



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

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CALIBRATION

Valid To: April 30, 2024

Certificate Number: 5104.04

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory to perform the following calibrations^{1, 4}:

I. Dimensional

Parameter/Equipment	Range	CMC ^{2, 5} ($\pm$)	Comments
Angle Plates	Up to 6 in	63 μ in	Cylindrical square, granite cube, Mu-checker, surface plate
Angle Blocks	(0 to 90) $^{\circ}$	5"	Rotary table, autocollimator, reflecting cube
Caliper Checker	Up to 8 in	(57 + 2L) μ in	Mu-checker, height master, surface plate
Calipers ³			
Length	Up to 8 in (8 to 12) in (12 to 20) in (20 to 40) in (40 to 72) in	290 μ in 290 μ in 300 μ in 600 μ in 640 μ in	Caliper checker, gage blocks
Depth	1 in	280 μ in	
Inside Diameter	1.617 67 in	290 μ in	

Parameter/Equipment	Range	CMC ^{2, 5} ($\pm$)	Comments
Chamfer Gauges ³	Up to 2 in	640 μ in	Ring gauges
Depth Micrometers ³	Up to 12 in	(42 + 2L) μ in	Ring gauges
Dial Caliper Gages	Up to 6 in	(280 + 15L) μ in	Gage blocks, surface plate
Feeler Gages ³	Up to 0.01 in	35 μ in	P&W Supermic, ring gages
Gage Blocks	Up to 0.11 in (0.11 to 1) in (1 to 4) in Up to 25 mm (25 to 50) mm (50 to 100) mm	4.5 μ in (4 + 0.8L) μ in (3 + 1.5L) μ in 0.11 μ m (0.1 + 0.02L) μ m (0.1 + 0.01L) μ m	Gage block comparator, Grade 1 gage blocks
Height Gages ³	Up to 8 in (8 to 24) in	(290 + 0.4L) μ in (280 + 1.3L) μ in	Gage blocks, surface plate
Height Master	Up to 18 in	(38 + 1.2L) μ in	Mu-checker, surface plate, gage blocks
Indicators ³ (Drop and Test)	Up to 4 in (4 to 10) in	(24 + 19L) μ in (250 + 9L) μ in	Micrometer head, gage blocks, surface plate, P&W Supermic
Inside Micrometers	Up to 4 in (4 to 24) in	230 μ in (69 + 3L) μ in	P&W Lab Master, gage blocks, riser block, sine plate, height master
Levels	± 1 div	1.2"	Autocollimator, reflective cube, rotary table
Outside Micrometers ³	Up to 3 in (3 to 20) in	33 μ in (52 + 1.8L) μ in	Gage blocks

Parameter/Equipment	Range	CMC ^{2, 5} (±)	Comments
Micrometer Heads ³	Up to 2 in	18 µin	Mu-checker, gage blocks
Mu Checkers ³	Up to 150 µin	3.2 µin	Gage blocks
Optical Comparator ³			
Linear Measurement X-Axis & Y-Axis	Up to 6 in (6 to 30) in	(60 + 0.6L) µin (13 + 8.3L) µin	Microrule, gage blocks, glass scale
Angular Measurement	Up to 360 °	44"	Angle blocks
Magnification	10X, 20X, 31.25X, 100X	(0.011 + 0.000 02L) in	Magnification checker
Plugs Cylindrical – Pin Gage	Up to 6 in	(2.5 + 4L) µin	P&W Lab Master, gage blocks
Protractors, Digital	(0 to 90)°	0.058°	Rotary table, level
Protractors, Bevel			
Angle Blade Parallelism	(0 to 35)° Up to 0.001 in	0.025° 34 µin	Angle blocks, Mu- checker, surface plate
Threaded Plugs			
Pitch Diameter Major Diameter Angle	Up to 6 in Up to 6 in (0 to 60)°	(130 + 0.2L) µin (10 + 1.7L) µin 1.5'	Gage blocks, thread wires, P&W Supermic, gage blocks, optical comparator
Ring Gauges – Adjustable Threaded			
Pitch Diameter Minor Diameter	Up to 4 in Up to 6 in	79 µin (11 + 1.5L) µin	Setting plug gages, P&W Supermic
Radius Gauge	Up to 1 in	300 µin	Optical comparator, radius screen

Parameter/Equipment	Range	CMC ^{2, 5} ($\pm$)	Comments
Ring Gauge – Plain	Up to 1 in (1 to 11) in	5.6 μ in (0.8 + 4.8L) μ in	Gage blocks, ring comparator, P&W Lab Master
Rotary Tables ³ Angle Flatness/Parallelism Compound Angle	360° Up to 0.1 in (15, 30, 45)°	1.4” 36 μ in 2.5”	Autocollimator, reflecting cube, Mu checker, surface plate, angle blocks
Sine Plates Angle Flatness & Parallelism	Up to 45° (5 in & 10 in Roller Spacing Only) Up to 0.001 in	4.7” 36 μ in	Angle blocks, gauge blocks, Mu checker, surface plate Mu checker, surface plate
Steel Rules	Up to 72 in	(130 + 37L) μ in	Optical comparator
Surface Plates ³ Overall Flatness Local Area Flatness	Up to 161 in <i>DL</i> Up to 0.001 in	(15 + 3.2DL) μ in 21 μ in	In accordance with Fed Spec GGG-P-463 using autocollimator Mu checker w/ probe
Thread Wires	(4 to 120) TPI	29 μ in	Plug gages, P&W Lab Master, gage blocks
Tri-Micrometers ³	Up to 4 in	250 μ in	Ring gages
V-Anvil Micrometers ³	Up to 1 in	86 μ in	Plain plug gages

