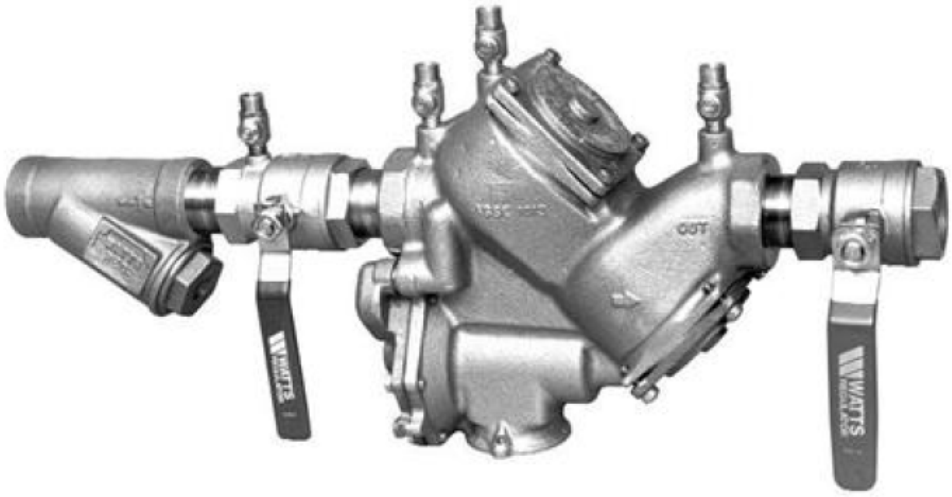
Cross-Connection Control



Basic Workshop
#2103

Renewal Workshop
#3102

Fleming Training Center
2022 Blanton Drive
Murfreesboro, TN 37129
http://tn.gov/environment/fleming/

Revised November 2011

CROSS-CONNECTION CONTROL

Instructor: Dennis Conger

RENEWAL - COURSE #3102

Tuesday
8:30 Greetings and Overview
8:45 Practice testing on RP and DC
10:30 Technical and Program Issues
11:30 Lunch
12:30 Practical Testing (RP and DC)

BASIC - COURSE #2103

Wednesday
8:30 The Essentials of Cross-Connection Control
10:30 RP (testing and operation)
11:30 Lunch
12:30 Demonstration (Lab)
1:30 Practice (Lab)

Thursday
8:30 Program Issues
9:45 DC (testing and operation)
10:15 Practice (Lab)
11:30 Lunch
12:30 Technical Issues
1:30 Practice (Lab)

Friday
8:30 Test Review
9:30 Written Exam
11:30 Lunch
12:30 Practical Testing (RP and DC)

Fleming Training Center

Your Partner in Clean Water
http://tn.gov/environment/fleming

CROSS-CONNECTION CONTROL

2022 Blanton Dr.
Murfreesboro, TN

Phone: 615-898-6508
Fax: 615-898-8064
E-mail: Dennis.Conger@tn.gov

Cross-Connection Control

Outline

- Basics of Cross-Connection Control
- Hydraulics
- Definitions
- Backflow Preventers
- Applications
- Backflow Testing Procedures

Basics of Cross-Connection Control

United States Environmental Protection Agency
Cross-Connection Control Manual
www.epa.gov/ogwdw/pdfs/crossconnection/crossconnection.pdf

Tennessee Department of Environment & Conservation
Cross-Connection Control Manual & Design Criteria
www.tn.gov/environment/fleming/docs/crossconnection.pdf

Authority

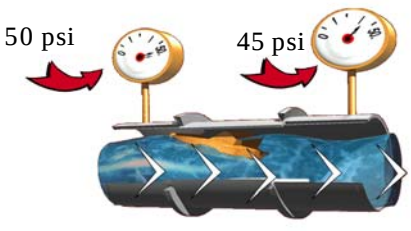
- Who has responsibility for the water served to the customer?
- Who has the responsibility to protect the water from cross-connections?
- What can happen if the water supplier does not act responsibly in the area of cross-connection control?
- Where does authority for the cross-connection control program come from?
- What can the water provider do to protect their system from contamination? Ultimately?

Hydraulics

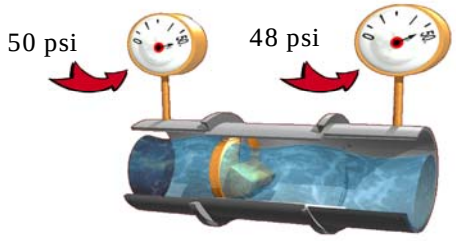
- Water pressure naturally tends to equalize

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

Normal Flow



No Flow



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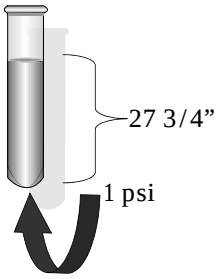
27 ¾" = 2.31 Feet of Head



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

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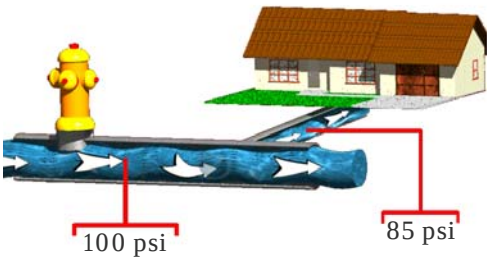
Normal Flow



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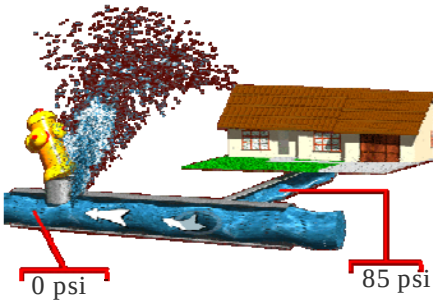
Reverse Flow



