Semiconductor Components, Instruments and Subsystems (SCIS)

Technology Community

Overview | 2023

SEMI speeds the time-to-better business results for its members across the global electronics design and manufacturing supply chain.

CONNECT - COLLABORATE - INNOVATE - GROW - PROSPER

50+ Years Later: SEMI is More Than Ever and Growing!

2023 Top Priorities

>2,500 members worldwide

SEMI is the only all-encompassing industry association.

Thought Leadership

1,000+ Standards

Expositions/ Conferences

EHS/ESG

Worldwide Offices

2,300+ Program Hours

170+ Tech Programs

20+ Tech Communities

Market Intelligence Reports

Strategic Tech Communities: ESDA, FOA, FlexTech, MSIG, SOIC

Tech partners: imec, Fraunhofer, CEA-Leti, IEEE, ITRI, AIST

Smart Initiatives

↓

Think Tanks

Talent Development, DEI & e-learning

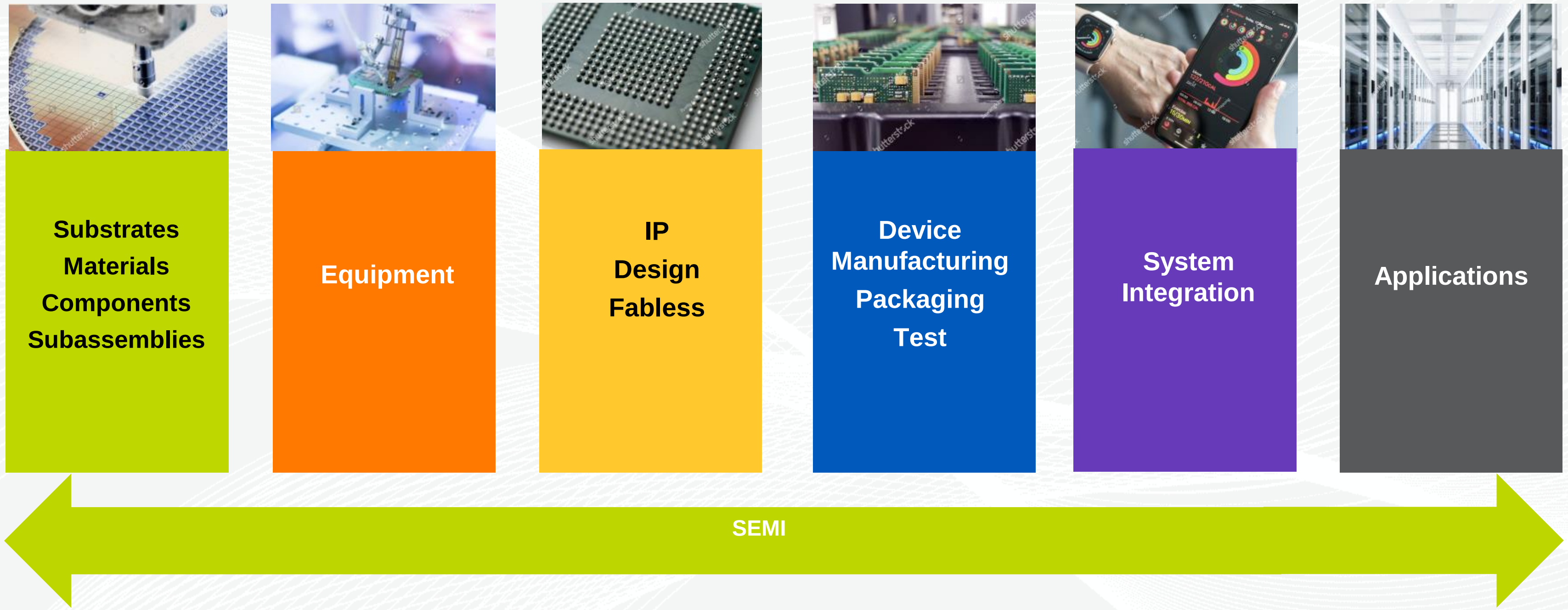
Global Advocacy

Supply Chain Management

Sustainability

SEMI Connects the Global Electronics Design and Manufacturing Supply Chain

Convergence and **new disruptions** are driving transformation to the digital era



Substrates
Materials
Components
Subassemblies

Equipment

IP
Design
Fabless

Device
Manufacturing
Packaging
Test

System
Integration

Applications

SEMI

Smart Initiatives

SMART DATA-AI

SMART MANUFACTURING

SMART MEDTECH

SMART MOBILITY

Technology Communities

ESDA Electronic System Design Alliance

FOA fab owners alliance

FlexTech

MEMS & SENSORS INDUSTRY GROUP

SOI industry consortium

Bringing the Supply Chain Together through Key SEMI Initiatives

semi

SMART DATA-AI

AI

Quantum Computing

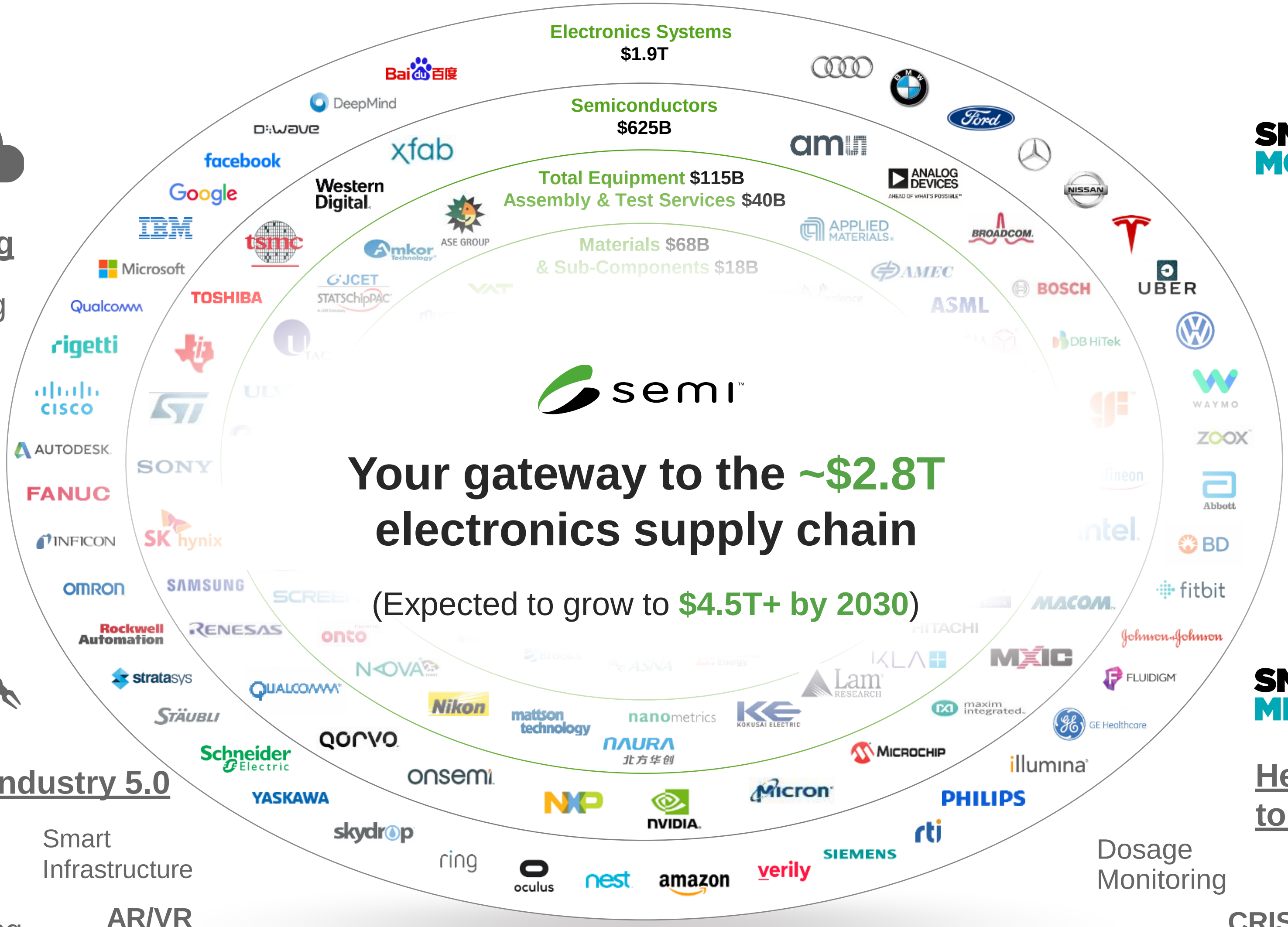
Machine Learning

5G to 6G

Bitcoin Mining

Blockchain

Digital Economy


Electronics Systems $1.9T

Semiconductors $625B

Total Equipment $115B

Assembly & Test Services $40B

Materials $68B & Sub-Components $18B

semi

Your gateway to the ~$2.8T electronics supply chain

(Expected to grow to $4.5T+ by 2030)

SMART MOBILITY

Near-zero fatalities

Zero Emissions

Autonomous Vehicles

Electric Vehicles

Driver Assistance

Fleet

Trucking

Smart City

SMART MANUFACTURING

4th Industrial Revolution → Industry 5.0

Realtime Configuration

Robotics

Smart Infrastructure

3D Printing

Adaptive Manufacturing

AR/VR

SMART MEDTECH

Health Span to Life Span

Fitness Tracking

Dosage Monitoring

Biometrics

Human Performance Monitoring

CRISPR

Wearables

2022 Market Data Estimates Sources: SEMI, IC Insights and TechInsights

ONE MEMBERSHIP OPENS THE DOOR TO A WORLD OF TECHNOLOGY COMMUNITIES

CONNECT

PARTICIPATE

TEACH

NETWORK

LISTEN

CONTRIBUTE

ATTEND

LEARN

CHALLENGE

ENGAGE

COLLABORATE

LEAD

DISCUSS

semi

SMART MEDTECH

SMART DATA

1010
01010101
101010101

SMART MOBILITY

SMART MANUFACTURING

STANDARDS

ELECTRONIC SYSTEMS DESIGN ALLIANCE

ESDA Electronic System Design Alliance

MEMS & SENSORS INDUSTRY GROUP

FLEXTECH

FlexTech

FAB OWNERS ALLIANCE

FOA fab owners alliance

NANO-BIO MATERIALS CONSORTIUM

nbmc nano-bio materials consortium

ENVIRONMENT, SUSTAINABILITY & GOVERNANCE

ESG

INFORMATION LEADERSHIP TECHNOLOGY

ITL

COLLABORATIVE ALLIANCE FOR SEMICONDUCTOR TEST

CAST

ELECTRONICS MATERIAL GROUP

EMG

SEMICONDUCTOR EQUIPMENT & APPLICATIONS

SE&A

SEMICONDUCTOR COMPONENTS, INTRUMENTS & SUBSYSTEM

SCIS

SEM I INTEGRATED PACKAGING, ASSEMBLY & TESTING

SiPAT

STRATEGIC INNOVATION PLATFORM

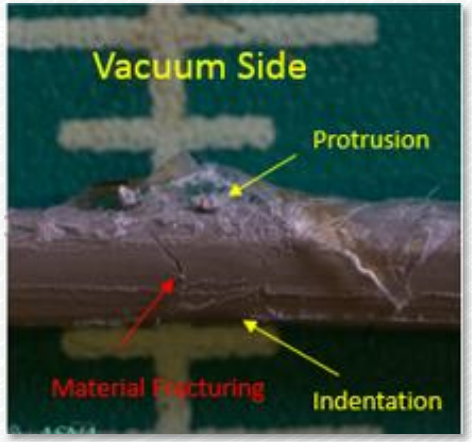
SIP

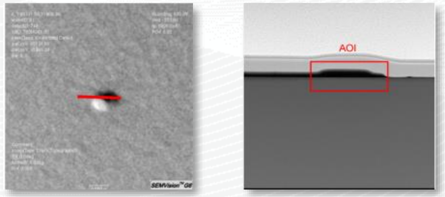
semi

Supply Chain Issue

Problem Statement: Defects introduced by process-critical OEM components affect final wafer quality resulting in lower yields and higher manufacturing costs.

- Several yield excursions are linked to wide range of component and sub-components induced defectivity.
- Components and sub-components defect traceability lack the rigor for advanced technologies (detectability, sensitivity/methodology).
- Existing standards, if any, are inadequate for addressing advanced process control requirements.





