



SCOPE OF ACCREDITATION TO ISO/IEC 17025:2005,
ANSI/NCSL Z540-1-1994 & ANSI/NCSL Z540.3-2006

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CALIBRATION

Valid To: November 30, 2018

Certificate Number: 2348.01

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 – Measuring Equipment ³	4.00 pH 7.00 pH 10.0 pH	0.023 pH 0.019 pH 0.025 pH	Standard buffer solution
Conductivity – Measuring Equipment ³	10 µS 100 µS 1412 µS 10 004 µS	1.8 µS 2.8 µS 6.6 µS 64 µS	Standard conductivity solution

II. Dimensional

Parameter/Equipment	Range	CMC ^{2,6} (±)	Comments
Gage Blocks	Up to 4 in (> 4 to 20) in	(3.1 + 1.5L) µin (4.3 + 1.6L) µin	Electronic comparator, master steel gage blocks
Micrometer ³	Up to 12 in	(4.8L + 0.6R) µin	Gage blocks

Parameter/Equipment	Range	CMC ^{2,6} (\pm)	Comments
Caliper ³	Up to 20 in	$(4.8L + 0.6R) \mu\text{in}$	Gage blocks
Dial Indicator ³	Up to 4 in	$(4.8L + 0.6R) \mu\text{in}$	Gage blocks
Height Gages ³	Up to 40 in	$(4.8L + 0.6R) \mu\text{in}$	Gage blocks
Cylindrical Plug, Pins and Ring Gages	Up to 1 in (>1 to 4) in (>4 to 16) in	$(7.3 + 1.3D) \mu\text{in}$ $(6.7 + 1.3D) \mu\text{in}$ $(11 + 1.5D) \mu\text{in}$	Universal measuring standard-Supra-500
Optical Flats	(1 to 8) in	6.0 μin	Standard optical flat
Thread Wires	(4 to 80) TPI	14 μin	Universal measuring standard-Supra-500
Measuring Microscopes ³	Up to 12 in	$(180 + 6.2L) \mu\text{in}$	Glass scale
Thread Plug Gage – Major/Pitch Diameter	(96 to 5) TPI	$(24 + 0.5D) \mu\text{in}$	Universal measuring standard-Supra-500 w/ thread wires
Thread Plug Gage – Minor Lead Angle	(96 to 5) TPI	$(95 + 5.4D) \mu\text{in}$ $(96 + 3.1D) \mu\text{in}$ 0.085 °	Quest thread view machine
Thread Ring Gage	(80 to 4.5) TPI	$(67 + 0.5D) \mu\text{in}$	Universal measuring standard-Supra-500 w/ probe

Parameter/Equipment	Range	CMC ² (±)	Comments
Surface Plate ³ – Flatness Repeatability	From (6 x 6) in to (36 x 72) in	13 μin 28 μin	Autocollimator Repeat-o-meter
Optical Comparator ³ – X axis Y axis	Up to 8 in Up to 4 in	71 μin 70 μin	Starrett-Sigma optical comparator HB 400
Angle Blocks ³	Up to 45°	1.4 arc sec	Sine plate, gage blocks and electronic indicator
Length	(0 to 40) in	1.5 m·in	Gage blocks, CMM, Supra 500, etc
Crimping Tools ³	Up to 1 in diameter	0.16 m·in	Pin gages, optical comparator, and pull tester
Precision Levels ³	(2 to 15) in	0.15 m·in	Gage blocks
Protractors/Clinometer ³	Up to 180°	41 arc sec	Sine Plate w/ angle blocks