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Backflow

- The undesirable reversal of flow of water or other substances into the potable water distribution supply
- Occurs due to:
  - Backpressure
  - Backsiphonage

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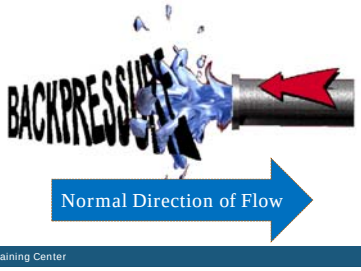
Backpressure

- Pressure in downstream piping greater than supply pressure



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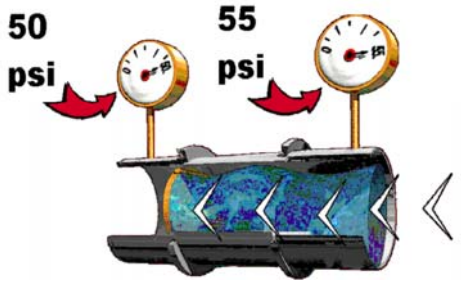
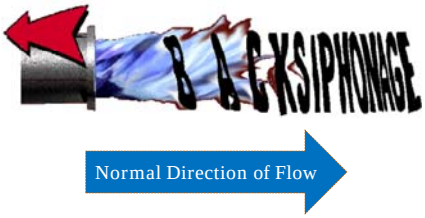
Backpressure

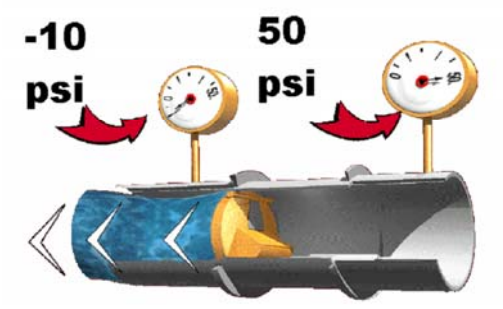


Backsiphonage

- Sub-atmospheric pressure in the water system



Backsiphonage



Cross-Connection

- An actual or potential connection between a potable water supply and any non-potable substance or source
- Cross-connection types:
  - Direct
  - Indirect

Direct Cross-Connection

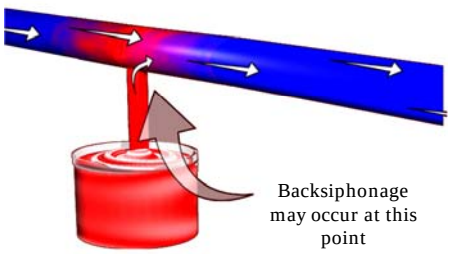
- A direct cross-connection is subject to backpressure or backsiphonage

Indirect Cross-Connection

- An indirect cross-connection is subject to backsiphonage only

Submerged Inlet

Aspirator Effect



Degree of Hazard

- Non-Health Hazard
  - Low hazard
  - Will not cause illness or death
  - Pollutant
- Health Hazard
  - High hazard
  - Causes illness or death
  - Contaminant

The Backflow Incident

For backflow to occur three conditions must be met:

1. There must be a cross-connection. A passage must exist between the potable water system and another source.
2. A hazard must exist in this other source to which the potable water is connected.
3. The hydraulic condition of either backsiphonage or backpressure must occur.

Five Means of Preventing Backflow

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

Air Gap

Approved Air Gap Separation

- Backsiphonage
- Backpressure
- Contaminant (health hazard)
- Pollutant (non-health hazard)

	Indirect		Direct
	Backsiphonage Only		Backpressure and Backsiphonage
	Continuous Use	Non-Continuous Use	
Health Hazard	**Air Gap**	**Air Gap**	**Air Gap**
Non – Health Hazard	**Air Gap**	**Air Gap**	**Air Gap**

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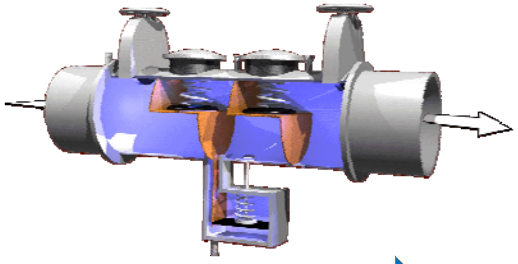
Reduced Pressure Principle Assembly



Normal Flow

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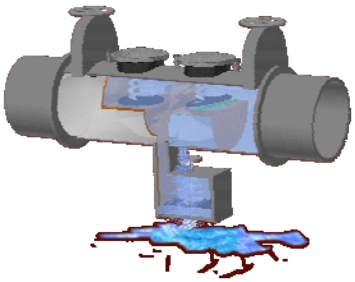
RP



Fouled Second Check with Backpressure

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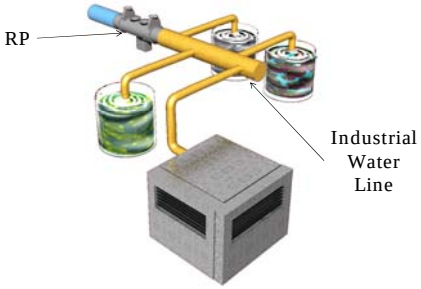
Where To Put an RP



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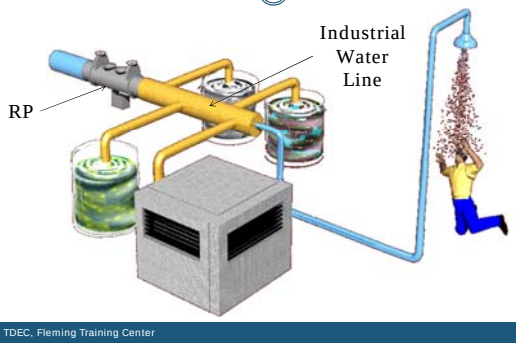
Where To Put an RP – Don't



