



Backflow & Cross Connection Prevention Manual

All references shall be in accordance with the most current specification by the following institutes, associations, and societies:

OSHA	Occupational Safety and Health Administration
NC-AWWA	North Carolina American Water Works Association
ABPA	American Backflow Prevention Association (Carolina Chapter)
ANSI	American National Standards Institute
ASTM	American Society for Testing Materials

This manual shall supersede all previous versions effective June 8, 2009. An installation in conflict with the standards presented in this manual shall be subject to inspection failure and/or discontinuation of service. Deviations from the standards presented in this manual due to design constraint or physical restriction must receive prior approval from the Town of Harrisburg Backflow Administrator.

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1.0 INTRODUCTION

Backflow assemblies are required to protect the public water systems operated by the purveyor and to provide the highest quality of drinking water possible to the free flowing tap, in accordance with NCAC Title15A Subchapter 18C and Chapter 62 of the Town of Harrisburg Code of Ordinances. The Town of Harrisburg shall be responsible for the maintenance and operation of the public water distribution system, the water service laterals and water service meters, in accordance with the Safe Drinking Water Act.

The customer(s) shall be responsible for the maintenance and operation of the private potable water service plumbing and backflow devices beyond the Town of Harrisburg water service meter to the free flowing tap. The participation of each customer is required to ensure the backflow device is properly installed, tested, and maintained.

This technical manual provides information regarding the approved backflow assemblies, enclosures and test kits; and technical specifications regarding the backflow location and installation methods, and backflow testing procedures and requirements; and the required technical details.

1.1 Degree of hazards.

- A.) The following table lists the types of facilities or services that have been identified by Harrisburg’s Public Works Department as having a potential for backflow of non-potable water into the public water supply system. Therefore, an approved backflow prevention assembly will be required on all such services according to the degree of hazard present. Other types of facilities or services not listed in this subsection may also be required to install approved backflow prevention assemblies if determined necessary by the Town's Backflow Administrator. As a minimum requirement, all commercial services will be required to install a double check valve assembly unless otherwise listed as follows: All assemblies and installations shall be subject to inspection and approval by Harrisburg’s Public Works Department.

Degree of Hazard Table

DCVA = Double check valve assembly	RP = Reduced pressure assembly
DCDA = Double check detector assembly	RPDA = Reduced pressure detector assembly
AG = Air gap	PVB = Pressure vacuum breaker
Aircraft and missile plants: RP	
Automotive service stations, dealerships, etc.:	
No health hazard: DCVA	
Health hazard: RP	
Automotive plants: RP	
Auxiliary water systems:	
Approved public/private water supply: DCVA	
Unapproved public/private water supply: AG	
Used water and industrial fluids: RP	
Bakeries:	

DCVA = Double check valve assembly

RP = Reduced pressure assembly

DCDA = Double check detector assembly

RPDA = Reduced pressure detector assembly

AG = Air gap

PVB = Pressure vacuum breaker

No health hazard: DCVA

Health hazard: Hazard

Beauty shops/barber shops:

No health hazard: DCVA

Health hazard: RB

Beverage bottling plants: RP

Breweries: RP

Buildings--Hotels, apartment houses, public and private buildings, or other structures having unprotected cross connections:

(Under five stories) No health hazard: DCVA

(Under five stories) Health hazard: RP

(Over five stories) All: RP

Canneries, packing houses, and rendering plants: RP

Chemical plants--Manufacturing, processing, compounding or treatment: RP

Chemically contaminated water system: RP

Commercial car-wash facilities: RP

Commercial greenhouses: RP

Concrete/asphalt plants: RP

Dairies and cold storage plants: RP

Dye works: RP

Film laboratories: RP

Fire systems:

No health hazard: DCDA

Health hazard (booster pumps, foams, antifreeze solution, etc.): RPDA

Hospitals, medical buildings, sanitarium, morgues, mortuaries, autopsy facilities, nursing and convalescent homes, medical clinics, and veterinary hospitals: RP

Individual commercial sales establishments (department stores):

No health hazards: DCVA

Health hazard: RP

Industrial facilities:

No health hazard: DCVA

Health hazard: RP

Laundries:

