USC

1

UF TREEO Conference

Evolution of Backflow Prevention Assembly Field Testing Procedures

3rd February 2025
St. Augustine, FL

2

Presenter

Henry Chang
Chief Engineer, USC Foundation

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Agenda

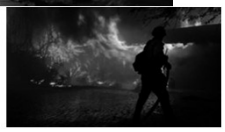
- What is New?
- Evolution of Backflow Prevention Assemblies Field Testing Procedures

4

So What's New?

5

Devastating Fires!!!!



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What's New at the USC Foundation?

USC Foundation for Cross-Connection Control and Hydraulic Research

7

What's New?

- Paul H. Schwartz –
  - Retired
  - Grandpa of three

8

What's New?

- USC FCCCHR Anniversary
  - Established on September 14, 1944
  - (September 14, 2024)

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New Approvals

- New Assemblies
- Modifications, Re-design & upgrades
- Removals

- Latest List – January 1, 2025

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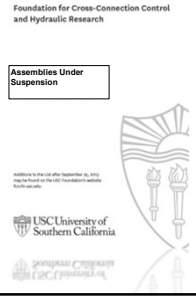
USC List of Approved Assemblies
USC List – Suspension

- Assembly Under Suspension
  - AS PART OF AN ASSEMBLY'S ONGOING APPROVAL PROCESS, MANUFACTURERS ARE REQUIRED TO SUBMIT SELECTED ASSEMBLIES FOR REVIEW AND RE-EVALUATION.
  - WHEN A MANUFACTURER FAILS TO PROVIDE A REQUIRED ASSEMBLY, THE ASSEMBLY'S APPROVAL IS SUSPENDED. ONCE THE ASSEMBLY SATISFACTORILY COMPLETES THE RENEWAL REVIEW AND RE-EVALUATION, THE SUSPENSION WILL BE REMOVED.



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USC List of Approved Backflow USC List on Mobile Devices

usclist.com

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USC List of Previously Approved Assemblies

usclist.com

- No Longer Approved
  - When first approved
  - When removed from List
    - Stopped manufacturing
    - For cause

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USC FCCCHR Industry Participation

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What's New with the USC Foundation & Industry?

State Regulations –
CA, CO, NC, MI, WV, DE

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What's New with the USC Foundation & Industry?

Frequency of Field Testing the Assemblies

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USC University of Southern California

Foundation for Cross-Connection Control and Hydraulic Research

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Recommended Annual Field Testing for Backflow Prevention Assemblies

The USC Foundation recommends annual field testing for all backflow prevention assemblies.

Field testing backflow prevention assemblies ensures they are functioning correctly. Assemblies are subject to failure, like any mechanical device. Field testing the assemblies on a scheduled basis becomes critical for safe drinking water, since all assemblies are installed to protect the public from pollutants or contaminants.

The standard practice of care in the cross-connection control and backflow prevention industry is to field test backflow prevention assemblies annually. The USC Foundation's *Manual of Cross-Connection Control, Tenth Edition*, recommends annual field testing. This recommendation is supported by the Water Research Foundation (AWWARF) report 90308F, entitled "*Impacts of Cross-Connections in North American Water Supplies*," which states that 94% of water suppliers require field tests annually or more frequently.

The USC Foundation's annual testing recommendation originates from its Approval Program for backflow prevention assemblies. As part of the program, all assemblies that pass the laboratory evaluation must also complete a one-year field evaluation. Therefore, the Foundation recommends annual field testing for assemblies. Field testing ensures installed assemblies operate correctly, protecting public health by safeguarding the drinking water.

For any questions about the recommendation for annual field testing of backflow prevention assemblies please contact the Foundation office.

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Evolution of the Backflow Prevention Assembly Field Testing Procedures

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Abstract

Review how the field testing procedures for the backflow prevention assemblies developed and evolved throughout the years and the reasons why they changed for the better.

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Discussion

How long have we had Backflow Preventers?

