American Water Works Association
California-Nevada Section

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.