DCVA = Double check valve assembly

RP = Reduced pressure assembly

DCDA = Double check detector assembly

RPDA = Reduced pressure detector assembly

AG = Air gap

PVB = Pressure vacuum breaker

No health hazard: DCVA

Health hazard (i.e., dry cleaners): RP

Lawn irrigation systems: RP

Malls or strip malls (frequent tenant change and photo labs, etc.): RP

Metal manufacturing, cleaning processing, and fabricating plants: RP

Mobile home parks:

No health hazard: DCVA

Health hazard: RP

Oil and gas production, storage or transmission properties: RP

Paper and paper products plants: RP

Pest control (exterminating and fumigating): RP

Plating plants: RP

Power plants: RP

Public swimming pools: RP

Radioactive materials or substances--Plants or facilities handling: RP

Restaurants:

No health hazard: DCVA

Health hazard: RP

Restricted, classified, or other closed facilities: RP

Rubber plants (natural or synthetic): RP

Sand and gravel plants: RP

Schools, and colleges: RP

Sewage and storm drain facilities: RP

Waterfront facilities and industries: RP

B.) **Low hazard.** All single-family residential homes will be considered a low hazard and shall have a minimum of a dual check valve device installed at the meter service. Dual check valves shall not be in-line tested.

C.) If no other backflow prevention assembly is specified a double check valve assembly must be installed on all private water systems.

2.0 INSTALLATION

1.2 GENERAL

- D.) Before installation of any backflow prevention assembly, all proper authorities must be contacted to obtain specifications on the type of assembly to install, size, location and rights of way. The local authorities are the Town of Harrisburg Backflow Administrator, Fire Marshall, Engineering Department, and the County Plumbing Inspector, Fire Marshall and/or N.C. Department of Transportation, as applicable.
- E.) The installation or replacement of a backflow prevention assembly for domestic or irrigation water use shall only be performed by a licensed plumber or utility contractor. All backflow prevention assemblies shall be tested by a certified backflow technician authorized by the Town. The installation of a backflow prevention assembly on a dedicated fire sprinkler service shall be performed by a licensed fire sprinkler contractor or utility contractor. Repairs to a backflow prevention assembly on a dedicated fire sprinkler system may only be performed by a fire sprinkler contractor.
- F.) Backflow assemblies must be located outside of the building(s). The backflow prevention assembly shall be installed immediately after the water service meter, outside of the public utility easement and/or public road rights-of-way, in accordance with the approved plans, specifications and details, unless authorized by the Backflow Administrator.
- G.) All irrigation services tapped off the public water main shall have an above ground reduced pressure backflow prevention assembly located behind the irrigation meter. Any irrigation line tapped off the domestic line shall have an above ground reduced pressure backflow prevention assembly on the irrigation line before any branch of the system.
- H.) Fire-line services utilizing pumps, fire department connects, (FDC) or of a high hazard shall have a Reduce Pressure Principal Detector Assembly installed. All other will require a Double Detector Check Valve Assembly. **All above ground fire-line backflow assemblies shall be concrete pad mounted with a heated protective enclosure to prevent freezing.**

2.2 REDUCED PRESSURE BACKFLOW ASSEMBLIES (RP)

A.) ABOVE GROUND:

- 1.) Reduced Pressure Backflow Assemblies (RP) shall be installed above ground in an approved enclosure. The enclosure shall be mounted on an appropriately sized concrete pad. The relief port shall have a minimum clearance of twelve (12) inches or a maximum of thirty (30) inches to the concrete pad. Outside installation will be required to have an ASSE1060 approved enclosure to prevent the assembly from vandalism and freezing. The protective structure must provide easy access to the assembly for testing or removal. The structure must have adequate drainage provided by hinged door or drain ports. ***Reference the Drain Port Requirements Table for the appropriate port drainage sizes. (Important: Wrapping the assembly with insulation is prohibited).***
- 2.) If the structure is non-removable and must be entered in order to test or repair the assembly, the same minimum and maximum clearances that are specified for inside installation shall apply. If the backflow assembly is located in area subject to vehicular traffic, then barriers such as bollards or

other approved structures shall be provided around the above ground assembly. ***Reference the standard ABOVE GROUND backflow assembly figures for further information.***

B.) **INDOOR:** Authorized by the Backflow Administrator on a case by case basis.

- 1.) If the assembly must be installed inside of the building a floor drain must be provided and sized in accordance with the ***Drain Port Requirements Table*** or the recommended manufactures specifications. The drainage pipe shall be provided with a vermin screen installed. ***Reference the standard INDOOR backflow assembly figures for further information***

2.3 **DOUBLE CHECK VALVE BACKFLOW ASSEMBLIES (DCVA)** Double Check Valve Assemblies may be installed in an ASSE1060 approved enclosure above ground or below ground in a vault.