III. Electrical – DC/Low Frequency

Parameter/Equipment	Range	CMC ^{2,4,6} (±)	Comments
DC Voltage – Generate ³	Up to 220 mV 220 mV to 2.2 V (2.2 to 11) V (11 to 22) V (22 to 220) V (220 to 1100) V	10 µV/V + 0.40 µV 6.4 µV/V + 0.70 µV 3.7 µV/V + 2.5 µV 3.7 µV/V + 4.0 µV 5.2 µV/V + 40 µV 6.9 µV/V + 0.40 mV	Fluke 5720A
DC Voltage – Measure ³	Up to 100 mV (0.1 to 1) V (1 to 10) V (10 to 100) V (100 to 1000) V	10 µV/V + 0.45 µV 6.1 µV/V + 0.50 µV 5.9 µV/V + 1.1 µV 8.9 µV/V + 50 µV 11 µV/V + 0.16 mV*	HP 3458A, option 002 *Add 12 µV/V × (V _{in} /100) ² for input >100 V
High Voltage	(1000 to 10 000) V (10 000 to 70 000) V	0.042 % + 0.6R 0.048 % + 0.6R	Vitretek 4700/HLV-70
DC Current – Generate ³	Up to 220 µA 220 µA to 2.2 mA (2.2 to 22) mA (22 to 220) mA 220 mA to 2.2 A Up to 20A	43 µA/A + 6.0 nA 53 µA/A + 7.0 nA 38 µA/A + 40 nA 45 µA/A + 0.70 µA 82 µA/A + 12.0 µA 53 µA/A + 0.50 mA	Fluke 5720A Fluke 5520A



Parameter/Equipment	Range	CMC ^{2,4,5} (±)	Comments
DC Current – Measure ³	Up to 100 nA 100 nA to 1 µA (1 to 10) µA (10 to 100) µA 100 µA to 1 mA (1 to 10) mA (10 to 100) mA 100 mA to 1A	0.022 % + 60 pA 36 µA/A + 60 pA 27 µA/A + 0.14 nA 33 µA/A + 1.1 nA 32 µA/A + 6.0 nA 31 µA/A + 70 nA 50 µA/A + 0.70 nA 0.014 % + 13 µA	HP 3458A, option 002
Resistance – Generate, Fixed Points ³	(1, 1.9) Ω (10, 19) Ω (100, 190) Ω (1, 1.9) kΩ (10, 19) kΩ (100, 190) kΩ (1, 1.9) MΩ 10 MΩ 19 MΩ 100 MΩ	0.011 % 37 µΩ/Ω 12 µΩ/Ω 11 µΩ/Ω 9.5 µΩ/Ω 24 µΩ/Ω 43 µΩ/Ω 43 µΩ/Ω 71 µΩ/Ω 0.015 %	Fluke 5720A
Resistance – Measure ³	(0 to 10) Ω (10 to 100) Ω 100 Ω to 1 kΩ (1 to 10) kΩ (10 to 100) kΩ (0.1 to 1) MΩ (1 to 10) MΩ (10 to 100) MΩ	21 µΩ/Ω + 60 µΩ 20 µΩ/Ω + 0.60 mΩ 14 µΩ/Ω + 0.60 mΩ 14 µΩ/Ω + 6.0 mΩ 14 µΩ/Ω + 60 mΩ 20 µΩ/Ω + 3.0 Ω 71 µΩ/Ω + 0.30 kΩ 0.064 % + 1.2 kΩ	HP 3458A, option 002
Electrical Simulation of Thermocouple ³ –			
Type J	(-210 to -100) °C (-100 to -30) °C (-30 to 150) °C (150 to 760) °C (760 to 1200) °C	0.29 °C 0.18 °C 0.18 °C 0.20 °C 0.27 °C	Fluke 5520A
Type K	(-200 to -100) °C (-100 to -25) °C (-25 to 120) °C (120 to 1000) °C (1000 to 1372) °C	0.34 °C 0.20 °C 0.22 °C 0.29 °C 0.41 °C	

Parameter/Equipment	Range	CMC ² (±)	Comments
Electrical Simulation of Thermocouple ³ – (cont)			
Type T	(-250 to -150) °C (-150 to 0) °C (0 to 120) °C (120 to 400) °C	0.42 °C 0.25 °C 0.23 °C 0.22 °C	Fluke 5520A
Type N	(-200 to -100) °C (-100 to -25) °C (-25 to 120) °C (120 to 410) °C (410 to 1300) °C	0.43 °C 0.26 °C 0.22 °C 0.21 °C 0.30 °C	
Type E	(-250 to -100) °C (-100 to -25) °C (-25 to 350) °C (350 to 650) °C (650 to 1000) °C	0.51 °C 0.18 °C 0.19 °C 0.19 °C 0.23 °C	
Type B	(600 to 800) °C (800 to 1000) °C (1000 to 1550) °C (1550 to 1820) °C	0.45 °C 0.36 °C 0.34 °C 0.37 °C	
Type S	(0 to 250) °C (250 to 1000) °C (1000 to 1400) °C (1400 to 1767) °C	0.50 °C 0.37 °C 0.41 °C 0.50 °C	
Type R	(0 to 250) °C (250 to 400) °C (400 to 1000) °C (1000 to 1767) °C	0.59 °C 0.38 °C 0.34 °C 0.43 °C	



