SUBSTRATE & SAMPLE CHAIN OF CUSTODY (CoC), LOGGING & INVENTORY TRACKING SOP

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Target Facility: Central Thin-Film & Vacuum Laboratory	**Compliance:** EPA QAPP / ISO 9001:2015 / ALCOA+	**Retention:** 10 Years (CMMS & Hardcopy)

1. PURPOSE & APPLICABILITY

This Standard Operating Procedure (SOP) defines mandatory protocols for logging, identifying, handling, tracking, and maintaining strict Chain of Custody (CoC) for all raw substrates, witness plates, and processed thin-film samples entering the Vacuum Laboratory. Compliance guarantees ALCOA+ data defensibility, eliminates sample cross-contamination, and ensures complete traceability from raw material intake through vacuum deposition, characterization, and archive storage.

2. SAFETY, HANDLING & ENVIRONMENT CONTROLS

• **Mandatory Cleanroom Attire:** Handling occurs exclusively inside ISO Class 6 laminar flow hoods using 6 mil powder-free nitrile gloves.
• **Non-Contact Tools:** Substrates must be handled using specialized Teflon-coated or vacuum-wand tweezers applied strictly at outer edges (≤1.0 mm rim). Direct glove-to-face contact is prohibited.
• **Desiccator & Storage Environment:** Raw and processed substrates must be stored in N■-purged vacuum desiccators (<10% Relative Humidity, 20°C ± 2°C) to prevent surface oxidation, hydrocarbon absorption, and moisture uptake.

3. SAMPLE IDENTIFICATION & ALPHANUMERIC SCHEME

Every incoming substrate unit or wafer batch must be assigned a unique alphanumeric Code ID upon intake. Diamond-scribing (rear non-active side) or laser etching is performed according to the standardized format:

Format Segment	Syntax Example	Definition & Operational Scope
Material Prefix	SIL / QTZ / SAP	Silicon (100/111), Quartz, Sapphire, Alumina, FCM, or RT/Duroid laminate
Intake Date Code	YYYYMMDD (20211128)	Universal ISO date code corresponding to physical lab receipt
Batch Sequence	B01 to B99	Sequential batch identifier for identical raw material shipment
Substrate Unit No.	#01 to #24	Individual wafer/substrate positioning within the batch carrier box

4. STEP-BY-STEP CHAIN OF CUSTODY & WORKFLOW PROCEDURE

Phase 1: Substrate Intake & Verification: Upon receipt, verify shipping integrity, inspect packaging seals, and log material certificate specs (crystallographic orientation, resistivity, thickness, surface roughness Ra < 0.5 nm) into CMMS.
Phase 2: Initial Mass & Dimensions Baseline: Record initial substrate mass using a calibrated analytical balance (±0.1 mg precision) and measure thickness across 5 points using a digital micrometer. Log values on CoC Form FM-COC-2021.
Phase 3: Pre-Deposition Cleaning Certification: Execute SOP-VAC-2021-10 (Acetone/IPA ultrasonic cleaning). Verify Water Break Free status and record cleanroom storage location (Desiccator Cabinet #, Shelf ID).
Phase 4: Vacuum Chamber Deposition Logging: Sign out sample on CoC form. Log chamber run parameters (Chamber Run ID, Target Material, Base Pressure <5x10■■ Torr, QCM rate/thickness readings, Substrate Temperature). Attach CoC Form to Chamber Run Sheet.
Phase 5: Post-Deposition Characterization & Transfer: Re-weigh post-deposition film sample, perform 10x optical microscope inspection for pinholes/peeling, and update CMMS inventory status ('In-Process' → 'Processed/Stored').
Phase 6: Archive, Transfer & Final Disposition: Package sample in anti-static gel-box or vacuum-sealed foil bag. Obtain physical sign-off signatures for external laboratory transfer or store in permanent sample archive Cabinet B-04.

5. DOCUMENTATION & CMMS INTEGRATION REQUIREMENTS

• **Hardcopy CoC Form:** Physical CoC Form FM-COC-2021 must accompany the substrate/sample container at every stage. Never leave un-tracked samples inside vacuum load-locks or cleanroom tables.
• **CMMS Synchronization:** All physical CoC logs must be uploaded to the CMMS database within 24 hours. Scanned CoC forms must be PDF/A format at 300 DPI resolution.
• **Discrepancy Protocols:** Any missing sample, damaged substrate, or broken CoC signature chain triggers an immediate Hold Order. Kadeem Manning (Tier II Tech) and Genevieve Lariviere (QA Manager) must be notified immediately.

6. CHAIN OF CUSTODY CONTROL MATRIX

Process Stage	Action Required	Target Spec / Acceptance Limit	Responsible Role
Intake & Inspection	Verify PO, certs, package seal	Zero shipping damage; certs match specs	Tier II Tech (Kadeem Manning)
Baseline Logging	Mass (0.1 mg) & 5-pt thickness	5-pt thickness variation < 2.0%	Tier II Tech (Kadeem Manning)
Solvent Cleaning	SOP-VAC-2021-10 execution	Water Break Free test > 30 seconds	Tier II Tech (Kadeem Manning)
Chamber Loading	Log CoC ID on Run Sheet	Base pressure < 5x10■■ Torr	Vacuum Operator / Tech
Post-Run Audit	Film mass, 10x optics inspection	Zero pinholes, zero film delamination	Tier II Tech / QA Specialist
Archive / Transfer	Gel-box seal, CoC signature sign-out	Complete dual-signature CoC transfer	QA Manager (Genevieve Lariviere)

7. AUTHORIZATION & QUALITY SIGN-OFF

Prepared By:	Kadeem Manning Tier II Vacuum Lab Specialist	**Signature:** *Kadeem Manning*	**Date:** Nov 28, 2021
Reviewed By:	Mark Tigges Field Operations Manager	**Signature:** *Mark Tigges*	**Date:** Nov 29, 2021
Approved By:	Genevieve Lariviere QA Program Manager	**Signature:** *Genevieve Lariviere*	**Date:** Nov 30, 2021