

**SEMATECH Provisional Test Method  
for Pressure Leak Testing Filter  
Cartridges Used in UPW Distribution  
Systems**

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# SEMATECH Provisional Test Method for Pressure Leak Testing Filter Cartridges Used in UPW Distribution Systems

Technology Transfer # 92010943B-STD

**SEMATECH**

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**Abstract:** This procedure provides a uniform method for detecting leakage in a cartridge filter by gas pressurization while the test specimen is submerged in a liquid of low surface tension. It is intended for verifying the assembly integrity of filter cartridges for ultrapure water distribution systems. This document is in development as an industry standard by Semiconductor Equipment and Materials International (SEMI). When available, adherence to the SEMI standard is recommended.

**Keywords:** Ultrapure Water Distribution Systems, Testing, Filters, Leakage

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## SEMASPEC #92010943B–STD

### SEMATECH Provisional Test Method for Pressure Leak Testing Filter Cartridges Used in UPW Distribution Systems

#### 1. Introduction

- 1.1 *Purpose*—This procedure provides a uniform method for detecting leakage due to mechanical failure in a cartridge filter by gas pressurization, while the test specimen is submerged in a liquid of low surface tension.
- 1.2 *Scope*—This method is intended for verifying the assembly integrity of filter cartridges for ultrapure water (UPW) distribution systems.
- 1.3 *Limitations*
- 1.3.1 This method is intended only for new components to be used in ultrapure water, without oxidants, and at ambient temperature.
- 1.3.2 This method is intended to test for assembly integrity only. The method is not applicable to the determination of bubble point or pore size. Consult the filter manufacturer for recommendations on appropriate pore size determination procedures.

#### 2. Referenced Documents

##### 2.1 *ASTM Standards*<sup>1</sup>

ASTM D5127	Standard Guide for Electronic Grade Water
ASTM E479	Guide for Preparation of a Leak Testing Specification
ASTM E432	Guide for Selection of a Leak Testing Method

##### 2.2 *ANSI Standards*<sup>2</sup>

ANSI B93.22M	Hydraulic Fluid Power – Filter Elements – Verification of Fabrication Integrity (technically identical to ISO 2942–1985 <sup>3</sup> )
ANSI B93.2	Fluid Power Systems and Products – Glossary

#### 3. Terminology

- 3.1 Filter terms are defined in accordance with ANSI B93.2.
- 3.2 *ultrapure water (UPW)*—type E-1 electronic grade water as defined in ASTM D5127.

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<sup>1</sup> American Society for Testing and Materials. 1916 Race St. Philadelphia PA 19103.

<sup>2</sup> American National Standards Institute. 1430 Broadway. New York NY 10018.

<sup>3</sup> International Organization for Standardization. Geneva, Switzerland.

#### 4. Summary of Test Method

The filter cartridge to be evaluated is assembled per the manufacturer's instructions into the test apparatus. The filter cartridge is submerged into the liquid at ambient temperature. The filter cartridge is pressurized, allowed to stabilize, and inspected for bubbles.

#### 5. Significance and Use

5.1 The immersion leak technique is used to locate leaks in filter assemblies and is not intended for pore size determination.

5.2 In low surface tension fluids, leakage will be reliably indicated by a continuous stream of bubbles. Scattered and occasional bubbles may be caused by the diffusion of the pressurized test gas through the wetted layers of the filter. Such "diffusion" bubbling will not begin immediately with the application of the test pressure. If questionable bubbling is observed, repeated pressurization may help clarify the significance. Apparent leaks that do not repeat with additional test cycles can be discounted.

#### 6. Apparatus

6.1 *Test Gauges or Electronic Sensors.* Redundant test pressure instruments are recommended. Test pressure indication accuracy should be  $\pm 1\%$ . Bubble detection is to be visual.

6.2 *Immersion Tank.* The tank must have dimensions sufficient for filter cartridge immersion to the required depth. A transparent tank is recommended to allow complete visual examination of all test article surfaces. Allow additional room for the holding fixture. Provide a nonsealing top closure to prevent splashing of the immersion liquid. A dark background may improve the contrast for easier bubble detection.

