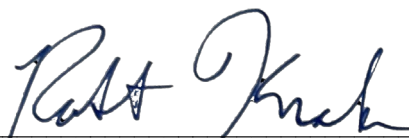


SCOPE OF ACCREDITATION TO ISO/IEC 17025:2017

<p>Mahr Inc. 1139 Eddy Street Providence, RI 02905 Mr. Anthony Clang Phone: 401-784-3214 Fax: 401-784-3238 E-mail: anthony.clang@mahr.com URL: http://www.mahr.com</p>	<p>Fields of Calibration Dimensional</p> <p>This laboratory is compliant to ANSI/NCSL Z540-1-1994; Part 1. (20/A01)</p>
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CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) ^{Notes 1,2}			
Measured Parameter or Device Calibrated	Range	Expanded Uncertainty ^{Note 3}	Remarks
DIMENSIONAL			
ANGULAR (20/D01)			
Electronic Level System Angle Measure	≤ 1000"	0.40"	Sine Plate with Gage Blocks
Protractors and Digital Angle Gage	≤ 90°	75"	Angle Blocks
GAGE BLOCKS (20/D03)			
Steel & Ceramic (See Note 8 for other materials)	0.05 in 0.100 in to 0.19 in 0.200 in to 0.950 in 1 in to 2 in 3 in 4 in	2.5 μin 2.5 μin 2.5 μin 3.0 μin 3.5 μin 4.5 μin	Gage Blocks and 130B Comparator
	1 mm 2.5 mm to 4.5 mm 5 mm to 24.5 mm 25 mm to 50 mm 75 mm 100 mm	62 nm 63 nm 65 nm 73 nm 88 nm 0.11 μm	
Long Gage Blocks	5 in to 20 in 125 mm to 500 mm	5.0 μin + 1.3 μin/in 0.13 μm + 0.0013 μm/mm	Gage Blocks and 130B Comparator

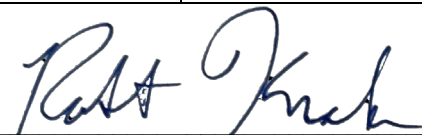
2026-02-24 through 2027-03-31
Effective dates


For the National Voluntary Laboratory Accreditation Program

CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) ^{Notes 1,2}			
Measured Parameter or Device Calibrated	Range	Expanded Uncertainty ^{Note 3}	Remarks
LENGTH and DIAMETER; STEP GAGES (20/D05)			
Dial and Digital Indicators	≤ 0.500 in (6.35 mm) > 0.500 in (6.35 mm) to 4.00 in (101.6 mm)	14 μin (0.4 μm) 31 μin (0.8 μm)	Indicator Calibrators
High Resolution Indicators	± 0.100 in (± 2.54 mm) ± 0.010 in (± 254 μm) ± 0.001 in (± 25.4 μm) ≤ 1.000 in (≤ 25.4 mm)	9 μin (0.22 μm) 7 μin (0.17 μm) 4 μin (0.10 μm) 5.6 μin (0.14 μm)	Microcalibrator Laser Interferometer
Marshaft Machines (Diameter and Length) MarShaft Scope Manual w/MC Field calibrations available ^{Note 4,7}	Length (< 2400 mm) Diameter (< 120 mm)	6 μm + 1.1L / 100 μm 2.2 μm + L / 100 μm	(L=mm) Helios Shaft Standard
MarShaft Scope Manual w/UNI Field calibrations available ^{Note 4,7}	Length (< 2400 mm) Diameter (< 220 mm)	9 μm + 1.2L / 100 μm 2 μm + L / 100 μm	(L=mm) Helios Shaft Standard
MarShaft Scope / Helios Scope Field calibrations available ^{Note 4,7}	Length (1000 mm) Diameter (< 80 mm)	5 μm + 1.2L / 100 μm 3 μm + L / 100 μm	(L=mm) Helios Shaft Standard
MarShaft Scope 250+ Field calibrations available ^{Note 4,7}	Length (< 250 mm) Diameter (< 40 mm)	4.3 μm + L / 100 μm 2.5 μm + L / 40 μm	(L=mm) Helios Shaft Standard
MarShaft Scope plus Field calibrations available ^{Note 4,7}	Length (< 1000 mm) Diameter (< 120 mm)	4 μm + 1.2L / 125 μm 3 μm + L / 125 μm	(L=mm) Helios Shaft Standard

