General Information

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Foreword

This foreword shall not be considered a part of the standard. However, it is offered to provide background information.

ASSE Product Standards are developed in the interest of consumer safety.

In potable water supply systems, there are many varied conditions which can develop and cause a reversal of the normal direction of flow (backflow) in the water supply lines. By this reversal of direction of flow, water from unintended sources can enter and contaminate the potable water in the supply lines and potable water source.

There are two basic types of backflow, identified by the two conditions that cause it:
(1)  Backpressure backflow is a reversal of the normal direction of flow in the pipe line due to a condition which causes the pressure in the system being supplied to become greater than that in the supply line; the system pressure being always above atmospheric.
(2)  Backsiphonage backflow is a reversal of the normal direction of flow in the pipe line due to a negative pressure (vacuum) being created in the supply line with the backflow source subject to atmospheric pressure.

The type of occupancy of the premises, the design and construction of the system, and the manner in which it is used are major influences on the possible incidence of backflow. Consequently, the degree of the hazard to which persons may be exposed varies from discomfort and minor illness, to fatal, if the backflow of contaminants into the potable water system is not completely prevented.

Due to the many variables in systems, devices of different performance characteristics are needed; each tailored to the system and its protection needs. This standard covers two (2) types of devices, which are identified as Reduced Pressure Principle Backflow Preventers (RP) and Reduced Pressure Principle Fire Protection Backflow Preventers (RPF). The RP and the RPF are identical in their backflow protection. The RPF, which was added to this standard in 1999, has specific performance requirements relating to its use on fire protection systems.

This standard is a composite of the most practical and effective behavioral characteristics for devices of this type, drawn on the experience of engineers, manufacturers, public health officials and others who are knowledgeable in this field and who have the responsibility of protecting our potable water supplies.

Although many of the material specifications are detailed within Section 4.1 of this standard, it is the responsibility of the manufacturer and the installer to comply with the relevant jurisdictional requirements.
The working group, which developed this standard revision, was set up within the framework of the Product Standards Committee of the American Society of Sanitary Engineering.

Recognition is made of the time volunteered by members of this working group and of the support of the manufacturers who participated in meetings for this standard.

This standard does not imply ASSE’s endorsement of a product which conforms to these requirements.

Compliance with this standard does not imply acceptance by any code body.

It is recommended that these devices be installed consistent with local codes by qualified and trained professionals.

This standard was promulgated in accordance with procedures developed by the American National Standards Institute (ANSI).

This edition was approved by the ASSE Board of Directors on August 9, 2011 as an ASSE standard.
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Reduced Pressure Principle Backflow Preventers and Reduced Pressure Principle Fire Protection Backflow Preventers

Section I

1.0 General

1.1 Application
The purpose of a Reduced Pressure Principle Backflow Preventer (RP) and a Reduced Pressure Principle Fire Protection Backflow Preventer (RPF) (herein referred to as the “assembly”) is to keep contaminated water from flowing back into a potable water distribution system when some abnormality in the system causes the pressure to be temporarily higher in the contaminated part of the system than in the potable water supply piping.

1.2 Scope

1.2.1 Description
This standard applies to two types of backflow prevention assemblies, identified as:

(a) Reduced Pressure Principle Backflow Preventers (RP); and
(b) Reduced Pressure Principle Fire Protection Backflow Preventers (RPF).

These assemblies consist of two (2) independently-acting check valves, internally force loaded to a normally closed position and separated by an intermediate chamber (or zone) in which there is a hydraulically operated relief means for venting to atmosphere, internally force loaded to a normally open position. These assemblies are designed to operate under continuous pressure conditions. The assembly shall include two (2) properly located, tightly closing shut-off valves, per Section 1.3.2.7, and properly located test cocks, per Section 1.3.2.5.

This standard also applies to Manifold Reduced Pressure Principle Backflow Assemblies consisting of two (2) or more complete Reduced Pressure Principle Backflow Preventers in parallel. The assemblies do not need to be of the same pipe size. The manifold size shall be identified by the single inlet and outlet of the Manifold Reduced Pressure Principal Backflow Assembly. Manifold Reduced Pressure Principle Backflow Assemblies shall include line-sized shut-off valves on each inlet and outlet of the assemblies making up the manifold.

1.2.2 Size Range
Connection pipe sizes shall be in accordance with Table 1.
## Table 1
Rated Water Flow and Maximum Allowable Pressure Loss for Various Sizes

<table>
<thead>
<tr>
<th>Size of Device</th>
<th>Rated Flow</th>
<th>RP Maximum Allowable Pressure Loss at Rated Flow</th>
<th>RPF Maximum Allowable Pressure Loss at Rated Flow</th>
</tr>
</thead>
<tbody>
<tr>
<td>NPS</td>
<td>DN</td>
<td>GPM</td>
<td>L/s</td>
</tr>
<tr>
<td>inch</td>
<td>mm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>¼</td>
<td>8</td>
<td>1.00</td>
<td>0.06</td>
</tr>
<tr>
<td>⅜</td>
<td>10</td>
<td>3.00</td>
<td>0.19</td>
</tr>
<tr>
<td>½</td>
<td>15</td>
<td>7.50</td>
<td>0.47</td>
</tr>
<tr>
<td>¾</td>
<td>18</td>
<td>20.00</td>
<td>1.26</td>
</tr>
<tr>
<td>¾</td>
<td>20</td>
<td>30.00</td>
<td>1.89</td>
</tr>
<tr>
<td>1</td>
<td>25</td>
<td>50.00</td>
<td>3.15</td>
</tr>
<tr>
<td>1 ¼</td>
<td>32</td>
<td>75.00</td>
<td>4.73</td>
</tr>
<tr>
<td>1 ½</td>
<td>40</td>
<td>100.00</td>
<td>6.31</td>
</tr>
<tr>
<td>2</td>
<td>50</td>
<td>160.00</td>
<td>10.09</td>
</tr>
<tr>
<td>2 ½</td>
<td>65</td>
<td>225.00</td>
<td>14.20</td>
</tr>
<tr>
<td>3</td>
<td>80</td>
<td>320.00</td>
<td>20.19</td>
</tr>
<tr>
<td>4</td>
<td>100</td>
<td>500.00</td>
<td>31.55</td>
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<td>6</td>
<td>150</td>
<td>1000.00</td>
<td>63.09</td>
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<td>8</td>
<td>200</td>
<td>1600.00</td>
<td>100.94</td>
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<tr>
<td>10</td>
<td>250</td>
<td>2300.00</td>
<td>145.11</td>
</tr>
<tr>
<td>12</td>
<td>300</td>
<td>3000.00</td>
<td>189.27</td>
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<td>233.43</td>
</tr>
<tr>
<td>16</td>
<td>400</td>
<td>4400.00</td>
<td>277.60</td>
</tr>
</tbody>
</table>

