



## *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 any additional program requirements in the field of calibration. 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 8 January 2009).



Presented this 13<sup>th</sup> day of June 2016.

A handwritten signature in blue ink, reading "Jim C. Bunt".

Senior Director of Quality and Communications  
For the Accreditation Council  
Certificate Number 462.02  
Valid to February 28, 2018

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



SCOPE OF ACCREDITATION TO ISO/IEC 17025:2005

NORTHSTAR CALIBRATION, INC.  
 1045 26th Place NW  
 Owatonna, MN 55060  
 John Moorhouse Phone: 507 444 9111

CALIBRATION

Valid To: February 28, 2018

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	(3.5 + 2.2L) μin	Gage block comparator
	Steel Up to 4 in (4 to 20) in	(2.9 + 1.3L) μin (3.7 + 1.7L) μin	
Length Standards	Up to 24 in	(67 + 2.1L) μin	Standard measuring machine
Cylindrical Plugs	Up to 4 in (4 to 20) in	(7.3 + 4.0L) μin (4.1 + 4.8L) μin	Universal measuring machine (UMM)

Parameter/Equipment	Range	CMC <sup>2,4</sup> ( $\pm$ )	Comments
Cylindrical Rings	(0.225 to 14.5) in	$(14 + 18L) \mu\text{in}$	UMM
Threaded Plugs – Pitch Diameter Major Diameter	Up to 6 in Up to 6 in	$(66 + 4.6L) \mu\text{in}$ $(49 + 5.6L) \mu\text{in}$	Supermic
Threaded Rings – Pitch Diameter Minor Diameter	Up to 8 in Up to 4 in (0.275 to 4) in (0.125 to 8) in	$(76 + 9.4L) \mu\text{in}$ $(200 + 8.6L) \mu\text{in}$ $(170 + 11L) \mu\text{in}$ $(210 + 0.2L) \mu\text{in}$	UMM Setting plugs Tri-bore micrometer Precision height gage
Tapered Threaded Plugs – Pitch Diameter Notch Length	Up to 3 in Up to 2 in	130 $\mu\text{in}$ $(210 + 0.2L) \mu\text{in}$	Supermic Precision height gage
Tapered Threaded Rings – Pitch Diameter Thickness of Ring	Up to 3 in Up to 2 in	140 $\mu\text{in}$ 27 $\mu\text{in}$	Set plugs Supermic
Thread Wires	Up to 0.12 in	7.0 $\mu\text{in}$	Supermic
Surface Plate – Flatness Flatness <sup>3</sup> Repeat Readings <sup>3</sup>	(17 to 43) in (17 to 43) in (50 to 160) in Up to 160 in	$(68 + 0.3D) \mu\text{in}$ $(78 + 0.4D) \mu\text{in}$ $(86 + 1.0D) \mu\text{in}$ 28 $\mu\text{in}$	Planekator Electronic level Repeat-o-meter
Calipers <sup>3</sup>	Up to 120 in	$(120 + 0.6R + 14L) \mu\text{in}$	Gage blocks and cylindrical ring
Micrometers <sup>3</sup>	Up to 24 in	$(67 + 0.6R + 9.6L) \mu\text{in}$	Gage blocks