A.) **BELOW GROUND:**

- 1.) ***3/4-inch and 1-inch Double Check Valve backflow assemblies:*** 3/4-inch and 1-inch Double Check Valve backflow assemblies shall be housed in a backflow box with the minimum inside dimensions of 12-inches Width, 21-inches Length, and 12-inches Depth. The backflow assembly must have at minimum 12-inches of vertical clearance between the washed stone and the bottom of the backflow assembly and 4-inches of vertical clearance between the top of the backflow assembly and the backflow box lid. A minimum of four (4) inches of no. 57 wash stone must be placed in the bottom of the backflow box. If the backflow assembly is located in area subject to vehicular traffic or in a pedestrian sidewalk, then the backflow box will need to be H-20 traffic rated and set flush to final grade. ***Reference the standard 3/4-INCH & 1-INCH BELOW GROUND DOUBLE CHECK VALVE backflow assembly figures for further information***
- 2.) ***2-inch thru 10-inch Double Check Valve backflow assemblies:*** 2-inch thru 10-inch Double Check Valve backflow assemblies shall be installed in a watertight H-20 traffic rated vault. Such vault shall have positive drainage by gravity to the surface of ground or a catch basin connected to a storm drainage system. The drainage pipe shall be provided with a vermin screen installed. All Double Check Valve Assemblies are required to have a minimum twelve (12) inches to a maximum (30) inches clearance from floor level to underside of body. ***Reference the standard 2-INCH TO 10-INCH BELOW GROUND DOUBLE CHECK VALVE backflow assembly figures for further information***

B.) **ABOVE GROUND:** If drainage cannot be provided the assembly unit must be installed above ground. Above ground installation will be required to have an ASSE1060 approved enclosure to prevent the assembly from vandalism and freezing. The enclosure shall be mounted on an appropriately sized concrete pad. If the backflow assembly is located in area near vehicular traffic, then barriers such as bollards or other approved structures shall be provided around the above ground assembly.

- 1.) ***3/4-inch and 1-inch Double Check Valve backflow assemblies:*** 3/4-inch and 1-inch Double Check Valve backflow assemblies shall be installed in an ASSE1060 approved enclosure above ground with the minimum inside dimensions of 12-inches Width, 21-inches Length,

and 22-inches Depth. The backflow assembly must have at minimum 12-inches of vertical clearance between concrete pad and the bottom of the backflow assembly and 4-inches of vertical clearance between the top of the backflow assembly and the backflow enclosure top. The backflow assembly shall not be located in area subject to vehicular traffic or in a pedestrian sidewalk. *Reference the standard 3/4-INCH & 1-INCH ABOVE GROUND DOUBLE CHECK VALVE (DCVA) backflow assembly figures for further information (DCVA)”*

2.) **2-inch thru 10-inch Double Check Valve backflow assemblies:** 2-inch thru 10-inch Double Check Valve backflow assemblies shall be installed in an ASSE1060 approved above ground enclosure. The above ground enclosure shall be suitable in size to encompass the entire backflow assembly. 12-inches to 30-inches of vertical clearance shall be maintained between concrete pad and the bottom of the backflow assembly. The backflow assembly shall not be located in area subject to vehicular traffic or in a pedestrian sidewalk. *Reference the standard 2-INCH TO 10-INCH ABOVE GROUND DOUBLE CHECK VALVE (DCVA) backflow assembly figures for further information*

C.) **INDOOR:** If the assembly must be installed inside of the building a floor drain must be provided and sized in accordance with the Drain Port Requirements Table or the recommended manufactures specifications. The drainage pipe shall be provided with a vermin screen installed. Reference the standard INDOOR backflow assembly figures for further information.

