



SCOPE OF ACCREDITATION TO ISO/IEC 17025:2005

NORTHSTAR CALIBRATION, INC.  
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CALIBRATION

Valid To: February 29, 2020

Certificate Number: 0462.02

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory to perform the following calibrations<sup>1</sup>:

I. Acoustical Quantities

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Sound Level Meters <sup>3</sup>	(94 to 114) dB	1.3 dB	Simpson 890-2 generator

II. Dimensional

Parameter/Equipment	Range	CMC <sup>2,4</sup> (±)	Comments
Gage Blocks	Ceramic Up to 4 in  Steel Up to 4 in (4 to 20) in	(3.5 + 2.2L) µin  (2.9 + 1.3L) µin (3.7 + 1.7L) µin	Gage block comparator
Length Standards	Up to 24 in	(67 + 2.1L) µin	Standard measuring machine
Cylindrical Plugs	Up to 1.2 in (1.2 to 4.0) in (4.0 to 20.0)	(6.9 + 0.5L) µin (8.9 + 0.11L) µin (1.7L + 1.6) µin	Universal measuring machine (UMM)

Parameter/Equipment	Range	CMC <sup>2,4</sup> ( $\pm$ )	Comments
Cylindrical Rings	(0.225 to 1.75) in (1.75 to 3.5) in (0.5 to 1.0) in (1.0 to 4.5) in (4.5 to 14.5) in	(2.1 + 11L) $\mu$ in (4.6 + 6.8L) $\mu$ in (5.7 + 0.16L) $\mu$ in 5.8 $\mu$ in (2.2 + 3.5L) $\mu$ in	UMM
Threaded Plugs – Pitch Diameter Major Diameter	Up to 6 in Up to 6 in	(66 + 4.6L) $\mu$ in (49 + 5.6L) $\mu$ in	Benchmic
Threaded Rings – Pitch Diameter Minor Diameter	Up to 8 in (Vert) (8 to 14) in (Horz) Up to 4 in (0.275 to 4) in (4 to 8) in (0 to 0.150) in	(75 + 6L) $\mu$ in (71 + 5.6L) $\mu$ in (200 + 8.6L) $\mu$ in (160 + 11L) $\mu$ in (210 + 1.2L) $\mu$ in (13 + 44L) $\mu$ in	UMM UMM Setting plugs Tri-bore micrometer Precision height gage Cylindrical pin gages
Tapered Threaded Plugs – Pitch Diameter Notch Length	Up to 3 in Up to 2 in	130 $\mu$ in (210 + 0.2L) $\mu$ in	Benchmic Precision height gage
Tapered Threaded Rings – Pitch Diameter Thickness of Ring	Up to 3 in Up to 2 in	140 $\mu$ in 27 $\mu$ in	Set Plugs Benchmic
Thread Wires	Up to 0.12 in	14 $\mu$ in	UMM
Surface Plate <sup>3</sup> – Flatness Repeat Readings	(17 to 43) in (17 to 43) in (50 to 160) in Up to 160 in	(52 + 0.4D) $\mu$ in (78 + 0.4D) $\mu$ in (86 + 1.0D) $\mu$ in 23 $\mu$ in	Planekator Electronic level Repeat-o-meter

Parameter/Equipment	Range	CMC <sup>2,4</sup> (±)	Comments
Calipers <sup>3</sup>	Up to 120 in	(120 + 0.6R + 4L) μin	Gage blocks and cylindrical ring
Micrometers <sup>3</sup>	Up to 24 in	(67 + 0.6R + 9.6L) μin	Gage blocks
Indicators <sup>3</sup>	Up to 6 in	(60 + 0.6R + 10L) μin	Gage blocks
Height Gages <sup>3</sup>	Up to 24 in (24 to 40) in	(63 + 0.6R + 14L) μin (310 + 0.6R + 4L) μin	Gage blocks and amplifier
Optical Comparators <sup>3</sup> – Linear Angular Magnification	Up to 12 in (0 to 360)° 10X to 50X	(150 + 4.6L) μin 0.05° 0.0023 in	Glass scales, mag checker & balls
Tape Measures, Pi Tapes, Steel Rules <sup>3</sup>	(0.5 to 18) ft (18 to 72) ft	(6900 + 5L) μin 0.013 in	Length fixture
Brinell Scopes <sup>3</sup> Microscopes <sup>3</sup> & Glass Line Reticles <sup>3</sup>	Up to 6 mm Up to 6 in	120 μm 190 μin	Ceramic scale Glass scale
Surface Finish Patch	Up to 250 μin	9.1 μin	Surface analyzer
Surface Finish Analyzer <sup>3</sup>	Up to 250 μin	7.2 μin	Surface finish patch
CMM <sup>3</sup> – Repeatability Linearity – Step Gage Laser Volumetric Bi-Directional	Up to 48 in  Up to 48 in Up to 240 in -- --	62 μin  150 μin (0.47L + 5.5) μin (90 + 13L) μin 55 μin	Master ball Step gage/laser  Ball bar Gage block

