

SEMI F39-0699

GUIDELINE FOR CHEMICAL BLENDING SYSTEMS

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1 Purpose

1.1 This guideline establishes terminology, classification, performance characterization, and qualification methods for chemical blending equipment.

2 Scope

2.1 This guideline applies to chemical blending equipment interfaced with Bulk Chemical Distribution Systems (BCDS).

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 Limitations

3.1 This guideline does not cover subject matter concerning chemical distribution capability of some chemical blending equipment, chemical blending methodology, or materials of construction used in this equipment.

4 Referenced Standards and Documents

SEMI F31 — Guide for Bulk Chemical Distribution Systems

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

5 Terminology

5.1 *accuracy* — a quantity describing the deviation of the mean blend ratio produced by the chemical blending equipment from the desired constituent ratio.

5.2 *assay* — a term used to determine the amount of a chemical constituent in a blend.

5.3 *baseline contamination level* — the level of impurity measured in the source fluids, including UPW and chemical.

5.4 *batch* — the end quantity of chemical resulting from the blending of the chemical constituents.

5.5 *blending* — combination of two or more chemicals to create a mixture which contains a desired ratio of constituents. A dilution process by this definition is also a blending process. However, blending is a more general case where UPW is not always one of the constituents. Therefore, the term blending will be used in the remainder of the document.

5.6 *Central Limit Theorem (CLT)* — the CLT is a probability theorem which allows the approximation of normality for any distribution. The CLT applied to chemical blending states that if a sufficient number of random samples are taken from the distribution of all chemical produced by chemical blending equipment, then the average measurement of these samples can be approximated to follow a normal distribution. A rule of thumb for the “sufficient number of batches” is thirty or greater.

5.7 *dilution* — combination of a concentrated chemical and UPW to create a lower concentration of the aqueous chemical.

5.8 *duty cycle* — the normal percentage of time that the chemical blending equipment is operating.

5.9 *mixing* — mechanical energy imparted to a combination of two or more chemical constituents used to create a homogenous solution.

5.10 *on-site blending* — chemical blending equipment used for blending chemical on location of the semiconductor manufacturing facility

5.11 *precision or repeatability* — a quantity describing the degree of achieving the same ratio of chemical constituents in the blend over time.

5.12 *production rate* — the volume of chemical able to be blended and provided to the BCDS per day.

6 Classification

6.1 Batch Blending — The process of chemical blending where the chemical constituents are combined and mixed in a tank before being made available for use.

6.2 Feed-forward Controlled Blending — Blending process which uses information (i.e., incoming chemical assay) of the chemical constituents as the basis for combining these constituents. Examples of feed-forward blending processes include, but are not limited to, those processes that use weight or volume for control.

6.3 Feedback Controlled Blending — Blending process which combines constituents based on measurements of the blended chemical. Examples of feedback controlled blending process include, but are not limited to, those processes controlled by measurements of density, conductivity, and chemical assay (by titration).

6.4 In-line Blending — The process of chemical blending where the chemical constituents are combined in line and are immediately available for use.

7 Performance Characterization

7.1 Blending Repeatability

7.1.1 Batch Blending

7.1.1.1 *Sample Collection* — A sample of at least thirty batches of blended chemical is taken. Assay of this chemical is measured.

7.1.1.2 *Calculations* — The mean and standard deviation of the batches are computed.

7.1.1.3 *Reporting* — When reporting repeatability, either of two methods is acceptable. Both methods quote precision in terms of the chemical assay.

7.1.1.3.1 *Repeatability at one concentration* = mean $\pm 3\sigma$ (where σ is in units of concentration).

7.1.1.3.2 *Repeatability in range of concentrations*: Individually calculate percent relative standard deviation at $3\sigma = (3\sigma/\text{mean}) \times 100\%$ for representative concentrations within the desired range (30 samples for each concentration, calculate a standard deviation and mean for each concentration). Repeat largest percent relative standard deviations at 3σ and concentration range examined or report percent relative standard deviation at 3σ for each individual concentration.

7.1.1.3.3 *Multiple Components* — If more than one non-aqueous chemical constituent exists in the blend, the precision for each must be quoted individually.

7.1.2 In-Line Blending

7.1.2.1 *Sample Collection* — At least thirty samples of blended chemical are taken. The time interval between samples must be at least one hour. Assay of this chemical is measured.

7.1.2.2 *Calculations* — The mean and standard deviation of the samples are computed.

7.1.2.3 *Reporting* — When reporting repeatability one of two methods is acceptable. Both methods quote precision in terms of the chemical assay.

7.1.2.3.1 *Repeatability at one concentration* = mean $\pm 3\sigma$ (where σ is in units of concentration).

7.1.2.3.2 *Repeatability in Range of Concentrations* — Individually calculate percent relative standard deviation at $3\sigma = (3\sigma/\text{mean}) \times 100\%$ for representative concentrations within the desired range (30 samples for each concentration, calculate a standard deviation and mean for each concentration). Repeat largest percent relative