### 1.2.3 Pressure Range

#### 1.2.3.1 An RP assembly shall be designed for a working pressure of at least 150.0 psi (1034.2 kPa).

#### 1.2.3.2 An RPF assembly shall be designed for a working pressure of at least 175.0 psi (1206.6 kPa).
1.2.4 Temperature Range
The assemblies shall be designed for a minimum temperature range of 33.0°F to 140.0°F (0.6°C to 60.0°C).

1.3 Limitations on Design

1.3.1 Structural Strength
All parts of the assembly shall be designed to withstand, without permanent distortion, the stresses developed by the hydrostatic test pressure, as well as the stresses resulting from a specified water working pressure coincident with operation under a specified unbalanced pressure condition.

1.3.2 Mechanical Function

1.3.2.1 Relief Valve Connections
(a) The relief valve discharge port shall be of a size that cannot be threaded for iron pipe size or connected with tubing, either internally or externally.
(b) Connection of an external relief valve to the main valve body shall not be a standard ANSI pipe thread.

1.3.2.2 Female Pipe Threaded Connections
Female pipe threaded connections shall be tapped into bosses in the body and shall be so constructed that it will not be possible to run a pipe into them far enough to restrict the flow through the assembly or interfere with working parts.

1.3.2.3 Repairability
(a) The internal parts of the assembly shall be accessible for inspection, repairs or replacements. The design shall permit this servicing without removing the assembly from the line by using the shut-off valves to isolate the assembly.
(b) All replacement parts of the assemblies of the same size and model shall be interchangeable with the original parts.
(c) Seats shall be replaceable.

1.3.2.4 Delivery Instructions
All assemblies shall be delivered for installation with the shut-off valves attached.

1.3.2.5 Test Cock Location
Test cocks shall be provided in the following locations:
(a) On the supply side of the inlet shut-off valve (not required on any sizes of type RPF assemblies).
(b) Between the inlet shut-off valve and the first check.
(c) Between the checks.
(d) Between the second check and the outlet shut-off valve.

1.3.2.6 Test Cock Size Inlet and Outlet Connection
For assemblies up to and including 1 inch (25 mm) pipe size, a minimum inlet and outlet thread on the test cocks shall be ⅛ NPT or SAE J513 ¼. For assemblies 1½ inch – 2 inch (32 mm – 50 mm), a minimum inlet and outlet thread on the test cocks shall be ¼ NPT. For assemblies 2½ inch – 4 inch (65 mm – 100 mm), a minimum inlet and outlet thread on the test cocks shall be ½ NPT. For assemblies 6 inch (150 mm) and larger, a minimum inlet and outlet thread on the test cocks shall be ¾ NPT. Test cock waterways shall be full port. Protective caps shall be provided on SAE test cocks to protect male outlet threads.
1.3.2.7 Shut-off Valves
(a) Shut-off valves shall be provided at the inlet and outlet of the assembly.
(b) Shut-off valves shall be resilient seated.
(c) For type RPF assemblies, the shut-off valves shall be UL or FM listed or approved for use in fire protection systems.
(d) The #1 shut-off is located at the inlet side of the assembly.
(e) The #2 shut-off is located at the outlet side of the assembly.

1.3.2.8 Air Gap Devices
When an air gap device is supplied as part of the assembly for the relief valve vent, it shall comply with ASME A112.1.3 and shall be in place during all testing.

1.4 Reference Standards

- ASME A112.1.3-2000 (R2010), Air Gap Fittings for Use with Plumbing Fixtures, Appliances and Appurtenances
- ASME B16.24-2006, Cast Copper Alloy Pipe Flanges and Flanged Fittings: Classes 150, 300, 400, 600, 900, 1500 and 2500
- ASME B1.20.1-1983 (R2006), Pipe Threads, General Purpose (Inch)
- ASME B1.20.3-1976 (R2008), Dryseal Pipe Threads (Inch)
- ASME MFC-14M-2003 (R2008), Measurement of Fluid Flow Using Small Bore Precision Orifice Meters
- ASSE Standard #1060-2006, Performance Requirements for Outdoor Enclosures for Fluid Conveying Components
- ASSE Standard Series 5000-2009, Cross Connection Control Professional Qualification Standard
- ASTM A 536-84 (2009), Standard Specification for Ductile Iron Castings
- AWWA C606-06, Grooved and Shouldered Joints
- CFR Title 21, Section 177, Food and Drugs: Indirect Food Additives: Polymers
- ISA 75.02.01-2008, Control Valve Capacity Test Procedures
- University of Southern California Foundation for Cross Connection Control & Hydraulic Research, Manual of Cross Connection Control, Tenth Edition
- UL 312-2010, Check Valves for Fire-Protection Service

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Section II

2.0 Test Specimens

2.1 Samples Submitted for Test

Three (3) assemblies of each type and model for sizes ¼ inch – 2 inch (6 mm – 50 mm), and one (1) assembly sized 2½ inch (65 mm) and larger shall be submitted by the manufacturer to the testing laboratory for evaluation.

Tests shall be performed in the order listed on one (1) assembly of each size submitted.

For alternate orientations, additional samples shall be submitted. Once the primary orientation assembly has completed and passed all Section III tests, the additional samples for an alternate orientation(s) shall be tested for each alternate orientation to all of the following sections:

(a) 3.1, Independence of Components; and
(b) 3.5, Allowable Pressure Loss at Rated Flow.