2026-02-24 through 2027-03-31

Effective dates

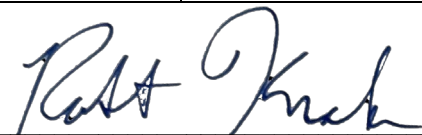


For the National Voluntary Laboratory Accreditation Program

CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) <small>Notes 1,2</small>			
Measured Parameter or Device Calibrated	Range	Expanded Uncertainty <small>Note 3</small>	Remarks
MarShaft CNC Field calibrations available <small>Note 4,7</small>	Length (< 1600 mm) Diameter (< 220 mm)	4 μm + 1.1L / 100 μm 2 μm + L / 100 μm	(L=mm) Helios Shaft Standard
Length – Air Amplifiers Field calibrations available <small>Note 4,7</small>	0.00015 in to 0.005 in	11 μin (0.27 μm)	AMR – Air Restrictor
Diameter – Air restrictor kits	≤ 0.00030 in > 0.00030 in to 0.003 in > 0.003 in to 0.005 in	9 μin 18 μin 27 μin	Gage Blocks, Dimensionair
Length and Diameter – Outside Micrometers 0.0001 in Resolution 0.001 in Resolution	< 6 in < 6 in	31 μin 300 μin	Gage Blocks
Universal Length Measuring Machines Field calibrations available <small>Note 4,7</small>	≤ 4.0 in > 4.0 in to 12.0 in ≤ 100 mm > 100 mm to 305 mm	3 μin + 0.4 μin/in 3.3 μin + 1.3 μin/in 0.076 μm + 0.0004 μm/mm 0.084 μm + 0.0013 μm/mm	Gage Blocks
	≤ 31 in (≤ 800 mm) ≤ 47.24 in (≤ 1200 mm) ≤ 78.8 in (≤ 2000 mm)	33 μin (0.84 μm) 45 μin (1.13 μm) 69 μin (1.75 μm)	Laser Interferometer
Length Amplifier Probe Systems	≤ 0.020 in 0.020 in to 0.160 in ≤ 0.10 in	3.5 μin 13 μin 5.6 μin	Gage Blocks Laser
Heidenhain CT Probes	Up to 2.37” (60mm)	7 μin (0.18 μm)	Laser Gage Blocks
Heidenhain MT Series Probes	up to 1.00” (25.4mm)	10μ” (0.25μm)	Laser

2026-02-24 through 2027-03-31

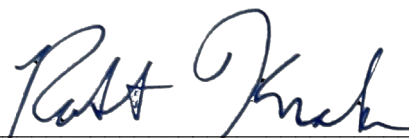
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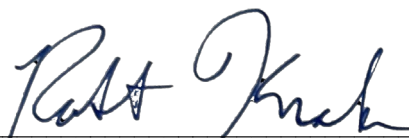
CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) <small>Notes 1,2</small>			
Measured Parameter or Device Calibrated	Range	Expanded Uncertainty <small>Note 3</small>	Remarks
Universal Height Measuring Machines Field calibrations available <small>Note 4,7</small>			
CX1	< 1000 mm	0.7 μm + (L/350) μm	Step Gage (L=mm) in formulas
CX2	< 1000 mm	2.3 μm + (L/350) μm	
817 CLM	< 1000 mm	1 μm + (L/500) μm	
816 CL	< 600 mm	2 μm + (L/350) μm	
814N & 814G	< 600 mm	6 μm + (L/2000) μm	
814SR	< 600 mm	12 μm + (L/2000) μm	
Indicating Height Stands	≤ 4 in (≤ 101.6 mm)	74 μin (1.8 μm)	Gage Blocks
Indicator (Universal) Calibrators Field calibrations available <small>Note 4,7</small>	≤ 0.5 in (≤ 12.7 mm)	9.0 μin (0.23 μm)	Gage Blocks
Optimar100 Field calibrations available <small>Note 4,7</small>	≤ 4.0 in (≤ 101.6 mm)	14 μin (0.36 μm)	Heidenhain Probe
Optimar25 Field calibrations available <small>Note 4,7</small>	≤ 1.0 in (≤ 25.4 mm) ≤ 1.0 in (≤ 25.4 mm) ≤ 1.0 in (≤ 25.4 mm)	6.0 μin (0.15 μm) 20 μin (0.50 μm) 18 μin (0.40 μm)	Laser Amplifier Probe System Gage Blocks
Gage Block and ID/OD Comparators Field calibrations available <small>Note 4,7</small>	≤ 0.002 in ≤ 10 μin	3.2 μin (0.08 μm) 0.5 μin (0.013 μm)	Gage Blocks