DRAIN PORT TABLE

Drain Port Requirements Table

RP Size	Rectangular Opening (in.)	Circular Opening (dia.)
3/4" - 1"	2 1/2 h X 5 w	(1) - 4"
2"	3 h X 6 1/2 w	(2) - 4"
3"	4 h X 7 w	(3) - 4"
4" - 6"	5 h X 10 w	(4) - 4"
8" - 10"	5 h X 20 w	n/a

3.0 BACKFLOW ASSEMBLIES MATERIAL SPECIFICATIONS

- A.) All backflow prevention assemblies must meet the requirements of the Town of Harrisburg and have National approvals from the University of Southern California Foundation for Cross-Connection Control and Hydraulic Research (USCFCCHR), The American Society of Sanitary Engineering (ASSE) and must conform to AWWA C506, and adhere to ANSI and ASTM standards. All assemblies installed on fire lines shall have approval by Factory Mutual Systems (FM).
- B.) All approved backflow assemblies must have the following manufacture information indicated on the backflow assembly:
- a) **Type**
 - b) **Manufacture Name**
 - c) **Size**
 - d) **Model**
 - e) **Serial Number**
- C.) All internal parts must be replaceable in line.
- D.) All assemblies must have four (4) resilient seated test cocks, having 1/4 turn ball valves with slotted or lever type operators. These test cocks shall be located in the following order:
- 1.) 1st test cock: Before the first shut-off valve.
 - 2.) 2nd test cock: Between the first shut-off valve and the 1st check valve.
 - 3.) 3rd test cock: Between the first and second check valve.
 - 4.) 4th test cock: Between the second check valve and the second shut-off valve.
- E.) All 3/4" - 2" backflow assemblies must have bronze or stainless steel bodies and bonnets and must be equipped with full port shut-off valves, of line size, having 1/4 turn lever type bronze or steel ball valves.
- F.) All 3" - 10" backflow assemblies shall have contained check valve modules. The bodies and bonnets must be made of one of the following: fusion bonded epoxy-coated cast iron, ductile iron or steel, or made of bronze or stainless steel. All 3" - 10" backflow assemblies must be equipped with manufactured approved resilient seated gate, wedge or ball valves with non-rising stems. The valves should have a manual hand wheel for operation.
- G.) Only a backflow prevention device with USCFCCHR approved gate valves located on the inlet and outlet side of a particular manufacture and model will be considered a complete approved assembly by the Town of Harrisburg. Residential Dual Check Valves will be exempt from these requirements.
- H.) If a backflow assembly is not on the approved list it may be submitted for review and approval by the Backflow Administrator. The Town of Harrisburg 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.

I.) **Approved Backflow Manufactures:** Backflow assemblies shall be manufactured by Ames Fire & Waterworks, CONBRACO, FEBCO, Flomatic Corporation, Watts Backflow Prevention Products, Wilkins Water Control Products, or an approved equal.

Ames Fire & Waterworks
1427 N. Market Blvd, Suite 9
Sacramento, CA 95834
Phone: 916.928.0123
Fax: 916.928.9333
www.ames-co.com

CONBRACO
P.O. Box 247
Matthews, NC 28106
Phone: 704.841.6000
Fax: 704.841.6021
conbraco@conbraco.com

FEBCO Headquarters
4381 N. Brawley Ave., Ste. 102
Fresno, CA 93722-3919
Phone: (800) 767-1234
Fax: (559) 441-5301
www.febcoonline.com

Flomatic Corporation
15 Pruyin's Island Drive
Glens Falls, NY 12801
Phone: 1-800-833-2040
Fax: 1-800-314-3155
www.flomatic.com

Watts Backflow Prevention Products
815 Chestnut Street
North Andover, MA 01845
Phone: 978-688-1811
Fax: 978-794-1848
www.watts.com

Wilkins Water Control Products
1747 Commerce Way
Paso Robles, CA 93446-3696
Phone: (805) 238-7100
Fax: (805) 238-5766
www.zurn.com

J.) **Approved Enclosure Manufactures:** Backflow enclosures assemblies shall be manufactured by Hot Box, Safe-T-Cover, G & C Enclosures, or an approved equal.

Hot Box
924 Lane Avenue North
Jacksonville, FL 32254
Phone: 800-736-0238
Fax: (904) 783-6965
www.hot-box.com

Safe-T-Cover
2710 Landers Avenue
Nashville, TN 37210
Toll Free: 1-800-245-6333
Email: Information
www.safe-t-cover.com

G & C Enclosures
60 Athens Drive
MT. Juliet TN. 37122
Phone: (888) 753-6565
Fax: (615) 754-6072
www.gcenclosures.com

3.0 TEST REQUIREMENTS

Upon complete installation of all backflow assemblies, the customer is responsible for having a certified backflow technician, approved by the Town of Harrisburg, to make all tests and repairs. A completed duplicate copy of all tests and repairs must be sent to the Backflow Administrator within thirty (30) days of completion. The customer must maintain a file of these reports for no less than five (5) years.