6.3 *Holding Fixture.* Ensure that the fixture is mechanically capable of maintaining the outlet seal against the applied load of the test pressure.

6.4 *Pressure Lines, Fittings, Shut-off Valves and Vent Valves,* of appropriate pressure ratings.

#### 7. Materials

7.1 *Test Gases and Fluids.* All test gases and test fluids should be stabilized to equal temperatures; 23°C (73°F) is preferred. Note any variation in the test environment. Both the test gas and the immersion fluid should be kept clean and oil-free. Replace immersion fluid regularly to prevent contamination.

7.2 *Nitrogen,* clean, dry, and pressurized using sufficient source pressure for the test requirements.

7.3 *Immersion Liquid.* Follow the manufacturer's recommendation for the appropriate, specified immersion fluid. Fluids with low surface tensions (less than 28 dynes/cm) are preferred.

7.5 *Gas Pressure Regulator,* of appropriate range.

## 8. Precautions

### 8.1 *Safety Precautions*

8.1.1 This test method may involve hazardous materials, operations, and equipment. This test method does not purport to address the safety considerations associated with its use. It is the responsibility of the user to establish appropriate safety and health practices and to determine the applicability of regulatory limitations before using this method.

8.1.2 **Warning:** This method may subject test specimens to the maximum performance rating of the products under evaluation. Adequate precautions must be taken to prevent injury to the person conducting the test.

### 8.2 *Technical Precautions*

8.2.1 This procedure cannot be used while filters are installed at the point of use.

8.2.2 **Caution:** The immersion fluid may contain contaminants that could be deposited on the filter surfaces. Filters that have been immersed should be additionally rinsed prior to use in critical systems.

8.2.3 Some filter assembly types are not designed for reverse pressurization. Confirm applicability with filter manufacturer before testing.

## 9. Sampling and Test Specimens

9.1 Ensure that the sample is appropriately mounted into the test holding fixture.

9.2 Test results may vary with component condition or temperature. Allow all components to reach equilibrium at the specified test temperature prior to testing (see Section 11). Test pressures and immersion fluids must conform to the filter manufacturer's recommendations.

## 10. Preparation of Apparatus

10.1 See Figure 1 for a pressure leak testing schematic.

## 11. Conditioning

11.1 Ambient temperature is  $23 \pm 3^{\circ}\text{C}$  ( $73 \pm 5^{\circ}\text{F}$ ).

11.2 All test articles should be stabilized to equal temperatures;  $23^{\circ}\text{C}$  ( $73^{\circ}\text{F}$ ) is preferred. Note any variation in the test environment.

## 12. Test Procedure

12.1 Record the filter cartridge identification by the manufacturer's product number and any individual filter cartridge serial or sample identification numbers.

12.2 Connect the filter cartridge to the test holding fixture. Ensure that the pressure line connections are tight and leak-free. Filter outlet fitting dimensions must be consistent with the filter manufacturer's recommendations. Close and tighten all gas pressure fittings according to the manufacturer's recommendations.

12.3 Immerse the filter cartridge and fixture subassembly into the immersion tank so they are completely covered by the test fluid to a minimum depth of 25 mm (1 in.).

- 12.4 Allow a minimum of five minutes for the filter to absorb the immersion fluid or follow the filter manufacturer's recommendations. Rotate the filter completely, pausing at 90-degree increments for 30 seconds at each increment during the soaking period.
- 12.5 Gradually open the pressure inlet valve to introduce test gas to the filter cartridge. Test pressure should be recommended by the filter manufacturer and must not exceed the filter's rated bubble point.
- 12.6 Allow 30 seconds of complete pressurization; visually examine all filter surfaces for continuous bubble formation. Examine the filter outlet connection for bubbles.
- 12.7 Relieve the test pressure. Rotate the filter 180 degrees and repeat steps 12.5 and 12.6.
- [Note: Pleated filters, in particular, may contain gas trapped in the filter structure. Do not misinterpret the release of trapped gas as evidence of filter leakage. The bubbling of trapped gas will not be continuous.]