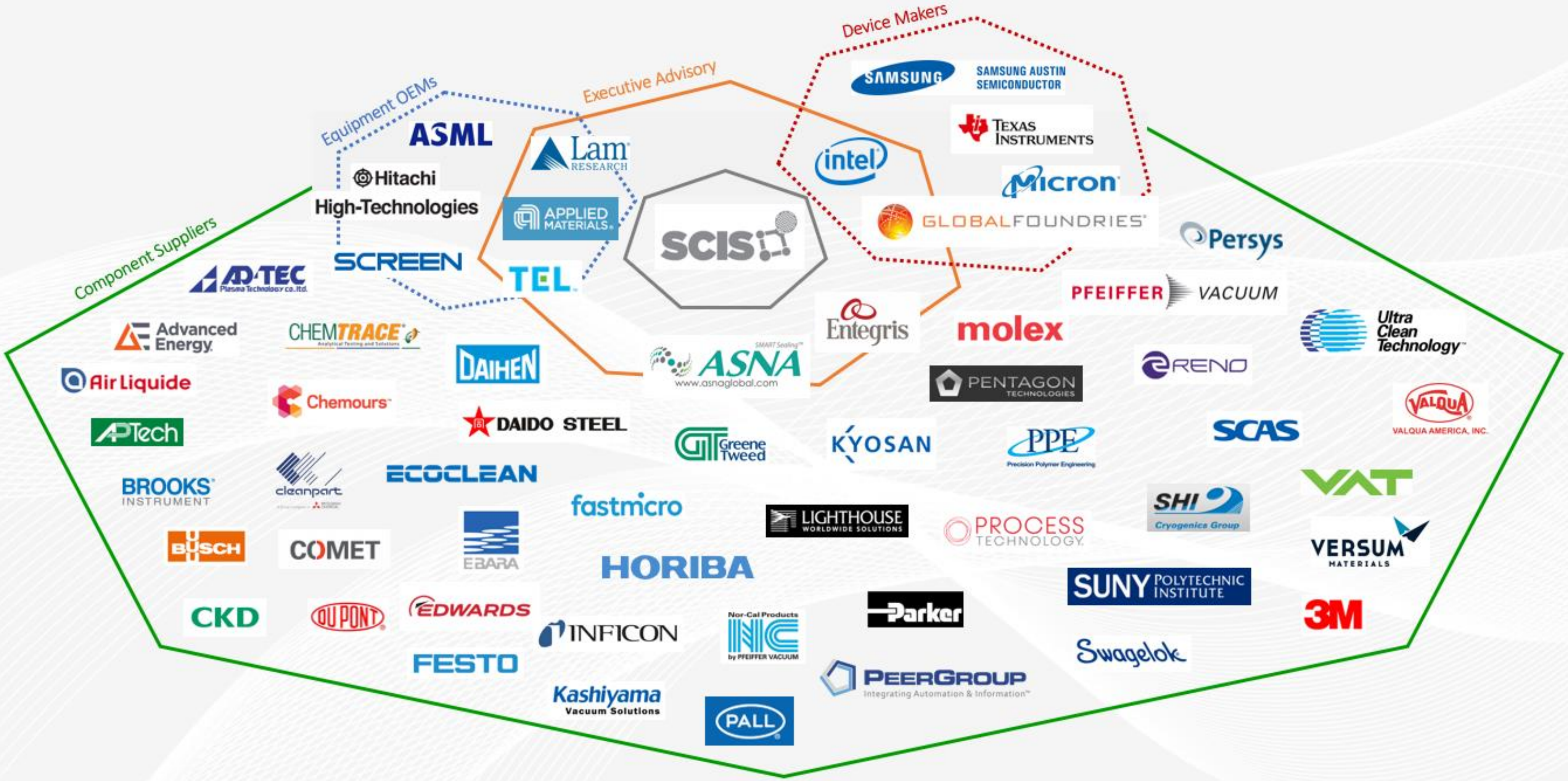
30-35 nm particles

SEMI SCIS Technology Community

(Semiconductor Components, Instruments, and Subsystems)

- Focus: Establishing a baseline for measuring defects introduced by process-critical components.
  - Particle or defect limits will not be defined but will focus on defining consistent methodologies for measuring defects.
- SCIS provides a forum that fosters discussion and aligns stakeholders on pre-competitive industry-critical issues.
  - Participants are not expected to disclose IP but are expected to provide parameters for standardized measurement.

Participating Companies



SCIS Organizational Structure

SCIS

Executive Advisory Committee

SCIS Steering Committee

Seals & Valves Group

Critical Chamber Components Group

Traceability Verification Group

RF Group

Gas Delivery Group

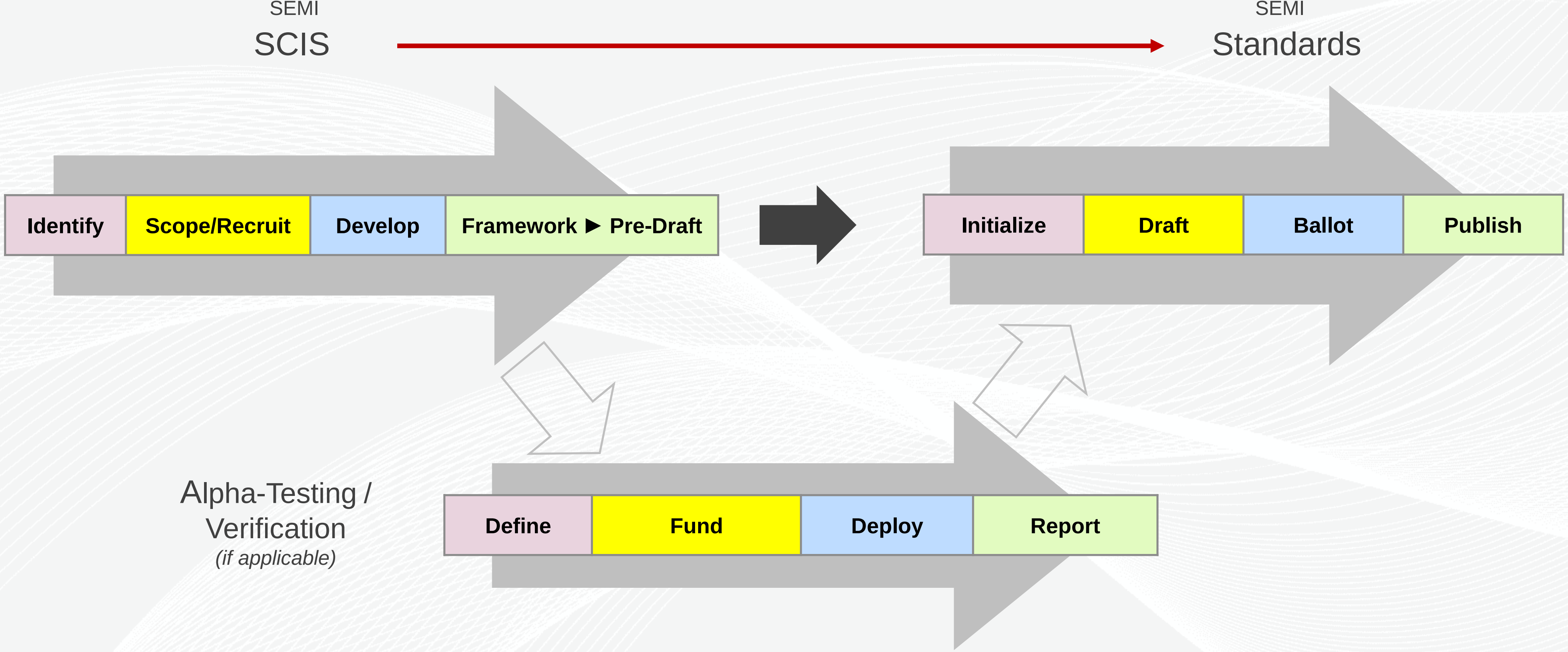
Liquid Delivery Group

Dry Pumps Group

Parts Clean Group

SCIS to Standards – Process Flow

SCIS structure and objectives enables end customer-driven initiatives leading to higher impact standards and shorter development timelines.



SEMI
SCIS

SEMI
Standards

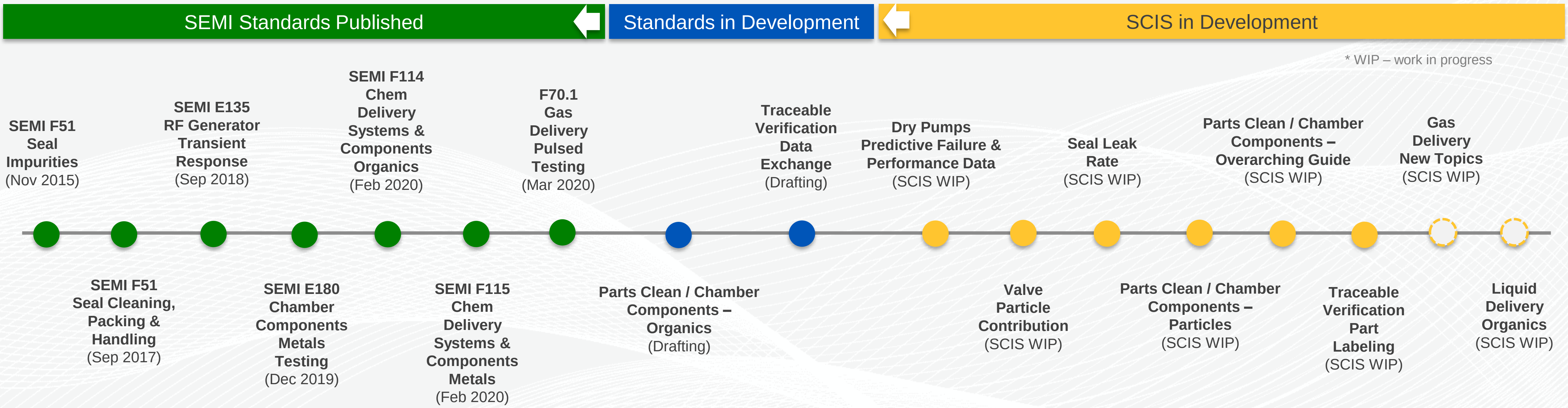
Identify | Scope/Recruit | Develop | Framework ► Pre-Draft

Initialize | Draft | Ballot | Publish

Alpha-Testing / Verification
(if applicable)

Define | Fund | Deploy | Report

SCIS Standardization Initiatives – Status


SEMI Standards Published

Standards in Development

SCIS in Development

* WIP – work in progress

SEMI F51 Seal Impurities
(Nov 2015)

SEMI F51 Seal Cleaning, Packing & Handling
(Sep 2017)

SEMI E135 RF Generator Transient Response
(Sep 2018)

SEMI E180 Chamber Components Metals Testing
(Dec 2019)

SEMI F114 Chem Delivery Systems & Components Organics
(Feb 2020)

SEMI F115 Chem Delivery Systems & Components Metals
(Feb 2020)

F70.1 Gas Delivery Pulsed Testing
(Mar 2020)

Parts Clean / Chamber Components – Organics
(Drafting)

Traceable Verification Data Exchange
(Drafting)

Dry Pumps Predictive Failure & Performance Data
(SCIS WIP)

Valve Particle Contribution
(SCIS WIP)

Seal Leak Rate
(SCIS WIP)

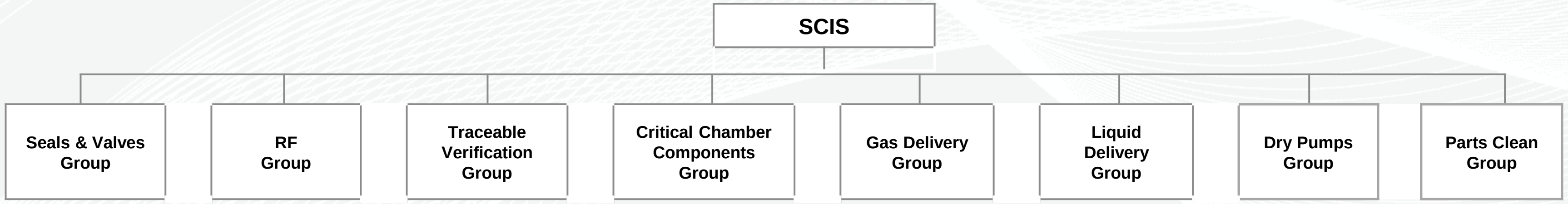
Parts Clean / Chamber Components – Particles
(SCIS WIP)

Parts Clean / Chamber Components – Overarching Guide
(SCIS WIP)

Traceable Verification Part Labeling
(SCIS WIP)

Gas Delivery New Topics
(SCIS WIP)

Liquid Delivery Organics
(SCIS WIP)


SCIS

- **Seals & Valves Group**
- **RF Group**
- **Traceable Verification Group**
- **Critical Chamber Components Group**
- **Gas Delivery Group**
- **Liquid Delivery Group**
- **Dry Pumps Group**
- **Parts Clean Group**

Semiconductor Components, Instruments and Subsystems (SCIS)

Technology Community

Joint Parts Clean and Critical Chamber Components (CCC) WGs

SCIS Parts Clean & CCC WG

- Participating companies include:

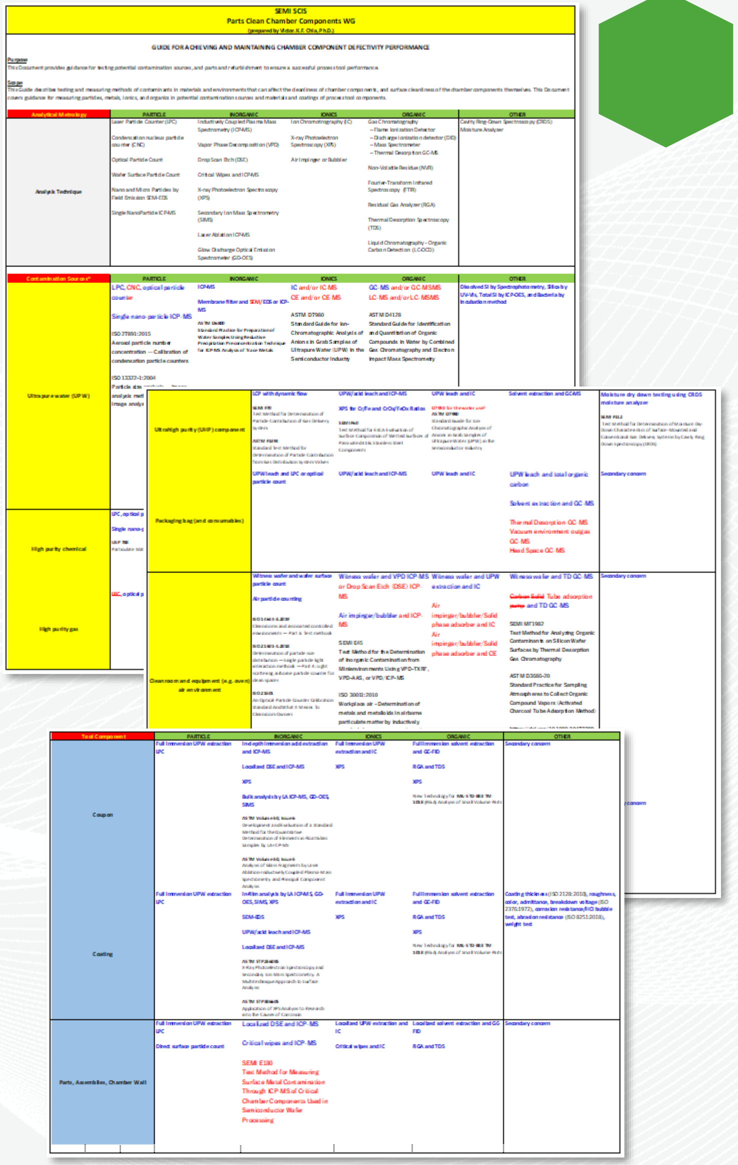
Air Liquide
APPLIED MATERIALS
ASML
SMART Sealing™ ASNA www.asnaglobal.com
cleanpart A Group Company of MITSUBISHI CHEMICAL
DAIDO STEEL
fastmicro
ECOCLEAN
FESTO
GlobalFoundries™
intel
Micron
NAURA
PENTAGON TECHNOLOGIES
Persys
SAMSUNG SAMSUNG AUSTIN SEMICONDUCTOR
SCAS
TEL™
Ultra Clean Technology™

Parts Clean & CCC WG - Status

- Current Activities:
  - Organics
  - Particles
  - “Over-arching” document on parts cleaning

Parts Clean & CCC WG - Status

- The WG has been focusing on:
  - **“Over-arching” document on parts cleaning** [1/2]
    - WG lead: Victor Chia (Air Liquide/Balazs)
    - WG plans to develop over-arching document into a full consensus Standard as a Guide
    - The Guide will provide users information on available test methods. It will be up to the user to determine which technique will be used for their needs
    - The Guide can also be referenced by users/customers
    - <u>Next Meeting</u>: Wednesday, December 7 at 8 AM (Pacific)



SEMI SCIS
Parts Clean Chamber Components WG
(prepared by Victor. K.F. Chia, Ph.D.)