Before beginning any tests or repairs on a fire protection system the customer will be responsible to notify all parties that could be effected by the shutting off of the water service during any procedures (i.e. alarm company, insurance agents, local fire officials).

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

2.2 APPROVED CERTIFIED TESTERS Any person interested in testing backflow assemblies in the Town of Harrisburg must have a certification from an approved school providing certification in Backflow Prevention Testing and Cross-Connection Control. The following schools have been approved by the Town of Harrisburg:

Fayetteville Public
Works Commission
P. O. Box 1089
Fayetteville, NC 28302
Phone: (910) 678-7439

City of Raleigh
Department of Public Utilities
P. O. Box 590
Raleigh, NC 27602
Phone: (919) 870-2897

University of Southern California
Foundation for Cross-Connection Control and
Hydraulic Research School of Engineering
BHE 314 University Park MC-0231
Los Angeles, California 90089-0231
Phone: (213) 743-2032

INFOTEC, LLC.
Post Office Box 1716
3744 Hwy 15/501
Carthage, NC 28327
Phone: 910-947-1115
Fax: 910-947-2496

Charlotte - Mecklenburg Utility Department
System Protection Division -Backflow
Prevention
5100 Brookshire Boulevard
Charlotte, North Carolina 28216
Phone: (704) 399-2426

University of Florida
Center for Training Research and Education for
Environmental Occupations (TREEO)
3900 SW 63rd Boulevard
Gainesville, Florida 32608
Phone: (904) 392-9570
fax: (352) 392-6910

- A.) All testers must also have a thorough understanding of the Town of Harrisburg Backflow Prevention Ordinance and adhere to test procedures for Double Check Valves and Reduce Pressure Principle Assemblies as listed in the current procedures from the University of Southern California Foundation for Cross-Connection and Hydraulic Research Manual of Cross-Connection Control.
- B.) A person wishing to be put on a list of approved testers for the Town of Harrisburg must provide the Town with a request letter with their full name, address, phone number (between 8 am and 5 p.m.), the name of the school from which certification was obtained and certificate number.
- C.) All tests must be done using test kits approved by the Town of Harrisburg.
- D.) 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.

- E.) A tester will be required to report any improperly installed assembly or installed non-approved manufacture's parts. Falsification of any records by the tester will result in the immediate removal from the approved tester list and be subject to penalties set forth in the ordinance.

1.3 REQUIREMENTS FOR TEST KITS All test kits used for testing backflow prevention assemblies shall meet the following requirements for approval by the Town of Harrisburg:

- A.) Must meet the requirements of the University of Southern California Foundation for Cross-Connection and Hydraulic Research standards for differential pressure gauges.
- B.) The Town of Harrisburg will require a calibration certificate (less than one year old) for each kit and re-calibration annually.
- C.) The test person must supply the Town of Harrisburg with the following information for each kit to be registered:

Backflow Test Kits:

- a) Type (Duplex/Differential)
- b) Manufacture
- c) Model
- d) Serial Number
- e) Calibration Date

Test Kit Owner Information:

- a) Company Name:
- b) Representative Name:
- c) Street Address:
- d) City, State, Zip
- e) Telephone No:

- D.) **Approved Backflow Test Kit Manufactures:** Backflow Test Kit shall be manufactured by CONBRACO, FEBCO, Midwest, Watts, or an approved equal.

CONBRACO
P.O. Box 247
Matthews, NC 28106
Phone: 704.841.6000
Fax: 704.841.6021
conbraco@conbraco.com

FEBCO Headquarters
4381 N. Brawley Ave., Ste. 102
Fresno, CA 93722-3919
Phone: (800) 767-1234
Fax: (559) 441-5301
www.febcoonline.com

Mid-West
6500 Dobry Dr.
Sterling Heights, MI 48314
Phone: 1-800-648-5778
Fax: 586-254-6509
www.midwestinstrument.com

Watts Backflow Prevention Products
815 Chestnut Street
North Andover, MA 01845
Phone: 978-688-1811
Fax: 978-794-1848
www.watts.com

