



SCOPE OF ACCREDITATION TO ISO/IEC 17025:2017,
ANSI/NCSL Z540-1-1994 & ANSI/NCSL Z540.3-2006

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CALIBRATION

Valid To: November 30, 2024

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 calibrations^{1, 7}:

I. Acoustical

Parameter/Equipment	Range	CMC ^{2, 8} (±)	Comments
Sound Level Meters ³ –			
94 dB	31.5 Hz to 12.5 kHz 16 kHz	0.30 dB 0.64 dB	Briel & Kjaer 4226
104 dB	31.5 Hz to 12.5 kHz 16 kHz	0.30 dB 1.0 dB	
114 dB	31.5 Hz to 12.5 kHz 16 kHz	0.30 dB 1.1 dB	

II. Chemical

Parameter/Equipment	Range	CMC ^{2, 8} (±)	Comments
pH – Measuring Equipment ³	4.00 pH 7.00 pH 10.00 pH	0.012 pH 0.012 pH 0.012 pH	Buffer solutions Fluke 5522A

Parameter/Equipment	Range	CMC ^{2, 8} (±)	Comments
Conductivity – Measuring Equipment ³	10 µS/cm 100 µS/cm 1410 µS/cm 10 000 µS/cm	0.56 µS/cm 2.2 µS/cm 4.7 µS/cm 41 µS/cm	Laboratory standard conductivity solution
Aerosol Particle Counters	(0.3 to 1.0) µm	2.9 %	TSI electrostatic classifier 3082 TSI condensation particle counter 3772

III. Dimensional

Parameter/Equipment	Range	CMC ^{2, 6} (±)	Comments
Gage Blocks	Up to 4 in (> 4 to 20) in	(2.4 + 1.6L) µin (3.1 + 1.6L) µin	Electronic comparator, master steel gage blocks
Caliper ³	Up to 20 in (> 20 to 40) in	(4.8L + 0.6R) µin (370 + 6L) µin	Gage blocks
Micrometer ³	Up to 12 in (> 12 to 36) in	(4.8L + 0.6R) µin (43 + 8.8L) µin	Gage blocks
Bench Micrometers	Up to 10 in	(12 + 1.3L) µin	Gage blocks
Dial, Digital & Test Indicator ³	Up to 4 in	(4.8L + 0.6R) µin	Gage blocks
Height Gages ³	Up to 40 in	(4.8L + 0.6R) µin	Gage blocks
Optical Flats	(1 to 8) in	6.0 µin	Standard optical flat

Parameter/Equipment	Range	CMC ^{2, 6} (\pm)	Comments
Measuring Microscopes ³	Up to 12 in	(95 + 3.0L) μ in	Glass scale
Cylindrical Gages – Plug & Pin Gages	Up to 1 in (> 1 to 4) in (> 4 to 16) in	(6.8 + 0.7D) μ in (5.4 + 2.2D) μ in (10 + 1.7D) μ in	Universal measuring standard-Supra-500
Plain Ring Gages	Up to 1 in (> 1 to 4) in (> 4 to 16) in	(13 + 0.9D) μ in (13 + 1.2D) μ in (12 + 2.2D) μ in	Universal measuring standard-Supra-500 w/ID probes
Thread Wires	(4 to 20) TPI (> 20 to 80) TPI	17 μ in 12 μ in	Supermicrometer™ Universal measuring standard-Supra-500
Thread Plug Gage – Pitch Diameter	(4 to 20) TPI (> 20 to 80) TPI	(28 + 1.5D) μ in (24 + 0.5D) μ in	Supermicrometer™ Universal measuring standard-Supra-500 w/ thread wires
Major Diameter	Up to 16 in	(11 + 1.5D) μ in	Universal measuring standard-Supra-500
Thread Plug Gage – Minor Lead Angle	(4 to 80) TPI	(95 + 5.4D) μ in (31 + 2.6D) μ in 0.054°	Quest thread view machine
Major Minor Pitch Flank Angle	Up to 6 in	(80 + 4.5L) μ in (84 + 3.8L) μ in (50 + 5.5L) μ in 0°6'32'	MicroScanner™
Thread Ring Gage –	(80 to 4.5) TPI	(67 + 0.5D) μ in	Universal measuring standard-Supra-500 w/ probe
Major Minor Pitch Flank Angle	Up to 6 in	(83 + 4.2L) μ in (81 + 4.9L) μ in (51 + 7.7L) μ in 0°6'23'	MicroScanner™

