

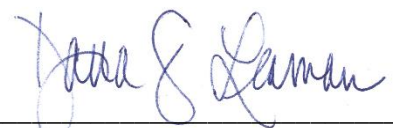
**SCOPE OF ACCREDITATION TO ISO/IEC 17025:2017**

<p><b>Mahr Inc.</b> 1139 Eddy Street Providence, RI 02905 Mr. Anthony Clang Phone: 401-784-3214 Fax: 401-784-3238 E-mail: <a href="mailto:anthony.clang@mahr.com">anthony.clang@mahr.com</a> URL: <a href="http://www.mahr.com">http://www.mahr.com</a></p>	<p><b>Fields of Calibration</b> 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) <sup>Notes 1,2</sup>**

Measured Parameter or Device Calibrated	Range	Expanded Uncertainty <sup>Note 3</sup>	Remarks
<b>DIMENSIONAL</b>			
<b>ANGULAR (20/D01)</b>			
Electronic Level System Angle Measure	≤ 1000"	0.40"	Sine Plate with Gage Blocks
Protractors and Digital Angle Gage	≤ 90°	75"	Angle Blocks
<b>GAGE BLOCKS (20/D03)</b>			
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 1 mm 2.5 mm to 4.5 mm 5 mm to 24.5 mm 25 mm to 50 mm 75 mm 100 mm	2.5 μin 2.0 μin 2.0 μin 2.6 μin 3.1 μin 4.0 μin 63 nm 51 nm 51 nm 65 nm 78 nm 0.10 μm	Gage Blocks and 130B Comparator
Long Gage Blocks	5 in to 20 in 125 mm to 500 mm	3.0 μin + 1.3μin/in 0.08 μm + 0.0013 μm/mm	Gage Blocks and 130B Comparator

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Effective dates

  
For the National Voluntary Laboratory Accreditation Program

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<b>LENGTH and DIAMETER; STEP GAGES (20/D05)</b>			
Dial and Digital Indicators	≤ 0.100 in > 0.100 in to 0.500 in	16 μin 61 μin	Indicator Calibrators
Marshaft Machines (Diameter and Length)	≤ 0.250 in > 0.250 in to 4 in	21 μin 60 μin	Indicator Calibrators
MarShaft Scope Manual w/MC Field calibrations available <small>Note 4,7</small>	Length (< 2400 mm) Diameter (< 120 mm)	6 μm + 1.1L / 100 μm 2.2 μm + L / 100 μm	(L = mm) Helios Shaft Standard
MarShaft Manual w/UNI Field calibrations available <small>Note 4,7</small>	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 <small>Note 4,7</small>	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 <small>Note 4,7</small>	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 <small>Note 4,7</small>	Length (< 1000 mm) Diameter (< 120 mm)	4 μm + 1.2L / 125 μm 3 μm + L / 125 μm	(L=mm) Helios Shaft Standard
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

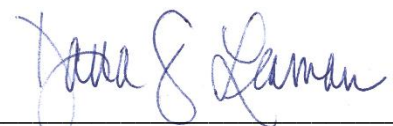
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High Resolution Indicators	± 0.100 in (± 2.54 mm)	9 µin (0.22 µm)	Microcalibrator
	± 0.010 in (± 254 µm)	7 µin (0.17 µm)	
	± 0.001 in (± 25.4 µm)	4 µin (0.10 µm)	Laser Interferometer
	≤ 1.000 in (≤ 25.4 mm)	5.6 µin (0.14 µm)	
Length – Air Amplifiers	0.00030 in to 0.0030 in	11 µin (0.27 µm)	AMR – Air Restrictor
Diameter – Air restrictor kits	≤ 0.00030 in	9 µin	Gage Blocks, Dimensionair
	> 0.00030 in to 0.003 in	18 µin	
	> 0.003 in to 0.005 in	27 µin	
Length and Diameter – Outside Micrometers	0.0001 in Resolution	31 µin	Gage Blocks
	0.001 in Resolution	300 µin	
Micrometer Standards	Up to 4 in	7.0 µin	ULM & Gage Blocks
	> 4in. to 14 in	6.0 µin + 1 µin/in	
Universal Length Measuring Machines Field calibrations available <small>Note 4,7</small>	< 5 in	8.4 µin	PLM1000-E Comparator
	≥ 5 in to 36 in	6.4 µin + 1 µin/in	
	≤ 4.0 in	3 µin + 0.4 µin/in	Gage Blocks
	> 4.0 in up to 12.0 in	3.3 µin + 1.3 µin/in	
≤ 100 mm	0.07 µm + 0.0041 µm/mm	Laser Interferometer	
> 100 mm up to 305 mm	0.081 µm + 0.013 µm/mm		
≤ 31 in (≤ 800 mm)	33 µin (0.84 µm)		
	≤ 47.24 in (≤ 1200 mm)	45 µin (1.13 µm)	
	≤ 78.8 in (≤ 2000 mm)	69 µin (1.75 µm)	