21

1903

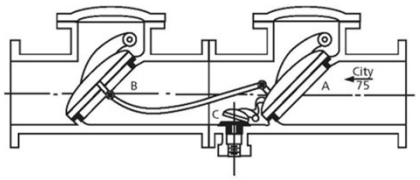
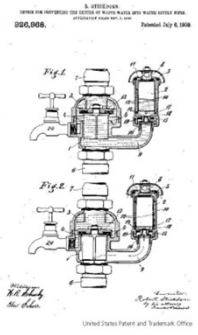


Figure 2.2
Double Check Valve designs, circa 1903

22

July 6, 1909



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May 22, 1934

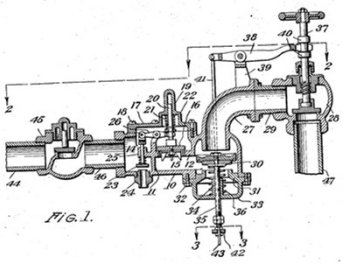
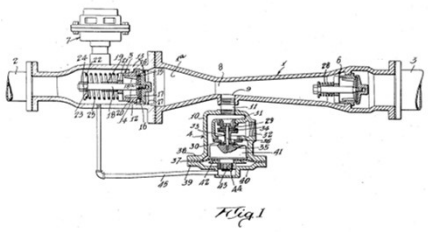


FIG. 1.

24

April 11, 1950



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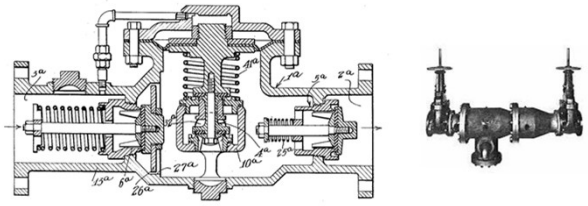
April 11, 1950



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June 30, 1930 - 50th AWWA Conference in St Louis, MO

- Committee #8 Formed on Cross-Connection Control

1. No cross connections should be permitted, and existing CC should be eliminated in shortest practical time

2. If elimination is impractical, water shall be connected thru a lab tested Check Valve properly installed, regularly tested and periodically cleaned & repaired.

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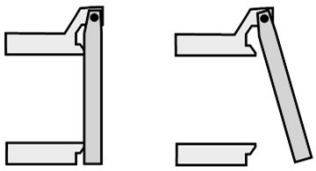
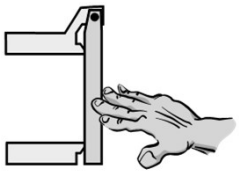
Swing Check Valve



Closed Opened

28

Closed ?



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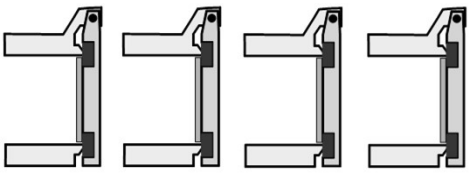
One is adequate, Two is good, Three is better, etc.



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Problems with Multiple Check Valves

- Long End to End Dimension
- Excessive pressure loss

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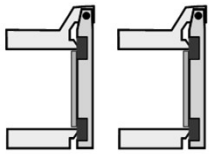
Two Check Valves
Reasonable/Practical Solution



Primary Secondary

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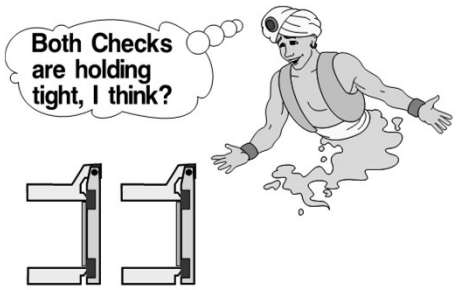

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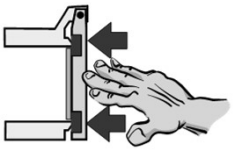
Test Effectiveness of
Check Valves ?