If the orientation of either of the checks changes from the primary to an alternate orientation, the assembly shall also be tested to all of the following sections:

(a) 3.4, Hydrostatic Backpressure Test of Checks;
(b) 3.8, Drip Tightness of First Check; and
(c) 3.9, Drip Tightness of Second Check.

If the orientation of the relief valve changes from the primary to an alternate orientation, the assembly shall also be tested to all of the following sections:

(a) 3.6, Relief Valve Opening Test;
(b) 3.7, Sensitivity of Differential Pressure Relief Valve Test;
(c) 3.10, Relief Valve Discharge Test with Atmospheric Supply Pressure;
(d) 3.11, Relief Valve Discharge with Positive Supply Pressure;
(e) 3.12, Backpressure/Backsiphonage Test; and
(f) 3.13, Relief Valve vs. Supply Fluctuation Test for Type RPF Assemblies.

2.2 Samples Tested

The testing agency shall select one (1) of each type and model and size for the full test.

2.3 Drawings

Assembly drawings and other data which are needed to enable a testing agency to determine compliance with this standard shall accompany assemblies when submitted for examination and performance testing under this standard.

2.4 Rejection

Failure of one (1) assembly shall result in a rejection of that type and model and size.

2.5 Manifold Assembly

A manifold assembly shall be tested per Sections 3.2, Hydrostatic Test of Complete Assembly, and 3.5, Allowable Pressure Loss at Rated Flow. The individual assemblies that make up the manifold shall meet all of the test sections of the standard in their intended orientation based on the nominal pipe size for each individual assembly.
3.0 Performance Requirements and Compliance Testing

NOTE: A failure due to dirt or debris is not cause for rejection. It is permissible to clean, but not replace fouled discs or seats during any test.

3.1 Independence of Components

3.1.1 Purpose
The purpose of this test is to determine that the shut-off valves, checks and relief valves operate without interfering with each other.

3.1.2 Procedure
Verify that the shut-off valves, checks and relief valves do not interfere with one another through their full range of travel.

3.1.3 Criteria
Any interference of one (1) component with another component shall result in a rejection of the assembly.

3.2 Hydrostatic Test of Complete Assembly

3.2.1 Purpose
The purpose of this test is to determine if the assembly withstands pressures of two (2) times the manufacturer’s maximum rated pressure without leakage or damage to the assembly.

3.2.2 Procedure
Seal the inlet and the outlet of the assembly. Pressurize the assembly through test cock #1 or #2 and hold a pressure of two (2) times the manufacturer’s maximum rated pressure for ten (10) minutes. The assembly's shut-off valves shall be in the full open position.

3.2.3 Criteria
Any external leaks shall result in a rejection of the assembly.

3.3 Seat Leakage Test for Shut-off Valves

3.3.1 Purpose
The purpose of this test is to determine the shut-off valves' capability to withstand a test pressure of two (2) times the manufacturer’s maximum rated pressure in the closed position without leakage.

3.3.2 Procedure
NOTE: Non-integral shut-off valves shall be removed for this test.

3.3.2.1 Procedure for the #1 Shut-off Valve
With the #1 shut-off valve in the closed position, slowly increase the pressure during a one (1) minute period on the inlet side from zero (0) psi to twice the manufacturer’s maximum rated pressure of the assembly. Hold the pressure for ten (10) minutes. Observe for leakage. Repeat the test, pressurizing the outlet side from zero (0) psi to twice the manufacturer’s maximum rated pressure of the assembly.
3.3.2.2 Procedure for the #2 Shut-off Valve
If the sealing mechanism is different between the #1 shut-off valve and the #2 shut-off valve, repeat Section 3.3.2.1 on the #2 shut-off valve.

3.3.3 Criteria
Any evidence of leakage during the test shall result in a rejection of the assembly.

### 3.4 Hydrostatic Backpressure Test of Checks

3.4.1 Purpose
The purpose of this test is to determine if the checks withstand pressures of two (2) times the manufacturer’s maximum rated pressure without leakage or damage to the assembly.

3.4.2 Procedure
Seal the outlet of the assembly. Pressurize the assembly through test cock #4 and hold a pressure of two (2) times the manufacturer’s maximum rated pressure for ten (10) minutes. Record if there is any leakage from the relief valve. Repeat the test, pressuring through test cock #3 with test cock #2 open and the relief valve mechanically held closed or isolated from the assembly. Record if there is any leakage at the inlet or the #2 test cock.

3.4.3 Criteria
Any leakage or indications of damage which prevents full compliance with the remainder of this standard shall result in a rejection of the assembly.

### 3.5 Allowable Pressure Loss at Rated Flow

3.5.1 Purpose
The purpose of this test is to determine the pressure loss through the assembly at any flow from zero (0) GPM to the rated flow. In addition, for RPF assemblies only, the purpose of this test is to determine if the pressure drop through the assembly generally increases from zero (0) flow to a flow of 50.00 GPM (3.15 L/s).

3.5.2 Procedure

3.5.2.1 RP Assemblies
Install the assembly per Figure 1 with a manometer or differential pressure gauge at gauge connections #1 and #2. These shall connect to ring piezometers per ISA 75.02. The supply source shall be capable of supplying a volume of water adequate to meet the flow requirements of the size of assembly on test and maintain an inlet pressure of at least 10.0 psi (68.9 kPa) greater than the allowable pressure loss at rated flow. The pressure loss through the piping between the shut-off valves of the assembly on test and the gauges at gauge connection #1 and #2 shall be subtracted from the differential pressure reading at gauge connection #1 and #2. Purge the system of air, then gradually increase the flow of water through the assembly until the required rated flow of water is achieved, per Table 1. Gradually decrease the flow of water to zero (0).