Parameter/Equipment	Range	CMC ^{2,6} (\pm)	Comments
Surface Plate ³ – Flatness Repeatability	(18 x 18) in to (36 x 72) in	13 μ in 28 μ in	Autocollimator Repeat-o-meter
Optical Comparator ³ – X axis Y axis Angle	Up to 12 in Up to 12 in Up to 360°	(46 + 4L) μ in (47 + 3L) μ in 2.5 min	Gage blocks Angle blocks
Angle Blocks ³	Up to 45°	2.1 arc sec	Sine plate, gage blocks & electronic indicator
Crimping Tools ³	Up to 1 in diameter	160 μ in	Pin gages, optical comparator & pull tester
Precision Levels ³	(2 to 15) in	150 μ in	Gage blocks
Protractors/Clinometer ³	Up to 180°	1.3 arc sec + 0.6R	Sine plate w/ angle blocks
Surface Roughness Specimens	Up to 400 μ in	0.62 μ in	SurfTest w/ reference specimen
Profilometers	Up to 400 μ in	0.55 μ in	Surface roughness specimen
Rotary Table	(1 to 360)°	4.1 arc sec	Renishaw laser
Steel Rules & Tapes – Steel Rules Measuring Tapes	Up to 72 in Up to 1200 in (in 40 in segments)	0.0027 in (6600 + 16L) μ in	Kudale TSCU

IV. Dimensional Testing¹

Parameter/Equipment	Range	CMC ^{2,6} (±)	Comments
Length – 1D ⁹	Up to 40 in	5.2 μin/in	Gage blocks, CMM, Supra 500, etc
	Up to 110 in	(12 + 0.8L) μin	Renishaw laser

V. Electrical – DC/Low Frequency

Parameter/Equipment	Range	CMC ^{2,4} (±)	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	8.5 μV/V + 0.40 μV 5.2 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 6.7 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	7.6 μV/V + 0.2 μV 4.1 μV/V + 0.3 μV 3.3 μV/V + 0.5 μV 5.6 μV/V + 30 μV 6.1 μV/V + 0.5 mV	Fluke 8588A
High Voltage	(1000 to 10 000) V (10 000 to 70 000) V	0.042 % + 0.6R 0.048 % + 0.6R	Vitrek 4700/HLV-70
DC Current – Generate ³	20 nA to 220 μA 220 μA to 2.2 mA (2.2 to 22) mA (22 to 220) mA 220 mA to 2.2 A (2.2 to 11) A (11 to 20) A (20 to 700) A	45 μA/A + 6.0 nA 53 μA/A + 7.0 nA 38 μA/A + 40 nA 48 μA/A + 0.70 μA 85 μA/A + 12 A 410 μA/A + 0.48 mA 1.1 mA/A + 0.75 mA 1.5 mA/A + 0.52 A	Fluke 5720A Fluke 5720A, Fluke 5725A Fluke 5522A, Keysight 6680A, HP 3458A, current shunts
Clamp Meters	(16.5 to 150) A (150 to 1000) A	0.59 % + 0.17 A 0.62 % + 0.54 A	Fluke 5522A w/ Fluke 5500 coils

Parameter/Equipment	Range	CMC ^{2, 4, 6} (\pm)	Comments		
DC Current – Measure ³	(10 to 20) pA	1.2 % + 3.5 fA	Keithley 6517A		
	(20 to 200) pA	1.2 % + 6 fA			
	(0.2 to 2) nA	0.27 % + 0.32 pA			
	(2 to 20) nA	0.24 % + 0.6 pA			
	(20 to 100) nA	0.022 % + 60 pA	HP 3458A, option 002		
	100 nA to 1 μ A	36 μ A/A + 60 pA			
	(1 to 10) μ A	27 μ A/A + 0.14 nA			
	(10 to 100) μ A	33 μ A/A + 1.1 nA			
	100 μ A to 1 mA	32 μ A/A + 7.0 nA			
	(1 to 10) mA	31 μ A/A + 70 nA			
(10 to 100) mA	50 μ A/A + 0.70 nA				
100 mA to 1A	0.014 % + 13 μ A				
(1 to 10) A	0.028 % + 0.43 mA	Fluke 8588A			
(10 to 30) A	0.07 % + 4.4 mA				
(30 to 100) A	0.026 %	HP 3458A, current shunts			
(100 to 700) A	0.038 %				
Resistance – Generate	(0 to 10.9999) Ω	46 $\mu\Omega/\Omega$ + 1 m Ω	Fluke 5522A		
	(11 to 32.9999) Ω	32 $\mu\Omega/\Omega$ + 1.5 m Ω			
	(33 to 109.9999) Ω	32 $\mu\Omega/\Omega$ + 1.4 m Ω			
	(110 to 329.9999) Ω	29 $\mu\Omega/\Omega$ + 2 m Ω			
	(0.33 to 1.099999) k Ω	29 $\mu\Omega/\Omega$ + 2 m Ω			
	(1.1 to 3.299999) k Ω	30 $\mu\Omega/\Omega$ + 20 m Ω			
	(3.3 to 10.99999) k Ω	29 $\mu\Omega/\Omega$ + 20 m Ω			
	(11 to 32.99999) k Ω	31 $\mu\Omega/\Omega$ + 0.2 Ω			
	(33 to 109.9999) k Ω	30 $\mu\Omega/\Omega$ + 0.2 Ω			
	(110 to 329.9999) k Ω	34 $\mu\Omega/\Omega$ + 7 Ω			
	(0.33 to 1.099999) M Ω	33 $\mu\Omega/\Omega$ + 7 Ω			
	(1.1 to 3.299999) M Ω	63 $\mu\Omega/\Omega$ + 50 Ω			
	(3.3 to 10.99999) M Ω	0.016 % + 70 Ω			
	(11 to 32.99999) M Ω	0.027 % + 2.7 k Ω			
	(33 to 109.9999) M Ω	0.056 % + 3.2 k Ω			
	Fixed Points ³	(1, 1.9) Ω		0.011 %	Fluke 5720A
		(10, 19) Ω		37 $\mu\Omega/\Omega$	
(100, 190) Ω		12 $\mu\Omega/\Omega$			
(1, 1.9) k Ω		11 $\mu\Omega/\Omega$			
(10, 19) k Ω		9.5 $\mu\Omega/\Omega$			
(100, 190) k Ω		24 $\mu\Omega/\Omega$			
(1, 1.9) M Ω		43 $\mu\Omega/\Omega$			
10 M Ω		43 $\mu\Omega/\Omega$			
19 M Ω		71 $\mu\Omega/\Omega$			
100 M Ω		0.015 %			

