Uniform Environment, Safety, and Health (ESH) Specification for Equipment Procurement (v.1.3)

International SEMATECH
Technology Transfer #01064135B-ENG

International SEMATECH and the **International SEMATECH logo** are registered service marks of International SEMATECH, Inc., a wholly-owned subsidiary of SEMATECH, Inc.

Product names and company names used in this publication are for identification purposes only and may be trademarks or service marks of their respective companies.

© 2002 International SEMATECH, Inc.

Uniform Environment, Safety, and Health (ESH) Specification for Equipment Procurement (v.1.3)

Technology Transfer #01064135B-ENG
International SEMATECH
January 31, 2003

Abstract: This document from the ESHF004 project is a non-confidential set of common environment, safety, and health (ESH) guidelines that device manufacturers may use in equipment purchasing specifications. These ESH guidelines were designed for use in purchasing semiconductor manufacturing tools and metrology/assembly/test equipment, including related support equipment such as cabinets, chillers, pumps, and other ancillary equipment. This document was compiled based on input from the member company participants of the International SEMATECH Equipment ESH Working Group.

Disclaimer: The objective of this publication is to develop guidelines that each device maker may use as a reference when considering the environment, safety, and health requirements for equipment it is purchasing from a particular supplier. The guidelines should facilitate clearer understanding between each device maker and its suppliers. Each device maker, of course, is free to propose and negotiate whatever terms it wishes with any supplier.

Keywords: Environmental Standards, Procedures, Procurement Specifications, Safety Standards, Test Equipment

Authors: Carl Williams (Safe Fab Solutions), Peter Dahlgren

Approvals: Walter Worth, Acting Project Manager
Jamie McLeroy, Law Department
Coleen Miller, Director, ESH
Laurie Modrey, Technical Information Transfer Team Leader

Table of Contents

1 EXECUTIVE SUMMARY 1
2 PURPOSE AND SCOPE 1
3 GENERAL REQUIREMENTS (SEE APPENDIX A FOR DEMONSTRATION METHODS) 1
4 EUROPEAN UNION DIRECTIVES 2
5 REGULATORY COMPLIANCE AND CUSTOMER SPECIFIC REQUIREMENTS 3
6 ADDITIONAL ESH AND ENERGY REQUIREMENTS 3
6.1 Resource Consumption – Chemical, Water, and Energy (Baseline Process) 3
6.2 Restrictions 4
6.3 Emissions and Waste Characterization (Baseline Process) 4
6.4 Optimization (Baseline Process) 5
6.5 Mass Balance (Baseline Process) 5
6.6 Exhaust 5
6.7 Equipment ESH Metrics 6
APPENDIX A Demonstration Methods 7
APPENDIX B Referenced Documents 13

1 EXECUTIVE SUMMARY

This document from the ESHF004 project represents a set of common environment, safety, and health (ESH) guidelines that device manufacturers (DM) may use as part of their equipment purchasing specifications. These ESH guidelines are designed for purchasing semiconductor manufacturing tools and metrology/assembly/test equipment, including related support equipment such as cabinets, chillers, pumps, and other ancillary equipment.

These guidelines were created to facilitate conformance with worldwide regulatory requirements and industry standards for protecting personnel and the facility. It is intended to ensure all tools are reviewed for ESH and ergonomic optimization and conformance before they are purchased or leased.

2 PURPOSE AND SCOPE

2.1 This specification applies to all semiconductor manufacturing equipment including beta versions, purchased, leased, loaned, or donated by DEVICE MAKER at any of its factories worldwide unless specifically exempted by DEVICE MAKER.

2.2 These specifications are intended to reduce risk to personnel, the environment, and facilities from potential hazards associated with equipment intended to manufacture or test semiconductors. It is intended to ensure that all equipment is reviewed before acquisition for environment, safety, and health (ESH) and ergonomics optimization and conformance.

2.3 These uniform ESH and ergonomic requirements were designed for use in purchasing semiconductor manufacturing tools and metrology/assembly/test equipment, including related support equipment such as cabinets, chillers, pumps, point of use (POU) abatement systems, and other ancillary equipment. This includes standard mechanical interface and automation equipment.

2.4 These requirements may also be applied to any support system used in manufacturing plants: peripheral equipment used with process equipment such as pumps, chillers, and compressors; facilities systems used in air conditioning; gas management, utilities supply, water treatment, abatement systems; energy supply; and chemical management.

3 GENERAL REQUIREMENTS (SEE APPENDIX A FOR DEMONSTRATION METHODS)

3.1 DEVICE MAKER (DM) has adopted published SEMI guidelines and standards as the basis for ESH design and construction specifications. Proper demonstration, applicable versions, and required documentation are described in Appendix A.

