



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

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CALIBRATION

Valid To: September 30, 2023

Certificate Number: 2560.01

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	(0.05 to 4) in (>4 to 12) in	(5.0 + 1.6L) µin (11 + 1.3L) µin	P&W Labmaster™, gage blocks
Micrometers ³ – Head, Inside, Outside & Depth	Up to 2 in (>2 to 20) in	(39 + 3L) µin (61 + 7L) µin	Gage blocks
Calipers ³ – Dial, Vernier & Digital	Up to 8 in (>8 to 48) in	270 µin + 0.6R 300 µin + 0.6R	Gage blocks
Indicators ³ – Dial & Digital	Up to 1 in Up to 6 in	14 µin + 0.6R 33 µin + 0.6R	P&W Labmaster™, gage blocks
Height Gages ³ – Dial, Vernier & Digital	Up to 24 in	(200 + 3.3L) µin	Gage blocks, surface plates
Ring Gages	(0.04 to 1.2) in (>1.2 to 2.4) in (>2.4 to 4) in (>4 to 10) in	9.1 µin 12 µin 16 µin 41 µin	P&W Labmaster™, gage blocks, master ring gages

Parameter/Equipment	Range	CMC ^{2,4} (±)	Comments
Thread Plug Gages – English & Metric, 60° Pitch Diameter, (8 to 80) TPI –			
Major Diameter	(0.06 to 4) in	(10 + 5.5L) μin	P&W Labmaster™, gage blocks, thread wires
Pitch Diameter	(0.05 to 2.5) in (>2.5 to 4) in	140 μin 150 μin	
Cylindrical Plug Gages & Thread Wires	Up to 7 in	(10 + 5.5L) μin	P&W Labmaster™, gage blocks

II. Electrical – DC/Low Frequency

Parameter/Equipment	Range	CMC ^{2,5} (±)	Comments
DC Voltage ³ – Generate	(0 to 220) mV 220 mV to 2.2 V (2.2 to 11) V (11 to 22) V (22 to 220) V (220 to 1000) V	9.9 μV/V + 0.40 μV 5.8 μV/V + 0.70 μV 4.0 μV/V + 2.5 μV 4.0 μV/V + 4.0 μV 5.8 μV/V + 40 μV 7.5 μV/V + 0.40 mV	Fluke 5720A
DC Voltage ³ – Measure	(0 to 100) mV (100 to 200) mV 200 mV to 1 V (1 to 2) V (2 to 10) V (10 to 20) V (20 to 200) V (200 to 1000) V (0 to 10) kV	26 μV/V + 0.30 μV 6.9 μV/V + 0.10 μV 9.9 μV/V + 0.30 μV 3.5 μV/V + 0.40 μV 9.6 μV/V + 0.50 μV 3.5 μV/V + 4.0 μV 5.2 μV/V + 40 μV 5.2 μV/V + 0.05 mV 0.04 % + 30 mV	HP 3458A Fluke 8508A Vitretek 4700

Parameter/Equipment	Range	CMC ^{2, 5} (±)	Comments
DC Current ³ – Generate	(0 to 220) μ A 220 μ A to 2.2 mA (2.2 to 22) mA (22 to 220) mA 220 mA to 2.2 A	46 μ A/A + 6.0 nA 40 μ A/A + 7.0 nA 40 μ A/A + 40 nA 63 μ A/A + 0.70 μ A 150 μ A/A + 12 μ A	Fluke 5720A
	(2.2 to 11.0) A	420 μ A/A + 0.48 mA	Fluke 5720A & 5725A
	(11 to 20) A	0.12 % + 0.75 mA*	Fluke 5520A-SC1100 *floor after 30 s
DC Current ³ – Measure	(0 to 0.1) μ A (0.1 to 1) μ A (1 to 10) μ A (10 to 200) μ A (0.2 to 2) mA (10 to 20) mA (20 to 200) mA 200 mA to 1 A (1 to 2) A (2 to 20) A	0.15 % + 40 pA 91 μ A/A + 40 pA 55 μ A/A + 0.10 nA 18 μ A/A + 0.40 nA 14 μ A/A + 4.0 nA 15 μ A/A + 40 nA 42 μ A/A + 0.80 μ A 180 μ A/A + 10 μ A 200 μ A/A + 16 μ A 440 μ A/A + 0.4 mA	HP 3458A, Fluke 8508A
Resistance ³ – Generate, Fixed Points	0 Ω 1 Ω 1.9 Ω 10 Ω 19 Ω 100 Ω 190 Ω 1 k Ω 1.9 k Ω 10 k Ω 19 k Ω 100 k Ω 190 k Ω 1 M Ω 1.9 M Ω 10 M Ω 19 M Ω 100 M Ω	59 $\mu\Omega$ 110 $\mu\Omega$ 210 $\mu\Omega$ 270 $\mu\Omega$ 510 $\mu\Omega$ 1.2 m Ω 2.2 m Ω 9.8 m Ω 19 m Ω 98 m Ω 190 m Ω 1.3 Ω 2.4 Ω 23 Ω 46 Ω 460 Ω 1.0 k Ω 12 k Ω	Fluke 5720A