Parameter/Equipment	Range	CMC <sup>2,4</sup> (±)	Comments
Indicators <sup>3</sup>	Up to 6 in	$(60 + 0.6R + 10L) \mu\text{in}$	Gage blocks
Height Gages <sup>3</sup>	Up to 24 in (24 to 40) in	$(63 + 0.6R + 14L) \mu\text{in}$ $(310 + 0.6R + 4L) \mu\text{in}$	Gage blocks and amplifier
Optical Comparators <sup>3</sup>			
Linear	Up to 12 in	$(150 + 4.6L) \mu\text{in}$	Glass scales
Angular	(0 to 360) Degrees	$(0.033 + 0.00016R)$ Degrees	Gage balls
Magnification	10X to 50X	0.0023 in	Glass scales
Tape Measures, Pi Tapes, Steel Rules <sup>3</sup>	(0.5 to 18) ft (18 to 72) ft	$(6900 + 5L) \mu\text{in}$ 0.013 in	Length fixture
Protractors	0° to 90°	15 minutes	Angle blocks
Brinell Scopes <sup>3</sup> Microscopes <sup>3</sup> & Glass Line Reticles <sup>3</sup>	Up to 6 mm Up to 6 in	120 $\mu\text{m}$ 190 $\mu\text{in}$	Ceramic scale Glass scale
Surface Finish Patch	Up to 250 $\mu\text{in}$	9.1 $\mu\text{in}$	Surface analyzer
Surface Finish Analyzer <sup>3</sup>	Up to 250 $\mu\text{in}$	7.2 $\mu\text{in}$	Surface finish patch
CMM <sup>3</sup> –			
Repeatability	Up to 48 in	62 $\mu\text{in}$	Master ball
Linearity –			Step gage/laser
Step Gage	Up to 48 in	150 $\mu\text{in}$	
Laser	Up to 40 in (41 to 240) in	$(4.2 + 0.62L) \mu\text{in}$ $(4.9 + 0.6L) \mu\text{in}$	
Volumetric	--	$(90 + 13L) \mu\text{in}$	Ball bar
Bi-Directional	--	55 $\mu\text{in}$	Gage block

### 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 4 in Up to 6 in	(210 + 0.2L) μin (20 + 3.4L) μin (3.9 + 3.4L) μin (7.1 + 2.2L) μin (150 + 5.6L) μin	Precision height gage Supermic UMM THV <sup>3</sup> Optical comparator
1-Dimensional Measurement <sup>3,7</sup>	Up to 40 in (41 to 240) in	(4.2 + 0.62L) μin (4.9 + 0.6L) μin	Laser
Angular Measurement <sup>7</sup> Up to 6" Length	0° to 90° 90° to 180° 0° to 90°	(0.048)° (0.063)° (0.0206)°	Optical comparator  Sine plate/ gage blocks/ amplifier
Radius Measurement <sup>7</sup>	Up to 2 in	(860 + 390L) μin	Optical comparator

### IV. Electrical – DC/Low Frequency

Parameter/Equipment	Range	CMC <sup>2,5,6</sup> (±)	Comments
DC Voltage – Generate <sup>3</sup>	(0 to 330) mV (0.33 to 3.3) V (3.3 to 33) V (33 to 330) V (330 to 1000) V	73 μV/V + 7.4 μV 83 μV/V + 5.2 μV 90 μV/V + 29 μV 83 μV/V + 250 μV 65 μV/V + 3.3 mV	Fluke 5500 SC600
DC Voltage – Measure <sup>3</sup>	(0 to 100) mV (0.1 to 1) V (1 to 10) V (10 to 100) V (100 to 1000) V  (1 to 40) kV	44 μV/V + 9.8 μV 47 μV/V + 12 μV 46 μV/V + 51 μV 56 μV/V + 550 μV 67 μV/V + 510 μV  0.015 % + 1.4 mV	HP 34401A     HP 34401A w/ Fluke 80K-40 HV divider probe

