

SEMI F41-0699

GUIDE FOR QUALIFICATION OF A BULK CHEMICAL DISTRIBUTION SYSTEM USED IN SEMICONDUCTOR PROCESSING

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1 Purpose

1.1 This Guide sets forth a logical and systematic approach to the qualification of a Bulk Chemical Distribution System that may be used by users and suppliers as a basis for developing site-specific BCDS specifications and performance criteria.

2 Scope

2.1 The qualification process includes evaluation of chemical from the chemical source, the fluid transfer system, the distribution piping, the day tank, as well as other intermediary points of transfer and storage that may be included in the qualification plan.

2.2 This guide assumes that the BCDS has been installed per the BCDS manufacturer's recommendations and the customer's specifications, and has been appropriately leak tested and shown to meet all requirements of mechanical and physical integrity up to the POU.

2.3 BCDS are typically tested for particle levels and trace metal impurities according to specified levels agreed upon in advance. For certain applications or specific chemicals, other testing may become incorporated in the qualification process. These other tests may include assay analysis, anion analysis, TOC analysis, moisture analysis, etc.

3 Limitations

3.1 This guide does not define the test methods that should be used for evaluation of samples taken during the qualification process, or distinguish test methods that will generate accurate and reliable results from those that will not generate accurate or reliable results.

3.2 This guide does not define or describe the sampling methodologies that are required in order to physically take a representative and a non-contaminated batch sample. However, appropriate sampling procedures and equipment must be used consistent with the actual specifications.

3.3 This guide does not define the type of containers that should be used for sampling. Pretreatment of containers is necessary to assure that the data generated

by testing actually measures the chemical being delivered to the process tool and not the impurities in the container itself, from the environment, or from human handling.

3.4 This guide does not address the type, level, or frequency of testing necessary and appropriate for ongoing monitoring of a BCDS.

3.5 This guide does not address the special case of a system designed and used for the generation and distribution of high purity water used in semiconductor processing.

3.6 This guide does not address the testing and prequalification of materials, subassemblies, or components used in a BCDS.

3.7 This guide does not address the protocols and requirements defined by the manufacturer concerning the installation of the BCDS.

3.8 This guide does not define the actual specifications generally negotiated between the user and the manufacturer of the BCDS, against which chemical samples are tested and qualification is passed.

3.9 This guide does not address the qualification process for chemicals through the process tool. While the sampling considerations and timing make the initial tool qualification a natural adjunct to the BCDS qualification, the responsibility for this task generally falls within a different jurisdiction and is generally handled separately.

4 Referenced Documents

4.1 SEMI Documents

4.1.1 *SEMI S-2* — Safety Guideline for Semiconductor Manufacturing Equipment

4.1.2 *SEMI E-4* — Guide for Standard Performance, Practices, and Sub-Assembly for High Purity Piping Systems and Final Assembly for Semiconductor Manufacturing Equipment

4.1.3 *SEMI F31* — Guide for Bulk Chemical Distribution Systems

4.2 Other Document

4.2.1 SIA National Technology Roadmap For Process Chemicals¹

5 Terminology

5.1 Acronyms and Abbreviations

5.1.1 BCDS — Bulk Chemical Distribution System

5.2 Definitions

5.2.1 *pickling* — To condition the BCDS by exposing to an aggressive chemical that extracts impurities from the internal surfaces of the system.

5.2.2 *sample* — Sample taken from a system into a sampling container and measured off-line.

6 Pre-Chemical Qualification

6.1 Advantage of Pre-Chemical Qualification — The pre-chemical qualification is designed to ensure that the piping systems and storage tanks are able to accept chemicals. This step is often initiated after the UPW system is functional and an acceptable resistivity is achieved but before chemicals are authorized to be brought on-site. Although UPW does not extract high levels of metallic and ionic impurities from the BCDS materials of construction, this step can ensure that the BCDS and distribution piping is free of any gross contamination that may have been introduced into the system during installation. In addition, the UPW flush can be effective for the elimination of some types of particles.

6.2 Particle Qualification — The BCDS is flushed with UPW and the levels of particles are measured using an on-line optical particle counter. The steps followed include:

6.2.1 Install an acceptable UPW water filter element(s) per the filter and BCDS manufacturer's specifications.

6.2.2 Fill the BCDS with UPW and recirculate internally to ensure that all piping is filled with UPW.

6.2.3 Begin sampling to a liquid particle counter downstream of the filters either at the outlet of the BCDS, the POU, or both. Follow an approved particle counting sampling procedure.

6.2.4 Continue recirculating and flushing until the particle concentrations in the desired channel or channels are observed at levels below the agreed-upon specification. An example of typical specification is the average of five consecutive ten minute readings of <X particles/ml @ $\geq Y$ micron.

6.3 Metallic Qualification — After reaching the particle specification for the UPW, a sample of UPW may be taken for trace metal analysis. This sample can be taken at the outlet of the BCDS, at an end point sample station and/or at the POU. An appropriate sample bottle precleaned for this test should be used to collect a sample. The sample bottle should be preconditioned before use and contamination-free techniques used for the actual sampling.

6.3.1 The steps to follow are:

6.3.1.1 Fill the sample bottle with the required volume for the analytical method to be used. The volume varies depending on analytical procedures and lab instrumentation.

6.3.1.2 Send samples to a designated laboratory capable of performing trace metal analysis. Use only a laboratory that has experience with these types of samples and that can test reliably in the sub-ppb range. The number of elements and concentrations that are to be analyzed will vary depending on customers' requirements.

6.3.1.3 Evaluate data and compare to the agreed-upon specification. A typical specification is <X ppb total and <X ppb per element.

6.3.1.4 If the trace metal specification is not met, drain or flush the entire BCDS and distribution piping and repeat the process.

6.3.1.5 If a maximum level of impurities is desired, a sample of the UPW used to charge the system should be tested to establish a baseline and to ensure that the incoming UPW is not the source of high impurities.

6.3.1.6 Once the BCDS has been qualified for particles and trace metals in UPW, the qualification of the BCDS in Chemical may be initiated.

7 Chemical Conditioning of The System

7.1 Advantages of Conditioning the System — Another precleaning step that may be used independently or in conjunction with a UPW flush is to condition the BCDS by actively flushing it with an aggressive chemical that extracts impurities from the internal surfaces of the system. This step is sometimes referred to as "pickling" the system. This extra step can help minimize the amount of time consumed in the qualification process by utilizing a chemical with more aggressive extraction properties than the actual chemical to be used in the line, thereby increasing the rate at which impurities are removed. This can shorten the amount of time needed until the actual chemical can be put into the line and shown to meet the qualification specifications. Since a goal of a well-designed qualification protocol is to minimize the amount of high

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