REDUCED PRESSURE PRINCIPAL ASSEMBLY TEST PROCEDURES

PREP	Notify customer Inspect area Flush test cocks (open 4, 3, open then close 1, 2, close 3, 4) Install fittings Inspect test kit - close all needle valves
OBSERVE CV1	Attach high hose to test cock #2 Attach low hose to test cock #3 Open test cock #3 slowly then open low pressure bleed valve Open test cock #2 slowly then open high pressure bleed valve Close high pressure bleed valve Close low pressure bleed valve Close shut-off valve #2 Observe check valve 1 - (record as close tight or leaking)
RECORD RELIEF VALUE	Open high control valve two full turns Open low control valve slowly (no more than 1/4 turn) Record relief valve opening (greater or less than 2.0 psid) Close low control valve only
RECORD CV 2 LEAKS OR CLOSED TIGHT	Bleed bypass hose by opening bypass valve Loosely attach bypass hose to test cock #4 Close bypass valve Tighten bypass hose to test cock #4 open test cock #4 Reset gauge - (open and close low pressure bleed valve) Open bypass valve two full turns Observe whether relief valve drips Record check valve #2 as (closed tight or leaking)

NOTE: TO POSITIVELY VERIFY THE CONDITION OF SHUT-OFF #2, WITH VENT VALVE STILL OPEN, CLOSE TC #2, IF SHUT-OFF IS LEAKING, THE GAUGE WILL FALL TO 0.0 PSI BUT THE RELIEF VALVE WILL NOT OPEN. IF GAUGE NEEDLE RISES, THEN SHUT-OFF #2 IS LEAKING AND THERE IS BACKPRESSURE IN THE CUSTOMER'S SYSTEM. IF SHUT-OFF #2 IS LEAKING VALUES FOR THE RELIEF VALVE AND BOTH CHECK VALVES ARE INACCURATE.

NOTE - BE PREPARED TO CLOSE VENT BY-PASS CONTROL VALVE

RECORD CV1	Close bypass valve Open test cock #2 Reset gauge - (open and close low pressure bleed valve) Record check valve #1 differential (greater or less than 5.0 psid) Close test cocks 2, 3, and 4 Remove vent hose from test cock #4
RECORD CV2	Move low hose to test cock #4 Move high hose to test cock #3 Open test cock #4 slowly then open low pressure bleed valve Open test cock #3 slowly then open high pressure bleed valve Close high pressure bleed valve

Close low pressure bleed valve
 Record check valve #2 differential (greater or less than 1.0 psid)

FINAL

Close test cocks - remove all equipment
 Open shut-off #2 slowly

**REDUCED PRESSURE ASSEMBLY
 TROUBLE SHOOTING**

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

Problem	May be caused by
Relief valve discharges continuously	1. Faulty 1 st Check Valve 2. Faulty 2 nd Check Valve with back-pressure 3. Faulty relief valve
Relief valve discharges intermittently	1. Properly working assembly with backsiphonage condition 2. 1 st check valve "buffer" is too small (example- less than 3.0 psi), with line pressure fluctuation 3. Water hammer
Relief valve discharges after #2 shut-off valve is shut (test #1)	1. Normally indicates faulty 1 st check valve A. Dirty or damaged disk B. Dirty or damaged seat
Relief valve would not open, differential on the gauge would not drop (test #1)	1. Leaky #2 shut-off valve with flow through assembly.
Relief valve would not open, differential drops to zero (test #1)	1. Relief valve stuck closed due to corrosion or scale 2. Relief valve sensing line(s) plugged
Relief valve opens too high (with sufficiently high 1 st check reading)	1. Faulty relief valve A. Dirty or damaged disk B. Dirty or damaged seat
1 st check reading too low (less than 3.0 psi "buffer") (test #1 & #3)	1. Dirty or damaged disk 2. Dirty or damaged seat 3. Guide members hanging up 4. Weak or broken spring
Leaky 2 nd check valve (backpressure test) 2 nd check valve reading too low (differential test)	1. Dirty or damaged disk 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 re-assembly of components, and **shall be non-toxic.**