Parameter/Equipment	Range	CMC ^{2,5} (±)	Comments
Resistance ³ – Measure	(0 to 2) Ω (2 to 20) Ω (20 to 200) Ω 200 Ω to 2 kΩ (2 to 20) kΩ (20 to 200) kΩ 200 kΩ to 2 MΩ (2 to 20) MΩ (20 to 200) MΩ 200 MΩ to 2 GΩ (2 to 20) GΩ	18 μΩ/Ω + 4 μΩ 11 μΩ/Ω + 14 μΩ 9.9 μΩ/Ω + 50 μΩ 9.9 μΩ/Ω + 0.5 mΩ 9.9 μΩ/Ω + 5 mΩ 9.9 μΩ/Ω + 50 mΩ 11 μΩ/Ω + 1 Ω 18 μΩ/Ω + 10 Ω 69 μΩ/Ω + 1 kΩ 170 μΩ/Ω + 100 kΩ 610 μΩ/Ω + 10 MΩ	Fluke 8508A
	(0.0 to 0.01) Ω	250 μΩ/Ω + 0.06 μΩ	Fluke 5720, Fluke 8508A

Parameter/Range	Frequency	CMC ^{2,5} (±)	Comments
Capacitance ³ – Generate			
(0.19 to 0.3999) nF	10 Hz to 10 kHz	0.85 % + 0.010 nF	Fluke 5520A-SC1100
(0.4000 to 1.0999) nF	10 Hz to 10 kHz	0.62 % + 0.010 nF	
(1.1000 to 3.2999) nF	10 Hz to 3 kHz	0.59 % + 0.010 nF	
(3.3000 to 10.9999) nF	10 Hz to 1 kHz	0.30 % + 0.010 nF	
(11.0000 to 109.999) nF	10 Hz to 1 kHz	0.30 % + 0.10 nF	
(110.000 to 329.999) nF	10 Hz to 1 kHz	0.30 % + 0.30 nF	
(0.330 00 to 1.099 99) μF	(10 to 600) Hz	0.29 % + 1.0 nF	
(1.100 00 to 3.299 99) μF	(10 to 300) Hz	0.30 % + 3.0 nF	
(3.3000 to 10.9999) μF	(10 to 150) Hz	0.30 % + 10 nF	
(11.0000 to 32.9999) μF	(10 to 120) Hz	0.47 % + 30 nF	
(33.000 to 109.999) μF	(10 to 80) Hz	0.53 % + 0.10 μF	
(110.000 to 329.999) μF	(0 to 50) Hz	0.53 % + 0.30 μF	
(0.330 00 to 1.099 99) mF	(0 to 20) Hz	0.53 % + 1.0 μF	
(1.100 00 to 3.299 99) mF	(0 to 6) Hz	0.52 % + 3.0 μF	
(3.3000 to 10.9999) mF	(0 to 2) Hz	0.52 % + 10 μF	
(11.0000 to 32.9999) mF	(0 to 0.6) Hz	0.87 % + 30 μF	
(33.00 to 110.00) mF	(0 to 0.2) Hz	1.3 % + 0.10 mF	

