

SEMI C97-1118

SPECIFICATION FOR DETERMINATION OF PARTICLE LEVELS OF GASES DELIVERED AS PIPELINE GAS OR BY PRESSURIZED GAS CYLINDER

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NOTICE: This Document replaces SEMI C6.2, SEMI C6.3, SEMI C6.4, SEMI C6.5, SEMI C6.6, and SEMI C6.7.

1 Purpose

1.1 This Document is intended to provide particle specification and test method for oxygen (O₂), hydrogen (H₂), and nitrogen (N₂) gases that are delivered as pipeline (bulk) gases or those contained in high pressure gas cylinders, in order to control particulate contamination from those gases.

2 Scope

2.1 This Document provides particle specification for gases, delivery source and particle grades as listed in Table 1.

Table 1 Particle Specification for Gases with Delivery Source and Grade

<i>Gas</i>	<i>Delivered As/By</i>	<i>Grade</i>
Oxygen bulk supply gas	Pipeline gas	20/0.02
Hydrogen gas	Pipeline gas	20/0.2
Nitrogen and argon bulk supply gases	Pipeline gas	20/0.02
Argon bulk supply gas	Pipeline gas	10/0.2
Nitrogen and argon bulk supply gases	Pipeline gas	10/0.1
Nitrogen	Pressure gas cylinders	10/0.2

2.2 This Document also provides a reference method for verification of particle levels.

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 Specification is not applicable to gases in liquid state.

4 Referenced Standards and Documents

4.1 None.

5 Terminology

5.1 Abbreviations and Acronyms

5.1.1 *CNC* — condensation nucleus counter

5.1.2 *FCD* — flow control device

5.1.3 *HPC* — high-pressure particle counter

5.2 Definitions

5.2.1 *background count* — the total number of counts registered by a specific particle counter within the time needed to sample 25 standard liters of gas under conditions where zero particles of specified size transverse the sensing volume, averaged over at least a sequence of 24 consecutive sampling periods of 25 standard liters each or eight consecutive periods of 30 minutes each, whichever is longer. The background count is to be reported as average value of obtained counts per standard liter, the number of hours on which the average is based is also reported.

5.2.2 *gas sample volume* — the volume of the sample interval, expressed in standard liters at standard conditions, 0°C and 1×10^5 Pa (1 atmosphere) pressure.

5.2.3 *grade* — the term typically used to describe the level of allowed particle concentration in a gas while determining a) particle concentration and b) the smallest particle size specified to be observed. The specified particle size indicates all particles equal to or larger. The grade specifies the maximal permissible concentration (X_p) of all particles equal to or larger of the size given in μm . (e.g., a grade 20/0.2 refers to a maximum concentration of 20 particles of a size equal to or larger 0.2 μm size per 25 standard liters gas volume).

5.2.4 *particle concentration* — the total number of particles counted, divided by the total gas sample volume, and corrected for background count as defined in ¶ 5.2.1, rounded to the nearest integer, for particles equal to or larger than the specified. Particle concentration is referenced to a volume of 25 standard liters.

5.2.5 *particle size/particle diameter* — the optical equivalent diameter as detected by a given light scattering particle counter.

6 Calculations

6.1 *Average Observed Concentration of Counts ($\bar{X}_M, \bar{X}_B$)* — The average concentration of counts, is calculated as:

$$\bar{X}_M = \frac{\sum X_{Mi}}{N_M} \quad \bar{X}_B = \frac{\sum X_{Bi}}{N_B} \quad (1)$$

where:

$\bar{X}_M$ = Average observed concentration of counts in the sample gas.

X_{Mi} = Concentration of particles observed in the i^{th} sample interval of the sample gas.

N_M = Number of sample intervals of the sample gas.

$\bar{X}_B$ = Average observed concentration of background counts.

X_{Bi} = Concentration of particles observed in the i^{th} sample interval of the background.

N_B = Number of sample intervals of the background.

6.2 *Calculated Concentration of Particles (X_C)* — The concentration of particles in the sample gas obtained by correcting the observed concentration in the sample gas for the observed concentration in the background, that is:

$$X_C = \bar{X}_M - \bar{X}_B \quad (2)$$

where:

X_C = Calculated concentration of particles in the sample gas.

$\bar{X}_M$ = Average observed concentration of counts in the sample gas.

$\bar{X}_B$ = Average observed concentration of background counts.

6.3 *Standard Deviation (S_M, S_B, S_C)* — A statistical measure of the spread of the concentration of the counts or particles. The first two are obtained from the interval and average concentrations and the number of intervals, that is:

$$S_M = \sqrt{\left[\frac{\sum (X_{Mi} - \bar{X}_M)^2}{N_M - 1} \right]} \quad S_B = \sqrt{\left[\frac{\sum (X_{Bi} - \bar{X}_B)^2}{N_B - 1} \right]} \quad (3)$$

where:

S_M = Standard deviation of $\bar{X}_M$.