



Examination Standard for Tools Used in the Semiconductor Industry

Class Number 7701

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Foreword

This standard is intended to verify that the products and services described will meet stated conditions of performance, safety and quality useful to the ends of property conservation. The purpose of this standard is to present the criteria for examination of various types of products and services.

Examination in accordance with this standard shall demonstrate compliance and verify that quality control in manufacturing shall ensure a consistent and reliable product.

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1 INTRODUCTION

1.1 Purpose

- 1.1.1** This standard is the basis for the certification agency's designation of manufacturing equipment (i.e., "Tools") used by the semiconductor industry in semiconductor cleanroom manufacturing occupancies where the processing of semiconductor components, such as microprocessors, memory components, etc., takes place. This standard provides for listing of semiconductor manufacturing equipment as it relates to promoting the practice of property conservation and business continuity.
- 1.1.2** Testing and certification criteria may include, but are not limited to, performance requirements, marking requirements, examination of manufacturing facility(ies), audit of quality assurance procedures, and a surveillance program.

1.2 Scope

- 1.2.1** This standard applies to equipment design and construction features with regard to the following items:
- Both metallic and non-metallic materials of construction. These materials may be used in ducts, pumps, piping, housings, etc.
 - Electrical systems with regard to preventing an electrical incident leading to contamination of the clean room and mitigation of fire.
 - Compatibility with regard to potentially flammable or combustible chemicals integral to the equipment operation.
 - Installation and operation of fixed fire detection/suppression equipment when applicable and supplied as part of the equipment.
 - Ventilation, gas or vapor leak detection and liquid leak detection and containment.
 - Assessment of the associated mechanical/electrical engineering controls, limiting devices, emergency off, and/or safety interlocks.

1.3 Basis for Certification

Certification is based upon satisfactory evaluation of the product and the manufacturer in the following major areas:

- 1.3.1** Satisfactory results of the analysis of the equipment (compliance with this standard);
- 1.3.2** Satisfactory examination of the manufacturing facilities and audit of quality control procedures may be made to evaluate the manufacturer's ability to consistently produce the product which is examined and tested, and the marking procedures used to identify the product. Subsequent surveillance may be required by the certification agency in accordance with the certification scheme to ensure ongoing compliance.

1.4 Basis for Continued Certification

Continued certification is based upon:

- 1.4.1** Production or availability of the product as Assessed, or as acceptably revised;
- 1.4.2** the continued use of acceptable quality control procedures;
- 1.4.3** satisfactory field experience; and,

- 1.4.4 examination of production samples for continued conformity to the requirements of this standard.

1.5 Basis for Requirements

- 1.5.1 The requirements of this standard are based on experience, research and testing, and/or the standards of other organizations. The advice of manufacturers, users, trade associations, jurisdictions and/or loss control specialists was also considered.
- 1.5.2 The requirements of this standard reflect tests and practices used to examine characteristics of tools used in the semiconductor industry for the purpose of obtaining Certification. Tools having characteristics not anticipated by this standard may be certified if performance equal, or superior, to that required by this standard is demonstrated.

1.6 Effective Date

- 1.6.1 The effective date of this certification standard mandates that all products tested for certification after the effective date shall satisfy the requirements of this standard.
- 1.6.2 The effective date of this standard is eighteen (18) months after the publication date of the standard for compliance with all requirements.

1.7 System of Units

- 1.7.1 Units of measurement used in this Standard are United States (U.S.) customary units. These are followed by their arithmetic equivalents in International System (SI) units, enclosed in parentheses. The first value stated shall be regarded as the requirement. The converted equivalent value may be approximate. Conversion of U.S. customary units is in accordance with ANSI/IEEE/ASTM SI 10.

1.8 Normative References

- 1.8.1 The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the cited edition applies.

ANSI/IEEE/ASTM SI 10, *American National Standard for Metric Practice*)

FM Approvals Standard Class 4910 – *Cleanroom Materials Flammability Test Protocol (Materials)*

FM Approvals Standard Class 4922 – *Fume Exhaust Ducts or Fume and Smoke Exhaust Ducts (Materials)*

FM Approvals Standard Class 4924 – *Pipe Insulation (Materials)*

FM Global Data Sheet 4-0 – *Special Protection Systems*

FM Global Data Sheet 4-8N – *Halon 1301 Fire Extinguishing Systems (Materials)*

FM Global Data Sheet 4-11N (NFPA 12) - *Carbon Dioxide Extinguishing Systems (Hydraulics – Systems Electric Panel)*

NFPA 79 – , *Electrical Standard for Industrial Machinery*

- 1.8.2 Due to the nature of potentially flammable and combustible materials of use, the FM Approvals Standard Class 3600 “Electrical Equipment for Use in Hazardous (Classified) Locations – General Requirements” and the following specific standards provide additional requirements for electrical, electronic, or electro-mechanical equipment used in clean room environments, where applicable. These

additional requirements are intended to address the hazards associated with this equipment when incorporating potentially flammable or combustible chemicals used within the equipment.