3.2 Equipment shall comply with the ESH and fire protection requirements set forth in the applicable version of SEMI S2 and its related and referenced SEMI documents. All sections in S2 that stipulate “should” will be interpreted as “shall.”

3.3 Equipment shall comply with the requirements set forth in the applicable version of SEMI S8. All sections in S8 that stipulate “should” will be interpreted as “shall.”

3.4 The supplier shall verify full conformance to the required SEMI documents. The supplier shall use a qualified, objective, independent third party(s), as determined by the qualification requirements set forth in SEMI S7 to assess the equipment and verify full conformance with SEMI S2, SEMI S8, and the other applicable supplemental SEMI documents in the Third-Party Conformance Evaluation Report.

3.5 Equipment shall conform to the applicable version of the *International SEMATECH Application Guide for SEMI S2 and SEMI S8*. The Application Guide shall help interpret the specific requirements and the application of particular provisions of SEMI S2 and SEMI S8.

3.6 Equipment shall comply with the safety and health requirements set forth in SEMI S1, SEMI S3, SEMI S4, SEMI S5, SEMI S6, SEMI S7, SEMI S9, SEMI S11, SEMI S12, and SEMI S13.

3.7 Equipment shall meet the requirements set forth in SEMI S14. Equipment shall be evaluated according to the requirements set forth in SEMI S14, and a status report shall be generated according to that document’s criteria. This may be integrated into the aforementioned Third-Party Conformance Evaluation Report or it may be presented as a “standalone” report.

3.8 Equipment shall have any residual risks categorized according to the criteria set forth in SEMI S10. A summary of all unresolved non-conformances, deficiencies, or other known hazards shall be presented with the Third-Party Conformance Evaluation Report, including an assigned risk code from SEMI S10.

3.9 The supplier shall use SEMI S15 when selecting gas detection equipment to be incorporated into the systems.

3.10 Suppliers shall use SEMI S16 when designing equipment and when preparing manual instructions for disposal practices.

3.11 Equipment that will interface with unmanned transport vehicles (UTVs) shall meet the requirements of SEMI S17.

4 EUROPEAN UNION DIRECTIVES

4.1 Equipment shall meet all applicable European Union (EU) directives and have affixed the official *Communaute Europeene* (CE) Mark label.

4.2 The supplier shall provide a copy of the EU Declaration of Conformity for the CE Mark at the same time the supplier provides the third-party SEMI S2/S8 evaluation report. If the supplier determines that its equipment does not require the CE Mark (e.g., because it is not a regulated product under EU regulations), the supplier shall provide supporting documentation in place of the declaration of conformance.

4.3 The requirement for CE Mark is intended to apply to ALL equipment, regardless of shipment destination, unless otherwise specifically directed in writing by DEVICE MAKER.

5 REGULATORY COMPLIANCE AND CUSTOMER SPECIFIC REQUIREMENTS

5.1 Equipment shall comply with all applicable laws and regulations. The design requirements covered in this specification are not all-inclusive. Therefore, the supplier must employ additional known applicable regulatory and industry standards that govern the equipment. It is the supplier's responsibility to have knowledge of and ensure compliance with these requirements.

5.2 Please see Appendix A for specific regulatory and site demonstration requirements identified by DEVICE MAKER.

5.2.1 Equipment shall comply with the equipment-related requirements set forth in the appropriate national and/or regional regulations, as specified in Appendix A.

5.2.2 Equipment shall comply with the equipment-related requirements set forth in the appropriate local regulations, as specified in Appendix A.

5.2.3 Equipment shall comply with the equipment-related requirements set forth in the appropriate adopted fire code, as specified in Appendix A.

5.2.4 Equipment shall comply with the equipment-related requirements set forth in the appropriate adopted building code, as specified in Appendix A.

5.2.5 Equipment shall comply with DEVICE MAKER custom ESH requirements for the site/location of intended delivery, as specified in Appendix A.

5.2.6 Equipment shall comply with any additional ESH requirements that may be set forth in any additional attachment to these specifications, as determined and provided by DEVICE MAKER for the delivery location. This may include conformity certifications. These requirements are specified in Appendix A

6 ADDITIONAL ESH AND ENERGY REQUIREMENTS

6.1 Resource Consumption – Chemical, Water, and Energy (Baseline Process)

6.1.1 The supplier shall provide a complete inventory of chemicals used or produced in the baseline process for the equipment being ordered as well as all other chemicals used with the equipment. In the absence of a specific agreement between the supplier and DEVICE MAKER, a baseline process shall be defined as a representative process adopted by a significant number of end users.