Parameter/Equipment	Range	CMC ² (±)	Comments
Electrical Simulation of Thermocouple ³ – Generate			
Type E	(-250 to -100) °C (-100 to -25.0) °C (-25.0 to 350) °C (350 to 650) °C (650 to 1000) °C	0.60 °C 0.19 °C 0.60 °C 0.19 °C 0.25 °C	Fluke 5520-SC1100
Type J	(-210 to -100) °C (-100 to -30.0) °C (-30 to 150) °C (150 to 760) °C (760 to 1200) °C	0.32 °C 0.19 °C 0.30 °C 0.20 °C 0.27 °C	
Type K	(-200 to -100) °C (-100 to -25) °C (-25 to 120) °C (120 to 1000) °C (1000 to 1372) °C	0.39 °C 0.21 °C 0.27 °C 0.31 °C 0.48 °C	
Type T	(-250 to -150) °C (-150 to 0.0) °C (0.0 to 120) °C (120 to 400) °C	0.75 °C 0.29 °C 0.27 °C 0.17 °C	

Parameter/Range	Frequency	CMC ^{2, 5} (±)	Comments
AC Voltage ³ – Generate			
(0 to 2.2) mV	(10 to 20) Hz 20 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 500) kHz 500 kHz to 1 MHz	280 μV/V + 4.0 μV 100 μV/V + 4.0 μV 240 μV/V + 4.0 μV 580 μV/V + 5.0 μV 0.16 % + 20 μV 0.31 % + 20 μV	Fluke 5720A
(2.2 to 22) mV	(10 to 20) Hz 20 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 500) kHz 500 kHz to 1 MHz	280 μV/V + 4.0 μV 100 μV/V + 4.0 μV 240 μV/V + 4.0 μV 580 μV/V + 5.0 μV 0.16 % + 20 μV 0.31 % + 20 μV	

Parameter/Range	Frequency	CMC ^{2,5} (±)	Comments
AC Voltage ³ – Generate (cont)			
(22 to 220) mV	(10 to 20) Hz 20 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 500) kHz 500 kHz to 1 MHz	280 μV/V + 12 μV 100 μV/V + 7.0 μV 240 μV/V + 7.0 μV 530 μV/V + 17 μV 0.16 % + 25 μV 0.31 % + 45 μV	Fluke 5720A
220 mV to 2.2 V	(10 to 20) Hz 20 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 500) kHz 500 kHz to 1 MHz	280 μV/V + 40 μV 100 μV/V + 15 μV 110 μV/V + 10 μV 140 μV/V + 30 μV 0.12 % + 0.20 mV 0.20 % + 0.30 mV	
(2.2 to 22) V	(10 to 20) Hz 20 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 500) kHz 500 kHz to 1 MHz	280 μV/V + 0.40 mV 100 μV/V + 0.15 mV 110 μV/V + 0.10 mV 130 μV/V + 0.20 mV 0.12 % + 2.0 mV 0.17 % + 3.2 mV	
(22 to 220) V	(10 to 20) Hz 20 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz	280 μV/V + 4.0 mV 100 μV/V + 1.5 mV 110 μV/V + 1 mV 180 μV/V + 2.5 mV	
(220 to 1100) V	(15 to 50) Hz 50 Hz to 1 kHz (1 to 20) kHz (20 to 30) kHz (30 to 50) kHz (50 to 100) kHz	350 μV/V + 16 mV 81 μV/V + 3.5 mV 200 μV/V + 6.0 mV 700 μV/V + 11 mV 700 μV/V + 11 mV 0.27 % + 45 mV	With Fluke 5725A