GUIDE FOR ACHIEVING AND MAINTAINING CHAMBER COMPONENT DEFECTIVITY PERFORMANCE

Purpose
This Document provides guidance for testing potential contamination sources, and parts and refurbishment to ensure a successful process tool performance

Scope
This Guide describes testing and measuring methods of contaminants in materials and environments that can affect the cleanliness of chamber components, and surface cleanliness of the chamber components themselves. This Document covers guidance for measuring particles, metals, ionics, and organics in potential contamination sources and materials and coatings of process tool components.

Analytical Metrology	PARTICLE	INORGANIC	IONICS	ORGANIC	OTHER
Analysis Technique	Laser Particle Counter (LPC) Condensation nucleus particle counter (CNC) Optical Particle Count Wafer Surface Particle Count Nano and Micro Particles by Field Emission SEM-EDS Single NanoParticle ICP-MS	Inductively Coupled Plasma Mass Spectrometry (ICP-MS) Vapor Phase Decomposition (VPD) Drop Scan Etch (DSE) Critical Wipes and ICP-MS X-ray Photoelectron Spectroscopy (XPS) Secondary Ion Mass Spectrometry (SIMS) Laser Ablation ICP-MS Glow Discharge Optical Emission Spectrometer (GD-OES)	Ion Chromatography (IC) X-ray Photoelectron Spectroscopy (XPS) Air Impinger or Bubbler	Gas Chromatography – Flame Ionization Detector – Discharge Ionization detector (DID) – Mass Spectrometer – Thermal Desorption GC-MS Non-Volatile Residue (NVR) Fourier-Transform Infrared Spectroscopy (FTIR) Residual Gas Analyzer (RGA) Thermal Desorption Spectroscopy (TDS) Liquid Chromatography - Organic Carbon Detection (LC-OCD)	Cavity Ring-Down Spectroscopy (CRDS) Moisture Analyzer

Parts Clean & CCC WG - Status

- The WG has been focusing on:
  - **Particles** [1/3]
    - WG Leads: Tommaso Orzali (ASML), Fuhe Li (Balazs), Erik Vermeulen (Fastmicro)

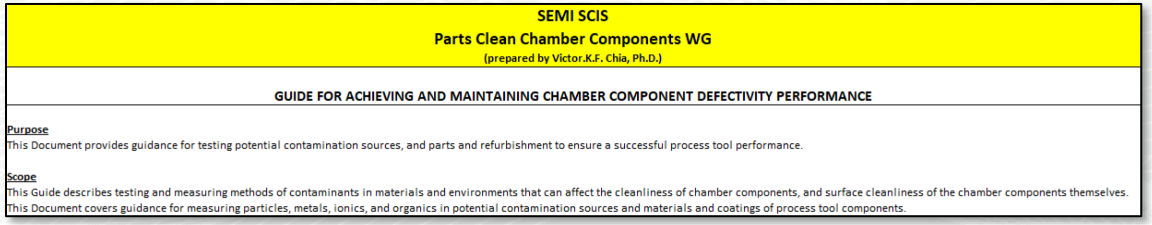
    - 3 parallel activities:
      - Guide Document + Test Method (Tape Lift-off) + Test Method (OPC/LPC)

Parts Clean & CCC WG - Status

- The WG has been focusing on:
  - **Particles** [2/3]

Guide Document

- Guide Document would be incorporated into the Over-arching Document effort



SEMI SCIS
Parts Clean Chamber Components WG
(prepared by Victor.K.F. Chia, Ph.D.)

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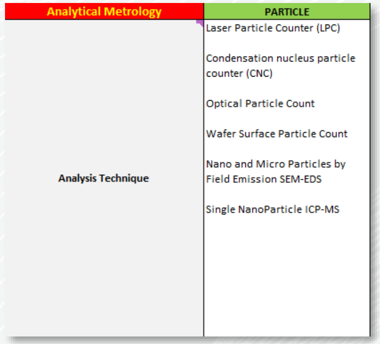
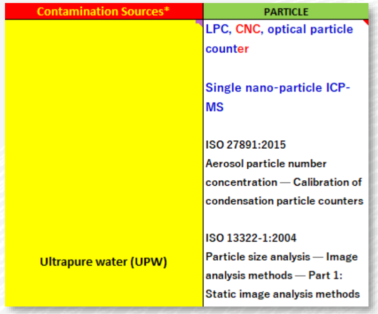
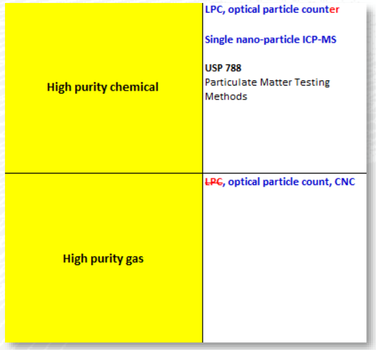


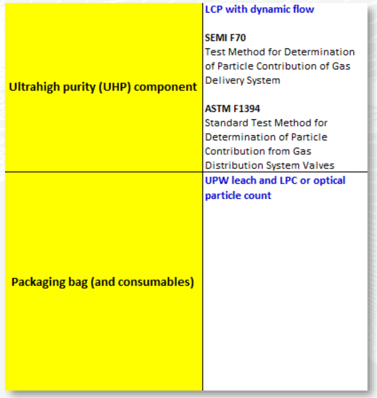
Analytical Metrology	PARTICLE
Analysis Technique	Laser Particle Counter (LPC) Condensation nucleus particle counter (CNC) Optical Particle Count Wafer Surface Particle Count Nano and Micro Particles by Field Emission SEM-EDS Single NanoParticle ICP-MS



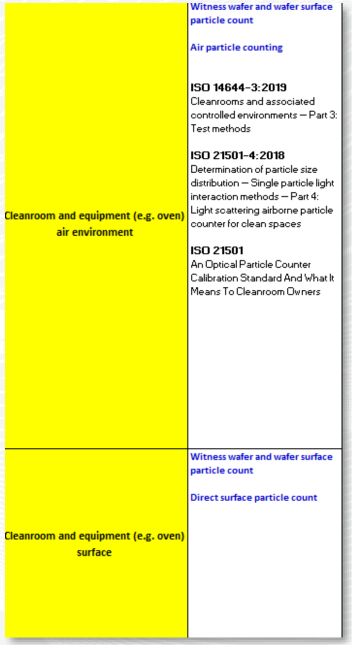
Contamination Sources*	PARTICLE
Ultrapure water (UPW)	LPC, CNC, optical particle counter Single nano-particle ICP-MS ISO 27891:2015 Aerosol particle number concentration — Calibration of condensation particle counters ISO 13322-1:2004 Particle size analysis — Image analysis methods — Part 1: Static image analysis methods



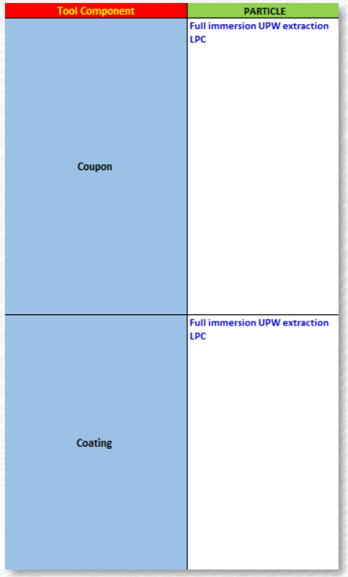
High purity chemical	LPC, optical particle counter Single nano-particle ICP-MS **USP 788** Particulate Matter Testing Methods
High purity gas	~~LPC~~, optical particle count, CNC



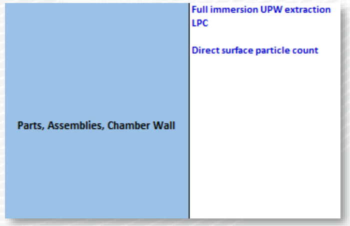
Ultrahigh purity (UHP) component	LCP with dynamic flow **SEMI F70** Test Method for Determination of Particle Contribution of Gas Delivery System **ASTM F1394** Standard Test Method for Determination of Particle Contribution from Gas Distribution System Valves
Packaging bag (and consumables)	UPW leach and LPC or optical particle count



Cleanroom and equipment (e.g. oven) air environment	Witness wafer and wafer surface particle count Air particle counting **ISO 14644-3:2019** Cleanrooms and associated controlled environments — Part 3: Test methods **ISO 21501-4:2018** Determination of particle size distribution — Single particle light interaction methods — Part 4: Light scattering airborne particle counter for clean spaces **ISO 21501** An Optical Particle Counter Calibration Standard And What It Means To Cleanroom Owners
Cleanroom and equipment (e.g. oven) surface	Witness wafer and wafer surface particle count Direct surface particle count



Tool Component	PARTICLE
Coupon	Full immersion UPW extraction LPC
Coating	Full immersion UPW extraction LPC



Parts, Assemblies, Chamber Wall	Full immersion UPW extraction LPC Direct surface particle count

Parts Clean & CCC WG - Status

- The WG has been focusing on:
  - **Particles** [3/3]

Test Method for Tape Lift-off

- Describes a quantitative analysis method for measuring ISO 14644-9 Surface Cleanliness by Particle concentration (SCP) of critical chamber components by using a replacement adhesive substrate to remove particles from the surface of interest and to measure them with a scatterometer or scanning surface inspection system (for particle counting) and then further analysis (via SEM/EDX) to identify elemental composition of particles
- WG will continue to align on key elements/framework under this SCIS WG
- This activity will eventually be moved to SEMI Standards for formal standards development

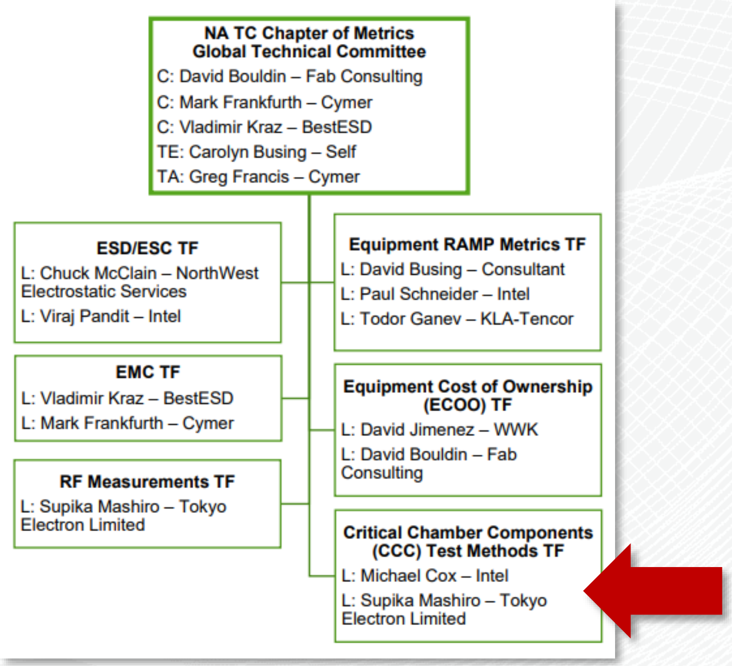
Test Method for OPC/LPC/Flushing

- Drafting, to be discussed at next meeting

- Next meeting: Wednesday, December 7 at 8 AM (Pacific)

Parts Clean & CCC WG - Status

- The WG has been focusing on:
  - **Organics**
    - In progress – draft circulated among WG members for inputs
      - Approach to structure is similar to SEMI E180, focusing on critical chamber components (CCC)
    - This activity has been transitioned to SEMI Standards for formal development
      - (SNARF # 6931) New Standard: *Test Method for Measuring Organics Contamination through Thermal Desorption or Solvent Extraction Gas Chromatography Mass Spectrometry of Critical Chamber Components Used in Semiconductor Wafer Processing and Inspection*



NA TC Chapter of Metrics Global Technical Committee
C: David Bouldin – Fab Consulting
C: Mark Frankfurth – Cymer
C: Vladimir Kraz – BestESD
TE: Carolyn Busing – Self
TA: Greg Francis – Cymer

ESD/ESC TF
L: Chuck McClain – NorthWest Electrostatic Services
L: Viraj Pandit – Intel

EMC TF
L: Vladimir Kraz – BestESD
L: Mark Frankfurth – Cymer

RF Measurements TF
L: Supika Mashiro – Tokyo Electron Limited

Equipment RAMP Metrics TF
L: David Busing – Consultant
L: Paul Schneider – Intel
L: Todor Ganev – KLA-Tencor

Equipment Cost of Ownership (ECOO) TF
L: David Jimenez – WWK
L: David Bouldin – Fab Consulting