3.5.2.2 RPF Assemblies
Install the assembly per Figure 1 with a manometer or differential pressure gauge at gauge connections #1 and #2. These shall connect to ring piezometers per ISA 75.02. The supply source shall be capable of supplying a volume of water adequate to meet the flow requirements of the size of assembly on test and maintain an inlet pressure of at least 10.0 psi (68.9 kPa) greater than the allowable pressure loss at rated flow. The pressure loss through the piping between the shut-off valves of the assembly on test and the gauges at gauge connection #1 and #2 shall be subtracted from the differential pressure reading at gauge connection #1 and #2. Purge the system of air. The pressure loss at flow shall be measured at increments of
5.00 GPM (0.32 L/s), starting at zero (0) flow up to 50.00 GPM (3.15 L/s). Gradually increase the flow of water through the assembly until the required rated flow of water is achieved, per Table 1. Increase the flow to 150% of the rated flow shown in Table 1 and record the differential pressure. Increase the flow to 200% of the rated flow shown in Table 1 and hold for five (5) minutes; then record the differential pressure. Gradually decrease the flow of water to zero (0).

**Figure 1**
Test Setup

**Figure 1A**
Assembly on Test

NOTES:
1. Gauge connections #1 & #2 shall be ring piezometers per ISA 75.02.
2. Gauge connections #1 & #2 shall be used for differential pressure readings during the flow test.
3. All pipe is line sized to the device.
3.5.3 Procedure - Reduced Pressure Manifold Assemblies
The rated flow for a manifold assembly shall be per Table 1; the inlet and the outlet of the manifold shall identify its size. During the flow test, while still at 200% of the rated flow per Table 1, alternately close and open shut-off valve #2 of each of the assemblies in the manifold, causing the flow to pass through each assembly in the manifold individually for five (5) minutes.

3.5.3.1 Manifold RP Assemblies
Install the assembly per Figure 1 with a manometer or differential pressure gauge at gauge connections #1 and #2. These shall connect to ring piezometers per ISA 75.02. The supply source shall be capable of supplying a volume of water adequate to meet the flow requirements of the size of assembly on test and maintain an inlet pressure of at least 10.0 psi (68.9 kPa) greater than the allowable pressure loss at rated flow. The pressure loss through the piping between the shut-off valves of the assembly on test and the gauges at gauge connections #1 and #2 shall be subtracted from the differential pressure reading at gauge connections #1 and #2. Purge the system of air, then gradually increase the flow of water through the assembly until the required rated flow of water is achieved, per Table 1. Increase the flow to 150% of the rated flow shown in Table 1 and record the differential pressure. Increase the flow to 200% of the rated flow shown in Table 1 and hold for five (5) minutes; then record the differential pressure. Gradually decrease the flow of water to zero (0).

3.5.3.2 Manifold RPF Assemblies
Install the assembly per Figure 1 with a manometer or differential pressure gauge at gauge connections #1 and #2. These shall connect to ring piezometers per ISA 75.02. The supply source shall be capable of supplying a volume of water adequate to meet the flow requirements of the size of assembly on test and maintain an inlet pressure of at least 10.0 psi (68.9 kPa) greater than the allowable pressure loss at rated flow. The pressure loss through the piping between the shut-off valves of the assembly on test and the gauges at gauge connections #1 and #2 shall be subtracted from the differential pressure reading at gauge connections #1 and #2. Purge the system of air. The pressure loss at flow shall be measured at increments of 5.00 GPM (0.32 L/s), starting at zero (0) flow up to 50.00 GPM (3.15 L/s). Gradually increase the flow of water through the assembly until the required rated flow of water is achieved, per Table 1. Increase the flow to 150% of the rated flow shown in Table 1 and record the differential pressure. Increase the flow to 200% of the rated flow shown in Table 1 and hold for five (5) minutes; then record the differential pressure. Gradually decrease the flow of water to zero (0).

3.5.4 Criteria
(a) The occurrence of pressure loss greater than those shown in Table 1 at flows from zero (0) GPM to rated flow (both ascending and descending) shall result in a rejection of the assembly.
(b) Any relief valve discharge during the flow test shall result in a rejection of the assembly.
(c) Failure of the pressure drop through the RPF assembly to generally increase from static up to a flow of 50.00 GPM (3.15 L/s) with a maximum total downward deviation of 10% from the highest previous value at any point shall result in a rejection of the assembly.
(d) Any damage or permanent deformation of the internal components shall result in a rejection of the assembly.

3.6 Relief Valve Opening Test

3.6.1 Purpose
The purpose of this test is to verify that the pressure relief valve starts to open when the pressure in the intermediate chamber (or zone) is at least 2.0 psi (13.8 kPa) lower than the pressure in the inlet of the assembly.
3.6.2 Procedure
Install the assembly as in Figure 1, including a bypass line with a needle valve and differential gauge between test cocks #2 and #3. Purge the system of air and pressurize the system to approximately 20.0 psi (137.9 kPa). Slightly open the needle valve until the gauge shows a decreasing differential pressure. Observe and note pressure when the first drop of water comes out of the relief valve.
(a) Close the needle valve and open the supply valve to restore the inlet pressure. The relief valve shall re-close tightly.
(b) Flow a small amount of water through the assembly to restore a differential pressure drop across the first check. Return the assembly to a static condition and record the first check’s differential pressure.
(c) Repeat the test, increasing the supply pressure in 10.0 psi (68.9 kPa) increments up to the manufacturer’s maximum rated pressure of the assembly.

3.6.3 Criteria
(a) A reading of less than 2.0 psi (13.8 kPa) at the time of the opening of the relief valve shall result in a rejection of the assembly.
(b) Failure of the relief valve to close drip tight shall result in a rejection of the assembly.

3.7 Sensitivity of Differential Pressure Relief Valve Test

3.7.1 Purpose
The purpose of this test is to determine if the differential pressure relief valve will discharge when the test cocks are fully opened one at a time.

3.7.2 Procedure
Install the assembly in a suitable hydraulic test line which is capable of maintaining an inlet pressure equal to the manufacturer’s maximum rated pressure.
(a) Close the #2 shut-off valve while maintaining the #1 shut-off valve fully open.
(b) Slowly open (four (4) seconds ± one (1) second) test cock #1 until fully open.
(c) Then slowly close (four (4) seconds ± one (1) second) test cock #1.
(d) Flow water by opening shut-off valve #2 to establish normal pressure gradient.
(e) Repeat steps (a) through (d) using test cocks #2, #3 and #4.

3.7.3 Criteria
Any evidence of discharge from the differential pressure relief valve when the test cocks are being operated shall result in a rejection of the assembly.