2026-02-24 through 2027-03-31
Effective dates


For the National Voluntary Laboratory Accreditation Program

CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) <small>Notes 1,2</small>			
Measured Parameter or Device Calibrated	Range	Expanded Uncertainty <small>Note 3</small>	Remarks
Dimetron plug and Bore gages	< 1 in	13 µin (0.33 µm)	Master Ring / Gage Blocks
	≥ 1 in to 2 in	17 µin (0.43 µm)	
	> 2 in to 3 in	18 µin (0.46 µm)	
	> 3 in to 4 in	18 µin (0.46 µm)	
	> 4 in to < 5 in	28 µin (0.71 µm)	
	> 0.125 in to 5 in	18 µin (0.46 µm)	
Thickness Gages Portable	≤ 0.00005 in	33 µin (0.84 µm)	Gage Blocks
	> 0.00005 to ≤ 0.0001 in	65 µin (1.6 µm)	
	> 0.0001 in to ≤ 0.001 in	720 µin (18 µm)	
Bench	≤ 1 in (≤ 25.4 mm)	31 µin (0.77 µm)	Gage Blocks
Digital, Dial & Vernier Calipers	Up to 8 in	300 µin (15 µm)	Gage Blocks / Master Ring
	> 8 in to 40 in	600 µin (30 µm)	
Inside Micrometers 0.0001 0.001	> 0 in to 4 in	32 µin	Master rings
		300 µin	
36 ID/OD Comparators ≤0.0001 Res. ≤0.00005 Res.	±0.010 in (±.254 mm)	250 µin	Master Ring / Gage Blocks
		66 µin	
MEASURING WIRES (20/D07)			
Thread Measuring Wires Diameter	≤ 0.55 in	6.5 µin	ASME B89.1.17 using Master Thread Measuring Wires and Universal Length machine
ROUNDNESS (20/D09)			
Roundness Artifacts/ Standards Diameters 0.124 in to 14.5 in	< 100 µin ≤ 0.004 in > 0.004 in to 0.04 in	1 µin 3.5 µin (0.09 µm) 25 µin (0.64 µm)	MFU 100, or MMQ400 Form/Geometry Measuring Machines

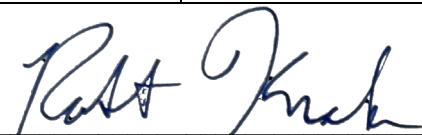
2026-02-24 through 2027-03-31
Effective dates