Parameter/Range	Frequency	CMC ^{2, 4} (±)	Comments
Capacitance – Generate ³ (10 to 1000) Hz	(0.19 to 0.4) nF (0.40 to 1.1) nF (1.1 to 3.3) nF (3.3 to 11) nF (11 to 33) nF (33 to 110) nF	0.54 % + 0.010 nF 0.54 % + 0.010 nF 0.51 % + 0.010 nF 0.26 % + 0.010 nF 0.26 % + 0.10 nF 0.26 % + 0.10 nF	Fluke 5520A
Capacitance – Generate ³ (10 to 1000) Hz (10 to 600) Hz (10 to 300) Hz (10 to 150) Hz (10 to 120) Hz (10 to 80) Hz DC to 50 Hz DC to 20 Hz DC DC DC DC	(0.11 to 0.33) μF (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 (0.11 to 0.33) mF (0.33 to 1.1) mF (1.1 to 3.3) mF (3.3 to 11) mF (11 to 33) mF (33 to 110) mF	0.26 % + 0.30 nF 0.26 % + 1.0 nF 0.26 % + 30 nF 0.26 % + 10 nF 0.41 % + 30 nF 0.47 % + 0.10 μF 0.47 % + 0.30 μF 0.46 % + 1.0 μF 0.46 % + 3.0 μF 0.46 % + 10 μF 0.76 % + 30 μF 1.2 % + 0.10 mF	Fluke 5520A



Parameter/Range	Frequency	CMC ^{2, 4} (±)	Comments
AC Voltage – Generate ³			
Up to 2.2 mV	(10 to 20) Hz	0.15 % + 4.0 μV	Fluke 5720A
	(20 to 40) Hz	0.16 % + 4.0 μV	
	40 Hz to 20 kHz	0.16 % + 4.0 μV	
	(20 to 50) kHz	0.25 % + 4.0 μV	
	(50 to 100) kHz	0.26 % + 5.0 μV	
	(100 to 300) kHz	0.38 % + 10 μV	
	(300 to 500) kHz	0.51 % + 20 μV	
	(0.5 to 1.0) MHz	0.90 % + 20 μV	
(2.2 to 22) mV	(10 to 20) Hz	0.040 % + 4.0 μV	
	(20 to 40) Hz	0.021 % + 4.0 μV	
	40 Hz to 20 kHz	0.022 % + 4.0 μV	
	(20 to 50) kHz	0.034 % + 4.0 μV	
	(50 to 100) kHz	0.073 % + 5.0 μV	
	(100 to 300) kHz	0.13 % + 10 μV	
	(300 to 500) kHz	0.17 % + 20 μV	
	(0.5 to 1.0) MHz	0.38 % + 20 μV	
(22 to 220) mV	(10 to 20) Hz	0.026 % + 12 μV	
	(20 to 40) Hz	0.010 % + 7.0 μV	
	40 Hz to 20 kHz	0.016 % + 7.0 μV	
	(20 to 50) kHz	0.024 % + 7.0 μV	
	(50 to 100) kHz	0.049 % + 17 μV	
	(100 to 300) kHz	0.095 % + 20 μV	
	(300 to 500) kHz	0.14 % + 25 μV	
	(0.5 to 1.0) MHz	0.29 % + 45 μV	