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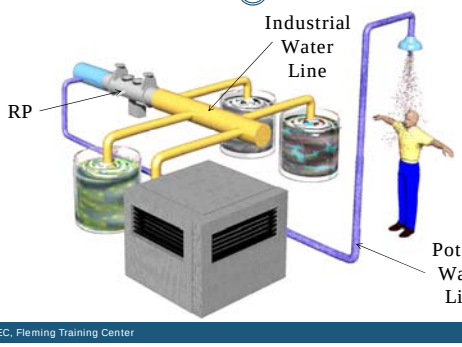
Where To Put an RP – Do



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RP Detector Assembly

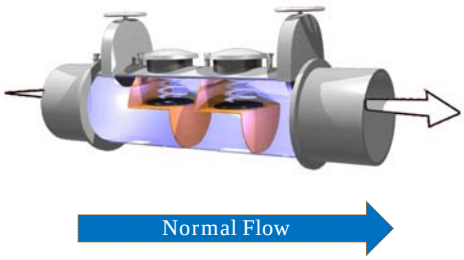
At least 3 GPM through bypass only

RP

- Backsiphonage
- Backpressure
- Contaminant (health hazard)
- Pollutant (non-health hazard)

	Indirect		Direct
	Backsiphonage Only		Backpressure and Backsiphonage
	Continuous Use	Non-Continuous Use	
Health Hazard	Air Gap	Air Gap	Air Gap
	RP	**RP**	**RP**
Non – Health Hazard	Air Gap	Air Gap	Air Gap
	RP	**RP**	**RP**

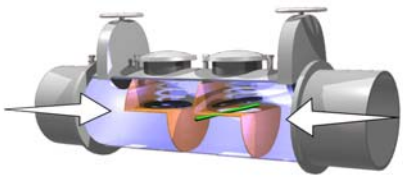
Double Check Valve Assembly (DC)



Normal Flow

Double Check Valve Assembly (DC)

- Second check fouled during backpressure

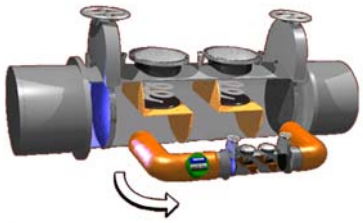


Double Check Valve Assembly (DC)

- Backsiphonage
- Backpressure
- Pollutant only

DC Detector Assembly

At least 3 GPM through bypass only



	Indirect		Direct
	Backsiphonage Only		Backpressure and Backsiphonage
	Continuous Use	Non-Continuous Use	
Health Hazard	Air Gap	Air Gap	Air Gap
	RP	RP	RP
Non – Health Hazard	Air Gap	Air Gap	Air Gap
	RP	RP	RP
	DC	**DC**	**DC**

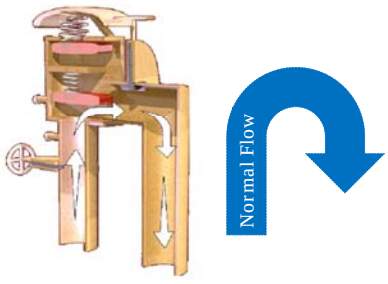
Proper Installation for DC and RP

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

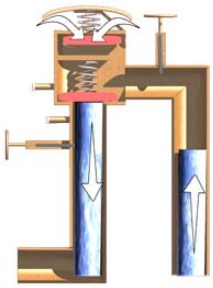
Proper Installation for DC and RP

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

Pressure Vacuum Breaker (PVB)

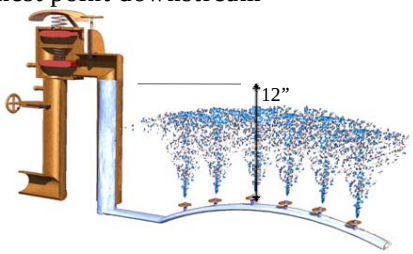


PVB Backsiphonage Condition



Installation of PVB

- Needs to be installed 12 inches above the highest point downstream



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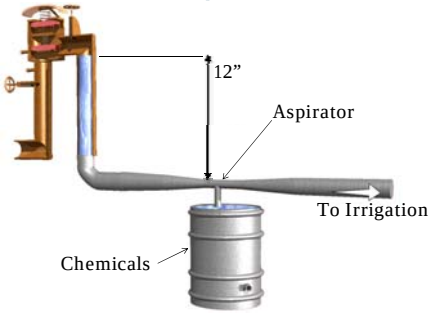
Pressure Vacuum Breaker



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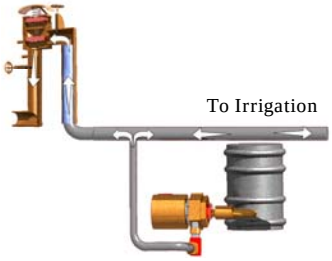
Pressure Vacuum Breaker

- Improper installation subject to backpressure



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Pressure Vacuum Breaker

- Backsiphonage Only
- Contaminant (health hazard)
- Pollutant (non-health hazard)
- Elevation - at least 12”

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	Indirect		Direct
	Backsiphonage Only		Backpressure and Backsiphonage
	Continuous Use	Non-Continuous Use	
Health Hazard	Air Gap	Air Gap	Air Gap
	RP	RP	RP
	PVB	**PVB**	
Non – Health Hazard	Air Gap	Air Gap	Air Gap
	RP	RP	RP
	DC	DC	DC
	PVB	**PVB**	