DOUBLE CHECK VALVE ASSEMBLY TEST PROCEDURES DIFFERENTIAL TEST METHOD

- PREP**
- Notify customer
 - Inspect area
 - Flush all test cocks
 - Install fittings
 - Inspect test kit - close all needle valves
- CV #1**
- Install vertical tube on test cock #3
 - Install compensating tee on test cock #2
 - Note: Test gauge and hoses must be at same height**
 - Attach high hose to compensating tee installed on test cock #2
 - Open test cock #2 slowly
 - Open high pressure bleed valve - bleed air from gauge
 - Close high pressure bleed valve
 - Open test cock #3 to fill vertical tube
 - Close test cock #3
 - Close shut-off valve #2
 - Close shut-off valve #1
 - Open test cock #3
 - Note: Gauge must read 1.0 psi or greater to pass**
 - Record value of check valve #1
- CV #2**
- Close test cock #2 and test cock #3
 - Open shut-off valve #1
 - Remove vertical tube from test cock #3
 - Move high hose and compensation tee from test cock #2 to test cock #3
 - Install vertical tube on test cock #4
 - Open test cock #3 slowly
 - Open high pressure bleed valve - bleed air from gauge
 - Close high pressure bleed valve
 - Open test cock #4 to fill tube
 - Close test cock #4
 - Close shut off valve #1
 - Open test cock #4
 - Note: Gauge must read 1.0 psi or greater to pass**
 - Record value of check valve #2
- FINAL**
- Close test cocks - remove all equipment
 - Open shut off valve #1
 - Open shut off valve #2 slowly

DOUBLE CHECK VALVE ASSEMBLY DIFFERENTIAL TROUBLESHOOTING GUIDE

CHECK VALVE #1 LEAKING

IN TEST #1 WATER STOPS RUNNING OUT OF THE VERTICAL TUBE INSTALLED AT TEST COCK #3 AND THE GAUGE READING STABILIZED AT 0.0 PSID. **THIS INDICATES A LEAKING CHECK VALVE #1.**

CHECK VALVE #2 LEAKING

IN TEST #2 WATER STOPS RUNNING OUT OF THE VERTICAL TUBE INSTALLED AT TEST COCK #4 AND THE GAUGE READING STABILIZED AT 0.0 PSID. **THIS INDICATES A LEAKING CHECK VALVE #2.**

SHUT-OFF VALVE #1 LEAKING

IN TEST #1 WATER CONTINUOUSLY FLOWS FROM THE VERTICAL TUBE INSTALLED AT TEST COCK #3. WITH THE COMPENSATING TEE INSTALLED ON TEST COCK #2 AND THE BLEED VALVE OPENED UNTIL THERE IS ONLY A SLIGHT DRIP FROM THE VERTICAL TUBE INSTALLED AT TEST COCK #3. **THIS INDICATES A LEAKING SHUT-OFF VALVE #1.**

SHUT-OFF VALVE #2 LEAKING WITH PRESSURE

IN TEST #2 WATER CONTINUOUSLY FLOWS FROM THE VERTICAL TUBE INSTALLED AT TEST COCK #4 WITH THE COMPENSATING TEE INSTALLED ON TEST COCK #3 AND THE BLEED VALVE FULLY OPEN. WATER CONTINUES TO FLOW FROM THE VERTICAL TUBE INSTALLED AT TEST COCK #4. **THIS INDICATES A LEAKING SHUT-OFF VALVE #2 WITH PRESSURE.**

SHUT-OFF VALVE #2 LEAKING WITH NO PRESSURE

IN TEST #2 WATER LEVEL IN THE VERTICAL TUBE INSTALLED AT TEST COCK #4 DROPS WHEN TEST COCK #4 IS OPENED. **THIS INDICATES A LEAKING SHUT-OFF VALVE #2 WITH NO PRESSURE.**

CHECK VALVE #2 AND SHUT-OFF VALVE #2 LEAKING WITH PRESSURE

IN TEST #1 WATER CONTINUOUSLY FLOWS FROM THE VERTICAL TUBE INSTALLED AT TEST COCK #4 WITH THE COMPENSATING TEE INSTALLED ON TEST COCK #2 AND THE BLEED VALVE FULLY OPEN. WATER CONTINUES TO FLOW FROM THE VERTICAL TUBE INSTALLED AT TEST COCK #3. **THIS INDICATES A LEAKING CHECK VALVE #2 AND LEAKING SHUT-VALVE #2 WITH PRESSURE.**

CHECK VALVE #2 AND SHUT-OFF VALVE #2 LEAKING WITH NO PRESSURE

IN TEST #1 WATER LEVEL IN THE VERTICAL TUBE INSTALLED AT TEST COCK #3 DROPS WHEN TEST COCK #3 IS OPENED. **THIS INDICATES A LEAKING CHECK VALVE #2 AND LEAKING SHUT-OFF VALVE #2 WITH NO PRESSURE**