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Protractors	0° to 180°	7 minutes	Angle blocks, surface plate
Squares	(1 to 24) in	82 μin	Square, height gage, amplifier
Levels	(1 to 24) in	2 minutes	Sine plate, gage blocks, surface plate

### III. Dimensional Testing/Calibration<sup>1</sup>

Parameter/Equipment	Range	CMC <sup>2, 4</sup> (±)	Comments
1-Dimensional Measurement <sup>7</sup>	Up to 24 in Up to 24 in Up to 20 in Up to 6 in	92 μin (20 + 3.4L) μin (3.9 + 3.4L) μin (150 + 5.6L) μin	Precision HG and amp Benchmic UMM Optical comparator
1-Dimensional Measurement <sup>3, 7</sup>	Up to 4 in Up to 240 in	(7.1 + 2.2L) μin (5.5 + 0.47L) μin	THV Laser
Angular Measurement <sup>7</sup> (Includes Angle Blocks)	(0 to 180)° (0 to 90)°	(0.033 + 0.000 16R)° 2' 50"	Optical comparator Sine plate, gage blocks
Radius Measurement	Up to 2 in	(860 + 390L) μin	Optical comparator

### IV. Electrical – DC/Low Frequency

Parameter/Equipment	Range	CMC <sup>2, 4, 6</sup> (±)	Comments
DC Voltage – Generate <sup>3</sup>	(0 to 3.3) V (3.3 to 33) V (33 to 1000) V	83 μV/V + 0.6R + 5.2 μV 90 μV/V + 0.6R + 29 μV 65 μV/V + 0.6R + 3.3 mV	Calibrator

Parameter/Equipment	Range	CMC <sup>2, 4, 6</sup> (±)	Comments
DC Voltage – Measure <sup>3</sup>	(0 to 1) V (1 to 10) V (10 to 1000) V	47 μV/V + 0.6R + 12 μV 46 μV/V + 0.6R + 51 μV 67 μV/V + 0.6R + 510 μV	Precision bench meter
	(1 to 10) kV	0.015 % + 0.6R + 1.4 mV	Precision bench meter with voltage divider
DC Current – Generate <sup>3</sup>	(0 to 33) mA (33 to 2.2) A (2.2 to 11) A	0.013 % + 0.6R + 1.9 μA 0.044 % + 0.6R + 38 μA 0.07 % + 0.6R + 440 μA	Calibrator
	(11 to 500) A	0.14 % + 0.6R + 2.3 mA	Calibrator, 50 turn coil
DC Current – Measure <sup>3</sup>	(0 to 10) mA (10 to 100) mA (0.1 to 3) A	0.038 % + 0.6R + 6.8 μA 0.084 % + 0.6R + 2.2 μA 0.14 % + 0.6R + 34 μA	Precision bench meter
Resistance – Generate <sup>3</sup>	(0 to 330) kΩ (0.33 to 1.1) kΩ (1.1 to 11) kΩ (11 to 330) kΩ (0.33 to 3.3) MΩ (3.3 to 33) MΩ (33 to 330) MΩ	0.011 % + 0.6R + 0.019 Ω 0.014 % + 0.6R + 0.021 Ω 0.039 % + 0.6R + 0.94 Ω 0.014 % + 0.6R + 11 Ω 0.018 % + 0.6R + 82 Ω 0.21 % + 0.6R + 570 Ω 0.62 % + 0.6R + 9.6 kΩ	Calibrator
Resistance – Measure <sup>3</sup>	(0 to 100) Ω (0.1 to 10) kΩ (10 to 1) MΩ (1 to 100) MΩ	0.12 % + 0.6R + 0.0049 Ω 0.011 % + 0.6R + 0.14 Ω 0.011 % + 0.6R + 16 Ω 0.93 % + 0.6R + 610 Ω	Precision bench meter