6.1.2 All chemicals, gases, and materials consumed or used by the system (as described in the baseline process) and the quantities thereof shall be listed in the inventory required above. “Non-process” waste (such as oil filters, pump oils, etc.) generated from supplier-prescribed routine preventative maintenance shall be included.

6.1.3 Before ordering, chemicals used or produced with the equipment shall be reviewed to determine if specific regulatory restrictions exist.

6.1.4 Materials Safety Data Sheets (MSDS) for all chemicals (provided or specified for use by the supplier) must be available before ordering equipment and taking delivery.

6.1.5 The DEVICE MAKER Environment, Safety, and Health department(s) must approve all chemicals used or produced within the equipment.

6.1.6 Perfluorocompounds (PFCs) can be used only when the supplier has demonstrated that all alternative chemistries are ineffective for the desired equipment or product performance. Written approval from the DEVICE MAKER is required.

6.1.7 The supplier must specify the typical and maximal power consumption of the equipment.

6.2 Restrictions

6.2.1 The equipment and its peripheral systems (e.g., refrigeration system) shall not use ozone-depleting substances (ODS) during their operation or maintenance.

6.2.2 See Appendix A for site-specific restrictions.

6.3 Emissions and Waste Characterization (Baseline Process)

6.3.1 The supplier shall characterize in quality and quantity the process byproducts, fugitive emissions, exhaust effluent, and wastewater for the baseline process.

6.3.2 For equipment that uses PFCs for plasma etch (including ash) and chamber cleaning, the supplier shall provide characterization data on the quantities of PFCs used and the PFCs and hazardous air pollutants (HAPs) emitted from the equipment. The U.S. Environmental Protection Agency (EPA) defines HAPs. The characterization data shall comply with the *Guidelines for Environmental Characterization of Semiconductor Equipment,* International SEMATECH Technology Transfer # 01104197A-XFR.

6.3.3 The supplier shall provide an engineering analysis and emissions measurement (based on the methods specified in the *Guidelines for Environmental Characterization of Semiconductor Equipment,* International SEMATECH, Technology Transfer # 01104197A-XFR) to verify that emissions goals are met for all equipment emissions.

6.3.4 Air emissions shall be measured to show the discharges of volatile organic compounds (VOCs), HAPs, and PFCs. VOCs, HAPs, and PFCs are those defined as such by the U.S. EPA. Emissions testing methods shall

6.3.4.1 Be by the DEVICE MAKER-approved method.

6.3.4.2 Be reported according to the *Guidelines for Environmental Characterization of Semiconductor Equipment*, International SEMATECH Technology Transfer #01104197A-XFR.

6.3.4.3 Include emissions from maintenance and parts cleaning operations in the emissions result.

6.3.4.4 Demonstrate a volumetric material balance that accounts for >90% of the fluoride, chlorine, and bromine atoms supplied to the tool.

6.4 Optimization (Baseline Process)

6.4.1 The supplier shall provide tool water usage data, including maximum, normal operation, and minimum (idle mode) water usage data.

6.4.2 The supplier shall provide exhaust optimization evidence to the DEVICE MAKER, using either the *I300I Recommended Exhaust Optimization Procedure* document or an alternative approved by the DEVICE MAKER.

6.5 Mass Balance (Baseline Process)

6.5.1 Chemical mass balance must be presented to show the composition and the quantity of each chemical in the supplier's equipment and the composition and the quantity of each waste stream discharged to each exhaust, wastewater, and separate chemical drain. The mass balance shall

6.5.1.1 Be on a per wafer basis.

6.5.1.2 Include chemicals used for supplier-prescribed maintenance and parts cleaning.

6.5.1.3 Be based on actual measurements.

6.5.2 The supplier must show a mass balance of water used in the equipment. The water balance shall

6.5.2.1 Indicate the purity of the water required.

6.5.2.2 Indicate the concentration of any contaminants such as metals, cyanides, organic compounds, and dissolved solids in the wastewater from each drain.

6.5.2.3 Be on a per-wafer basis.

6.5.2.4 Include water usage during tool idle time.

6.6 Exhaust

6.6.1 Equipment heat exhaust, solvent exhaust, acid exhaust, base exhaust, and ammonia exhaust shall be plumbed separately.

6.6.2 Each exhaust connection shall be identified and labeled by the supplier.

6.7 Equipment ESH Metrics

6.7.1 The supplier shall complete the questionnaire included in *Environment, Safety, and Health (ESH) Metrics For Semiconductor Manufacturing Equipment*, International SEMATECH, Technology Transfer # 01064135B–ENG.