Parameter/Equipment	Range	CMC ² (±)	Comments
Vee Block Parallelism to Adjacent Side	Up to 0.001 in	68 µin	Plug gauge, Mu checker, surface plate
Parallelism to Opposite Side	Up to 0.001 in	36 µin	Angle block, Mu checker, surface plate
Side Squareness Surface	Up to 0.001 in	64 µin	Granite cube, Mu checker, surface plate
Flatness & Parallelism	Up to 0.001 in	34 µin	Mu checker, surface plate

II. Dimensional Testing

Parameter	Range	CMC ^{2, 5} (±)	Comments
Dimensional Measurement – 1D			
Length	Up to 13 in	$(2 + 4.2L) \mu\text{in}$	Universal length measuring machine
	Up to 4 in	78 µin	Micrometer Set
	Up to 4 in	$(133 + 1L) \mu\text{in}$	Optical comparator (x-axis only)
	Up to 24 in	$(32 + 2.3L) \mu\text{in}$	Gage blocks, Mu checker & surface plate
	Up to 1 200 in	$(0.007 + 0.000 2L) \text{ in}$	Steel rule
Height	Up to 18 in	$(60 + 2.6L) \mu\text{in}$	Height master, Mu checker & surface plate
Depth	Up to 1 in	150 µin	Drop indicator
Flatness/Parallelism	Up to 0.001 in	36 µin	Mu checker and surface plate
Go/No-Go	Up to 1 in	$(120 + 8L) \mu\text{in}$	Pin gages
Squareness	Up to 11.31 inDL	56 µin	Granite cube, Mu checker & surface

Parameter/Equipment	Range	CMC ² (±)	Comments
Dimensional Measurement – 2D Angle	Up to 360°	74"	Optical comparator
Radius	Up to 1 in	260 µin	

III. Electrical – DC/Low Frequency

Parameter/Equipment	Range	CMC ^{2, 4} (±)	Comments
DC Voltage ³ – Generate	Up to 329.9999 mV Up to 3.299 999 V Up to 32.999 99 V (30 to 329.9999) V (330 to 1 020) V	13 µV/V + 0.7 µV 7 µV/V + 1.3 µV 8 µV/V + 13 µV 12 µV/V + 0.1 V 12 µV/V + 1 mV	Fluke 5522A Multiproduct calibrator
DC Voltage ³ – Measure	Up to 100 mV 100 mV to 1 V (1 to 10) V (10 to 100) V 100 V to 1 kV	7.8 µV/V + 0.4 µV 6.8 µV/V + 0.35 µV 6.8 µV/V + 0.65 µV 9 µV/V + 40 µV 19 µV/V + 0.5 mV	HP 3458A Opt 002 8.5-digit multimeter
DC Current ³ – Generate	Up to 329.999 µA Up to 3.299 99 mA Up to 32.9999 mA Up to 329.999 mA Up to 1.099 99 A (1.1 to 2.999 99) A Up to 10.9999 A (11 to 20.5) A	100 µA/A + 13 nA 67 µA/A + 33 nA 67 µA/A + 0.17 µA 67 µA/A + 1.7 µA 0.13 mA/A + 27 µA 0.25 mA/A + 27 µA 0.33 mA/A + 0.33 mA 0.67 mA/A + 0.5 mA	Fluke 5522A multiproduct calibrator
DC Current ³ – Measure	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 1 A	39 µA/A + 46 pA 30 µA/A + 46 pA 27 µA/A + 0.11 nA 28 µA/A + 0.86 nA 28 µA/A + 5.6 nA 28 µA/A + 56 nA 45 µA/A + 0.56 µA 0.13 mA/A + 10 µA	HP 3458A Opt 002 8.5-digit multimeter

Parameter/Range	Frequency	CMC ^{2,4} (±)	Comments
AC Voltage ³ – Generate			
(1 to 32.999) 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	0.53 mV/V + 4 µV 0.1 mV/V + 4 µV 0.13 mV/V + 4 µV 0.17 mV/V + 4 µV 2.3 mV/V + 8 µV 5.3 mV/V + 33 µV	Fluke 5522A multiproduct calibrator
(33 to 329.999) 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	0.2 mV/V + 5.3 µV 0.1 mV/V + 5.3 µV 0.11 µV/V + 5.3 µV 0.23 mV/V + 5.3 µV 0.53 mV/V + 21 µV 1.3 mV/V + 47 µV	
(0.33 to 3.299 99) 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	0.2 mV/V + 33 µV 0.1 mV/V + 40 µV 0.13 mV/V + 40 µV 0.2 mV/V + 33 µV 0.43 mV/V + 83 µV 1.1 mV/V + 0.27 mV	
(3.3 to 32.9999) V	(10 to 45) Hz 45 Hz to 10 kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.2 mV/V + 0.43 mV 0.1 mV/V + 0.4 mV 0.16 mV/V + 0.4 mV 0.23 mV/V + 0.4 mV 0.6 mV/V + 1.1 mV	
(33 to 329.999) V	45 Hz to 1 kHz (1 to 10) kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.13 mV/V + 1.3 mV 0.13 mV/V + 4 mV 0.02 mV/V + 4 mV 0.2 mV/V + 4 mV 1.3 mV/V + 33 mV	
(330 to 1020) V	45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.2 mV/V + 6.7 mV 0.2 mV/V + 6.7 mV 0.2 mV/V + 6.7 mV	

