



SCOPE OF ACCREDITATION TO ISO 17025:2017

CALSOURCE
1005 West Fayette Street
Suite 4D
Syracuse, NY 13204
Bradley J. Darois Phone: 315 425 1151

CALIBRATION

Valid To: June 30, 2024

Certificate Number: 2133.01

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. Dimensional

Parameter/Equipment	Range	CMC ^{2, 4} (±)	Comments
Gage Blocks – Length	Up to 1 in (>1 to 6) in	3.6 μin (5.0 + 0.5L) μin	P&W Labmaster™ & master gage blocks
Hand Tools – Angle ³	Up to 180°	76”	Angle blocks
Micrometers ³ – Inside, Outside, Depth	Up to 20 in	(0.6R + 10L) μin	Gage blocks
Calipers ³ – Outside, Inside, Depth & End Face	Up to 48 in	(0.6R + 5.0L) μin	Gage blocks
Dial Indicators ³	0.015 in (>0.015 to 4) in	110 μin (0.6R + 100) μin	Starrett indicator calibrator
Dial Indicators	0.015 in (>0.015 to 4) in	70 μin (0.6R + 40) μin	P&W model C Supermicrometer™

Parameter/Equipment	Range	CMC ^{2,4} (±)	Comments
Height Gages ³	(1 to 24) in	(65 + 1.0L) μin	Gage blocks, surface plate
Plug/Pin Gages	(0.005 to 10) in	(22 + 10D) μin	P&W universal Supermicrometer™, ASME grade 1 gage blocks
Plain Rings	(0.25 to 9) in	(20 + 7.0D) μin	P&W universal Supermicrometer™, ASME grade 1 gage blocks, master rings
Tape Measure ³ (Steel)	Up to 100 ft	0.037 in	Gage blocks & reference ruler
Rulers ³	Up to 40 in	0.013 in	Gage blocks & reference ruler
Generic Test Fixtures – Linear Measurement	Up to 10 in Up to 7 in	36 μin 150 μin	P&W Model C™ Optical comparator
Angle Measurement	(0 to 360)°	10 μin	
Radius Measurement	Up to 7 in	240 μin	
Length Measurement – Volumetric	(18 x 20 x 16) in	530 μin	CMM
Length Measurement – X, Y, Z Linear Axis	(18 x 20 x 16) in	340 μin	CMM
Thread Plug Gages – Pitch Diameter	Up to 2 in (2 to 8) in	73 μin (73 + 18D) μin	Using thread measuring wires

Parameter/Equipment	Range	CMC ^{2, 4} (\pm)	Comments
Surface Plates ³ –			
Flatness Overall	(20 to 70) in Diagonal (80 to 161) in Diagonal	(45 + 1D) μ in 160 μ in	Planekator
Flatness Local Area (Repeat Reading)	Up to 0.001 in	25 μ in	Datum gauge (Repeat-o-meter TM)

II. Electrical – DC/Low Frequency

Parameter/Equipment	Range	CMC ^{2, 5, 6} (\pm)	Comments
DC Voltage ³ – Measure	Up to 200 mV 200 mV to 2V (2 to 20) V (20 to 200) V (200 to 1000) V	4.5 μ V/V + 0.1 μ V 3.3 μ V/V + 0.4 μ V 3.3 μ V/V + 4.0 μ V 5.8 μ V/V + 40 μ V 5.8 μ V/V + 0.5 mV	Fluke 8508A/01
Voltage Divider	(1 to 10) kV Up to 200 mV 200 mV to 20 V	0.13 % 46 μ V/V + 60 nV 0.35 μ V/V	HP 3458A w/ divider Fluke 8508A/02
DC Voltage ³ – Generate	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	7.8 μ V/V + 0.4 μ V 5.3 μ V/V + 0.7 μ V 4.0 μ V/V + 2.5 μ V 5.4 μ V/V + 4.0 μ V 6.6 μ V/V + 40 μ V 7.7 μ V/V + 400 μ V	Fluke 5720A/03
Fixed Point	10 V	2.0 parts in 10 ⁶ V	Fluke 7000 & 7000N
DC Current ³ – Measure	Up to 200 μ A 200 μ A to 2 mA (2 to 20) mA (20 to 200) mA 200 mA to 2.0 A (2 to 20) A	37 μ A/A + 0.4 nA 13 μ A/A + 4.0 nA 14 μ A/A + 40 nA 48 μ A/A + 0.8 μ A 0.018 % + 16 μ A 0.039 % + 400 μ A	Fluke 8508A/01

