

SEMI F30-0710

START-UP AND VERIFICATION OF PURIFIER PERFORMANCE TESTING FOR TRACE GAS IMPURITIES AND PARTICLES AT AN INSTALLATION SITE

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 April 30, 2010. Available at www.semi.org in July 2010; originally published in 1998.

1 Purpose

1.1 The purpose of this procedure is to verify the performance of purifiers by employing analytical instrumentation to measure gas impurities and particles to customer specifications. If specific inlet challenge(s) and/or inlet measurements are required, it should be discussed beforehand with the customer. Inlet impurities must be measured by part-per-million (ppm) or part-per-billion (ppb) analytical equipment. This procedure applies only to large scale bulk purifiers rated at greater than 50 liters-per-minute (LPM) flow rate.

2 Scope

2.1 Verification of performance of large scale purifiers in nitrogen, argon, helium, oxygen, and hydrogen service. Verification tests are done at ppb or sub-ppb levels of gaseous impurities and sub-micron sizes of particles measured downstream of any installed filter modules. Tests are done at maximum achievable flow of purifier, and/or customer's specified percentages of maximum flow.

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 Detection of ppb and sub-ppb gaseous impurity levels are achievable using atmospheric pressure ionization mass spectrometry (APIMS), which is the preferred method of choice, and the reduction gas detector (RGD)-gas chromatograph. APIMS is currently not available for oxygen service. A partial list of non-APIMS measuring equipment for use in oxygen service is in Appendix 1 for commonly measured impurities.

4 Referenced Standards and Documents

4.1 SEMI Standards and Safety Guidelines

SEMI F58 — Test Method for Determination of Moisture Dry-Down Characteristics of Surface-Mounted and Conventional Gas Delivery Systems by Atmospheric Pressure Ionization Mass Spectroscopy (APIMS)

SEMI F68 — Test Method for Determining Purifier Efficiency

5 Terminology

5.1 Abbreviations and Acronyms

5.1.1 APIMS — atmospheric pressure ionization mass spectrometry

5.1.2 DID-GC — discharge ionization detector-gas chromatograph

5.1.3 FID-GC — flame-ionization detector-gas chromatograph

5.1.4 FT-IR — Fourier transform infrared

5.1.5 NDIR — nondispersive infrared

5.1.6 RGD-GC — reduction gas detector-gas chromatograph

5.1.7 TOF — time of flight

5.1.8 ppb — parts per billion

5.1.9 *ppm* — parts per million

5.2 Symbols

5.2.1 CH_4 — methane

5.2.2 CO — carbon monoxide

5.2.3 CO_2 — carbon dioxide

5.2.4 H_2 — hydrogen

5.2.5 H_2O — moisture

5.2.6 N_2 — nitrogen

5.2.7 O_2 — oxygen

6 Summary of Method

6.1 The purifier is installed or started, and the operation is checked. Each purifier bed is regenerated or a new purifier is installed, and analytical tests are done. The analytical results determine if the purified gas meets the customer specifications.

7 Interferences

7.1 The following external sources might contribute to misleading or high analytical results. Some identified sources are: unpurged dead-ended piping or isolation valves, leaks in gas distribution system, insufficient purge flow, and insufficient system clean-up time.

8 Apparatus

8.1 Face seal fitting(s) with metal gaskets and stainless steel tubing for sampling.

8.2 Dynamic dilution system for diluting calibration standards to ppb and sub-ppb levels for calibration of analytical equipment.

8.3 *APIMS* — The sample gas, nitrogen or argon, is introduced into an APIMS where a small amount of it is ionized. By collision with ionized nitrogen, impurity molecules are ionized with high efficiency. The mass analyzer, which can be a quadrupole, time-of-flight (TOF), or even a magnetic sector, separates and focuses the ions by their mass-to-charge ratio. An electron multiplier detects and counts each ion fragment and amount.

8.4 *Reduction Gas Detector-Gas Chromatograph (RGD-GC)* — Reduction gas detector is a heated mercuric oxide bed that reacts with reducing gases, such as hydrogen and carbon monoxide. The mercury evolved is detected and displayed as a peak. The GC employs a heated molecular sieve column to separate the H_2 and CO .

8.5 *Ultratrace Analytical Instrumentation Required Other than APIMS* — Ultratrace instrumentation is defined as having sufficient sensitivity to measure all impurities of interest at the specified level of the customer at the ppb or sub-ppb level.

8.6 Particle counter: CNC or Laser counter.

8.7 Data collection and reduction system.

9 Reagents and Materials

9.1 Certified calibration standards.

10 Safety Precautions

10.1 This test method may involve hazardous materials, operations, and equipment. The test method does not purport to address the safety considerations associated with its use. It is the responsibility of the user to establish appropriate safety and health practices and determine the applicability of regulatory limitations before using this method.

10.2 The testing area should have adequate room ventilation and atmospheric monitors.