International Standards Program to the Vietnam Semiconductor Strategy Summit
August 2014
v2
About SEMI Standards

• Established in 1973
• Experts from the microelectronic, display, photovoltaic, and related industries
• Exchange ideas and develop globally-accepted technical standards
• We are international
  – United States | Japan | Europe | Taiwan | Korea | China

• High-Profile SEMI Standards
  – Wafer Dimensions, Materials
  – Metrics (Factory efficiency/equipment reliability)
  – Equipment Interface
    • SEMI Equipment Communication Standards (SECS) / Generic Equipment Model (GEM)
    • Hardware/Automated Material Handling Systems (including 300 mm, 450 mm)
  – Environmental, Health and Safety
    • Safety for semiconductor (S2) and FPD (S26), Energy conservation (S23)
  – Photovoltaic
Critical Role of Standardization

SEMİ Standards Reduce Manufacturing Complexity, Allowing Companies to Focus on Innovation
Economic Impact of Standards

- **US National Institute of Standards and Technology (NIST) Study**
  - Calibration, Standard Test Methods, and Software Standards
    - $9.6 billion in benefits between 1996 and 2011

- **Association Française de Normalisation (AFNOR) Study**
  - Over 70% of companies participating in standardization reported that it enabled them to anticipate future market requirements

- **German Industry Study (DIN)**
  - Standards contribute more to economic growth than patents and licenses

- **UK Department of Trade and Industry**
  - Standards contribute £2.5 billion annually to economic growth in the UK
Benefits of SEMI Standards

• Benefits for your company
  – Improve communication within and across industries
  – Increase manufacturing efficiency, reduce costs
  – Accelerate product development
  – Enable faster commercialization and interoperability
  – Simplify installation and testing
  – Protect users and the environment
  – Increase market access and acceptance

• Benefits for participating
  – Influence the final standard
  – Get a head start in complying with the standard
  – Network and build relationships
  – Enhance industry visibility
SEMI Standards Program

Consensus-based Standards Development

• SEMI Standards are created through developing consensus in the industry.

• Worldwide distribution of document drafts and ballots ensures global consensus.

• SEMI Standards activities are open to all interested parties, including users, suppliers, trade organizations, and government agencies.
Get Involved!

• Get your company support
• Register today:  [www.semi.org/standardsmembership](http://www.semi.org/standardsmembership)

• SEMI Standards Technical Committees

  Assembly & Packaging
  Automated Test Equipment
  Automation Technology
  Compound Semiconductor Mat’ls
  Environmental Health & Safety
  Facilities
  FPD Materials & Components
  FPD Metrology
  Gases
  High-Brightness LED
  Information & Control
  Liquid Chemicals
  MEMS / NEMS
  Metrics
  Micropatterning
  Photovoltaic
  Photovoltaic Materials
  Physical Interfaces & Carriers
  Silicon Wafer
  Traceability
  3DS-IC
  (three-dimensional stacked integrated circuits)
High Profile SEMI Standards

- **Wafer Dimensions**
  - Polished Wafers (M1)
- **Metrics**
  - Factory efficiency, equipment reliability, and availability
- **Equipment Interface**
  - SEMI Equipment Communication Standards (SECS)
  - Generic Equipment Model (GEM)
- **Environmental, Health and Safety**
  - Safety for semiconductor (S2) and FPD (S26)
  - Energy conservation (S23)
- **300 mm, 450 mm**
  - Automated Material Handling Systems
- **Photovoltaic**
  - Materials, equipment communications
- **Anti-counterfeiting / Product Authentication**
SEMI EHS Guidelines by Topic [1/2]

**Equipment**
- S2 – Semiconductor manufacturing equipment
- S26 – Flat Panel Display manufacturing systems

**Equipment related**
- S1 – Safety labels
- S3 – Process liquid heating systems
- S6 – Exhaust ventilation
- S13 – Manuals
- S14 – Fire risk assessment and mitigation
- S17 – Unmanned transport vehicles
- S22 – Electrical safety design
- S28 – Robots and load ports safety
SEMI EHS Guidelines by Topic [2/2]

Environment

• S12 – Equipment decontamination
• S16 – Reduction of environmental impact at end of life
• S23 – Energy, utilities, and materials conservation
• S29 – Fluorinated greenhouse gas emission

Chemicals, Gases, & Distribution

• S4 – Chemical cylinder separation
• S5 – Flow limiting devices
• S18 – Silane flammable silicon compounds
• S25 – Hydrogen peroxide storage & handling

Personnel

• S8 – Ergonomics
• S19 – Installation, maintenance, and service personnel training
• S21 – Worker protection
• S24 – Multi-employer work areas

Other

• S7 – Evaluator qualifications
• S10 – Risk assessment/evaluation
• S27 – Evaluation reports
Materials

M1 - Specification for Polished Single Crystal Silicon Wafers

- Provides the essential dimensional and certain other common characteristics of silicon wafers, including polished wafers as well as substrates for epitaxial and certain other kinds of silicon wafers.

- Provides wafer spec for 2, 3 inch, and 100, 125, 150, 200, 300, and 450 mm
Facilities

- **F1 - Specification for Leak Integrity of High-Purity Gas Piping Systems and Components**
  - This Specification defines the leak testing requirements and leakage rates for high-purity gas piping systems and components used in semiconductor manufacturing.

