



SCOPE OF ACCREDITATION TO ISO/IEC 17025:2005
& ANSI/NCSL Z540-1-1994

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CALIBRATION

Valid To: February 28, 2020

Certificate Number: 1741.14

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory to perform the following calibrations¹:

I. Chemical

Parameter/Equipment	Range	CMC ² (±)	Comments
pH Meters ³	4 7 10	0.04 0.04 0.05	Standard pH solutions
Conductivity Meters ³	0.77 µS/cm 9.76 µS/cm 99.4 µS/cm 996 µS/cm	0.37 µS/cm 0.38 µS/cm 2.2 µS/cm 5.4 µS/cm	Standard conductivity solutions
Refractometers ³	(5, 15, 40, 70) % Brix	0.033 % Brix	Sucrose solutions

II. Dimensional

Parameter/Equipment	Range	CMC ^{2,5} (±)	Comments
Pin Gage ³ – Class ZZ	Up to 1.0 in	80 µin	Micrometer
Calipers ³	Up to 60 in	(4.6 + 9.8 L) µin + 0.6R	Gage blocks

Parameter/Equipment	Range ⁵	CMC ^{2,5} (\pm)	Comments
Micrometers ³	Up to 60 in	$(4.6 + 9.8L) \mu\text{in} + 0.6R$	Gage blocks
Linear Indicators ³ – Dial and Test	Up to 4 in	$(3 + 9.4L) \mu\text{in} + 0.6R$	Gage blocks
Height Gages ³	Up to 48 in	$(53 + 8.9L) \mu\text{in} + 0.6R$	Gage blocks w/surface plate
Steel Rules ³	Up to 72 in	$(1.5 + 10L) \mu\text{in} + 0.6R$	Gage blocks
Tape Measures ³	(Up to 25) ft	$(1.5 + 10L) \mu\text{in} + 0.6R$	Gage blocks
Angle Indicators and Protractors ³	30°, 45°, 60°, 75°, 90°	0.03°	Angle block set
Feeler/Thickness Gages ³	Up to 1 in	80 μin	Micrometer
Coating Thickness Gages ³ (Film, Ultrasonic)	Up to 60 mils	0.1 mils	Coating thickness standards
Optical Comparators ³	Up to 18 in 10x to 250x 0 to 90°	150 μin 0.014 in 0.1°	Glass Scale Angle block set
Vision systems ³ – X-Y Linearity	Up to 18 in	$(52 + 2.9L) \mu\text{in}$	Grid plate
Z Axis	Up to 4 in	60 μin	Gage blocks

Parameter/Equipment	Range	CMC ^{2,5} (±)	Comments
Interim Verification of Coordinate Measuring Machines ³ –			
X, Y, Z Linearity	Up to 36 in	(30 + 2.9L) μin	Gage blocks
Volumetric Performance	Up to 10 in	120 μin	Ball bar
Laser Micrometers ³	Up to 2 in	(20 + 3.7L) μin	Plug gages
Surface Plates ³ Grades AA, A and B –			
Repeatability	0.002 in	40 μin	Repeat-o-meter
Flatness	Up to 60 DL in (>60 to 120) DL in	(31 + 0.2DL) μin (30 + 0.3DL) μin	Federal level system

III. Electrical – DC/Low Frequency

Parameter/Equipment	Range	CMC ^{2,6} (±)	Comments
DC Voltage – Measure ³	(0 to 100) mV	11 μV/V + 3 μV	Agilent 3458A
	100 mV to 1 V	10 μV/V + 0.3 μV	
	(1 to 10) V	10 μV/V + 0.05 μV	
DC Voltage – Measure ³	(10 to 100) V	12 μV/V + 0.3 μV	Vitretek 4700 w/ HVL-100
	(100 to 1000) V	27 μV/V + 0.1 μV	
	(1 to 10) kV	0.03 % + 0.03 V	
DC Voltage – Generate ³	(10 to 100) kV	0.05 % + 0.3 V	Fluke 5500A
	(0 to 330) mV	73 μV/V + 3 μV	
	330 mV to 3.3 V	61 μV/V + 5 μV	
DC Voltage – Generate ³	(3.3 to 33) V	61 μV/V + 50 μV	
	(33 to 330) V	67 μV/V + 500 μV	
	(100 to 1020) V	69 μV/V + 1.5 mV	