Parameter/Range	Frequency	CMC ^{2, 4} (±)	Comments
AC Voltage ³ – Measure			
Up to 10 mV	(1 to 20) Hz (20 to 40) Hz (40 to 100) Hz 100 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 250) kHz (250 to 500) kHz 500 kHz to 1 MHz (1 to 2) MHz	4.1 $\mu\text{V}/\text{V}$ + 34 μV 1.6 mV/V + 27 μV 0.77 mV/V + 27 μV 1.8 mV/V + 27 μV 1.6 mV/V + 27 μV 7.1 mV/V + 37 μV 40 mV/V + 72 μV 0.12 mV/V + 2.4 μV 0.12 mV/V + 2.4 μV 0.12 mV/V + 2.4 μV	HP 3458A Opt 002 8.5-digit multimeter
(10 to 100 mV)	(10 to 20) Hz (20 to 40) Hz (40 to 100) Hz 100 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 250) kHz (250 to 500) kHz 500 kHz to 1 MHz (1 to 2) MHz	4.1 mV/V + 20 μV 1.6 mV/V + 20 μV 0.68 mV/V + 10 μV 1.8 mV/V + 10 μV 1.6 mV/V + 40 μV 6.1 mV/V + 80 μV 20 mV/V + 0.5 mV 30 mV/V + 0.6 mV 50 mV/V + 2 mV 0.1 V/V + 5 mV	
100 mV to 1 V	(10 to 20) Hz (20 to 40) Hz (40 to 100) Hz 100 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 250) kHz (250 to 500) kHz 500 kHz to 1 MHz (1 to 2) MHz	4.1 mV/V + 0.2 mV 1.6 mV/V + 0.2 mV 0.68 mV/V + 0.1 mV 1.8 mV/V + 0.1 mV 1.6 mV/V + 0.4 mV 6.1 mV/V + 0.8 mV 20 mV/V + 5 mV 30 mV/V + 6 mV 50 mV/V + 20 mV 0.1 V/V + 50 mV	
(1 to 10) V	(10 to 20) Hz (20 to 40) Hz (40 to 100) Hz 100 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 250) kHz (250 to 500) kHz 500 kHz to 1 MHz (1 to 2) MHz	4.1 mV/V + 2 mV 1.6 mV/V + 2 mV 0.68 mV/V + 1 mV 1.8 mV/V + 1 mV 1.6 mV/V + 4 mV 6.1 mV/V + 8 mV 20 mV/V + 50 mV 30 mV/V + 60 mV 50 mV/V + 0.2 V 0.1 V/V + 0.5 V	

Parameter/Range	Frequency	CMC ^{2,4} (±)	Comments
AC Voltage ³ – Measure (cont)			
(10 to 100) V	(10 to 20) Hz (20 to 40) Hz (40 to 100) Hz 100 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 250) kHz (250 to 500) kHz 500 kHz to 1 MHz	4.1 mV/V + 20 mV 1.6 mV/V + 20 mV 0.68 mV/V + 10 mV 1.8 mV/V + 10 mV 1.6 mV/V + 40 mV 6.1 mV/V + 80 mV 20 mV/V + 0.5 V 30 mV/V + 0.6 V 50 mV/V + 2 V	HP 3458A Opt 002 8.5 digit multimeter
(100 to 1 000) V	(10 to 20) Hz (20 to 40) Hz (40 to 100) Hz 100 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz	4.3 mV/V + 0.3 V 1.8 mV/V + 0.3 V 0.88 mV/V + 0.2 V 2.2 mV/V + 0.2 V 1.6 mV/V + 0.4 V 6.1 mV/V + 2 V	
AC Current ³ – Generate			
(29 to 329.99) µA	(10 to 20) Hz (20 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (10 to 30) kHz	0.13 µA/A + 67 nA 0.1 µA/A + 67 nA 80 nA/A + 67 nA 0.2 µA/A + 0.1 µA 0.53 µA/A + 0.13 µA 1.1 µA/A + 0.27 µA	Fluke 5522A multiproduct calibrator
(0.33 to 3.299 99) mA	(10 to 20) Hz (20 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (10 to 30) kHz	0.13 µA/A + 0.1 µA 80 nA/A + 0.1 µA 0.67 µA/A + 0.1 µA 0.13 µA/A + 0.13 µA 0.33 µA/A + 0.2 µA 70 nA/A + 0.4 µA	
(3.3 to 32.999 9) mA	(10 to 20) Hz (20 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (10 to 30) kHz	0.12 µA/A + 0.13 µA 60 nA/A + 0.13 µA 57 nA/A + 0.13 µA 53 nA/A + 0.13 µA 0.13 µA/A + 2 µA 0.27 µA/A + 2.7 µA	