Parameter/Range	Frequency	CMC ^{2,4} (±)	Comments
AC Voltage – Generate ³ (cont)			
220 mV to 2.2 V	(10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (0.5 to 1.0) MHz	0.025 % + 40 µV 0.010 % + 15 µV 0.0056 % + 8.0 µV 0.0098 % + 10 µV 0.013 % + 30 µV 0.043 % + 80 µV 0.10 % + 0.20 mV 0.18 % + 0.30 mV	Fluke 5720A
(2.2 to 22) V	(10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (0.5 to 1.0) MHz	0.025 % + 0.40 mV 0.010 % + 0.15 mV 0.0074 % + 50 µV 0.0097 % + 0.10 mV 0.012 % + 0.20 mV 0.033 % + 0.60 mV 0.10 % + 2.0 mV 0.19 % + 3.2 mV	
(22 to 220) V	(10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz	0.026 % + 4.0 mV 0.010 % + 1.5 mV 0.0066 % + 0.60 mV 0.011 % + 1.0 mV 0.019 % + 2.5 mV	
AC Voltage – Measure ³			
Up to 10 mV	1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz	0.037 % + 3.1 µV 0.045 % + 3.1 µV 0.15 % + 3.1 µV 0.58 % + 3.0 µV 4.7 % + 4.0 µV	HP 3458A, option 002
(10 to 100) mV	1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (0.3 to 1) MHz	0.090 % + 2.1 µV 0.018 % + 2.1 µV 0.051 % + 2.1 µV 0.10 % + 2.1 µV 0.35 % + 10 µV 1.2 % + 10 µV	
100 mV to 1 V	1 kHz (1 to 20) kHz (20 to 50) kHz	0.010 % + 21 µV 0.018 % + 21 µV 0.037 % + 21 µV	

Parameter/Range	Frequency	CMC ^{2,4,6} (±)	Comments
AC Voltage – Measure ³ (cont)			
100 mV to 1 V	(50 to 100) kHz (100 to 300) kHz (0.2 to 1) MHz	0.095 % + 21 µV 0.35 % + 0.10 mV 1.2 % + 0.10 mV	HP 3458A, option 002
(1 to 10) V	(10 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (0.3 to 1) MHz	0.010 % + 0.40 mV 0.010 % + 0.21 mV 0.018 % + 0.21 mV 0.037 % + 0.21 mV 0.094 % + 0.21 mV 0.35 % + 1.0 mV 1.7 % + 1.0 mV	
(10 to 100) V	1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.025 % + 2.1 mV 0.026 % + 2.1 mV 0.043 % + 2.1 mV 0.14 % + 2.1 mV	
(100 to 1000) V	1 kHz (1 to 20) kHz	0.033 % + 21 mV 0.047 % + 21 mV	
High Voltage (1000 to 10 000) V (10 000 to 70 000) V	60 Hz 60 Hz	0.18 % + 0.6R 0.14 % + 0.6R	Vitrek 4700/HLV-70
AC Current – Generate ³			
Up to 220 µA	(10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (50 to 10) kHz	0.028 % + 16 nA 0.019 % + 10 nA 0.016 % + 8.0 nA 0.044 % + 12 nA 0.12 % + 65 nA	Fluke 5720A
220 µA to 2.2 mA	(10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.027 % + 40 nA 0.018 % + 35 nA 0.015 % + 350 nA 0.025 % + 0.11 µA 0.11 % + 0.65 µA	
(2.2 to 22) mA	(10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.028 % + 0.40 µA 0.018 % + 0.35 µA 0.015 % + 0.35 µA 0.024 % + 0.55 µA 0.11 % + 5.0 µA	