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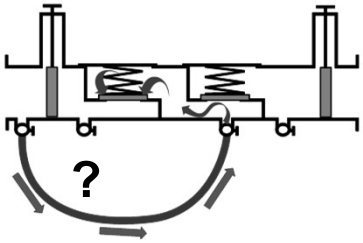
Single Hose - Full Backpressure



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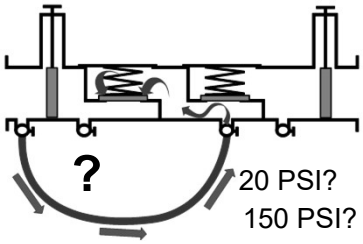
Full Backpressure - How Much?



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What is the Criteria for Failure?

A Little = OK ?

A Lot = Leak ?

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What May Cause Check Leak?

- Rust
- Debris
- Rags
- Pair of Pants

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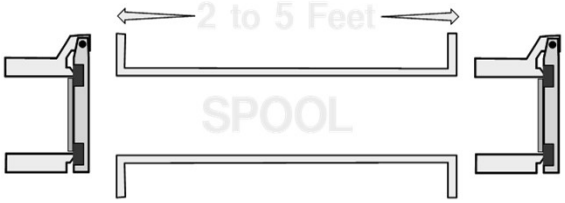
Check Valves Spaced Apart



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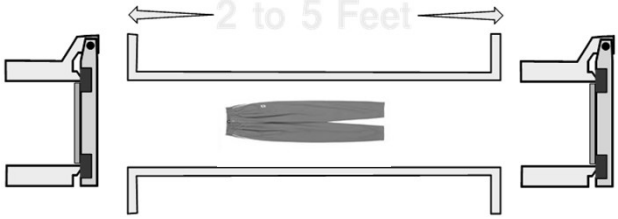
Check Valves Spaced Apart



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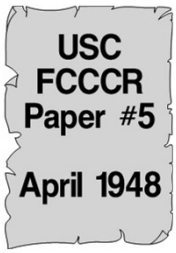
Field Test



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Paper No. 5 - April 1948

- Classified backflow preventers
- Double check valve assembly
- Superior pressure principle assembly
- Reduced pressure principle assembly
- Pressure vacuum breaker
- Non-pressure type vacuum breaker
- Established Laboratory and Field Evaluation Program for RP and DC
- Report of field investigations
- Established field test procedures

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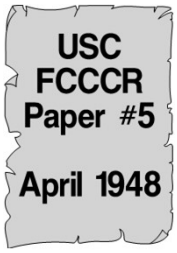
Field Test



Record backpressure when check valve "shuts in"

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"FIELD" Test Goals

- Insitu (in-place or original position)
- Static (non-flowing)
- Operation of Components
- "Field" vs "Laboratory" Tests

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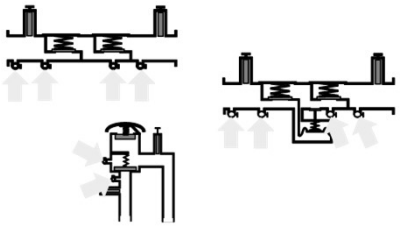
Goal - Insitu

- Field Test Without Having to Remove From Pipeline
- Early check arrangements had to be removed from line for inspection or testing

45

Testcocks



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Goal - Static

- No Flow Through the backflow preventer Under Test

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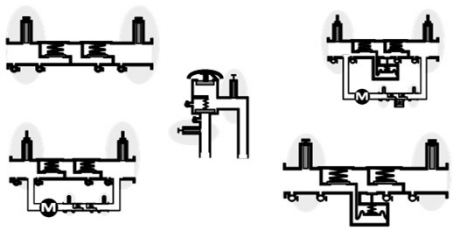
Shutoff Valves



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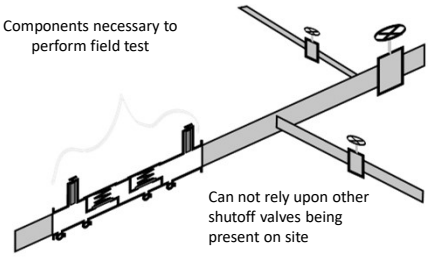
Shutoff Valves

Components necessary to perform field test



Can not rely upon other shutoff valves being present on site

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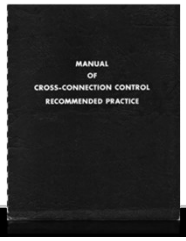
In-Line Testable

50

Manual of Cross-Connection Control, 7th Edition-1985

• Requirement for resilient seated shutoff valves and test cocks on all new assemblies.



