CROSS-CONNECTION CONTROL MANUAL

1.1 INTRODUCTION

As water purveyor, the Orange Water and Sewer Authority (OWASA) is responsible for providing safe drinking water to its customers. One way that this is accomplished is through a backflow prevention and cross-connection control program. An effective cross-connection control program requires coordination between OWASA, OWASA's customers, and plumbers. This manual has been designed to provide specifications for test procedures, test kits, backflow assemblies and their installation.

The ultimate goal is to provide protection for the water systems operated by the purveyor and to provide the highest quality of drinking water possible to the free flowing tap. The participation of each customer by properly installing and maintaining a backflow assembly is one more step in assuring that the public drinking water is safe and clean.

1.2 MATERIALS

1.2.1 Backflow Prevention Devices

1.2.1.1 Approved Backflow Prevention Assemblies

All backflow prevention assemblies shall meet the requirements of OWASA, have approvals from the University of Southern California Foundation for Cross-Connection Control and Hydraulic Research (USC FCCCHR) and the American Society of Sanitary Engineering (ASSE), conform to AWWA C510 (double-check valve assemblies) or AWWA C511 (reduced pressure assemblies), and adhere to ANSI and ASTM standards. All assemblies installed on fire lines shall have approval by Factory Mutual system (FM).

If a backflow assembly is not on the approved list, it may be submitted to OWASA for review and approval. OWASA shall have the right to remove any assembly from the approved list if it fails to operate in a satisfactory manner or no longer meets specifications.

All backflow assembly internal parts shall be replaceable in line.

All assemblies shall have four (4) resilient seated test cocks, having ¼ turn ball valves with slotted or lever type operators. These test cocks shall be located in the following order:

Test cock	Location
Test cock #1	Before the first shut-off valve.
Test cock #2	Between the first shut-off valve and the first check valve.
Test cock #3	Between the first check valve and the second check valve.
Test cock #4	Between the second check valve and the second shut-off valve.

All ¾" – 2" backflow assemblies shall have bronze or stainless steel bodies and bonnets and shall be equipped with full port shut-off valves, of line size, and have ¼ turn lever type bronze or stainless steel ball valves.

All 3" – 10" backflow assemblies shall have contained check valve modules. The bodies and bonnets shall be made of one of the following: fusion bonded epoxy-coated cast iron, ductile iron or steel; bronze bodies and bonnets; or stainless steel.

All assemblies shall be equipped with manufactured approved resilient seated gate or wedge valves with rising stems. The valves shall have a manual hand wheel for operation.

Only a backflow prevention device with USC FCCCHR approved gate valves located on the inlet and outlet side of a particular manufacture and model will be considered a complete approved assembly by OWASA.

1.2.1.2 Reduced Pressure Principle Assembly (RP)

A reduced pressure principle assembly shall be used for potential Cross-Connections between the potable water system and supplies that are hazardous to health. Reduced pressure principle assemblies shall be in accordance with ANSI/AWWA C511 and have USC & ASSE approvals.

1.2.1.3 Reduced Pressure Principle Detector Assembly (RPDA)

A reduced pressure principle detector assembly shall be used in vaults and inside buildings on unmetered fire protection systems that are used as fire protection systems only and contain **hazardous materials** or have a booster pump. The vault or building must have a positive drain. Reduced pressure principle detector assemblies shall be in accordance with ANSI/AWWA C511 and have USC, ASSE and FM approvals.

The bypass line with meter shall contain an appropriately sized reduced pressure principle backflow preventer. The reduced pressure principle detector assembly shall be furnished with a bypass meter that read in gallons.

1.2.1.4 Double Check Valve Assembly (DCVA)

A double check valve assembly shall be used for potential Cross-Connections between the potable water system and supplies that are objectionable but not hazardous to health. Double check valve assemblies shall be in accordance with ANSI/AWWA C510 and have USC & ASSE approvals.