Parameter/Range	Frequency	CMC ^{2,4,5} (\pm)	Comments
AC Current – Generate ³ (cont)			
(22 to 220) mA	(10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.028 % + 4.0 μ A 0.018 % + 3.5 μ A 0.017 % + 2.5 μ A 0.026 % + 3.5 μ A 0.12 % + 10 μ A	Fluke 5720A
220 mA to 2.2 A	20 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.030 % + 35 μ A 0.051 % + 80 μ A 0.73 % + 0.16 mA	
AC Current – Measure ³			
Up to 100 μ A 100 μ A to 1 mA (1 to 10) mA (10 to 100) mA 100 mA to 1 A	100 Hz to 5 kHz	0.076 % μ A + 31 nA 0.037 % μ A + 0.21 μ A 0.040 % μ A + 2.1 μ A 0.040 % μ A + 21 μ A 0.12 % μ A + 0.21 mA	HP 3458A, option 002
Oscilloscopes ³ –			
Amplitude DC Signal Into 50 Ω Load Into 1 M Ω Load	(-6.6 to 6.6) V (-130 to 130) V	0.25 % + 40 μ V 0.050 % + 40 μ V	Fluke 5520A/SC1100
Rise Time	< 300 ps	+0 ps/-100 ps	
Leveled Sine Wave Flatness, Relative to 50 kHz 5 mV _(p-p) to 5.5 V _(p-p)	50 Hz to 100 MHz (100 to 300) MHz (300 to 600) MHz 600 MHz to 1.1 GHz	1.5 % + 100 μ V 2.0 % + 100 μ V 4.0 % + 100 μ V 5.0 % + 100 μ V	
Time Marker Into 50 Ω Load	(5 to 50) ms 20 ms to 2 ns	(25 + 1000 <i>t</i>) parts in 10 ⁶ 2.5 parts in 10 ⁶	<i>t</i> is time in seconds.
Gauss Meter ³	(0 to 200) Gauss	0.88 %	Helmholtz coil/zero gauss chamber
Tachometers ³	(40 to 35 000) RPM	0.012 %	Shimpo strobe

IV. Electrical – RF/Microwave

Parameter/Range	Frequency	CMC ^{2,5} (±)	Comments
<p>Power Sensor – Calibration Factors</p> <p>(-30 to 20) dBm (-30 to 20) dBm</p>	<p>0.1 MHz to 4.2 GHz 50 MHz to 26.5 GHz</p>	<p>2.8 % <i>CF</i> 3.5 % <i>CF</i></p>	<p>Agilent power sensors 8482A & 8485A <i>CF</i> is calibration factor</p>
<p>Amplitude Modulation³ –</p> <p>Carrier: (0.15 to 10) MHz Depth: Up to 99 %</p> <p>Carrier: 10 MHz to 1.3 GHz Depth: Up to 99 %</p>	<p>(20 to 50) Hz 50 Hz to 10 kHz</p> <p>(20 to 50) Hz 50 Hz to 50 kHz (50 to 100) kHz</p>	<p>3.8 % 2.7 %</p> <p>3.8 % 1.6 % 3.8 %</p>	<p>HP 8902A measuring receiver w/ 11722A power sensor</p>
<p>Frequency Modulation³ –</p> <p>Carrier: 250 kHz to 10 MHz Dev: Up to 40 kHz</p> <p>Carrier: 10 MHz to 1.3 GHz Dev: Up to 400 kHz</p>	<p>20 Hz to 10 kHz</p> <p>(20 to 50) Hz 50 Hz to 100 kHz (100 to 200) kHz</p>	<p>2.9 %</p> <p>5.9 % 1.3 % 5.9 %</p>	<p>HP 8902A measuring receiver w/ 11722A power sensor</p>
<p>Phase Modulation³ –</p> <p>Carrier: 150 kHz to 10 MHz</p> <p>Carrier: 10 MHz to 1.3 GHz</p>	<p>200 Hz to 10 kHz</p> <p>200 Hz to 20 kHz</p>	<p>4.8 %</p> <p>3.7 %</p>	<p>HP 8902A measuring receiver w/ 11722A power sensor</p>
<p>Relative Power – Measure³</p> <p>(0 to -10) dBm (-10 to -20) dBm (-20 to -30) dBm (-30 to -40) dBm (-40 to -50) dBm (-50 to -60) dBm</p>	<p>10 MHz to 26.5 GHz</p>	<p>0.080 dB 0.10 dB 0.12 dB 0.13 dB 0.15 dB 0.17 dB</p>	<p>HP 8902A measuring receiver w/ 11722A and 11792A power sensors</p>



Parameter/Range	Frequency	CMC ² (±)	Comments
Relative Power – Measure ³ (cont) (-60 to -70) dBm (-70 to -80) dBm (-80 to -90) dBm (-90 to -100) dBm	10 MHz to 26.5 GHz	0.20 dB 0.23 dB 0.28 dB 0.33 dB	HP 8902A measuring receiver w/ 11722A and 11792A power sensors

