

SEMI PV24-1011

GUIDE FOR AMMONIA (NH₃) IN CYLINDERS, USED IN PHOTOVOLTAIC APPLICATIONS

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1 Purpose

1.1 This Document provides a suggested maximum impurity level for ammonia (NH₃) that is used in the photovoltaic industry.

2 Scope

2.1 This Document refers to an “as supplied” product; not point of use. Its quality is determined in a gaseous phase, at a delivery point agreed between the supplier and user, regardless of the phase in which the material was delivered.

2.2 This Document is a guide and complete analytical methods are not contained within. A selected list of available techniques is found in § 8, Available Techniques.

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3 Description

3.1 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 flammable.

4 Referenced Standards and Documents

4.1 *SEMI Standards and Safety Guidelines*

SEMI C10 — Guide for Determination of Method Detection Limits

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

5 Terminology

5.1 None.

6 Properties of Ammonia

Table 1 Properties of Ammonia

	<i>Metric Units</i>	<i>US Units</i>
Molecular Formula	NH ₃	NH ₃
CAS Number	7664-41-7	7664-41-7
Molecular weight	17.031	17.031
Boiling point at 101.3 kPa (1 atm)	−33.4°C	−28.2°F
Density of gas at 0°C (32°F) and 101.3 kPa (1 atm)	0.771 kg/m ³	0.0481 lb/ft ³
Specific gravity of gas at 0°C and 101.3 kPa (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 Suggested Values for Ammonia

Table 2 Suggested Values for Ammonia

<i>Grade</i> ^{#1}		99.995%
<i>Impurities</i>	<i>Available Techniques</i> ^{#2}	<i>Maximum Level (ppm-v)</i> ^{#3}
Carbon monoxide (CO)	GC-PDID, GC-RGD, GC-TCD	2
Hydrocarbons C ₁ – C ₃	GC-PDID, GC-HID, GC-TCD, THC, GC-FID	1.5
Nitrogen (N ₂)	GC-PDID, GC-HID, GC-TCD	5
Oxygen (O ₂)	GC-PDID, GC-HID, GC-TCD	1.5
Hydrogen (H ₂)	GC-PDID, GC-HID, GC-TCD, GC-RGD	1
Water (H ₂ O) (v/v)	FTIR, CRDS, TDLAS	4
TOTAL LISTED IMPURITIES		15

#1 A numerical Grade is defined as the value achieved when the specified impurities are subtracted from 100%.

#2 Unless otherwise indicated, the method detection limits will be determined using SEMI C10, resulting in value that will be less than or equal to the Maximum Level for each impurity. Analytical methods should be selected accordingly. Known analytical interferences should be considered. See § 8.

#3 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.

8 Available Techniques

8.1 Available techniques that may be used to determined impurities are listed within this section.

8.1.1 *CRDS* — Cavity ring down spectroscopy,

8.1.2 *DID* — Discharge ionization detector,

8.1.3 *FID* — Flame ionization detector,

8.1.4 *FTIR* — Fourier transform infrared spectroscopy,

8.1.5 *GC* — Gas chromatograph,

8.1.6 *HID* — Helium ionization detector,

8.1.7 *PDID* — Pulsed discharge ionization detector,

8.1.8 *RGD* — Reduction gas detector,

8.1.9 *TCD* — Thermal conductivity detector,

8.1.10 *TDLAS* — Tunable diode laser absorption spectrometry,

8.1.11 *THC* — Total hydrocarbon analyzer.

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