Parameter/Equipment	Range	CMC ^{2, 6} (\pm)	Comments
DC Current – Measure ³	(0 to 100) nA 100 nA to 1 μ A (1 to 10) μ A (10 to 100) μ A 100 μ A to 1 mA (1 to 10) mA (10 to 100) mA 100 mA to 1 A Up to 100A	32 μ A/A + 0.04 nA 23 μ A/A + 0.04 nA 23 μ A/A + 0.1 nA 23 μ A/A + 0.8 nA 23 μ A/A + 5 nA 23 μ A/A + 50 nA 37 μ A/A + 0.5 μ A 0.011 % + 10 μ A 0.25 %	Agilent 3458A Empro Shunt w/ Agilent 3458A
DC Current – Generate ³	(0 to 3.3) mA (3.3 to 33) mA (33 to 330) mA 330 mA to 2.2 A (2.2 to 11) A	0.016 % + 0.05 μ A 0.013 % + 0.25 μ A 0.013 % + 3.3 μ A 0.037 % + 44 μ A 0.08 % + 330 μ A	Fluke 5500A
DC Current – Generate Clamp-On Meters (Toroidal) (Non-Toroidal)	Up to 550 A Up to 550 A	0.39 % + 0.5 A 0.65 % + 0.5 A	Fluke 5500A w/5500 coil
DC Power - Generate ³ 33 mV to 1020 V (3.3 to 329.99) mA (0.33 to 11) A	(0.01 to 330) W (0.33 to 11) kW	0.05 % 0.10 %	Fluke 5500A
Resistance – Measure ³	(0 to 10) Ω (10 to 100) Ω 100 Ω to 1k Ω (1 to 10) k Ω (10 to 100) k Ω 100 k Ω to 1M Ω (1 to 10) M Ω (10 to 100) M Ω 100 M Ω to 1 G Ω	18 $\mu\Omega/\Omega$ + 50 $\mu\Omega$ 15 $\mu\Omega/\Omega$ + 0.5 m Ω 14 $\mu\Omega/\Omega$ + 0.5 m Ω 12 $\mu\Omega/\Omega$ + 5 m Ω 12 $\mu\Omega/\Omega$ + 50 m Ω 17 $\mu\Omega/\Omega$ + 2 Ω 51 $\mu\Omega/\Omega$ + 100 Ω 0.05 % + 1 k Ω 0.5 % + 10 k Ω	Agilent 3458A

Parameter/Equipment	Range	CMC ^{2, 4, 6} (±)	Comments	
Resistance – Generate ³	(0 to 11) Ω (11 to 33) Ω (33 to 330) Ω 330 Ω to 3.3 kΩ (3.3 to 33) kΩ (33 to 110) kΩ (110 to 330) kΩ 330 kΩ to 3.3 MΩ (3.3 to 11) MΩ (11 to 33) MΩ (33 to 110) MΩ (110 to 330) MΩ	0.015 % + 0.008 Ω 0.015 % + 0.015 Ω 0.011 % + 0.015 Ω 0.011 % + 0.06 Ω 0.011 % + 0.6 Ω 0.014 % + 6 Ω 0.015 % + 6 Ω 0.019 % + 55 Ω 0.073 % + 550 Ω 0.13 % + 550 Ω 0.61 % + 5.5 kΩ 0.61 % + 17 kΩ	Fluke 5500A	
Insulation Resistance ³ – Fixed Points	1 MΩ, 10 MΩ 100 MΩ, 1 GΩ 10 GΩ, 100 GΩ	1.2 %	Standard resistors	
Inductance – Generate ³ Fixed Points	100 μH 50 mH 500 mH 2H	0.32 % 0.14 % 1.2 % 0.14 %	Genrad 1480 Series	
Capacitance – Generate ³	(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 μF to 1.1 mF	(50 to 1000) Hz (50 to 1000) Hz (50 to 1000) Hz (50 to 1000) Hz (50 to 1000) Hz (50 to 400) Hz (50 to 400) Hz (50 to 200) Hz (50 to 100) Hz (50 to 100) Hz	1 % + 0.01 nF 0.32 % + 0.1 nF 0.32 % + 0.3 nF 0.32 % + 1 nF 0.43 % + 3 nF 0.44 % + 10 nF 0.5 % + 30 nF 0.63 % + 100 nF 0.86 % + 300 nF 1.3 % + 300 nF	Fluke 5500A
Decade Steps	10 pF to 90 μF	1.3 %	Time electronics 1071	