- **F47 - Specification for Semiconductor Processing Equipment Voltage Sag Immunity**
  - This Specification defines the voltage sag immunity required for semiconductor processing, metrology, and automated test equipment.

- **F61 - Guide for Ultrapure Water System Used in Semiconductor Processing**
  - This guide establishes the typical definitional requirements for an ultrapure water (UPW) system used in semiconductor manufacturing.

- **E76 - Guide for 300 mm Process Equipment Points of Connection to Facility Services**
  - This guide defines the positioning of the equipment points of connection (EPOC), required on semiconductor processing equipment for hookup to facility utility services.
Facilities Standards
Information & Control (I&C)
Factory Automation Software

• **E4 – SEMI Equipment Communications Standard 1 Message Transfer (SECS-I)**
  – Defines a communication interface suitable for the exchange of messages between semiconductor processing equipment and a host.
    • Semiconductor processing equipment includes equipment intended for wafer manufacturing, wafer processing, process measuring, assembly and packaging.
    • A host is a computer or network of computers which exchange information with the equipment to accomplish manufacturing.
  – This standard provides a means for independent manufacturers to produce equipment and/or hosts which can be connected without requiring specific knowledge of each other.

• **E5 – SEMI Equipment Communications Standard 2 Message Content (SECS-II)**
  – Defines the details of the interpretation of messages exchanged between intelligent equipment and a host.
  – SECS-II gives form and meaning to messages exchanged between equipment and host using a message transfer protocol, such as SECS-I.
    • It is the intent of this Standard to be fully compatible with SEMI E4
  – The messages defined in the Standard support the most typical activities required for IC manufacturing.
Information & Control (I&C)

Factory Automation Software

• E30 – Generic Model for Communications and Control of Manufacturing Equipment (GEM)
  – GEM defines a standard implementation of SECS-II for all semiconductor manufacturing equipment.
  – The GEM standard defines a common set of equipment behavior and communications capabilities that provide the functionality and flexibility to support the manufacturing automation programs of semiconductor device manufacturers.

• E37 – High-Speed SECS Message Services (HSMS) Generic Services
  – Intended for applications where higher speed communication is needed or when a simple point-to-point topology is insufficient.
  – Defines a communication interface suitable for the exchange of messages between computers in a semiconductor factory.
Information & Control (I&C)

Factory Automation Software

- Equipment Data Acquisition (EDA) Interface Standards
  - E132, Specification for Equipment Client Authentication and Authorization
    - Security for access to the equipment information
  - E120, Specification for the Common Equipment Model (CEM) and E125, Specification for Equipment Self Description (EqSD)
    - Data model (metadata) for the available data from the equipment
  - E134, Specification for Data Collection Management
    - Mechanism for defining and enabling data acquisition from the equipment
Information & Control (I&C) Factory Automation Software

• E142 - Specification for Substrate Mapping
  – Defines the data items that are required to report, store and transmit map data for substrates such as wafers, frames, strips and trays.

• E167 - Specification for Equipment Energy Saving Mode Communications (EESM)
  – Defines messaging and behavior to facilitate a reduced rate of energy consumption in production equipment.
  – Provides a mechanism for the factory system (host) to initiate (and terminate) an equipment energy saving mode.

• E169 - Guide for Equipment Information System Security
  – Establishes a common basis for equipment information system security
Metrics

• **E10 - Specification for Definition and Measurement of Equipment Reliability, Availability, and Maintainability (RAM) and Utilization**
  – Provides a standardized methodology for measuring reliability, availability, and maintainability (RAM) and utilization performance of equipment in a manufacturing environment.
  • Establishes a common basis for communication between users and suppliers of semiconductor manufacturing equipment.

• **E79 - Specification for Definition and Measurement of Equipment Productivity**
  – Defines metrics and calculations for measurement of equipment productivity

• **E149 - Guide for Equipment Supplier-Provided Documentation for the Acquisition and Use of Manufacturing Equipment**
  – Presents recommendations for content and usability of documentation provided by the equipment supplier to the equipment purchaser for acquisition and use of semiconductor, flat panel display (FPD), or other related manufacturing equipment.
Metrics

• **E33 - Guide for Semiconductor Manufacturing Equipment Electromagnetic Compatibility (EMC)**
  - Provides recommendations to help assure that manufacturing equipment used for manufacturing semiconductor devices will operate reliably without failures caused by electromagnetic interference (EMI).

• **E78 - Guide to Assess and Control Electrostatic Discharge (ESD) and Electrostatic Attraction (ESA) for Equipment**
  - Aims to minimize the negative impact on productivity caused by static charge and electric fields in semiconductor manufacturing equipment.
Metrics

• E35 - Guide to Calculate Cost of Ownership (COO) Metrics for Semiconductor Manufacturing Equipment
  – Provides standard metrics for evaluating unit production cost effectiveness of manufacturing equipment in the semiconductor and related industries.

• E124 - Guide for Definition and Calculation of Overall Factory Efficiency (OFE) and Other Associated Factory-Level Productivity Metrics
  – Describes metrics that show how well a factory is operating compared to how well it could be operating (for the given product mix)
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- Traceability
- 3DS-IC
  (three-dimensional stacked integrated circuits)