Parameter/Equipment	Range	CMC ^{2, 4, 5} (\pm)	Comments
Resistance – Measure ³	(0 to 2) Ω (2 to 20) Ω (20 to 200) Ω 200 Ω to 2 k Ω (2 to 20) k Ω (20 to 200) k Ω 200 k Ω to 2 M Ω (2 to 20) M Ω (20 to 200) M Ω 200 M Ω to 2 G Ω (2 to 20) G Ω	16 $\mu\Omega/\Omega$ + 4 $\mu\Omega$ 11 $\mu\Omega/\Omega$ + 0.014 m Ω 8.5 $\mu\Omega/\Omega$ + 0.05 m Ω 8.2 $\mu\Omega/\Omega$ + 0.5 m Ω 8.3 $\mu\Omega/\Omega$ + 5 m Ω 8.1 $\mu\Omega/\Omega$ + 50 m Ω 13 $\mu\Omega/\Omega$ + 1 Ω 21 $\mu\Omega/\Omega$ + 10 Ω * 0.008 % + 1 k Ω * 0.02 % + 100 k Ω * 0.076 % + 10 M Ω *	Fluke 8588A *High Voltage Mode
	(0.1 to 2) G Ω (2 to 20) G Ω (20 to 200) G Ω (0.2 to 2) T Ω (2 to 10) T Ω	0.27 % + 20 k Ω 0.27 % + 0.2 M Ω 0.44 % + 2 M Ω 0.44 % + 20 M Ω 1.3 % + 0.2 G Ω	Keithley 6517A
Electrical Simulation of Thermocouple ³ –			
Type J	(-210 to 1200) $^{\circ}\text{C}$	0.13 $^{\circ}\text{C}$	Fluke 5522A w/ zero reference junction & SPRT
Type K	(-200 to 1372) $^{\circ}\text{C}$	0.13 $^{\circ}\text{C}$	
Type T	(-250 to 400) $^{\circ}\text{C}$	0.13 $^{\circ}\text{C}$	
Type N	(-200 to 1300) $^{\circ}\text{C}$	0.14 $^{\circ}\text{C}$	
Type E	(-250 to 1000) $^{\circ}\text{C}$	0.14 $^{\circ}\text{C}$	
Type B	(600 to 1820) $^{\circ}\text{C}$	0.15 $^{\circ}\text{C}$	
Type S	(0 to 1767) $^{\circ}\text{C}$	0.15 $^{\circ}\text{C}$	
Type R	(0 to 1767) $^{\circ}\text{C}$	0.15 $^{\circ}\text{C}$	
Capacitance – Measure ³	(0.1 to 1) nF (0.2 to 10) nF (10 to 100) nF (0.1 to 1) μF (1 to 10) μF (10 to 100) μF (0.1 to 1) mF (1 to 10) mF (10 to 100) mF	0.24 % + 1 pF 0.087 % + 2 pF 0.054 % + 10 pF 0.049 % + 0.1 nF 0.056 % + 1 nF 0.077 % + 10 nF 0.078 % + 0.1 μF 0.09 % + 1 μF 0.096 % + 10 μF	Fluke 8588A

