

SEMI C3.20-0414 (Reapproved 0319) SPECIFICATION FOR HELIUM (He), IN CYLINDERS, 99.9995% QUALITY

This Standard was technically approved by the Gases Global Technical Committee. This edition was approved for publication by the global Audits and Reviews Subcommittee on December 17, 2018. Available at www.semiviews.org and www.semi.org in March 2019; originally published in 1982; previously published April 2014.

NOTICE: This Document was reapproved with minor editorial changes.

1 Purpose

1.1 The purpose of this Document is to provide specifications for helium (He) that is used in the semiconductor industry.

2 Scope

2.1 This Document covers requirements for helium used in the semiconductor industry.

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 Description

3.1 Helium is a rare gas or cryogenic liquid that is inert, colorless, odorless, and tasteless.

4 Limitations

4.1 None.

5 Referenced Standards and Documents

5.1 *SEMI Standards and Safety Guidelines*

SEMI C3 — Specification for Gases

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

6 Terminology

6.1 Terminology appropriate to this Standard is defined in SEMI C3.

7 Requirements

7.1 Purity and other requirements for helium are given in Table 1.

Table 1 Impurity and Other Requirements for Helium

Purity	99.9995%
Impurities	Maximum Acceptable Level (ppm) ^{#1}
Carbon monoxide and carbon dioxide (CO + CO ₂)	1
Nitrogen (N ₂)	2
Oxygen (O ₂)	0.5
Total Hydrocarbons expressed as Methane (THC)	0.5
Water (H ₂ O) (v/v)	0.5
TOTAL SPECIFIED IMPURITIES	4.5

^{#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.

8 Properties of Helium (for information only)

	<i>Metric Units</i>	<i>US Units</i>
CAS Number	7440-59-7	7440-59-7
Molecular Weight	4.003	4.003
Boiling point at 1 atm	-268.9°C	-452.0°F
Density of gas at 21.1°C (70°F) and 1 atm	0.1656 kg/m ³	0.01034 lb/ft ³
Specific gravity of gas at 21.1°C and 1 atm (air = 1)	0.138	0.138
Density of liquid at boiling point	124.9 kg/m ³	7.798 lb/ft ³

9 Test Method for Determining Impurity Limits (See Notes 1, 2)

9.1 *Carbon Monoxide and Carbon Dioxide* — This method is for the determination of carbon monoxide and carbon dioxide in helium using a gas chromatograph with a flame ionization detector and methanizer.

9.1.1 *Detection Limit* — 100 ppb (mole/mole).

9.1.2 *Instrument Parameters*

9.1.2.1 Column: PorapakTM T or Q, 3 m (9.8 ft.) by 3 mm (1/8 in.) ss; or Chromosorb[®] 102, 2 m (6.6 ft.) by 3 mm ss; or equivalent.

9.1.2.2 Carrier Flow: 30 mL/min helium.

9.1.2.3 Sample Volume: 0.5 to 2.0 mL.

9.1.2.4 Temperatures:

- *Detector* — 280°C.
- *Column Oven* — 60°C.
- *Methanizer* — 350°C.

9.1.3 *Calibration Standards* — 1 to 10 ppm (mole/mole) carbon monoxide, 1 to 10 ppm (mole/mole) carbon dioxide, balance helium.

9.1.4 *Operating Procedure*

9.1.4.1 Inject the calibration standard into the column using a gas sampling valve. Record the retention times and peak areas. Order of elution is carbon monoxide, carbon dioxide.

9.1.4.2 Inject the sample to be tested in same manner as the calibration standard. Record the retention times and peak areas.

9.1.4.3 Repeat ¶ 9.1.4.1.

9.1.4.4 Compare the average peak areas of the calibration standard to that of the helium sample being tested. Calculate the concentrations of carbon monoxide and carbon dioxide, using the formula below. The result may not exceed the specification in Table 1 of this Standard.

$$\frac{\text{Sample Peak Area}}{\text{Standard Peak Area}} \times \frac{\text{Concentration of Standard}}{\text{Concentration of Sample}} = \text{Concentration of Sample} \quad (1)$$

9.2 *Nitrogen* — This method is for the determination of nitrogen in helium using a gas chromatograph with a helium ionization detector.

¹ Trademarks are owned by Sigma-Aldrich.