Parameter/Range	Frequency	CMC ^{2, 4} (±)	Comments
AC Current ³ – Generate (cont)			
(33 to 329.999) mA	(10 to 20) Hz (20 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (10 to 30) kHz	0.12 μ A/A + 13 μ A 60 nA/A + 13 μ A 27 nA/A + 13 μ A 67 nA/A + 33 μ A 0.13 μ A/A + 67 μ A 0.27 μ A/A + 0.13 mA	Fluke 5522A multiproduct calibrator
(0.33 to 1.099 99) A	(10 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.12 μ A/A + 33 μ A 33 nA/A + 67 μ A 0.4 μ A/A + 0.67 mA 1.7 μ A/A + 3.3 mA	
(1.1 to 2.999 99) A	(10 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	1.7 μ A/A + 67 μ A 1.7 μ A/A + 37 μ A 1.7 μ A/A + 0.67 mA 1.7 μ A/A + 3.3 mA	
(3 to 10.999 9) A	(10 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz	70 nA/A + 1.3 mA 67 nA/A + 1.3 mA 2 μ A/A + 1.3 mA	
(11 to 20.5) A	(10 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz	80 nA/A + 3.3 mA 0.1 μ A/A + 3.3 mA 2 μ A/A + 3.3 mA	
AC Current ³ – Measure			
(5 to 100) μ A	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 1 kHz	4.5 mA/A + 34 nA 1.6 mA/A + 30 nA 0.68 mA/A + 34 nA 0.68 mA/A + 35 nA	HP 3458A Opt 002 8.5-digit multimeter
100 μ A to 1 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	4.5 mA/A + 0.23 μ A 1.7 mA/A + 0.23 μ A 0.68 mA/A + 0.23 μ A 0.38 mA/A + 0.22 μ A 0.68 mA/A + 0.23 μ A 4.5 mA/A + 0.45 mA 6.3 mA/A + 2 μ A	

Parameter/Range	Frequency	CMC ^{2, 4} (±)	Comments
AC Current ³ – Measure (cont)			
(1 to 10) mA	(10 to 20) Hz	4.5 mA/A + 2.3 µA	HP 3458A Opt 002 8.5 digit multimeter
	(20 to 45) Hz	1.7 mA/A + 2.3 µA	
	(45 to 100) Hz	0.68 mA /A + 2.3 µA	
	100 Hz to 5 kHz	0.38 mA /A + 2.1 µA	
	(5 to 20) kHz	0.68 mA /A + 2.3 µA	
	(20 to 50) kHz	4.5 mA/A + 4.5 µA	
	(50 to 100) kHz	6.3 mA/A + 20 µA	
(10 to 100) mA	(10 to 20) Hz	4.5 mA/A + 23 µA	
	(20 to 45) Hz	1.7 mA/A + 23 µA	
	(45 to 100) Hz	0.69 mA/A + 23 µA	
	100 Hz to 5 kHz	0.38 mA/A + 21 µA	
	(5 to 20) kHz	0.69 mA/A + 20 µA	
	(20 to 50) kHz	4.5 mA/A + 45 µA	
	(50 to 100) kHz	6.2 mA/A + 0.17 mA	
100 mA to 1 A	(10 to 20) Hz	4.5 mA/A + 0.23 mA	
	(20 to 45) Hz	1.8 mA/A + 0.23 mA	
	(45 to 100) Hz	0.91 mA/A + 0.23 mA	
	100 Hz to 5 kHz	1.1 mA/A + 0.25 mA	
	(5 to 20) kHz	3.4 mA/A + 0.22 mA	
	(20 to 50) kHz	11 mA/A + 0.45 mA	

Parameter/Equipment	Range	CMC ^{2,4} (±)	Comments
Resistance ³ – Generate	Up to 10.9999 Ω (11 to 32.9999) Ω (33 to 109.999 9) Ω (110 to 329.9999) Ω (0.33 to 1.099 999) kΩ (1.1 to 3.299 999) kΩ (3.3 to 10.999 99) kΩ (11 to 32.999 99) kΩ (33 to 109.9999) kΩ (110 to 329.999 99) kΩ (0.33 to 1.099 999) MΩ (1.1 to 3.299 999) MΩ (3.3 to 10.999 99) MΩ (11 to 32.999 99) MΩ (33 to 109.9999) MΩ (110 to 329.999 9) MΩ (330 to 1 100) MΩ	27 μΩ/Ω + 6.7 mΩ 20 μΩ/Ω + 10 mΩ 19 uΩ/Ω + 10 mΩ 19 μΩ/Ω + 13 mΩ 19 μΩ/Ω + 13 mΩ 19 μΩ/Ω + 0.13 Ω 19 μΩ/Ω + 67 mΩ 19 μΩ/Ω + 0.67 Ω 19 μΩ/Ω + 0.67 Ω 21 μΩ/Ω + 6.7 Ω 21 μΩ/Ω + 6.7 Ω 40 μΩ/Ω + 0.1 kΩ 87 μΩ/Ω + 0.17 kΩ 0.17 mΩ/Ω + 1.7 Ω 0.33 mΩ/Ω + 2 Ω 2 mΩ/Ω + 17 kΩ 17 mΩ/Ω + 0.33 MΩ	Fluke 5522A multiproduct calibrator
Resistance ³ – Generate Fixed	0.1 Ω 2 mΩ 5 mΩ 10 mΩ	3.3 μΩ 0.5 μΩ 0.5 μΩ 1.2 μΩ	Simpson current shunts
Resistance ³ – Measure	Up to 10 Ω (10 to 100) Ω 100 Ω to 1 kΩ (1 to 10) kΩ (10 to 100) kΩ 100 k Ω to 1 MΩ (1 to 10) MΩ (10 to 100) MΩ 100 M Ω to 1 GΩ	18 μΩ/Ω + 79 μΩ 17 μΩ/Ω + 0.58 mΩ 15 μΩ/Ω + 0.68 mΩ 15 μΩ/Ω + 2.1 mΩ 15 μΩ/Ω + 30 mΩ 20 μΩ/Ω + 2.4 Ω 59 μΩ/Ω + 0.13 kΩ 0.6 mΩ/Ω + 1.6 kΩ 5.6 mΩ/Ω + 54 kΩ	HP 3458A Opt 002 8.5-digit multimeter

