

SEMI C3.56-0312 (Reapproved 0618) SPECIFICATION FOR DIBORANE MIXTURES

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1 Purpose

1.1 To define the specification and analytical methods and validate the specifications for diborane mixtures.

2 Scope

2.1 Diborane is not used as a pure gas but as a mixture with balance gases of N₂, H₂, Ar, He, or SiH₄.

2.2 The quality of the mixture is affected by a number of factors which include:

- the purity of the gases used for mixture preparation;
- component filling precision;
- the cylinder preparation process and *in-situ* reactions of diborane with the internal surface of the cylinder.

2.2.1 Furthermore, the elapsed time after filling is important due to the chemical instability, and hence decomposition, of the diborane (see Appendix 1).

2.2.2 All component gases shall adhere to the appropriate SEMI Specification, if available.

2.3 The quality of the final mixture can be checked after manufacturing by analyzing each cylinder for the concentration of diborane and for key impurities (tracers), namely H₂, N₂, O₂.

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 DIN Standard¹

DIN 50457-1 — Testing of Materials for Semiconductor Technology – Determination of the Volume Fraction of Components in Dopant Gas Mixtures by Wet-Chemical Methods – Part 1: Diborane in Hydrogen Diborane Mixtures

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

4 Specifications

4.1 Mixing Tolerances

Table 1 Mixing Tolerances for Diborane Mixtures

<i>Concentration of Diborane</i>	<i>Preparation Tolerance Level</i>
10–999 ppm	±20%
0.1–10%	±5%

¹ Deutsches Institut für Normung e.V., Available from Beuth Verlag GmbH, Burggrafenstrasse 4-10, D-10787 Berlin, Germany; <http://www.din.de>

4.2 Analytical Precision — Determination of Diborane Content

Table 2 Analytical Precision for Diborane Content in Diborane Mixtures

Concentration of Diborane	Analytical Precision
10–99 ppm	±3%
100–999 ppm	±2%
0.1–10%	±2%

#1 N.B. Analytical precision is based on at least six replicate determinations.

4.3 Impurities

4.3.1 In the final mixture the concentration of impurities should fulfill the following condition:

$$c_i(\text{mix}) = \left[\frac{x_{(\text{diborane})}}{100} \cdot c_i(\text{diborane}) \right] + \left[\frac{x_{(\text{main})}}{100} \cdot c_i(\text{main}) \right] \quad (1)$$

where:

$c_i(\text{mix})$ = concentration of impurity i in the mixture (ppm).

$c_i(\text{diborane})$ = maximum concentration of impurity i in diborane (ppm).

$c_i(\text{main})$ = maximum concentration of impurity i in the balance gas (ppm).

$x_{(\text{diborane})}$ = concentration of diborane in the mixture (%).

$x_{(\text{main})}$ = concentration of balance gas in the mixture (%).

5 Properties of Diborane

Table 3 Properties of Diborane

Molecular Formula	B ₂ H ₆
CAS Number	19287-45-7
Molecular Weight	27.67
Melting Point	–165°C
Boiling Point	–93°C
Flash Point	–90°C
Relative Density, Gas	0.95 (Air = 1)
Appearance/Color	Colorless gas
Odor	Repulsive, Sickly Sweet

6 Analytical Procedure for the Determination of Diborane Concentration

NOTE 1: This procedure is for the determination of the diborane content using a Fourier transform infrared analyzer.

6.1 *Detection Limit* — 2 ppm (mole/mole).

6.2 *Instrument Parameters*

6.2.1 *Cell Path Length*

6.2.1.1 10 cm (mixtures 100 ppm to 10%).

6.2.1.2 10 m (mixtures up to 100 ppm).