1.2.1.5 Double Check Detector Assembly (DCDA)

A double check detector assembly shall be used on unmetered fire protection systems that are used for fire protection systems only and contain no objectionable material. Double check detector assemblies shall be used for Cross-Connections between the potable water system and supplies that are not

hazardous to health. Double check detector assemblies shall be in accordance with ANSI/AWWA C510 and have USC, ASSE and FM approvals.

The bypass line with meter shall contain an appropriately sized double check valve assembly. The double check detector assembly shall be furnished with a bypass meter that read in gallons.

1.2.2 Backflow Prevention Device Enclosures

Backflow prevention devices shall be installed in accordance with the manufactures standards and specifications. All installations of backflow prevention devices shall be in insulated structures designed specifically to prevent the backflow preventer from freezing. Double check valve assemblies and double check detector assemblies may be installed in an approved vault.

1.3 INSTALLATION SPECIFICATIONS

1.3.1 General

1.3.1.1 An approved backflow prevention assembly shall be installed on the service line of any facility that OWASA identifies as having potential for backflow. The type of backflow prevention assembly installed will be determined by OWASA and shall depend upon the degree of hazard as stated in OWASA's "Ordinance for the Control of Backflow and Cross-Connection". If the hazard cannot be determined, a reduce pressure principle assembly shall be installed.

1.3.1.2 Fire line services using pumps or toxic or hazardous additives shall have a reduced pressure principle detector assembly (RPDA) installed. Fire line services that contain no objectionable material and that do not use pumps shall have a double check detector assembly (DCDA) installed. All fire line backflow assemblies installed above ground shall have heat within the protective housing.

1.3.1.3 An irrigation system tapped off a public water main shall have a backflow prevention assembly located behind the water meter before any branch of the system. An irrigation system tapped off a residential or commercial domestic service line shall have a backflow prevention assembly on the irrigation line before any branch of the system.

1.3.1.4 The installation location of all backflow prevention assemblies shall be in an area that provides a safe working environment for testing and maintenance. This area shall be readily accessible, away from electrical hazards, and free from dirt.

1.3.1.5 Protective structures shall be used to prevent freezing or vandalism of backflow prevention assemblies installed outside above ground. The backflow prevention assembly shall be protected from freezing in accordance with the State Plumbing Code. The backflow prevention assembly must be readily accessible for maintenance and testing including removing the entire assembly. Adequate drainage shall be provided by hinged door or drain ports along the bottom of the walls of the protective structure. The minimum drain size shall be in accordance with section1.3.2. Insulation shall not be wrapped around the assembly.

1.3.1.6 The backflow prevention assemblies' installation shall be in accordance with the manufacturer's information, North Carolina State Building Code Vol. II, North Carolina Division of Environmental Health, and OWASA. Installation of backflow prevention assemblies shall be upstream of the first branch line leading off the service line. If OWASA determines that it is impossible or impractical for the backflow prevention assembly to be installed outside, it may be installed just inside the building. All backflow assemblies shall be installed in an upright horizontal direction unless the manufacturer approves the assembly for vertical installation. A licensed plumbing or utility contractor must install the backflow prevention assembly. A licensed fire sprinkler contractor must install fire line backflow prevention assemblies.

1.3.1.7 The backflow prevention assembly is the responsibility of the customer to install and maintain. If damage occurs to the assembly for any reason it is the customer's responsibility to repair or replace the backflow prevention assembly.

1.3.1.8 Once installation is completed, the customer shall have the backflow prevention assembly inspected by an OWASA approved certified tester. The test results shall be submitted to OWASA for the initial test and annual tests thereafter. All rubber parts in the device shall be replaced every five (5) years.

1.3.2 Reduced Pressure Principle Assemblies

Reduced pressure principle assemblies (RP) shall be installed above ground in an approved vented housing. Reduced pressure principle assemblies must be installed in an upright horizontal direction. The relief port shall have a minimum clearance of twelve inches (12") and a maximum clearance of thirty inches (30") to the concrete pad. The housing shall have adequate drainage provided by hinged doors or drain ports that meet the following requirements.

