Listing Evaluation Criteria for Backflow Preventer and Automatic Boiler or Chiller Filling Device with Pressure Regulating Management

Product Standards Committee Resolutions
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**Foreword**

This foreword shall not be considered a part of the listing evaluation criteria (LEC); however, it is offered to provide background information.

ASSE standards and LECs are developed in the interest of consumer safety.

The device is designed to be connected directly to a building’s incoming potable water supply to fill from empty or refill a heating or chilled water system without the use of a pump. It accomplishes this by utilizing the pressure already generated by the incoming potable supply. The device contains integral system backflow protection as well as an electronic pressure regulator.

**Device Operation**

1. Incoming potable/boosted water enters the unit through the inlet filter ball valve.
2. Water passes through a check valve and through a normally closed inlet solenoid valve.
3. Water continues to pass through the manifold and through the second check valve.
4. Water now passes through a further ball valve as it enters into the heating or chilled water system.
5. Once the required system pressure is achieved the inlet solenoid valve closes and the drain solenoid valve opens.
6. The drain solenoid valve now releases the water that lies between the inlet solenoid valve and the second check valve to drain using a siphon effect to introduce an air gap within the device’s manifold.
7. This cycle is repeated as and when the system requires “topping up.”
8. Thereafter the device constantly monitors the connected systems operation for backflow.

Function of this device is similar to that of a device that conforms with ASSE 1012. The similarities and differences are stated within the LEC.

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

This LEC does not imply ASSE’s endorsement of a product which conforms to these requirements. Compliance with this LEC 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. It is recommended that these devices be maintained and serviced per the manufacturer’s recommendation, filters are replaced at regular intervals per the manufacturer’s instructions.
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1. General

1.1 Application
Direct-type boiler and chiller fill valve assemblies with integral backflow preventer and system pressure regulator (herein referred to as the "device") are used to control the inflow of water into heating and cooling systems to ensure sufficient system pressure. Devices protect the potable water supply against backflow due to backpressure and backsiphonage.

1.2 Scope

1.2.1 Description
Devices incorporate two independent check valves in series separated by a means of discharging to a drain by way of a valve and air gap, a means to automatically control flow based on a pressure range, and a means of atmospheric venting to allow drainage. Devices shall only be installed in the vertical up-vertical down (VUVD) orientation. Check valves shall be force-loaded to a normally closed position.

Note: A device conforming with Figure 1 uses a configuration similar to an ASSE 1012 device, with additional subcomponents. The combination of check valves C1 and C2 along with solenoid S2, the float vent valve, and air gap comprise an assembly similar to a backflow preventer with intermediate atmospheric vent.

1.2.2 Minimum Flow Capacity
The device shall be able to flow at minimum 3.7 US gal/min (14 L/min) at a flowing pressure of 30 psi (207 kPa).

1.2.3 Pressure Range
The device shall be designed for a maximum incoming line pressure of 100 psi (689 kPa).

1.2.4 Temperature Range
The device shall be designed for a maximum incoming water temperature of 140 °F (60 °C).

1.2.5 Size and Connections
Connections shall be in compliance with the standards referred to in local plumbing codes.
Pipe threads shall comply with one of the following standards
   a. ASME B1.20.1 NPT or NPSM,
   b. ASME B1.20.3 dryseal,
   c. ASME B1.20.7 hose threads, or
   d. ISO 228 G1/2 threads

1.2.6   Electrical Requirements
The device shall comply with the appropriate electrical requirements of UL 60730-1 or BS EN 60730-1, 9, or comply with the applicable requirements of UL 1951. The maximum power consumption during system fill or refill shall be less than 50 W.

1.2.7   Air Gap Fittings
Integral air gap devices shall comply with ASME A112.1.3.

1.3   Reference Documents
Referenced standards shall be to the revision of the standard given. Below are the current revisions at time of this standard’s publication.
   • ASME A112.1.3-2000 (R2019), Air Gap Fittings for use with Plumbing Fixtures, Appliances, and Appurtenances
   • ASME B1.20.1-2013 (R2018) - Pipe Threads, General Purpose (inch)
   • ASME B1.20.3-1976 (R2018) - Dryseal Pipe Threads (Inch)
   • ASSE 1012-2009, Performance Requirements for Backflow Preventers with an Intermediate Atmospheric Vent
   • ASSE 1081-2014, Performance Requirements for Backflow Preventers with Integral Pressure Reducing Boiler Feed Valve and Intermediate Atmospheric Vent Style for Domestic and Light Commercial Water Distribution Systems
   • BS EN 60730-1:2016, Automatic electrical controls. General requirements
   • ISO 7-1:1994, Pipe threads where pressure-tight joints are made on the threads — Part 1: Dimensions, tolerances and designation
   • ISO 228-1:2000, Pipe threads where pressure-tight joints are not made on the threads — Part 1: Dimensions, tolerances and designation
   • United Kingdom Statutory Instruments, The Water Supply (Water Fittings) Regulations 1999 No. 1148
   • UL 969-2017, Marking and Labeling Systems
   • UL 1951-2017, Standard for Electric Plumbing Accessories
   • UL 60730-1, Edition 5 (2016), Automatic Electrical Controls for Household and Similar Use - Part 1: General Requirements
2. Test Specimens and Test Laboratory

