

# Backflow Prevention Assembly Tester Expected Range of Knowledge

Approved by the Backflow Prevention Assembly Tester 10/11/05

**The Expected Range of Knowledge is a Foundation upon which the Tester will build a strong professional capability.**

*NOTE:* This Expected Range of Knowledge is intended to provide a comprehensive outline of topics that should be known and understood by a prospective Backflow Prevention Assembly Tester. The Prospective Tester should refer to the Backflow Prevention Assembly Tester Training Resource Listing to assist in acquiring the Expected Range of Knowledge.

## EXPECTED RANGE OF KNOWLEDGE

### Backflow Prevention Assembly Testers

#### 1. Introduction –

The Backflow Prevention Assembly Tester should have a basic understanding of:

- 1.1 The History of Water Distribution Systems.
- 1.2 The History, Causes, and Effects of Cross-connections
- 1.3 The History of the Methods of Backflow Prevention and Backflow Prevention Assemblies.

#### 2. Hydraulics and Theory of Backflow –

The Backflow Prevention Assembly Tester should have a Working Familiarity with:

##### 2.1 Definitions - Hydraulics

Pressure including Absolute Pressure, Atmospheric Pressure, and Gauge Pressure, Negative Pressure (Vacuum).

- 2.1.1 Sources of Pressure including Static Head, Thermal Expansion, Pumps.
- 2.1.2 Head Loss.
- 2.1.3 Water Hammer.
- 2.1.4 Gradient.
- 2.1.5 Venturi Effect.

##### 2.2 Calculations – Hydraulics

- 2.2.1 Calculations involving Water Column Height and Resulting Pressure.
- 2.2.2 Calculate Differential Pressure.

##### 2.3 Hydraulic Theory

- 2.3.1 The relationship between Absolute Pressure and Atmospheric Pressure.
- 2.3.2 The Term Gauge Pressure and its relationship to Absolute Pressure.
- 2.3.3 The Term Vacuum (Negative Pressure) and its relationship to Atmospheric Pressure and Absolute Pressure.
- 2.3.4 Head Loss.
- 2.3.5 Static Pressure.
- 2.3.6 Thermal Expansion.
- 2.3.7 Water Hammer.

##### 2.4 Definitions – Backflow

- 2.4.1 Backsiphonage and Backpressure.
- 2.4.2 Backflow.
- 2.4.3 Direct and Indirect Cross-connections.
- 2.4.4 Degrees of Hazard.
- 2.4.5 Containment (Service) Protection.
- 2.4.6 Isolation (Internal) Protection.

- 2.5 Backflow Theory
  - 2.5.1 List the Conditions that Cause Backflow.
  - 2.5.2 Cross-connections and the difference between an Indirect and a Direct Cross-connection
  - 2.5.3 Backsiphonage and the Principle Causes for its occurrence.
  - 2.5.4 Backsiphonage due to Aspiration (Venturi Effect) in a closed piping system.
  - 2.5.5 Backpressure and the Principle Causes for its occurrence.
  - 2.5.6 The difference between the Terms Contaminant and Pollutant.
  - 2.5.7 Degree of Hazard.
  - 2.5.8 Submerged Inlets to Plumbing Fixtures and the Type of Backflow Condition that results.
  - 2.5.9 The Difference between Containment (Service) and Isolation (Internal) Protection.

