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

SEMATECH
Technology Transfer 92010944B-STD

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Abstract: This test method is used to determine mechanical pressure resistance of filter cartridges for UPW distribution systems. It is used to verify that filter cartridges will withstand their rated pressurization without integrity failure or permanent mechanical deformation. 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, Flow Rates, Pressure Measurement

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SEMASPEC #92010944B–STD

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1. Introduction

1.1 *Purpose*—The purpose of this document is to provide a uniform test method for the verification of forward pressure ratings of cartridge filters used in ultrapure water (UPW) distribution systems.

1.2 *Scope*—This method applies to filter cartridges used in ultrapure water distribution systems.

2. Referenced Documents

2.1 ASTM D5127 Standard Guide for Electronic Grade Water[1]

2.2 *ANSI Standards*[2]

ANSI B93.25M Hydraulic Fluid Power – Filter elements – Verification of Collapse/Burst Resistance (Rev. 1987) (technically identical to ISO 2941: 1974.[3])

ANSI B93.2 Fluid Power Systems and Products – Glossary

2.5 SEMASPEC #92010943B–STD SEMATECH Provisional Test Method for Pressure Leak Testing Filter Cartridges Used in UPW Distribution Systems[4]

3. Terminology

3.1 Filter terms are defined in accordance with ANSI B93.2.

3.2 *AC fine test dust*[5]—a graded, naturally occurring dust frequently used as a polydisperse test aerosol. It is composed of 68% SiO_2, 16% Al_2O_3, and 4.6% Fe_2O_3. Of the total mixture, 73% are particles less than 20 μm in size. Additionally, 39% of these particles (size < 20 μm) are composed of particles < 5 μm.

3.3 *ultrapure water*—type E-1 electronic grade water as defined in ASTM D5127.

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[1] American Society for Testing and Materials. 1916 Race St. Philadelphia PA 19103.

[2] American National Standards Institute. 1430 Broadway. New York, NY 10018.

[3] International Organization for Standardization. Geneva, Switzerland.

[4] SEMATECH. 2706 Montopolis Dr. Austin, TX 78741.

[5] Distributed by AC Spark Plug Division, General Motors Corporation, Flint, MI.

4. Summary of Method

Water is recirculated through the test filter (see Figure 1). Inert particulates (such as AC fine test dust) are used to load the filter to the desired test pressure. The test pressure is then maintained at constant conditions for a specified length of time. Unless otherwise specified by the filter manufacturer, the filter should be kept at the maximum rated pressure for a minimum of ten minutes. Survival of the filter is diagnosed by integrity testing the filter according to SEMASPEC #92010943B–STD after the duration of the test.

5. Significance and Use

5.1 As filters remove particles, those particles become restrictions to flow through the filter and differential pressure across the filter increases. Therefore, it is necessary that filters be capable of resisting pressure loads, which may become significant percentages of the pressure capability of the system in which they are used. This method may be used to verify the mechanical pressure resistance of a cartridge filter.

5.2 This test may be used to confirm that a filter cartridge will withstand exceptional conditions of use without loss of mechanical strength by testing a filter after exposure to those conditions.

5.3 This test may be used to comparatively quantify the loss of mechanical strength due to exposure to exceptional conditions by comparing the results on test specimens that have and have not been exposed to the exceptional conditions.

6. Apparatus

6.1 *Test Stand*, per schematic (see Figure 1).

6.2 *Pressure Indicator*, accurate to ± 0.2 psi (pounds per square inch).

6.3 *Mixing Apparatus*.

6.4 *Stopwatch*.

6.5 *Thermometer*. Range and accuracy are not critical.

7. Materials

7.1 *AC Fine Test Dust*.

8. Precautions

8.1 *Safety Precautions*—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.

8.2 *Technical Precautions*

8.2.1 Different filter types have widely varying loading curves, so it is not possible to specify the loading rate. It is important to load the filter at a moderate rate, however, to ensure that the particle loading is consistent and continuous over the entire surface of the tested

filter. Time taken to load to full pressure should exceed five minutes. Highly concentrated local loading may cause atypical stress concentration.

8.2.2 The specified test particulate is AC fine test dust. Other test particulate may be used; however, the selected test particulate must not in any way absorb the applied stress load of the test and thereby improve the performance of the tested filter.

8.3 *Interferences*

8.3.1 The tensile, creep, and flex resistance properties of the polymeric materials used in UPW filters may be significantly affected by temperature. Test system temperature must be monitored and, if necessary, controlled.

8.3.2 Different pump types may affect the test results. Positive displacement pumps may produce transient pressure waves not detectable by mechanical gauges or pressure transducers with extensive signal conditioning.

9. Sampling and Test Specimens

Test results may vary with component condition or temperature. Allow all components to reach equilibrium at the specified test temperature before testing (see Section 11).

