

SEMI C6.4-90 (Reapproved 1102) PARTICLE SPECIFICATION FOR GRADE 20/0.02 NITROGEN (N₂) AND ARGON (Ar) DELIVERED AS PIPELINE GAS

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1 Purpose

1.1 The purposes of this document are: (1) to set a maximum permissible particle concentration for 20/0.02 grade nitrogen and argon bulk supply gases, and (2) to describe a reference method for its verification.

2 Scope

2.1 This document applies only to nitrogen gas and argon gas delivered through pipelines; it is not applicable to cylinder gases or gases in their liquid state.

2.2 This standard does not purport to address safety issues, if any, associated with its use. It is the responsibility of the users of this standard to establish appropriate safety health practices and determine the applicability or regulatory limitations prior to use.

3 Terminology

3.1 Variables

V_{Mi}	Volume of the i^{th} sample interval of the pipeline gas
V_{Bi}	Volume of the i^{th} sample interval of the background
X_{Mi}	Concentration of particles observed in the i^{th} sample interval of the pipeline gas
X_{Bi}	Concentration of particles observed in the i^{th} sample interval of the background
N_M	Number of sample intervals of the pipeline gas
N_B	Number of sample intervals of the background
$\bar{X}_M$	Average observed concentration of counts in the pipeline gas sample
$\bar{X}_B$	Average observed concentration of background counts
$\bar{X}_C$	Calculated concentration of particles in the pipeline gas
S_M	Standard deviation of $\bar{X}_M$
S_B	Standard deviation of $\bar{X}_B$
S_C	Standard deviation of $\bar{X}_C$

3.2 *Gas Sample Volume* (V_{Mi} , V_{Bi}) — The volume of the sample interval, expressed in standard liters at standard conditions, 0°C (32°F) and 1.00° atmosphere

pressure. Standard Cubic Feet (SCF) is defined at 21.1°C (70°F) and 1.00° atmosphere pressure.

3.3 *Average Observed Concentration of Counts* ($\bar{X}_M$, $\bar{X}_B$) — The average concentration of counts, i.e.:

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

3.4 *Calculated Concentration of Particles* ($\bar{X}_C$) — The concentration of particles in the pipeline gas obtained by correcting the observed concentration in the pipeline gas for the observed concentration in the background, i.e.:

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

3.5 *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, i.e.:

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

The third is obtained from the first two, i.e.:

$$S_C = (S_M^2 + S_B^2)^{1/2}$$

NOTE 1: These expressions are derived from an assumption of a Gaussian (Normal) distribution.

4 Apparatus

4.1 *Particle Counter* — An instrument suitable for counting particles in gaseous nitrogen or argon with a minimum detection efficiency of 90% at 0.02 micrometers as determined by the manufacturer of the particle counter. Condensation nucleus counters (CNCs) typically satisfy this requirement.

4.2 *Pressure Reducer* — An accessory required for counters operated at atmospheric pressure, it should

preferably use expansion of the gas through a critical orifice.

5 Test Method

NOTE 2: The details of sampling configuration, measurement procedure, and instrument calibration procedure and frequency must be agreed upon by the user and supplier, taking into account good engineering practice.

5.1 Determine the average observed concentration of counts in the background ($\bar{X}_B$) by passing air, nitrogen or argon, believed to be free of particles of 0.02 micrometers or more in diameter, through the instrument and recording the total number of counts. Count a minimum of 8 sample intervals, each at least 25 standard liters (0.95 SCF) or 30 minutes, whichever is greater. A suggested assembly for performing this test, using a filter which removes particles in this size range, is shown in Figure 1. Calculate $\bar{X}_B$ as defined in Section 3. $\bar{X}_B$ must not exceed 2 particles per 25 standard liters.

5.2 The sampling point should be at outlet of system, and sampling lines should be as short as possible.

5.3 A suggested sampling probe configuration for turbulent main line flow is shown in Figure 2. The flow rate in the sampling tube at pipeline pressure should be set so that the mean sampling flow velocity at the probe inlet matches as closely as possible the axial flow velocity in the pipeline. The pitot sampling tube ID should be no less than 2 mm (0.08 inch). The orifice and sampling horn should be sized so that the mean flow velocity at the particle counter probe inlet matches the axial flow velocity in the horn as closely as possible.

5.4 Count the particles in each of at least 8 sample intervals. Each sample interval must be at least 25 standard liters or 30 minutes, whichever is greater. Record the number of counts and the sample volume for each interval. Calculate $\bar{X}_C$ and S_C , as defined in Section 3.

6 Specification

6.1 *Maximum Permissible Particle Concentration* — 20 particles per 25 standard liters as determined by the instrument specified in Section 4.

6.2 The specification will be considered met if the calculated concentration of particles plus two standard deviations does not exceed 20 particles per 25 standard liters, i.e.:

$$\bar{X}_C + 2^* S_C \leq 20 \text{ particles/25 standard}$$

7 Report

7.1 The report shall contain the values of all the variables defined in Section 3.

8 Precision

8.1 This test procedure defines the requirements to satisfy the specification at the 95% confidence level.

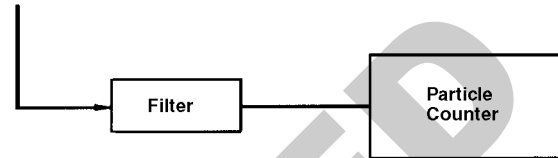


Figure 1
Suggested Assembly for Determining Particle Counter Background

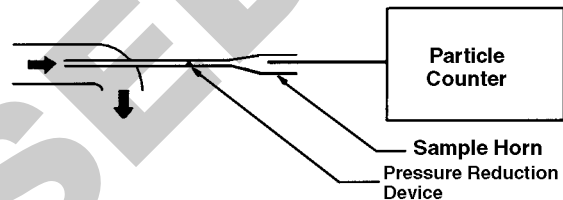


Figure 2
Schematic Diagram of Configuration for Obtaining Particle Samples from Pipelines

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