Parameter/Equipment	Range	CMC ^{2, 5, 6} (±)	Comments
DC Current ³ – Generate	Up to 220 µA	42 µA/A + 6.0 nA	Fluke 5720A w/ 5725A Fluke 5520 Fluke 5520 w/ coil
	220 µA to 2.2 mA	41 µA/A + 7.0 nA	
	(2.2 to 22) mA	37 µA/A + 40 nA	
	(22 to 220) mA	47 µA/A + 10 µA	
	220 mA to 2.2 A	81 µA/A + 49 µA	
	(2.2 to 10) A	0.037 % + 480 nA	
	(10 to 20) A	21 mA	
	(20 to 1000) A	0.65 %	
Resistance ³ – Measure	Up to 2 Ω	18 µΩ/Ω + 4 µΩ	Fluke 8508A
	(2 to 20) Ω	11 µΩ/Ω + 14 µΩ	
	(20 to 200) Ω	9.0 µΩ/Ω + 50 µΩ	
	200 Ω to 2 kΩ	9.2 µΩ/Ω + 0.5 mΩ	
	(2 to 20) kΩ	9.3 µΩ/Ω + 5 mΩ	
	(20 to 200) kΩ	9.5 µΩ/Ω + 50 mΩ	
	200 kΩ to 2 MΩ	12 µΩ/Ω + 1 Ω	
	(2 to 20) MΩ	31 µΩ/Ω + 100 Ω	
	(20 to 200) MΩ	0.013 % + 10 kΩ	
	200 MΩ to 2 GΩ	0.063 % + 1 MΩ	
	(1 to 10) kΩ	1.6 µΩ/Ω	Thomas 1 Ω & Fluke 8508A/01
Resistance ³ – Generate	Up to 11 Ω	42 µΩ/Ω + 0.001 Ω	Fluke 5520A
	(11 to 33) Ω	32 µΩ/Ω + 0.0015 Ω	
	(33 to 110) Ω	30 µΩ/Ω + 0.0014 Ω	
	(110 to 330) Ω	29 µΩ/Ω + 0.002 Ω	
	330 Ω to 1.1 kΩ	30 µΩ/Ω + 0.002 Ω	
	(1.1 to 3.3) kΩ	29 µΩ/Ω + 0.02 Ω	
	(3.3 to 11) kΩ	30 µΩ/Ω + 0.02 Ω	
	(11 to 33) kΩ	30 µΩ/Ω + 0.2 Ω	
	(33 to 110) kΩ	30 µΩ/Ω + 0.2 Ω	
	(110 to 330) kΩ	34 µΩ/Ω + 2 Ω	
	330 kΩ to 1.1 MΩ	34 µΩ/Ω + 2 Ω	
	(1.1 to 3.3) MΩ	65 µΩ/Ω + 30 Ω	
	(3.3 to 11) MΩ	0.014 %	
	(11 to 33) MΩ	0.034 %	
	(33 to 110) MΩ	0.055 %	
	(110 to 330) MΩ	0.35 %	
330 MΩ to 1.1 GΩ	1.6 %		

Parameter/Equipment	Range	CMC ^{2, 5, 6} (±)	Comments
Resistance ³ – Generate			
Fixed Points	1 Ω	96 μΩ/Ω	Fluke 5720A
	1.9 Ω	96 μΩ/Ω	
	10 Ω	24 μΩ/Ω	
	19 Ω	28 μΩ/Ω	
	100 Ω	11 μΩ/Ω	
	190 Ω	11 μΩ/Ω	
	1 kΩ	9.3 μΩ/Ω	
	1.9 kΩ	9.4 μΩ/Ω	
	10 kΩ	10 μΩ/Ω	
	19 kΩ	10 μΩ/Ω	
	100 kΩ	13 μΩ/Ω	
	190 kΩ	13 μΩ/Ω	
	1 MΩ	22 μΩ/Ω	
	1.9 MΩ	23 μΩ/Ω	
	10 MΩ	42 μΩ/Ω	
	19 MΩ	62 μΩ/Ω	
	100 MΩ	0.011 %	
	1 Ω	0.7 μΩ/Ω	Thomas 1 Ω

