

SEMI F38-0720

TEST METHOD FOR EFFICIENCY QUALIFICATION OF POINT-OF-USE (POU) GAS FILTERS

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NOTICE: This Document was completely rewritten in 2019.

1 Purpose

1.1 The purpose of this Document is to define a comprehensive standard test sequence to qualify the particle filtration efficiency achievable using point-of-use (POU) gas filters.

2 Scope

2.1 This Test Method defines an evaluation method for POU filters of various media (e.g., metallic, ceramic, and polymeric) typically used for filtering inert and process gases in semiconductor applications. POU filters are designed to handle relatively low flow rates (0.5 to 50 slm) and moderately high pressure drops. The filter housing and filtration element are combined into one sealed and inseparable unit.

2.2 This Test Method is intended to demonstrate the ability of a POU gas filter to equal or exceed a specific particle filtration efficiency class when challenged with a monodispersed aerosol in the size range described in § 7.6.

NOTICE: SEMI Standards and Safety Guidelines do not purport to address all safety issues associated with their use. It is the responsibility of the users of the Documents to establish appropriate safety and health practices, and determine the applicability of regulatory or other limitations prior to use.

3 Limitations

3.1 These test methods do not apply to gas filter cartridges.

3.2 These test methods do not apply to bulk gas filters (>50 slm).

3.3 The various media (e.g., metallic, ceramic, and polymeric) may have slightly different critical particle sizes (most penetrating particle sizes). Therefore, many challenge tests have to be performed over a range of particle sizes to assure that the “worst case” challenge has been performed.

3.4 The efficiency test is for steady state flow and room temperature only. Comparison to efficiency in pulsed flow, elevated temperature etc. will have to be developed separately.

3.5 Statistical evaluation on the variability in efficiency of a media type should be done with a valid sample size. This evaluation is not within the scope of this Test Method.

3.6 The upper concentration limit of the condensation nucleus counter (CNC) as specified by the manufacturer should not be exceeded. Exceeding the CNC concentration will understate the challenge concentration due to coincidence counting, thus affecting filter efficiency calculations.

3.7 This is not intended as a method for precise determination of filter efficiency. It is intended as a means for determining if a filter has an efficiency equal to or better than an approximate nominal value. Commercially available radioactive neutralizers have pressure limitations. Users should be aware of these limits.

4 Referenced Standards and Documents

4.1 SEMI Standards and Safety Guidelines

SEMI C59 — Specification for Nitrogen

NOTICE: Unless otherwise indicated, all documents cited shall be the latest published versions.

5 Terminology

5.1 Abbreviations and Acronyms

5.1.1 *CNC* — condensation nucleus counter

5.1.2 *LRV* — log reduction value

5.1.3 *psig* — pound force per square inch, gauge

5.1.4 *POU* — point-of-use

5.1.5 *scf* — standard cubic feet per minute

5.1.6 *slpm* — standard liter per minute

5.2 Definitions

5.2.1 *aerosol* — a suspension of fine solid particles or liquid droplets in air or another gas.

5.2.2 *filter cartridge* — the filtration element that removes particles from incoming gas stream.

5.2.3 *filter housing* — the shell that contains filter cartridge.

5.2.4 *filtration unit* — the assembly consisting filtration housing and cartridge.

5.2.5 *log reduction value (LRV)* — a way of expressing particle retention of a filter; logarithmic ratio of particle concentration upstream of the filter to the particle concentration downstream of the filter. For example, a filter with a fractional penetration of 0.00001 has an LRV of 5 and an efficiency of 99.999%.

5.2.6 *most penetrating particle size* — a measure of particle size at which penetration through the filter is a maximum and the efficiency of the filter is at a minimum.¹

5.2.7 *spool piece* — a straight connection piece with similar end connections and orifice size to the component to be tested. This is used in place of the component to establish test system background level prior to installing the component under test.

6 Summary of Method

6.1 The test sequence consists of three steps:

6.1.1 Static background with spool piece.

6.1.2 Filter challenge with first monodispersed particle size (see § 7.6 for particle size test sequence).

6.1.3 Filter challenge with subsequent monodispersed particle sizes to ensure testing at most penetrating particle size if performed.

7 Apparatus and Facility

7.1 *Gas Source* — 99.9994% Nitrogen (Grade 5.4) per SEMI C59.

7.2 *Particle Detector* — A condensation nucleus counter (CNC) with a counting efficiency of 50% at 0.01 µm is required to measure total particle concentration of particles greater than 0.01 µm. The CNC must meet a background level as specified in § 8.1.2.

7.3 *Test Environment* — Particle challenge testing does not require a clean area. Testing in a Class 100 area is recommended but not required. Refer to § 7.7 for installation precautions.

7.4 *Configuration for Efficiency Test* — Figure 1 shows test setup. The setup consists of:

- an aerosol generation system,
- aerosol concentration detectors,

¹ Rubow, K.L., Davis, C.B., “Particle Penetration Characteristics of Porous Metal Filter Media for High Purity Gas Filtration.” Proceedings of Institute of Environmental Sciences Annual Technical Meeting, 1991.