Parameter/Equipment	Range	CMC ^{2, 4, 5} (±)	Comments
Capacitance – Generate ³	(0.22 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 (0.11 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	0.54 % + 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 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 0.53 % + 3.0 μF 0.54 % + 10 μF 0.88 % + 30 μF 1.3 % + 0.1 mF	Fluke 5522A

Parameter/Range	Frequency	CMC ^{2, 4} (±)	Comments
AC Voltage – Generate ³			
300 μV to 2.2 mV	(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	0.15 % + 4.0 μV 0.11 % + 4.0 μV 0.09 % + 4.0 μV 0.14 % + 4.0 μV 0.17 % + 5.0 μV 0.23 % + 10 μV 0.51 % + 20 μV 0.59 % + 20 μV	Fluke 5720A, Fluke 5725A
(2.2 to 22) mV	(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	0.040 % + 4.0 μV 0.019 % + 4.0 μV 0.015 % + 4.0 μV 0.034 % + 4.0 μV 0.059 % + 5.0 μV 0.12 % + 10 μV 0.19 % + 20 μV 0.30 % + 20 μV	

Parameter/Range	Frequency	CMC ^{2,4} (±)	Comments
AC Voltage – Generate ³ (cont)			
(22 to 220) mV	(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	0.026 % + 12 μV 0.010 % + 7.0 μV 0.016 % + 7.0 μV 0.024 % + 7.0 μV 0.049 % + 17 μV 0.095 % + 20 μV 0.14 % + 25 μV 0.29 % + 45 μV	Fluke 5720A, Fluke 5725A
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 0.0051 % + 8.0 μV 0.0087 % + 10 μV 0.013 % + 30 μV 0.043 % + 80 μV 0.10 % + 0.20 mV 0.18 % + 0.30 mV	
(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 0.005 % + 50 μV 0.086 % + 0.10 mV 0.012 % + 0.20 mV 0.030 % + 0.60 mV 0.10 % + 2.0 mV 0.16 % + 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 0.0058 % + 0.60 mV 0.011 % + 1.0 mV 0.019 % + 2.5 mV	
(220 to 750) V	(15 to 50) Hz 50 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.031 % + 16 mV 0.008 % + 3.5 mV 0.017 % + 6.0 mV 0.06% + 11 mV 0.23% + 45 mV	
(750 to 1100) V	(15 to 50) Hz 50 Hz to 1 kHz (1 to 20) kHz (20 to 30) kHz	0.031 % + 16 mV 0.008 % + 3.5 mV 0.017 % + 6.0 mV 0.06 % + 11 mV	

Parameter/Range	Frequency	CMC ^{2,4} (±)	Comments
AC Voltage – Measure ³			Fluke 8588A
Up to 10 mV	1 Hz to 2 kHz (2 to 10) kHz (10 to 30) kHz (30 to 100) kHz (100 to 300) kHz (300 to 1000) kHz	0.034 % + 1.1 μV 0.042 % + 1.1 μV 0.048 % + 1.1 μV 0.32 % + 1.1 μV 1.1 % + 4.0 μV 2.2 % + 4.0 μV	
(10 to 100) mV	1 Hz to 2 kHz (2 to 10) kHz (10 to 30) kHz (30 to 100) kHz (100 to 300) kHz (300 to 1000) kHz	0.007 % + 0.5 μV 0.012 % + 0.5 μV 0.024 % + 1 μV 0.055 % + 5 μV 0.23 % + 30 μV 1.2 % + 100 μV	
100 mV to 1 V	1 Hz to 2 kHz (2 to 10) kHz (10 to 30) kHz (30 to 100) kHz (100 to 300) kHz (300 to 1000) kHz	0.009 % + 5 μV 0.012 % + 5 μV 0.023 % + 10 μV 0.055 % + 50 μV 0.21 % + 0.3 mV 1.1 % + 1 mV	
(1 to 10) V	1 Hz to 2 kHz (2 to 10) kHz (10 to 30) kHz (30 to 100) kHz (100 to 300) kHz (300 to 1000) kHz	0.007 % + 0.05 mV 0.012 % + 0.05 mV 0.022 % + 0.1 mV 0.055 % + 0.5 mV 0.23 % + 3 mV 0.12 % + 10 mV	
(10 to 100) V	1 Hz to 2 kHz (2 to 10) kHz (10 to 30) kHz (30 to 100) kHz (100 to 300) kHz (300 to 1000) kHz	0.01 % + 0.5 mV 0.012 % + 0.5 mV 0.025 % + 1 mV 0.061 % + 5 mV 0.39 % + 50 mV 0.12 % + 500 mV	
(100 to 1000) V	1 Hz to 2 kHz (2 to 10) kHz (10 to 30) kHz (30 to 100) kHz	0.1 % + 25 mV 0.1 % + 25 mV 0.027 % + 25 mV 0.059 % + 100 mV	
High Voltage (1000 to 10 000) V (10 000 to 50 000) V	60 Hz 60 Hz	0.18 % + 0.6R 0.14 % + 0.6R	Vitrek 4700/HLV-70