Parameter/Range	Frequency	CMC ^{2, 4, 6} (±)	Comments
AC Voltage – Measure ³			
Up to 10 mV	(1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz	0.03 % + 0.03 % range 0.02 % + 0.01 % range 0.03 % + 0.01 % range 0.1 % + 0.01 % range 0.5 % + 0.01 % range 4 % + 0.02 % range	Agilent 3458A
10 mV to 10 V	(1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz	0.008 % + 0.004 % range 0.008 % + 0.002 % range 0.014 % + 0.002 % range 0.03 % + 0.002 % range 0.08 % + 0.002 % range 0.3 % + 0.01 % range	
(10 to 100) V	(1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz	0.02 % + 0.004 % range 0.02 % + 0.002 % range 0.02 % + 0.002 % range 0.035 % + 0.002 % range 0.12 % + 0.002 % range 0.4 % + 0.01 % range	
(100 to 600) V	(1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.041 % + 0.004 % range 0.041 % + 0.002 % range 0.061 % + 0.002 % range 0.013 % + 0.002 % range 0.31 % + 0.002 % range	
(Up to 10) kV	Up to 60 Hz	0.13 % + 0.1 V	Vitretek 4700 w/HVL-100
(10 to 100) kV	60 Hz	0.13 % + 0.4 V	

Parameter/Range	Frequency	CMC ^{2, 4, 6} (±)	Comments
AC Voltage – Generate ³			
(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	0.35 % + 20 μV 0.15 % + 20 μV 0.2 % + 20 μV 0.25 % + 20 μV 0.35 % + 33 μV 1 % + 60 μV	Fluke 5500 A
(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	0.25 % + 50 μV 0.05 % + 20 μV 0.10% + 20 μV 0.16 % + 40 μV 0.24 % + 170 μV 0.7 % + 330 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	0.15 % + 250 μV 0.03 % + 60 μV 0.08 % + 60 μV 0.14 % + 300 μV 0.24 % + 1.7 mV 0.5 % + 3.3 mV	
(3.3 to 33) V	(10 to 45) Hz 45 Hz to 10 kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.15 % + 2.5 mV 0.04 % + 600 μV 0.08 % + 2.6 mV 0.19 % + 5 mV 0.24 % + 17 mV	
(33 to 330) V	45 Hz to 1 kHz (1 to 10) kHz (10 to 20) kHz	0.05 % + 6.6 mV 0.08 % + 15 mV 0.09 % + 33 mV	
(330 to 1000) V	45 Hz to 1 kHz (1 to 5) kHz 5 kHz to 10 kHz	0.06 % + 80 mV 0.2 % + 100 mV 0.2 % + 500 mV	