### **13. Data Analysis**

#### *13.1 Calculation*

- 13.1.1 Record the location and characteristics of any bubbling detected. *Gently* probe the apparent leak site with a dull probe to clarify the location and type of leak.
- 13.1.2 If leakage is evident at the filter outlet connection, examine the O-rings and associated sealing surfaces for evidence of mechanical damage. Note any significant observations.

### **14. Data Presentation**

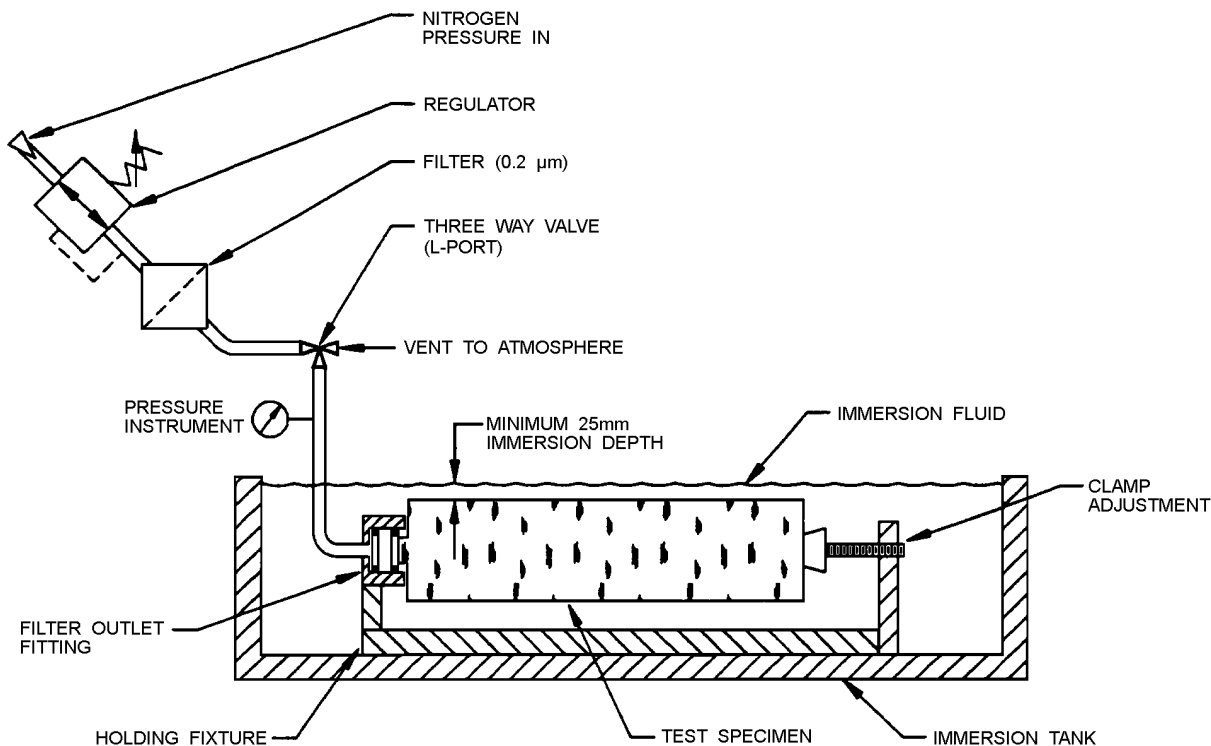
Prepare a final report of the test results as follows:

- 14.1 *Name of Test Operator.*
- 14.2 *Product Information.* Include the manufacturer, product number, lot number, and any serial or other sample identification number of the tested filter.
- 14.3 *Test Gas and Immersion Fluid.*
- 14.4 *Test Apparatus.*
- 14.5 *Summary of Observed Results.* Include a sketch of the tested filter; note any observed leak locations on the sketch.

### **15. Precision and Bias**

The primary test criterion is any visual observation of leakage as evidenced by continuous bubbling. The test technique does not lend itself to determination of precision because of the visual judgement involved. In cases of very small leaks, the test is limited in resolution and repeatability due to operator differences in visual acuity.

## 16. Illustrations



**Figure 1 Pressure Leak Testing Schematic**

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