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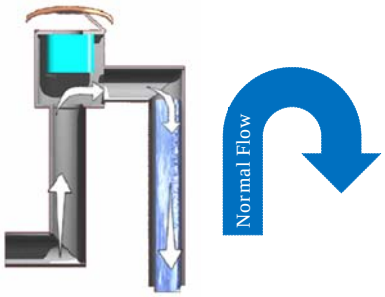
Atmospheric Vacuum Breaker (AVB)



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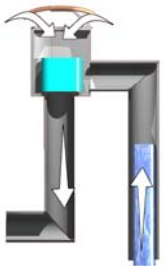
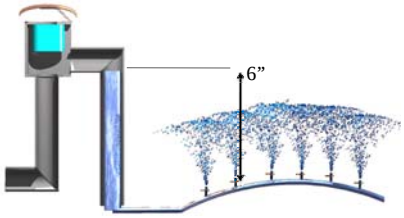
Atmospheric Vacuum Breaker (AVB)

- Backsiphonage condition

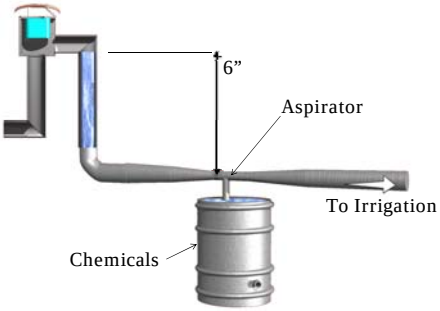


Installation of AVB

- Needs to be installed 6 inches above the highest point downstream

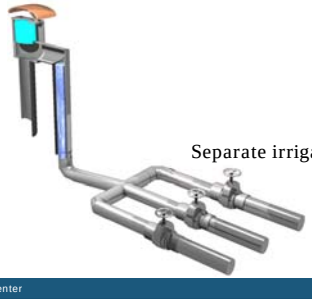


Atmospheric Vacuum Breaker



Atmospheric Vacuum Breaker

- Improper installation: downstream shutoff valves



Atmospheric Vacuum Breaker

- Backsiphonage Only
- Contaminant (health hazard)
- Pollutant (non-health hazard)
- Elevation - at least 6”
- Non-Continuous Use

	Indirect		Direct
	Backsiphonage Only		Backpressure and Backsiphonage
	Continuous Use	Non-Continuous Use	
Health Hazard	Air Gap	Air Gap	Air Gap
	RP	RP	RP
	PVB	PVB	
		AVB	
Non – Health Hazard	Air Gap	Air Gap	Air Gap
	RP	RP	RP
	DC	DC	DC
	PVB	PVB	
		AVB	

Testing of Assemblies

- Annual testing required
- Must be conducted by certified personnel

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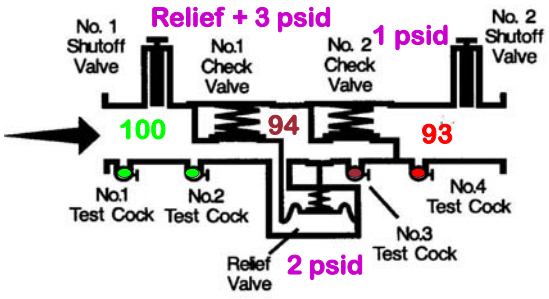
RP



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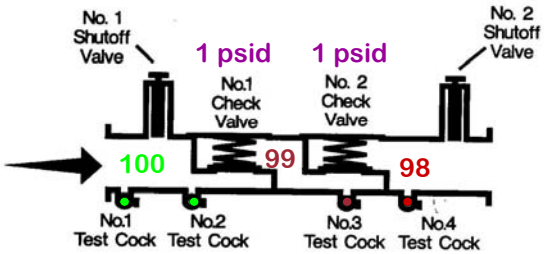
DC



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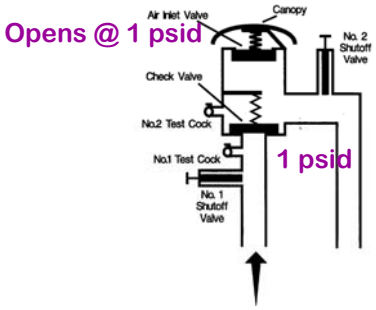
PVB



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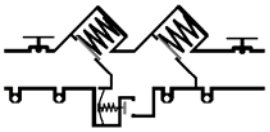
Test Procedure

Reduced Pressure Principle Assembly

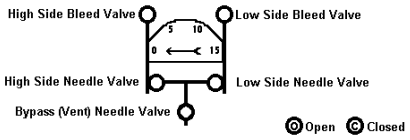
TENNESSEE PROCEDURE
FOR TESTING
REDUCED PRESSURE PRINCIPLE BACKFLOW PREVENTION DEVICES



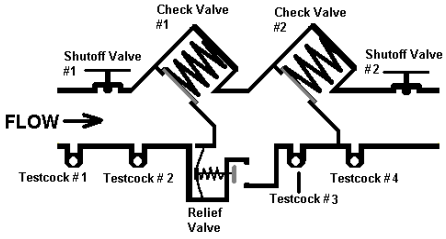
Five Valve Gauge

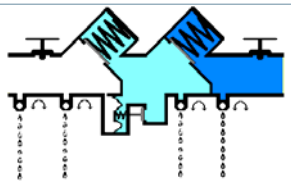
Test Kit
including a

Differential Pressure Gauge



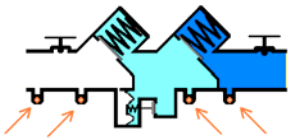
Reduced Pressure Principle Assembly



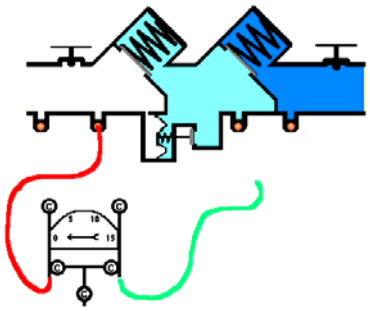


A. Initial Setup

1. Flush test cocks by:
   a. opening test cock #4 to establish flow thru the unit. (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 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