Parameter/Range	Frequency	CMC <sup>2, 4, 6</sup> (±)	Comments
AC Voltage – Measure <sup>3</sup>	(0 to 1) V	0.41 % + 0.6R + 55 μV 0.14 % + 0.6R + 57 μV 0.74 % + 0.6R + 52 μV	Precision bench meter
	(1 to 750) V	0.44 % + 0.6R + 31 mV 0.17 % + 0.6R + 42 mV 0.52 % + 0.6R + 130 mV	
	(1 to 10) kV	60 Hz	(0.5 % + 0.6R) V

Parameter/Range	Frequency	CMC <sup>2, 4, 6</sup> (±)	Comments
AC Voltage – Generate <sup>3</sup> (0 to 3.3) V  (33 to 330) V  (330 to 1020) V	(10 to 45) Hz 45 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 500) kHz  45 Hz to 20 kHz  45 Hz to 10 kHz	0.41 % + 0.6R + 16 μV 0.07 % + 0.6R + 1.2 mV 0.14 % + 0.6R + 16 mV 0.7 % + 0.6R + 31 mV 0.7 % + 0.6R + 3.1 mV  0.14 % + 0.6R + 160 mV  0.07 % + 0.6R + 36 mV	Calibrator
AC Current – Measure <sup>3</sup> (0 to 1) A  (1 to 3) A  (10 to 500) A  (3 to 1000) A  Welders	(3 to 5) Hz (5 to 10) Hz 10 Hz to 5 kHz  (3 to 5) Hz (5 to 10) Hz 10 Hz to 5 kHz  50 Hz to 1 kHz  50 Hz to 1 kHz  DC Volt DC Amps	0.12 % + 0.6R + 770 μA 0.33 % + 0.6R + 770 μA 0.091 % + 0.6R + 770 μA  0.12 % + 0.6R + 4.8 mA 0.34 % + 0.6R + 4.4 mA 0.097 % + 0.6R + 4.8 mA  0.2 % + 0.6R + 0.096 A  0.24 % + 0.6R + 0.032 A  5.6 % + 0.6R + 0.55 mV 3.7 % + 0.6R mV	Multimeter   Multimeter, current clamp  Multimeter, shunt  DMM, clamp meter, load bank
AC Current – Generate <sup>3</sup> (0 to 2.2) A  (2.2 to 11) A  (10 to 500) A	(10 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz  (45 to 65) Hz (65 to 500) Hz 500 Hz to 1 kHz  (45 to 65) Hz	0.29 % + 0.6R + 400 μA 0.21 % + 0.6R + 370 μA 0.89 % + 0.6R + 380 μA 0.72 % + 0.6R + 70 uA  0.14 % + 0.6R + 4.6 mA 0.15 % + 0.6R + 5.1 mA 0.30 % + 0.6R + 8.5 mA  1.2 % + 0.6R + 480 mA	Calibrator  Calibrator/ 50 turn coil

Parameter/Range	Frequency	CMC <sup>2, 4, 6</sup> (±)	Comments
Capacitance – Generate <sup>3</sup> (0.33 to 330) nF (1.1 to 3.3) μF (3.3 to 33) μF (33 to 330) μF (330 to 1.1) mF	50 Hz to 1 kHz 50 Hz to 1 kHz (50 to 400) Hz (50 to 100) Hz (50 to 100) Hz	2.7 μF/F + 0.6R + 0.45 nF 0.0037 μF/F + 0.6R + 4.4 μF 0.0045 μF/F + 0.6R + 38 μF 0.0077 μF/F + 0.6R + 360 μF 0.013 μF/F + 0.6R + 420 μF	Calibrator
Oscilloscopes <sup>3</sup> –  Level Sine Wave 50 kHz Reference  Level Sine Flatness 5 mV to 5.5 V  Vertical Gain DC – Into 50 Ω Into 1 MΩ  Square Wave – Into 50 Ω Into 1 MΩ  Time Marker Output Into 50 Ω  Pulse Rise Time 5 mV to 2.5 V(p-p)	1 mV to 5.5 V(p-p)  50 kHz to 100 MHz (100 to 300) MHz (300 to 600) MHz  (0 to 6.6) V (0 to 130) V  1 mV to 6.6 V(p-p) 1 mV to 130 V(p-p)  5 s to 50 ms 20 ms to 2 ns In 5-2-1 sequence  ≤350 ps	2.0 % + 300 μV  3.6 % + 300 μV 4.1 % + 300 μV 6.1 % + 330 μV  0.24 % + 400 μV 0.051 % + 400 μV  0.24 % + 400 μV 0.10 % + 400 μV  25 + 1000t μs/s 2.5 μs/s  +0/-120 ps	Calibrator  Relative to 50 kHz reference       t = time in seconds

