Primary Standards Laboratory
Dimensional Standards Project

Fact Sheet

The Primary Standards Laboratory (PSL) maintains a wide variety of primary dimensional standards to assure accurate and traceable measurements for its customers. Sub-micrometer capabilities include gage blocks, roundness, thread wires, gaging balls, surface roughness, step gages, line standards, and three-dimensional measurements (see below). All primary dimensional standards are directly traceable to the Systeme International through the National Institute of Standards and Technology (NIST), other National Metrology Institutes, or to the wavelength of light. Most of the measurements listed here are accredited by the National Voluntary Laboratory Accreditation Program (NVLAP) administered by NIST.

3D artifact measurements are performed using a Leitz PMM-C-Infinity Coordinate Measuring Machine (CMM) with QUINDOS software. The CMM can measure in a 1.2m × 1.0m × 0.6m volume with a resolution of 0.004 µm.

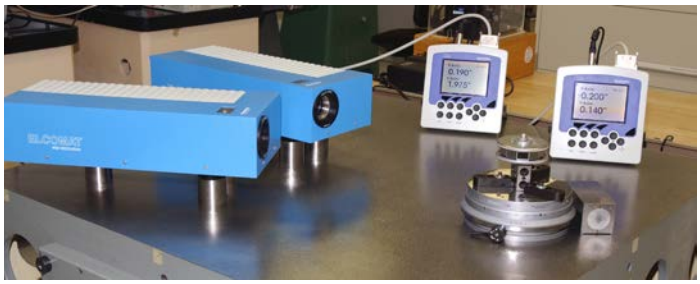
Customer short gage blocks (up to 4” or 100 mm) are measured by comparison to reference blocks using a redundant drift-eliminating design. The PSL measures its reference blocks against the wavelength of light on a Brown & Sharpe automated 2-color laser-based gage block interferometer. Customer long gage blocks are measured by comparison to reference blocks calibrated by NIST.

Silicon Artifact

Gage blocks, angle blocks, thread wires, gaging balls, index tables, optical polygons and squares, true squares, step gages, plain ring gages, optical flats, roundness, and surface roughness reference standards can be certified.

Dimensional Capabilities

Below is a representative sample of PSL uncertainties. The PSL is accredited by NVLAP under Lab Code 105002-0 by the National Institute of Standards and Technology/National Voluntary Laboratory Accreditation Program (NIST/NVLAP). For full details, see http://ts.nist.gov/standards/scopes/1050020.pdf



Calibration of an Optical Polygon

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MEASURED PARAMETER OR DEVICE CALIBRATED	RANGE	UNCERTAINTY (k=2)	REMARKS
ANGULAR (20/D01)			
Angle Blocks		0.50”	Standard Sizes, 1” to 45°
Optical Squares		0.46”	
True Squares		0.10”	
Angular/Rotary Index Tables and	30° increments	0.06”	Stack method
Optical Polygons	30° increments	0.50”	Comparison method
GAGE BLOCKS (20/D03)			
Gage Blocks	0 mm to 100 mm	35 nm + 0.19L nm	Interferometry, Single wring
	0 in to 4 in	1.4 µin + 0.19L µin	
	< 1 mm	41 nm	Mechanical Comparison
	< 0.04 in	1.6 µin	
	1 mm to 100 mm	37 nm + 0.32L nm	
	0.04 in to 4 in	1.5 µin + 0.32L µin	
	125 mm to 500 mm	0.13µm + 0.36L nm	
	5 in to 20 in	5.0 µin + 0.36L µin	
MEASURING WIRES (20/D07)			
All Standard Thread		0.19 µm	Comparison to NIST-calibrated Masters
Measuring Wires	29° and 60°	7.3 µin	
OPTICAL REFERENCE PLANES (20/D08)			
Optical Reference Planes, Diameter		30 nm	Comparison to NIST-calibrated Masters, 30 nm
	0 in to 10 in	1.2 µin	
ROUNDNESS (20/D09)			
Roundness	0 in to 100 mm	5.4 nm + 5.1 %	Spindle error deconvolution at limited points.
	0 in to 4 in	0.2 µin + 5.1 %	
	0 in to 350 mm	11 nm + 6.8 %	Spindle-compensated trace.
	0 in to 14 in	0.42 µin + 6.8 %	
SPHERICAL DIAMETER; PLUG/RING GAGES (20/D11)			
Gaging Balls Calibration Spheres	1 mm to 25 mm	0.16 µm	Comparison to NIST-calibrated Masters
	0.03125 in to 1 in	6.3 µin	
Plain plug/ring gages	0 in to 250 mm	94 nm + 1.1L nm	
	0 in to 10 in	3.7 µin + 1.1L µin	
Plain ring gages	0 in to 250 mm	0.20 µm + 0.90L nm	
	0 in to 10 in	8.0 µin + 0.90L µin	
SURFACE TEXTURE (20/D12)			
Step Height Standards	0 µm to 50 µm	1 nm ± 1.0 % of value	Coherence Scanning Interferometry
		0.33 µin + 0.87 %	
Roughness Average (Ra)	0 µin to 7 µin	0.92 µin + 0.74 %	Stylus comparison with certified masters
	8 µin to 32 µin	3.5 µin + 0.61 %	
	33 µin to 150 µin		
COORDINATE MEASURING MACHINES (20/D16)			
Dimensional Gages	0 m to 1 m	0.2 µm + 0.76L µm	1 D
	0 m to 1.4 m	0.34 µm + 1.2L µm	2 D

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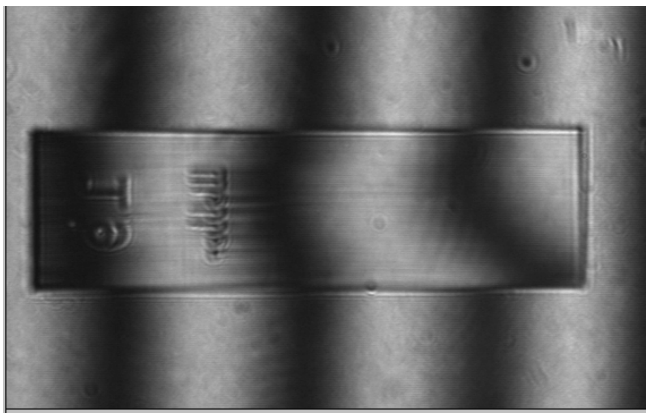

Fringes Observed by Gage Block Interferometry

Major Resources

- State-of-the-art laboratory environmental controls (as good as ± 0.01°C stability and ±5% RH)
- Leitz PMM-C-Infinity 12-10-6 Coordinate Measuring Machine with low-force probing
- Talyrond 73HPR high-precision roundness measuring system
- Brown & Sharpe automated 2-color laser gage-block interferometer
- Elcomat HR autocollimators
- Federal 4" and 24" gage block comparators
- Laser-augmented SIP MI-6B micro-indicator
- Talysurf 6 automated surface roughness measuring system
- Taylor-Hobson CCI white light interferometer

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