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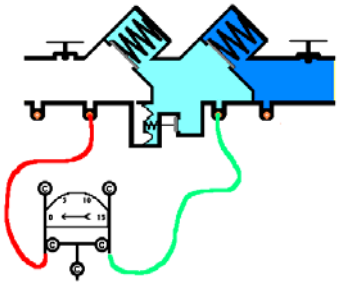

5. Connect low side hose of the test kit to test cock #3

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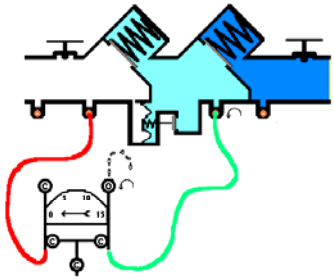

6. Open test cock #3
7. Open the low side bleed valve to purge air from the test kit.

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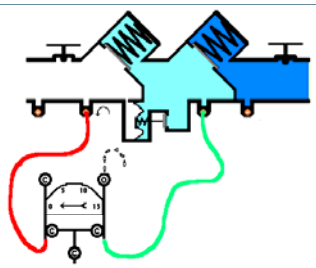

8. Open test cock #2 **SLOWLY** (If this test cock is opened too quickly, it may cause the relief valve to open. To achieve accurate test measurements, it is important NOT to open the relief valve until the appropriate time)

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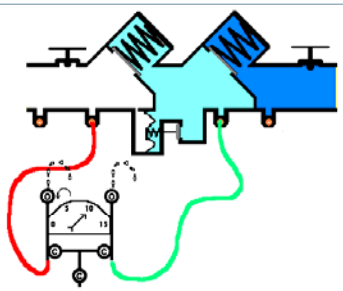
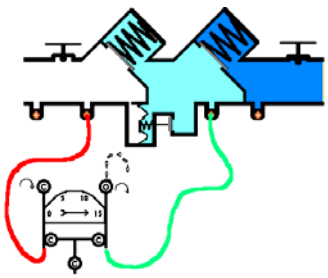


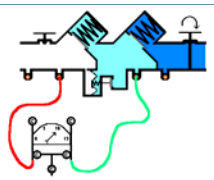
9. Open the high side bleed valve to purge air from the test kit.

TDEC, Fleming Training Center



10. Close the high side bleed valve.
11. After the gauge reaches the upper end of the scale, close the low side bleed valve.

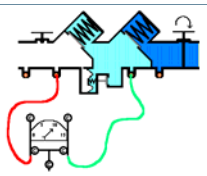
TDEC, Fleming Training Center



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 device and that check valve #1 is leaking.

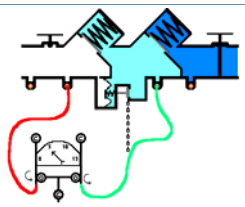
Response:

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.

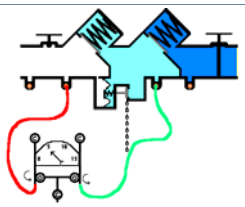
- If the gauge stabilizes at a point above the relief valve opening point, proceed to Section B.
- If the pressure drops to relief valve opening point, end the test at this point, complete the test report indicating a failed device.



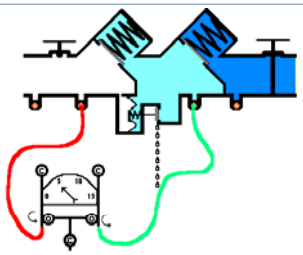
B. Evaluate the Opening Point of the Relief Valve

Purpose: To determine that the relief valve is opening when the pressure in the zone is less than 2 psi of supply pressure and holding tight in other conditions.

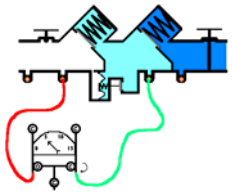
1. Open the high side valve one turn.



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.)



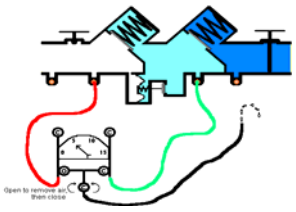
3. As the gauge drops, observe the relief valve discharge opening. When water begins to drip from the discharge opening, record the reading on the gauge. This reading is the relief valve opening point.



4. Close the low side valve.

Response:

- If the relief valve opened before the gauge drops below 2 psi, record the opening point on the test report and proceed to Section C.
- If the relief valve opened at a pressure less than 2 psi or did not open, end the test at this point, complete the test report indicating a failed device.

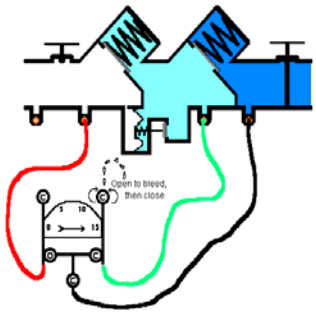


C. Test #2 Check For Leakage Against Backpressure

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

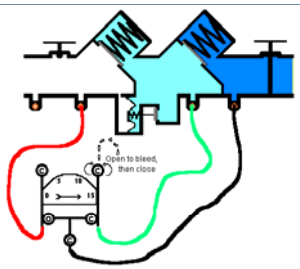
1. Open the bypass valve to purge air from the bypass line. Then close.

