

SEMI C3.12-1109

SPECIFICATION FOR AMMONIA (NH₃) IN CYLINDERS, 99.998% QUALITY

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1 Purpose

1.1 The purpose of this document is to provide specification for ammonia (NH₃) that is used in the semiconductor industry.

2 Scope

2.1 This document covers requirements for ammonia used in the semiconductor industry.

NOTICE: 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 and health practices and determine the applicability of regulatory or other limitations prior to use.

3 Referenced Standards and Documents

3.1 None.

4 Description

4.1 Ammonia is a colorless, alkaline gas having a pungent odor. Ammonia dissolves readily in water. It is shipped as a liquefied gas under its own vapor pressure. It is combustible.

5 Specifications

5.1 Quality: 99.998%

Impurities	Maximum Acceptable Level (ppm) ^{#1}
Carbon monoxide (CO)	1
Hydrocarbons C ₁ – C ₃	1
Nitrogen (N ₂)	5
Oxygen (O ₂)	2
Water (H ₂ O) (v/v)	3
TOTAL LISTED IMPURITIES	12

#1 An analysis of significant figures has not been considered. The number of significant figures will be based on analytical accuracy and the precision of the provided procedure.

NOTE 1: This specification applies to the gas phase of the cylinder as delivered.

6 Physical Constants (for information only)

	Metric Units	US Units
Molecular Formula	NH ₃	NH ₃
CAS Number	7664-41-7	7664-41-7
Molecular weight	17.031	17.031
Boiling point at 1 atm	-33.4°C	-28.2°F

	<i>Metric Units</i>	<i>US Units</i>
Density of gas at 0°C (32°F) and 1 atm	0.771 kg/m ³	0.0481 lb/ft ³
Specific gravity of gas at 0°C and 1 atm (air = 1)	0.597	0.597
Density of liquid at 21.1°C (70°F)	608.7 kg/m ³	38.00 lb/ft ³

7 Analytical Procedures

NOTE 2: Observe proper safety procedures for handling and venting the ammonia sample.

NOTE 3: Introduce the calibration standard as many times as necessary to achieve the desired precision.

NOTE 4: All the gases used in the analysis of the sample should contain not more than 10% of the specified value of the component of interest unless otherwise specified.

NOTE 5: All carrier lines, carrier pressure regulators and sample containers are to be constructed of stainless steel and cleaned. The systems must be assembled without pipe threads, PTFE tape or polymeric seal materials.

7.1 Carbon Monoxide, Oxygen and Nitrogen — This procedure is for the determination of carbon monoxide, oxygen and nitrogen in ammonia using a gas chromatograph with a helium ionization detector.

NOTE 6: Due to the extreme sensitivity of the helium ionization detector, the system is to be helium leak tested to a maximum of 10^{-7} atm-cc/sec.

7.1.1 Detection Limits — 25 ppb (mole/mole) carbon monoxide, 30 ppb (mole/mole) oxygen, 50 ppb (mole/mole) nitrogen.

7.1.2 Instrument Parameters

7.1.3 Columns

- **Column 1** — HayeSep® A or equivalent, 100/120 mesh, 3.28 m (10 ft.) by 3.2 mm (1/8 in.) 0.085 ID.
- **Column 2** — HayeSep® A or equivalent, 100/120 mesh, 3.28 m (10 ft.) by 3.2 mm (1/8 in.) 0.085 ID.

7.1.3.1 Carrier Flow — 30 mL/min helium, minimum of 99.9999% purity having a maximum of 40 ppb carbon dioxide.

7.1.3.2 Sample Volume — 1.0 mL.

7.1.3.3 Temperatures

- **Detector** — 125°C
- **Columns** — 27°C

7.1.3.4 Determine the breakdown voltage of the detector. Set operating voltage at 10 volts below breakdown.

7.1.4 Calibration Standards — 1–2 ppm (mole/mole) carbon monoxide, 2–3 ppm (mole/mole) oxygen, 5–6 ppm (mole/mole) nitrogen, balance helium (having a total of other impurities of less than 1 ppm).

7.1.5 Operating Procedure

7.1.5.1 Set timing interval on sample select valve to 10 seconds.

7.1.5.2 Set timing interval on gas sampling valve to 3:30 minutes.

7.1.5.3 Set timing interval #3 to 4:20 minutes.

7.1.5.4 Do not change the initial sample flow setting once established.

7.1.5.5 Obtain a continuous flow of the calibration standard using a clean stainless steel line (0.02 in. ID).

7.1.5.6 Inject the calibration standard onto the precolumn with the gas sampling valve. Record the retention times and peak areas. Order of elution is nitrogen, oxygen, and carbon monoxide.