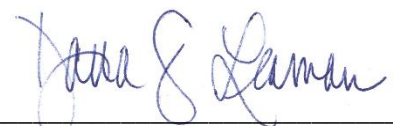


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Length Amplifier Probe Systems	≤ 0.020 in 0.020 in to 0.160 in	3.5 μin 13 μin	Gage Blocks
Universal Height Measuring Machines Field calibrations available <small>Note 4,7</small>			
CX1	< 1000 mm	0.7 μm + (L/350) μm 2.3 μm + (L/350) μm	Step Gage
CX2	< 1000 mm	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 12 μm + (L/2000) μm	
814SR	< 600 mm	μm	(L=mm) in formulas
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)	71 μin (1.8 μm)	Heidenhain Probe
Optimar25 Field calibrations available <small>Note 4,7</small>	≤ 1.0 in (≤ 25.4 mm)	44 μin (1.1 μm)	
Gage Block and ID/OD Comparators Field calibrations available <small>Note 4,7</small>	≤ 0.002 in	3.2 μin (0.08 μm)	Gage Blocks
	≤ 10 μin	0.5 μin (0.013 μm)	
Dimentron plug	< 1 in ≥ 1 in to 2 in > 2 in to 3 in	13 μin (0.33 μm) 17 μin (0.43 μm) 18 μin (0.46 μm)	Master Ring / Gage Blocks



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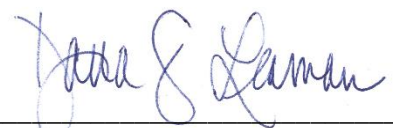
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**CALIBRATION LABORATORIES**

**NVLAP LAB CODE 200605-0**

<b>CALIBRATION AND MEASUREMENT CAPABILITIES (CMC)</b> <small>Notes 1,2</small>			
<b>Measured Parameter or Device Calibrated</b>	<b>Range</b>	<b>Expanded Uncertainty</b> <small>Note 3</small>	<b>Remarks</b>
Thickness Gages Portable  Bench  Digital, Dial & Vernier Calipers  Inside Micrometers 0.0001 0.001	> 3 in to 4 in > 4 in to < 5 in > 0.125 in to 5 in	18 μin (0.46 μm) 28 μin (0.71 μm) 18 μin (0.46 μm)	Master Ring / T-50075
	≤ 0.00005 in > 0.00005 in to ≤ 0.0001 in > 0.0001 in to ≤ 0.001 in	33 μin (0.84 μm) 65 μin (1.6 μm) 720 μin (18 μm)	Gage Blocks
	≤ 1 in (≤ 25.4 mm)	31 μin (0.77 μm)	Gage Blocks
	Up to 8 in > 8 in to 40 in	300 μin (15 μm) 600 μin (30 μm)	Gage Blocks / Master Ring
	> 0 in to 4 in	32 μin 300 μin	Master rings
<b>MEASURING WIRES ( 20/D07)</b>			
Thread Measuring Wires Diameter	≤ 0.55 in	6.5 μin	ASME B89.1.17 using Master Thread Measuring Wires and Universal Length machine
<b>ROUNDNESS (20/D09)</b>			
Roundness Artifacts/ Standards Diameters 0.124 in to 14.5 in	roundness < 100 μin roundness ≤ 0.004 in  roundness > 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
<b>SPHERICAL DIAMETER; PLUG / RING GAGES (20/D11)</b>			