3. **Administration of Cross-connection Control Programs -**

The Backflow Prevention Assembly Tester should have a Basic Understanding of the following:

- 3.1 The Regulations and Codes Relating to Cross-connection Control including -
  - 3.1.1 Federal Regulations – The Safe Drinking Water Act
  - 3.1.2 State Regulations.
    - 3.1.2.1 California Code of Regulations, Title 17, Sections 7583-7604
    - 3.1.2.2 Nevada. (NAC 445-A)
    - 3.1.2.3 Applicable Plumbing Code(s) which may be, or include:
      - 3.1.2.3.1 Uniform Plumbing Code
      - 3.1.2.3.2 California Plumbing Code, Calif. Code of Regulations Title 24, Part 5
      - 3.1.2.3.3 Nevada Plumbing Code
- 3.2 The role and responsibilities of the following:
  - 3.2.1 Health Agencies (State and Local).
  - 3.2.2 Water Purveyor.
  - 3.2.3 Cross-connection Control Specialist.
  - 3.2.4 Plumbing Official (Administrative Authority).
  - 3.2.5 Backflow Prevention Assembly Tester.
  - 3.2.6 Consumer.
- 3.3 The following terms as they pertain to the Uniform Plumbing Code -
  - 3.3.1 Administrative Authority.
  - 3.3.2 Accessibility.
  - 3.3.3 Approval.
  - 3.3.4 Backflow including Backpressure and Backsiphonage.
  - 3.3.5 Critical Level.
  - 3.3.6 Plumbing System including Plumbing Fixtures and Appurtenances.
  - 3.3.7 Potable Water
  - 3.3.8 Water Distribution System.

- 3.4 Cross-connection Control Programs
  - 3.4.1 The Definitions of Laws, Regulations, Ordinances, Rules, Provisions and Policies.
  - 3.4.2 The Difference between “Approved” and “Listed”
    - 3.4.2.1 Listing Agencies
    - 3.4.2.2 Approving Agencies
  - 3.4.3 The Major Provisions of a Water Supplier’s Cross-connection Control Program.
  - 3.4.4 The Water Supplier’s possible Courses of Action if a consumer is in non-compliance..
  - 3.4.5 Certification of –
    - 3.4.5.1 Cross-connection Control Program Specialists
    - 3.4.5.2 Backflow Prevention Assembly Testers
  - 3.4.6 Record Keeping/Reporting
    - 3.4.6.1 Test Reports
      - 3.4.6.1.1 Physical Identification of Backflow Prevention Assembly Tested.
      - 3.4.6.1.2 Field Test Data.
      - 3.4.6.1.3 Tester Identification.
      - 3.4.6.1.4 Retention of Test Reports.
    - 3.4.6.2 Improper Installations.

4. **Methods and Assemblies to Prevent Backflow -**

The Backflow Prevention Assembly Tester is Expected to have a basic Understanding of:

- 4.1 The following are Cross-connections and Unapproved Devices:
  - 4.1.1 Swing Connections.
  - 4.1.2 Spools.
  - 4.1.3 Three/Four Way Connections.
  - 4.1.4 Single Check Valve.
  - 4.1.5 Dual Checks – Vented and Unvented.
  - 4.1.6 Other Unapproved Assemblies/Devices.
- 4.2 The Various Methods for Preventing Backflow including the Design, Operation, Major Components, and Installation Requirements of each Method (as appropriate)-
  - 4.2.1 Air Gap.
  - 4.2.2 Barometric Loop.
  - 4.2.3 Antisiphon Devices.
    - 4.2.3.1 Atmospheric Vacuum Breaker (AVB).
    - 4.2.3.2 Pressure Vacuum Breaker (PVB).
    - 4.2.3.3 Spill Resistant Vacuum Breaker (SVB).
    - 4.2.3.4 Double Check Valve Assembly (DC).
    - 4.2.3.5 Reduced Pressure Principle Assembly ( RP).
    - 4.2.3.6 Detector Assemblies (Either Double Check (DCDA) or Reduced Pressure (RPDA)).
  - 4.2.4 Proper Applications for Each of the Methods/Assemblies used to Prevent Backflow
  - 4.2.5 Types of Methods/Assemblies used to protect against a health hazard (contaminant).

- 4.2.6 The Types of Methods/Assemblies used to protect against a non-health hazard (pollutant).
- 4.2.7 Types of Methods/Assemblies used to protect against Backsiphonage.
- 4.2.8 Types of Methods/Assemblies used to protect against Backpressure.
  