Drain Port Requirements

RP Size	Minimum Opening
¾" – 1"	15 sq. in.
2"	20 sq. in.
3"	30 sq. in.
4" – 6"	50 sq. in.
8" – 10"	100 sq. in.

If the assembly must be installed inside the building, the following clearance specifications must be met:

The minimum clearances for ¾" through 2" reduced pressure assemblies installed inside a building shall be four inches (4") between the wall and shut off valves, thirty inches (30") between the wall and the side of the assembly with test cocks, and six inches (6") between the wall and the side of the assembly without test cocks. A minimum four inch (4") floor drain shall be provided for the relief port.

The minimum clearances for 3" through 10" reduced pressure assemblies installed inside a building shall be eight inches (8") between the wall and shut off valves, thirty inches (30") between the wall and the side of the assembly with test

cocks, and twelve inches (12") between the wall and the side of the assembly without test cocks. The relief port shall a minimum clearance of twelve (12") and a maximum clearance of thirty inches (30"). The floor drain shall be sized in accordance with the manufacture's flow chart for the relief valve.

1.3.3 Double Check Valve Assemblies

Double check valve assemblies (DCVA) may be installed above ground in an approved housing or below ground in a drained vault. Double check valve assemblies must be installed in an upright horizontal direction. If the DCVA is installed below ground, it must be installed in an OWASA approved vault. The vault must have positive drainage by gravity to surface of ground or to a catch basin. If positive drainage cannot be accomplished, the DCVA shall be installed above ground in a protective enclosure. The underside of the double check valve assembly shall have a minimum clearance of twelve inches (12") and a maximum clearance of thirty inches (30") to the ground or floor.

If the DCVA is installed in a vault, it must be easily accessible for testing and maintenance. The length and width of the vault shall be such that the entire assembly may be removed. The following horizontal clearances shall be met:

The minimum clearances for ¾" through 1" double check assemblies installed in vaults shall be four inches (4") between the wall and shutoff valves, eight inches (8") between the wall and the side of the assembly with test cocks, and four inches (4") between the wall and the side of the assembly without test cocks. These devices shall be installed in a Brooks medium meter box inside diameter 20" X 12".

1½" through 2" double check assemblies shall be installed in a meter box manufactured by Stay-Rite Tank Co. or equal. The inside size of the box shall be 3' x 4' x 2.5' deep. The lid shall be a Hilliday #S1R3036 or equal.

All 3" through 10" double check valve assemblies shall be installed in vaults. Vaults shall be precast concrete with Bilco JD-2AL aluminum door cast in place and 4" positive drain. All vaults shall be manufactured by Stay-Rite Tank Co. or D & M Concrete. Minimum sizes shall be subject to tee clearances noted:

3" DCVA - 8.6' x 6' x 6.5' in height
4" DCVA - 10' x 6' x 6.5' in height
6" DCVA - 10' x 6' x 6.5' in height
8" DCVA - 10' x 6' x 6.5' in height

All double check assemblies are required to have a minimum twelve (12") inches to a maximum thirty (30") inches clearance from floor level to underside.

If the assembly must be installed inside of the building, the following clearance specifications must be met: Minimum twelve (12") to maximum thirty (30') inches clearance from floor level to underside body.

The minimum clearances for ¾" through 2" double check assemblies installed inside a building shall be four inches (4") between the wall and shut off valves,

thirty inches (30") between the wall and the side of the assembly with test cocks, and six inches (6") between the wall and side of the assembly without test cocks.

The minimum clearances for 3" through 10" double check assemblies installed inside a building shall be eight inches (8") between the wall and shutoff valves, thirty inches (30") between the wall and the side of the assembly with test cocks, and twelve inches (12") between the wall and side of the assembly without test cocks.