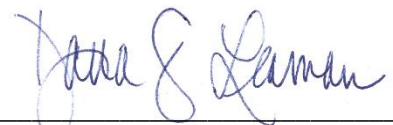
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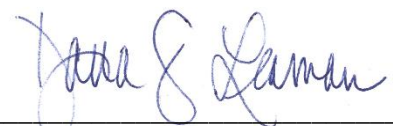
<b>CALIBRATION AND MEASUREMENT CAPABILITIES (CMC)</b> <small>Notes 1,2</small>			
<b>Measured Parameter or Device Calibrated</b>	<b>Range</b>	<b>Expanded Uncertainty</b> <small>Note 3</small>	<b>Remarks</b>
Plug Gages, Master Balls, Pins, Wires (OD and Length)	≤ 4 in	7 μin	Gage Blocks & Mahr 828 CiM , ULM100
	≥ 4 in	10 μin + 1 μin/in	Gage Blocks & Mahr 828 CiM , ULM100
Ring Gages (ID and Length)	< 5 in	8.4 μin	Gage Blocks & PLM1000-E
	≥ 5 in to 36 in	6.4 μin + 1 μin/in	
	Up to 2 in	6 μin	Gage Blocks & 136B-3 Comparator
	> 2 in to 4 in	7 μin	
	> 4 in to 14 in	7 μin + 1 μin/in	
	0.030 in to 5.0 in	8 μin	Master Rings & Mahr 828 CiM, ULM
> 5.0 in to 14 in		10 μin + 1 μin/in	
Gage Blocks & 136B-3 Comparator	≤ 1 in	6 μin	
	> 1 in to 2 in	7 μin	
	> 2 in to 4 in	8 μin	
	> 4 in to 14 in	8 μin + 1 μin/in	
Master Rings/Gage Blocks & PLM1000-e Comparator	< 5 in	8.4 μin	
	> 5 in up to 33 in	6.4 μin + 1 μin/in	
Air Rings	≤ 4 in	17 μin	Master Disc/Plug, Mahr Air Amplifier Calibrator, Electronic Amplifier
	> 4 in to 14 in	17 μin + 3.5 μin/in	
Air Plugs	≤ 4 in	17 μin	Master Rings, Mahr air Amplifier, Electronic Amplifier
	> 5 in to 10 in	17 μin + 3.5 μin/in	
Tapered Plug and Rings - Diameter	≤ 4 in	30 μin	Gage Blocks/ 136B-3 Comparator

**SURFACE TEXTURE (20/D12)**

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Surface Roughness:			
Ra (Roughness Average)	1 µin to 250 µin	1 µin	Mahr Surface and Contour Measuring Machines
Rz	1 µin to 500 µin	2.5 µin	
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			832 Amplifier, Sine Plate & Gage blocks
Flatness	< 0.08 in	17 µin	
Parallelism	< 0.08 in	17 µin	
Runout (Total Runout)	< 0.08 in	17 µin	
Surface Contour			
Angle	≤ 90°	36"	LD-120, Contour 1 Master (D = Distance in mm)
Distance X	≤ 83 mm	D/100 µm + 1.5 µm	
Distance Z	≤ 6.3 mm	D/100 µm + 1.5 µm	(R= Radius in mm)
Radius	< 22.5 mm	0.12R µm	
Surface Finish / Contour Measuring Machines Field calibrations available <small>Note 4,7</small>			
Ra (Roughness Average)	1 µin to 250 µin	1.2 µin (0.030 µm)	Contour-2 ball master, Displacement standard, Surface Finish Standard
Wt	< 60 µin/in.	2.0 µin (0.05 µm)	Optical Flat
Displacement Length	180 µin to 240 µin 1 mm to 70 mm	3.0 µin (0.076 µm) 16 µin (0.41 µm)	Step Height Standard Gage Blocks
Gage Pin Radius	2 mm to 4 mm	6.3 µin (0.16 µm)	Gage Pin



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Sphere Radius	> 4 mm to 25 mm	20 µin (0.51 µm)	Precision Sphere (2 ball master)
<b>TWO DIMENSIONAL GAGES (20/D15)</b>			
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)	
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
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	4.0 µin (0.10 µm)	MFU100 / MMQ400-2 Form and Geometry Measuring Machines

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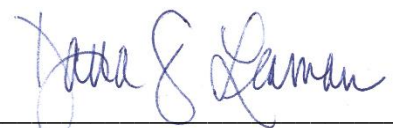


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<b>Measured Parameter or Device Calibrated</b>	<b>Range</b>	<b>Expanded Uncertainty</b> <small>Note 3</small>	<b>Remarks</b>
Runout  Diameter: ≤ 14.5 in and Height: ≤ 13.75 in	> 0.004 in to 0.040 in  ≤ 0.004 in	25 μin (0.64 μm)  5.0 μin (0.13 μm)	MFU100 / MMQ400-2 Form and Geometry Measuring Machines
Total Runout  Diameter: ≤ 14.5 in and Height: ≤ 13.75 in	> 0.004 in to 0.040 in  ≤ 0.004 in > 0.004 in to 0.040 in	25 μin (0.64 μm)  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
Coning Error	< 10 μin / in	1.2 μin (0.030 μm)	Precision Sphere
Probe Calibration	< 0.040 in	40 μin (1.0 μm)	Gage Blocks
Straightness	< 2 μm / 100 mm	3.0 μin (0.08 μm)	Optical Straight Edge
Z Axis Parallelism	< 10 μm / m	16 μin (0.41 μm)	Cylindrical Square
X Axis Perpendicular	< 10 μm / m	12 μin (0.30 μm)	Straight Edge
<b>END</b>			

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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  $1.5 \mu\text{m} / 38.1 \text{ nm}$  for chrome carbide,  $2.3 \mu\text{m} / 58.4 \text{ nm}$  for tungsten carbide to the uncertainty listed.

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