

# **Specification and Verification of Metallic Extractables in Fluid Handling Components**

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## **Abstract**

Semiconductor process equipment that handles liquid chemicals must not add significant amounts of metallic contaminants to the chemicals. Extraction of metallic contamination from the valves, fittings, tubing, piping, and other components used to assemble the equipment must be negligible. In addition, as industry requirements get more stringent, the acceptable level of contamination extracted from these components must decrease.

This paper describes a method to set design specifications for the maximum extraction rate of metallic impurities from components. The maximum allowable contaminant concentrations in process chemicals are defined in The 1994 National Technology Roadmap for Semiconductors published by the Semiconductor Industry Association (SIA). The method described in this paper sets the contamination-added budget for chemical handling systems at 20% of the SIA maximum. This means that chemical handling systems must not contribute to contaminant concentrations in process chemicals by more than 20% of the allowable contaminant concentration. To determine specifications for individual components, system specifications are normalized for surface area. For 1997, the design specification for the maximum metal extraction rate is 1.0 ng/cm<sup>2</sup>/day within 7 days of chemical contact. This specification decreases to 0.5 ng/cm<sup>2</sup>/day in 1998. FSI International's Chemical Management Division (CMD) uses this design specification for component selection and system qualification.

This paper also presents analytical methods that can be used to verify that components and systems assembled using those components meet the design specification. Testing methods are based on FSI International, Inc.'s proprietary and patented DyconE<sup>x</sup> <sup>SM</sup> technology using hydrochloric acid, hydrofluoric acid, or nitric acid. This technique measures the rate of metal extraction over time. Data from dynamic extraction testing of components, such as valves, piping, filters, and pumps, shows that some of the components meet the specification, while others fail. Data from system testing indicates that systems easily meet the specification.