3.8 Drip Tightness of First Check

3.8.1 Purpose
The purpose of this test is to determine if the static pressure drop across the first check is at least 3.0 psi (20.7 kPa) greater than the pressure differential between the inlet line pressure, and the zone pressure required to open the relief valve for all line pressures from 20.0 psi (137.9 kPa) up to the manufacturer’s maximum rated water pressure, but not less than 150.0 psi (1034.2 kPa).

3.8.2 Procedure
Connect the high side hose of a differential pressure gauge to test cock #2 and the low side hose to test cock #3. Open test cocks #2 and #3 and bleed air from the gauge. Flow a sufficient amount of water through the #2 shut-off valve to re-establish the normal pressure gradient across the first check. When the differential across the first check stabilizes, record the differential pressure. Repeat for each 10.0 psi (68.9 kPa) increment between 20.0 psi (137.9 kPa) and the manufacturer’s maximum rated pressure, but not less than 150.0 psi (1034.2 kPa).
3.8.3 Criteria
Failure of the first check to maintain a static pressure differential of at least 3.0 psi (20.7 kPa) greater than the pressure differential between the inlet line pressure and the zone pressure required to open the relief valve (as determined in Section 3.6) shall result in a rejection of the assembly.

NOTE: The 3.0 psi (20.7 kPa) difference between the first check closing value and the relief valve opening point is for laboratory evaluation only and not for field test pass/fail criteria.

3.9 Drip Tightness of Second Check

3.9.1 Purpose
The purpose of this test is to determine if the second check prevents flow at 1.0 psi (6.9 kPa).

3.9.2 Procedure
Install a sight glass in test cocks #3 and #4. Purge the system of air and open the test cocks to the sight glasses. With the downstream gate on the assembly closed and test valve #2 open, pressurize the inlet of the assembly until there is water filling the sight glass column at test cock #3 to at least 42 inches (1069 mm) measured above the water level in the sight glass at test cock #4. Close the supply valve tightly. Wait for ten (10) minutes. When no further fall of water is observed in the sight glass at test cock #3, record the difference in the water levels between sight glasses at test cocks #3 and #4.

3.9.3 Criteria
A height difference of less than 28 inches (711 mm) between the sight glasses shall result in a rejection of the assembly.

3.10 Relief Valve Discharge Test with Atmospheric Supply Pressure

3.10.1 Purpose
The purpose of this test is to verify that when there is no backflow and the supply pressure is atmospheric, the relief valve shall discharge water from the intermediate chamber (or zone) to atmosphere at the rate of discharge shown in Table 2 with the pressure in the intermediate chamber (or zone) not exceeding 1.5 psi (10.3 kPa).

3.10.2 Procedure
Close test valve #3. Disconnect the differential gauge from test cocks #2 and #3. Install a sight glass on test cock #3. Remove the second check or hold the second check wide open by mechanical means. Allow inlet pressure to fall to atmosphere via test cock #2. Open test valve #3 in the secondary water supply line slowly until the pressure in the intermediate chamber (or zone) is 1.5 psi (10.3 kPa) [i.e.: 42 inch (1069 mm) water column]; then record the relief valve discharge rate.

3.10.3 Criteria
A relief valve rate of discharge less than shown in Table 2 shall result in a rejection of the assembly.

3.11 Relief Valve Discharge with Positive Supply Pressure

3.11.1 Purpose
The purpose of this test is to verify that when there is backflow and the supply pressure is 2.0 psi (13.8 kPa) or greater, the relief valve shall discharge water from the intermediate chamber.
(or zone) to atmosphere at the rate of discharge, shown in Table 2, with the pressure in the zone at least 0.5 psi (3.4 kPa) below supply pressure.

### 3.11.2 Procedure

Install the assembly per Figure 1. Remove the second check or hold the second check wide open by mechanical means. Install a pressure gauge at test cock #4 and a differential gauge between test cock #2 and test cock #3. Open test cocks #2 and #3. Purge the air and pressurize the system to a minimum of 25.0 psi (172.4 kPa) inlet pressure. Close test valve #1 and test valve #2. Open test valve #3 in the secondary water supply, then slowly open test valve #4 until the intermediate chamber (or zone) pressure is 0.5 psi (3.4 kPa) below the supply pressure [i.e.: the differential gauge reads 0.5 psi (3.4 kPa)], or test valve #4 is fully open. Record the discharge rate from the relief valve.

**Table 2**

<table>
<thead>
<tr>
<th>Size of Device</th>
<th>Minimum Flow Through Relief Valve</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>GPM</td>
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<tr>
<td>NPS</td>
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<td>8</td>
</tr>
<tr>
<td>⅜</td>
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<td>350</td>
</tr>
<tr>
<td>16</td>
<td>400</td>
</tr>
</tbody>
</table>
3.11.3 Criteria
A relief valve rate of discharge less than shown in Table 2 shall result in a rejection of the assembly.

3.12 Backpressure/Backsiphonage Test

3.12.1 Purpose
The purpose of this test is to verify that there is no backsiphonage of water from the downstream piping into the supply line when both check valves become fouled and a vacuum is created in the inlet of the assembly.

3.12.2 Procedure
Test the assembly per the University of Southern California Foundation for Cross-Connection Control & Hydraulic Research (USC FCCC&HR) backpressure / backsiphonage protocol, as indicated in the USC Manual of Cross-Connection Control, Tenth Edition.

3.12.3 Criteria
Any indication of damage or permanent deformation that prevents full compliance with the remainder of this standard shall result in a rejection of the assembly. Any evidence of water being drawn from downstream into the upstream transparent collection tube shall result in a rejection of the assembly.

3.13 Relief Valve vs. Supply Pressure Fluctuation Test for Type RPF Assemblies Only

3.13.1 Purpose
The purpose of this test is to verify that there is no discharge from the relief valve when the supply pressure fluctuates 15.0 psi (103.4 kPa) and the assembly is at static.

3.13.2 Procedure
With the assembly installed per Figure 1, pressurize from the inlet to 100.0 psi (689.5 kPa). Bleed all air from the system. While at static, increase the supply to 115.0 psi (792.9 kPa) taking five (5) seconds, and then reduce the supply to 100.0 psi (689.5 kPa) taking five (5) seconds.