Parameter/Range	Frequency	CMC ^{2,4,6} (±)	Comments
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 (5 to 10) kHz	0.028 % + 16 nA 0.019 % + 10 nA 0.016 % + 8.0 nA 0.032 % + 12 nA 0.12 % + 65 nA	Fluke 5720A, Fluke 5725A
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 0.013 % + 35 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	
(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 µA 0.018 % + 3.5 µA 0.017 % + 2.5 µA 0.026 % + 3.5 µA 0.12 % + 10 µA	Fluke 5720A
220 mA to 2.2 A	20 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.030 % + 35 µA 0.051 % + 80 µA 0.73 % + 0.16 mA	
(2.2 to 11) A	40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.50 % + 0.17 mA 0.10 % + 0.38 mA 0.36 % + 0.75 mA	
(11 to 20.5) A	(45 to 100) Hz 100 Hz to 1 kHz (1 to 5) kHz	0.14 % + 5 mA 0.17 % + 5 mA 3.4 % + 0.75 mA	Fluke 5522A
Clamp Meters			
(20.5 to 150) A	(45 to 65) Hz (65 to 400) Hz	0.48 % + 0.035 A 0.79 % + 0.077 A	Fluke 5522A w/5500 coil
(150 to 1025) A	(45 to 65) Hz (65 to 400) Hz	0.58 % + 0.19 A 1.5 % + 0.35 A	

Parameter/Range	Frequency	CMC ^{2, 4} (±)	Comments
AC Current – Measure ³			
Up to 20 µA	1 Hz to 2 kHz (2 to 10) kHz (10 to 30) kHz	0.21 % + 2.5 nA 0.21 % + 2.5 nA 0.23 % + 2.5 nA	Fluke 8588A
(20 to 200) µA	1 Hz to 2 kHz (2 to 10) kHz (10 to 30) kHz (30 to 100) kHz	0.03 % + 5 nA 0.062 % + 5 nA 0.09 % + 5 nA 0.45% + 10 nA	
200 µA to 2 mA	1 Hz to 2 kHz (2 to 10) kHz (10 to 30) kHz (30 to 100) kHz	0.028 % + 50 nA 0.053 % + 50 nA 0.09 % + 50 nA 0.045 % + 0.1 µA	
(2 to 20) mA	1 Hz to 2 kHz (2 to 10) kHz (10 to 30) kHz (30 to 100) kHz	0.029 % + 0.5 µA 0.055 % + 0.5 µA 0.09 % + 0.5 µA 0.46 % + 1 µA	
(20 to 200) mA	1 Hz to 2 kHz (2 to 10) kHz (10 to 30) kHz	0.029 % + 5 µA 0.054 % + 5 µA 0.074 % + 5 µA	
200 mA to 2 A	1 Hz to 2 kHz (2 to 10) kHz (10 to 30) kHz	0.031 % + 0.1 mA 0.084 % + 0.1 mA 0.084 % + 0.1 mA	
(2 to 20) A	1 Hz to 2 kHz (2 to 10) kHz	0.089 % + 0.1 mA 0.11 % + 0.5 mA	
(20 to 30) A	1 Hz to 2 kHz (2 to 10) kHz	0.085 % + 12 mA 0.15 % + 12 mA	
Oscilloscopes ³ –			
Amplitude DC Signal Into 50 Ω Load Into 1 MΩ Load	(-6.6 to 6.6) V (-130 to 130) V	0.25 % + 40 µV 0.050 % + 40 µV	Fluke 5522A/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 µV 2.0 % + 100 µV 4.0 % + 100 µV 5.0 % + 100 µV	
Time Marker Into 50 Ω Load	(5 to 50) ms 20 ms to 2 ns	(25 + 1000t) parts in 10 ⁶ 2.5 parts in 10 ⁶	
			t is time in seconds

Parameter/Range	Frequency	CMC ^{2,4} (±)	Comments
Tachometers ³	(6 to 99 999) RPM	0.004 %	Frequency standard w/LED
Phase – Measure (0 to 360)°	5 Hz to 2 kHz (2 to 5) kHz (5 to 10) kHz (10 to 50) kHz	0.03° 0.04° 0.05° 0.06°	Clark Hess 6000A