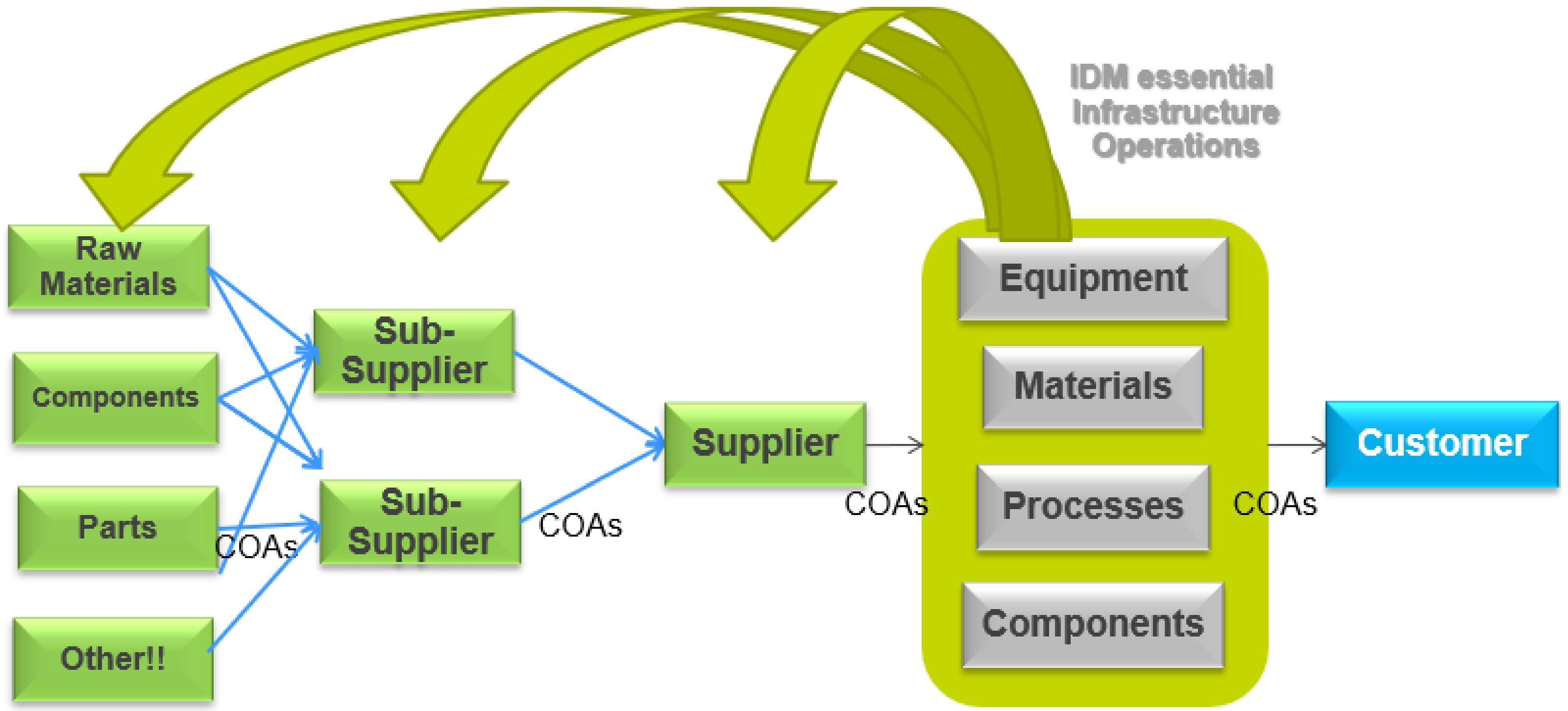
Critical Chamber Components (CCC) Test Methods TF
L: Michael Cox – Intel
L: Supika Mashiro – Tokyo Electron Limited

Semiconductor Components, Instruments and Subsystems (SCIS)

Technology Community

Traceable Verification

Traceable Verification - Requires Data Integration

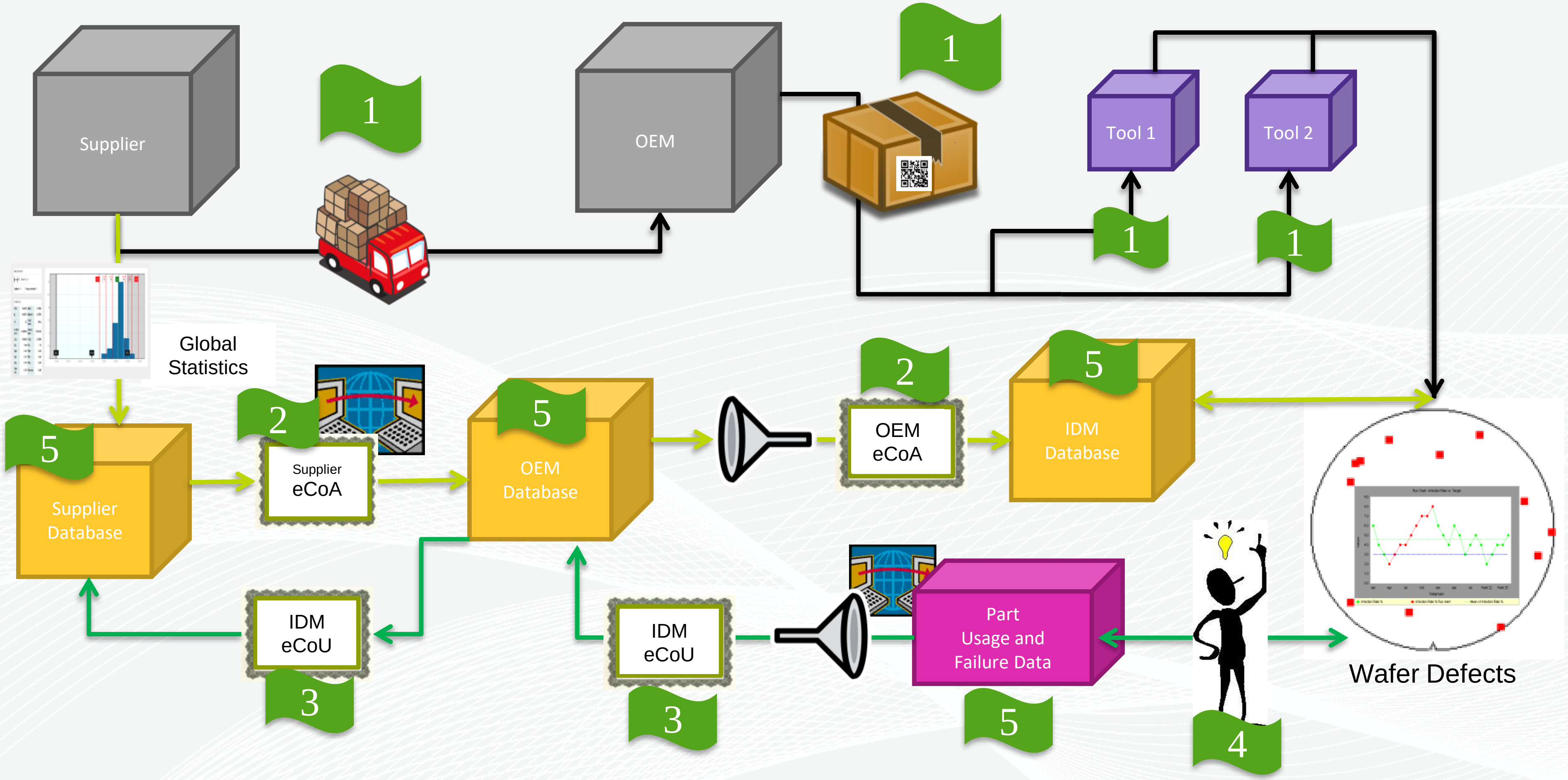


- ❑Collaboration, Traceability & Standards are key Ingredient to ensure alignment
- ❑In Line process monitoring controls and traceability at every stage goes far beyond the outgoing COAs of supply chain

Requirements

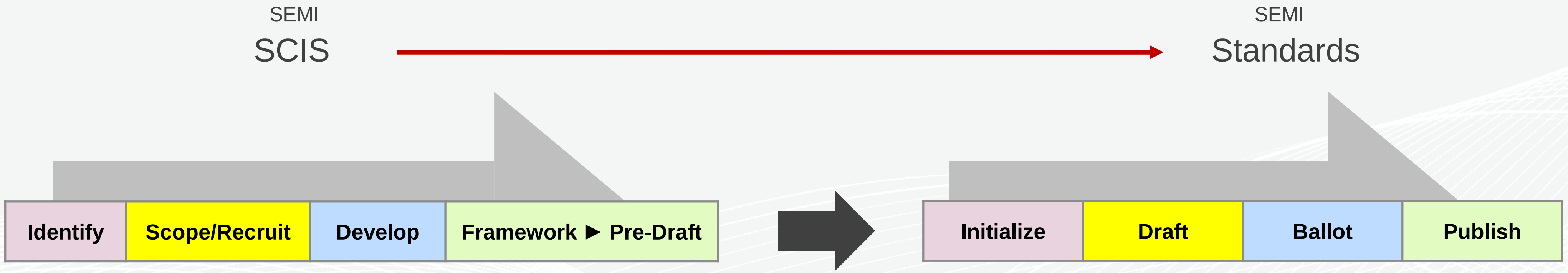
1. Standardized Identification (SNARF# 6448)
   - Easy ID – e.g. 2D Bar code will link to UUID for data reference
2. Standardized Data Format (SNARF# 6449)
   - Standardized scalable Information Exchange templates by commodity
     - ECOC/ECOA templates
3. Data Push method – extensions to Standardized Data Format
   - Deliver information prior to receipt and point of use
   - COU – Certificate of Use back to supplier (Failure modes, lifetime and CIP, etc.)
4. Data Pull method
   - Supplier / Source Web Site
5. History Tracking System (Use and Failure)
   - External (supplier)
   - Internal (customer)

Working Together for a New Data Infrastructure



- Sharing manufacturing data on parts and materials is critical for improvement and excursion containment
- Fabs must use data to find and share learnings with suppliers and IDMs
- Easy look up of “missing” data 4

SCIS Traceable Verification Activities to Standards



SEMI
SCIS

SEMI
Standards

Identify | **Scope/Recruit** | **Develop** | **Framework ► Pre-Draft**

Initialize | **Draft** | **Ballot** | **Publish**

<ins>SCIS Framework Development Completed</ins>:

- *SCIS Traceable Verification Group*
- Label BC Method
- Quality System Label Content (External, Stored)
- Template Format
- Data Transport Method
- Storage Location and Ownership
- Secure Access Requirements
- Encryption Requirements
- Data Backup and Storage

<ins>SEMI Standards Activity Established</ins>:

- *Equipment & Materials Traceability Task Force*
- New Standard: Specification for Equipment and Materials Labels (#6448)
- New Standard: Specification for Equipment and Materials Part Traceability (#6449)

Equipment & Materials Traceability Task Force

Activities & Status [1/2]

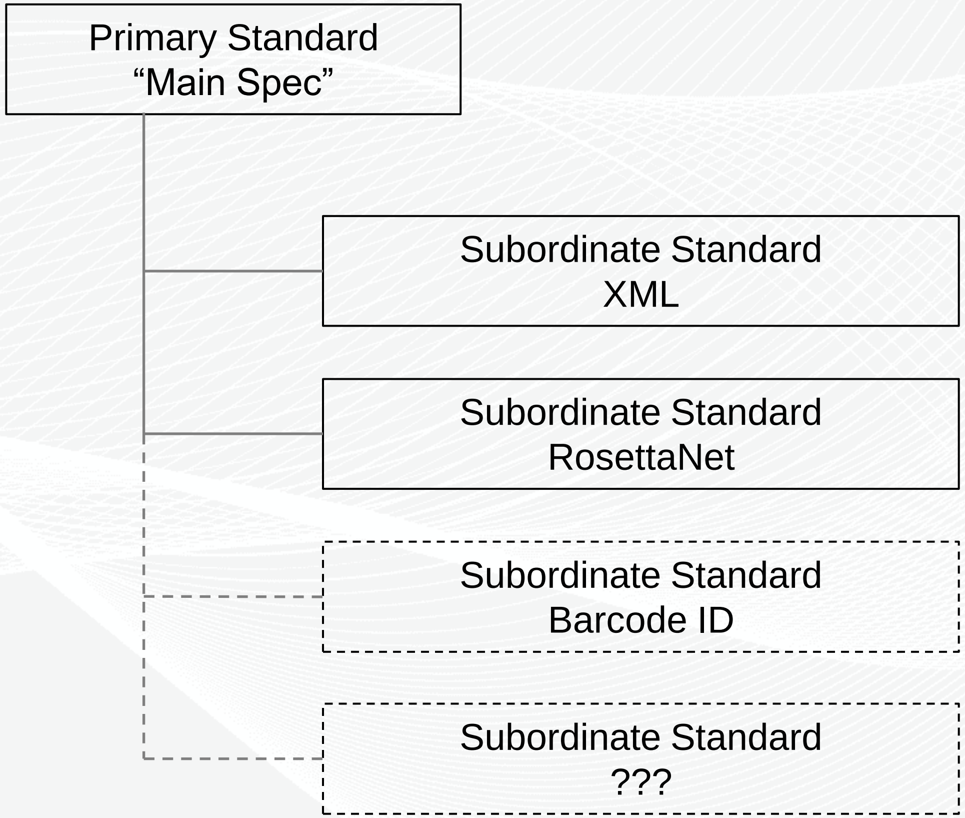
- **New Standard: Specification for Equipment and Materials Labels (SEMI Draft Document # 6448)**
  - Ballot was developed using VDA 4992 - MAT Label and eMat data exchange at the Material Label format.
  - SEMI has held separate meetings with OEM and IDM representatives to discuss concerns as well as efforts to realize material traceability.

  - Status:
    - Current 6448 SNARF will be abolished
      - This will take place at the North America Chapter of the Traceability Technical Committee meeting on November 10
    - The TF plans to start a new activity based on an alternative standardization approach
      - Discussions on the new standardization approach will be taken back to SCIS Traceable Verification WG for re-engineering (this removes 6448 from the balloting process for now)
      - Next SCIS Traceable Verification WG meeting to be announced
    - The TF also plans to continue its other existing activity in parallel (6449 – eCOA)
      - A strawman document will be circulated once drafting is complete
    - OEM stakeholders are requested to engage at the document development level

Equipment & Materials Traceability Task Force

Activities & Status [2/2]

- **New Standard: Specification for Equipment and Materials Part Traceability (SEMI Draft Document# 6449)**
  - Purpose: Specification for communicating part quality
    - Standardized scalable electronic Information Exchange templates by commodity – eCOC/ECOA Templates
  - Status: Drafting in progress
  - Looking for samples of suppliers' eCOA to ensure all information is captured in the new Standard
  - Ballot contributors always welcome!



Semiconductor Components, Instruments and Subsystems (SCIS)

Technology Community

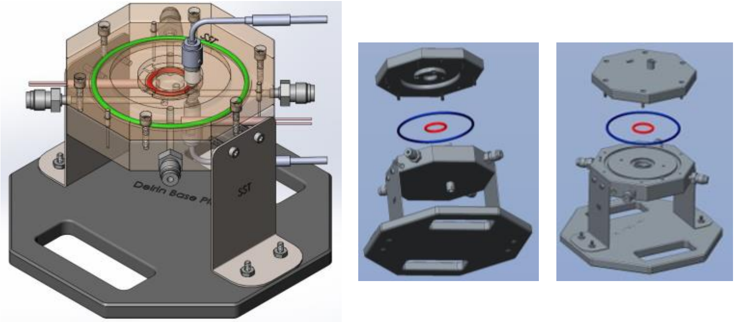
Seals WG

SCIS Seals Group

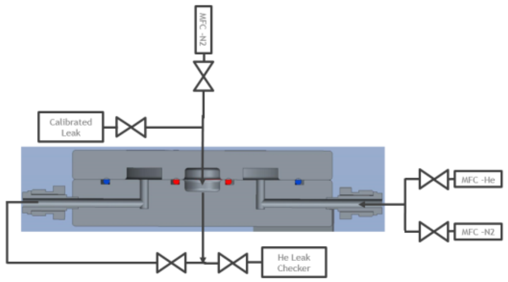
Leak Rate Project [1/4]

- Focus: Seal Leak Rate
  - Rationale: Seal failure can generate defects through atmospheric leaks into process environments or from degraded seal material. There is a need to develop a standardized way for measuring a seal’s ability to hold vacuum when exposed to elevated temperatures and/or process and clean chemistries.