Parameter/Range	Frequency	CMC ^{2, 4} (±)	Comments
Capacitance ³ – Generate			
(220 to 399.9) pF	10 Hz to 10 kHz	0.33 % of rdg + 6.7 pF	Fluke 5522A multiproduct calibrator
(0.4 to 1.0999) nF	10 Hz to 10 kHz	0.33 % of rdg + 6.7 pF	
(1.1 to 3.2999) nF	10 Hz to 3 kHz	0.33 % of rdg + 6.7 pF	
(3.3 to 10.9999) nF	10 Hz to 1 kHz	0.17 % of rdg + 6.7 pF	
(11 to 32.9999) nF	10 Hz to 1 kHz	0.17 % of rdg + 67 pF	
(33 to 109.999) nF	10 Hz to 1 kHz	0.17 % of rdg + 67 pF	
(110 to 329.999) nF	10 Hz to 1 kHz	0.17 % of rdg + 0.2 nF	
(0.33 to 1.099 99) µF	(10 to 600) Hz	0.17 % of rdg + 1 nF	
(1.1 to 3.299 99) µF	(10 to 300) Hz	0.17 % of rdg + 2 nF	
(3.3 to 10.9999) µF	(10 to 150) Hz	0.17 % of rdg + 6.7 nF	
(11 to 32.9999) µF	(10 to 120) Hz	0.27 % of rdg + 20 nF	
(33 to 109.999) µF	(10 to 80) Hz	0.3 % of rdg + 67 nF	
(110 to 329.999) µF	DC to 50 Hz	0.3 % of rdg + 0.2 µF	
(0.33 to 1.099 99) mF	DC to 20 Hz	0.3 % of rdg + 0.7 µF	
(1.1 to 3.299 99) mF	DC to 6 Hz	0.3 % of rdg + 2 µF	
(3.3 to 10.9999) mF	DC to 2 Hz	0.3 % of rdg + 6.7 µF	
(11 to 32.9999) mF	DC to 0.6 Hz	0.5 % of rdg + 20 µF	
(33 to 110) mF	DC to 0.2 Hz	0.7 % of rdg + 67 µF	

Parameter/Equipment	Range	CMC ^{2, 4} (±)	Comments
Inductance ³ – Generate	(0 to 999.999) mH	23 mH/H + 90 nH	IET LC-400L-SC decade inductor
Electrical Simulation OF Thermocouple Indicators ³ – Source/Measure			
Type B	(600 to 800) °C (800 to 1000) °C (1000 to 1550) °C (1550 to 1820) °C	0.44 °C 0.36 °C 0.32 °C 0.35 °C	Fluke 5522A multiproduct calibrator
Type C	(0 to 15) °C (150 to 650) °C (650 to 1000) °C (1000 to 1800) °C (1800 to 2316) °C	0.30 °C 0.27 °C 0.31 °C 0.44 °C 0.70 °C	

Parameter/Equipment	Range	CMC ² (±)	Comments
Electrical Simulation OF Thermocouple Indicators ³ – Source/Measure (cont)			
Type E	(-250 to -100) °C (-100 to -25) °C (-25 to 350) °C (350 to 650) °C (650 to 1000) °C	0.43 °C 0.20 °C 0.19 °C 0.20 °C 0.23 °C	Fluke 5522A multiproduct calibrator
Type J	(-210 to -100) °C (-100 to -30) °C (-30 to 150) °C (150 to 760) °C (760 to 1200) °C	0.26 °C 0.18 °C 0.17 °C 0.21 °C 0.24 °C	
Type K	(-200 to -100) °C (-100 to -25) °C (-25 to 120) °C (120 to 1000) °C (1000 to 1372) °C	0.33 °C 0.20 °C 0.21 °C 0.25 °C 0.37 °C	
Type N	(-200 to -100) °C (-100 to -25) °C (-25 to 120) °C (120 to 410) °C (410 to 1300) °C	0.40 °C 0.25 °C 0.22 °C 0.21 °C 0.27 °C	
Type R	(0 to 250) °C (250 to 400) °C (400 to 1000) °C (1000 to 1767) °C	0.51 °C 0.37 °C 0.34 °C 0.38 °C	
Type S	(0 to 250) °C (250 to 1000) °C (1000 to 1400) °C (1400 to 1767) °C	0.46 °C 0.36 °C 0.37 °C 0.44 °C	
Type T	(-250 to -150) °C (-150 to 0) °C (0 to 120) °C (120 to 400) °C	0.52 °C 0.24 °C 0.18 °C 0.20 °C	