Parameter/Range	Frequency	CMC ^{2,4} (±)	Comments
AC Current – Measure ³			
(0 to 100) µA	(10 to 20) Hz (20 to 45) Hz 45 Hz to 1 kHz 100 Hz to 5 kHz	0.4 % + 0.03 % range 0.15 % + 0.03 % range 0.06 % + 0.03 % range 0.06 % + 0.03 % range	Agilent 3458A
(1 to 100) mA	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz (5 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.4 % + 0.02 % range 0.15 % + 0.02 % range 0.06 % + 0.02 % range 0.03 % + 0.02 % range 0.06 % + 0.02 % range 0.4 % + 0.04 % range 0.55 % + 0.15 % range	
(0.1 to 1) A	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz (5 to 20) kHz (20 to 50) kHz	0.4 % + 0.02 % range 0.16 % + 0.02 % range 0.08 % + 0.02 % range 0.1 % + 0.02 % range 0.3 % + 0.02 % range 1 % + 0.04 % range	
(1 to 10) A	(45Hz to 1 kHz)	0.97 % + 5 mA	Fluke 287
1 to 100A	@ 60) Hz	0.32%	Empro Shunt w/DMM
AC Current – Generate ³			
(29 to 330) µA	(10 to 20) Hz (20 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.3 % + 0.15 µA 0.15 % + 0.15 µA 0.15 % + 0.25 µA 0.48 % + 0.15 µA 1.5 % + 0.15 µA	Fluke 5500A
0.33 mA 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	0.24 % + 0.3 µA 0.12 % + 0.3 µA 0.12 % + 0.3 µA 0.24 % + 0.3 µA 0.72 % + 0.3 µA	
(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	0.24 % + 3 µA 0.12 % + 3 µA 0.11 % + 3 µA 0.24 % + 3 µA 0.72 % + 3 µA	
(33 to 330) mA	(10 to 20) Hz (20 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.24 % + 30 µA 0.12 % + 30 µA 0.11 % + 30 µA 0.24 % + 30 µA 0.72 % + 30 µA	

Parameter/Range	Frequency	CMC ^{2,4} (±)	Comments
AC Current – Generate ³ (Cont) 330 mA to 2.2 A (2.2 to 11) A	(10 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (45 to 65) Hz (65 to 500) Hz 500 Hz to 1 kHz	0.24 % + 300 μA 0.12 % + 300 μA 0.9 % + 300 μA 0.08 % + 2 mA 0.12 % + 2 mA 0.4 % + 2 mA	Fluke 5500A
AC Current – Generate Clamp-On Meters – (Up to 550) A (Toroidal) (Non Toroidal)	(50 to 400) Hz (50 to 400) Hz	0.43 % + 0.5 A 0.68 % + 0.5 A	Fluke 5500A w/5500 coil
AC Power – Generate ³ (45 to 65) Hz; (33 to 330) mV, PF=1 (3.3 to 8.99) mA (9 to 32.99) mA (33 to 89.99) mA (90 to 329.99) mA (0.33 to 0.8999) A (0.9 to 2.1999) A (2.2 to 4.4999) A (4.5 to 11) A	110 μW to 3 mW (3 to 11) mW (1.1 to 30) mW (3 to 110) mW (11 to 300) mW (30 to 730) mW 73 mW to 1.5 W 150 mW to 3.6 W	0.48 % 0.3 % 0.42 % 0.3 % 0.42 % 0.3 % 0.42 % 0.3 %	Fluke 5500A