3.13.3 Criteria
Any discharge from the relief valve shall result in a rejection of the assembly.

3.14 Air Gap Device Backsiphonage Test
NOTE: This test applies only to assemblies supplied with an air gap device.

3.14.1 Purpose
The purpose of this test is to determine if the backflow protection between the air gap device and the relief valve discharge port(s) is adequate.

3.14.2 Procedure
Attach the inlet of the assembly to a vacuum source. Remove the first moving member. Attach the air gap device to the assembly as prescribed by the manufacturer. Seal the air gap device outlet; then fill with water until it overflows. Apply 25 inches (635 mm) of Hg vacuum to the inlet of the assembly.

3.14.3 Criteria
Evidence of water in the air gap device carrying over into the relief valve discharge port(s) shall result in a rejection of the assembly.
3.15 Deterioration at Manufacturer’s Extremes of Temperature and Pressure Ranges

3.15.1 Purpose
The purpose of this test is to verify that when exposed to water at extremes of manufacturer’s temperature at its maximum rated pressure, the assembly continues to meet the performance requirements of this standard.

3.15.2 Procedure

3.15.2.1 Assemblies shall be tested at 40.0°F (4.4°C) and at the manufacturer’s maximum rated temperature.

3.15.2.2 Water at the manufacturer’s maximum rated temperature and maximum rated pressure shall be circulated through the assembly at a flow rate per Table 3 for one-hundred (100) hours.

3.15.2.3 While still at temperature, test the assembly to:
   a) Section 3.6, Relief Valve Opening Test;
   b) Section 3.8, Drip Tightness of First Check; and
   c) Section 3.9, Drip Tightness of Second Check.
### Table 3
Minimum Hot Water Flow for Various Sizes

<table>
<thead>
<tr>
<th>Size of Device</th>
<th>Minimum Hot Water Flow</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>NPS</td>
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<td></td>
<td>inch</td>
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<td>14</td>
<td>350</td>
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<tr>
<td>16</td>
<td>400</td>
</tr>
</tbody>
</table>

#### 3.15.2.4 Upon completion of the one-hundred (100) hours, flow ambient water through the assembly. Once the assembly reaches ambient temperature, retest the assembly to Section 3.2, Hydrostatic Test of Complete Assembly, and Section 3.4, Hydrostatic Backpressure Test of Checks.

#### 3.15.2.5 Cold Water Test
Flow water maintained at or below 40.0°F (4.4°C) through the assembly for at least one (1) hour. After one hour, retest the assembly to Section 3.15.2.3.

#### 3.15.3 Criteria
Failure to meet the requirements of Sections 3.15.2.3 following both the hot water and cold water tests, and 3.15.2.4 following the ambient water test shall result in a rejection of the assembly.
3.16 Cycle Test

3.16.1 Purpose
The purpose of this test is to determine if the assembly sustains any damage, permanent deformation or impairment of operation as a result of the cycling tests.

3.16.2 Procedures - Cycle for Type RP Assemblies Only
The assembly shall be tested in either its primary or alternate orientation.

(a) Flow ambient water through the assembly at 25% of rated flow at a minimum of 30.0 psi (206.8 kPa) for three (3) seconds minimum.
(b) Cease flow. Hold the assembly at a static pressure of 30.0 psi (206.8 kPa) for six (6) seconds minimum.
(c) While the assembly is at static, increase the backpressure to 150.0 psi (1034.2 kPa) or the manufacturer's maximum rated pressure, if higher, for six (6) seconds minimum.
(d) Decrease the supply pressure to atmospheric. Hold for six (6) seconds minimum.
(e) Increase the supply pressure to 150.0 psi (1034.2 kPa) or the manufacturer's rated pressure, if higher, and hold for six (6) seconds minimum.
(f) Repeat (a) through (e) for 1,250 cycles. Test per Section 3.15.2.3.
(g) Flow water through the assembly at 50% of rated flow.
(h) Repeat (b) through (f).
(i) With the relief valve open to atmosphere, apply a backpressure of 1.0 psi (6.9 kPa) for ten (10) minutes and observe for dripping from the vent.
(j) With the relief valve open to atmosphere, apply a backpressure equal to the maximum rated working pressure of the assembly for ten (10) minutes and observe for dripping from the vent.
(k) Raise the pressure at the inlet of the assembly to 20.0 psi (137.9 kPa) and maintain for ten (10) minutes.
(l) Raise the pressure at the inlet of the assembly to the manufacturer's maximum rated pressure and maintain for ten (10) minutes.
(m) Flow water through the assembly at 75% of rated flow.
(n) Repeat (b) through (f).
(o) Flow water through the assembly at 100% of rated flow.
(p) Repeat (b) through (f).
(q) Repeat (i) through (l).

3.16.3 Procedure - Cycle for Type RPF Devices Only
The assembly shall be tested in either its primary or alternate orientation.

(a) Flow water through the assembly at 25% of rated flow at a minimum of 30.0 psi (206.8 kPa) for three (3) seconds minimum.
(b) Cease flow. Hold the assembly at a static pressure of 30.0 psi (206.8 kPa) for six (6) seconds minimum.
(c) While the assembly is at static, increase the backpressure to 175.0 psi (1206.6 kPa) or the manufacturer's maximum rated pressure, if higher, for six (6) seconds minimum.
(d) Increase the supply pressure to 175.0 psi (1206.6 kPa) or manufacturer's maximum rated pressure, if higher, and hold for six (6) seconds minimum.
(e) Then fluctuate the supply from 175.0 psi (1206.6 kPa) down to 100.0 psi (689.5 kPa) for five-hundred (500) cycles.
(f) Repeat these steps (a) through (e) ten (10) times. Test per Section 3.15.2.3.
(g) With the relief valve open to atmosphere, apply a backpressure of 1.0 psi (6.9 kPa) for ten (10) minutes and observe for dripping from the vent.
(h) With the relief valve open to atmosphere, apply a backpressure equal to the maximum rated working pressure of the assembly for ten (10) minutes and observe for dripping from the vent.
(i) Test per Section 3.4, Hydrostatic Backpressure Test of Checks.