Parameter/Range	Frequency	CMC ^{2, 5, 6} (±)	Comments
Capacitance – Measure			
100 pF to 1000 μF	12.5 Hz to 10 kHz	0.18 %	Genrad 1689
Phase ³ – Generate			Fluke 5520A
	(10 to 65) Hz	0.1°	
	(65 to 500) Hz	0.25°	
	500 Hz to 1 kHz	0.5°	
	(1 to 5) kHz	2.5°	
	(5 to 10) kHz	5°	
	(10 to 30) kHz	10°	
Inductance – Generate			General radio 1482-x standard inductors
100 μH	100 Hz to 10 kHz	0.26 μH	
1 mH		0.0011 mH	
10 mH		0.011 mH	
100 mH		0.11 mH	
1 H	100 Hz to 1 kHz	0.0011 H	
10 H		0.011 H	

Parameter/Range	Frequency	CMC ^{2, 6} (±)	Comments
AC Current ³ – Generate			
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	0.029 % + 16 nA 0.019 % + 10 nA 0.015 % + 8 nA 0.035 % + 12 nA 0.12 % + 65 nA	Fluke 5720A
(0.22 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 % + 35 nA 0.03 % + 110 nA 0.12 % + 650 nA	
(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	0.029 % + 400 nA 0.019 % + 350 nA 0.017 % + 350 nA 0.023 % + 550 nA 0.12 % + 5 mA	
(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	0.029 % + 4.0 µA 0.021 % + 3.5 µA 0.018 % + 2.5 µA 0.024 % + 3.5 µA 0.12 % + 10 µA	
220 mA to 2.2 A	(20 to 1000) Hz (1 to 5) kHz (5 to 10) kHz	0.029 % + 35 µA 0.047 % + 80 µA 0.74 % + 160 µA	Fluke 5720A w/ 5725A
(2.2 to 11) A	(40 to 1000) Hz (1 to 5) kHz (5 to 10) kHz	0.049 % + 170 µA 0.097 % + 380 µA 0.37 % + 750 µA	
(11 to 20.5) A	(45 to 100) Hz 100 Hz to 1 kHz	0.15 % + 5 mA 0.22 % + 5 mA	Fluke 5520A LCOMP off
(20.5 to 1000) A	(45 to 65) Hz	0.27 % + 5 mA	Fluke 5520 & coil

Parameter/Range	Frequency	CMC ^{2, 6} (\pm)	Comments
AC Current ³ – Measure			
Up to 200 μ A	(1 to 10) Hz 10 Hz to 10 kHz (10 to 30) kHz (30 to 100) kHz	0.033 % + 20 nA 0.05 % + 20 nA 0.075 % + 20 nA 0.47 % + 20 nA	Fluke 8508A
200 μ A to 2 mA	(1 to 10) Hz 10 Hz to 10 kHz (10 to 30) kHz (30 to 100) kHz	0.032 % + 200 nA 0.031 % + 200 nA 0.081 % + 200 nA 0.42 % + 200 nA	
(2 to 20) mA	(1 to 10) Hz 10 Hz to 10 kHz (10 to 30) kHz (30 to 100) kHz	0.032 % + 2 μ A 0.043 % + 2 μ A 0.076 % + 2 μ A 0.42 % + 2 μ A	
(20 to 200) mA	(1 to 10) Hz 10 Hz to 10 kHz (10 to 30) kHz	0.032 % + 20 μ A 0.031 % + 20 μ A 0.085 % + 20 μ A	
200 mA to 2 A	10 Hz to 2 kHz (2 to 10) kHz (10 to 30) kHz	0.063 % + 200 μ A 0.074 % + 200 μ A 0.31 % + 200 μ A	
(2 to 20) A	10 Hz to 2 kHz (2 to 10) kHz	0.083 % + 2 mA 0.26 % + 2 mA	
AC Voltage ³ – Generate			
Up 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 500 kHz to 1 MHz	0.028 % + 4 μ V 94 μ V/V + 4 μ V 84 μ V/V + 4 μ V 0.03 % + 4 μ V 0.06 % + 5 μ V 0.12 % + 10 μ V 0.15 % + 20 μ V 0.28 % + 20 μ V	Fluke 5720A
(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 500 kHz to 1 MHz	0.028 % + 4 μ V 94 μ V/V + 4 μ V 84 μ V/V + 4 μ V 0.03 % + 4 μ V 0.06 % + 5 μ V 0.12 % + 10 μ V 0.15 % + 20 μ V 0.28 % + 20 μ V	