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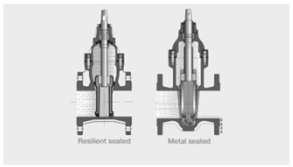

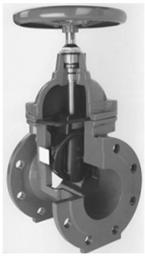

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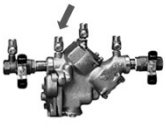

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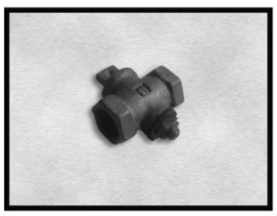

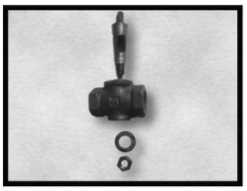

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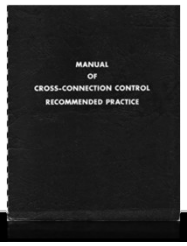
Manual of Cross-Connection Control, 4th Edition-1969

- Requirement for inline repairability



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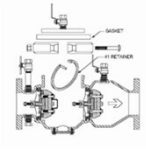
In-Line Repairable



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Goal - Operation of Components

- PREVENT BACKFLOW

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Where Do the Different Field Test Procedures Come From?

- Recommended Practices
- State/Regional Requirements
- Local Requirements
- Manufacturers

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Some of the Field Test Procedures

- Double Check Valve
- Reduced Pressure Principle Assembly
- Pressure Vacuum Breaker
- Spill Resistant Pressure Vacuum Breaker

60

Double Check Valve Field Test Procedures

- Duplex Gage
- Sight Tube
- Differential Gage

61

Manual of Cross-Connection Control, 1st Edition-1960

- Field test procedures for DC (w/duplex gage)

62

63

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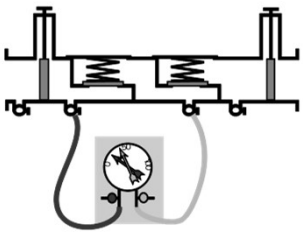
Duplex Gage Method



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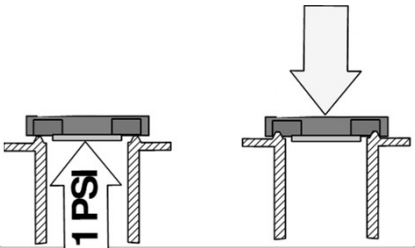
Direction of Flow - Backpressure



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Manual of Cross-Connection Control, 9th Edition-1993

- Field test procedure for DC changed from backpressure test to direction of flow test.

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DC - Sight Tube Methods

- Hold 1 PSI
- Closing / opening Point

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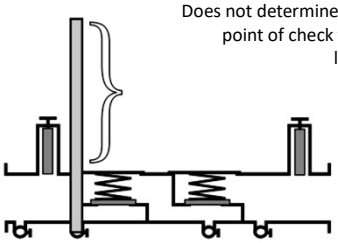
Hold 1 PSI

Does not determine closing point of check valve (i. loading)



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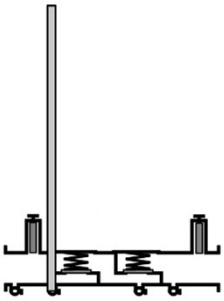
Closing Point



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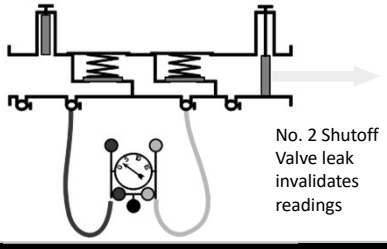
DC - Differential Gage