- 4.3 Backflow Assemblies –
  - 4.3.1 Standard Pipe Sizes.
  - 4.3.2 Lists of Approved assemblies:
    - 4.3.2.1 USC FCCC & HR.
    - 4.3.2.2 California Approved List.
    - 4.3.2.3 Nevada Approved List.
  - 4.3.3 Identification Information found on the Assemblies – includes Manufacturer, Model, Size, Serial Number..
  - 4.3.4 Test Cocks and their Locations on each of the Types of Assemblies.
  
- 4.4 Field Testing and Troubleshooting of Backflow Prevention Assemblies –
  - 4.4.1 Field Testing Equipment
    - 4.4.1.1 Recognized List of Gauges
    - 4.4.1.2 Components of the Field Test Gauge
    - 4.4.1.3 Operation of the Field Test Gauge.
    - 4.4.1.4 Proper Handling and Storage of the Field Test Gauge.
    - 4.4.1.5 Calibration and Verification of Accuracy of the Field Test Gauge.
    - 4.4.1.6 Vertical Tube.
    - 4.4.1.7 Bleed-off Valve Arrangement.
    - 4.4.1.8 A Field Test Gauge for Backflow Prevention Assemblies in Potable Water Systems
    - 4.4.1.9 A Field Test Gauge for Backflow Prevention Assemblies in Non-Potable Systems (If applicable – do not use the same gauge for non-potable systems as is used for potable systems.)
  
- 4.5 Field Testing Procedures.
  - 4.5.1 The Preliminary Steps to a Field Test and their Importance.
  - 4.5.2 Procedure to properly Inspect an Air Gap.
  - 4.5.3 Procedure to properly Inspect an AVB.
  - 4.5.4 Procedure to properly Field Test the RP.
  - 4.5.5 Procedure to properly Field Test the DC.
  - 4.5.6 Procedure to properly Field Test the PVB.
  - 4.5.7 Procedure to properly Field Test the SVB.
  - 4.5.8 Procedure to properly Field Test the DCDA.
  - 4.5.9 Procedure to properly Field Test the RPDA.
  - 4.5.10 The Process necessary to Return a Backflow Prevention Assembly to Normal Operating Conditions following a Field Test.
  
- 4.6 Field Test Reports.
  - 4.6.1 Assembly Identification.
  - 4.6.2 Field Test Results.
    - 4.6.2.1 Check Valves.
    - 4.6.2.2 Differential Pressure Relief Valve.



- 4.6.2.3 Air Inlet Valve.
- 4.6.2.4 Repair/Maintenance Performed.
- 4.6.2.5 Distribution of Test Reports.
- 4.6.3 Tester Identification.
- 4.7 Troubleshooting a Failed Assembly:
  - 4.7.1 Malfunctioning Shutoff Valves
    - 4.7.1.1 RP – Consequences of Leaking #2 Shutoff Valve
    - 4.7.1.2 DC – Consequences of Leaking #1 and #2 Shutoff Valves.
    - 4.7.1.3 PVB - Consequences of Leaking #1 and #2 Shutoff Valves.
    - 4.7.1.4 SVB – Consequences of leaking #1 and #2 Shutoff Valves.
  - 4.7.2 The Probable Causes for Malfunctioning Check Valves.
  - 4.7.3 The Probable Causes of a Malfunctioning Differential Pressure Relief Valve.
  - 4.7.4 The Probable Causes of a Malfunctioning Air Inlet.
- 4.8 Tools -
  - 4.8.1 Specialty Tools.
  - 4.8.2 Tools to Remove Access Ports or Covers Under Spring Load.
  - 4.8.3 Wrenches.
  - 4.8.4 Screwdrivers.
- 4.9 Safety Precautions.
  - 4.9.1 Confined Space.
  - 4.9.2 Removal of Access Ports or Covers Under Spring Load.
  - 4.9.3 Tool Usage.