Parameter/Range	Frequency	CMC ^{2, 6} (±)	Comments
AC Voltage ³ – Generate (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 500 kHz to 1 MHz	0.028 % + 12 μV 94 μV/V + 7 μV 84 μV/V + 7 μV 0.03 % + 7.0 μV 0.06 % + 17 μV 0.12 % + 20 μV 0.15 % + 25 μV 0.28 % + 45 μV	Fluke 5720A
(0.22 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 500 kHz to 1 MHz	0.028 % + 40 μV 94 μV/V + 15 μV 48 μV/V + 8 μV 79 μV/V + 10 μV 0.02 % + 300 μV 0.05 % + 80 μV 0.14 % + 200 μV 0.21 % + 300 μV	
(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 500 kHz to 1 MHz	0.028 % + 400 μV 95 μV/V + 150 μV 54 μV/V + 50 μV 90 μV/V + 100 μV 0.02 % + 200 μV 0.035 % + 600 μV 0.14 % + 2 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 (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz	0.028 % + 4 mV 0.012 % + 1.5 mV 62 μV/V + 0.6 mV 90 μV/V + 1 mV 0.018 % + 2.5 mV 0.091 % + 16 mV 0.48 % + 40 mV 0.85 % + 80 mV	Fluke 5720A, volt- hertz limitation over 100 kHz. Max output is 2.2 x 10 ⁷ V-Hz.
(220 to 1100) V	(15 to 50) Hz 50 Hz to 1 kHz	0.031 % + 16 mV 0.008 % + 3.5 mV	Max 250 V for (15 to 50) Hz
(220 to 750) V	(30 to 50) kHz (50 to 100) kHz	0.062 % + 11 mV 0.24 % + 45 mV	Fluke 5720A w/ 5725A
(220 to 1100) V	(1 to 20) kHz (20 to 30) kHz	0.017 % + 6 mV 0.062 % + 11 mV	

Parameter/Range	Frequency	CMC ^{2, 5, 6} (±)	Comments
AC Voltage – Measure			
600 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	0.22 % + 1.3 µV 0.079 % + 1.3 µV 0.048 % + 1.3 µV 0.088 % + 2.0 µV 0.14 % + 2.5 µV 0.26 % + 4.0 µV 0.27 % + 8.0 µV	Fluke 5790A/03
Flatness – 500 kHz to 30 MHz (Relative to 1 kHz)	500 kHz to 1.2 MHz (1.2 to 2) MHz (2 to 10) MHz (10 to 20) MHz (20 to 30) MHz	0.08 % + 1.0 µV 0.08 % + 1.0 µV 0.19 % + 1.0 µV 0.4 % + 1.0 µV 0.75 % + 2.0 µV	
(2.2 to 7) 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	0.092 % + 1.3 µV 0.042 % + 1.3 µV 0.025 % + 1.3 µV 0.06 % + 2.0 µV 0.08 % + 2.5 µV 0.16 % + 4.0 µV 0.17 % + 8.0 µV	
Flatness – 500 kHz to 30 MHz (Relative to 1 kHz)	500 kHz to 1.2 MHz (1.2 to 2) MHz (2 to 10) MHz (10 to 20) MHz (20 to 30) MHz	0.08 % + 1.0 µV 0.08 % + 1.0 µV 0.19 % + 1.0 µV 0.4 % + 1.0 µV 0.75 % + 1.0 µV	
(7 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	0.033 % + 1.3 µV 0.021 % + 1.3 µV 0.014 % + 1.3 µV 0.025 % + 2.0 µV 0.035 % + 2.5 µV 0.086 % + 4.0 µV 0.092 % + 8.0 µV	
Flatness – 500 kHz to 30 MHz (Relative to 1 kHz)	500 kHz to 1.2 MHz (1.2 to 2) MHz (2 to 10) MHz (10 to 20) MHz (20 to 30) MHz	0.08 % 0.08 % 0.19 % 0.4 % 0.75 %	