Parameter/Equipment	Range	CMC ^{2,4} (±)	Comments
AC Power – Generate ³ (45 to 65) Hz; 330 mV to 1020 V, PF=1			
(3.3 to 8.99) mA	1.1 mW to 9 W	0.3 %	Fluke 5500A
(9 to 32.99) mA	3 mW to 33 W	0.18 %	
(33 to 89.99) mA	11 mW to 90 W	0.3 %	
(90 to 329.99) mA	30 mW to 330 W	0.18 %	
(0.33 to 0.8999) A	110 mW to 900 W	0.3 %	
(0.9 to 2.1999) A	300 mW to 2200 W	0.18 %	
(2.2 to 4.4999) A	730 mW to 4500 W	0.25 %	
(4.5 to 11) A	1.5 kW to 11.2 kW	0.3 %	
Thermocouple Simulation ³ –			
Type B	(600 to 800) °C (800 to 1820) °C	0.58 °C 0.47 °C	Fluke 5500A
Type E	(-250 to -100) °C (-100 to 650) °C (650 to 1000) °C	0.64 °C 0.38 °C 0.34 °C	
Type J	(-210 to -100) °C (-100 to 760) °C (760 to 1200) °C	0.4 °C 0.31 °C 0.36 °C	
Type K	(-200 to -100) °C (-100 to 1000) °C (1000 to 1372) °C	0.46 °C 0.39 °C 0.53 °C	
Type R	(0 to 250) °C (250 to 1000) °C (1000 to 1767) °C	0.72 °C 0.48 °C 0.53 °C	
Type S	(0 to 250) °C (250 to 1400) °C (1400 to 1767) °C	0.61 °C 0.5 °C 0.6 °C	
Type T	(-250 to -150) °C (-150 to 0) °C (0 to 400) °C	0.79 °C 0.37 °C 0.3 °C	

Parameter/Equipment	Range	CMC ^{2,4} (±)	Comments
RTD ³ –			
Simulation Pt 50 thru 1000	(-200 to 200) °C (200 to 600) °C (600 to 800) °C	0.19 °C 0.31 °C 0.43 °C	Beamex MC2-MF
Measure – 4 Wire Pt 50 thru 1000	(-200 to 200) °C (200 to 600) °C (600 to 800) °C	0.13 °C 0.25 °C 0.37 °C	
Oscilloscopes ³ –			
Square Wave Amplitude:			Fluke 5500A SC600
50 Ω at 1 kHz	1.0 mV to 6.6 V _{pk-pk}	0.32 % + 40 μV	
1 MΩ at 1 kHz	1.0 mV to 130 V _{pk-pk}	0.16 % + 40 μV	
DC Voltage Amplitude:			
50 Ω Load	(0 to ±6.6) V	0.3 % + 40 μV	
1 MΩ Load	(0 to ±130) V	0.07 % + 40 μV	
Level Sine Wave:			
Frequency	Up to 600 MHz	3.3 μHz/Hz	
Amplitude	50 kHz Reference 50 kHz to 100 MHz (100 to 300) MHz (300 to 600) MHz	2.4 % + 300 μV 4.4 % + 300 μV 4.9 % + 300 μV 7.3 % + 300 μV	
Flatness (Bandwidth)	50 kHz to 100 MHz (100 to 300) MHz (300 to 600) MHz	2.1 % + 100 μV 2.6 % + 100 μV 4.9 % + 100 μV	
Time Markers:			
Into a 50 Ω Load	5 s to 50 ms 20 ms to 1 ns	(30 + 1000 <i>t</i>) μs/s 3.5 μs/s	<i>t</i> = time in seconds
Rise Time:	1 kHz to 10 MHz < 300 ps	120 pS 120 pS	

IV. Electrical – RF/Microwave

Parameter/Equipment	Range	CMC ^{2,6} (±)	Comments
RF Power – Measure 10 MHz to 18 GHz	(-20 to 30) dBm 1 μW to 100 mW	1.8 %	HP EMP-442A/8481A
	(0 to 44) dBm 1 mW to 25 W	1.8 %	HP EMP-442A/8481B
	(-10 to 35) dBm 100 μW to 3 W	1.8 %	HP EMP-442A/8481H
50 MHz	1 μW to 10 mW	1.4 %	HP 432A w/ 478A
Power Meters – Range Calibration	3 μW to 100 mW	0.3 %	HP 11683A range calibrator

V. Fluid Quantities

Parameter/Equipment	Range	CMC ² (±)	Comments
Fume Hoods – Air Velocity Only ³	(20 to 200) ft/min	4.5 %	Anemometer
Viscosity Meters ³	202 cP 480 cP 2 000 cP 16 000 cP 32 000 cP	1.5 cP 1.4 cP 1.4 cP 1.5 cP 150 cP	Standard viscosity solution w/ bath

