

SEMI F115-0220

TEST METHOD FOR THE DETERMINATION OF METALLIC ELEMENTS PRESENT ON WETTED SURFACES OF ULTRA HIGH PURITY CHEMICAL DELIVERY SYSTEMS AND COMPONENTS

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1 Purpose

1.1 This Document defines a test method for determining metallic elements present on the wetted surfaces of ultra high purity (UHP) chemical delivery systems and components.

2 Scope

2.1 This Test Method is applicable to UHP chemical delivery systems and components. Examples of test samples include valves, regulators, filters, mass flow controllers, tubing, weld fittings, and face seal fittings.

2.2 This Test Method could also be used to determine the contamination contributed from an assembly or fabrication area.

2.3 This Document details the method to extract and measure ultrapure water (UPW) extractable metallic elements present on the wetted surfaces.

2.4 This Test Method could be used to evaluate the effectiveness of various flushing or purging processes.

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 Limitations

3.1 This Test Method is limited to metallic components of which the majority are comprised of SEMI F20 or similar stainless steels. Other metals, such as nickel-based alloys, used for construction of UHP components can also be evaluated using this method.

3.2 This method does not apply to polymer based components or systems. It is recognized that some polymers are used for seats and seals in some metal components. This polymer content is minor in surface area compared to the metal surface area and should have little influence on the overall test results.

3.3 This Test Method can be used for UHP components with wetted elastomeric materials. However, the analysis results can be affected by elastomeric materials. In order to avoid such interference, it requires the generation or obtaining of the spectra or fingerprint of the elastomeric material separately, then the deduction of the elastomeric material from the analysis results.

3.4 The results from this test are for static conditions and actual process application results may vary over time or continued use.

3.5 This Test Method is intended for use by operators who understand the use of the test apparatus and equipment at a level equivalent to twelve months of experience.

3.6 This Test Method will not provide any recommendations for flushing or purging steps.

4 Referenced Standards and Documents

4.1 SEMI Standards and Safety Guidelines

SEMI E49.2 — Guide for the Qualification of Polymer Assemblies used for Liquid Chemicals Systems in Semiconductor Equipment

SEMI E49.8 — Guide for High Purity and Ultrahigh Purity Gas Distribution Systems in Semiconductor Manufacturing Equipment

SEMI F20 — Specification for 316L Stainless Steel Bar, Forgings, Extruded Shapes, Plate, and Tubing for Components Used in General Purpose, High Purity and Ultra-High Purity Semiconductor Manufacturing Applications

SEMI F63 — Guide for Ultrapure Water Used in Semiconductor Processing

4.2 *ASTM Standard*¹

ASTM D5127 — Standard Guide for Ultra-Pure Water Used in the Electronics and Semiconductor Industries

4.3 *ISO Standard*²

ISO 14644-1 — Cleanrooms and Associated Controlled Environments – Part 1: Classification of Air Cleanliness by Particle Concentration

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

5 Terminology

5.1 *Abbreviations and Acronyms*

5.1.1 *CAD* — computer aided design

5.1.2 *ICP-MS* — inductively coupled plasma-mass spectrometry

5.1.3 *MFC* — mass flow controller

5.1.4 *UHP* — ultra high purity

5.1.5 *UPW* — ultrapure water

5.2 *Definitions*

5.2.1 *contaminant* — an undesirable substance on the wetted surfaces of UHP chemical delivery systems and components that can be transferred to the process fluid.

5.2.2 *leachate* — the solution obtained from the leaching process which includes the ultrapure water and the metallic compounds extracted from the wetted surfaces of UHP chemical delivery systems and components.

5.2.3 *test component* — an individual piece or a complete assembly of individual pieces being tested, including industrial products that are manufactured as independent units, capable of being joined with other pieces or components. Example of these components include valves, fittings, regulators, tubing, mass flow controllers, and chemical delivery tubing and fittings.

6 Apparatus

6.1 *Inductively Coupled Plasma-Mass Spectrometry (ICP-MS)* — An analytical instrument that detects metallic elements in the liquid phase. A liquid sample is introduced into nebulizer to generate aerosols. The aerosols then enter into the plasma torch and the stream is separated into individual atoms by the plasma's extreme temperature. The plasma also ionizes the atoms and those ions are extracted from the plasma through a series of cones into a mass spectrometer. In the spectrometer, they are separated on the basis of their mass-to-charge ratio and strike a detector which generates a signal proportional to the concentration. A quantitative concentration of a test sample can be determined by calibrating the instrument with certified reference material. The ICP-MS used in this Test Method must be calibrated using standard laboratory practices and manufacturer's recommendations.

7 Reagents and Materials

7.1 *Test Fluid* — UPW is required to use for metallic element analysis as the extraction fluid used in this Test Method. The UPW water purity is critical to the sensitivity of the test. With higher levels of UPW purity, the background levels

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