PRESSURE VACUUM BREAKER TEST PROCEDURES

PREP Notify customer
Inspect area
Flush test cocks
Install fittings
Remove inlet air valve canopy
Inspect test kit - close all needle valves

NOTE: MAKE SURE THAT ALL HOSES AND GUAGES ARE AT THE SAME ELEVATION AS THE PRESSURE VACUUM BREAKER

NOTE: DO NOT HAVE TEST KIT ATTACHED TO BACKFLOW PREVENTER WHEN OPENING #1 SHUT-OFF VALVE

AIR INJET VALVE Attach high side hose to test cock #2
Open test cock #2 slowly
Open high pressure bleed valve then close high pressure bleed valve
Close #2 shut-off valve, then close #1 shut-off valve
Slowly open high pressure bleed valve no more than 1/4 turn, until air inlet valve opens
NOTE: Air inlet valve must open 1.0 psi or greater to pass
Record value of air inlet valve

CV Close test cock #2
Remove high side hose from test cock #2
Re-open #1 shut-off valve to repressurize the assembly
Attach high side hose to test cock #1
Open test cock #1 slowly
Open high pressure bleed valve then close high pressure bleed valve
Close #1 shut-off valve
Open test cock #2 until water drains out of the body
NOTE: To pass, test gauge must read 1.0 psi or greater when water stops flowing from test cock #2
Record value of check valve

FINAL Close test cocks 1 and 2 and remove test equipment
Open #1 shut-off valve, then open #2 shut-off valve
Replace air inlet valve canopy

PRESSURE VACUUM BREAKER TROUBLE SHOOTING

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

Problem	May be caused by
Air inlet valve does not open, as gauge drops to 0.0 psid	<ol style="list-style-type: none"> 1. Air inlet disk stuck to seat 2. Broken or missing air inlet spring 3. "Old Style" pressure vacuum breaker (nonleaded air inlet valve)
Air inlet valve does not open, and differential on gauge will not drop	<ol style="list-style-type: none"> 1. Leaky #1 shut-off valve 2. Parallel installation with leaky #2 shut-off valve
Air inlet opens below 1.0 psid	<ol style="list-style-type: none"> 1. Dirty or damaged air inlet disk 2. Scale build up on seat
Water runs continuously from test cock #2 (test #2)	<ol style="list-style-type: none"> 1. Leaky #1 shut-off valve

DOUBLE CHECK VALVE ASSEMBLY TROUBLE SHOOTING

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

Problem	May be caused by
1 st check reading to low (test #1) 2 nd check reading to low (test #2)	<ol style="list-style-type: none"> 1. Dirty or damaged disk 2. Broken or missing air inlet spring 3. Guide members hanging up 4. Weak or broken spring

Repair Note: Lubricants shall only be used to assist with the re-assembly of components, and **shall be non-toxic.**

STANDARD BACKFLOW DETAILS

Detail Title	Sheet No:
Reduced Pressure Backflow Assembly	
ABOVE GROUND 3-4 INCH TO 2 INCH RP	1
ABOVE GROUND 2 HALF INCH TO 10 INCH RP	2
Double Check Valve Backflow Assembly	
ABOVE GROUND 3-4 INCH TO 2 INCH DCVA	3
ABOVE GROUND 2 HALF INCH TO 10 INCH DCVA	4
BELOW GROUND 3-4 INCH TO 11-2 INCH DCVA	5
BELOW GROUND 2 INCH DCVA	6
BELOW GROUND 2 HALF INCH TO 10 INCH DCVA	7
Fire Service Backflow Assembly	
FIRE SERVICE ABOVE GROUND 2 HALF-INCH TO 10 INCH RPDA	8
FIRE SERVICE BELOW GROUND 2 HALF INCH TO 10 INCH DCDA	9
FIRE SERVICE ABOVE GROUND 2 HALF-INCH TO 10 INCH DCDA	10
* Indoor Backflow Assembly	
* (Indoor assemblies must be approved by the Backflow Administrator)	
INDOOR 3-4 INCH TO 2 INCH RP	11
INDOOR 2 HALF INCH TO 10 INCH RP	12
INDOOR 3-4 INCH TO 2 INCH DCVA	13
INDOOR 2 HALF INCH TO 10 INCH DCVA	14
Misc.	
TEST COCK ASSEMBLY	15