1.4 TESTING

1.4.1 Test Requirements

Upon completed installation of a backflow assembly, the customer is responsible for having a certified backflow technician, approved by OWASA, perform all tests and repairs. A duplicate copy of all completed tests and repairs must be sent to OWASA's Water Distribution Department within ten (10) business days after completion. The customer must maintain a file of these reports for no less than three (3) years.

If an assembly is in need of repair before the annual test period, the customer will be responsible for having the repair made immediately by an approved backflow technician. Any repaired assembly must be tested upon completion of any repairs. All repair parts must be of the assembly manufacture's approval.

1.4.2 Approved Certified Testers

1.4.2.1 Any person interested in testing backflow assemblies in OWASA's service area must be certified by an approved Backflow Prevention Testing and Cross-Connection Control school. The tester shall submit a copy of their current certificate to OWASA. The following schools have been approved by OWASA:

Fayetteville Public Works Commissions
P.O. Box 1089
Fayetteville, NC 28302
Mr. Tim Davis – Coordinator
(910) 223-4699

City of Raleigh
Dept. of Public Utilities
P.O. Box 590
Raleigh, NC 27602
Mr. Ben Yarborough – Coordinator
(919) 870-2889

City of Durham
Dept. of Water Resources
Division of Water Supply & Treatment
101 City Hall Plaza
Durham, NC 27701
Mr. Steve Bledsoe – Coordinator

(919) 560-4194

University of Southern California
Foundation for Cross-Connection Control and Hydraulic Research
School of Engineering
BHE-314 University Park MC-0231
Los Angles, CA 90089-0231
Mr. Paul H. Schwartz, P.E. – Coordinator
(213) 743-2032

1.4.2.2 All testers must have a thorough understanding of OWASA's Backflow and Cross-Connection Control Ordinance and adhere to test procedures for double-check valve assemblies and reduce pressure principle assemblies as listed in the University of Southern California Foundation for Cross-Connection and Hydraulic Research Manual of Cross-Connection Control.

1.4.2.3 A person wishing to be put on the list of approved testers for OWASA's service area must provide OWASA with a request letter with their full name, address, day-time phone number, the name of the school from which certification was obtained, and certificate number.

1.4.2.4 All tests must be completed using test kits approved by OWASA in accordance with 1.4.3.5.

1.4.2.5 Full consent from the customer must be granted to the tester before any test procedures take place. The tester must make sure the customer can provide safety for life and property during the entire testing or repair procedure. Until these safety precautions have been met no tests shall be completed.

1.4.2.6 The tester is required to report to OWASA and the customer any improperly installed assembly or any installation of non-approved manufacture’s parts. Falsification of any records by the tester will result in the immediate removal of the tester from the approved tester list and the tester will be subject to penalties set forth in OWASA's Backflow and Cross-Connection Ordinance.

1.4.3 Requirements for Test Kits:

All test kits used for testing backflow prevention assemblies shall meet the following requirements for approval by OWASA.

1.4.3.1 Each test kit must meet the requirements of the University of Southern California Foundation for Cross-Connection Control and Hydraulic Research standards for differential pressure gauges and duplex gauges.

1.4.3.2 OWASA will require a calibration certificate (less than one year old) for each kit. Each test kit shall be re-calibrated annually.

1.4.3.3 The tester must supply OWASA with the following information for each test kit to be registered:

Manufacturer of Kit
Type of Kit (Duplex/Differential)
Serial Number
Owner's Name, Address, and Phone
Date of Calibration

1.4.3.4 All registered test kits shall be maintained in accurate working order. All repairs to test kits shall be made immediately. Upon completion of any repair to a test kit, recalibration is required. The calibration certificate must be submitted to OWASA. Failure to notify OWASA of a malfunctioning test kit will cause the kit to be removed from OWASA's approved list.