Parameter/Range	Frequency	CMC ^{2, 5, 6} (±)	Comments
AC Voltage – Measure (cont)			
(22 to 70) 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	0.028 % + 1.5 μV 0.017 % + 1.5 μV 75 μV/V + 1.5 μV 0.017 % + 2 μV 0.032 % + 2.5 μV 0.057 % + 4 μV 0.075 % + 8 μV	Fluke 5790A/03
(70 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	0.023 % + 1.5 μV 95 μV/V + 1.5 μV 47 μV/V + 1.5 μV 75 μV/V + 2 μV 0.019 % + 2.5 μV 0.028 % + 4 μV 0.042 % + 8 μV	
(220 to 700) 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	0.024 % + 1.5 μV 81 μV/V + 1.5 μV 40 μV/V + 1.5 μV 56 μV/V + 2 μV 98 μV/V + 2.5 μV 0.024 % + 4 μV 0.05 % + 8 μV	
700 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	0.03 % 68 μV/V 29 μV/V 53 μV/V 79 μV/V 0.019 % 0.031 %	
22 mV to 7 V	500 kHz to 1.2 MHz (1.2 to 2) MHz	0.06 % 0.06 %	
Flatness – 500 kHz to 30 MHz (Relative to 1 kHz)	(2 to 10) MHz (10 to 20) MHz (20 to 30) MHz	0.12 % 0.17 % 0.38 %	
(2.2 to 7) 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	0.03 % 73 μV/V 28 μV/V 56 μV/V 90 μV/V 0.03 % 0.06 %	

Parameter/Range	Frequency	CMC ^{2, 5, 6} (±)	Comments
AC Voltage – Measure (cont)			
Flatness – 10 Hz to 500 kHz (Relative to 1 kHz)	(10 to 30) Hz 2.2 mV to 7 V	0.12 %	Fluke 5790A/03
	(30 to 120) kHz 2.2 mV to 7 V	0.059 %	
	(120 to 500) kHz (2.2 to 22) mV	0.12 %	
	(120 to 500) kHz (22 to 70) mV	0.077 %	
	(120 to 500) kHz (70 to 220) mV	0.059 %	
	(120 to 500) kHz (220 to 700) mV	0.045 %	
	(120 to 500) kHz 700 mV to 7 V	0.035 %	
(7 to 22) V	(10 to 20) Hz	0.03 %	
	(20 to 40) Hz	69 µV/V	
	40 Hz to 20 kHz	30 µV/V	
	(20 to 50) kHz	53 µV/V	
	(50 to 100) kHz	90 µV/V	
	(100 to 300) kHz	0.022 %	
	(300 to 500) kHz	0.045 %	
(22 to 70) V	(10 to 20) Hz	0.03 %	
	(20 to 40) Hz	73 µV/V	
	40 Hz to 20 kHz	36 µV/V	
	(20 to 50) kHz	62 µV/V	
	(50 to 100) kHz	100 µV/V	
	(100 to 300) kHz	0.024 %	
	(300 to 500) kHz	0.05 %	
500 kHz to 1 MHz	0.14 %		
(70 to 220) V	(10 to 20) Hz	0.03 %	
	(20 to 40) Hz	73 µV/V	
	40 Hz to 20 kHz	36 µV/V	
	(20 to 50) kHz	73 µV/V	
	(50 to 100) kHz	0.011 %	
	(100 to 300) kHz	0.03 %	
	(300 to 500) kHz	0.06 %	

Parameter/Range	Frequency	CMC ^{2, 5, 6} (±)	Comments
AC Voltage – Measure (cont)			
(220 to 700) V	(10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz	0.03 % 0.013 % 46 μV/V 0.015 % 0.06 %	Fluke 5790A/03
(700 to 1000) V	(10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz	0.03 % 0.013 % 50 μV/V 0.015 % 0.06 %	
(1 to 10) kV	(45 to 65) Hz	0.6 %	HP 3458A w/ divider
Distortion – Measure	20 Hz to 20 kHz (20 to 100) kHz	1.3 % 2.4 %	HP 8903A

Parameter/Equipment	Range	CMC ^{2, 6} (±)	Comments
Capacitance ³ – Generate	(0.19 to 3.3) nF (3.3 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 (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	0.6 % + 0.01 nF 0.33 % + 0.01 nF 0.26 % + 0.1 nF 0.26 % + 0.3 nF 0.28 % + 1 nF 0.26 % + 3 nF 0.28 % + 10 nF 0.42 % + 30 nF 0.47 % + 100 nF 0.47 % + 300 nF 0.45 % + 1 μF 0.47 % + 3 μF 0.47 % + 10 μF 0.78 % + 30 μF 1.3 % + 100 μF	Fluke 5520A