Parameter/Equipment	Range	CMC ² (±)	Comments
Electrical Simulation of RTD Indicators ³ –			
Pt 385, 100 Ω	(-200 to -80) °C (-80 to 0) °C (0 to 100) °C (100 to 300) °C (300 to 400) °C (400 to 630) °C (630 to 800) °C	0.03 °C 0.03 °C 0.05 °C 0.06 °C 0.07 °C 0.08 °C 0.15 °C	Fluke 5522A multiproduct calibrator
Pt 3926, 100 Ω	(-200 to -80) °C (-80 to 0) °C (0 to 100) °C (100 to 300) °C (300 to 400) °C (400 to 630) °C	0.03 °C 0.03 °C 0.05 °C 0.06 °C 0.07 °C 0.08 °C	
Pt 3916, 100 Ω	(-200 to -190) °C (-190 to -80) °C (-80 to 0) °C (0 to 100) °C (100 to 260) °C (260 to 300) °C (300 to 400) °C (400 to 600) °C (600 to 630) °C	0.17 °C 0.03 °C 0.03 °C 0.04 °C 0.05 °C 0.05 °C 0.06 °C 0.07 °C 0.15 °C	
Pt 385, 200 Ω	(-200 to -80) °C (-80 to 0) °C (0 to 100) °C (100 to 260) °C (260 to 300) °C (300 to 400) °C (400 to 600) °C (600 to 630) °C	0.03 °C 0.03 °C 0.03 °C 0.03 °C 0.18 °C 0.09 °C 0.1 °C 0.11 °C	
Pt 385, 500 Ω	(-200 to -80) °C (-80 to 0) °C (0 to 100) °C (100 to 260) °C (260 to 300) °C (300 to 400) °C (400 to 600) °C (600 to 630) °C	0.03 °C 0.03 °C 0.03 °C 0.04 °C 0.05 °C 0.05 °C 0.06 °C 0.07 °C	
Pt 385, 1 000 Ω	(-200 to 0) °C (0 to 100) °C (100 to 260) °C (260 to 300) °C (300 to 600) °C (600 to 630) °C	0.02 °C 0.02 °C 0.03 °C 0.04 °C 0.05 °C 0.05 °C	

Parameter/Equipment	Range	CMC ^{2, 5} (±)	Comments
Electrical Simulation of RTD Indicators ³ – (cont)			
Ni 120, 120 Ω	(-80 to 0) °C (0 to 100) °C (100 to 260) °C	0.05 °C 0.05 °C 0.09 °C	Fluke 5522A multiproduct calibrator
Cu 427, 10 Ω	(-100 to 260) °C	0.2 °C	
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 % of rdg + 40 μV 0.05 % of rdg + 40 μV	Fluke 5522A multiproduct calibrator
Amplitude – Square Wave 50 Ω Load	± 1 mVp-p to ± 6.6 Vp-p 10 Hz to 10 kHz	0.25 % of rdg + 40 μV	
1 MΩ Load	± 1 mVp-p to ± 130 Vp-p 10 Hz to 1 kHz (1 to 10) kHz	0.1 % of rdg + 40 μV 0.25 % of rdg + 40 μV + 0 ps/- 100 ps	
Rise Time	< 300 ps	11 mV/V + 0.8 mV 15 mV/V + 0.7 mV 30 mV/V + 0.7 mV	
Leveled Sine Wave (Relative to 50 kHz)	5 mVp-p to 5.5 Vp-p 50 kHz to 100 MHz (100 to 300) MHz (300 to 600) MHz	(25 + 1000T) μs/s 2.5 μs	
Time Marker Into 50 Ω Load	50 ms to 5 s 1 ns to 20 ms		
Leveled Sine Wave – Flatness Into 50 Ω load	5 mVp-p to 5.5 Vp-p 50 kHz Reference 50 kHz to 100 MHz (100 to 300) MHz (300 to 600) MHz 5 mVp-p to 3.5 Vp-p 600 MHz to 1.1 GHz	2 % of rdg + 0.3 mV 3.5 % of rdg + 0.3 mV 4 % of rdg + 0.3 mV 6 % of rdg + 0.3 mV 7 % of rdg + 0.3 mV	