Parameter/Range	Frequency	CMC ^{2, 5} (±)	Comments
AC Voltage ³ – Measure			
(0 to 10) 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 300) kHz	0.48 % + 3.0 μV 0.18 % + 3.0 μV 0.08 % + 1.1 μV 0.043 % + 1.1 μV 0.18 % + 1.1 μV 0.84 % + 1.1 μV 4.8 % + 2.0 μV	HP 3458A
(10 to 100) mV	(100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz (1 to 2) MHz	2.4 % + 10 μV 3.6 % + 10 μV 6.0 % + 10 μV 12 % + 10 μV	
(10 to 200) mV	(1 to 10) Hz (10 to 40) Hz (40 to 100) Hz 100 Hz to 2 kHz (2 to 10) kHz (10 to 30) kHz (30 to 100) kHz	180 μV/V + 14 μV 150 μV/V + 4 μV 130 μV/V + 4 μV 120 μV/V + 2 μV 120 μV/V + 4 μV 350 μV/V + 8 μV 810 μV/V + 20 μV	Fluke 8508A
100 mV to 1 V	(1 to 2) MHz	12 % + 0.10 mV	HP 3458A
100 mV to 2 V	(1 to 10) Hz (10 to 40) Hz (40 to 100) Hz 100 Hz to 2 kHz (2 to 10) kHz (10 to 30) kHz (30 to 100) kHz (100 to 300) kHz 300 kHz to 1 MHz	160 μV/V + 120 μV 120 μV/V + 20 μV 98 μV/V + 20 μV 75 μV/V + 20 μV 98 μV/V + 20 μV 240 μV/V + 40 μV 580 μV/V + 200 μV 0.35 % + 2 mV 1.2 % + 20 mV	Fluke 8508A
(1 to 10) V	(1 to 2) MHz	12 % + 1.0 mV	HP 3458A
(2 to 20) V	(1 to 10) Hz (10 to 40) Hz (40 to 100) Hz 100 Hz to 2 kHz (2 to 10) kHz (10 to 30) kHz (30 to 100) kHz (100 to 300) kHz 300 kHz to 1 MHz	160 μV/V + 1.2 mV 120 μV/V + 0.20 mV 98 μV/V + 0.20 mV 75 μV/V + 0.20 mV 98 μV/V + 0.20 mV 240 μV/V + 0.40 mV 580 μV/V + 2.0 mV 0.35 % + 20 mV 1.2 % + 0.20 V	Fluke 8508A

Parameter/Range	Frequency	CMC ^{2, 5} (±)	Comments
AC Voltage ³ – Measure (cont)			
(20 to 200) V	(1 to 10) Hz (10 to 40) Hz (40 to 100) Hz 100 Hz to 2 kHz (2 to 10) kHz (10 to 30) kHz (30 to 100) kHz (100 to 300) kHz 300 kHz to 1 MHz	160 μV/V + 12 mV 120 μV/V + 2.0 mV 98 μV/V + 2.0 mV 75 μV/V + 2.0 mV 98 μV/V + 2.0 mV 240 μV/V + 4.0 mV 580 μV/V + 20 mV 0.35 % + 200 mV 1.2 % + 2.0 V	Fluke 8508A
(200 to 1000) V	(1 to 10) Hz (10 to 40) Hz 40 Hz to 10 kHz (10 to 30) kHz (30 to 100) kHz	160 μV/V + 70 mV 130 μV/V + 20 mV 110 μV/V + 20 mV 240 μV/V + 40 mV 590 μV/V + 0.20 V	
(0 to 7) kV	(50 to 60) Hz	0.15 % + 0.10 V	Vitretek 4700
AC Current ³ – Generate			
(0 to 220) μA	(10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.16 % + 16 nA 0.15 % + 10 nA 0.10 % + 8.0 nA 0.33 % + 12 nA 0.73 % + 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	0.099 % + 40 nA 0.088 % + 35 nA 0.072 % + 35 nA 0.31 % + 0.11 μA 0.71 % + 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	0.093 % + 0.40 μA 0.081 % + 0.35 μA 0.072 % + 0.35 μA 0.31 % + 0.55 μA 0.71 % + 5.0 μA	