Test Jig



Seal Test Apparatus Schematic – Without Chemistry



Test Methodology

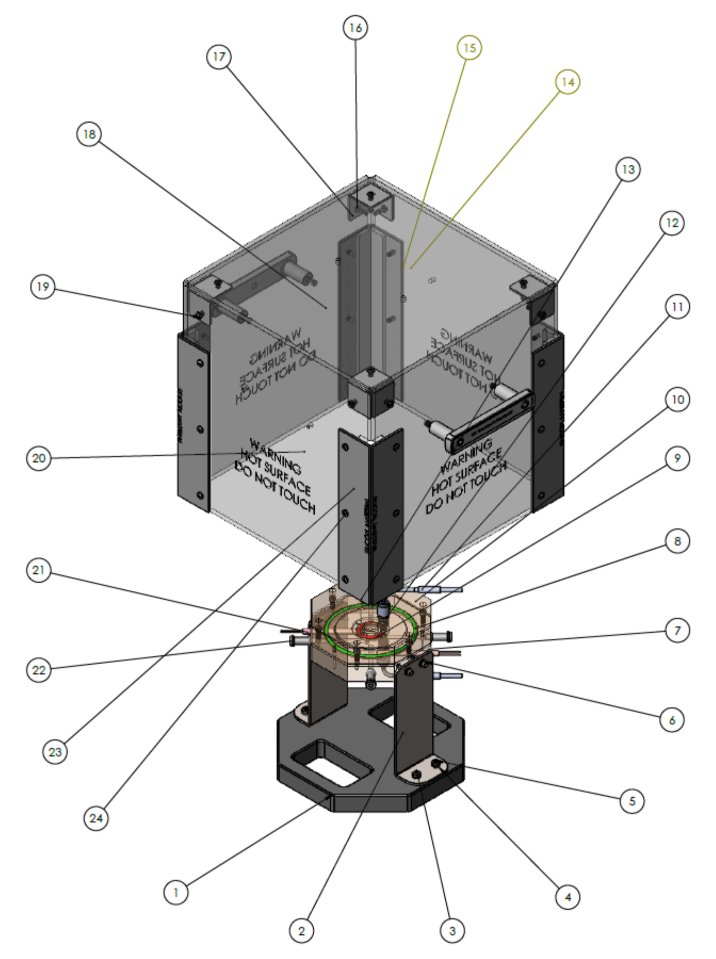
Goal: use Alpha testing to see how o-rings perform to determine measurement objectives at each temp

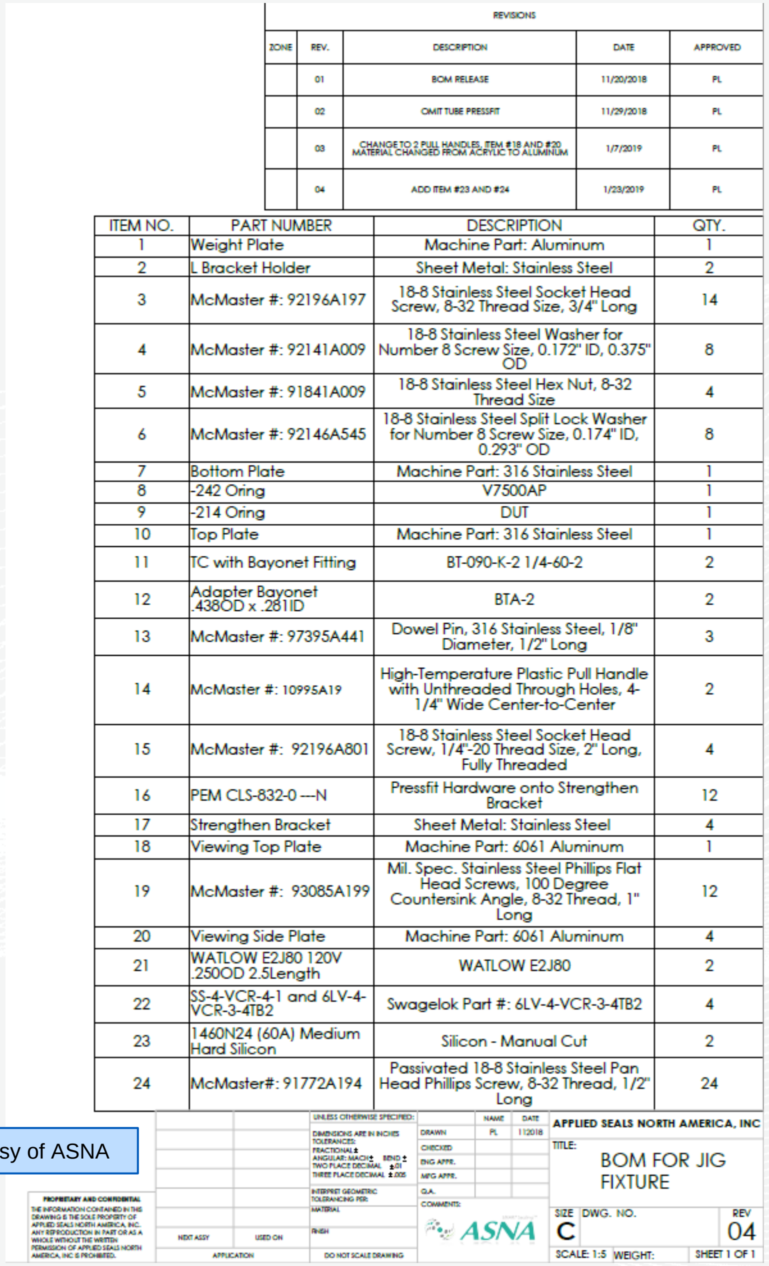
- Step 1
  - Room temp / 21°C
  - 5 measures during dwell time
- Step 2
  - Ramp Temp to 200°C
  - this temp may be a variable depending on material type post Alpha
- Step 3
  - 5 measures at ramped temperature
  - Dwell time 24hrs
- Step 4
  - Cool down to 21°C/room temp
  - Fan control is OKAY for faster cooling
- Step 5
  - 5 measures to be taken within (maximum) first few hrs of the cool down to 21°C/room temp

SCIS Seals Group

Leak Rate Project [2/4]

- BOM





REVISIONS

ZONE	REV.	DESCRIPTION	DATE	APPROVED
	01	BOM RELEASE	11/20/2018	PL
	02	OMIT TUBE PRESSFIT	11/29/2018	PL
	03	CHANGE TO 2 PULL HANDLES, ITEM #18 AND #20 MATERIAL CHANGED FROM ACRYLIC TO ALUMINUM	1/7/2019	PL
	04	ADD ITEM #23 AND #24	1/23/2019	PL

ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	Weight Plate	Machine Part: Aluminum	1
2	L Bracket Holder	Sheet Metal: Stainless Steel	2
3	McMaster #: 92196A197	18-8 Stainless Steel Socket Head Screw, 8-32 Thread Size, 3/4" Long	14
4	McMaster #: 92141A009	18-8 Stainless Steel Washer for Number 8 Screw Size, 0.172" ID, 0.375" OD	8
5	McMaster #: 91841A009	18-8 Stainless Steel Hex Nut, 8-32 Thread Size	4
6	McMaster #: 92146A545	18-8 Stainless Steel Split Lock Washer for Number 8 Screw Size, 0.174" ID, 0.293" OD	8
7	Bottom Plate	Machine Part: 316 Stainless Steel	1
8	-242 Oring	V7500AP	1
9	-214 Oring	DUT	1
10	Top Plate	Machine Part: 316 Stainless Steel	1
11	TC with Bayonet Fitting	BT-090-K-2 1/4-60-2	2
12	Adapter Bayonet .438OD x .281ID	BTA-2	2
13	McMaster #: 97395A441	Dowel Pin, 316 Stainless Steel, 1/8" Diameter, 1/2" Long	3
14	McMaster #: 10995A19	High-Temperature Plastic Pull Handle with Unthreaded Through Holes, 4-1/4" Wide Center-to-Center	2
15	McMaster #: 92196A801	18-8 Stainless Steel Socket Head Screw, 1/4"-20 Thread Size, 2" Long, Fully Threaded	4
16	PEM CLS-832-0 ---N	Pressfit Hardware onto Strengthen Bracket	12
17	Strengthen Bracket	Sheet Metal: Stainless Steel	4
18	Viewing Top Plate	Machine Part: 6061 Aluminum	1
19	McMaster #: 93085A199	Mil. Spec. Stainless Steel Phillips Flat Head Screws, 100 Degree Countersink Angle, 8-32 Thread, 1" Long	12
20	Viewing Side Plate	Machine Part: 6061 Aluminum	4
21	WATLOW E2J80 120V .250OD 2.5Length	WATLOW E2J80	2
22	SS-4-VCR-4-1 and 6LV-4-VCR-3-4TB2	Swagelok Part #: 6LV-4-VCR-3-4TB2	4
23	1460N24 (60A) Medium Hard Silicon	Silicon - Manual Cut	2
24	McMaster#: 91772A194	Passivated 18-8 Stainless Steel Pan Head Phillips Screw, 8-32 Thread, 1/2" Long	24

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES
TOLERANCES:
FRACTIONAL ±
ANGULAR: MACH ± BEND ±
TWO PLACE DECIMAL ±.01
THREE PLACE DECIMAL ±.005
INTERPRET GEOMETRIC TOLERANCING PER:
MATERIAL
FINISH
DO NOT SCALE DRAWING

NEXT ASSY USED ON
APPLICATION

	NAME	DATE
DRAWN	PL	112018
CHECKED		
ENG APPR.		
MFG APPR.		
Q.A.		

COMMENTS:

ASNA

APPLIED SEALS NORTH AMERICA, INC

TITLE:
BOM FOR JIG FIXTURE

SIZE C DWG. NO. REV 04

SCALE: 1:5 WEIGHT: SHEET 1 OF 1

PROPRIETARY AND CONFIDENTIAL
THE INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF APPLIED SEALS NORTH AMERICA, INC. ANY REPRODUCTION IN PART OR AS A WHOLE WITHOUT THE WRITTEN PERMISSION OF APPLIED SEALS NORTH AMERICA, INC IS PROHIBITED.

CAD Courtesy of ASNA

SCIS Seals Group

Leak Rate Project [3/4]

- Operating Procedures
  - Provides detailed, step-by-step procedures for conducting seal leak rate alpha test

- Alignment needed on key requirements
  - O-ring prep prior to testing
  - Room temperature range
  - # of leak rate measurements taken
  - Ramp temperature, gradient
  - Dwell time
  - Conditioning

Operating Procedures – Contents:

1) Safety
2) Background Information
3) O-Ring Test Jig Facilities & Hardware Requirements
4) Configuring the O-Ring Test Jig for Operation
5) Calibrating the O-Ring Test Jig for Operation
6) Preparing an O-Ring for Leak-Rate Test on the Jig
7) Running an O-Ring Leak-Rate Test on the Jig
8) Recording an O-Ring Leak-Rate Test Result
9) Calculating Gauge Repeatability & Reliability
10) Alpha Testing Sampling Requirements

Document

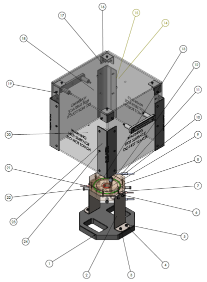
SCIS Seals Group

Leak Rate Project [4/4]

Alpha Test Production Flow

SCIS Seal Suppliers

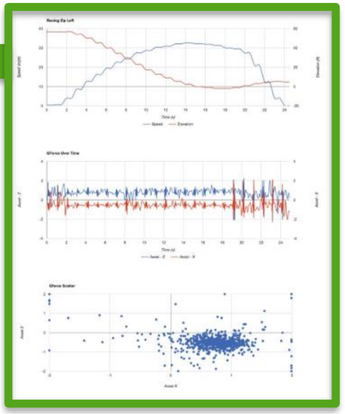
Test Jig Manufacture



Leak Detector Provider

Seals Alpha Testing

Testing Site



SCIS Seals Group

Project Contributions - Update

Item / Resource	Contributor	Status
Testing Site	TEL US	Confirmed
Leak Detector	Edwards	Confirmed
Valves	CKD USA	Confirmed
Fittings	Swagelok	Confirmed
PLC	Festo	Confirmed
Test Fixture - Assembly	TEL US	Confirmed
Test Fixture - Materials	TEL US	Fixture (machined) parts done – early Nov 2022
Firestop Material / Thermal Insulation	???	Discussion in progress Ongoing discussion re: material details

Many thanks to our contributors!!

