

SEMI C14-95 (Reapproved 1102)

TEST METHOD FOR PARTICLE SHEDDING PERFORMANCE OF 25 cm GAS FILTER CARTRIDGES

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1 Purpose

1.1 The purpose of this document is to define a comprehensive standard test sequence to derive particle-related qualification data for 25 cm (10 inch) filter cartridges.

2 Scope

2.1 This test method defines a particle shedding evaluation method for 25 cm filter cartridges of various media (e.g., PTFE, PVDF, polycarbonate, nylon, and polysulfone) commonly used individually or in assemblies to remove particles from gas lines. The filter cartridges are separable from the housings which can be cleaned and tested independently.

2.2 This standard does not purport to address safety issues, if any, associated with its use. It is the responsibility of the users of this standard to establish appropriate safety health practices and determine the applicability or regulatory limitations prior to use.

3 Limitations

3.1 These test methods do not apply to point-of-use (POU) filters, for which separate methods have been developed.

3.2 Cartridge filter performance cannot be characterized by a single data point, as conditions of use (e.g., pressure drop, transient pressure surges) determine the importance of a particular measurement. A sequence of tests, designed to measure filter responses under various conditions, is necessary when evaluating cartridge filters.

3.3 The order of the test sequence will affect the test results, and it is designed for fair comparisons of different aspects of filter operations. Hence, it is important to follow the prescribed test sequence.

4 Summary of Method

4.1 The test sequence (shown schematically in Figure 1) consists of three steps:

1. Break-in
2. Pulse

3. Final Purge

5 Apparatus and Facility

5.1 *Gas Source* — Clean, dry nitrogen or dry air with less than 0.5 ppm moisture and less than 0.5 ppm total hydrocarbons.

5.2 *Particle Detectors* — A condensation nucleus counter (CNC) with a counting efficiency of 50%, as reported by the manufacturer, at 0.01 μm is recommended to measure total particle concentration greater than 0.01 μm .

5.3 *Test Environments* — A clean room environment is not required during testing; however, the test component should be unpacked and assembled in a Class 100 clean area to prevent ambient contamination.

5.4 *Configuration for Break-in Test* — The schematic of the test setup apparatus is shown in Figure 2. All components used in the test apparatus, including the flowmeter, valves, tubing, and filter housing, are 2.5 cm (1 inch) components or have 2.5 cm (1 inch) inlet and outlet connections. The apparatus consists of (1) a differential pressure sensor that can accurately measure Δp in the range 0.01 bar (0.15 psid) to 0.2 bar (3.0 psid) between the upstream and downstream pressure of the test component, (2) a flow control system that permits instantaneous change of flow corresponding to a Δp of 0.01 bar to 0.2 bar across the filter, and (3) a CNC downstream of the test filter.

5.5 *Configuration for Pulse Test* — The schematic of the test setup is the same as the break-in test.

5.6 *Sample Installation* — Reasonable precautions should be taken when installing the test filter or spool piece to avoid particle contamination of the system from ambient air. These precautions may include, but are not limited to, installation in a Class 100 laminar flow area, installation in a purged glove bag or other controlled ambient enclosure, use of a purge flow downstream of the sample point so that all parts of the system are under purge, isolation, or termination of the CNC sample flow, and isolation of the isokinetic sampler exhaust from ambient.

5.7 *Sampling System Design* — Customary practices should be employed for the design of the sampling

system. Care should be taken to provide an adequate exhaust length so that back diffusion of particles does not affect the system background at 2 times the sampling flow rate. This length will depend upon the particle concentration in the ambient environment and other factors.

6 Procedure

6.1 Static Background Test

6.1.1 This test applies to all apparatus described in this document and should be performed prior to other tests.

6.1.2 Remove the filter cartridge from the filter housing and replace the test filter in Figure 2 with the empty housing.

6.1.3 Purge the system at 100 m³/hr (3530 standard cubic feet per hour (scfh)). Measure particle concentration for a minimum of 45 sample intervals, each at least 6 standard liters (0.19 scf) or 4 minutes, whichever is greater. Continue to purge the system until 45 consecutive sample intervals without a particle being detected are recorded.

6.2 Dynamic Background Test

6.2.1 This test applies to the apparatus for pulse test as shown in Figure 2 with the test filter replaced by an empty filter housing.

6.2.2 Purge at a flow rate of 5 m³/hr (177 scfh) until 5 consecutive 60-second sample intervals without a particle being detected are recorded.

6.2.3 Set the CNC sample interval time to 180 seconds. Synchronize the start of this test with the start of a CNC sample interval.

6.2.4 Purge at a flow rate of 5 m³/hr (177 scfh) for 190 seconds.

6.2.5 Instantaneously switch to a flow rate of 100 m³/hr (3530 scfh) by turning ON the solenoid valve and purge for 160 seconds.

6.2.6 Turn OFF the solenoid valve and purge at a flow rate of 5 m³/hr (177 scfh) for 200 seconds.

6.2.7 Repeat Section 6.2.5 and Section 6.2.6 until 20 consecutive pulses without a particle being detected are recorded.

6.3 Break-in Test

6.3.1 The test setup apparatus is shown in Figure 2. Purge at a relatively low flow rate corresponding to a Δp of 0.01 bar (0.15 psid) across the filter until 5 consecutive 60-second sample intervals without a particle being detected are recorded.

6.3.2 Increase the purge flow rate so that the corresponding Δp is at least 0.1 bar and the flow rate is at least 45 m³/hr (1590 scfh).

6.3.3 Record hourly particle concentration averages.

6.3.4 Stop the test when no particles are detected in 3 consecutive hourly sampling intervals.

6.4 Pulse Test

6.4.1 The apparatus is shown in Figure 2. Purge at a relatively low flow rate corresponding to a Δp of 0.01 bar across the filter until 5 consecutive 60-second sample intervals without a particle being detected are recorded.

6.4.2 Set the CNC sample interval to 180 seconds. Synchronize the start of this test with the start of a CNC sample interval.

6.4.3 Purge at a low flow rate corresponding to a Δp of 0.01 bar across the filter for 190 seconds.

6.4.4 Instantaneously switch to a higher flow rate corresponding to a Δp of 0.1 bar (0.15 psid) across the filter by turning ON the solenoid valve and purge for 160 seconds.

6.4.5 Turn OFF the solenoid valve and purge at a low flow rate ($\Delta p = 0.01$ bar) of 200 seconds.

6.4.6 Repeat Section 6.4.4 and Section 6.4.5 (160 secs ON and 200 secs OFF) for a series of 10 flow pulses.

6.5 Final Purge Test

6.5.1 Purge the filter at a Δp of 0.2 bar (3 psid) or a flow rate of 90 m³/hr (3180 scfh), whichever is greater, for 3 hours. Record the particle concentration.

6.5.2 Decrease the flow so that $\Delta p = 0.1$ bar (0.15 psid) or the flow rate is 45 m³/hr (1590 scfh), whichever is greater, and purge for 1 hour. Record the particle concentration.

7 Reporting of Test Results

7.1 Raw data should be reported for each test in the format of a table including the number of sample intervals, the sampling volume of each interval, the sampling time of each interval, and the total number of particles registered in each interval. In addition, the relevant parameters for each test described in Sections 7.2–7.6 should be identified.

7.2 *Static Background Test* — Identify the period of time required to obtain 3 consecutive hourly sampling intervals without a particle being detected.

7.3 *Dynamic Background Test* — Identify period of time required to obtain 20 consecutive flow pulses without a particle being detected.