

SEMI C6.7-93 (Reapproved 1111)

PARTICLE SPECIFICATION FOR GRADE 10/0.2 NITROGEN IN HIGH PRESSURE GAS CYLINDERS

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NOTICE: This Document was reapproved with minor editorial changes.

1 Purpose

1.1 The purposes of this Document are (1) to set a maximum permissible particle concentration for 10/0.2 grade cylinder nitrogen, and (2) to describe a reference method for its verification.

2 Scope

2.1 This Specification applies to nitrogen contained in high pressure gas cylinders; it is not applicable to pipeline gases.

2.2 A nitrogen cylinder consists of three components: (1) a cylinder bottle, (2) compressed nitrogen contained within, and (3) a cylinder valve. Each component can be a particle source. This Specification applied to the total number of particles detected in the gas as obtained from the cylinder under a prescribed condition. No consideration is given to the origin of the particles.

2.3 It is known that pressure reduction, if not controlled, can produce a large number of artifact particles through nucleation and condensation. To avoid this complication, this Specification adopts particle counters that can be operated at a pressure up to 200 bar (3000 psi), eliminating the need for pressure reduction and its associated problems.

2.4 It is known that particle content in cylinder gases varies with time because particles can be lost to cylinder walls by diffusion or sedimentation, and detached from cylinder walls by flow pulses or mechanical shocks. It is important to measure particle concentration under the worst conditions which represent typical handling of gas cylinders. This Specification describes a standard shock test that fulfills the above requirements and provides a procedure to count particles immediately after the shock.

2.5 If this test method is to be used for more than one cylinder, then each cylinder must be tested. It is known that particle contamination in cylinder gases is a strong function of the handling history of the individual cylinders. Cylinders in the same batch of filling are usually returned from various customers after various periods of service. Uniform quality can not be assumed for the same batch of cylinders unless each of them has gone through a dedicated process that erases the memory of previous history prior to filling. Therefore, batch sampling at 10% or 20% cannot be accepted because of the significant differences among cylinders.

2.6 The requirement of 100% sampling restricts the total amount of gas in each cylinder that can be used for sampling purposes. This restriction, in turn, calls for certain relaxation of the statistical requirement for particle sampling at low concentration 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 Referenced Standards and Documents

3.1 None.

4 Terminology

4.1 *Abbreviations and Acronyms*

4.1.1 *FCD* — flow control device

4.1.2 *HPC* — high-pressure particle counter

4.1.3 *SCF* — standard cubic feet

4.2 Variables

4.2.1 X_{Bi} — observed particle concentration in the i^{th} sample interval of the background.

4.2.2 X_{Mi} — observed particle concentration in the i^{th} sample interval before shocks.

4.2.3 X_{Ni} — observed particle concentration in the i^{th} sample after shocks.

4.2.4 N_B — number of sample intervals of the background.

4.2.5 N_M — number of sample intervals before shocks.

4.2.6 N_N — number of sample intervals after shocks.

4.2.7 $\bar{X}_B$ — averaged observed particle concentration of the background.

4.2.8 $\bar{X}_M$ — averaged observed particle concentration before shocks.

4.2.9 $\bar{X}_N$ — averaged observed particle concentration after shocks.

4.2.10 X_P — calculated particle concentration before shocks.

4.2.11 X_Q — calculated particle concentration after shocks.

4.2.12 S_B — standard deviation of $\bar{X}_B$.

4.2.13 S_M — standard deviation of $\bar{X}_M$.

4.2.14 S_N — standard deviation of $\bar{X}_N$.

4.2.15 SE_P — standard deviation of X_P .

4.2.16 SE_Q — standard deviation of X_Q .

4.3 Averaged Observed Concentration ($\bar{X}_B$, $\bar{X}_M$, $\bar{X}_N$)

- $\bar{X}_B = \text{SUM}(X_{Bi}) / N_B$

- $\bar{X}_M = \text{SUM}(X_{Mi}) / N_M$

- $\bar{X}_N = \text{SUM}(X_{Ni}) / N_N$

4.4 Calculate Concentration (X_P , X_Q)

- $X_P = \bar{X}_M - \bar{X}_B$

- $X_Q = \bar{X}_N - \bar{X}_B$

4.5 Standard Deviation (S_B , S_M , S_N)

- $S_B = [\text{SUM}(X_{Bi} - \bar{X}_B)^2 / (N_B - 1)]^{1/2}$

- $S_M = [\text{SUM}(X_{Mi} - \bar{X}_M)^2 / (N_M - 1)]^{1/2}$

- $S_N = [\text{SUM}(X_{Ni} - \bar{X}_N)^2 / (N_N - 1)]^{1/2}$

4.6 Standard Error (SE_P , SE_Q)

- $SE_P = [(S_M^2 / N_M) + (S_B^2 / N_B)]^{1/2}$

- $SE_Q = [(S_N^2 / N_N) + (S_B^2 / N_B)]^{1/2}$