Semiconductor Components, Instruments and Subsystems (SCIS)

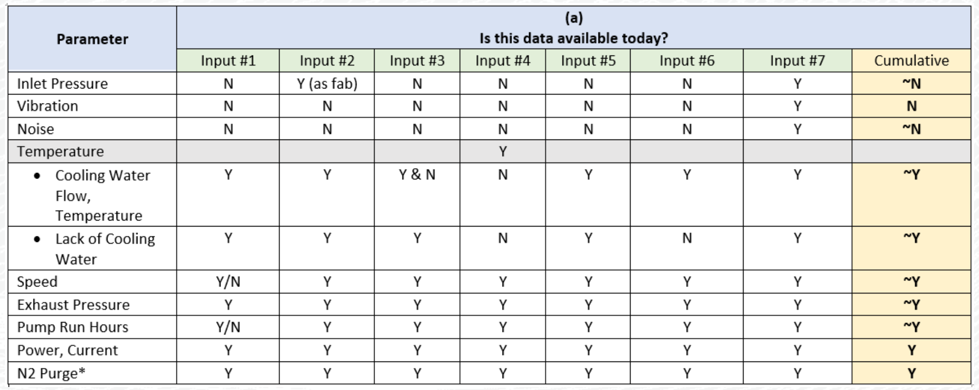
Technology Community

Dry Pumps

Dry Pumps

- Background:
  - Critical pump data can be utilized for predictive pump failure detection. Some of this data can be obtained today while others are not yet widely available.
  - Parameters evaluated include:
    - Inlet Pressure
    - Vibration Noise
    - Temperature
    - Speed
    - Exhaust Pressure
    - Pump Run Hours
    - Power, Current
    - N2 Purge

Pump Data Survey *(excerpt)*



Parameter	(a) Is this data available today?							
	Input #1	Input #2	Input #3	Input #4	Input #5	Input #6	Input #7	Cumulative
Inlet Pressure	N	Y (as fab)	N	N	N	N	Y	**~N**
Vibration	N	N	N	N	N	N	Y	**N**
Noise	N	N	N	N	N	N	Y	**~N**
Temperature				Y				
• Cooling Water Flow, Temperature	Y	Y	Y & N	N	Y	Y	Y	**~Y**
• Lack of Cooling Water	Y	Y	Y	N	Y	N	Y	**~Y**
Speed	Y/N	Y	Y	Y	Y	Y	Y	**~Y**
Exhaust Pressure	Y	Y	Y	Y	Y	Y	Y	**~Y**
Pump Run Hours	Y/N	Y	Y	Y	Y	Y	Y	**~Y**
Power, Current	Y	Y	Y	Y	Y	Y	Y	**Y**
N2 Purge*	Y	Y	Y	Y	Y	Y	Y	**Y**

  - Reviewed existing standards
    - ISO (vibration on rotational equipment)
    - SEMI (data communication, specific device model)
      - SEMI E73, Specification for Vacuum Pump Interfaces - Dry Pumps
      - SEMI E54.18, Specification for Sensor/Actuator Network Specific Device Model for Vacuum Pump Device

Dry Pumps

SCIS Pump
Vibration DRAFT

- Status: Drafting completed on guide for measuring vibration

- Guide for Measuring Vibration of Dry Pumps
  - There are many pump parameters that can be used to determine its health → Vibration is just one of these parameters
  - Draft provides guidance on how vibration measurements are taken for dry pumps
  - Draft also provides guidelines for evaluating pumps for use at customer sites
  - Elements considered include:
    - Sensor Considerations
      - Type
      - Location
      - # of Sensors
    - Data Collection
      - Interface
      - Frequency
      - Sampling Rate
      - Communication
  - This guide does not address how the data is processed to determine the health of the pump

Inputs Received

- WG Discussion
  - Input received calls for 2 parts (signal, alarm)
  - Most customers want the signal and they do their own processing
  - WG to take a closer look at SEMI E54.18 and SEMI E54.1 standards
    - SEMI E54.18 — Specification for Sensor/Actuator Network Specific Device Model for Vacuum Pump Device
    - SEMI E54.1 — Standard for Sensor/Actuator Network Common Device Model
    - Revision to incorporate vibration signal
  - Current vibration draft:
    - Refers to E54.18 (or other accepted methods) for communicating vibration signal
    - Acknowledges data processing, but does not address it (outside of scope, IP sensitivity)

Dry Pumps - Status

- Next Steps
  - WG soliciting inputs on whether to take on pump communication or move on to next parameter
  - If on pump communication, should the efforts focus on new tools vs on backwards compatibility for old tools?

SEMI E54.18

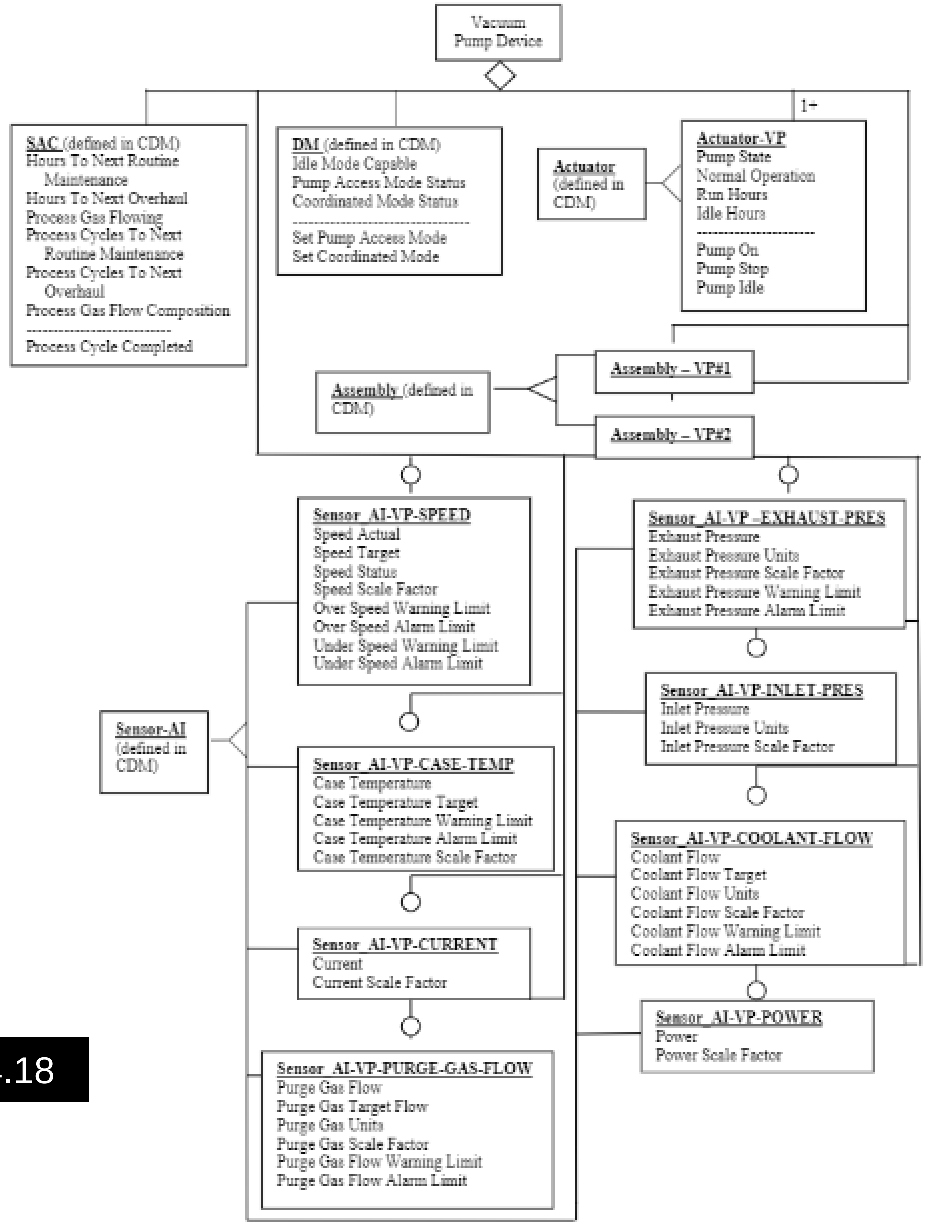


Figure 1
VPD High Level Structure

Semiconductor Components, Instruments and Subsystems (SCIS)

Technology Community

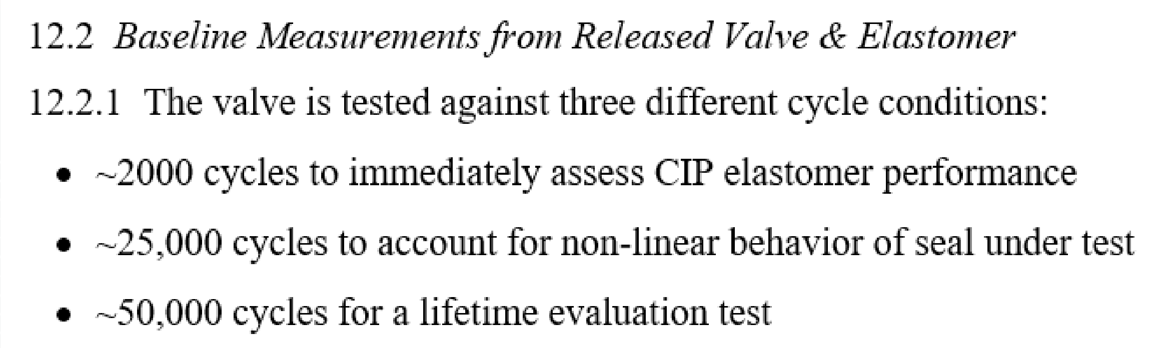
Valves WG

SCIS Valves Activity

- Particle Contribution from Slit Valves (Wafer Transfer Valves)
  - Rationale: There is interest in minimizing particles generated by either elastomer or valve assembly
    - Traditionally, at qualification the particle contribution of valves & original elastomer are considered
    - Usually, the next step is the introduction of CIP elastomer
    - If CIP elastomer proves superior (i.e., less particle shed) than original elastomer, then focus can shift to optimizing valve operation parameters (if performance improvement of elastomer is deemed insufficient)
    - And/or if CIP elastomer still fails to meet performance criteria, then focus shifts to changing valve design, valve operation

SCIS Activities in Development

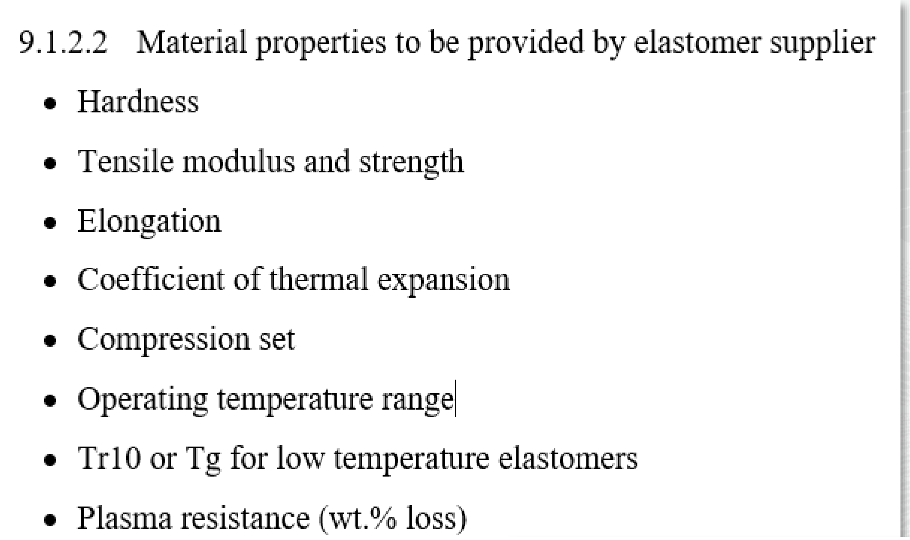
- **Particle Contribution from Slit Valves (Wafer Transfer Valves)**
  - Status: Drafting in Progress



12.2 *Baseline Measurements from Released Valve & Elastomer*

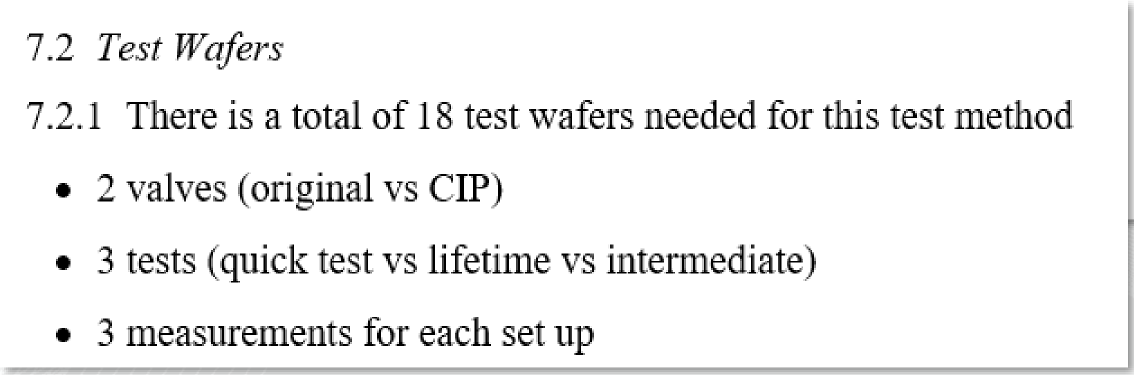
12.2.1 The valve is tested against three different cycle conditions:

- ~2000 cycles to immediately assess CIP elastomer performance
- ~25,000 cycles to account for non-linear behavior of seal under test
- ~50,000 cycles for a lifetime evaluation test



9.1.2.2 Material properties to be provided by elastomer supplier

- Hardness
- Tensile modulus and strength
- Elongation
- Coefficient of thermal expansion
- Compression set
- Operating temperature range
- Tr10 or Tg for low temperature elastomers
- Plasma resistance (wt.% loss)
- Filler material
- He permeation
- Outgassing



7.2 *Test Wafers*

7.2.1 There is a total of 18 test wafers needed for this test method

- 2 valves (original vs CIP)
- 3 tests (quick test vs lifetime vs intermediate)
- 3 measurements for each set up

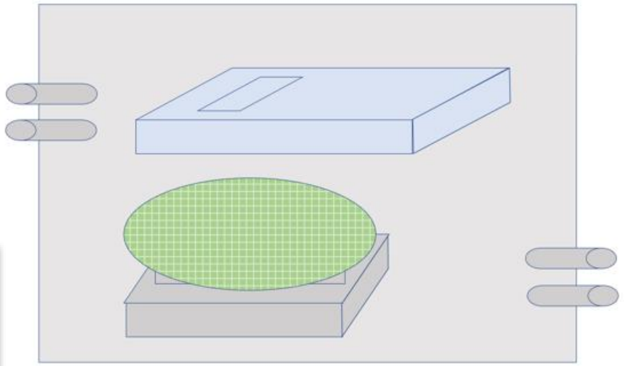
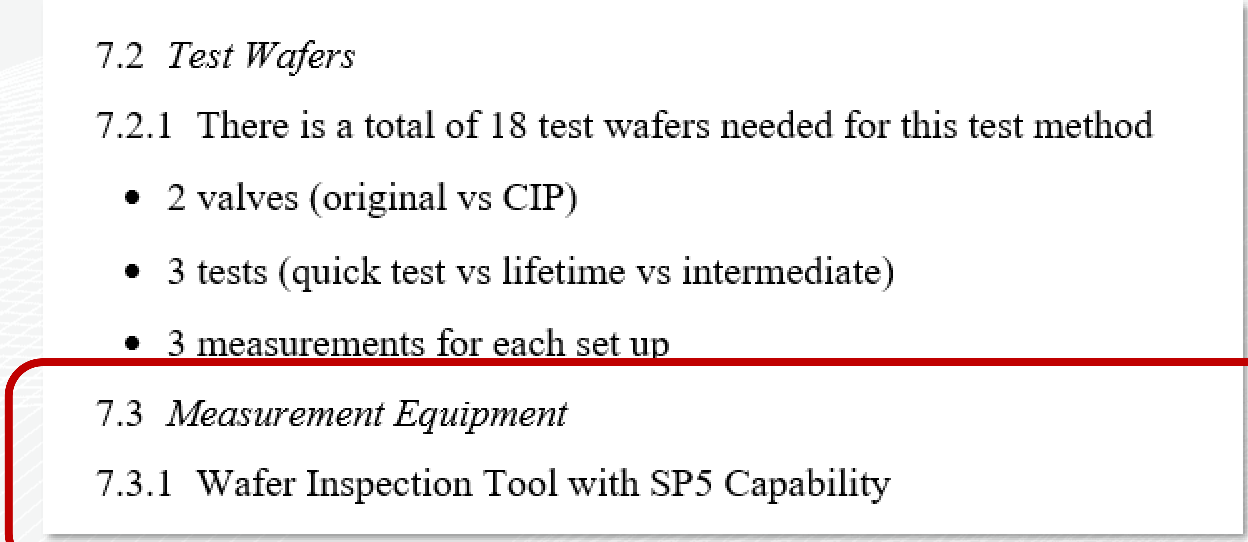


Figure 1
Testing Apparatus for Valve Particle Measurement

SCIS Activities in Development

- **Particle Contribution from Slit Valves (Wafer Transfer Valves)**
  - Status: Drafting in Progress



7.2 *Test Wafers*

7.2.1 There is a total of 18 test wafers needed for this test method

- 2 valves (original vs CIP)
- 3 tests (quick test vs lifetime vs intermediate)
- 3 measurements for each set up

7.3 *Measurement Equipment*

7.3.1 Wafer Inspection Tool with SP5 Capability

Current draft calls for wafer inspection tool with SP5 capability.