Parameter/Equipment	Range	CMC ^{2,4} (±)	Comments
Oscilloscopes ³ – (cont)			
Leveled Sine Wave – Frequency Into 50 Ω Load	50 kHz to 1.1 GHz	0.25 μHz/Hz	Fluke 5522A multiproduct calibrator
Edge Characteristics Into 50 Ω Load		+ 0 ps/-100 ps	
Rise Time	≤ 300 ps	2 % of rdg + 0.2 mV	
Amplitude	5 mVp-p to 2.5 Vp-p	2.5 μHz/Hz	
Frequency	900 Hz to 11 MHz		
Wave Generator – Amplitude (Square, Sine, & Triangle) Into 50 Ω	10 Hz to 10 kHz	30 mV/V + 0.1 mV	
Into 1 MΩ	1.8 mVp-p to 2.5 Vp-p 10 Hz to 10 kHz 1.8 mVp-p to 55 Vp-p	30 mV/V + 0.1 mV 25 μHz/Hz + 15 mHz	
Wave Generator – Frequency (Square, Sine, & Triangle)	10 Hz to 10 kHz		
Input Impedance – Measure: Resistance		0.1 % of rdg	
Into 50 Ω Load	(40 to 60) Ω	0.1 % of rdg	
Into 1 MΩ Load	500 kΩ to 1.5 MΩ		
Capacitance Into 1 MΩ Load	(5 to 50) pF	5 % of rdg + 0.5 pF	

IV. Mechanical

Parameter/Equipment	Range	CMC ² (±)	Comments
Velometers & Anemometers	(50 to 200) fpm (200 to 1 200) fpm	1.7 % of rdg + 5.8 fpm 2.2 % of rdg + 1.5 fpm	Standard anemometer
Balances & Scales ³			
(0.00001 g Resolution)	Up to 210 g (210 to 3200) g	0.18 mg 7.6 mg	ASTM Class 1 weights and internal procedure BP042.
(0.01 g Resolution)	(3.2 to 31) kg	59 mg	ASTM Class 4 weights and internal procedure BP042
(0.1 g Resolution)	Up to 300 lb (300 to 650) lb	7.6 mg 59 mg	ASTM Class 6 weights and internal procedure BP042
Barometers	(28 to 32) inHg	0.09 inHg	Manometer w/ master barometer
Durometer Force			
Type A, B, E, & O Types C, D, & DO Type OO & OOO	Up to 821 gf Up to 4532 gf Up to 114 gf	0.14 gf 0.14 gf 0.14 gf	Class 4 Weights, Analytical Balance
Durometer Indenter – Length	(0.09 to 0.11) in	130 µin	Optical comparator
Dynamometer ³ –	Up to 5000 g (2 to 1000) lbf (1000 to 5000) lbf (5000 to 10 000) lbf	4.2 mg 0.06 % of rdg + 0.06 lbf 0.08 % of rdg + 0.11 lbf 0.004 % of rdg + 3.7 lbf	ASTM Class 1 & S weights ASTM Class 6 weights load cell, multimeter
Flow Meters ³	Up to 2 slpm (2 to 20) slpm	0.9 % of rdg + 0.003 slpm 0.7 % of rdg + 0.044 slpm	Alicat flow controller

Parameter/Equipment	Range	CMC ² (±)	Comments
Rockwell Hardness Testers ³	HRA HRBW HRC HRD HRE HRF	1.2 HRA 1.2 HRBW 0.7 HRC 1.2 HRD 1.3 HRE 1.3 HRF	Indirect verification per ASTM E18 using test blocks
Brinell Hardness Testers ³	230 HBW 309 HBW	3.3 HBW 5.5 HBW	Indirect verification per ASTM E10 using test blocks
Force Indicating Devices ³	Up to 210 g (2 to 400) lbf (400 to 1000) lbf (1000 to 5000) lbf (5000 to 10 000) lbf	0.64 mg 0.03 % of rdg 0.03 % of rdg + 0.3 lbf 0.03 % of rdg + 0.9 lbf 0.03 % of rdg + 2.7 lbf	ASTM Class 6 weights, load cell, multimeter
Mass	Up to 2 g (2 to 210) g (210 to 3200) g (3200 to 31 000) g	0.02 % of rdg + 13 µg 0.000 07 % of rdg + 30 µg 0.000 4 % of rdg + 1 mg 0.000 27 % of rdg + 80 mg	Sartorius MC 210 S balance, ASTM Class 1 & 4 weights Sartorius MC 210-03S balance, ASTM Class 1 & 4 weights Sartorius MSA31 scale, ASTM Class 1 & 4 weights GP-30K scale, Class 1 & 4 weights
Pipettes	(0.5 to 10 000) µL	0.04 % of rdg + 0.03 µL	Precision balances, distilled water
Volumetric Ware	Up to 2 000 mL	0.04 % of rdg	Precision balances, distilled water
Barometers	(28 to 32) inHg	0.09 inHg	Manometer w/ master barometer

