SEMI F29-0997 (Reapproved 0611)
TEST METHOD FOR PURGE EFFICACY OF GAS SOURCE SYSTEM PANELS

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 May 13, 2011. Available at www.semiviews.org and www.semi.org in June 2011; originally published September 2003; previously published November 2003.

SUPERSEDED

1 Purpose

1.1 This Document defines the purge efficacy test method recommended for determining the minimum acceptable level of purge efficacy for gas source systems used in semiconductor manufacturing. It is also intended as an aid to the procurement of gas source equipment.

NOTE 1: Users of this Specification are encouraged to submit suggested revisions or other comments to SEMI.

2 Scope

2.1 This Specification applies to gas source equipment used in semiconductor manufacturing facilities and comparable research and development areas. It includes contamination testing requirements for gas source systems.

2.2 The tests covered by this Document are as follows:

2.2.1 Purge efficacy with a non-interactive gas using manufacturers' standard purge sequence.

2.2.2 Purge efficacy with a non-interactive gas using the test method specified purge sequence.

2.2.3 Purge efficacy with an interactive gas using manufacturers' standard purge sequence.

2.2.4 Purge efficacy with an interactive gas using the test method specified purge sequence.

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 Document is not intended to determine the safe operation of a gas source system. The test method described here is for determining the removal efficacy of hazardous gas from the pigtail portion of the gas panel during routine cylinder change operations (pre-purge). It does not address the purge condition after the change of the cylinder (post-purge) nor the purge of the entire gas source system which is usually performed following its initial installation or during maintenance (maintenance purge).

3.2 Because the response time of moisture and oxygen analyzers utilizing different technologies can differ significantly, this can lead to the possibility that different instruments will report different peak heights when measuring identical contaminant spikes. Therefore, results of tests should only be compared when similar analyzers are used.

4 Referenced Standards and Documents

4.1 None.

5 Terminology

5.1 *Abbreviations and Acronyms*

5.1.1 *ppb* — molar parts per billion, same as ppbv.

5.1.2 *ppm* — molar parts per million, same as ppmv.

5.2 *Definitions*

5.2.1 *clean dry air (CDA)* — filtered air filtered to 0.02 mm and dried to a dew point of at least −80°C.

Documents Document Sharing Hub

Full document details: SEMI F29-0997-0611R

5.2.2 *dry down* — removal of residual moisture in a gas delivery or distribution system, often accomplished by flowing a stream of high purity dry inert gas continuously through the system for an extended period of time.

5.2.3 *dwell time* — the time for which vacuum or pressure is applied during the evacuation or pressurization steps of a purge operation.

5.2.4 *interactive gas* — a gas that will readily adsorb to the surface of a vessel used to contain or transport it. Examples of interactive gases are hydrogen chloride and moisture.

5.2.5 *non-interactive gas* — a gas that will not adsorb to the surface of a vessel used to contain or transport it. Examples of non-interactive gases are oxygen and nitrogen.

5.2.6 *pigtail* — the pigtail is the part of the gas source equipment that is the flexible connection between the cylinder and the gas panel.

5.2.7 *pigtail bleed* — a pigtail bleed is a reverse flow of purge gas from the pigtail to minimize atmospheric intrusion into the gas panel.

5.2.8 *purge cycle* — following the initial process vent step, a cycle is defined as a pressurization step followed by an evacuation step.

5.2.9 *purified nitrogen* — nitrogen purified to meet the following characteristics:

- *Moisture* — <20 ppb
- *Oxygen* — <10 ppb
- *Total Hydrocarbons* — <1 ppm
- *CO_2* — <1 ppm
- *CO* — <1 ppm

6 Ordering Information

6.1 Orders for equipment or services requiring purge efficacy testing in accordance with this test method shall include the following:

6.1.1 This Test Method number and date of issue.

6.1.2 Test requirements as defined in the detailed specifications for the specific product being purchased.

6.1.3 Whether certifications of tests and a report of the test results is required.

7 Requirements

7.1 *Personnel Qualification* — Personnel performing tests in accordance with this Specification shall have suitable training and experience. Such personnel should, as a minimum,