For the National Voluntary Laboratory Accreditation Program

CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) ^{Notes 1,2}			
Measured Parameter or Device Calibrated	Range	Expanded Uncertainty ^{Note 3}	Remarks
SPHERICAL DIAMETER; PLUG / RING GAGES (20/D11)			
Master Plugs, Pins, Wires, Master Balls and Micrometer standards (OD and Length)	> 4.000 in	7.5 μin	Gage Blocks & ULM300
	≥ 4.000 in	8.0 μin	Gage Blocks & 828 CiM
	> (4.000 to 12.000) in	10 μin+ 1 μin/in	
	< 5.000 in	6.0 μin	Gage Blocks & PLM1000-E
	> (5.000 to 36.000) in	4.5+(0.25L) μin	
Master Ring Gages and inside diameters (ID and Length)	≤ 1.000 in	7.0 μin	Gage Blocks & 136B-3 Comparator
	> (1.000 to 2.000) in	7.5 μin	
	> (2.000 to 4.5000) in	8.0 μin	
Master Ring Gages and inside diameters (ID and Length)	(0.030 to 5.000) in	8 μin	Master rings and 828 CiM/ULM300
	>5.000	10 μin + 1 μin/in	
	≤ 5.000 in	6.0 μin	Master ring & PLM1000-E
Air Rings	> (5.000 to 33.0) in	4.5+(0.25L) μin	
	≤ 1.000 in	7.0 μin	Gage Blocks & 136B-3 Comparator
	> (1.000 to 2.000) in	7.5 μin	
Air Rings	> (2 to 4.500) in	8.0 μin	
	≤ 4 in	17 μin	Master Disc/Plug, Mahr Air Amplifier Calibrator, Electronic Amplifier
Air Plugs	> 4 in to 14 in	17 μin + 3.5 μin/in	
	≤ 4 in	17 μin	Master Rings, Mahr Air Amplifier, Electronic Amplifier
Air Plugs	> 5 in to 10 in	17 μin + 3.5 μin/in	
	≤ 4 in	30 μin	Gage Blocks/ 136B-3 Comparator
Tapered Plug and Rings - Diameter	≤ 4 in	30 μin	

2026-02-24 through 2027-03-31

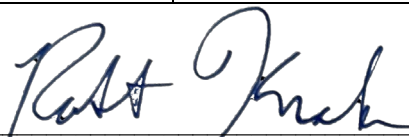
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For the National Voluntary Laboratory Accreditation Program

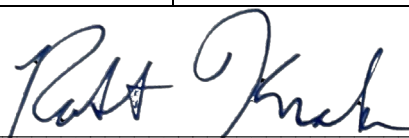
CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) <small>Notes 1,2</small>			
Measured Parameter or Device Calibrated	Range	Expanded Uncertainty <small>Note 3</small>	Remarks
SURFACE TEXTURE (20/D12)			
Surface Roughness Ra (Roughness Average) Rz	1 µin to 250 µin 1 µin to 500 µin	1 µin 2.5 µin	Mahr Surface and Contour Measuring Machines
Flatness	Up to 14.5 in	4.5 µin	Optical Flat
Optical Flats	< 14.5 in (round) or < 13 in (rectangular)	4.5 µin (0.11 µm)	Optical Flat
General Surface Variance Measurements Flatness Parallelism Runout (Total Runout)	< 0.08 in < 0.08 in < 0.08 in	17 µin 17 µin 17 µin	832 Amplifier, Sine Plate & Gage blocks, Granite surface plate
Length / Height	Up to 24" (610mm)	17µin	832 Amplifier probe system with Gage blocks
Surface Contour Angle Distance X Distance Z Radius	≤ 90° ≤ 83 mm ≤ 6.3 mm < 22.5 mm	36" (D/100) + 1.5 µm (D/100) + 1.5 µm 0.12R µm	LD-120, Contour 1 Master (D = Distance in mm) (R= Radius in mm)
Surface Finish & Contour Measuring Machines Field calibrations available <small>Note 4,7</small> Ra (Roughness Average) Rz	1 µin to 250 µin 1 µin to 500 µin	1.0 µin (0.025 µm) 2.5 µin	Contour-2 ball master, Displacement standard, Surface Finish Standard or Mahr Surface and Contour Measuring Machine
Wt	< 60 µin/in	6.0 µin (0.15 µm)	Optical Flat
Displacement	180 µin to 240 µin	3.0 µin (0.076 µm)	Step Height Standard