Parameter/Equipment	Range	CMC ² (±)	Comments
Electrical Simulation of Thermocouples & Thermocouple Indicators ³ –			
Type B	(600 to 800) °C (800 to 1000) °C (1000 to 1550) °C (1550 to 1820) °C	0.44 °C 0.34 °C 0.3 °C 0.33 °C	Fluke 5520A
Type C	(0 to 150) °C (150 to 650) °C (650 to 1000) °C (1000 to 1800) °C (1800 to 2316) °C	0.3 °C 0.26 °C 0.31 °C 0.5 °C 0.84 °C	
Type E	(-250 to -100) °C (-100 to -25) °C (-25 to 350) °C (350 to 650) °C (650 to 1000) °C	0.5 °C 0.16 °C 0.14 °C 0.16 °C 0.21 °C	
Type J	(-210 to -100) °C (-100 to -30) °C (-30 to 150) °C (150 to 760) °C (760 to 1200) °C	0.27 °C 0.16 °C 0.14 °C 0.17 °C 0.23 °C	
Type K	(-200 to -100) °C (-100 to -25) °C (-25 °C to 120) °C (120 to 1000) °C (1000 to 1372) °C	0.33 °C 0.18 °C 0.16 °C 0.26 °C 0.4 °C	
Type L	(-200 to -100) °C (-100 to 800) °C (800 to 900) °C	0.37 °C 0.26 °C 0.17 °C	
Type N	(-200 to -100) °C (-100 to -25) °C (-25 to 120) °C (120 to 410) °C (410 to 1300) °C	0.4 °C 0.22 °C 0.19 °C 0.18 °C 0.27 °C	
Type R	(0 to 250) °C (250 to 400) °C (400 to 1000) °C (1000 to 1767) °C	0.57 °C 0.35 °C 0.33 °C 0.4 °C	

Parameter/Equipment	Range	CMC ^{2, 5, 6} (±)	Comments
Electrical Simulation of Thermocouples & Thermocouple Indicators – (cont)			
Type S	(0 to 250) °C (250 to 1000) °C (1000 to 1400) °C (1400 to 1767) °C	0.47 °C 0.36 °C 0.37 °C 0.46 °C	Fluke 5520A
Type T	(-250 to -150) °C (-150 to 0) °C (0 to 120) °C (120 to 400) °C	0.63 °C 0.24 °C 0.16 °C 0.14 °C	
Type U	(-200 to 0) °C (0 to 600) °C	0.56 °C 0.27 °C	
Electrical Simulation of RTD ³ –			
Pt 385, 100 Ω	(-200 to 0) °C (0 to 100) °C (100 to 300) °C (300 to 400) °C (400 to 630) °C	0.052 °C 0.072 °C 0.092 °C 0.13 °C 0.13 °C	Fluke 5520A
Pt 3926, 100 Ω	(-200 to 0) °C (0 to 100) °C (100 to 300) °C (300 to 400) °C (400 to 630) °C	0.052 °C 0.072 °C 0.092 °C 0.11 °C 0.13 °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	0.26 °C 0.041 °C 0.051 °C 0.061 °C 0.072 °C 0.082 °C 0.092 °C 0.11 °C 0.24 °C	
AC Power, Low Frequency ³ – Generate			
3.3 mA to 21 A, (45 to 65) Hz	(33 to 330) mV (0.33 to 1020) V	0.16 % 0.14 %	Fluke 5520A

Parameter/Equipment	Range	CMC ^{2, 5, 6} (±)	Comments
DC Power ³ – Generate (0.33 to 30) mA (0.33 to 3) A (3 to 21) A	 33 mV to 1020 V 33 mV to 1020 V 33 mV to 1020 V	 0.025 % 0.024 % 0.09 %	 Fluke 5520A
Oscilloscope ³ – Squarewave Signal (50 Ω at 1 kHz) (1 MΩ at 1 kHz) Leveled Sine Wave Amplitude 50 kHz reference 50 kHz to 100 MHz (100 to 300) MHz (300 to 600) MHz (600 to 3200) MHz Flatness (Rel. to 50 kHz) 50 kHz to 100 MHz (100 to 300) MHz (300 to 600) MHz (600 to 3200) MHz Time Marker (50 Ω Source & Period) 5 s to 50 ms 20 ms to 2 ns Rise Time	 1 mV to 6.6 V 1 mV to 130 V 50 kHz reference 50 kHz to 100 MHz (100 to 300) MHz (300 to 600) MHz (600 to 3200) MHz 50 kHz to 100 MHz (100 to 300) MHz (300 to 600) MHz (600 to 3200) MHz 5 s to 50 ms 20 ms to 2 ns ≤350 ps	 0.28 % + 48 μV 0.12 % + 48 μV 2.4 % + 300 μV 4.2 % + 300 μV 4.7 % + 300 μV 7 % + 300 μV 7.7 % + 300 μV 1.8 % + 100 μV 2.5 % + 100 μV 4.7 % + 100 μV 7 % + 100 μV 26 ns + 0.07 ms 2.6 μs/s +0 / -100 ps	 Fluke 5520A/SC600 Fluke 9500B/9530 Fluke 5520A/SC600 Fluke 9500B/9530 Fluke 5520A/SC600