Parameter/Equipment	Range	CMC <sup>2, 5, 6</sup> ( $\pm$ )	Comments
DC Current – Generate <sup>3</sup>	(0 to 3.3) mA (3.3 to 33) mA (33 to 330) mA (0.33 to 2.2) A (2.2 to 11) A	0.013 % + 1.9 $\mu$ A 0.011 % + 1.9 $\mu$ A 0.024 % + 15 $\mu$ A 0.044 % + 38 $\mu$ A 0.07 % + 440 $\mu$ A	Calibrator
DC Current – Measure <sup>3</sup>	(0 to 10) mA (10 to 100) mA (0.1 to 1) A (1 to 3) A	0.038 % + 6.8 $\mu$ A 0.084 % + 2.2 $\mu$ A 0.12 % + 19 $\mu$ A 0.14 % + 34 $\mu$ A	HP 34401A
Resistance – Generate <sup>3</sup>	(0 to 11) $\Omega$ (11 to 33) $\Omega$ (33 to 110) $\Omega$ (110 to 330) $\Omega$ (0.33 to 1.1) k $\Omega$ (1.1 to 3.3) k $\Omega$ (3.3 to 11) k $\Omega$ (11 to 33) k $\Omega$ (33 to 110) k $\Omega$ (110 to 330) k $\Omega$ (0.33 to 1.1) M $\Omega$ (1.1 to 3.3) M $\Omega$ (3.3 to 11) M $\Omega$ (11 to 33) M $\Omega$ (33 to 110) M $\Omega$ (110 to 330) M $\Omega$	0.014 % + 0.0094 $\Omega$ 0.014 % + 0.018 $\Omega$ 0.012 % + 0.018 $\Omega$ 0.011 % + 0.019 $\Omega$ 0.014 % + 0.021 $\Omega$ 0.039 % + 0.94 $\Omega$ 0.011 % + 0.71 $\Omega$ 0.058 % + 5.0 $\Omega$ 0.017 % + 5.9 $\Omega$ 0.014 % + 11 $\Omega$ 0.018 % + 65 $\Omega$ 0.018 % + 82 $\Omega$ 0.071 % + 600 $\Omega$ 0.21 % + 570 $\Omega$ 0.61 % + 6.3 k $\Omega$ 0.62 % + 9.6 k $\Omega$	Fluke 5500 SC600
Resistance – Measure <sup>3</sup>	(0 to 100) $\Omega$ (0.1 to 1) k $\Omega$ (1 to 10) k $\Omega$ (10 to 100) k $\Omega$ (0.1 to 1) M $\Omega$ (1 to 10) M $\Omega$ (10 to 100) M $\Omega$	0.12 % + 0.0049 $\Omega$ 0.011 % + 0.017 $\Omega$ 0.011 % + 0.14 $\Omega$ 0.011 % + 1.6 $\Omega$ 0.011 % + 16 $\Omega$ 0.046 % + 64 $\Omega$ 0.93 % + 610 $\Omega$	HP 34401A

Parameter/Range	Frequency	CMC <sup>2, 5, 6</sup> (±)	Comments
AC Voltage – Measure <sup>3</sup>			
(0 to 100) mV	(3 to 5) Hz (5 to 10) Hz (10 to 20) Hz (20 to 50) Hz (50 to 100) Hz (100 to 300) Hz	0.12 % + 48 µV 0.41 % + 55 µV 0.073 % + 58 µV 0.14 % + 57 µV 0.74 % + 52 µV 0.52 % + 27 µV	HP 34401A
(1 to 750) V	(3 to 5) Hz (5 to 10) Hz (10 to 20) Hz (20 to 50) Hz (50 to 100) Hz (100 to 300) Hz	0.12 % + 26 mV 0.44 % + 31 mV 0.089 % + 34 mV 0.17 % + 42 mV 0.79 % + 63 mV 0.52 % + 130 mV	
AC Voltage – Generate <sup>3</sup>			
(1 to 33) mV	(10 to 45) Hz 45 Hz to 10 kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 500) kHz	0.088 % + 12 µV 0.015 % + 10 µV 0.02 % + 10 µV 0.11 % + 10 µV 0.41 % + 16 µV 0.96 % + 59 µV	Fluke 5500 SC600
(33 to 330) mV	(10 to 45) Hz 45 Hz to 10 kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 500) kHz	0.062 % + 44 µV 0.017 % + 18 µV 0.019 % + 17 µV 0.041 % + 21 µV 0.12 % + 49 µV 0.33 % + 120 µV	
330 mV to 3.3 V	(10 to 45) Hz 45 Hz to 10 kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 500) kHz	0.41 % + 1.6 mV 0.07 % + 1.2 mV 0.07 % + 1.2 mV 0.14 % + 1.6 mV 0.7 % + 3.1 mV 0.7 % + 3.1 mV	
(3.3 to 33) V	(10 to 45) Hz 45 Hz to 1 kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.41 % + 16 mV 0.07 % + 12 mV 0.07 % + 12 mV 0.14 % + 16 mV 0.7 % + 31 mV	
(33 to 330) V	45 Hz to 1 kHz (1 to 10) kHz (10 to 20) kHz	0.07 % + 120 mV 0.07 % + 120 mV 0.14 % + 160 mV	
(330 to 1020) V	45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.07 % + 36 mV 0.07 % + 36 mV 0.07 % + 36 mV	