2.1 Samples Submitted
An adequate number of samples of each type, model and size shall be submitted by the manufacturer to complete the required tests. Access to and instructions to use the appropriate electronic controls to perform the tests is required.

2.2 Samples Tested
The testing agency shall select 1 or more of each type, model and size. Test shall be performed in the order in this LEC.

2.3 Documentation
Assembly drawings, installation instructions and other data which are needed to enable a testing agency to determine compliance with this standard shall accompany devices when submitted for examination and performance tests under this LEC.

2.4 Rejection
Failure of 1 device shall result in a rejection of that type, model and size.
3. Performance Requirements and Compliance Testing

3.1 Hydrostatic Testing of Complete Device

3.1.1 Purpose
The purpose of this test is to determine the device’s ability to withstand a pressure of 200 psi (1379 kPa) or twice the manufacturer’s maximum rated pressure, whichever is greater.

3.1.2 Procedures
Follow the manufacturer’s instructions to operate the following test.

a. Open valve MV1. Energize (open) valve MS1. Ensure valve S2 is open. Flow water at 60.0 °F ± 10.0 °F (15.6 °C ± 5.5 °C) through the device to purge it of air.

b. Energize (close) valve MS2 and open valve MV2. Purge remaining air from device.

c. Close valve MV2. Pressurize the system to a hydrostatic pressure of 200 psi ± 5.0 psi (1379 kPa ± 34.5 kPa) or twice the manufacturer’s maximum rated pressure, whichever is greater. Hold the pressure for a period of 5 minutes +10 /–0 seconds and examine the device for leaks.

3.1.3 Criteria
Any leaks or indications of damage shall result in a rejection of the device.

*Figure 1 – Schematic of the device*
3.2 Hydrostatic Test of Checks

3.2.1 Purpose
The purpose of this test is to determine whether leakage or damage occurs when check valves are individually subjected to a pressure of 200 psi (1379 kPa) or twice the manufacturer’s maximum rated pressure, whichever is greater, applied downstream of each check valve.

3.2.2 Procedures
Follow the manufacturer’s instructions to operate the following test. Follow the steps Table 1. Vent to atmosphere or close the valves as prescribed in Table 1. Where Table 1 states to pressurize, increase the pressure at the given valve to 200 psi ± 5.0 psi (1379 kPa ± 34.5 kPa) or twice the manufacturer’s maximum rated pressure, whichever is greater, for 5 minutes.

<table>
<thead>
<tr>
<th>Step</th>
<th>Check under test</th>
<th>MV1</th>
<th>MA1</th>
<th>MS1</th>
<th>MA2 and MA3</th>
<th>MA4</th>
<th>MV2</th>
<th>MS2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>C1</td>
<td>Closed</td>
<td>Vent</td>
<td>Open&lt;sup&gt;1&lt;/sup&gt;</td>
<td>Pressurize</td>
<td>Closed</td>
<td>Closed</td>
<td>Closed&lt;sup&gt;1&lt;/sup&gt;</td>
</tr>
<tr>
<td>2</td>
<td>C2</td>
<td>Open</td>
<td>Closed</td>
<td>Closed&lt;sup&gt;1&lt;/sup&gt;</td>
<td>Vent</td>
<td>Pressurize</td>
<td>Closed</td>
<td>Closed&lt;sup&gt;1&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

<sup>1</sup>Open and closed refers to the valve path, not the solenoid state.

3.2.3 Criteria
Any indications of water at any valve vented to atmosphere or damage shall result in a rejection of the device. Any water observed due to the compression of a check valve disc shall not be cause for rejection of the device.

3.3 Water Hammer (Shock Test)

3.3.1 Purpose
The purpose of this test is to determine whether the device, when subjected to a pressure of 300 psi (2068 kPa) or 3 times the manufacturer’s maximum rated working pressure, whichever is greater, withstands the shock wave produced in the downstream piping.