APPENDIX A
DEMONSTRATION METHODS

Paragraph #	Specification	Method of Demonstration	Date/Version or Control #	Required Documents	Document Delivery Date	Comments
3.1	SEMI Documents	See below	See below	See below		
3.2	SEMI S2	Third-party evaluation	Current version	Third-party report		See SEMI S7 and SEMI S2 Sections 8 and 9
3.3	SEMI S8	Third-party evaluation	Current version	Third-party report		
3.4	SEMI Documents	Integral to SEMI S2/S8 third-party evaluations above	Current versions	Third-party report		Third-party qualifications are described in SEMI S7
3.5	International SEMATECH Application Guide	Integral to SEMI S2/S8 third-party evaluations above	Current version	Third-party report		Version 2.0 only applies to SEMI S2-93A and SEMI S8-95
3.6	SEMI S1, S3, S4, S5, S6, S7, S9, S11, S12, S13	Integral to SEMI S2/S8 third-party evaluations above	Current versions	Referenced, used and integral to SEMI S2/S8 third-party reports referenced above	Detailed report with statement of conformance to requirements and risk assessment	
3.7	SEMI S14	Supplier or third-party assessment	Current version			This shall include a combustible materials report and surface area description for materials of construction (internal and external)

Paragraph #	Specification	Method of Demonstration	Date/Version or Control #	Required Documents	Document Delivery Date	Comments
3.8	SEMI S10	Document and categorize risk of SEMI S2/S8 non-conformance items or other known hazards including those identified in the third-party SEMI S2/S8 report(s)	Current version	Summary report showing the severity of each hazard and its likelihood of occurrence. Use SEMI S10 table to assign a risk description to each item		
3.9	SEMI S15	Supplier or third-party assessment	Current version	Design documents and inventory accompanied by a detection requirement assessment for hazards associated with the equipment and baseline processes	Documentation and instructions consistent with requirements specified	Verify that detection systems are compliant with requirements stated in SEMI S15
3.10	SEMI S16	Supplier or third-party assessment	Current version			
3.11	SEMI S17	Supplier or third-party assessment	Current version	Product assessment verifying conformance for equipment features and interface to UTVs		
4.1	EU Directives	Supplier or third-party assessment	Machinery Directive 98/37/EC, Pressure Equipment Directive 97/23/EC, Electromagnetic Compatibility Directive 89/336/EEC, Low Voltage Directive 73/23/EEC	CE Mark affixed to the equipment		Additional directives may apply
4.3	EU Directives	Supplier or third-party assessment	See above	Supplier Declaration of Conformity		If CE Mark is N/A the supplier shall provide supporting documentation
5.1	(DM* Insert)					

* DM = Device Manufacturer

Paragraph #	Specification	Method of Demonstration	Date/Version or Control #	Required Documents	Document Delivery Date	Comments
5.2.1	(DM* Insert)					
5.2.2	(DM* Insert)					
5.2.3	(DM* Insert)					
5.2.4	(DM* Insert)					
5.2.5	(DM* Insert)					
5.2.6	(DM* Insert)					
6.1.1	Chemical Inventory	Supplier generated list	N/A	Chemical list		Supplier shall provide estimated quantities for use including consumables
6.1.2	Chemical Inventory	Supplier generated list	N/A	See Above		
6.1.3	Chemical regulatory impact	Supplier assessment	N/A	Supplier provided regulatory impact assessment		Supplier shall provide an analysis of all known regulatory restrictions for chemicals listed in the chemical inventory

* DM = Device Manufacturer

Paragraph #	Specification	Method of Demonstration	Date/Version or Control #	Required Documents	Document Delivery Date	Comments
6.1.4	MSDS	Supplied documents	Most current	Material Safety Data Sheets (MSDS)		Supplier shall provide MSDS' for all baseline process chemicals and consumables shipped with the equipment
6.1.5	Chemical Approvals	DM written authorization	Dated before shipment	Written authorization from DM		
6.1.6	PFCs	Supplier statement	Dated before shipment	Supplier provided statement that no PFCs are used		If PFCs are to be used, written authorization from DM must be received
6.1.7	Energy	Supplier report	N/A	Report of measurements or calculations for typical and maximal power consumption		
6.2.1	ODS'	Supplier statement	Dated before shipment	Suppler provided statement that no ODS' are used		If ODS' are to be used, written authorization from DM must be received
6.3.1	Emissions and Waste Characterization	See below	See below	See below		
6.3.2	Emissions and Waste Characterization for PFCs	Detailed characterization	International SEMATECH Guidelines for Environmental Characterization of Semiconductor Equipment	Data report		