2026-02-24 through 2027-03-31
Effective dates


For the National Voluntary Laboratory Accreditation Program

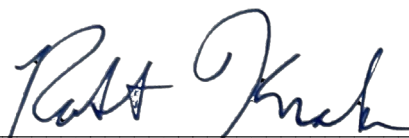
CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) <small>Notes 1,2</small>			
Measured Parameter or Device Calibrated	Range	Expanded Uncertainty <small>Note 3</small>	Remarks
Length	1 mm to 70 mm	16 µin (0.41 µm)	Gage Blocks
Gage Pin Radius	2 mm to 4 mm	7.0 µin (0.18 µm)	Gage Pin
Sphere Radius	> 4 mm to 25 mm	20 µin (0.51 µm)	Precision Sphere (2 ball master)
TWO DIMENSIONAL GAGES (20/D15)			
Concentricity Diameter: ≤ 14.5 in and Height: ≤ 13.75 in	≤ 0.004 in > 0.004 in to 0.040 in	5.0 µin (0.12 µm) 25 µin (0.64 µm)	MFU100 / MMQ400-2 Form and Geometry Measuring Machines
Cylindricity Height: ≤ 1.5 in and Diameter: ≤ 14.5 in	≤ 0.0001 in	2.0 µin (0.05 µm)	MFU100 / MMQ400-2 Form and Geometry Measuring Machines
Height: ≤ 4.0 in and Diameter: ≤ 14.5 in	≤ 0.004 in	6.0 µin (0.15 µm)	
Height: > 4.0 in to 13.75 in and Diameter: ≤ 14.5 in	≤ 0.004 in	16 µin (0.41 µm)	
Height: ≤ 4.0 in and Diameter: ≤ 14.5 in	> 0.004 in to 0.040 in	26 µin (0.66 µm)	
Height: > 4.0 in to 13.75 in and Diameter: ≤ 14.5 in	> 0.004 in to 0.040 in	30 µin (0.76 µm)	
Straightness (Z) (X)	14.5 in 4 in	0.03 + (L/1000) µm 0.05 + (L/1000) µm	L = Length in mm
Flatness Diameter: ≤ 14.5 in and Height: ≤ 13.75 in	≤ 0.004 in > 0.004 in to 0.040 in	3.5 µin (0.089 µm) 25 µin (0.64 µm)	MFU100 / MMQ400-2 Form and Geometry Measuring Machines

2026-02-24 through 2027-03-31
Effective dates


For the National Voluntary Laboratory Accreditation Program

CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) <small>Notes 1,2</small>			
Measured Parameter or Device Calibrated	Range	Expanded Uncertainty <small>Note 3</small>	Remarks
Parallelism Diameter: ≤ 14.5 in and Height: ≤ 13.75 in	≤ 0.004 in > 0.004 in to 0.040 in	4.5 μin (0.11 μm) 34 μin (0.87 μm)	MFU100 / MMQ400-2 Form and Geometry Measuring Machines
Perpendicularity Diameter: ≤ 14.5 in and Height: ≤ 13.75 in	≤ 0.004 in > 0.004 in to 0.040 in	4.0 μin (0.10 μm) 25 μin (0.64 μm)	MFU100 / MMQ400-2 Form and Geometry Measuring Machines
Runout Diameter: ≤ 14.5 in and Height: ≤ 13.75 in	≤ 0.004 in > 0.004 in to 0.040 in	5.0 μin (0.13 μm) 25 μin (0.64 μm)	MFU100 / MMQ400-2 Form and Geometry Measuring Machines
Total Runout Diameter: ≤ 14.5 in and Height: ≤ 13.75 in	≤ 0.004 in > 0.004 in to 0.040 in	6.0 μin (0.15 μm) 25 μin (0.64 μm)	MFU100 / MMQ400-2 Form and Geometry Measuring Machines
Geometry / Form Measuring Machines Field calibrations available <small>Note 4,7</small>			
Radial Departure	< 50 μin	1.2 μin (0.030 μm)	Precision Sphere
Axial Deviation	< 50 μin	1.0 μin (0.025 μm)	Optical Flat
Probe Calibration	< 0.040 in	40 μin (1.0 μm)	Gage Blocks
Z Axis Straightness	< 2 μm / 100 mm	3.0 μin (0.08 μm)	Cylindrical Square
Z Axis Parallelism	< 10 μm / m	16 μin (0.41 μm)	Cylindrical Square
X Axis Perpendicular	< 10 μm / m	12 μin (0.30 μm)	Optical flat
X Axis Straightness	< 7.0 in / 180 mm	8 μin (0.20 μm)	Optical flat
END			