FM Approvals Standard Class 3610 - *Intrinsically Safe Apparatus and Associated Apparatus for Use in Class I, II and III, Division 1 Hazardous (Classified) Locations*

FM Approvals Standard Class 3611 - *Electrical Equipment for Use in Class I, Division 2; Class II, Division 2; and Class III, Divisions 1 and 2 Hazardous (Classified) Locations*

FM Approvals Standard Class 3615 - *Explosion proof Electrical Equipment*

FM Approvals Standard Class 3620 - *Purged and Pressurized Electrical Equipment*

FM Approvals Standard Class 6310/6330 - *Combustible Gas Detectors*

- 1.8.3** Tool equipment for use internationally may be required to meet the local codes and standards of its end use location. When this is the case, Assessment of the equipment to the local codes and standards will likely take precedence, but shall meet the same intent of equipment performance.

1.9 Clarification Statement on the Use of the Above Referenced Standards

- 1.9.1** The applicable requirements of the standards referenced in Section 1.8 are to be used to determine compliance as it applies to the various design and construction features of the product submitted for Assessment.

1.10 Terms and Definitions

- 1.10.1** For purposes of this standard, the following terms apply:

Headcase – For purposes of this standard is defined as an area directly above the working surface of a wet bench.

Minienvironment – For purposes of this standard is defined as a localized environment created by an enclosure to isolate the product from contamination and people. (www.semiatech.org; SEMI E44-95)

Module – For purposes of this standard is defined as an independently operable unit that is part of a tool or system. (www.semiatech.org; SEMI E21-94)

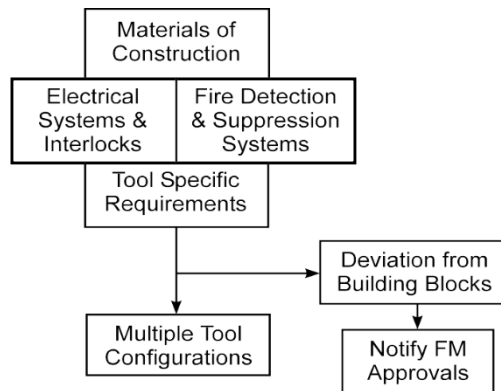
Tool – For purposes of this standard is defined as any piece of semiconductor fabrication or inspection equipment designed to process wafers delivered in cassettes or cassettes in containers intended for use with an automated material transport system. (www.semiatech.org; SEMI E15-91)*Italic Word or Phrase*
– definition in regular type

2 GENERAL INFORMATION

2.1 Product Information

2.1.1 It is a general understanding in the industry that the type of equipment addressed by this standard is custom built rather than mass produced. Therefore this equipment assessment program is based on a building block approach involving sub-assemblies since many of these items are likely to be used in more than one piece of equipment. This approach is intended to reduce efforts involved with future equipment assessment programs which are based on blocks of assemblies previously used and determined to be compliant. It also allows for multiple identical equipment units to be produced without additional examination, as well as addressing only the areas of subsequent modifications.

2.1.2 This concept is also displayed in the following chart.



2.2 Certification Application Requirements

2.2.1 The manufacturer shall provide the following preliminary information with any request for certification consideration:

- A complete list of all models, types, sizes, and options for the products or services being submitted for certification consideration;
- the number and location of manufacturing facilities;
- marketing/ordering literature showing general specifications and functions of the equipment. These are generally very useful in determining project costs and may also be used as attachments to the final report for equipment Assessment projects. Typically, one copy will be sufficient;
- product identification or sales specification sheet for the product being assessed. The product shall have a unique and traceable means of identification;
- instruction manual(s) providing installation, operation, and maintenance instructions;
- quality control procedures document(s) detailing routine testing and final inspection procedures;
- production drawings (stating information to assess compliance; i.e. amount of non FM Approvals Class 4910 polymeric material not to exceed 1% of the Tool's total weight);
- electrical schematic(s);
- final assembly drawing and parts lists (i.e. wiring/cable rating including size, flammability rating, etc.);
- sub-assembly drawings or piece-part drawings/assembly drawings sufficient to detail primary circuit components, operator controls, enclosure design, and safety interlocks and limit controls;

- product label drawing(s) showing all required marking information. The label drawing shall show proposed artwork indicating the manufacturer's name, address, model and serial numbers, equipment ratings, warning markings, and the certification agency's mark of conformity;
- protective grounding detail drawing(s) showing the method of protective grounding provided, including location, size, and marking;
- documentation control specification showing proposed method of controlling documents which may be identified as critical documents by the certification agency. These drawings will be identified by the certification agency at the conclusion of the certification program;
- all documents shall identify the manufacturer's name, document number or other form of reference, title, date of last revision, and revision level;
- all documents shall be provided with English translation.