VI. Mechanical

Parameter/Equipment	Range	CMC ^{2, 5, 6} (±)	Comments
Force – Measure, Measuring Equipment ³	Up to 1000 lbf Up to 250 lbf Up to 500 lbf Up to 1000 lbf Up to 5000 lbf Up to 10000 lbf Up to 20000 lbf	0.017 % + 0.6R 0.23 lbf 0.43 lbf 0.9 lbf 4.8 lbf 9 lbf 19 lbf	Class F weights Load cells w/ indicator
Scales and Balances ³	(1 to 20 000) g (>20 to 5000) kg Up to 1000 lbs (1000 to 120 000) lbs (1 to 500) mg Up to 5 g Up to 10 g Up to 30 g Up to 50 g Up to 100 g Up to 200 g Up to 300 g Up to 500 g Up to 1000 g Above 1000 g	0.017 % + 0.6R 0.017 % per 20 000 lb + 0.6R 0.017 % + 0.6R 0.017 % per 20 000 lb + 0.6R 0.013 mg + 0.6R 0.043 mg + 0.6R 0.062 mg + 0.6R 0.092 mg + 0.6R 0.17 mg + 0.6R 0.31 mg + 0.6R 0.63 mg + 0.6R 0.93 mg + 0.6R 1.5 mg + 0.6R 3.1 mg + 0.6R 3.1 mg per 1000 g + 0.6R	Class F weights (applied load) Class 1 weights (applied load)
Torque – Measuring Equipment ³	5 in·lbf to 600 ft·lbf	0.65 %	CDI Suretest 5000-ST
Rotary Torque Tools ³	(0.02 to 2) N·m (1 to 10) N·m (02 to 20) N·m (0.75 to 75) N·m (18 to 180) N·m (50 to 500) N·m	1.3 % FS 1.3 % FS 1.3 % FS 1.3 % FS 1.3 % FS 1.3 % FS	Crane – torque star w/rotary transducers

Parameter/Equipment	Range	CMC ^{2,5,6} (±)	Comments
Torque Testers ³	Up to 250 ft·lbf	0.13 %	Class F weights & arms
Atmospheric Pressure (Vacuum) ³	(0.01 to 28.5) inHg	0.011 in Hg	Heise ST-2H with HQS Series Modules
Barometric Pressure ³	(17 to 34) inHg	0.02%	Mensor CPG2300
Pressure – Measuring, Measuring Equipment ³ – Pneumatic & Hydraulic	Up to 50 in H ₂ O Up to 10 psig Up to 50 psig Up to 100 psig Up to 500 psig Up to 1500 psig (0 to 3000) psig (5 to 10 000) psig	0.038 in H ₂ O 0.04 % FS 0.03 % FS 0.033 % FS 0.035 % FS 0.035 % FS 0.07 % FS 0.07 % FS	Heise ST-2H with HQS series modules Druck DPI-104-3000 Druck DPI-104-10K
Indirect Verification of Rockwell Hardness Testers ³	HRC: Low Medium High HRBW: Low Medium High HRA: Low Medium High HREW Low Medium High	0.92 HRC 0.92 HRC 0.92 HRC 1.6 HRBW 1.2 HRBW 1 HRBW 0.82 HRA 0.81 HRA 0.81 HRA 0.81HREW 0.81 HREW 0.81 HREW	Indirect verification per ASTM E18