Parameter/Equipment	Range	CMC <sup>2, 6</sup> (±)	Comments
Electrical Calibration of Thermocouple Indicating Devices <sup>3</sup> –			
Type J	-210 °C to -100 °C -100 °C to 1200 °C	0.34 °C 0.26 °C	Calibrator
Type K	-200 °C to -100 °C -100 °C to 1000 °C 1000 °C to 1372 °C	0.39 °C 0.30 °C 0.38 °C	
Type T	-250 °C to -150 °C -150 °C to 400 °C	0.66 °C 0.31 °C	

#### V. Mechanical

Parameter/Equipment	Range	CMC <sup>2, 5</sup> (±)	Comments
Force <sup>3</sup> – Compression & Tension	Up to 250 lbf	0.2 %	Precision weights
	Up to 1000 lbf	0.28 %	Load cells
	(1000 to 10 000) lbf (10 000 to 50 000) lbf	0.083 % 0.32 %	
Durometers <sup>3</sup>	Up to 10 lbf	0.20 %	Scale or load cell
Pressure/Vacuum Gauges <sup>3</sup> & Transducers <sup>3</sup>	(-14.7 to 100) psig	0.21 % full scale	Druck DPI 610
	(0 to 2000) psi	0.1 % full scale + 0.028 <i>P</i>	Dead weight tester <i>P</i> is applied pressure
	(2000 to 10 000) psi	0.12 % full scale	
Torque Testers <sup>3</sup>	2 in·ozf to 100 in·lbf (10 to 250) ft·lbf (251 to 1500) ft·lbf	(0.059 + 0.000 70 <i>A</i> ) in·lbf (0.060 + 0.012 <i>A</i> ) ft·lbf (1.3 + 0.0070 <i>A</i> ) ft·lbf	Weights & radius arms <i>A</i> is applied torque



Parameter/Equipment	Range	CMC <sup>2, 4, 5</sup> (±)	Comments
Torque Tools <sup>3</sup>	2 in·ozf to 100 ft·lbf 2 in·ozf to 250 ft·lbf (250 to 1000) ft·lbf	1.0 % 1.0 % 0.8 %	Torque tester
Mass (Weights) <sup>3</sup>	(1 to 500) g  (1 to 10) lb  (10.1 to 75) lb	1.2 mg  120 mg  0.0012 lb (550 mg)	520 g balance, weight sets  Verification with Class 1, 4 and F weights, precision scale  Precision scale, weight set
Scales and Balances <sup>3</sup>	1 g to 3 kg (3.1 to 25) kg (50 to 1000) lb (1001 to 5000) lb (5001 to 10 000) lb	(0.20 + 0.6R) g (1.0 + 0.6R) g (0.30 + 0.6R) lb (1.6 + 0.6R) lb (2.1 + 0.6R) lb	Verification with Class 1, 4 and F weights
Indirect Verification of Brinell Hardness Testers <sup>3</sup> –  10/500/15  10/3000/15	Up to 225 HBW  (226 to 650) HBW	1.7 HBW  1.9 HBW	Indirect verification method per ASTM E10 of Brinell hardness testers <sup>3</sup>
Indirect Verification of Microindentation Hardness Testers (Knoop & Vickers) <sup>3</sup> –  Knoop  Vickers	(100 to 250) HK (251 to 650) HK > 650 HK  (100 to 240) HV (241 to 600) HV > 600 HV	11 HK 33 HK 64 HK  26 HV 75 HV 160 HV	Indirect verification method per ASTM E92

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Indirect Verification of Rockwell and Rockwell Superficial Hardness Testers <sup>3</sup>	HRA: Low Medium High  HRBW: Low Medium High  HRC: Low Medium High  HR15N: Low Medium High  HR30N: Low Medium High  HR45N: Low Medium High  HR15TW: Low Medium High  HR30TW: Low Medium High  HR45TW: Low Medium High	1.4 HRA 1.4 HRA 1.5 HRA  1.9 HRBW 1.5 HRBW 1.0 HRBW  1.3 HRC 1.4 HRC 1.0 HRC  1.3 HR15N 1.2 HR15N 1.4 HR15N  1.9 HR30N 2.0 HR30N 1.8 HR30N  1.4 HR45N 1.4 HR45N 1.4 HT45N  1.5 HR15TW 1.5 HR15TW 1.7 HR15TW  1.9 HR30TW 2.0 HR30TW 1.8 HR30TW  2.0 HR45TW 1.7 HR45TW 1.7 HR45TW	ASTM E18