V. Fluid Quantities

Parameter/Equipment	Range	CMC ^{2,5} (±)	Comments
Flow – Gas ³	(0.5 to 5) sccm (5 to 50) sccm (0.05 to 0.5) lpm (0.5 to 5) lpm (3 to 30) lpm (30 to 100) lpm (100 to 2500) lpm	1.2 % 1.2 % 0.28 % 0.26 % 0.42 % 0.65 % 1.2 %	DH instruments flow meter calibrator Molbox 1 #536 Alicat MCR2500SLM
Flow – Liquid ³	Up to 60 gpm	0.28 %	Flow technology turbine meter

VI. Mechanical

Parameter/Equipment	Range	CMC ^{2,5,6} (±)	Comments
Pressure Gauges and Transducer / Vacuum ³	(-15 to 6000) psia (1 to 10 000) psi (725 to 72 500) psi	0.011 % + 0.6R 0.026 % + 0.6R 0.037 % + 0.6R	Mensor CPC 8000 DH Instruments pressure calibrator, PPCA-G DH-Budenberg 5306

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Parameter/Equipment	Range	CMC ^{2,5,6} (±)	Comments
Torque Analyzers ³	(4 to 50) in·lbf (30 to 400) in·lbf (80 to 1000) in·lbf (200 to 2000) ft·lbf	0.30 % 0.29 % 0.29 % 0.30 %	Torque arms with Class F
Torque Wrenches ³	4 in·lbf to 2000 ft·lbf	0.58 %	CDI torque/force analyzer, 200-400-02
Air Velocity Instruments	(25 to 1000) fpm (1000 to 8000) fpm	2.1 % 2.4 %	Omega WT4401-D Petit Tube
Force Gages and Transducers ³	(1 to 100) lbf (1 to 1000) lbf (350 to 30 000) lbf (5000 to 60 000) lbf	0.28 % 0.25 % 0.12 % 0.99 %	Dead weights Morehouse force machine w/ load cell Baldwin hydraulic
Durometer Calibrator – A-Scale D-Scale	 (56.08 to 820.87) g (0 to 4.53) kg	 3.4 g 0.012 kg	 25 lbf load cell
Mass	1 mg to 20 g (20 to 200) g 200 g to 1 kg 1 kg to 45 kg	14 µg 0.074 mg 0.28 g 5.8 g	Calibrated weight sets and balances
Pipettes	10 µL (10 to 100) µL (100 to 1000) µL 1000 µL to 10 mL	0.81 % 0.096 % 0.20 % 0.096 %	Sartorius CC111 Sartorius WZA 225-CW mass comparator
Balances ³	(0 to 310) g (0 to 4100) g (0 to 15) kg	0.30 mg + 0.6R 52 mg + 0.6R 0.63 g + 0.6R	Class 1 master weights



Parameter/Equipment	Range	CMC ^{2, 5, 6} (\pm)	Comments
Scales ³	(0 to 100) lb (0 to 1000) lb	5.5 g + 0.6R 0.13 kg + 0.6R	Class 4 master weights
Indirect Verification of Rockwell Hardness Testers ³	HRA Low Mid High HRBW Low Mid High HRC Low Mid High HR15N Low Mid High HR15TW Low Mid High HR30N Low Mid High HR30TW Low Mid High HR45N Low Mid High	0.35 HRA 0.22 HRA 0.28 HRA 0.54 HRBW 0.71 HRBW 0.54 HRBW 0.63 HRC 0.52 HRC 0.43 HRC 0.46 HR15N 0.44 HR15N 0.52 HR15N 0.34 HR15TW 0.31 HR15TW 0.46 HR15TW 0.50 HR30N 0.53 HR30N 0.64 HR30N 0.68 HR30TW 0.36 HR30TW 0.31 HR30TW 0.56 HR45N 0.35 HR45N 0.29 HR45N	ASTM E18



