

SEMI F70-0302

TEST METHOD FOR DETERMINATION OF PARTICLE CONTRIBUTION OF GAS DELIVERY SYSTEM

This test method was technically approved by the Global Facilities Committee and is the direct responsibility of the Japanese Facilities Committee. Current edition approved by the Japanese Regional Standards Committee on January 11, 2002. Initially available at www.semi.org January 2002; to be published March 2002.

1 Purpose

1.1 The purpose of this document is to provide a standardized methodology and procedure for measuring the particle contribution performance of a gas delivery system in terms of number of particles added to gas flowing through the system. This standardized procedure is intended to be used commonly by the component suppliers, gas suppliers, equipment suppliers, and users.

2 Scope

2.1 This test method applies to all types of surface mount and conventional gas delivery systems used in semiconductor manufacturing facilities and comparable research and development areas.

NOTICE: 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 and health practices and determine the applicability of regulatory or other limitations prior to use.

3 Limitations

3.1 All components must meet quality requirements as established and controlled by manufacturers prior to testing (e.g., dimensional, functional, etc).

3.2 Care should be exercised in handling of components to maintain manufacturer's specifications.

4 Referenced Standards and Documents

4.1 ISO Standards¹

ISO 14644-1 — Cleanrooms and Associated Controlled Environments – Part 1: Classification of air cleanliness

4.2 JIS Standards²

JIS B 9921 — Light Scattering Automatic Particle Counter

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 *LPC* — laser particle counter

5.1.3 *MFC* — mass flow controller

5.1.4 *MFV* — mass flow meter

5.1.5 *slm* — standard liters per minute, the gas volumetric flow rate measured in liters per minute at 0°C and 1 atm.

¹ International Organization for Standardization, ISO Central Secretariat, 1 rue de Varembé, Case postale 56, CH-1211 Geneva 20, Switzerland. Telephone: 41.22.749.01.11; Fax: 41.22.733.34.30; <http://www.iso.ch>

² Japanese Industrial Standards, Available through the Japanese Standards Association, 1-24, Akasaka 4-Chome, Minato-ku, Tokyo 107-8440, Japan. Telephone: 81.3.3583.8005; Fax: 81.3.3586.2014; <http://www.jsa.or.jp>

5.2 Definitions

5.2.1 *background counts* — particle counts contributed by the test apparatus (including false counts) with the spool piece in the place of the test object as function of particle size.

5.2.2 *counting efficiency* — the ratio of the particle concentration calculated from the particle counts to the actual particle concentration in the sampled gas for particles equal to or larger than a given particle size.

5.2.3 *design flow rate* — flow rate normally applied to the gas delivery system.

5.2.4 *false counts* — particle counts contributed by electrical noise or by other events and not particles in the sampled gas.

5.2.5 *gas delivery system* — a system installed in semiconductor manufacturing equipment to supply process and carrier gases to reactors, which typically consists of tubing, fittings, valves, filters, mass flow controllers and regulators; can be surface mount or conventional system.

5.2.6 *minimum counting particle diameter* — a predefined minimum diameter of particles to be counted in this test method.

5.2.7 *particle counts* — a counted value from a laser particle counter (LPC) or condensation nucleus counter (CNC) shown for particles or larger than or equal to the minimum counting particle diameter.

5.2.8 *sample flow rate* — the volumetric flow rate through the particle counter.

5.2.9 *spool piece* — a null component consisting of a straight piece of electropolished tubing or like object and appropriate fittings used in place of the test system to establish the background.

5.2.10 *test flow rate* — the volumetric flow rate through the test system

6 Required Apparatus

6.1 *Filter* — Filters with the following performance specified by the manufacturer.

Characteristic	Performance	Condition
Filtration Efficiency	9 log	particle size: 0.02 μm
Flow Rate	300 slm	inlet pressure: 0.34 MPa

6.2 *Tubing Material* — 1/4 inch or 3/8 inch SUS 316L electropolished tubing or better.

6.3 *Particle Counter* — The particle counter may be either LPC or CNC of which the minimum counting particle diameter is 0.1 μm or smaller, and has the following performance as specified by JIS B 9921.