3.16.4 The University of Southern California Foundation for Cross-Connection Control & Hydraulic Research (USC FCCC&HR) life cycle test protocol in the *Manual of Cross Connection Control, Tenth Edition*, is acceptable, provided the number of cycles and the flow rates are not less than those as specified in Section 3.16.2 for RP assemblies or Section 3.16.3 for RPF assemblies.

3.16.5 Criteria
For RP assemblies, failure to pass Section 3.15.2.3 at any point during the cycle test shall result in a rejection of the assembly. Leakage from the second check as evidenced by dripping from the vent during sections 3.16.2(i) and 3.16.2(j) shall result in a rejection of the assembly.

For RPF assemblies, failure to pass Section 3.15.2.3 and 3.5, Allowable Pressure Loss at Rated Flow, shall result in a rejection of the assembly. Leakage from the second check as evidenced by dripping from the vent during sections 3.16.3(g) and 3.16.3(h) shall result in a rejection of the assembly.

### 3.17 Body Strength Test for Type RPF Assemblies

3.17.1 Purpose
The purpose of this test is to determine if the assembly is capable of withstandling the pressures specified in Section 3.17.2 without leakage or damage to the assembly.

3.17.2 Procedure
During this test, it is permitted to mechanically hold the relief valve closed. Seal the inlet and outlet of the assembly. Open the shut-off valves and purge the system of air. Pressurize the assembly with water to four (4) times the manufacturer’s maximum rated pressure and hold for five (5) minutes.

3.17.3 Criteria
Any structural failure that causes leakage shall result in a rejection of the assembly.

NOTE: Leakage of seals or gaskets at flanges or threaded joints shall not be cause for rejection.

### 3.18 Seat Adhesion Test for Type RPF Assemblies

3.18.1 Purpose
The purpose of this test is to verify that after long term contact between a seat and a disc, adhesion has not occurred.

NOTE: This test may be performed on a different assembly from the assembly used for the previous performance tests.

3.18.2 Procedure
Test the assembly per UL Standard 312, *Check Valves for Fire-Protection Service*, Section 18, *Adhesion Test for Resilient Material*.

3.18.3 Criteria
Failure to meet any of the requirements of UL Standard 312, *Check Valves for Fire-Protection Service*, Section 18, *Adhesion Test for Resilient Material*, shall result in a rejection of the assembly.
3.19 High Velocity Test for Type RPF Assemblies

3.19.1 Purpose
The purpose of this test is to determine if the assembly can withstand ninety (90) minutes of water flow at 30.0 ft/sec (9.1 m/sec) without sustaining any permanent damage to internal components.

NOTE: This test may be performed on a different assembly from the assembly used for the previous performance tests.

3.19.2 Procedure
With the assembly installed per Figure 1, close all test cocks and open shut-off valves #1 and #2. Slowly increase the flow velocity to 30.0 ft/sec (9.1 m/sec) and maintain for ninety (90) minutes, then slowly decrease flow to zero (0) and maintain for ninety (90) minutes. At the conclusion of the test, visually inspect the internal components for damage or permanent deformation.

3.19.3 Criteria
No portions of the device shall dislodge or restrict flow.

3.20 Field Evaluation Test for RP and RPF Devices When Required by the Authority Having Jurisdiction

3.20.1 Purpose
The purpose of this test is to ensure that after a one-year field evaluation, the assembly is capable of meeting the minimum performance requirements per the field test requirements in ASSE Standard Series 5000, Appendix E.

3.20.2 Procedure
Three (3) assemblies of each model and size and type shall undergo a one-year field evaluation. Field evaluations shall conform to the pass/fail criteria of the field test requirements as listed in ASSE Standard Series 5000, Appendix E.

When assemblies are identical, except for inlet and outlet connections, only the larger size needs to be tested.

When more than one (1) orientation is being evaluated, two (2) shall be in the primary orientation and at least one (1) assembly shall be installed in each alternate orientation.

NOTE: For the purpose of this test, the alternate orientation is defined as either the check or the relief valve being installed in a different position from the primary orientation.

Field installation sites shall be on different water distribution systems. All field locations shall be static (no flow). The assembly shall be flowed at a rate of 10.00 GPM to 50.00 GPM (0.63 L/s to 3.15 L/s) for ten (10) minutes prior to each field test.

NOTE: The manufacturer is permitted to install a fourth assembly to be evaluated in the event one (1) of the three (3) primary assemblies fails for reasons other than manufacturing design.

Each assembly shall be field tested upon installation, at a minimum of once per quarter and at the conclusion of the one-year field evaluation. One (1) assembly shall be field tested on a monthly basis.
3.20.3 Criteria
A minimum of three (3) assemblies shall successfully complete all the field tests during a one (1) year evaluation period. If additional assemblies were installed, they must also successfully complete the one-year field test unless rendered inoperable by an act of God or accidental damage. Each assembly shall be evaluated independently. Wear which does not prevent successful completion of the monthly/quarterly evaluations shall not be cause for failure. If at any time during the one-year field test an assembly fails a monthly/quarterly evaluation test, the components shall be cleaned (but not replaced), reassembled and retested. The field test shall conclude when all assemblies have been evaluated. Upon completion of the one-year field test, the assembly shall be disassembled and inspected for manufacturing defects and/or indications of permanent deformation. Failure to obtain a passing field test at any time during the evaluation period shall result in a rejection of the assembly. Failure of an RP relief valve opening point for any reason other than that caused by dirt or debris shall be cause for failure.
Section IV

4.0 Detailed Requirements

4.1 Materials

Alloys, rubber, engineered plastics or other materials which are adaptable and will give at least equivalent trouble-free performance in service shall be allowed. In such cases, it shall be the responsibility of the manufacturer to demonstrate to an approved ASSE testing agency that the material has been successfully used in similar applications for at least one (1) year.

4.1.1 Materials in Contact with Water
Solder and fluxes containing lead in excess of 0.2% shall not be used in contact with potable water.