- Two hose method
  - High and Low side hoses
- One hose method
  - High side hose only

71

Two Hose Method



No. 2 Shutoff Valve leak invalidates readings

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Two Hose Method

- Can Not Perform Test Accurately if:
  - No. 2 Shutoff valve leaks
  - No. 2 Check Valve leaks
  - No. 1 Check Valve leaks
- Can Perform Test Accurately only if:
  - No. 2 Shutoff Valve is drip tight, and
  - Both Check Valves Hold Tight

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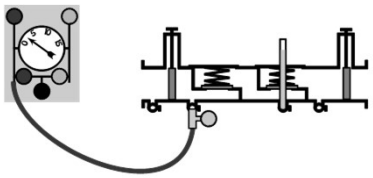
One Hose Method



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One Hose Method

- Can Test with Shutoff Valves Leak
- Determines Closing Point of Each Check Valve

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RP Field Test Procedures

- Visual Indication Test Procedures
- Order of Tests
- Second Check Differential

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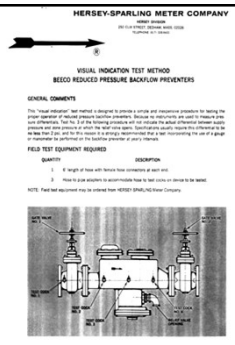
RP Test Procedures using a single hose



HERSEY-SPARLING METER COMPANY

VISUAL INDICATION TEST METHOD
BEECO REDUCED PRESSURE BACKFLOW PREVENTERS

GENERAL COMMENTS

FIELD TEST EQUIPMENT REQUIRED

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VISUAL INDICATION TEST METHOD
BEECO REDUCED PRESSURE BACKFLOW PREVENTERS

GENERAL COMMENTS

This "visual indication" test method is designed to provide a simple and inexpensive procedure for testing the proper operation of reduced pressure backflow preventers. Because no instruments are used to measure pressure differentials, Test No. 3 of the following procedure will not indicate the **actual** differential between supply pressure and zone pressure at which the relief valve opens. Specifications usually require this differential to be **no less** than 2 psi, and for this reason it is strongly recommended that a test incorporating the use of a gauge or manometer be performed on the backflow preventer at yearly intervals.

FIELD TEST EQUIPMENT REQUIRED

QUANTITY	DESCRIPTION
1	6' length of hose with female hose connectors at each end.
3	Hose to pipe adapters to accommodate hose to test cocks on device to be tested.

NOTE: Field test equipment may be ordered from HERSEY-SPARLING Meter Company.

78

Manual of Cross-Connection Control, 1st Edition-1960

- Field test procedures for RP (w/mercury manometer)

79

80

Manual of Cross-Connection Control, 5th Edition-1974

- Field test procedures for RP used differential pressure gage

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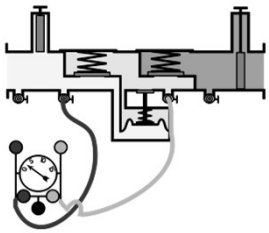
RP Field Test
One hose or Two hose Method?



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RP – Field Test Procedure

- Relief Valve Opening Point Test
  - It is one of the objectives of the field test procedure to determine the opening point value of the relief valve; the first time it opens under normal field operation.

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RP – Field Test Procedure

- Relief Valve Opening Point Test
  - In normal field operation, the corresponding field test should evaluate the assembly under the same conditions.

84

RP – Field Test Procedure one-hose method

- Test for Tightness of No. 1 Check Valve
- Test for Tightness of No. 2 Check Valve
- Tested Similar to a DC Test

85

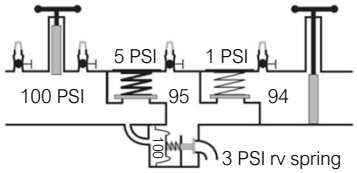
RP – Field Test Procedure one-hose method

- Test No. 3 – Relief Valve Opening Point Test
- Tested at low pressure not the supply working pressure of the system or normal field operation

86

Reduced Pressure Principle Assembly (RP)