2026-02-24 through 2027-03-31
Effective dates


For the National Voluntary Laboratory Accreditation Program

Notes

Note 1: A Calibration and Measurement Capability (CMC) is a description of the best result of a calibration or measurement (result with the smallest uncertainty of measurement) that is available to the laboratory's customers under normal conditions, when performing more or less routine calibrations of nearly ideal measurement standards or instruments. The CMC is described in the laboratory's scope of accreditation by: the measurement parameter/device being calibrated, the measurement range, the uncertainty associated with that range (see note 3), and remarks on additional parameters, if applicable.

Note 2: Calibration and Measurement Capabilities are traceable to the national measurement standards of the U.S. or to the national measurement standards of other countries and are thus traceable to the internationally accepted representation of the appropriate SI (Système International) unit.

Note 3: The uncertainty associated with a measurement in a CMC is an expanded uncertainty with a level of confidence of approximately 95 %, typically using a coverage factor of $k = 2$. However, laboratories may report a coverage factor different than $k = 2$ to achieve the 95 % level of confidence. Units for the measurand and its uncertainty are to match. Exceptions to this occur when marketplace practice employs mixed units, such as when the artifact to be measured is labeled in non-SI units and the uncertainty is given in SI units (Example: 5 lb weight with uncertainty given in mg).

Note 3a: The uncertainty of a specific calibration by the laboratory may be greater than the uncertainty in the CMC due to the condition and behavior of the customer's device and specific circumstances of the calibration. The uncertainties quoted do not include possible effects on the calibrated device of transportation, long term stability, or intended use.

Note 3b: As the CMC represents the best measurement results achievable under normal conditions, the accredited calibration laboratory shall not report smaller uncertainty of measurement than that given in a CMC for calibrations or measurements covered by that CMC.

Note 3c: As described in Note 1, CMCs cover calibrations and measurements that are available to the laboratory's customers under *normal conditions*. However, the laboratory may have the capability to offer special tests, employing special conditions, which yield calibration or measurement results with lower uncertainties. Such special tests are not covered by the CMCs and are outside the laboratory's scope of accreditation. In this case, NVLAP requirements for the labeling, on calibration reports, of results outside the laboratory's scope of accreditation apply. These requirements are set out in Annex A.5 of NIST Handbook 150, Procedures and General Requirements.

Note 4: Uncertainties associated with field service calibration may be greater as they incorporate on-site environmental contributions, transportation effects, or other factors that affect the measurements. (This note applies only if marked in the body of the scope.)

Note 5: Values listed with percent (%) are percent of reading or generated value unless otherwise noted.

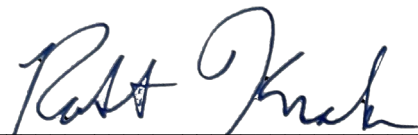
Note 6: NVLAP accreditation is the formal recognition of specific calibration capabilities. Neither NVLAP nor NIST guarantee the accuracy of individual calibrations made by accredited laboratories.

Note 7: This laboratory has field service technicians located across the U.S., Mexico, Brazil and South America. Field calibrations may be provided by these technicians at the customer facility.

Note 8: Uncertainties listed are for steel blocks. Add 1.5 μm / 38.1 nm for chrome carbide, 2.3 μm / 58.4 nm for tungsten carbide to the uncertainty listed.

2026-02-24 through 2027-03-31

Effective dates



For the National Voluntary Laboratory Accreditation Program