

SEMI F21-1102

CLASSIFICATION OF AIRBORNE MOLECULAR CONTAMINANT LEVELS IN CLEAN ENVIRONMENTS

This classification was technically approved by the global Facilities Committee and is the direct responsibility of the North American Facilities Committee. Current edition approved by the North American Regional Standards Committee on August 29, 2002. Initially available at www.semi.org September 2002; to be published November 2002. Originally published in 1995.

1 Purpose

1.1 The purpose of this standard is to classify microelectronics clean environments with respect to their molecular (non-particulate) contaminant levels. This standard classification provides a consistent means of communicating acceptable contaminant levels of groups of specific airborne molecular contaminants. See Related Information 1 appended to this standard.

2 Scope

2.1 This standard classification is to be used in the specification of semiconductor clean environments (including process tool environments) and of contamination control and measurement equipment performance.

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 Terminology

4.1 Definitions

4.1.1 *acid* — a corrosive material whose chemical reaction characteristic is that of an electron acceptor.

4.1.2 *base* — a corrosive material whose chemical reaction characteristic is that of an electron donor.

4.1.3 *condensable* — a substance (other than water), typically having a boiling point above room temperature at atmospheric pressure, capable of condensation on a clean surface.

4.1.4 *dopant* — a chemical element which modifies the electrical properties of a semiconductive material.

5 Basis of Classification

5.1 Classification is by the maximum allowable total gas phase concentration of each category of material. This classification system is depicted in § 6. The combination of a quantitative class for each of the four categories yields a classification describing an environment.

5.2 The maximum cumulative gas phase concentrations of the four categories may be different.

5.3 Each category is designated by the letter “M,” followed by the first letter of the category name A, B, C, or D.

5.4 The integer following the category designator shall indicate the maximum total gas phase concentration in parts per trillion molar (pptm 1×10^{-12}). For example, a category MA-10 has a maximum allowable total concentration of 10 parts per trillion molar for the category of interest.

6 Classification

Material Category	1 ^{#1}	10 ^{#1}	100 ^{#1}	1000 ^{#1}	10,000 ^{#1}
Acids	MA-1	MA-10	MA-100	MA-1000	MA-10,000
Bases	MB-1	MB-10	MB-100	MB-1000	MB-10,000
Condensables	MC-1	MC-10	MC-100	MC-1000	MC-10,000
Dopants	MD-1	MD-10	MD-100	MD-1000	MD-10,000

#1 Concentration, in parts per trillion.

7 Reference Test Methods

7.1 Analytical methods capable of measuring the classified levels at the agreed level of confidence shall be used.

8 Related Documents

8.1 SEMI Standards

SEMI E45 — Test Method for the Determination of Inorganic Contamination from Minienvironments Using Vapor Phase Decomposition-Total Reflection X-Ray Spectroscopy (VPD-TXRF), VPD-Atomic Absorption Spectroscopy (VPD-AAS), or VPD/Inductively Coupled Plasma-Mass Spectrometry (VPD/ICP-MS)

SEMI E46 — Test Method for the Determination of Organic Contamination from Minienvironments Using Ion Mobility Spectrometry (IMS)

8.2 Other

8.2.1 Berro, N., Cook, J.P.D., *et al.*, "Airborne Contamination of Semiconductor Wafers Traced to Humidification Plant Additives," *Journal of the IES*, pp. 15–18, November 1993

8.2.2 Buchmann, K. and Rudolph, J., "Gas Chromatography of Radioactive Inorganic Compounds," *Journal of Radiational Chemistry*, 32(2): 245–64, 1976

8.2.3 Dixon, W.J., "Processing Data for Outliers," *Biometrics*, 9(7): 74–89

8.2.4 Kasi, S.R., Liehr, M., Thiry, P.A., *et al.*, "Hydrocarbon Reaction with HF-Cleaned Si (100) and Effects on Metal-Oxide-Semiconductor Device Quality," *Applied Physics Letters*, 59: 108–110, 1992

8.2.5 Kelly, T.J. and Kinkead, D.A., "Testing of Chemically Treated Adsorbent Air Purifiers," *ASHRAE Journal*, August 1993

8.2.6 Kinkead, D.A., "Controlling a Killer: How to Win the War Over Gaseous Contaminants," *Cleanrooms*, June 1993.

8.2.7 Kinkead, D.A. and Higley, J.K., "Targeting Gaseous Contaminants in Wafer Fabs: Fugitive Amines," *Microcontamination*, pp. 37–40, June 1993

8.2.8 Mori, E.J., Dowdy, J.D., and Shive, L.W., "Correlating Organophosphorus Contamination of Wafer Surfaces with HEPA Filter Installation," *Microcontamination*, pp. 35–37, November 1992

8.2.9 Muller, A.J., *et al.*, "Volatile Cleanroom Contaminants: Sources and Detection," *Solid State Technology*, September 1994, page 61

8.2.10 Muller, A.J., Psota-Keity, L.A., and Sinclair, J.K., "Concentrations of Organic Vapors and Their Surface Arrival Rates at Surrogate Wafers During Processing in Clean Rooms," *Proceedings of the Electrochemical Society: Semiconductor Cleaning Technology*, Hollywood, FL, Ruzyllo, J. and Novak, R.E. (eds.), vol. 90–9, pp. 204–211, 1990

8.2.11 Seeman, D.J., "Fluid Seal Urethane Gels/Chemical Compounds: The Need to Establish Standards and Standard Test Procedures for Their Acceptance in the Cleanroom Environment," *Proceedings of 38th Annual Technical Meeting of IES*, Nashville, TN, pp. 492–497, May 1992