Parameter/Range	Frequency	CMC <sup>2, 5, 6</sup> ( $\pm$ )	Comments
AC Current – Measure <sup>3</sup>			
(0 to 1) A	(3 to 5) Hz (5 to 10) Hz 10 Hz to 5 kHz	0.12 % + 770 $\mu$ A 0.33 % + 770 $\mu$ A 0.091 % + 770 $\mu$ A	Multimeter
(1 to 3) A	(3 to 5) Hz (5 to 10) Hz 10 Hz to 5 kHz	0.12 % + 4.8 mA 0.34 % + 4.4 mA 0.097 % + 4.8 mA	
(3 to 500) A	10 Hz to 5 kHz	2.3 mA	Multimeter/ current clamp
AC Current – Generate <sup>3</sup>			
(29 to 300) $\mu$ A	(10 to 20) Hz (20 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	39 $\mu$ A/A + 63 $\mu$ A 18 $\mu$ A/A + 63 $\mu$ A 18 $\mu$ A/A + 63 $\mu$ A 79 $\mu$ A/A + 63 $\mu$ A 0.029 % + 140 $\mu$ A	Calibrator
(0.33 to 3.3) mA	(10 to 20) Hz (20 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.022 % + 63 $\mu$ A 0.012 % + 63 $\mu$ A 0.012 % + 63 $\mu$ A 0.022 % + 63 $\mu$ A 0.061 % + 140 $\mu$ A	
(3.3 to 33) mA	(10 to 20) Hz (20 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.18 % + 58 $\mu$ A 0.11 % + 60 $\mu$ A 0.11 % + 60 $\mu$ A 0.18 % + 58 $\mu$ A 0.47 % + 120 $\mu$ A	
(33 to 333) mA	(10 to 20) Hz (20 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.29 % + 56 $\mu$ A 0.21 % + 57 $\mu$ A 0.20 % + 57 $\mu$ A 0.29 % + 56 $\mu$ A 0.72 % + 70 $\mu$ A	
(0.33 to 2.2) A	(10 to 20) Hz (20 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz	0.29 % + 400 $\mu$ A 0.29 % + 400 $\mu$ A 0.21 % + 370 $\mu$ A 0.89 % + 380 $\mu$ A	
(2.2 to 11) A	(45 to 65) Hz (65 to 500) Hz (0.5 to 1) kHz	0.14 % + 4.6 mA 0.15 % + 5.1 mA 0.30 % + 8.5 mA	
(10 to 500) A	(45 to 65) Hz	0.14 % + 2.3 mA	Calibrator/ 50 turn coil