Parameter/Equipment	Range	CMC ² (±)	Comments
Hardness Block Verification	HR45TW		United True Blue II hardness tester
	Low	0.90 HR45TW	
	Mid	0.50 HR45TW	
	High	0.60 HR45TW	
	HREW		
	Low	0.63 HREW	
	Mid	0.49 HREW	
	High	0.64 HREW	
	HRA		
	Low	0.37 HRA	
	Mid	0.26 HRA	
	High	0.28 HRA	
	HRBW		
	Low	0.55 HRBW	
	Mid	0.72 HRBW	
	High	0.55 HRBW	
	HRC		
	Low	0.64 HRC	
	Mid	0.58 HRC	
	High	0.45 HRC	
	HR15N		
	Low	0.47 HR15N	
	Mid	0.47 HR15N	
	High	0.53 HR15N	
	HR15TW		
	Low	0.39 HR15TW	
	Mid	0.33 HR15TW	
	High	0.49 HR15TW	
	HR30N		
	Low	0.52 HR30N	
Mid	0.58 HR30N		
High	0.69 HR30N		
HR30TW			
Low	0.69 HR30TW		
Mid	0.41 HR30TW		
High	0.35 HR30TW		



Parameter/Equipment	Range	CMC ^{2.5} (±)	Comments
Hardness Block Verification (cont)	HR45N Low Mid High HR45TW Low Mid High HREW Low Mid High	0.59 HR45N 0.49 HR45N 0.34 HR45N 0.92 HR45TW 0.52 HR45TW 0.61 HR45TW 0.63 HREW 0.51 HREW 0.66 HREW	United True Blue II hardness tester
Durometers Type A, B, O Type C, D, DO Indenter Geometry Length Diameter Angle Radius	(0 to 100) DUROS (0 to 100) DUROS Up to 0.2 in Up to 1 in (0 to 90)° Up to 1 in	0.72 DUROS 0.68 DUROS 0.58 m·in 0.41 m·in 0.049 ° 0.18 m·in	REX-1 durometer calibrator Optical comparator
Acceleration – Sensitivity / Frequency Response	(0.5 to 10) Hz (5 to 10 000) Hz (10 000 to 15 000)Hz	1.7 % 1.9 % 2.2 %	Modal Shop 9155 w/ PCB accelerometers



VII. Thermodynamics

Parameter/Range	Frequency	CMC ^{2,5,6} (±)	Comments
Temperature – Measure	(-80 to 420) °C	0.029 °C	Burns PRT w/ Hart scientific 7380
	(400 to 1600) °C	0.27 % + 0.6R	Type R TC w/ Tempsens cal-sys 1700
Infrared / Pyrometers ³	(50 to 1000) °C	1.3 °C + 0.6R	SBIR 4100G
	(500 to 1600) °C	0.40 % + 0.6R	Tempsens cal-sys1700
Relative Humidity – Measuring Equipment ³			
(10 to 50) °C	(5 to 95) % RH	1.1 % RH	Rotronic AG-HC2-S
Dew Point	(100 to -65) °C	0.32 °C	Edge tech 1500
Environmental Chambers	(-80 to 1000) °C	2.0 °C	Type K TCs and Vaisala RH probe

VIII. Time & Frequency

Parameter/Range	Frequency	CMC ² (±)	Comments
Frequency –Measuring Equipment	10 MHz Reference Signal	2.0 parts in 10 ¹⁰ Hz	Datum 9390-6000 w/ GPS



Parameter/Range	Frequency	CMC ² (±)	Comments
Frequency – Measure	1 MHz to 40 GHz	9.3 parts in 10 ⁹ Hz 1.4 part in 10 ⁷ Hz	10 MHz signal from Datum 9390-6000 w/ GPS to: 53131 counter 5352B counter

IX. Optical Quantities

Parameter/Range	Frequency	CMC ^{2,5} (±)	Comments
Light meters	(5 to 200) fc (200 to 2000) fc	2.8 % 3.1 %	Hoffman light source with PCS 600 light meter

¹ This laboratory offers commercial calibration service.

² 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.

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 In the statement of CMC, percentages are to be read as percent of reading, unless noted otherwise.

⁶ In the statement of 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 under test in microinches, D is the numerical value of the nominal diameter of the device measured in inches.

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Accredited Laboratory

A2LA has accredited

MICRO QUALITY CALIBRATION INC.

Chatsworth, CA

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 the requirements of ANSI/NCSLI Z540-1-1994 and the requirements of ANSI/NCSLI Z540.3-2006 and 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 23rd day of January 2017.

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

President and CEO
For the Accreditation Council
Certificate Number 2348.01
Valid to November 30, 2018

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