- Pressure Zones



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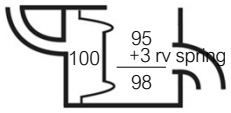
Reduced Pressure Principle Assembly (RP)

- Relief Valve Pressure Zone



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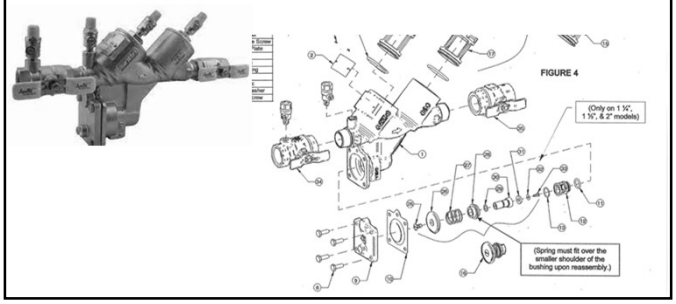
Reduced Pressure Principle Assembly (RP)

- Relief Valve Pressure Zone

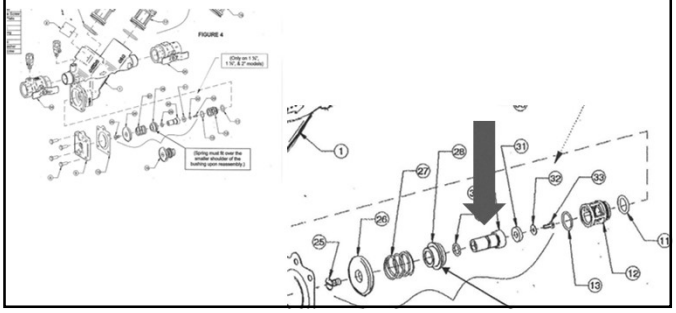
89

Reduced Pressure Principle Assembly (RP)

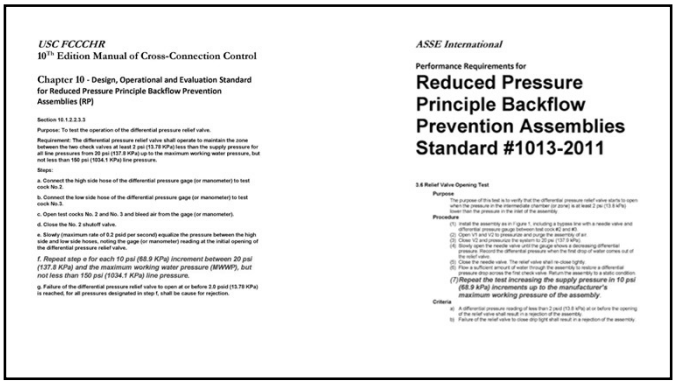


90

Reduced Pressure Principle Assembly (RP)

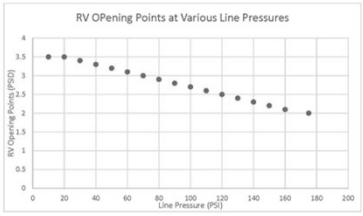


91



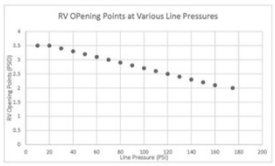
92

RV Opening Points @ Various Line Pressures



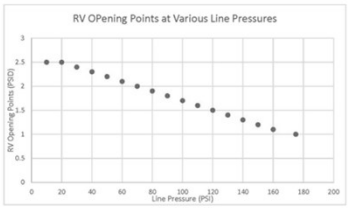
93

RV Opening Points @ Various Line Pressures



Upon Installation

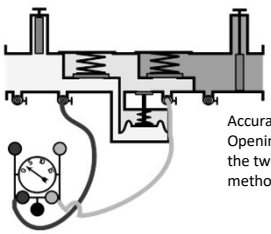
After year(s) of Service



94

RP Field Test

One hose or Two hose Method?