2.3 Equipment and Process Protection Requirements

The following is applicable to tools, such as, but not limited to, wet benches, spin rinse dryers, alcohol vapor dryers, chemical mechanical polish and spray acid/solvent tools, unless specifically noted.

2.3.1 Materials of Construction

2.3.1.1 Tool Housing or Shell

The tool housing or shell includes walls, view ports, rear doors, minienvironment enclosures, modular compartments, internal plenums, horizontal working surface and electrical headcase.

1. Process modules handling flammable or combustible liquids or gases shall be constructed of metal or other suitable non-combustible material (ex. quartz).
2. Working and subsurface areas of noncombustible wet benches handling flammable or combustible liquids shall be protected by certified Water Mist, CO₂ or FM-200 Systems.
3. All other process tools shall be constructed of metal whenever possible, or of FM Approvals Class 4910 material.

Fixed fire protection of the subsurface area of noncombustible wet benches handling flammable or combustible liquids is not required when:

- there are no plastic tanks, plastic piping or other combustible material in the subsurface area including plastic parts made of material which meet FM Approvals Class 4910 requirements and,
- there are no flammable or combustible piping or pumps.

2.3.1.2 Internal Components

1. Piping, tanks (including the tank outer jacket of a dual wall tank), process baths, valves and pumps shall be constructed of FM Approvals Class 4910 materials. If necessary, some of these items can be tolerated as conventional (non FM Approvals Class 4910 materials) plastic along with printed circuit boards, knobs, hinges, handles and low-voltage cables.
2. However, in no case shall the amount of non FM Approvals Class 4910 material exceed 1% by weight of the total weight of the tool. Additionally, the use of non FM Approvals Class 4910 material shall be spread throughout the tool, i.e., no concentrations permitted.

Exception: A cast resin dry-type transformer is not to be included when meeting this requirement.

NOTE: It shall be noted that all materials not certified to FM Approvals Class 4910 are not alike in terms of potential fire exposure. If non certified materials are used, materials like polypropylene, polyethylene, polycarbonate, acrylics and standard PVC shall be avoided. Materials such as Halar, Teflon, PVDF and CPVC shall be used since they are generically closer to meeting the requirements of FM Approvals Class 4910 Standard.

3. Fixed fire protection equipment is required when flammable or combustible liquids are not present in the tool.

2.3.1.3 Piping

Process tool piping shall be constructed of material compatible with the chemical. Flammable and combustible liquids shall be conveyed in metallic welded piping.

2.3.1.4 High Efficiency Particulate Air (HEPA) or Ultra Low Particulate Air (ULPA) Filter Modules HEPA or ULPA filters installed in tools shall be certified, or equivalent.

2.3.1.5 Hookup Duct Connection

The tool hookup duct connection(s) shall meet FM Approvals Class 4922 requirements.

2.3.2 Electrical Systems

2.3.2.1 Hazardous (classified) Location Equipment

Electrical equipment rated for use in hazardous (classified) location shall be provided when equipment employs the use of flammable gases or flammable liquids.

2.3.2.2 Cabling/Wiring

Cable/wiring used in the equipment should be FM Approvals Group 1 rated. Individual wiring conductors within enclosed metallic raceways, metallic conduit, or FM Approvals Class 4910 material are exempt from this criteria.

2.3.2.3 Process Liquid Heating

Whenever possible, process liquid heating shall be done using heat transfer systems using hot water or other noncombustible heat transfer media. Another option would be to remotely heat the chemicals themselves in a properly designed heat exchanger that is external from the tool.

1. The order of preference of process bath heating is:
 - a. indirect or outboard in-line heaters with low flow/over temperature interlocks
 - b. embedded heaters
 - c. bonded heaters
 - d. immersion heaters (not acceptable for process baths; may be used in internal tanks supplying process baths and shall be provided with high temperature limit switch protection)
2. The heating of any flammable or combustible liquid shall only be done in a noncombustible (metal) bench or tool.