VI. Electrical – RF/Microwave

Parameter/Range	Frequency	CMC ^{2,4,5} (±)	Comments
Power Sensor – Calibration Factors (-30 to 20) dBm (-30 to 20) dBm	0.1 MHz to 4.2 GHz 50 MHz to 26.5 GHz	2.8 % <i>CF</i> 3.5 % <i>CF</i>	Agilent power sensors 8482A & 8485A <i>CF</i> is calibration factor
Amplitude Modulation ³ – Carrier: (0.15 to 10) MHz Depth: Up to 99 % Carrier: 10 MHz to 1.3 GHz Depth: Up to 99 %	(20 to 50) Hz 50 Hz to 10 kHz (20 to 50) Hz 50 Hz to 50 kHz (50 to 100) kHz	3.8 % 2.7 % 3.8 % 1.6 % 3.8 %	HP 8902A measuring receiver w/ 11722A power sensor
Frequency Modulation ³ – Carrier: 250 kHz to 10 MHz Dev: Up to 40 kHz Carrier: 10 MHz to 1.3 GHz Dev: Up to 400 kHz	20 Hz to 10 kHz (20 to 50) Hz 50 Hz to 100 kHz (100 to 200) kHz	2.9 % 5.9 % 1.3 % 5.9 %	HP 8902A measuring receiver w/ 11722A power sensor

Parameter/Range	Frequency	CMC ^{2, 4, 5} (±)	Comments
Phase Modulation ³ – Carrier: 150 kHz to 10 MHz Carrier: 10 MHz to 1.3 GHz	200 Hz to 10 kHz 200 Hz to 20 kHz	4.8 % 3.7 %	HP 8902A measuring receiver w/ 11722A power sensor
Absolute Power – Measure ³ (0 to -10) dBm (-10 to -20) dBm (-20 to -30) dBm (-30 to -40) dBm (-40 to -50) dBm (-50 to -60) dBm (-60 to -70) dBm (-70 to -80) dBm (-80 to -90) dBm (-90 to -100) dBm (-100 to -110) dBm (-110 to -120) dBm	10 MHz to 26.5 GHz	0.08 dB 0.10 dB 0.12 dB 0.13 dB 0.15 dB 0.17 dB 0.20 dB 0.23 dB 0.28 dB 0.33 dB 0.39 dB 0.43 dB	HP 8902A measuring receiver w/ 11722A & 11792A power sensors

VII. Fluid Quantities

Parameter/Equipment	Range	CMC ^{2, 5, 8} (±)	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 Molbox1 Alicat MCR2500SLM
Flow – Liquid ³	(0.02 to 3) gpm (0.5 to 60.0) gpm (1.5 to 160) gpm	0.11 % 0.09 % 0.09 %	Flow technology turbine meter

VIII. Magnetic Quantities

Parameter/Equipment	Range	CMC ^{2, 5} (±)	Comments
Gauss Meter ³	(1 to 200) Gauss	0.88 %	Helmholtz coil, zero gauss chamber

IX. Optical Quantities

Parameter/Equipment	Range	CMC ^{2, 5, 8} (±)	Comments
Illuminance – Light meters	(5 to 200) fc (200 to 2000) fc	2.8 % 3.1 %	Hoffman light source w/ PCS 600 light meter
Optical Wavelength – Measure	(700 to 1650) nm	0.00048%	Keysight 86120A
Optical Absolute Power - Measure	-20 dBm @ 850 nm -20 dBm @ 1550 nm	0.091 dBm 0.090 dBm	Agilent 81624A
Optical Power Linearity – Measure			
850 nm	0 dBm -10 dBm -20 dBm -30 dBm -40 dBm -50 dBm	0.022 dBm 0.024 dBm 0.023 dBm 0.024 dBm 0.024 dBm 0.029 dBm	Agilent 81624A
1310 nm	0 dBm -10 dBm -20 dBm -30 dBm -40 dBm -50 dBm	0.023 dBm 0.024 dBm 0.025 dBm 0.025 dBm 0.027 dBm 0.030 dBm	
1550 nm	0 dBm -10 dBm -20 dBm -30 dBm -40 dBm -50 dBm	0.022 dBm 0.025 dBm 0.023 dBm 0.024 dBm 0.024 dBm 0.030 dBm	