Parameter/Range	Frequency	CMC <sup>2,5,6</sup> (±)	Comments
Capacitance – Generate <sup>3</sup> (0.33 to 11) nF (11 to 110) nF (110 to 330) nF (0.33 to 1.1) μF (1.1 to 3.3) μF (3.3 to 11) μF (11 to 33) μF (33 to 110) μF (110 to 330) μF (330 to 1.1) mF	50 Hz to 1 kHz 50 Hz to 1 kHz 50 Hz to 1 kHz 50 Hz to 1 kHz 50 Hz to 1 kHz (50 to 400) Hz (50 to 400) Hz (50 to 200) Hz (50 to 100) Hz (50 to 100) Hz	5.5 μF/F + 0.043 nF 2.9 μF/F + 0.16 nF 2.7 μF/F + 0.45 nF 0.0021 μF/F + 2.4 μF 0.0037 μF/F + 4.4 μF 0.0039 μF/F + 12 μF 0.0045 μF/F + 38 μF 0.0059 μF/F + 130 μF 0.0077 μF/F + 360 μF 0.013 μF/F + 420 μF	Fluke 5500A/SC600
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 <sub>(p-p)</sub> 1 mV to 130 V <sub>(p-p)</sub> 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	Fluke 5500A/SC600 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 to -100) °C (-100 to -30) °C (-30 to 150) °C (150 to 760) °C (760 to 1200) °C	0.34 °C 0.25 °C 0.21 °C 0.22 °C 0.26 °C	Fluke 5500A/SC600
Type K	(-200 to -100) °C (-100 to -25) °C (-25 to 120) °C (120 to 1000) °C (1000 to 1372) °C	0.39 °C 0.26 °C 0.22 °C 0.30 °C 0.38 °C	
Type T	(-250 to -150) °C (-150 to 0) °C (0 to 120) °C (120 to 400) °C	0.66 °C 0.30 °C 0.22 °C 0.31 °C	

#### V. Mechanical

Parameter/Equipment	Range	CMC <sup>2, 5</sup> (±)	Comments
Force <sup>3</sup> –			
Load Cells	(0 to 1000) lbf (1000 to 10 000) lbf (10 000 to 50 000) lbf	0.28 % 0.083 % 0.32 %	Load cells Precision weights
Compression & Tension Testing Machines	(0 to 1000) lbf (1000 to 10 000) lbf (10 000 to 50 000) lbf	0.28 % 0.083 % 0.32 %	
Spring Testers	(0 to 1000) lbf (1000 to 10 000) lbf (10 000 to 50 000) lbf	0.28 % 0.083 % 0.32 %	
Dynamometers	(0 to 1000) lbf (1000 to 10 000) lbf (10 000 to 50 000) lbf	0.28 % 0.083 % 0.32 %	
Durometers <sup>3</sup>	(0 to 10) lbf	0.20 %	Scale or load cell

Parameter/Equipment	Range	CMC <sup>2,5</sup> (±)	Comments
Pressure/Vacuum Gauges <sup>3</sup> Transducers <sup>3</sup>	(-14.7 to 100) psig	0.21 % full scale	Druck DPI 610
	(0 to 10 000) psi	0.1 % full scale	Dead weight tester
Torque Testers <sup>3</sup>	2 in·ozf to 100 in·lbf (10 to 250) ft·lbf (251 to 1500) ft·lbf	(0.059 + 0.00070A) in·lbf (0.060 + 0.012A) ft·lbf (1.3 + 0.0070A) ft·lbf	Weights & radius arms A is applied Torque
Torque Tools <sup>3</sup>	2 in·ozf to 250 ft·lbf (250 to 1000) ft·lbf	1.3 % 1.6 %	Torque tester
Mass (Weights) <sup>3</sup>	(0.1 to 1.0) lb	3 mg	520 g scale
	(1 to 10) lb	120 mg	Verification with Class 1, 4 and F weights
	(10.1 to 75) lb	0.0012 lb (550 mg)	Precision scale
Scales & Balances <sup>3</sup>	1 g to 3 kg (3.1 to 25) kg	(0.20 + 0.6R) g (1.0 + 0.6R) g	Verification with Class 1, 4 and F weights
	(50 to 1000) lb (1001 to 5000) lb (5001 to 10 000) lb	(0.30 + 0.6R) lb (1.6 + 0.6R) lb (2.1 + 0.6R) lb	R is resolution of scale/balance
Indirect Verification of Brinell Hardness Testers at the Test Conditions: <sup>3</sup>			
10/3000/15	< 225 HBW (225 to 650) HBW	1.9 HBW 2.4 HBW	Indirect verification method per ASTM E10