3.3.2 Procedure

a. Install the device per Figure 2. Electronic pressure recorders shall be used in the performance of this test.

b. Close valve to the expansion tank V3.

c. Bleed air out of all the lines, including internal lines to the sensors.

d. Per the manufacturer’s instructions, open valve MV1, valve MS1, and valve MV2. Close valve MS2.

e. A suitable flow shall be established through the device which, in combination with a quickly closing shut-off valve, V2, will produce a shock wave measured at P2 equal to 300 psi (2068 kPa) or 3 times the manufacturer’s maximum rated working pressure of the device, whichever is greater.

f. Repeat step E, 4 times.

3.3.3 Criteria

Any indication of leakage (excluding the vents) or damage which impairs the intended functions of the device shall result in a rejection of the device.

3.4 Endurance Test

3.4.1 Purpose

The purpose of the test is to expose the device to the normal estimated life.

3.4.2 Procedure

a. Install the device per Figure 2.

b. Verify V3 to expansion tank is shut

c. Set the incoming flowing water pressure to 72.5 ± 7.25 psi (500 ± 50.0 kPa) at P1. Set the water temperature to 68 ± 18 °F (20 ± 10 °C).

d. Activate the device to perform a fill and discharge cycle.

e. Repeat step d for 5000 cycles.

3.4.3 Criteria

Any indication of damage which impairs the intended functions of the device shall result in a rejection of the device.

3.5 Reseating Tightness of Downstream Check

Device shall comply with the *Reseating Tightness of the Downstream Check Test* within ASSE 1012.

3.6 Reseating Tightness of Upstream Check

Device shall comply with the *Reseating Tightness of the Upstream Check* test within ASSE 1012.

3.7 Backflow Through the Upstream Check
Close valve MS2 and open valve MS1. Device shall comply with the Backflow Through the Upstream Check test within ASSE 1012.

3.8 Atmospheric Vent Verification

3.8.1 Purpose
The purpose of this test is to determine if the atmospheric vent opens under a backflow pressure condition. This test is similar to the Atmospheric Vent Open Pressures test of ASSE 1012.

3.8.2 Procedure
a. Install the device per Figure 2. Foul the downstream check valve as described in table 1 and figure 3 from 1012. Open valves V1 and V2 to purge the system of air. Measure the flow rate.
b. Set the flowing pressure to P1 to 25.0 psi ± 1.0 psi (172.4 kPa ± 6.9 kPa). Close valve V2. Observe for any discharge past the air gap device.
c. Reduce the pressure at P1 until water discharges from the air gap device. Record the pressure at P1 and P2.
d. Repeat b) and c) at 100.0 psi (689 kPa) or the maximum pressure of the device.

3.8.3 Criteria
Under a backpressure condition, failure of the atmospheric vent to open by the time the supply pressure reaches 80% of the downstream pressure shall result in a rejection of the device.

3.9 Backsiphonage
Device shall comply with the Backsiphonage Test of ASSE 1012. Ensure that the flow path at solenoid S1 is open.

Do not repeat this test for orientations other than the vertical-up vertical-down (VUVD) orientation described by the manufacturer and Figure 1.

3.10 Backsiphonage and Backpressure
Device shall comply with the backsiphonage and backpressure test of ASSE 1012.

Do not repeat this test for orientations other than the vertical-up vertical-down (VUVD) orientation described by the manufacturer and Figure 1.

3.11 Reduced Downstream Pressure Deviation Test
3.11.1 Purpose
To verify set outlet pressure does not vary from changes in supply pressure.

3.11.2 Procedure
a. Install the device into the test fixture per Figure 3.
b. Fill the fixture and purge the system of air.
d. Maintain the supply pressure at 50.0 psi (345 kPa).
   - Open the bleed valve V7 and bleed through the 1/16 inch (1.6 mm) orifice
   - adjust the device to deliver a reduced pressure of one-half (½) of the manufacturer’s maximum reduced pressure rating, or 35.0 psi (240 kPa), whichever is less as indicated by the downstream pressure gage.
e. With the bleed valve still open, increase the supply pressure to 80.0 psi (552 kPa) and record the downstream pressure.
f. Return the supply pressure to 50.0 psi (345 kPa) and record the reduced outlet pressure.
g. Record the downstream pressure at each supply pressure and compare to manufacturer’s published data.

3.11.3 Criteria
The set outlet pressure shall not deviate more than 3 PSI throughout the test.

3.12 Reduced pressure adjustment range test

3.12.1 Purpose
The purpose of this test is to verify the manufacturer’s stated adjustment range.

3.12.2 Procedure
a. Install the device into the test fixture per Figure 3.
b. Fill the fixture and purge the system of air.
d. Maintain the supply pressure at 100 psi (345 kPa).
   - Open the bleed valve V7 and bleed through the 1/16 inch (1.6 mm) orifice
  e. Set the device to the maximum output pressure
  - Once the device reaches the maximum output pressure, hold the output pressure for one minute with V7 open.
f. Set the device to the minimum output pressure
  - Once the device reaches the minimum output pressure, hold the output pressure for one minute with V7 open.