X. Mechanical

Parameter/Equipment	Range	CMC ^{2, 5, 6, 8} (±)	Comments	
Pressure Gauges & Transducer / Vacuum ³	Pneumatic	(0 to 17) psia Up to 600 psig Up to 3000 psig Up to 6000 psig	Mensor CPC 8000	
		Up to 10 000 psig	DH Instruments pressure calibrator, PPCH-G	
	Hydraulic	(5 to 40 000) psig	0.030 %	Ruska Model 2450-701
		(725 to 72 500) psi	0.030 %	DH-Budenberg 5306
Torque Analyzers ³	(1 to 10) ozf·in (10 to 100) ozf·in (4 to 50) lbf·in (30 to 400) lbf·in (80 to 1000) lbf·in (20 to 250) lbf·ft (200 to 2000) lbf·ft	0.16 % 0.12 % 0.065 % 0.025 % 0.026 % 0.017 % 0.086 %	Torque arms w/ Class F weights	
Torque Tools ³	(1 to 10) ozf·in (10 to 100) ozf·in (4 to 50) lbf·in (30 to 400) lbf·in (80 to 1000) lbf·in (20 to 250) lbf·ft (200 to 2000) lbf·ft	0.11 % 0.01 % 0.19 % 0.51 % 0.34 % 0.34 % 0.36 %	Mountz MTX10Z AWS: QC10-100 CDI torque, force & tension calibration system, Model: 200-400-02	
Air Velocity Instruments	(25 to 350) fpm (350 to 1000) fpm (1000 to 9000) fpm	2.6 % 2.4 % 1.3%	Omega WT4401-D petit tube	
Force Gages & Transducers ³	(1 to 100) lbf (1 to 1000) lbf	0.049 % 0.037 %	Dead weights	
	(350 to 1000) lbf (1000 to 30 000) lbf	0.12 % 0.026 % + 1.5 lbf	Morehouse force machine w/ load cell	
	(30 000 to 100 000) lbf	0.028 %		

Parameter/Equipment	Range	CMC ^{2, 5, 6, 8} (±)	Comments
Durometer Calibrator – A-Scale D-Scale	(56.08 to 820.87) g (0 to 4.53) kg	2.6 g 0.012 kg	25 lbf load cell
Pipettes	≤ 10 µL ≤ 100 µL ≤ 1000 µL ≤ 5 mL ≤ 10 mL	0.015 µL 0.017 µL 0.040 µL 0.045 µL 0.066 µL	Sartorius CC111, Sartorius WZA 225-CW mass comparator
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	0.52 DUROS 0.46 DUROS 0.58 m·in 0.41 m·in 0.049° 0.18 m·in	REX-1 durometer calibrator Optical comparator
Indirect Verification of Rockwell Hardness Testers ³	HRA Low Mid High HRBW Low Mid High HRC Low Mid High HR15N Low Mid High	0.31 HRA 0.22 HRA 0.19 HRA 0.60 HRBW 0.50 HRBW 0.68 HRBW 0.56 HRC 0.46 HRC 0.40 HRC 0.54 HR15N 0.47 HR15N 0.61 HR15N	ASTM E18

Parameter/Equipment	Range	CMC ^{2,8} (±)	Comments
Indirect Verification of Rockwell Hardness Testers ³ (cont)	HR15TW Low Mid High HR30N Low Mid High HR30TW Low Mid High HR45N Low Mid High HR45TW Low Mid High	0.29 HR15TW 0.29 HR15TW 0.47 HR15TW 0.35 HR30N 0.52 HR30N 0.57 HR30N 0.40 HR30TW 0.38 HR30TW 0.34 HR30TW 0.56 HR45N 0.35 HR45N 0.29 HR45N 0.89 HR45TW 0.62 HR45TW 0.61 HR45TW	
Direct Verification of Rockwell Hardness Testers ³			
Verification of Test Force	(15 to 150) kgf	0.08 % + 0.01 kgf	Load cell
Verification of Depth-Measuring Device	(0 to 260) µm	0.17 µm	Digital indicator system
Accelerometers –			
Vibration 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
Shock - Linearity	Up to 10 000 g	2.3 %	
Dynamic Pressure - Linearity	Up to 15 000 psi	3.1 %	

Parameter/Equipment	Range	CMC ^{2, 8} (±)	Comments
Balances ³	Up to 310 g Up to 4100 g Up to 15 kg	0.3 mg + 0.6R 48 mg + 0.6R 0.52 g + 0.6R	Class 1 master weights
Scales ³	Up to 100 lb Up to 1000 lb Up to 7200 lb	7.7 g + 0.6R 0.12 kg + 0.6R 0.051 % + 0.6R	Class 4 master weights Standard weights
Mass – Measure (Metric)	30 kg 25 kg 20 kg 10 kg 5 kg 3 kg 2 kg 1 kg 500g 300 g 200 g 100 g 50 g 30 g 20 g 10 g 5 g 3 g 2 g 1 g 500 mg 300 mg 200 mg 100 mg 50 mg 30 mg 20 mg 10 mg 5 mg 3 mg 2 mg 1 mg	15 mg 13 mg 10 mg 5.3 mg 2.3 mg 4.9 mg 2.3 mg 1.6 mg 0.57 mg 0.36 mg 0.19 mg 0.19 mg 73 µg 64 µg 6.8 µg 6.1 µg 4.3 µg 4.2 µg 4.5 µg 2.9 µg 2.7 µg 3.2 µg 2.5 µg 2.5 µg 2.4 µg 3.0 µg 2.4 µg 2.4 µg 2.5 µg 2.9 µg 2.5 µg 2.4 µg	Single substitution