7.1.1 Be trained and experienced in operation of gas source control equipment,

7.1.2 Be trained and experienced in the use of oxygen and moisture analyzers, and

7.1.3 Be familiar with the operation and calibration of the specific equipment used in performing the tests.

8 Apparatus

8.1 *Oxygen Analyzer* — The oxygen analyzer should meet or exceed the following characteristics:

- *Limit of Detection* — 10 ppb
- *Accuracy* — ±10 ppb

8.2 *Moisture Analyzer* — The moisture analyzer should meet or exceed the following characteristics:

- *Limit of Detection* — 10 ppb
- *Accuracy* — ±10 ppb

SUPERSEDED

Documents
Document Sharing Hub
Full document details: SEMI F29-0997-0611R

8.3 *Pressure Transducer* — The transducer should be of a high-purity type with minimal dead volume and meet or exceed the following characteristics:

- Accuracy — ±3.4 kPa (0.5 psi)
- Hysteresis — ±3.4 kPa (0.5 psi)
- Non-Repeatability — ±0.7 kPa (0.1 psi)

8.4 *Mass Flow Controller or Flow Meter* — The mass flow controller or flow meter should be accurate to ±0.2 slpm.

8.5 *Moisture Source* — The moisture source must be capable of providing a 2 slpm continuous flow of 2.0 ± 0.2 ppm moisture in nitrogen mixture at 138 kPa (g) [20 psi (g)] for a minimum of 30 minutes.

9 Procedure

9.1 Purge efficacy determination with non-interactive gas at manufacturer's recommended pressure, vacuum, and dwell times.

9.1.1 Connect gas source equipment as in Figure 1.

NOTE 2: To avoid biasing the test results by substantially increasing piping volume to be purged, the dead space between the cylinder connection and the valves isolating the analyzer and the contaminant source must be small compared to the total pigtail volume. The use of mono-block valve and flow-through type pressure transducer is highly recommended.

9.1.1.1 However, the pigtail is connected to the cylinder valve during the purge in an actual cylinder change operation. The small additional volume to be purged in the test setup may be used to account for the volume of the cylinder valve outlet cavity, which must be purged during a cylinder change.

9.1.2 To challenge the gas panel with a known contaminant gas, completely fill and pressurize the gas source system to 207 kPa (g) [30 psi (g)] with CDA as measured at the pigtail with the pressure transducer.

9.1.3 Using purified nitrogen as the purge gas, complete one purge cycle at the manufacturer's recommended pressure, vacuum, and dwell times.

9.1.4 Flow purified nitrogen using a pigtail bleed at 1 slpm or at the oxygen analyzer manufacturer's recommended flow rate, whichever is higher, into the oxygen analyzer for 10 minutes or until below the detection limit of the oxygen analyzer.

9.1.5 Record the pressure and peak oxygen concentration in Table 1. It is highly recommended that, in addition to the peak oxygen concentration, the oxygen concentration readings also be recorded at regular intervals during the measurement, so that a graph of the oxygen concentration level in the pigtail bleed gas versus time can be drawn if necessary.

9.1.6 Repeat ¶¶ 9.1.2 through 9.1.5 for 2, 5, 25, and 50 purge cycles at the manufacturer's recommended pressure, vacuum and dwell times. Additional tests using other purge cycle numbers are encouraged and may provide a more complete characterization of the purge performance of the test piece.

9.1.7 Plot the peak residual oxygen concentration versus cycles as in Figure 2 for manufacturer's recommended pressure, vacuum, and dwell times.

9.2 Purge efficacy determination with non-interactive gas at standard pressure, vacuum and dwell times.

9.2.1 Connect the gas source equipment as in Figure 1.

SUPERSEDED

Documents Document Sharing Hub
Full document details: SEMI F29-0997-0611R