure relief valve of the water heater. The thermal expansion device shall control the water pressure to prevent the pressure relief valve of the water heater from discharging. (Perhaps mention closed systems on residential areas about discharging water heaters at minimum)

## **Section 21. Water Heater Temperature-Pressure Relief Valves**

All storage water heaters operation above atmospheric pressure shall be provided with an approved, self-closing (levered) pressure relief and temperature valve or combination thereof, except for nonstorage instantaneous heaters. Such valves shall be installed in the shell of the water heater tank or may be installed in hot water outlet, provided the thermo-bulb extends into the shell of the tank. Temperature relief valves shall be so located in the tank as to be actuated by water in the top 1/8 of the tank served.

For installations with separate storage tank, said valve shall be installed on the tank and there shall not be any type of valve installed between the water heater and the storage tank. There shall not be a check valve or shut off valve between a relief valve and the heater or tank which it serves. The relief valve shall not be used as a means of controlling thermal expansion.

## **Section 22. Safety Standards-Duplicate Equipment in Parallel Required**

Where the use of water is critical to the continuation of normal operations or protection of life, property, or equipment, duplicate units shall be provided to avoid the necessity of discontinuing water service to test or repair a backflow prevention assembly. Until such time as a parallel unit has been installed where the continuance of service is critical, the Cross-Connection Control Manager/Coordinator or designee shall notify the occupant of the premises, in writing, of plans to interrupt water service and arrange for a mutually acceptable time to test or repair the assembly.

# **Cross-Connection Control Program Audit Checklist For Sanitary Surveys**

## **Backflow Prevention Assemblies Testing:**

- All existing assemblies and air gaps must be tested or inspected within a 12 month period.
- All assemblies must have a status of Passed as determined from testing procedure. Air gaps must pass inspection.
- Assemblies that have a status of Failed or have not been tested within the 12 month period, will be given a strict compliance date (90 days maximum, 15 days maximum for High Risk High Hazard).
- Each tester must have a current and valid Certificate of Competency and test kit certification. See document entitled: *State Guidance for Certificate of Competency for Testing and Evaluating of Backflow Prevention Assemblies*.
- Copies of Certificate of Competency and test kit certifications must be on file for each tester.
- All test reports must be approved and properly recorded (all required sections completed).
- Testers must use DWS procedures for testing RP and DC. See document entitled: *State Guidance for Backflow Prevention Assembly Performance Evaluations*.

## **Enforcement:**

- All premises with assemblies not tested or have a status of Failed in which the compliance date has passed are disconnected from the distribution system.
- All premises that have been documented and notified that protection is needed and the compliance date has passed have been disconnected from the distribution system.
- All enforcement issues have been resolved for premises that are not in compliance with the policy or ordinance (installation requirements, repairs, etc).

## **Records:**

- Master List of all assemblies and air gaps used for premises isolation including location, assembly used, make, model, size, serial number etc.
- Test reports documenting assemblies have been tested annually and within the 12 month time period.

- Site inspection reports
- Copies of each tester's Certificate of Competency and test kit certification
- Annual public education documents and pamphlets
- Notifications to customers regarding compliance
- Approved Plan
- Approved Policy/Ordinance
- Residential Written Surveys

### **Public Education:**

- Water System must provide public education about cross-connections and backflow prevention at least once annually to all customers. This may include bill inserts, public service announcements, pamphlet distribution, and consumer confidence report articles.

### **Surveys/Site Inspections:**

Distribution system is broken down into two categories: **Residential** and **Non-Residential**

#### **Inspections:**

**Nonresidential Inspections:** Within a five year cycle all nonresidential establishments without backflow protection are inspected. The cycle is then repeated on the 6<sup>th</sup> year.

**Residential Surveys:** A goal of 20% of the residential customers is surveyed each year (for larger systems Statistical population will be proposed). The actual percentage will be agreed upon by the Division of Water Supply and Water System. The same customer may not be surveyed within a five year period. Inspections are performed on all establishments that meet criteria. The cycle is repeated on the 6<sup>th</sup> year.

### **Residential Surveys/Inspections:**

- Written surveys are sent to residential customers.
- Written surveys are reviewed and sites that meet criteria for possible cross-connections are inspected.
- Results from all Inspections are recorded on an approved field sheet with a determination of the need for backflow prevention assembly.
- New residential customers are given questionnaires at service request along with information about cross-connection and backflow prevention. Results of the questionnaires are reviewed and sites that meet criteria are inspected.

- Secondary meters: If secondary meters are issued, these are inspected. If this is not done presently, start with all new meters, list all existing secondary meters, and draft a schedule of inspection for existing (approved by DWS).
- Well systems: Premises without backflow prevention assemblies that also have well systems must be inspected for cross-connections and a well user agreement signed. If this is not performed presently, start with all new wells drilled within the distribution area in the last year, list all existing well systems within the distribution system, and draft schedule for inspection (approved by DWS).

### **Non-Residential Surveys/Inspections**

- All non-residential establishments are initially inspected or required to have an assembly. All non-residential establishments not requiring an assembly will be inspected at least annually. If this is not done presently, start with all new non-residential establishments, list all existing non-residential establishment, prioritize according to hazard, and draft schedule for inspection. These establishments are prioritized into High Risk Health Hazards, Health Hazards or Non-Health Hazard.
- Results from all Inspections are recorded on an approved field sheet with a determination of the need for backflow prevention assembly.

### **Sites Requiring Backflow Preventions Assemblies or Air Gaps:**

- Sites that are deemed High Risk Health Hazard and Health Hazard by the water system must be protected by an approved RP, RP detector assembly, or an air gap (premises isolation only).
- Sites that are deemed Low Hazards may be protected by DC, RP, DC detector, RP detector, or air gap (premise isolation only).
- Only Class 1-3 Commercial fire prevention systems (non-chemical fire lines) may allow DC and DC detector assemblies. See document entitled: *State Guidance on Residential and Commercial Fire Sprinkler Systems*.
- Lawn Irrigation systems supplied by the water system must have an approved RP or RP detector assembly at minimum. See document entitled: *State Guidance on Lawn Irrigation Systems*.
- Residential Fire Systems: Flow-Through and Combination systems do not require the use of assemblies. Closed Residential Fire Systems require a DC at minimum.

### **Backflow Prevention Assembly Installation and Repair:**

- All assemblies must be approved. See document entitled *State Guidance for Approved Backflow Prevention Assemblies*.
- Assemblies are installed in the approved orientation.
- Installation of assemblies should follow criteria set forth in State's Cross-Connection Control Manual and in plan.
- RP assemblies must never be placed in a pit, vault, or area subject to flooding.

- The RP's relief valve must have an approved air gap and can never be submerged or directly connected to a drainage system of any sort.
- The assembly must never be altered.
- After assembly is installed, it must pass the initial performance evaluation and be inspected for satisfaction of all installation criteria. The inspection is documented.
- Assemblies must be repaired according to manufacturer's procedures with approved parts.
- After repair, the assembly must be tested and have a status of Passed.