Parameter/Equipment	Range	CMC ^{2, 8} (±)	Comments
Mass – Measure (Avoirdupois)	1 lb 5 lb 10 lb 25 lb 50 lb	5.3 µlb (2.4 mg) 5.3 µlb (2.4 mg) 2.1 µlb (9.5 mg) 11 µlb (4.8 mg) 33 µlb (15 mg)	Single substitution
	500 lb 1000 lb	0.026 lb (12 g) 0.068 lb (31 g)	Load cell

XI. Thermodynamics

Parameter/Equipment	Range	CMC ^{2, 5, 6, 8} (±)	Comments
Temperature – Measure & Measuring Equipment	(-196 to -80) °C (-80 to 100) °C (100 to 660) °C	0.034 °C 0.021 °C 0.039 °C	Fluke 1560 w/SPRT, TempSens cal-sys -196/-80 & Fluke 7380
	(400 to 1600) °C	0.27 % + 0.6R	Type R TC w/ TempSens cal-sys 1700
Infrared / Pyrometers ³	(50 to 500) °C	1.4 °C + 0.6R	Fluke 9132 ε 0.95 λ 8 to 14 µm
	(150 to 1200) °C	0.48 % + 0.6R	IsoTech Pegasus R970 ε 0.995 λ 9 to 14 µm
Humidity – Measuring Equipment (10 to 30) °C	(5 to 15) % RH (5 to 25) % RH (25 to 35) % RH (35 to 50) % RH (50 to 65) % RH (65 to 80) % RH (80 to 95) % RH	0.40 % 0.49 % 0.52 % 0.59 % 0.62 % 0.66 % 0.83 %	Rotronic HC2-SH & GEO 2000
Temperature – Measuring Equipment, Fixed Point	Triple Point of Water	8.3 mK	Pond Engineering TPW
	Liquid Nitrogen	7.5 mK	

Parameter/Equipment	Range	CMC ^{2, 5, 6, 8} (\pm)	Comments
Humidity – Measure ³	(-50 to 90) °C	(Frost Point) 1.1 °C	Chilled mirror
		(Dew Point) 0.14 °C	
	(10 to 30) °C	(5 to 15) % RH 0.20 % (5 to 25) % RH 0.35 % (25 to 35) % RH 0.40 %	Rotronic HC2-SH
	(10 to 30) °C	(35 to 50) % RH 0.47 % (50 to 65) % RH 0.51 % (65 to 80) % RH 0.56 % (80 to 95) % RH 0.75 %	Rotronic HC2-SH
Dew Point	(100 to -65) °C	0.32 °C	Edge tech 1500
Environmental Chambers, Ovens, Furnaces, Freezers, Temperature Baths & Dry Wells ¹⁰	(-80 to 1000) °C	2.0 °C	Type K TCs & Vaisala RH probe

XII. Time & Frequency

Parameter/Equipment	Range	CMC ^{2, 8} (\pm)	Comments
Frequency – Measuring Equipment	10 MHz Reference Signal	2.0 parts in 10 ¹⁰ Hz	Datum 9390-6000 w/ GPS
Frequency – Measure	1 MHz to 40 GHz	9.3 parts in 10 ⁹ Hz	10 MHz signal from Datum 9390-6000 w/GPS to: 53131 counter
		1.4 part in 10 ⁷ Hz	53152A counter
Stopwatches	Up to 24 hrs	0.048 s/day	Timometer 4500

- ¹ This laboratory offers commercial dimensional testing and 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 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. CMCs 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.
- ⁷ This scope meets A2LA's *P112 Flexible Scope Policy*.
- ⁸ 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.
- ⁹ This laboratory meets *R205 – Specific Requirements: Calibration Laboratory Accreditation Program* for the types of dimensional tests listed above and is considered equivalent to that of a calibration.
- ¹⁰ The contributions from the “best existing device” are not included in the CMC claim.



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 17025:2017 *General requirements for the competence of testing and calibration laboratories*. This laboratory also meets the requirements of ANSI/NCSL Z540-1-1994 and the requirements of ANSI/NCSL 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 April 2017).



Presented this 30th day of January 2023.

A blue ink signature of Mr. Trace McInturff, written over a horizontal line.

Mr. Trace McInturff, Vice President, Accreditation Services
For the Accreditation Council
Certificate Number 2348.01
Valid to November 30, 2024
Revised June 21, 2023

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