1.4.3.5 Approved Backflow Assembly Testing Equipment

Manufacturer	Model
ITT Barton	100 BFT
Conbraco	40-100-TK
	40-200-TK
Febco	RP TK-1 (RP only)
Midwest	830 RP
	890 DC
Watts	TK-DP

1.4.4 Preparation for Backflow Prevention Assembly Field Test Procedures

1.4.4.1 Obtain permission from the owner or representative to shut down the water supply. Just prior to testing, the customer should be notified that the water service will be discontinued temporarily. Before beginning any test or repair on a fire protection system, the customer will be responsible to notify all parties that could be affected by shutting off the water service during testing or repair. (i.e. alarm company, insurance agents, and local fire officials).

1.4.4.2 Observe and record the physical conditions of the assembly and surrounding area. Observe the direction of flow. Is this the correct assembly for its application?

1.4.4.3 Record or verify the following information on each assembly:

Manufacturer
Model
Serial Number
Size of Assembly
Location of Assembly

1.4.4.4 Determine which test kit is required for assembly being tested:

- A reduced pressure principle assembly requires a differential gauge.
- A double check valve assembly requires a duplex gauge.

1.4.4.5 To remove any lodged or foreign material that might interfere with the test, flush the test cocks. First open test cock #4 to establish flow through assembly. Then open and close test cock #1, test cock #2 (open test cock #2 slowly), and test cock #3 one at a time. To finish, close test cock #4. When testing a RP assembly, be careful not to activate the relief valve during this process. Attach the appropriate fittings to the test cocks and follow the test steps outlined for the particular assembly.

1.4.5 Suggested Testing Procedures for Reduced Pressure Principle Assemblies

The purpose of this test is:

- To verify that a minimum of 5.0 psi is maintained across check valve #1.
- To check that the relief valve opening is at or above 2.0 psi.
- To verify that check valve #2 will hold tight against backpressure.
- To verify that a minimum of 1.0 psi is maintained across check valve #2.

Follow preparation steps in section 1.4.4. Operate test cock #2 very slowly.

1) Attach the high pressure hose to test cock #2. Attach the low pressure hose to test cock #3. The high control valve should be open on the test kit. It can remain open throughout all four tests. The low control valve and the bypass control valve should be closed.

2) Open the high and low bleed valves. Slowly open test cock #3 and test cock #2. This will bleed air from the test kit and assembly. It is important that the test cocks be opened in this order to prevent the relief valve from opening.

3) Close the high bleed valve. Close the low bleed valve (close low bleed valve last). Close shutoff valve #2. Observe differential pressure across check valve #1. This should be greater than 5.0 psi.

4) Open low control valve one quarter turn only. Record the opening point of the relief valve when water begins to drip from the assembly. This reading should be greater than 2.0 psi. Close the low control valve

5) Open the bypass control valve and bleed air from hose. Loosely attach bypass hose to test cock #4. Close the bypass control valve and tighten bypass line. Open test cock #4

6) Open low bleed valve. Close low bleed valve. Open bypass control valve, the differential should remain at or above 5.0 psi. Record status of check valve #2 (leaked or held tight). Close bypass control valve. Open low bleed valve to reestablish accurate pressure reading across check valve #1. Close low bleed valve

7) Record gauge reading. This is the differential pressure across check valve #1. Close test cock #2. Close test cock #3. Close test cock #4. Bleed test kit. Close bypass control valve on test kit. Remove hoses.

8) Attach high pressure hose to test cock #3. Attach low pressure hose to test cock #4. Open high and low bleed valves. Open test cock #4. Open test cock #3. Bleed test kit. Close high bleed valve. Close low bleed valve.

9) Record gauge reading. This is the differential pressure at check valve #2. This reading should be greater than 1.0 psi. Close test cock #4. Close test cock #3

10) Open shut off valve #2. Open all closed bleed valves. Open all closed control valves. Drain test kit. Remove hoses. Notify customer water service is back on.

1.4.6 Backflow Preventer Testing and Maintenance
Trouble Shooting Guide – Reduced Pressure Principle Assembly

Many problems can be corrected by cleaning the internal components. Carefully observe the condition of all components.