III. Electrical – RF/Microwave

Parameter/Equipment	Range	CMC ^{2,5} (±)	Comments
RF Power Reference	1 mW, 50 MHz	0.006 mW	Tegam F1130B
RF Power Sensor Calibration Factors	100 kHz to 4.6 GHz (4.6 to 18) GHz (18 to 26.5) GHz	0.67 % 1.2 % 2.5 %	Tegam F1130B, Tegam 1830A HP 8485A, HP E4418B
S-Parameter – S ₁₁ /S ₂₂ Magnitude (linear)	100 kHz to 10 MHz 10 MHz to 3 GHz (3 to 9) GHz (9 to 18) GHz	1 % of rdg + 0.005 lin 1.2 % of rdg + 0.007 lin 2.2 % of rdg + 0.02 lin 4.2 % of rdg + 0.04 lin	Keysight E5063A
S-Parameter – S ₁₁ /S ₂₂ Phase (Degrees) ⁹	100 kHz to 10 MHz, rho >0.025 100 kHz to 10 MHz, rho >0.1 10 MHz to 3 GHz, rho >0.05 10 MHz to 3 GHz, rho >0.1 (3 to 9) GHz, rho >0.1 (3 to 9) GHz, rho >0.2 (9 to 18) GHz, rho >0.2	12° 3.6° 9.4° 4.8° 12° 6° 17°	Keysight E5063A
Attenuation – Source, 1dB Steps	(1 to 3) dB, <1 GHz (1 to 3) dB, (1 to 11) GHz (1 to 3) dB, (11 to 18) GHz (4 to 7) dB, <1 GHz (4 to 7) dB, (1 to 11) GHz (4 to 7) dB, (11 to 18) GHz (8 to 11) dB, <1 GHz (8 to 11) dB, (1 to 11) GHz (8 to 11) dB, (11 to 18) GHz	0.18 dB 0.20 dB 0.18 dB 0.16 dB 0.14 dB 0.23 dB 0.26 dB 0.27 dB 0.58 dB	HP8494B
Attenuation – Source, 10dB Steps	(10 to 30) dB, <1 GHz (10 to 30) dB, (1 to 11) GHz (10 to 30) dB, (11 to 18) GHz (40 to 70) dB, <1 GHz (40 to 70) dB, (1 to 11) GHz (40 to 70) dB, (11 to 18) GHz (80 to 110) dB, <1GHz (80 to 110) dB, (1 to 11) GHz (80 to 110) dB, (11 to 18) GHz	0.24 dB 0.61 dB 0.59 dB 0.63 dB 0.65 dB 0.77 dB 1.6 dB 2.3 dB 4.7 dB	HP8496B

V. Mechanical

Parameter/Equipment	Range	CMC ^{2, 5} (±)	Comments
Pressure, Nitrogen ³ –			
Gage/Absolute Pressure	(0.2 to 25) psi (1.7 to 100) psi (2 to 1000) psi	20 x 10 ⁻⁶ psi	Ruska piston gage
Gage Pressure, Hydraulic ³	(1000 to 10 000) psi	0.05 % + 0.10 psi	Ametek TQ-100 DWT
Negative Gage Pressure	(-14.5 to 0) psi	30 x 10 ⁻⁶ psi	Ruska piston gage
Barometric	(10 to 16) psia	0.01 %	DHI RPM4
Low	(0.01 to 2) in H ₂ O (2 to 10) in H ₂ O	0.000 34 in H ₂ O 0.0021 in H ₂ O	Micro tector Hook gage
Balances/Scales ³	(1 to 500) mg (1 to 100) g (200 to 1000) g (1 to 10) kg (10 to 450) kg	0.017 mg 0.18 mg 1.7 mg 17 mg 0.022 kg	Using NIST Class F, ASTM Class 1 or 2 weights
Mass – Weight Sets, Fixed Point	1 mg 2 mg 3 mg 5 mg 10 mg 20 mg 30 mg 50 mg 100 mg 200 mg 300 mg 500 mg 1 g 2 g 3 g 5 g	0.002 mg 0.002 mg 0.0022 mg 0.002 mg 0.002 mg 0.002 mg 0.0022 mg 0.002 mg 0.0021 mg 0.0021 mg 0.0024 mg 0.003 mg 0.0045 mg 0.0044 mg 0.0059 mg 0.0044 mg	ASTM E617 & NIST Handbook 105-1 by double substitution method using ASTM E- 617 Class 0 to 4 weights & mass comparators & balances