## VI. Thermodynamics

Parameter/Equipment	Range	CMC <sup>2, 4</sup> (±)	Comments
Infrared Thermometers <sup>3</sup>	(70 to 750) °F	(1.6 + 0.0022R) °F	Black body calibrator

## VII. Time & Frequency

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Frequency – Generate	(0 to 12) kHz 12 kHz to 2 MHz 50 kHz to 600 MHz	28 µHz/Hz + 1.3 mHz 26 µHz/Hz + 16 mHz 2.7 µHz/Hz	Calibrator
Digital Tachometers	(0 to 12) kHz 12 kHz to 2 MHz 50 kHz to 600 MHz	28 µHz/Hz + 1.3 mHz 26 µHz/Hz + 16 mHz 2.7 µHz/Hz	Calibrator
Mechanical Tachometers	(0 to 12) kHz	28 µHz/Hz + 1.3 mHz	Calibrator
Frequency – Measure <sup>3</sup>	(0 to 160) MHz 40 MHz to 1.3 GHz	3.2 µHz/Hz 5.9 µHz/Hz	Counter
Timers <sup>3</sup>	(0 to 24) hrs	5.9 µs/s	Counter

<sup>1</sup> This laboratory offers commercial dimensional testing/calibration service and field calibration service.

<sup>2</sup> Calibration and Measurement Capability (CMC) is the smallest uncertainty of measurement that a laboratory can achieve within its scope of accreditation when performing more or less routine calibrations of nearly ideal measurement standards or nearly ideal measuring equipment. CMCs represent expanded uncertainties expressed at approximately the 95 % level of confidence, usually using a coverage factor of  $k = 2$ . The actual measurement uncertainty of a specific calibration performed by the laboratory may be greater than the CMC due to the behavior of the customer's device and to influences from the circumstances of the specific calibration.

<sup>3</sup> Field calibration service is available for this calibration and this laboratory meets A2LA R104 – *General Requirements: Accreditation of Field Testing and Field Calibration Laboratories* for these calibrations. Please note the actual measurement uncertainties achievable on a customer's site can normally be expected to be larger than the CMC found on the A2LA Scope. Allowance must be made for aspects such as the environment at the place of calibration and for other possible adverse effects such as those caused by transportation of the calibration equipment. The usual allowance for the actual uncertainty introduced by the item being calibrated, (e.g. resolution) must also be considered and this, on its own, could result in the actual measurement uncertainty achievable on a customer's site being larger than the CMC.

<sup>4</sup> In the statement of CMC,  $L$  is the numerical value of the nominal length of the device measured in inches;  $D$  is the numerical value of the diagonal length of the device measured in inches;  $R$  is the resolution of the device under test.

<sup>5</sup> In the statement of CMC, % denotes percent of reading unless otherwise noted.

<sup>6</sup> The measurands stated are generated using the indicated instrument (see Comments). This capability is suitable for the calibration of the devices intended to measure the measurand in the ranges indicated. CMCs are expressed as either a specific value that covers the full range or as a fraction of the reading plus a fixed floor specification.

<sup>7</sup> This laboratory meets R205 – *Specific Requirements: Calibration Laboratory Accreditation Program* for the types of dimensional calibrations listed above. Accredited test reports issued containing appropriate statements of measurement results, measurement uncertainty, and traceability are considered equivalent to a “calibration” certificate.



## *Accredited Laboratory*

A2LA has accredited

**NORTHSTAR CALIBRATION, INC.**

*Owatonna, MN*

for technical competence in the field of

**Calibration**

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005 *General requirements for the competence of testing and calibration laboratories*. This laboratory also meets R205 – Specific Requirements: Calibration Laboratory Accreditation Program. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (*refer to joint ISO-ILAC-IAF Communiqué dated April 2017*).



Presented this 28<sup>th</sup> day of June 2018.

A handwritten signature in blue ink, appearing to read "L. Anderson", written over a horizontal line.

President and CEO  
For the Accreditation Council  
Certificate Number 462.02  
Valid to February 29, 2020

*For the calibrations to which this accreditation applies, please refer to the laboratory's Calibration Scope of Accreditation.*