TDEC, Fleming Training Center



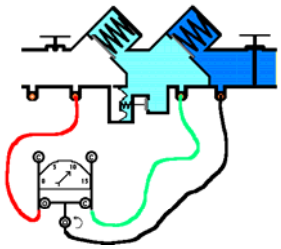
2. Connect the bypass hose to test cock #4, then open test cock #4.

TDEC, Fleming Training Center



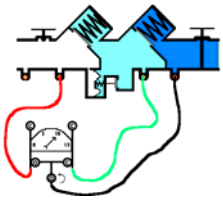
3. Open low side bleed valve to reestablish setup pressure in the zone between the 2 checks. Then close the low side bleed valve.

TDEC, Fleming Training Center



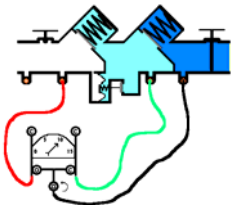
4. Open the bypass valve. (This will allow supply pressure to be routed to the zone between check valve #2 and shutoff valve #2).
5. Observe the gauge reading.

TDEC, Fleming Training Center



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 setup pressure and evaluate again.

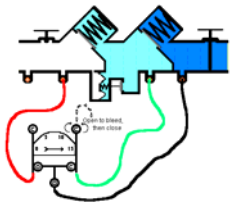
TDEC, Fleming Training Center



Response:

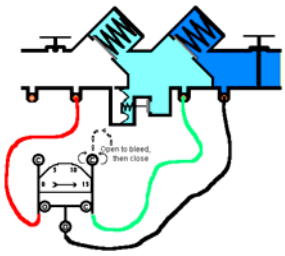
- If the check valve is holding tight, record this on the test report and proceed to Section D.
- If the check valve is NOT holding tight, end the test at this point, complete the test report indicating a failed device and a leaking check valve #2.

TDEC, Fleming Training Center



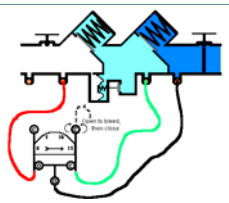
D. Evaluate the Drop Across #1 Check in Direction of Flow

Purpose: To determine that the static pressure drop across check valve #1 is 3 psi greater than the opening of the relief valve. (A reading less than 3 psi 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.)



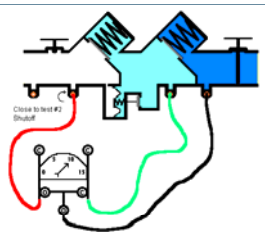
1. Open the low side bleed valve to reestablish setup pressure in the zone.
2. Close the low side bleed valve.

Response: Observe the gauge reading.



a. A stable gauge pressure reading 3 psi 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.

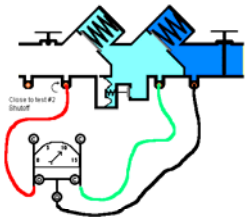
b. If the gauge pressure drops to relief valve opening point, end the test at this point, complete the test report indicating a failed device and a leaking check valve #1.



E. Test the #2 Shutoff Valve for Leakage

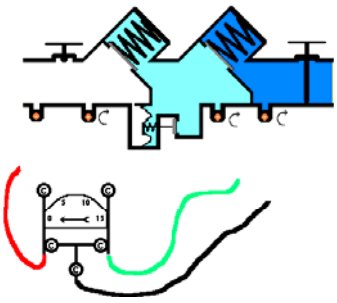
Purpose: To determine that shutoff valve #2 is holding tight.

1. Close test cock #2.

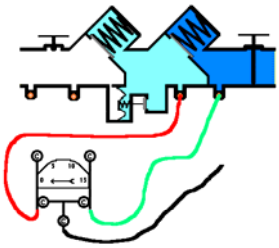


Response:

- 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. Make the owner aware that repair 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 greater than 1 psi.

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.

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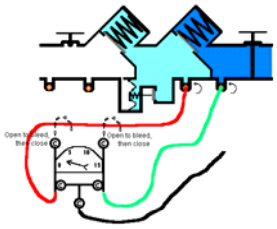

3. Open test cock #4.
4. Open test cock #3.
5. Open the low side bleed valve to purge air from the test kit.
6. Open the high side bleed valve to purge air from the test kit.
7. Close the high side bleed valve.
8. Close the low side bleed valve.

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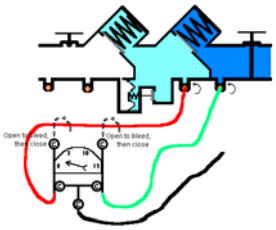

Response:

Observe the gauge reading.

a. A stable gauge pressure reading 1 psi 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 psi, complete the test report indicating that repairs MUST be made to check valve #2.

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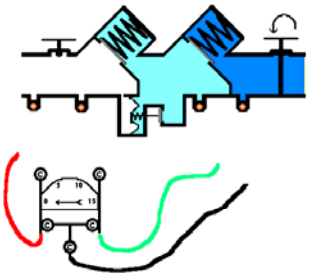

9. Close all test cocks, disconnect all hoses, remove fittings and drain test kit. Open shutoff valve #2.

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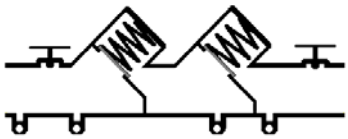
Test Procedure