Accuracy of RV Opening point led to the two hose method

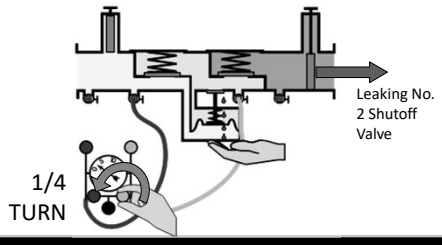
95

RP Field Test Procedures

- Order of Tests
- Second Check Differential

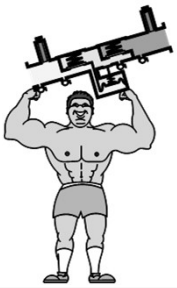
96

RP Field Test - RV Opening Pt.



97

Exercising the Relief Valve



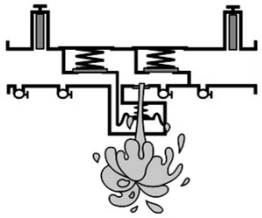
98

Exercising the Relief Valve

- Causing the relief valve to open and close before recording the opening point.
- Will tend to increase the opening point value.
  - Perhaps from failing value to passing value
- RV doesn't get "exercised" prior to needed use.

99

Premature RV Discharge



- Bleeding Testcocks
- Bleeding Gage
- Testing Check Valves First

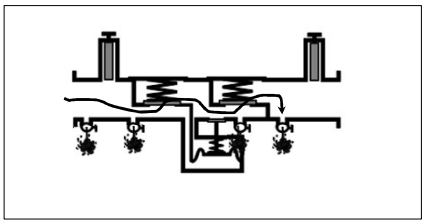
100

Manual of Cross-Connection Control, 10th Edition-2009

- Field test procedures for all assemblies have been improved / enhanced

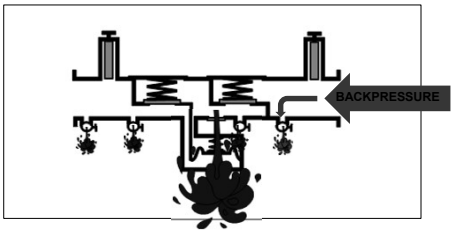
101

RP - Test Cock Flushing – 9th



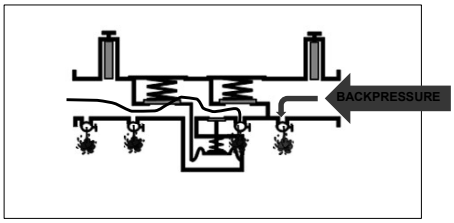
102

RP - Test Cock Flushing – 9th



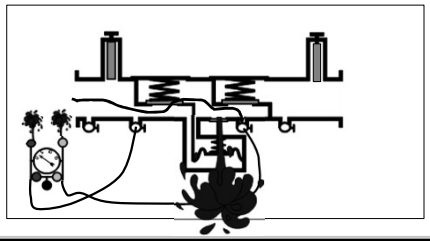
103

RP - Test Cock Flushing – 10th



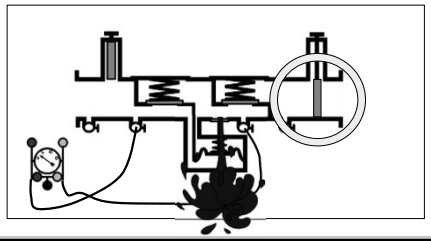
104

RP – Flushing Field Test Kit– 9th



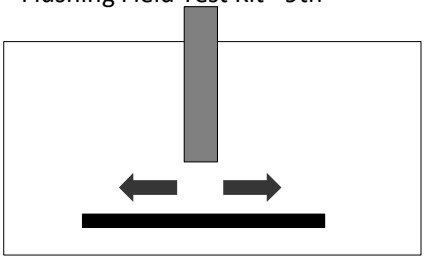
105

RP – Flushing Field Test Kit– 9th



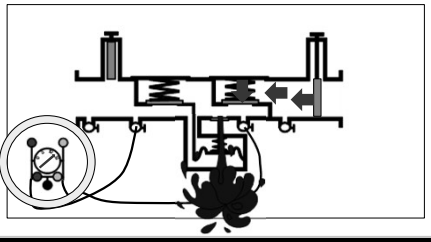
106

RP – Flushing Field Test Kit– 9th



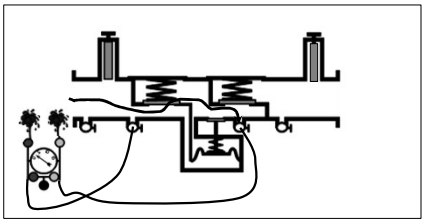
107

RP – Flushing Field Test Kit– 9th



108

RP – Flushing Field Test Kit– 10th