3.12.3 Criteria
Failure of the device to maintain maximum and minimum outlet pressures to within ± 3.0 psi (21 kPa) of the manufacturer’s stated adjustment range shall result in a rejection of the device.

3.13 **Flow and pressure test**

3.13.1 **Purpose**
The purpose of this test is to test the minimum water flow capacity versus the maximum allowable pressure loss across the device.

3.13.2 **Procedure**
The test system, as described in Figure 3, shall be equipped with means for accurately measuring the rate of flow through the device and indicating or recording pressures.

- Pressure gauges shall be located approximately
  - Five (5) pipe diameters (dimension “a”) upstream
  - Ten (10) pipe diameters (dimension “b”) downstream of the device.
  - The supply system shall be capable of supplying a volume of potable water adequate to meet the maximum flow requirements of the device on test while sustaining a steady inlet pressure of not less than 25% of the rated working pressure of the device.

a. Install the device into the test fixture per Figure 3.
b. Fill the fixture and purge the system of air.
c. Set the incoming pressure at 50 psi.
d. Close shut-off valves V3, V7, and V8. Open the supply valve(s) fully, and then gradually open discharge valve V8 until a flow rate of 3.7 gpm (14 lpm flow) or the manufacturer’s minimum whichever is greater is reached.
e. Record the pressure loss over the device.

3.13.3 **Criteria**
A pressure loss greater than 25 psi shall result in the rejection of the device.

3.14 **Deterioration at Extremes of Manufacturer’s Temperature Range**

3.14.1 **Purpose**
The purpose is to evaluate whether the device will continue to operate after being exposed to extremes of the manufacturer’s given temperatures.

3.14.2 **Procedure**
Perform the procedure *Deterioration at Extremes of Manufacturer’s Temperature Range* in ASSE 1012, except:

- The maximum temperature shall be per section 1.2.4
- Do not perform the *Atmospheric Vent Leakage* test
- Do not perform the steam test

Repeat sections 3.8 and 3.10.

3.14.3 **Criteria**
Failure to comply with Sections 3.8 and 3.10 when retested shall result in a rejection of the device.

4. Detailed Requirements

4.1 Materials in Contact with Water
Solder and fluxes containing lead in excess of 0.2% shall not be used in contact with potable water. Metal alloys in contact with potable water shall not exceed 8% lead.

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, 177 or the material shall be certified as non-toxic by an independent approved laboratory.

Copper alloys in contact with water and containing more than 15% zinc (Zn) by weight shall be resistant to dezincification. When tested in accordance with ISO 6509-1, the maximum depth of dezincification shall not exceed 200 μm.

Copper alloys in contact with water and containing more than 15% zinc (Zn) by weight shall be resistant to stress corrosion. There shall be no evidence of cracking when tested in accordance with ASTM B858 or ISO 6957 in a test solution of 9.5 pH.

4.2 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 maximum rated operating temperature of the device without change in physical characteristics which would prevent full compliance with all requirements of the standard.

4.3 Metal to Metal Seating
Metal to metal seating check valves shall not be permitted.

4.4 Pipe Threads
Taper pipe threads except dryseal shall be in compliance with ANSI/ASME Standard B1.20.1. Dryseal shall comply with ANSI/ASME Standard B1.20.3.

4.5 Installation Instructions
Maintenance instructions shall be supplied to instruct:
   a. How to clean the mechanical components in case of debris or scale buildup.
   b. How to test the unit in the event that the check valves or other components in the device or the downstream system need to be serviced.
   c. That the orientation of the device must be installed in the vertical up vertical down orientation.
   d. Installation instructions shall be supplied with the maximum and minimum pressures that the outlet can be reduced to.

4.6 Markings
Each device shall have the following information marked on it where it will be visible after the device has been installed:

(a) Name of manufacturer or trademark;
(b) Type or model number of the device;
(c) Maximum rated working pressure;
(d) Maximum water temperature for which the device is designed;
(e) Serial number or other marking consistent with the manufacturer’s standard practice;
(f) The direction of water flow through the device.

The marking shall be either cast, etched, stamped, molded, or engraved on the body of the device, on a durable metal plate securely attached to the device, or on a label compliant to UL 969.

5. Definitions
Definitions not located in this section are located in the Plumbing Dictionary, Sixth Edition, published by ASSE.