Parameter/Equipment	Range	CMC ^{2, 8} (±)	Comments
Mass – Weight Sets, Fixed Point (cont)	10 g 20 g 30 g 50 g 100 g 200 g 300 g 500 g 1 kg 2 kg 3 kg 5 kg 10 kg 25 kg	0.018 mg 0.021 mg 0.022 mg 0.027 mg 0.053 mg 0.067 mg 0.15 mg 0.21 mg 0.33 mg 0.64 mg 2.7 mg 4.1 mg 5.2 mg 7.1 mg	ASTM E617 & NIST Handbook 105-1 by double substitution method using ASTM E- 617 Class 0 to 4 weights & mass comparators 7 balances
Torque – Measuring Equipment	(2 to 20) ozf·in (15 to 200) ozf·in (4 to 50) lbf·in (30 to 400) lbf·in (80 to 1000) lbf·in (20 to 250) lbf·ft (100 to 1000) lbf·ft	0.063 ozf·in 0.59 ozf·in 0.15 lbf·in 1.2 lbf·in 3.0 lbf·in 0.73 lbf·ft 2.9 lbf·ft	Torque arm & weights
Torque Wrenches	(2 to 20) ozf·in (15 to 200) ozf·in (4 to 50) lbf·in (30 to 400) lbf·in (80 to 1000) lbf·in (20 to 250) lbf·ft (100 to 1000) lbf·ft	0.24 ozf·in 2.4 ozf·in 0.6 lbf·in 4.8 lbf·in 12 lbf·in 3.0 lbf·ft 12 lbf·ft	CDI torque system
Force – Compression, Measuring Equipment	(100 to 2000) lbf (1 to 20 000) lbf (5 to 50 000) lbf (10 to 100 000) lbf	0.29 lbf 3.1 lbf 13 lbf 20 lbf	Load cells Load cells / weights Load cells Load cells
Force – Tension, Measuring Equipment	(100 to 2000) lbf	0.3 lbf	Load cells

VI. Thermodynamics

Parameter/Equipment	Range	CMC ^{2, 8} (±)	Comments
Relative Humidity ³	(10 to 95) % RH	2.0 % RH	Rotronic RH transmitter, Fluke Hydra data logger
Thermometers ³ – Temperature, Measuring Equipment	(-197 to 100) °C (100 to 420) °C (-40 to 250) °F	0.016 °C 0.028 °C 0.05 °F	Hart 1594A, SPRT
IR Thermometers	(-15 to 120) °C (35 to 500) °C	1.2 °C 1.6 °C Emissivity 0.95	Hart Scientific 4180 Hart Scientific 4181
Welch Allyn Blackbody	(29 to 43) °C	0.072 °C	Master blackbody, SPRT

VII. Time & Frequency

Parameter/Equipment	Range	CMC ^{2, 5, 8} (±)	Comments
Frequency – Measuring Equipment	10 MHz	1.7 pHz/Hz	Microchip S650, GPS
Frequency – Measure	(1 to 40) Hz 40 Hz to 10 MHz 0.01 Hz to 2 MHz 1 Hz to 225 MHz 200 MHz to 5 GHz 500 MHz to 26.5 GHz	0.052 % 0.011 % 2.6 µHz/Hz + 5 µHz 4.7 nHz/Hz 4.5 nHz/Hz 1.6 nHz/Hz	Agilent 3458A Agilent 53131A, GPS HP 5352B, GPS
Stopwatches	15 min to 24 hr	300 ms	Microchip S650

¹ This laboratory offers commercial calibration and field calibration services.

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 (A2LA Cert. No. 2133.01) Revised 05/21/2024

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. 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 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 in microinches, D is the numerical value of the nominal diameter of the device measured in inches.
- ⁵ In the statement of CMC, the value is defined as the percentage of reading.
- ⁶ 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.
- 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 Uncertainty is assumed to be 180 deg for all values outside the defined conditions.



Accredited Laboratory

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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 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 21st day of January 2022.

A blue ink signature of the Vice President of Accreditation Services.

Vice President, Accreditation Services
For the Accreditation Council
Certificate Number 2133.01
Valid to June 30, 2024
Revised May 21, 2024

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