

NEXA NANO-FABRICATION FACILITY

EQUIPMENT CALIBRATION & VERIFICATION SHEET

Bay 3 – Thin Film Photolithography Zone | Metrology Core B

✓ CALIBRATION PASSED

Status: APPROVED FOR USE

Valid: 24-Jul-2026 to 24-Jan-2027

SECTION 1: EQUIPMENT IDENTIFICATION & SPECIFICATIONS

Equipment Name:	OptiSpec 5000 Laser Ellipsometer	Asset Control ID:	NFX-EQ-ELL-094
Manufacturer:	Meridian Precision Instruments Inc.	Serial Number:	MPI-2023-8849-X
Model Number:	OS-5000-DUV-HighRes	Cleanroom Location:	Bay 3 / Workstation B-02
Measurement Range:	0.5 nm – 5,000.0 nm	Cleanroom Class:	ISO 5 (Class 100 Standard)
Laser Wavelengths:	632.8 nm (HeNe), 355.0 nm (UV)	Calibration Cycle:	6 Months (Semi-Annual)
Primary Contact:	Dr. Aris Thorne (Metrology Lead)	Department:	Microfabrication Systems

SECTION 2: ENVIRONMENTAL MONITORING DURING CALIBRATION

Ambient Temperature:	20.1 °C (±0.3 °C limit)	Relative Humidity:	42.5% RH (±3.0% limit)
Laminar Airflow:	0.45 m/s (HEPA Filtration)	Particle Count (0.5 µm):	280 particles/m ³ (Pass ISO 5)
Vibration Control:	Active Isolation Table ON	Barometric Pressure:	1013.2 mbar (Nominal)

SECTION 3: TRACEABLE CALIBRATION REFERENCE STANDARDS

Standard ID	Description	Nominal Value / Spec	NIST / ISO Cert #	Cal Date	DueDate
NFX-STD-SiO2-10	Thermal SiO ₂ Standard Wafer	14.8 nm ± 0.15 nm	NIST-98421-B	10-Jan-2026	10-Jan-2027
NFX-STD-SiO2-100	Thermal SiO ₂ Standard Wafer	101.4 nm ± 0.20 nm	NIST-98422-B	10-Jan-2026	10-Jan-2027
NFX-STD-SiO2-1000	Thermal SiO ₂ Standard Wafer	1002.5 nm ± 0.50 nm	NIST-98425-C	15-Feb-2026	15-Feb-2027
NFX-STD-SI-RI	Single Crystal Si Standard	$n = 3.8650 @ 632.8 \text{ nm}$	ISO-17025-882	04-Mar-2026	04-Mar-2027

SECTION 4: MULTI-POINT MEASUREMENT RESULTS (AS-FOUND VS. AS-LEFT)

Parameter Test	Reference	As-Found	As-Left	Tolerance	Status
Ultra-Thin SiO ₂ Film Thickness	14.80 nm	15.02 nm	14.83 nm	± 0.15 nm	✓ PASS
Medium SiO ₂ Oxide Film Thickness	101.40 nm	101.95 nm	101.44 nm	± 0.30 nm	✓ PASS
Thick SiO ₂ Oxide Film Thickness	1002.50 nm	1004.10 nm	1002.72 nm	± 1.00 nm	✓ PASS
Refractive Index (n) @ 632.8nm	1.4570	1.4592	1.4572	± 0.0010	✓ PASS
Incident Angle Calibration (θ)	70.000°	70.045°	70.002°	± 0.010°	✓ PASS
Polarizer Zero Angle Alignment	0.000°	0.018°	0.001°	± 0.005°	✓ PASS
Laser Power Stability (632.8nm Output)	5.00 mW	4.88 mW	4.98 mW	± 0.10 mW	✓ PASS
Sample Stage Repeatability (X/Y Axis)	0.000 µm	0.420 µm	0.080 µm	± 0.250 µm	✓ PASS

NEXA MICROFABRICATION METROLOGY CORE

EQUIPMENT CALIBRATION RECORD | CONTINUATION SHEET

Equipment ID: NFX-EQ-ELL-094

Cal Date: 24-Jul-2026

SECTION 5: 200mm WAFER UNIFORMITY MAP & UNCERTAINTY BUDGET

9-Point Uniformity Test (100 nm Nominal Wafer)

Pt #	Position (X, Y mm)	Thickness	Dev.
1	Center (0, 0)	101.42 nm	+0.02 nm
2	Top (0, 80)	101.55 nm	+0.15 nm
3	Bottom (0, -80)	101.38 nm	-0.02 nm
4	Left (-80, 0)	101.45 nm	+0.05 nm
5	Right (80, 0)	101.48 nm	+0.08 nm
6	Top-Left (-56, 56)	101.51 nm	+0.11 nm
7	Top-Right (56, 56)	101.53 nm	+0.13 nm
8	Bottom-Left (-56, -56)	101.35 nm	-0.05 nm
9	Bottom-Right (56, -56)	101.39 nm	-0.01 nm

Statistical Summary:

Mean Thickness ($\bar{x}$): **101.45 nm** | Std Deviation (σ): **0.068 nm**
Max Non-Uniformity [$\frac{\text{Max}-\text{Min}}{2\bar{x}}$]: **0.098%** (Limit: < 0.25%)

Measurement Uncertainty Budget

Uncertainty Source	Std Unc.	Type
Calibration Standard Unc.	0.075 nm	Type A
Detector Non-linearity	0.032 nm	Type B
Wavelength Drift (HeNe)	0.015 nm	Type B
Temperature Variation	0.020 nm	Type B
Repeatability (10 runs)	0.028 nm	Type A
Combined Std Unc. (u_c)	0.089 nm	—
Coverage Factor (k)	2.00	—
Expanded Unc. (U)	± 0.178 nm	95% CI

Compliance Statement:

The calculated expanded measurement uncertainty ($U = 0.178 \text{ nm}$) is well within the facility allowable tolerance limit of $\pm 0.300 \text{ nm}$. Test Accuracy Ratio (TAR) exceeds 4:1.

SECTION 6: MAINTENANCE, ADJUSTMENTS & ACTION ITEMS

- Optical Clean:** Cleaned HeNe 632.8 nm beam expander lenses and analyzer Rochon prism using cleanroom grade isopropyl alcohol (IPA 99.9%) and optical wipes.
- Laser Alignment:** Adjusted incident angle goniometer zero position offset by -0.043° to restore absolute mechanical alignment with sample stage.
- Detector Calibration:** Recalibrated photomultiplier tube (PMT) gain curve and dark current baseline noise offset.
- Software & Firmware Update:** System control firmware upgraded to v4.8.2. Baseline calibration matrix updated in system memory.

SECTION 7: QUALITY ASSURANCE AUTHORIZATION & SIGN-OFF

Calibrated By (Technician):

Julian Vance, Senior Metrology Tech

Approved By (QA Manager):

Dr. Elena Rostova, QA Director

Signature: J. Vance

Signature: E. Rostova

Date: 24-Jul-2026

Date: 24-Jul-2026

This calibration certificate is issued in compliance with ISO/IEC 17025:2017 general requirements for laboratory competence. Results relate only to the item calibrated specified herein.

Calibration Label Replica

NEXA CLEANROOM CALIBRATION

Asset ID: NFX-EQ-ELL-094
Cal Date: 24-JUL-2026 By: J.V.
Next Due: 24-JAN-2027 Status: **PASS**

DO NOT REMOVE OR TAMPER