There are concerns regarding accessibility of such equipment.

Are there other alternative measurement approaches that still meet current (and emerging) process needs?

Status

- Previous outreach efforts to other valve manufacturers (SMC, V-Tex, GNB Group), unfortunately, did not lead to new participation
- Valves WG is in search for stakeholders willing to drive working particles draft to completion
- In the mean time, the WG continues to solicit feedback on the working draft

New SCIS Activity Proposed for 2023

- Subfab Data Integration
  - It would help Fabs to address a scaling challenge when seeking to contextualize the data. The general intent would be to address known missing FMEA signals (for vacuum health and other key parameters). Therefore, there is a desire for either a new standard or clearer guidelines.

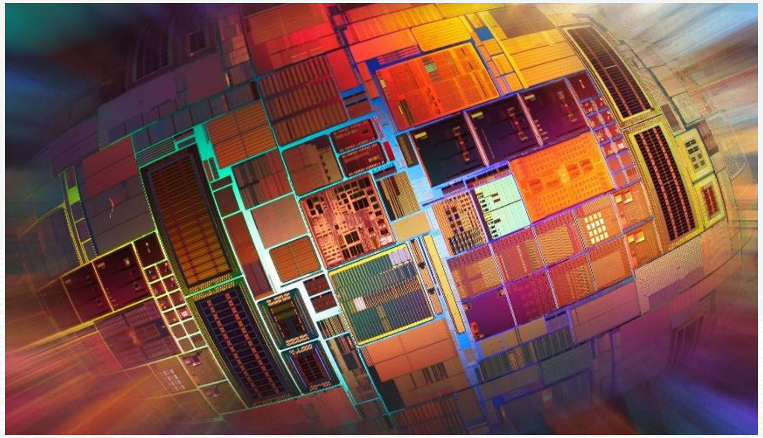
- Suggested Next Steps
  - Sub-fab is a broad topic, encompasses multiple components. There are also environmental/regulatory considerations
  - Before forming any dedicated WGs (e.g., on abatement, on chillers), an SCIS community-wide survey will be issued to specifically identify key subfab areas of concern, pain points, etc.
    - Survey would be issued YE2022 or early 2023

SCIS Meeting Calendar 2023 *(Proposed)*

SCIS F2F Meetings
April 3 10:00 AM to 2:00 PM, Pacific
July 12 @ SEMICON West 2023 12:00 Noon to 2:00 PM, Pacific
Late-Oct, early-Nov 2023 10:00 AM to 2:00 PM, Pacific

- **SEMI Industry Strategy Symposium (ISS)**
  (January 8-11) in Half Moon Bay, CA
- **NA Standards Spring 2023 Meetings**
  (April 3-6) in Milpitas, CA
- **SEMI Advanced Semiconductor Manufacturing Conference (ASMC)**
  (May 1-4) in Saratoga Springs, NY
- **SEMICON West 2023**
  (July 11-13) in San Francisco, CA

Contact Information



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SEMI Standards Published

Published SCIS Standards

SEMI F51

Guide for Elastometric Sealing Technology

November 2015 (1115 Update)

Provided Test Methods on Seal Impurities – TOC, surface extractable metallics, ash metals, outgassing, ionics

September 2017 (0917 Update)

Seal Cleaning, Handling, and Packaging

SEMI E135

Test Method for RF Generators to Determine Transient Response for RF Power Delivery Systems Used in Semiconductor Processing Equipment

September 2018 (0918 Update)

- Define nominal load, high impedance load and low impedance load
- Add new Related Information section covering:
  - ➢ Rationale for the limited number of required test loads
  - ➢ Expected control system gain variation as a function of load impedance on a linear load
  - ➢ Nonlinear (plasma) loads

SEMI Standards Published

Published SCIS Standards

SEMI E180

Test Method for Measuring Surface Metal Contamination Through ICP-MS of Critical Chamber Components Used in Semiconductor Wafer Processing

New Standard

- Provides a method for a quantitative analysis for surface trace-metal concentration of critical chamber components (CCCs) by using inductively coupled plasma-mass spectrometry (ICP-MS)

Published SCIS Standards

SEMI Standards Published

SEMI F70.1 - Test Method for Determination of Particle Contribution of Gas Delivery System

- Provides a standardized methodology and procedure for measuring the particle contribution performance of a gas delivery system in terms of number of particles added to gas flowing through the system.
- Applies to surface mount and conventional gas delivery systems used in semiconductor manufacturing equipment.

SEMI F114 - Test Method for the Determination of Organic Contaminants Present on Wetted Surfaces of Ultra High Purity Chemical Delivery Systems and Components

- Defines a test method for determining organic compounds on the wetted surfaces of ultra high purity (UHP) chemical delivery systems and components.
- Examples of test samples include valves, regulators, filters, and mass flow controllers, tubing, weld fittings, and face seal fittings.

SEMI F115 - Test Method for the Determination of Metallic Elements Present on Wetted Surfaces of Ultra High Purity Chemical Delivery Systems and Components

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

SCIS Activities in Development

- **Seal Leak Rate**
  - Rationale: Seal failure can generate defects through atmospheric leaks into process environments or from degraded seal material. There is a need to develop a standardized way for measuring a seal’s ability to hold vacuum when exposed to elevated temperatures and/or process and clean chemistries.

- **Particle Contribution from Slit Valves (Wafer Transfer Valves)**
  - Rationale: There is interest in minimizing particles generated by either elastomer or valve assembly
    - Traditionally, at qualification the particle contribution of valves & original elastomer are considered
    - Usually, the next step is the introduction of CIP elastomer
    - If CIP elastomer proves superior (i.e., less particle shed) than original elastomer, then focus can shift to optimizing valve operation parameters (if performance improvement of elastomer is deemed insufficient)
    - And/or if CIP elastomer still fails to meet performance criteria, then focus shifts to changing valve design, valve operation

- **Pump Data for Predictive Pump Failure Detection**
  - Rationale: Critical pump data can be utilized for predictive pump failure detection. Some of this data can be obtained today while others are not yet widely available.

- **Organic Contamination from Critical Components in Relevant Solvents**
  - Rationale: Evidence from end-users has linked organic contamination to wafer quality. To date, no standards exist for determining relative organic levels from critical components — most preferably on a bulk and specific basis.

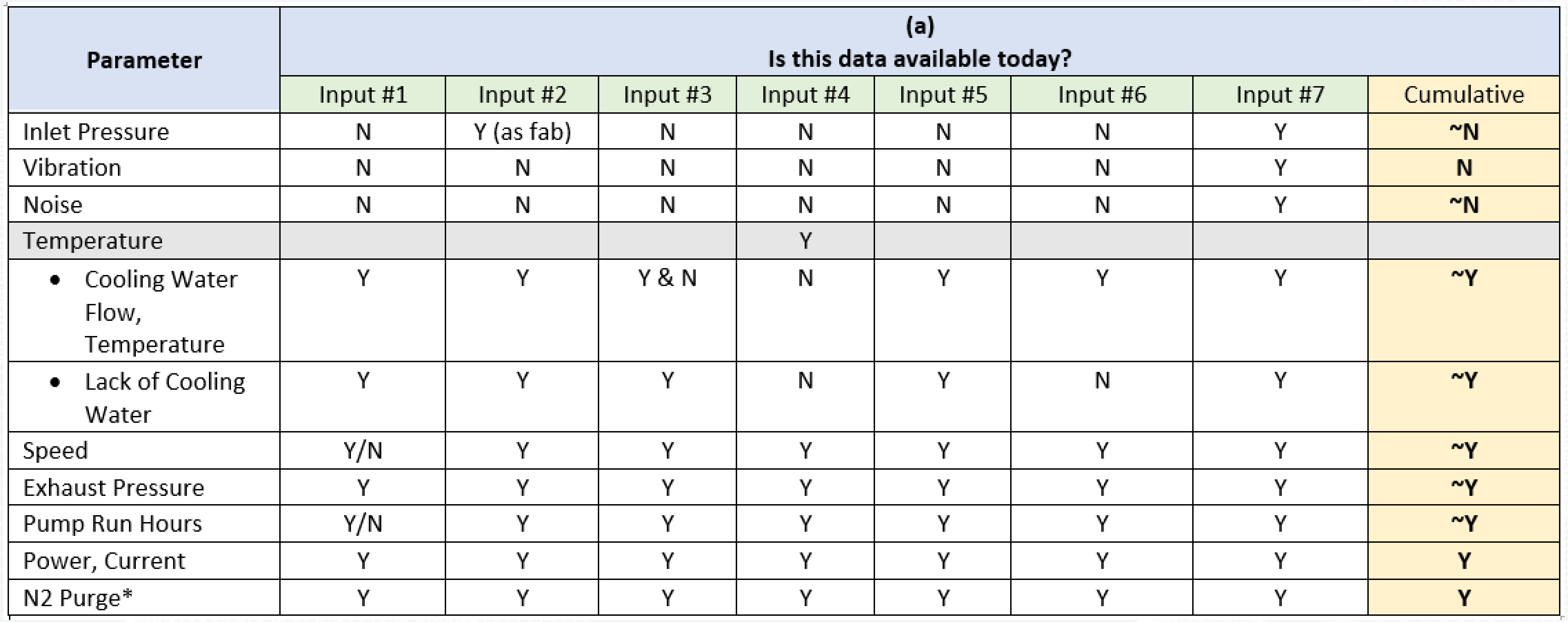
- **RF Generator Reliability** – SCIS is revisiting topic and plans to identify key contributing issues

SCIS Activities in Development

- **Parts Cleaning**
  - Rationale: Defectivity can be introduced by various sources during parts cleaning process. There is a need for guidance on available test methodologies and other considerations that impact part cleanliness.
    - Activities on organics, particles as well as development of an over-arching guide for achieving and maintaining chamber component defectivity performance

Dry Pumps
Survey Results [1/2]

- Compiled (a)

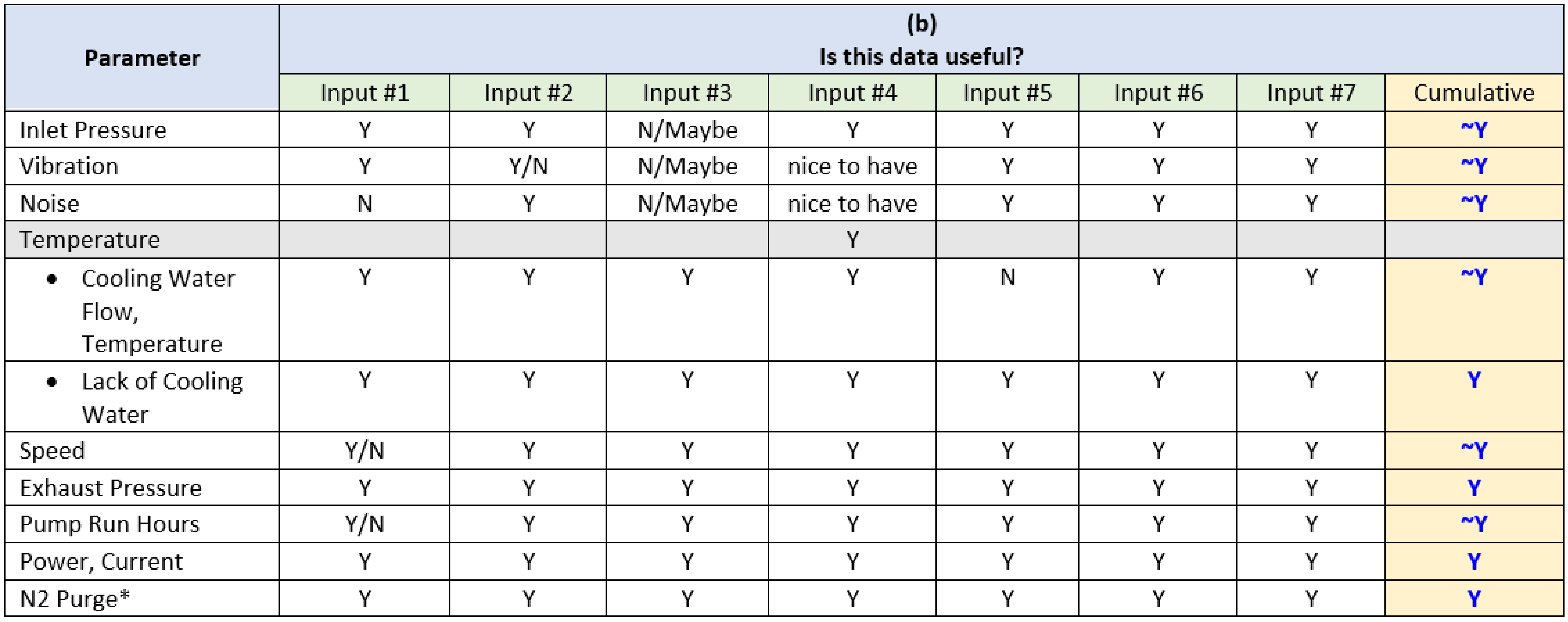


Parameter	**(a) Is this data available today?**							
	Input #1	Input #2	Input #3	Input #4	Input #5	Input #6	Input #7	Cumulative
Inlet Pressure	N	Y (as fab)	N	N	N	N	Y	**~N**
Vibration	N	N	N	N	N	N	Y	**N**
Noise	N	N	N	N	N	N	Y	**~N**
Temperature				Y				
• Cooling Water Flow, Temperature	Y	Y	Y & N	N	Y	Y	Y	**~Y**
• Lack of Cooling Water	Y	Y	Y	N	Y	N	Y	**~Y**
Speed	Y/N	Y	Y	Y	Y	Y	Y	**~Y**
Exhaust Pressure	Y	Y	Y	Y	Y	Y	Y	**~Y**
Pump Run Hours	Y/N	Y	Y	Y	Y	Y	Y	**~Y**
Power, Current	Y	Y	Y	Y	Y	Y	Y	**Y**
N2 Purge*	Y	Y	Y	Y	Y	Y	Y	**Y**