10. Preparation of Apparatus

10.1 Fill the test stand with 0.2-μm filtered water.

10.2 See Figure 1 for a typical pressure stress schematic.

11. Conditioning

Ambient temperature is 23 ± 3°C (73 ± 5°F).

12. Procedure

12.1 Test the filter for assembly integrity per SEMASPEC #92010943B–STD. Filters that fail this initial integrity test should not be pressure-proof tested.

12.2 Install the device in the test housing and initiate the flow. Adjust the test system flow so the differential pressure across the test filter is at least 20% of the filter's maximum pressure rating.

12.3 Measure the water temperature and record the value.

12.4 Turn on the mixer and slowly add AC fine test dust to the reservoir. Monitor the system pressure. The filter differential pressure will rise as the test dust loads the filter. Continue loading until the differential pressure equals the maximum rated pressure of the filter.

12.5 When the test pressure is achieved, begin timing. The minimum recommended duration of the test is ten minutes.

12.6 Adjust pump speed or bypass as needed to maintain test pressure.

12.7 At the end of the test, shut off the pump, relieve pressure, and remove the test filter from the system.

12.8 Confirm the assembly integrity of the filter according to SEMASPEC #92010943B–STD.

13. Data Analysis

13.1 Record the water temperature.

13.2 Record the pressure of the test.

13.3 Record the time held at the test pressure. The filter should retain assembly integrity at the maximum rated pressure consistent with the manufacturer's claims.

14. Data Presentation

Prepare a final report that contains the following:

14.1 *Date of Test*.

14.2 *Test Objective*.

14.3 *Test Parameters*, such as required number of cycles, test duration, test temperature, and test pressure.

14.4 *Test Results*, such as an example of the pressure profile.

14.5 *Description of Items Tested*, including items such as material type, material manufacturer, lot number, date manufactured, product part number or model number, and component size.

14.6 *Test Conclusions*.

15. Precision and Bias

15.1 The precision of the procedure in SEMASPEC #92010944B–STD for verification of forward pressure ratings for cartridge filters for UPW distribution systems is being determined.

15.2 Bias of the procedure in SEMASPEC #92010944B–STD for verification of forward pressure ratings for cartridge filters for UPW distribution systems is being determined.

16. Illustrations

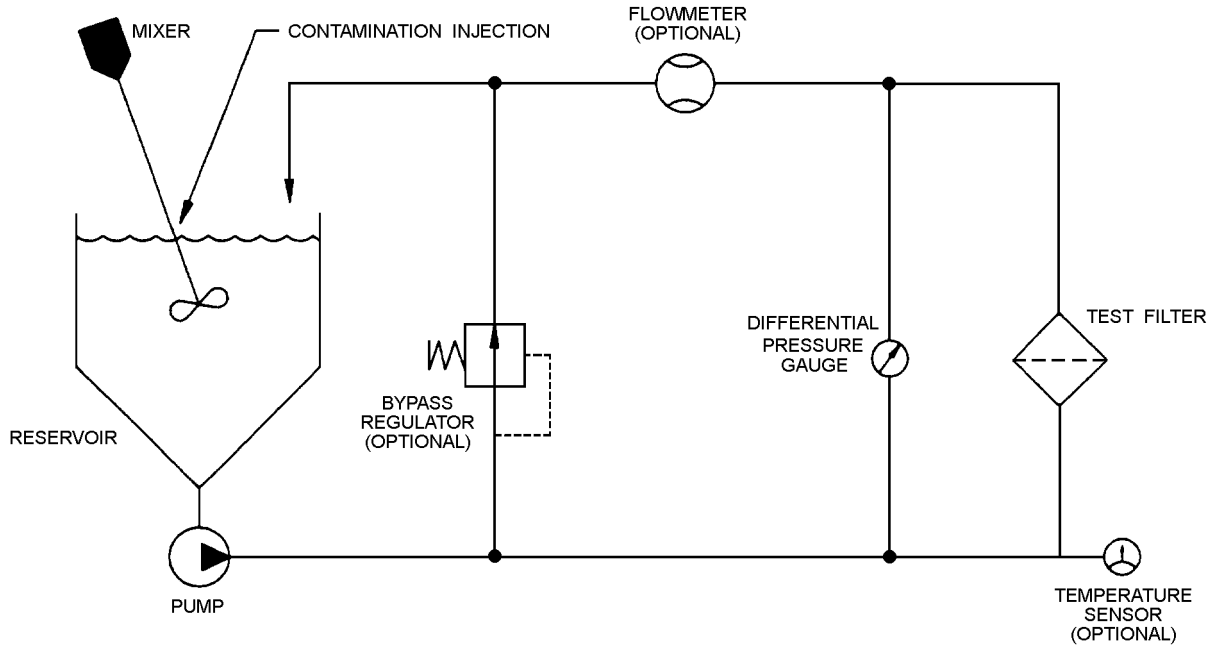

Figure 1 Pressure Stress Schematic

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