Double Check Valve Assembly

TENNESSEE PROCEDURE FOR TESTING
DOUBLE CHECK VALVE ASSEMBLY
BACKFLOW PREVENTION DEVICES

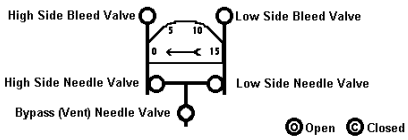


Five Valve Gauge

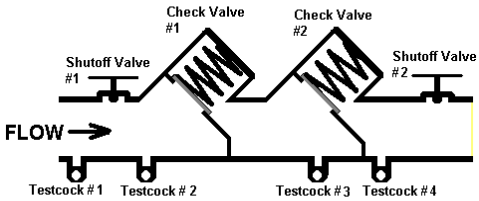
Test Kit

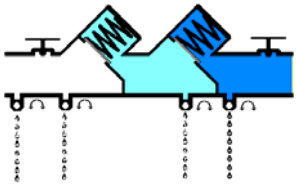
including a

Differential Pressure Gauge



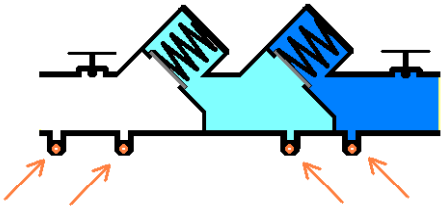
Double Check Valve Assembly



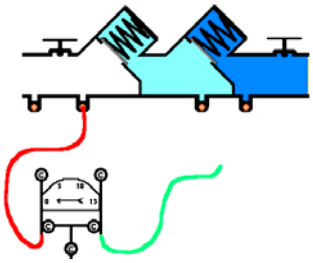


A. Initial Setup

1. Flush test cocks by:
   a. opening test cock #4 to establish flow through the unit. (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

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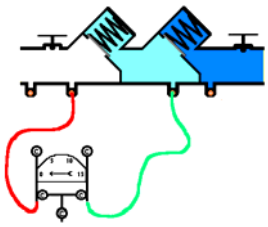
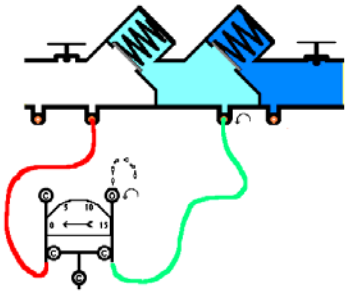


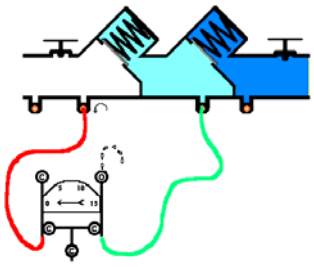
5. Connect low side hose of the test kit to test cock #3

TDEC, Fleming Training Center



6. Open test cock # 3
7. Open the low side bleed valve to purge air from the test kit

TDEC, Fleming Training Center



8. Open test cock #2

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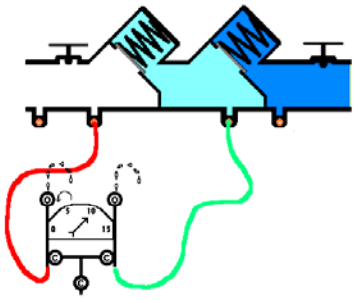
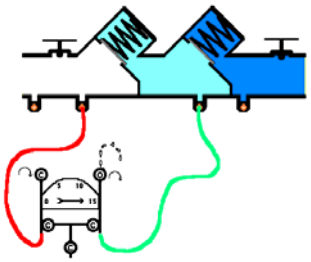


9. Open the high side bleed valve to purge air from the test kit

TDEC, Fleming Training Center



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. Unit now ready to begin the test.

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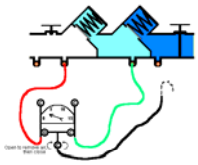
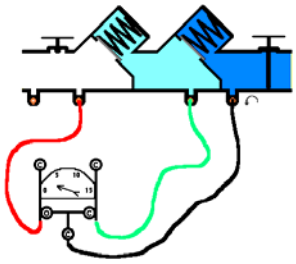
B. Test #2 Check For Leakage Against Backpressure



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

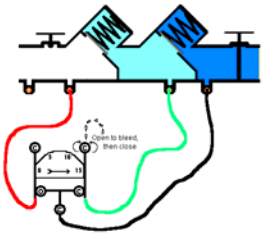
1. Open the high side valve
2. Open the bypass valve to purge air from the bypass line. Then close.

TDEC, Fleming Training Center



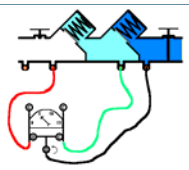
3. Connect the bypass hose to test cock #4, then open test cock #4.

TDEC, Fleming Training Center



4. Open low side bleed valve to reestablish setup pressure in the zone between the 2 checks. Then close low side bleed valve.

TDEC, Fleming Training Center



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 psi indicates a leaking check valve #2.

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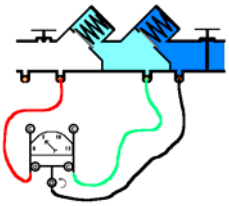
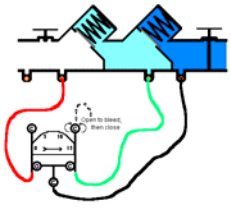


Response:

- 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 device and a leaking check valve #2.

TDEC, Fleming Training Center

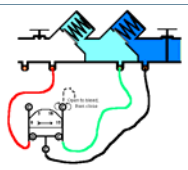


C. Evaluate the Drop Across #1 Check in Direction of Flow

Purpose: To determine that the static pressure drop across check valve #1 is 1 psi 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.

TDEC, Fleming Training Center



Response:

Observe the gauge reading.

a. A stable gauge pressure reading 1 psi or greater indicates that check valve one is holding tight with an adequate pressure differential. Record this on the test report.

b. If the gauge pressure drops below 1 psi, end the test at this point, complete the test report indicating a failed device.

