

SEMI F23-0518

SPECIFICATION FOR PARTICLE CONCENTRATION OF GRADE 10/0.2 HYDROGEN

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NOTICE: Paragraphs entitled ‘NOTE:’ are not an official part of this Standard or Safety Guideline and are not intended to modify or supersede the official Standard or Safety Guideline. These have been supplied by the global technical committee to enhance the usage of the Standard or Safety Guideline.

1 Purpose

1.1 The purpose of this Standard is to set a maximum permissible particle concentration for 10/0.2 grade hydrogen and to describe a reference method for its verification.

2 Scope

2.1 This Standard applies to hydrogen (H₂) delivered through specialty gas systems at pressures up to 8×10^5 Pa (8 atmospheres). This method is not suitable for direct sampling from high pressure cylinders at pressures above 8×10^5 Pa (8 atmospheres).

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 *SEMI Standards and Safety Guidelines*

SEMI C6.3 — Particle Specification for Grade 20/0.2 Hydrogen (H₂) Delivered as Pipeline Gas

3.2 *JSA Standards*¹

JIS B 9921 — Light Scattering Automatic Particle Counter

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

4 Terminology

4.1 Variables

4.1.1 V_{Mi} — volume of the i^{th} sample interval of the system gas.

4.1.2 V_{Bi} — volume of the i^{th} sample interval of the background.

4.1.3 X_{Mi} — concentration of particles observed in the i^{th} sample of interval of the system gas.

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

4.1.5 N_M — number of sample intervals of the system gas.

4.1.6 N_B — number of sample intervals of the background.

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4.1.7 $\bar{X}_M$ — average observed concentration of counts in the system gas sample.

4.1.8 $\bar{X}_B$ — average observed concentration of background counts.

4.1.9 $\bar{X}_C$ — calculated concentration of particles in the system gas.

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

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

4.1.12 S_C — standard deviation of $\bar{X}_C$.

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

4.3 *average observed concentration of counts* ($\bar{X}_M$, $\bar{X}_B$) — The average concentration of counts, that is:

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

4.4 *calculated concentration of particles* ($\bar{X}_C$) — the concentration of particles in the system gas obtained by correcting the observed concentration in the system gas for the observed concentration in the background, that is:

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

4.5 *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:

$$S_M = \sqrt{\frac{\sum (X_{Mi} - \bar{X}_M)^2}{(N_M - 1)}}$$

$$S_B = \sqrt{\frac{\sum (X_{Bi} - \bar{X}_B)^2}{(N_B - 1)}}$$

NOTE 1: The third is obtained from the first two, that is:

$$S_C = \sqrt{S_M^2 + S_B^2}$$

5 Requirements

5.1 *Maximum Permissible Particle Concentration* — 10 particles per 25 standard liters as determined by the instrument specified in § 6.

5.2 The specification will be considered met if the calculated concentration of particles plus 2 times the standard deviation does not exceed 10 particles per 25 standard liters, that is:

$$\bar{X}_C + 2 \times S_C \leq 10 \text{ particles/25 standard liters}$$

6 Apparatus

6.1 *Particle Counter* — An instrument suitable for counting particles in compressed flammable gases at a pressure of up to 8×10^5 Pa (8 atmospheres) with a 50% counting efficiency should reach 90% at 0.3 micrometer or smaller. The resolving power of the instrument near 0.2 micrometer should be no worse than 10%. The counting efficiency is determined by a calibration at 1×10^5 Pa (1 atmosphere) pressure using polystyrene latex spheres in an inert gas and a reference particle counter with a proven counting efficiency of not less than 95% at 0.2 micrometer.

NOTE 2: Suitable test methods for determining counting efficiency and resolving power are contained in Japanese Industrial Standard JIS B 9921, Light Scattering Automatic Particle Counter. More sensitive particle counters result in a higher measured particle concentration.