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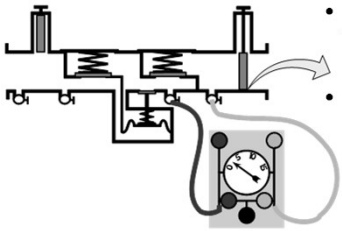
RP - Second Check Differential



- No. 2 Shutoff Valve Must be Drip Tight
- Fluctuating Line Pressure

110

Manual of Cross-Connection Control, 5th Edition- 1974

- Field test procedures added for PVB

111

Manual of Cross-Connection Control, 9th Edition- 1993

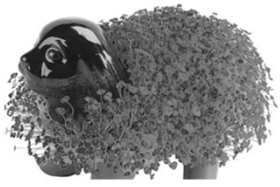
- Field test procedures added for SVB

112

Manual of Cross-Connection Control, 7th Edition- 1985

- Field test procedures added preliminary steps (Notify, Identify, Inspect, Observe), and recommend yearly accuracy verification of gage equipment

113



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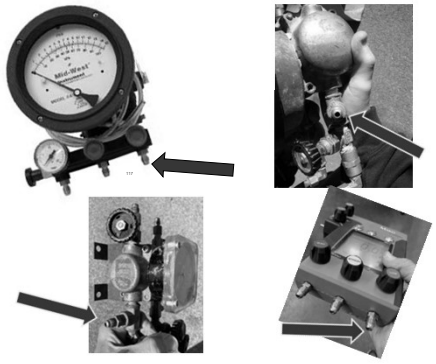
Gauge / Field Test Kit

- Handling / Holding the Field Test Kit
  - Affecting your field testing results

116



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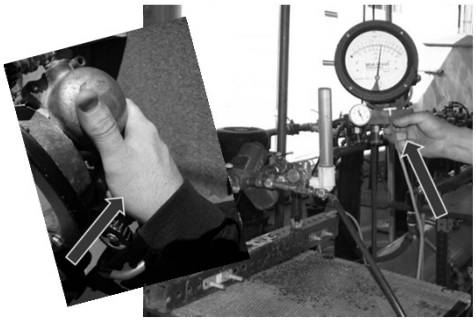

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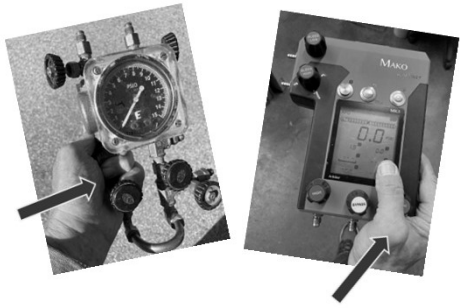

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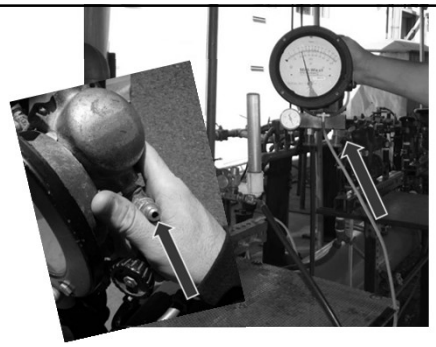
120



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In Conclusion

- Historical Development of Field Test Procedures
- Suitable for "Field" Use
- BEWARE of Shortcuts or Modifications
  - May produce false information
- Goal is the operation of the components to prevent Backflow

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Questions & Discussions

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