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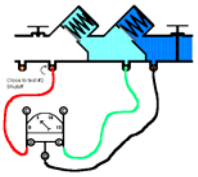
D. Test the #2 Shutoff Valve for Leakage

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.

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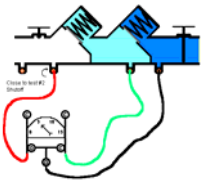
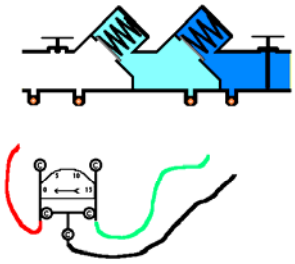


Response:

- If the shutoff valve holds tight, record this on the test report.
- If the shutoff valve leaks, record this on the test report, make the owner aware that repair MUST occur.

TDEC, Fleming Training Center

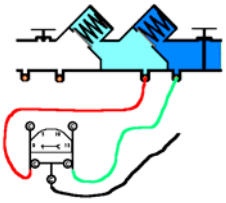


2. Close all test cocks, disconnect all hoses, close all test kit valves.

TDEC, Fleming Training Center

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

Purpose: To determine that the pressure drop across check valve #2 is greater than 1 psi.



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

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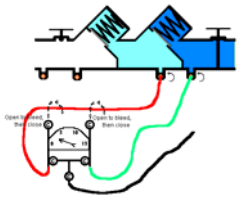

3. Open test cock #4
4. Open test cock #3
5. Open the low side bleed valve to purge air from the test kit.
6. Open the high side bleed valve to purge air from the test kit.
7. Close the high side bleed valve.
8. Close the low side bleed valve.

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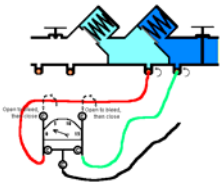

Response:

· Observe the gauge reading.

a. A stable gauge pressure reading 1 psi 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 psi, complete the test report indicating that repairs MUST be made to check valve #2.

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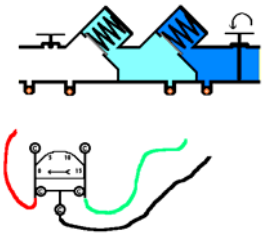

9. Open shutoff valve #2, close all test cocks, disconnect all hoses, remove fittings and drain test kit.

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Reduced Pressure Principle Assembly
5 Valve Procedure

A. Initial Setup

1. Flush test cocks by:
    a. opening test cock #4 to establish flow through the unit. (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 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 is opening when the pressure in the zone is less than 2 psi 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 before the gauge drops to 2 psi, record the opening point on the test report and proceed to Section C.

- If the relief valve opened at a pressure less that 2 psi 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.

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 psi 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 psi 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, make the owner aware that repair 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 greater than 1 psi.

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.

Response:

- Observe the gauge reading.
  a. A stable gauge pressure reading 1 psi or above indicates that check valve #2 is holding tight with and adequate pressure differential. Record this on the test report form.
  b. If the pressure drops below 1 psi, complete the test report indicating 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.

Double Check Valve Assembly Test Procedure
5 Valve

A. Initial Setup

1. Flush test cocks by:
   a. opening test cock #4 to establish flow through the unit. (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

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
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 psi indicates a leaking check valve #2.

Response:

- If the check valve is holding tight, record this on the test report and proceed to Section C.
- 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 psi 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 psi 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 psi, 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.

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, 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 greater than 1 psi.

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.

Response:

- Observe the gauge reading.
  a. A stable gauge pressure reading 1 psi 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 psi, complete the test report indicating 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.

Reduced Pressure Principle Assembly
3 Valve Procedure

A. Initial Setup

1. Flush test cocks by:
    a. opening test cock #4 to establish flow through the unit. (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 is opening when the pressure in the zone is less than 2 psi 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 before the gauge drops to 2 psi, record the opening point on the test report and proceed to Section C.

- If the relief valve opened at a pressure less than 2 psi 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 psi 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. 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 psi 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 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, 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 greater than 1 psi.

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.

Response:

- Observe the gauge reading.
  a. A stable gauge pressure reading 1 psi or above indicates that check valve #2 is holding tight.
  b. If the pressure drops below 1 psi, complete the test report indicating 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.

Double Check Valve Assembly Test Procedure
3 Valve

A. Initial Setup

1. Flush test cocks by:
   a. opening test cock #4 to establish flow through the unit. (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

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 psi 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 psi or greater.

1. Loosen the low side hose connection to reestablish pressure in the zone between the checks and then tighten.

Response:

- Observe the gauge reading.
    a. A stable gauge pressure reading 1 psi 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 psi, 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.

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, 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 greater than 1 psi.

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.

Response:

- Observe the gauge reading.
    a. A stable gauge pressure reading 1 psi 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 psi, complete the test report indicating 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.

BACKFLOW DEVICE TEST REPORT

Service Address_____

Name of Premises_____ **Location of device**_____

Device_____ _____ _____ _____
Manufacturer | Model | Size | Serial Number

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 ☐	Closed Tight ☐ Leaked ☐	Held at _____ psid Leaked ☐	Closed Tight ☐ Leaked ☐	Held at _____ psid Leaked ☐

Double Check Valve Assembly

Check Valve # 2 Backpressure Test	Check Valve #1	No. 2 Shutoff Valve	Check Valve #2	Backflow Assembly Status
Closed Tight ☐ Leaked ☐	Held at _____ psid Leaked ☐	Closed Tight ☐ Leaked ☐	Held at _____ psid Leaked ☐	**Passed** ☐ **Failed** ☐

Date_____ Time_____ Certified Tester #_____

Test by (Signature)_____ Print Name_____

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

Comments:_____