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
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<p>Indirect Verification of Microindentation Hardness Testers (Knoop &amp; Vickers)<sup>3</sup> –</p> <p>Knoop</p> <p>Vickers</p>	<p>(100 to 250) HK (251 to 650) HK &gt; 650 HK</p> <p>(100 to 240) HV (241 to 600) HV &gt; 600 HV</p>	<p>11 KHN 33 KHN 64 KHN</p> <p>26 HV 75 HV 164 HV</p>	<p>Indirect verification method per ASTM E384</p>
<p>Indirect Verification of Rockwell &amp; Rockwell Superficial Hardness Testers<sup>3</sup></p>	<p>HRA: (20 to 65) HRA (70 to 78) HRA (80 to 84) HRa</p> <p>HRBW: (40 to 59) HRBW (60 to 79) HRBW (80 to 100) HRBW</p> <p>HRC: (20 to 30) HRC (35 to 55) HRC (60 to 65) HRC</p> <p>HR15N: (70 to 77) HR15N (78 to 88) HR15N (90 to 92) HR15N</p> <p>HR30N: (42 to 50) HR30N (55 to 73) HR30N (77 to 82) HR30N</p> <p>HR45N: (20 to 31) HR45N (37 to 61) HR45N (66 to 72) HR45N</p> <p>HR15TW: (74 to 80) HR15TW (81 to 86) HR15TW (87 to 93) HR15TW</p>	<p>1.4 HRA 1.4 HRA 1.5 HRA</p> <p>1.9 HRBW 1.5 HRBW 1.0 HRBW</p> <p>1.3 HRC 1.4 HRC 1.0 HRC</p> <p>1.3 HR15N 1.2 HR15N 1.4 HR15N</p> <p>1.9 HR30N 2.0 HR30N 1.8 HR30N</p> <p>1.4 HR45N 1.4 HR45N 1.4 HT45N</p> <p>1.5 HR15TW 1.5 HR15TW 1.7 HR15TW</p>	<p>ASTM E18</p>

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
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Indirect Verification of Rockwell & Rockwell Superficial Hardness Testers <sup>3</sup> (cont)	HR30TW: (43 to 56) HR30TW (57 to 69) HR30TW (70 to 83) HR30TW  HR45TW: (13 to 32) HR45TW (33 to 52) HR45TW (53 to 73) HR45TW	1.9 HR30TW 2.0 HR30TW 1.8 HR30TW  2.0 HR45TW 1.7 HR45TW 1.7 HR45TW	ASTM E18
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#### VI. Thermodynamics

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Infrared Thermometers <sup>3</sup>	(70 to 750) °F	(1.6 + 0.0022T) °F	Black body calibrator T is measured Temperature

#### VII. Time & Frequency

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Frequency – Measuring Equipment <sup>3</sup>	(0 to 12) kHz (12 kHz to 2) MHz	28 µHz/Hz + 1.3 mHz 26 µHz/Hz + 16 mHz	Fluke 5500A
	50 kHz to 600 MHz	2.7 µHz/Hz	Fluke 5500A/SC600
Frequency – Measure <sup>3</sup>	(0 to 160) MHz 40 MHz to 1.3 GHz	3.2 µHz/Hz 5.9 µHz/Hz	Racal Dana 1992
Timers <sup>3</sup>	(0 to 24) hrs	5.9 µs/s	Racal Dana 1992

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

<sup>2</sup> Calibration and Measurement Capability Uncertainty (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 numerical value of the resolution of the device in microinches.
- <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. CMC's 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.