Paragraph #	Specification	Method of Demonstration	Date/Version or Control #	Required Documents	Document Delivery Date	Comments
6.3.3	Emissions goals	Detailed characterization	International SEMATECH Guidelines for Environmental Characterization of Semiconductor Equipment and DM Goals	Engineering analysis and data report with comparison to DM goals		DM Insert Goals Here
6.3.4	Emissions assessment	DM specified approved method	Data specified	Data report		See 6.3.4.1 thru 6.3.4.4
6.4.1	Water Optimization	Calculation by DM approved method	Data specified	Calculation results including minimum and maximum usage		
6.4.2	Exhaust Optimization	Supplier report	Most current	Results of I300I Recommended Exhaust Optimization Procedure		
6.5.1	Chemical mass balance	Supplier report	Most current	Mass balance report as approved by the DM		See 6.5.1.1 thru 6.5.1.3
6.5.2	Water mass balance	Supplier report	Most current	Mass balance report as approved by the DM		See 6.5.2.1 thru 6.5.2.4
5.6.1	Exhaust	Supplier statement and documentation	N/A	Statement and report verifying that exhausts are not mixed		
6.6.2	Exhaust labeling	Supplier statement and documentation	N/A	Statement and documentation verifying that exhaust connections are properly labeled		
6.7	Equipment ESH Metrics	Supplier report	*Environment, Safety, and Health (ESH) Metrics for Semiconductor Manufacturing Equipment,* International SEMATECH, Technology Transfer # 02034261A-TR	Completed questionnaire		www.sematech.org

APPENDIX B
REFERENCED DOCUMENTS

1. SEMI S1-0701 Safety Guideline for Equipment Safety Labels
2. SEMI S2-93A Safety Guidelines for Semiconductor Manufacturing Equipment
3. SEMI S2-0302 Environmental, Health, and Safety Guideline for Semiconductor Manufacturing Equipment
4. SEMI S2-0200E Environmental, Health, and Safety Guideline for Semiconductor Manufacturing Equipment
5. SEMI S3-91 Safety Guidelines for Heated Chemical Baths
6. SEMI S4-92 Safety Guideline for the Segregation/Separation of Gas Cylinders Contained in Cabinets
7. SEMI S5-93 Safety Guideline for Flow Limiting Devices
8. SEMI S6-93 Safety Guideline for Ventilation
9. SEMI S7-96 Safety Guidelines for Environmental, Safety, and Health (ESH) Evaluation of Semiconductor Manufacturing Equipment
10. SEMI S8-0701 Safety Guidelines for Ergonomics Engineering of Semiconductor Manufacturing Equipment
11. SEMI S8-95A Safety Guidelines for Ergonomics/Human Factors Engineering of Semiconductor Manufacturing Equipment
12. SEMI S9-1101 Safety Guideline for Electrical Design Verification Tests for Semiconductor Manufacturing Equipment
13. SEMI S10-1296 Safety Guideline for Risk Assessment
14. SEMI S11-1296 Environmental, Safety, and Health Guidelines for Semiconductor Manufacturing Equipment Mini-environments
15. SEMI S12-0298 Guidelines for Equipment Decontamination
16. SEMI S13-0298 Safety Guidelines for Operation and Maintenance Manuals Used with Semiconductor Manufacturing Equipment
17. SEMI S14-0200E Safety Guidelines for Fire Risk Assessment and Mitigation for Semiconductor Manufacturing Equipment
18. SEMI S15-0200 Safety Guideline for the Evaluation of Toxic and Flammable Gas Detection Systems
19. SEMI S16-0600 Environmental, Health, and Safety Guidelines for Semiconductor Manufacturing Equipment Disposal
20. SEMI S17-0701 Safety Guideline for Unmanned Transport Vehicle (UTV) Systems
21. International SEMATECH Application Guide 2.0 for SEMI S2-93 and SEMI S895
22. International SEMATECH Guidelines for Environmental Characterization of Semiconductor Equipment, Technology Transfer #01104197A-XFR

23. International SEMATECH, I300I, Recommended Exhaust Optimization Procedure
24. European Union -- Machinery Directive 98/37/EC
25. European Union -- Pressure Equipment Directive 97/23/EC
26. European Union -- Electromagnetic Compatibility Directive 89/336/EEC
27. European Union -- Low Voltage Directive 73/23/EEC

International SEMATECH Technology Transfer
2706 Montopolis Drive
Austin, TX 78741

http://www.sematech.org
e-mail: info@sematech.org