Parameter/Equipment	Range	CMC ^{2,6} (±)	Comments
Indirect Verification of Rockwell Hardness Testers ³ (cont)	HR15N Low Medium High HR30N Low Medium High HR45N Low Medium High HR15TW Low Medium High HR30TW Low Medium High HR45TW Low Medium High	0.81 HR15N 0.81 HR15N 0.81 HR15N 0.82 HR30N 0.82 HR30N 0.82 HR30N 0.82 HR45N 0.81 HR45N 0.82 HR45N 0.81 HR15TW 0.81 HR15TW 0.82 HR15TW 0.82 HR30TW 0.81 HR30TW 0.81 HR30TW 0.81 HR45TW 0.81 HR45TW 0.81 HR45TW	Indirect verification per ASTM E18
Indirect Verification of Vickers Hardness Testers ³ Vickers < 1 kgf	HV: Low Mid High	2.9 HV 11 HV 11 HV	ASTM E384 w/ ASTM E92
Indirect Verification of Brinell Hardness Testers ³ – HBW 10mm/3000kg	HBW: Low Medium High	4.5 HBW 4.5 HBW 2.6 HBW	ASTM E10

Parameter/Equipment	Range	CMC ^{2,6} (±)	Comments
Speed ³ – Optic/Non-Contact:			
RPM Totalizer/Rate Meters	(6 to 200 000) rpm	0.017 %	Monarch PLT200
Contact: RPM Totalizer/Rate Meters	(0.5 to 20 000) rpm	0.22 %	Monarch PLT200 w/ 10cm wheel
Speed/RPM/Rate Simulation	(6 to 200 000) rpm	0.003%	Agilent 33120A

VII. Thermodynamics

Parameter/Equipment	Range	CMC ² (±)	Comments
Relative Humidity – Measure, Measuring Equipment ³	(10 to 90) % RH	1.2 % RH	Vaisala M170 w/ HMP-76
Temperature – Measure ³	(-200 to 0) °C	0.038 °C	Fluke 1523 w/ 5615 PRT Probe
	(0 to 300) °C	0.05 °C	
	(300 to 420) °C	0.08 °C	Fluke 1523 w/5624 PRT Probe
	(300 to 1000) °C	0.11 °C	
Temperature – Measuring Equipment ³	(-30 to 125) °C	0.34 °C	Fluke 7103 micro bath
	(33 to 300) °C	1.1 °C	Thermoworks 3001
	(150 to 1000) °C	3.1 °C	Hart 9150 furnace w/5624 PRT Probe
	(1000 to 1200) °C	7.2 °C	Hart 9150 furnace

VIII. Time and Frequency

Parameter/Equipment	Range	CMC ^{2, 6} (±)	Comments
Timers & Stopwatches ³	(1 to 3600) s	0.2 s	Stopwatch
Frequency – Generate ³	0.01 Hz to 2 MHz	30 µHz/Hz + 5 µHz	Fluke 5500A
	Up to 15 MHz	0.003 %	HP 33120A
	5 kHz to 3 GHz	0.44 µHz/Hz	R&S Model SME03
Frequency – Measure ³	(0 to 350) MHz	0.35 µHz/Hz	Agilent 53220A

¹ This laboratory offers commercial calibration and field calibration services, where noted.

² 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. Calibration and Measurement Capabilities 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.

³ 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.

⁴ The stated measured values are determined using the indicated instrument (see Comments). This capability is suitable for the calibration of the devices intended to measure or generate the measured value in the ranges indicated. CMC's are expressed as either a specific value that covers the full range or as a percent or fraction of the reading plus a fixed floor specification.

⁵ The statement of the CMC, L is the numerical value of the nominal length of the device measured in inches, R is the numerical value of the resolution of the device in microinches. In the statement of the Range or the CMC, DL is the diagonal length of the device in inches.

⁶ Unless otherwise noted, percentage refers to percent of reading.

⁷ The type of instrument or material being calibrated is defined by the parameter. This indicates the laboratory is capable of calibrating instruments that measure or generate the values in the ranges indicated for the listed measurement parameter.



Accredited Laboratory

A2LA has accredited

J.A. KING & COMPANY, LLC

Ledbetter, KY

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 8 January 2009).



Presented this 29th day of December 2017.

A handwritten signature in black ink, written over a horizontal line.

President and CEO
For the Accreditation Council
Certificate Number 1741.14
Valid to February 29, 2020
Revised October 18, 2018

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