4.1.2 Elastomers and Polymers
All elastomers and polymers in contact with the water shall comply with the requirements of the United States Code of Federal Regulations (CFR) Title 21, Section 177 or the material shall be certified as non-toxic by an independent approved laboratory.

4.1.3 Ferrous Cast Parts
Ferrous cast parts shall conform to ASTM A126 for gray iron or ASTM A536 Grade 65-45-12 for ductile iron.

4.1.4 Ferrous Cast Parts in Contact with Water
Ferrous cast parts in contact with the water flowing through the assembly shall be protected against corrosion by epoxy coating or by other equivalent approved methods.

4.1.5 Stainless Steel Components
Stainless steel components in contact with water shall be Series 300.

4.1.6 Non-Ferrous Wetted Parts
Non-ferrous wetted parts shall have a corrosion resistance at least equal to an alloy of 79% copper.

4.1.7 Internal Non-Cast Parts
Internal non-cast parts shall have a corrosion resistance at least equal to an alloy of 79% copper.

4.1.8 Springs
Springs in contact with the water flowing through the assembly shall have a corrosion resistance at least equal to stainless steel, Series 300.

4.1.9 Flexible Non-Metallic Parts
Diaphragms, valve discs, seat facings or other flexible non-metallic parts shall be designed for continuous exposure to water at the extreme operating temperature ranges and maximum rated pressure of the assembly without change in physical characteristics which would prevent full compliance with all requirements of the standard.

4.1.10 Check Valve and Relief Seats - Materials
Metal to metal seating shall not be acceptable. Either seat, valve disc or both shall be of non-metallic materials to assure pressure tight seating and re-seating.

4.1.11 Seat Rings
Seat rings shall have a corrosion resistance at least equal to an alloy of 79% copper.
4.1.12 Test Cock - Material
Test cocks wetted components shall have corrosion resistance at least equal to an alloy of 79% copper.

4.1.13 Pipe Flanges
Pipe flanges shall conform to ASME B16.24 for bronze flanges and ASTM A126 for cast iron flanges.

4.1.14 Pipe Threads
(a) Taper pipe threads, except dryseal, shall be in compliance with ASME B1.20.1.
(b) Dryseal shall be in compliance with ASME B1.20.3.

4.2 Grooved Connections
Inlet and outlet grooved connections shall comply with AWWA C606, Grooved and Shouldered Joints.

4.3 Marking Instructions

4.3.1 Marking of Assembly
Each assembly shall have the following information marked on it where it will be visible after the assembly has been installed:

(a) Manufacturer's name or trademark.
(b) Type (RP or RPF) and model number of the assembly.
(c) Maximum rated pressure.
(d) Maximum rated temperature.
(e) Serial number consistent with the manufacturer's standard practice.
(f) Nominal valve size.
(g) The direction of water flow.
(h) Each shut-off valve shall be marked with the manufacturer's name or trademark and model number.

For manifold assemblies, markings (a) through (g) are required for each individual assembly. Markings (a), (b), (e) and (f) are required on the manifold assembly.

4.3.2 The markings shall be either cast, etched, stamped or engraved on the body of the assembly or on a brass or stainless steel plate securely attached to the assembly with a corrosion resistant means.

4.4 Installation and Maintenance Instructions

4.4.1 Complete instructions for installation and maintenance, including drawings or schematic sketches which may be useful to the installer, shall be packaged with each assembly.

4.4.2 The installation instructions shall indicate the tested and approved installation orientation of the assembly.

4.4.3 Maintenance
All assemblies shall be capable of being maintained or repaired while in-line.

4.4.4 Field Testing
Manufacturer's recommendations for field testing shall be furnished.
Section V

5.0 Definitions

Definitions not found in this section are located in the Plumbing Dictionary, Sixth Edition, published by ASSE.
Appendix A - Installation Guidelines

This Appendix shall not be considered a part of the Standard.

A1.0 Recommended Installation Guidelines

A1.1 General

A1.1.1 The installer shall read all installation instructions furnished with the assembly by the manufacturer before attempting to install the assembly.

A1.1.2 The assembly shall not be installed in an underground vault or pit.

A1.1.3 It is not acceptable to install plumbing fixtures or valves between the upstream and downstream shut-off valves of the assembly. This shall include, but not be limited to, strainers, pressure regulating valves and flow control valves.

A1.1.4 The assembly shall be installed in an accessible location with sufficient clearance to permit periodic testing and maintenance.

A1.1.5 Pipelines shall be thoroughly flushed of foreign matter before the assembly is installed.

A1.1.6 Assemblies shall be tested by a Certified Backflow Prevention Assembly Tester after the assembly has been installed and periodically thereafter as recommended by local plumbing codes, but at least annually.

A1.1.7 The relief valve of the assembly is capable of discharging large quantities of water/liquid. Special consideration shall be given to the location of the assembly installation, to ensure that adequate drainage is provided, as any relief valve discharge will cause damage to the surrounding area. The relief valve discharge shall not be piped directly to a drain without a proper air gap.

A1.1.8 Enclosures shall comply with ASSE Standard #1060, Performance Requirements for Outdoor Enclosures for Fluid Conveying Components.

A1.2 Orientation

A1.2.1 The assembly shall be installed only in the orientation that the assembly has been laboratory tested per this standard. This installation orientation shall be clearly indicated in the manufacturer’s installation instructions.

A1.2.2 Local code will govern the height of the installation above adequate drains. The installation shall be made so that no part of the assembly can be submerged. The recommended minimum height above ground to the bottom of the unit is 12 inches (305 mm) with a maximum suggested height of 30 inches (762 mm), so the assembly can easily be serviced.
A1.3 Side Clearances

A1.3.1 For assemblies sized ¼ inch – 3 inch (6 mm – 75 mm), it is recommended that a minimum of 24 inches (610 mm) clearance be provided between the side of the assembly containing the test ports and the adjacent side wall. If the test ports are located at the top or bottom of the assembly, at least one other side shall be provided with 24 inches (610 mm) of clearance. Each of the other sides shall be provided with a minimum of 12 inches (305 mm) of clearance.

A1.3.2 For assemblies sized 4 inch – 10 inch (100 mm – 250 mm), each of the dimensions stated in Section A1.3.1 shall be increased 100%.