6.3.1 *Counting Efficiency*

Diameter of Polystyrene Latex Standard Particle	Counting Efficiency
Minimum countable particle diameter of the counter (See #1)	50 $\pm$ 20%
1.5 to 2.0 $\times$ Minimum countable particle diameter of the counter	100 $\pm$ 10%

#1 For a CNC, the minimum countable diameter shall be defined as a diameter having counting efficiency of 50 $\pm$ 20%.

6.3.2 *False Count* — Equal to or less than 1 in 5 minutes.

6.3.3 *Acceptable Error of Flow Rate* — $\pm 5\%$

6.4 *Sampler* — A system used to perform partial sampling of the gas stream exiting the test system, that consists of a diffuser equipped with a pressure reducing device in which gradual expansion to atmospheric pressure occurs and a sample probe. It is desirable that the sampler is designed to obtain isokinetic sampling. The average velocity of gas

flowing through the sample probe should approximate the average velocity in the external tubing in which the sample probe is inserted. The sample probe overlap with the external tube must be of appropriate length, and it must be confirmed before use that the surrounding atmospheric gas is not drawn in the sample.

7 Test Condition

7.1 *Test Gas* — Liquid Nitrogen (LN₂) or cleaner Nitrogen (N₂) or Argon (Ar)

7.2 *Temperature* — Room temperature (between 18 and 26°C)

7.3 *Environment* — ISO/FDIS 14644-1 class 5 or better.

8 Preparation of Apparatus

8.1 Set up apparatus and the gas supply system as shown in Figure 1.

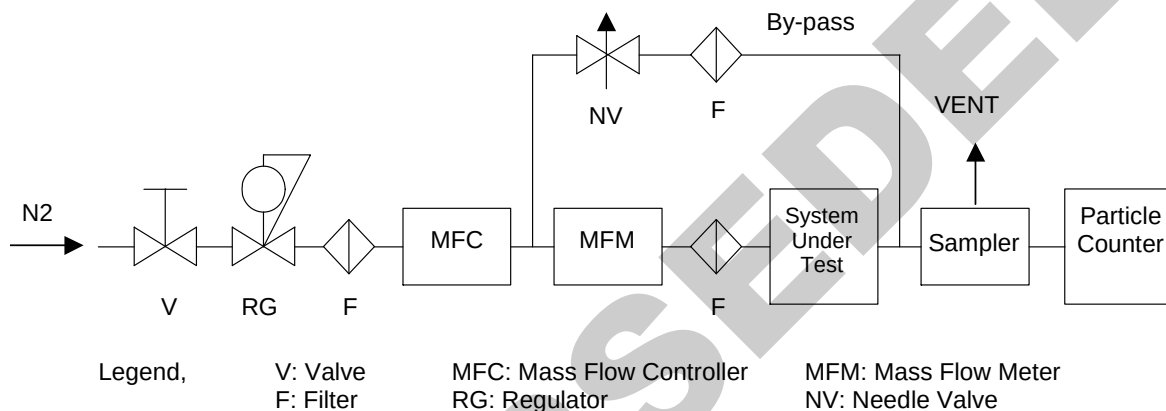


Figure 1
Test Set Up Basic Flow Diagram

8.2 If the test flow rate is equal to or less than the sample flow rate required by the particle counter, insert a filter in place of the sampler to fulfill the sample flow rate. (See Figure 2.)

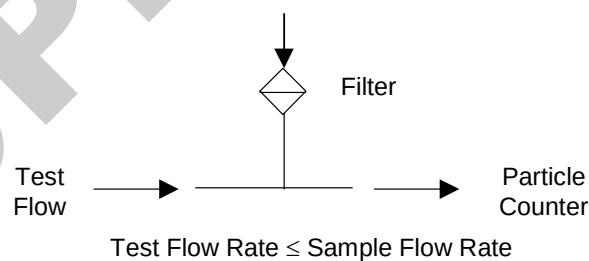


Figure 2
Full Sampling

8.3 If the test flow rate is higher than the sample flow rate required by the particle counter, use the sampler for partial sampling. (See Figure 3.) To establish the test flow rate and obtain an isokinetic condition, it is required to adjust the MFC in the test set up and the NV on the by-pass line. The by-pass line is required to have a capability to handle the maximum test flow when the valves in the system under test is closed position during the pulse test.