Parameter/Equipment	Range	CMC ² (±)	Comments
Pressure Gages, Pressure Transducers ³	(0.000 01 to 0.5) in H ₂ O (0.072 to 7.5) psig (7.5 to 60) psig (60 to 1000) psig (1000 to 10 000) psig	0.03 % of rdg 0.12 % of rdg 0.0001 % of rdg + 0.0012 psi 0.000 04 % of rdg + 0.038 psi 0.000 06% of rdg + 0.011 psi	Comparison to manometer Comparison to mensor 2400 digital pressure gage Dead weight tester
Vacuum Gages ³	(-30 to 0) inHg	0.09 inHg	Comparison to master manometer
Torque Transducers	Up to 27.6 lbf·in (27.6 to 150) lbf·in 150 lbf·in to 60 lbf·ft (60 to 2 000) lbf·ft	0.007 % of rdg + 0.004 lbf·in 0.06 % of rdg + 0.000 1 lbf·in 0.3 % of rdg + 0.009 lbf·ft 0.08 % of rdg + 0.000 5 lbf·ft	Torque wheels, torque arms, Class 6 weights
Torque Tools ³	(4 to 50) lbf·in (30 to 400) lbf·in (80 to 1 000) lbf·in (20 to 250) lbf·ft (60 to 600) lbf·ft (200 to 2 000) lbf·ft	0.17 % of rdg + 0.11 lbf·in 0.41 % of rdg + 0.05 lbf·in 0.42 % of rdg + 0.02 lbf·in 0.39 % of rdg + 0.07 lbf·ft 0.3 % of rdg + 0.01 lbf·ft 0.3 % of rdg + 0.004 lbf·ft	CDI torque machine

V. Thermodynamics

Parameter/Equipment	Range	CMC ^{2, 6} ($\pm$)	Comments
Humidity ³ –	(10 to 90) % RH (90 to 95) % RH	1.4 % RH 2.1 % RH	Vaisala HMI70 temperature/humidity indicator, salts
Temperature ³ – Measure	(-20 to 60) °C (-270 to -210) °C (-210 to 400) °C (400 to 1 370) °C (-270 to 400) °C (400 to 1370) °C (-200 to 100) °C (100 to 300) °C (300 to 500) °C (500 to 660) °C	0.25 °C 0.7 °C 0.6 °C 1.3 °C 0.6 °C 1.3 °C 0.046 °C 0.065 °C 0.085 °C 0.12 °C	Vaisala HMI41 temperature/humidity indicator Comparison to datalogger w/ type T thermocouple probe Comparison to Fluke 5500A, w/ Type T thermocouple probe Fluke/Hart 5628 PRT w/ HP 3458A Opt 002 8.5-digit multimeter
Temperature ³ – Measuring Equipment	(-25 to 400) °C (-25 to 100) °C (100 to 300) °C (300 to 400) °C	0.6 °C 0.046 °C 0.065 °C 0.085 °C	Dry well, Fluke w/ type K thermocouple probe Dry Well, Burns engineering PRT w/ HP 3458A Opt 002 8.5-digit multimeter
Thermocouple ³ (Wires, Probes) –	(-25 to 400) °C	0.07 °C	Ice bath, Dry-well, Burns engineering PRT w/ HP 3458A Opt 002 8.5-digit multimeter, Fluke 5500A
Infrared Thermometers ³	(-20 to 660) °C 50 °C 100 °C 200 °C 300 °C 400 °C	0.3 °C 1.4 °C 1.4 °C 1.8 °C 1.5 °C 1.6 °C	Comparison to Burns Engineering PRT w/ HP 3458A Opt 002 8.5-digit multimeter, blackbody source $\epsilon = 0.96$, $\lambda = (8 \text{ to } 14) \mu\text{m}$ Ametek ETC-400R blackbody source (cavity) $\epsilon = 0.96$, $\lambda = (8 \text{ to } 14) \mu\text{m}$

VI. Time & Frequency

Parameter/Equipment	Range	CMC ^{2, 6} (±)	Comments
Frequency – Measure ³	(1 to 40) Hz 40 Hz to 10 kHz 10 kHz to 1 MHz (1 to 20) MHz (20 to 100) MHz	500 µHz/Hz 100 µHz/Hz 3.6 µHz/Hz + 1 Hz 0.4 Hz 2.4 Hz	HP 3458A Opt 002 8.5-digit multimeter, HP 5334A counter
Stopwatches & Timers ³	Up to 24 hr	0.12 s	Time signal receiver
Tensile Testers ³	Up to 24 in/min	0.14 % of rdg + 0.013 in/min	Steel rule, stopwatch
Rotational Indicating Devices ³	Up to 30 000 rpm	0.011 % of rdg + 1.3 rpm	Comparison to Ametek 1726 digital tachometer
Tachometers ³	(20 to 300) rpm (300 to 3000) rpm (3000 to 30 000) rpm	0.009 % of rdg + 0.03 rpm 0.01 % of rdg + 0.14 rpm 0.01 % of rdg + 1.3 rpm	Comparison to Ametek 1965 digistrobe

¹ This laboratory offers commercial calibration.

² Calibration and Measurement Capability Uncertainty (CMC)² 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 of nearly ideal measuring equipment. CMC's 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

³ Field calibration service is available for this calibration. Please note the actual measurement uncertainties achievable on a customer's site can normally be expected to be larger than the Calibration and Measurement Capability Uncertainty (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 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, L is the numerical value of the nominal length of the device measured in inches, DL is the numerical value of the diagonal length of the device measured in inches and T represents the time.

⁶ 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

MICHELLI MEASUREMENT GROUP, LLC

Goleta, 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 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 13th day of June 2023.

A blue ink signature of Mr. Trace McInturff.

Mr. Trace McInturff, Vice President, Accreditation Services
For the Accreditation Council
Certificate Number 5104.04
Valid to April 30, 2024.
Revised January 2, 2024

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