PROBLEM	MAY BE CAUSED BY
Relief valve discharges continuously	1. Faulty check valve #1 2. Faulty check valve #2 with backpressure condition 3. Faulty relief valve
Relief valve discharges intermittently	1. Properly working assembly with back siphonage condition 2. Check valve #1 "buffer" is too small (i.e. less than 3.0 psi), with line pressure fluctuation 3. Water hammer
Relief valve discharges after shutoff valve #2 is closed (Step #3)	1. Normally indicates faulty check valve #1 a. Dirty or damaged disc b. Dirty or damaged seat
Relief valve would not open, differential on the gauge would not drop (Step #4)	1. Leaky shutoff valve #2 with flow through the assembly
Relief valve would not open, differential drops to zero (Step #4)	1. Relief valve stuck closed due to corrosion or scale 2. Relief valve sensing line plugged
Relief valve opens too high (With sufficiently high check valve #1 reading observed) (Step #4)	1. Faulty relief valve a. Dirty or damaged disc b. Dirty or damaged seat
Check Valve #1 is reading too low (less than 3.0 psi "buffer") (Step #7)	1. Dirty or damaged disc 2. Dirty or damaged seat 3. Guide members hanging up 4. Weak or broken spring
Leaky check valve #2	1. Dirty or damaged disc 2. Dirty or damaged seat 3. Guide members hanging up 4. Weak or broken spring

Repair Note: Lubricants shall only be used to assist with the reassembly of components, and shall not be toxic. Use only food-grade lubricants.

1.4.7 Suggested Testing Procedures for Double Check Valve Assemblies

The purpose of this test is:

To verify that check valve #1 and check valve #2 will hold tight against backpressure. The confirmation test will verify whether the check valves will hold tight against backpressure and will determine if either shutoff valve leaks.

Instructions for testing check valve #2 are in parenthesis ().

1) Follow preparation steps in section 1.4.4. Attach the high pressure hose to test cock #2(#3) and the low pressure hose to test cock #3(#4).

2) Open the high bleed and low bleed control valves, then close the valves. Close shutoff valve #2. Close shutoff valve #1.

3) Open the high bleed valve and reduce the pressure on the supply side to 2 psi less than the pressure on the customer side.

4) Observe whether the 2 psi split between the needles is maintained and record. If needles hold 2 psi split check valve #1(#2) is holding tight. Close all test cocks. Open shutoff valve #1. Repeat steps for check valve #2. Open shutoff valve #1 and shutoff valve #2. Remove hoses.

5) If split isn't maintained or if there is any question on the results of this test, do confirmation test.

Confirmation Test

1) Open shutoff valve #1. Open low control valve to remove air from bypass hose. Connect bypass hose to the test cock #1 and close low control valve. Open test cock #1.

2) Close shutoff valve #1. Loosen the hose connection at test cock #3 (#4) to lower pressure in assembly at least 10 psi. Open both high and low control valves simultaneously and reduce supply side by 2.5 psi and increase customer side by 2.5 psi.

3) Observe whether the 5.0 psi split is maintained, and record results. If split can be maintained with control valves closed, check holds tight. If the split can not be maintained see the trouble shooting guide (Section 1.4.8).

4) Close all test cocks. Open shutoff valve #1 and shutoff valve #2. Remove hoses. Notify customer water service is back on.

1.4.8 Backflow Preventer Testing and Maintenance
Trouble Shooting Guide – Double Check Valve Assemblies

Many problems can be corrected by cleaning the internal components. Carefully observe the condition of all components.

PROBLEM	MAY BE CAUSED BY
During conformation test needles on test kit both increase in pressure	Shut-off valve #1 leaks
During conformation test needles both fall to zero	Shut-off valve #2 leaks (no backpressure exists)
During conformation test needles converge	Check valve leaks
Leaky check valve	1. Dirty or damaged disc 2. Dirty or damaged seat 3. Guide members hanging up 4. Weak or broken spring

Repair Note: Lubricants shall only be used to assist with the reassembly of components, and shall not be toxic. Use only food-grade lubricants.