Dry Pumps

Survey Results [2/2]

- Compiled (b)



Parameter	(b) Is this data useful?							
	Input #1	Input #2	Input #3	Input #4	Input #5	Input #6	Input #7	Cumulative
Inlet Pressure	Y	Y	N/Maybe	Y	Y	Y	Y	**~Y**
Vibration	Y	Y/N	N/Maybe	nice to have	Y	Y	Y	**~Y**
Noise	N	Y	N/Maybe	nice to have	Y	Y	Y	**~Y**
Temperature				Y				
• Cooling Water Flow, Temperature	Y	Y	Y	Y	N	Y	Y	**~Y**
• Lack of Cooling Water	Y	Y	Y	Y	Y	Y	Y	**Y**
Speed	Y/N	Y	Y	Y	Y	Y	Y	**~Y**
Exhaust Pressure	Y	Y	Y	Y	Y	Y	Y	**Y**
Pump Run Hours	Y/N	Y	Y	Y	Y	Y	Y	**~Y**
Power, Current	Y	Y	Y	Y	Y	Y	Y	**Y**
N2 Purge*	Y	Y	Y	Y	Y	Y	Y	**Y**

Equipment & Materials Traceability Task Force

Activities & Status [1/5]

- **New Standard: Specification for Equipment and Materials Labels (SEMI Draft Document # 6448)**
  - To define material Bar Code Label (BCL) standard for all incoming direct materials, parts, and consumables for semiconductor manufacturing.
  - Addresses traceability requirements along the incoming material and parts supply chain to enable effective isolation of defects in the manufacturing process or post manufacturing quality investigation
  - For suppliers and Original Equipment Manufacturers (OEMs) of direct materials, parts, consumables, repaired parts, clean parts and refurbish parts that have a Certificate of Analysis (COA) or Certificate of Conformance (CoC)
  - Specifies data that is included in Equipment and Material Labels for both machine readable 2D barcode and human readable format in accordance with VDA 4992 - MAT Label and eMat data exchange

Part.No.: **9800131640** Index: A
Quantity: **1** MS-Level: 1
Ordering Code: AV452127CFNR2
Add.Info:
Part Name: Anvil (2000 KG)
Package-ID: 3SUN830417592000123456789
1. Batch: 457000000000000A
2. Batch:
Prod. Date: 20200424
Expiry Date: 20990218
Supplier-ID: 83-041-7592
Order Number: ABCXYZ
Man. Part-No: SL105103MAA-S
Man. Location: US-Anaheim
Supplier-Data:
Supplier: NumberOne Corporation
Delivery Note:

Figure 1
Example MAT Label (Large Format – 45mm x 78mm)

Part No.: **9800131640**
Quantity: 1 Index: A
1. Batch: 457000000000000A
2. Batch:
Expiry Date: 20990218
Supplier-ID: 83-041-7592
Package-ID: 3SUN830417592000123456789

Figure 2
Example MAT Label (Small Format – 20mm x 50mm)

Equipment & Materials Traceability Task Force
Activities & Status [2/5]

- **New Standard: Specification for Equipment and Materials Labels (SEMI Draft Document # 6448)**

Label Information

- Label Version
- Label Revision (of VDA's spec)

Part Information

- Customer Part Number
- Manufacturer Part Number
- Ordering Code
- Part Description (Part Name)
- Manufacturer ID
- Manufacturer Location
- Revision Level / Index
- Additional Part Information

More Part Information

- Date of Manufacturing
- Expiration Date
- RoHS
- Moisture Sensitivity Level

Logistic and Traceability Information

- Supplier Name
- Supplier ID (or DUNS number)
- Package ID
- Quantity
- Unit of Measure
- Batch-No (e.g., volume, production)
- Batch-No (for clean or repair)
- Order Number
- Delivery Note Number
- Supplier Data

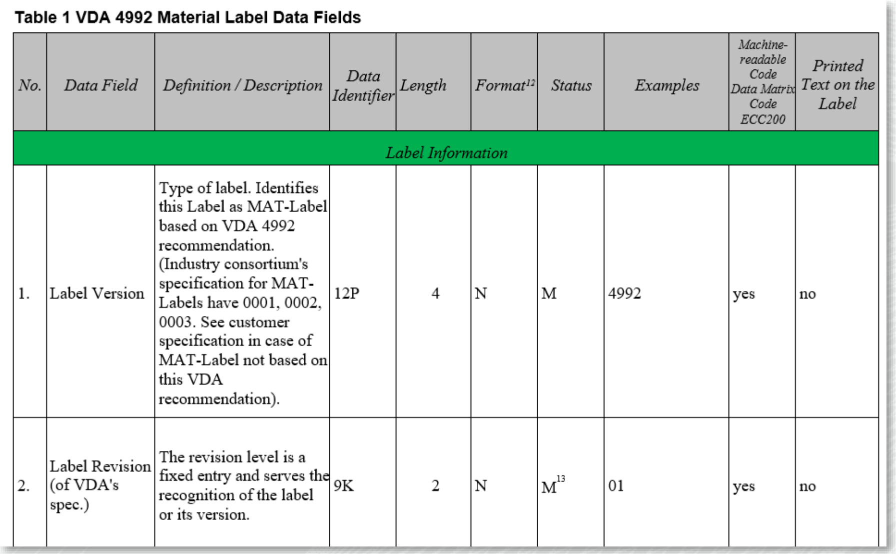


Table 1 VDA 4992 Material Label Data Fields

No.	*Data Field*	*Definition / Description*	*Data Identifier*	*Length*	*Format*^{12}	*Status*	*Examples*	*Machine-readable Code Data Matrix Code ECC200*	*Printed Text on the Label*
Label Information									
1.	Label Version	Type of label. Identifies this Label as MAT-Label based on VDA 4992 recommendation. (Industry consortium's specification for MAT-Labels have 0001, 0002, 0003. See customer specification in case of MAT-Label not based on this VDA recommendation).	12P	4	N	M	4992	yes	no
2.	Label Revision (of VDA's spec.)	The revision level is a fixed entry and serves the recognition of the label or its version.	9K	2	N	M^{13}	01	yes	no

Equipment & Materials Traceability Task Force

Activities & Status [3/5]

- **New Standard: Specification for Equipment and Materials Labels (SEMI Draft Document # 6448)**
  - Material Label Use Case Scenarios (as part of Related Information Section)

Cleaned Part

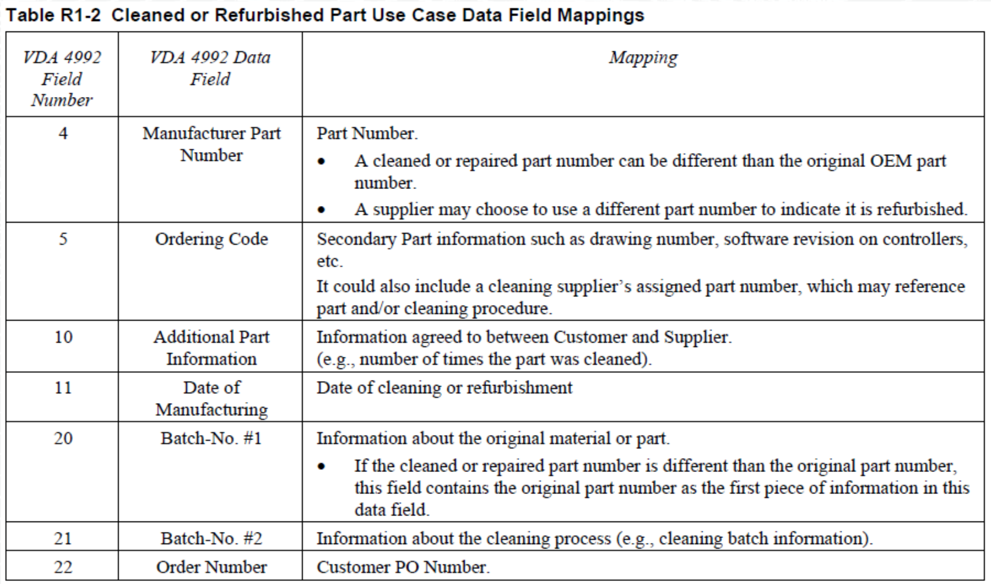


Table R1-2 Cleaned or Refurbished Part Use Case Data Field Mappings

VDA 4992 Field Number	*VDA 4992 Data Field*	*Mapping*
4	Manufacturer Part Number	Part Number. • A cleaned or repaired part number can be different than the original OEM part number. • A supplier may choose to use a different part number to indicate it is refurbished.
5	Ordering Code	Secondary Part information such as drawing number, software revision on controllers, etc. It could also include a cleaning supplier's assigned part number, which may reference part and/or cleaning procedure.
10	Additional Part Information	Information agreed to between Customer and Supplier. (e.g., number of times the part was cleaned).
11	Date of Manufacturing	Date of cleaning or refurbishment
20	Batch-No. #1	Information about the original material or part. • If the cleaned or repaired part number is different than the original part number, this field contains the original part number as the first piece of information in this data field.
21	Batch-No. #2	Information about the cleaning process (e.g., cleaning batch information).
22	Order Number	Customer PO Number.

New Part

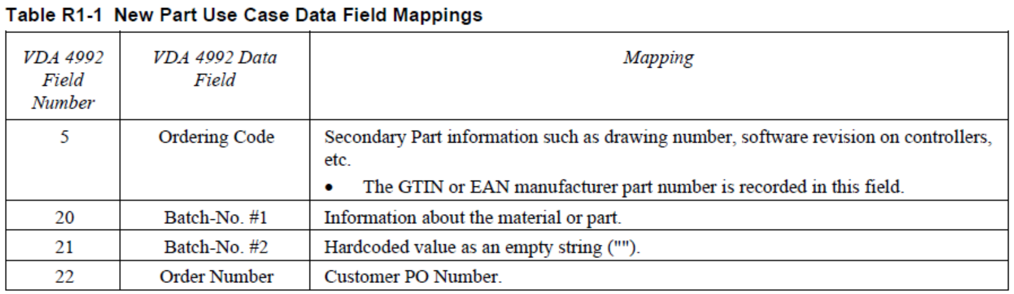


Table R1-1 New Part Use Case Data Field Mappings

VDA 4992 Field Number	*VDA 4992 Data Field*	*Mapping*
5	Ordering Code	Secondary Part information such as drawing number, software revision on controllers, etc. • The GTIN or EAN manufacturer part number is recorded in this field.
20	Batch-No. #1	Information about the material or part.
21	Batch-No. #2	Hardcoded value as an empty string ("").
22	Order Number	Customer PO Number.

Consumable Material

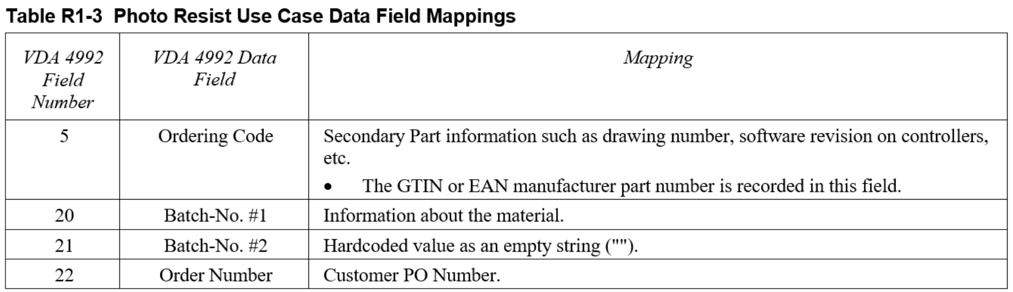
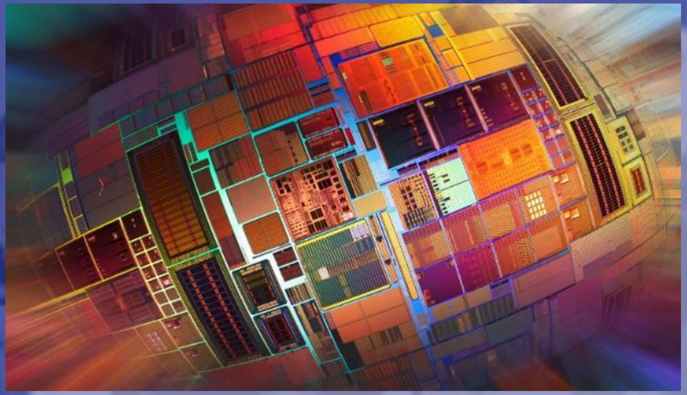


Table R1-3 Photo Resist Use Case Data Field Mappings

VDA 4992 Field Number	*VDA 4992 Data Field*	*Mapping*
5	Ordering Code	Secondary Part information such as drawing number, software revision on controllers, etc. • The GTIN or EAN manufacturer part number is recorded in this field.
20	Batch-No. #1	Information about the material.
21	Batch-No. #2	Hardcoded value as an empty string ("").
22	Order Number	Customer PO Number.

Contact Information



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