

SEMI F118-1121

TEST METHOD FOR DETERMINATION OF MOISTURE DRY-DOWN CHARACTERISTICS OF GAS DELIVERY COMPONENTS

This Standard was technically approved by the Gases Global Technical Committee. This edition was approved for publication by the global Audits and Reviews Subcommittee on August 12, 2021. Available at www.semiviews.org and www.semi.org in November 2021. Previously published as SEMI C91.

NOTICE: This Document replaces SEMI C91-1115.

NOTICE: The section symbol (§) is used to reference a numbered section, paragraph, or header and all subordinate paragraphs, headers, and embedded material (i.e., EXCEPTIONs, lists) therein. The paragraph symbol (§) is used to reference a particular numbered paragraph and embedded material therein. When duplicated (i.e., §§ and §§) the symbols are used to reference more than one section or paragraph, respectively.

1 Purpose

1.1 This Test Method describes the procedure for determination of the moisture dry-down characteristics of components used in gas delivery systems. The results of this test can be used for the qualitative ranking of gas delivery components based on the design as it relates to moisture dry-down performance of the system.

2 Scope

2.1 This Test Method applies to all types of in-line components used in gas delivery systems for precise delivery of gaseous species used in semiconductor manufacturing. The in-line components applicable are valves (pneumatic, manual and hybrid types), mass flow controllers (MFCs), pressure regulators, filters and passive components such as pressure gauges/transducers and flow meters.

2.2 *Test Medium* — The test medium shall be nitrogen. Other inert gases will have different purging characteristics and may dry a system more quickly or slowly. Reactive gases shall not be used as they may react chemically with moisture. Considerations relating to corrosion resistance are outside the scope of the present Standard, although the test procedure may prove useful in corrosion studies. The results will provide a ranking with respect to moisture contribution arising as a result of differences in design.

2.3 *Operating Situations* — Moisture contribution from a gas delivery component may be the result of improper design and construction, contamination arising in its manufacture, or from subsequent exposure to ambient air or non-dry gas. Thus, it is necessary to consider two main situations:

2.3.1 The ‘initial dry-down’ situation, which is determined by the moisture content of the component in the as-received condition, with the effects of manufacturing process and design, surface quality, pre-treatment and packaging convoluted together. This test is optional and may be omitted based on the objective of the testing.

2.3.2 The ‘response to an upset’ situation, which is determined by the amount of moisture taken up by the component and subsequently released in any exposure after receipt during its operation independently or as part of a gas delivery system.

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 This Test Method allows the determination of moisture dry-down characteristics which can be used, for example, to qualitatively rank components. Since different moisture dry-down characteristics are permissible in different situations, selecting the ‘best’ component requires consideration of how they will be used, either qualitatively or through a numerical simulation of component behavior.

3.2 The Test Method can only be used for qualification/certification of gas delivery components based on different designs and internal materials such as seats/seals.

4 Referenced Standards and Documents

4.1 SEMI Standards and Safety Guidelines

SEMI C15 — Test Method for ppm and ppb Humidity Standards

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

5 Terminology

5.1 Abbreviations and Acronyms

5.1.1 *APIMS* — atmospheric pressure ionization mass spectroscopy

5.1.2 *CRDS* — cavity ring down spectroscopy

5.1.3 *DUT* — device under test

5.1.4 *EPSS* — electropolished stainless steel

5.1.5 *ppm* — molar parts per million ($\mu\text{mole/mole}$). The same as ppmv.

5.1.6 *ppb* — molar parts per billion (nmole/mole). The same as ppbv.

5.1.7 *ppt* — molar parts per trillion (pmole/mole). The same as pptv.

5.1.8 *slpm* — standard liters per minute.

5.2 Definitions

5.2.1 *baseline* — an instrument response under steady state conditions.

5.2.2 *device under test (DUT)* — gas delivery component subjected to test.

5.2.3 *glove box* — an enclosure that contains a controlled atmosphere, usually inert.

5.2.4 *induction time* — the elapsed time between when humidified gas is introduced to the DUT and when moisture is detected at the moisture analyzer. For a DUT which is perfectly transparent to moisture, the induction time is equal to the residence time of the gas in the system.

5.2.5 *peak height* — the maximum moisture concentration recorded when a moisture input of pre-defined length and concentration is introduced to a DUT.

5.2.6 *response time* — the time required for the DUT to reach steady state after a change in concentration.

5.2.7 *standard liters per minute (slpm)* — the gas volumetric flow rate measured in liters per minute at 0°C and 1 atm.

6 Summary of Test Method

6.1 This Test Method consists of initial dry-down and moisture input tests for gas delivery components such as MFCs, pneumatic and manual valves (including hybrid valves), pressure regulators and filters.

6.2 MFCs will vary in dry-down performance based on their flow rating and therefore the dry-down performance of only comparable flow rate MFCs should be compared. In addition, the flow rates of MFCs to be tested shall be within the specified flow requirements of the analyzer.

6.3 Pressure regulators shall be tested in the fully open condition; that is, the regulator adjusted for minimal pressure drop through it. The effect of varying the pressure drop across the regulator on the moisture dry-down is outside the scope of this Standard.

6.4 Manual valves shall be tested at the fully open condition so as to allow maximum flow through the valve. For pneumatic valves, manufacturer-recommended air actuation pressures shall be supplied to actuate the valve for normally closed valves. For normally open valves, air actuation will be necessary to turn off the valve during testing.

6.5 Particle filters shall be tested at the maximum flow rating as specified by the manufacturer.