Parameter/Range	Frequency	CMC ^{2, 5} (±)	Comments
AC Current ³ – Generate (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	0.092 % + 4.0 μA 0.081 % + 3.5 μA 0.078 % + 2.5 μA 0.32 % + 3.5 μA 0.71 % + 10 μA	Fluke 5720A
220 mA to 2.2 A	20 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.61 % + 35 μA 0.40 % + 80 μA 2.0 % + 1.6 mA	Fluke 5720A
(2.2 to 11) A	40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.11 % + 0.17 mA 0.25 % + 0.38 mA 1.0 % + 0.75 mA	With Fluke 5725A
(11 to 20.5) A	(40 to 100) Hz 100 Hz to 1 kHz (1 to 5) kHz	0.19 % + 5.9 mA 0.21 % + 5.9 mA 3.7 % + 5.9 mA	Fluke 5520A-SC1100
AC Current ³ – Measure			
(0 to 200) μA	(1 to 10) Hz 10 Hz to 10 kHz (10 to 30) kHz (30 to 100) kHz	550 μA/A + 20 nA 550 μA/A + 20 nA 750 μA/A + 20 nA 0.46 % + 20 nA	Fluke 8508A
200 μA to 2 mA	(1 to 10) Hz 10 Hz to 10 kHz (10 to 30) kHz (30 to 100) kHz	330 μA/A + 0.20 μA 320 μA/A + 0.20 μA 750 μA/A + 0.20 μA 0.46 % + 0.20 μA	
(2 to 20) mA	(1 to 10) Hz 10 Hz to 10 kHz (10 to 30) kHz (30 to 100) kHz	330 μA/A + 2.0 μA 320 μA/A + 2.0 μA 750 μA/A + 2.0 μA 0.46 % + 2.0 μA	
(20 to 100) mA	(30 to 50) kHz (50 to 100) kHz	0.48 % + 20 μA 0.48 % + 20 μA	HP 3458A, option II
(20 to 200) mA	(1 to 10) Hz 10 Hz to 10 kHz (10 to 30) kHz	330 μA/A + 20 μA 290 μA/A + 20 μA 690 μA/A + 20 μA	Fluke 8508A

Parameter/Range	Frequency	CMC ^{2, 5} (±)	Comments
AC Current ³ – Measure (cont)			
100 mA to 1 A	(30 to 50) kHz	1.2 % + 0.40 mA	HP 3458A, option II
200 mA to 2 A	10 Hz to 2 kHz (2 to 10) kHz (10 to 30) kHz	690 μA/A + 0.20 mA 820 μA/A + 0.20 mA 0.35 % + 0.20 mA	Fluke 8508A
(2 to 20) A	10 Hz to 2 kHz (2 to 10) kHz	920 μA/A + 2.0 mA 0.29 % + 2.0 mA	
(20 to 100) A (100 to 200) A (200 to 1200) A	(30 to 1000) Hz (30 to 1000) Hz (30 to 1000) Hz	0.58 % + 20 mA 0.35 % + 20 mA 0.36 % + 200 mA	Fluke 8508A with AEMC SR704

Parameter/Equipment	Range	CMC ^{2, 4, 5} (±)	Comments
Low Resistance (Earth Resistance) ³ – Generate	100 mΩ to 4.99 Ω (5 to 29.9) Ω (30 to 199.9) Ω (200 to 499) Ω 500 Ω to 1.999 kΩ (2 to 4.99) kΩ (5 to 10) kΩ	0.012 Ω + 0.4 % 0.016 Ω + 0.23 % 0.057 Ω + 0.22 % 0.31 Ω + 0.23 % 0.57 Ω + 0.21 % 0.49 % 14 Ω + 0.16 %	Fluke 5320A, HVA, 80k-40 & 5320A- LOAD
High Resistance (Insulation Resistance) ³ – Generate	(10 to 39.99) kΩ (40 to 99.99) kΩ (100 to 199.99) kΩ (200 to 999.99) kΩ (1 to 9.999) MΩ (10 to 999.9) MΩ (1 to 10) GΩ 100 GΩ	47 Ω + 0.16 % 23 Ω + 0.22 % 11 Ω + 0.23 % 8.6 Ω + 0.23 % 1.8 Ω + 0.35 % 2.9 Ω + 0.6 % 1.1 MΩ + 1.2 % 3.5 GΩ	Fluke 5320A, HVA, 80k-40 & 5320A- LOAD
High Resistance (Insulation Resistance) ³ – Source with R Multiplier	(0.35 to 99.99) GΩ (100 to 999.9) GΩ (1 to 10) TΩ	2.6 MΩ + 2 % 6.3 kΩ + 2.9 % 4.9 %	Fluke 5320A, HVA, 80k-40 & 5320A- LOAD

Parameter/Equipment	Range	CMC ^{2, 4, 5} (±)	Comments
Ground Bond Resistance ³ – Decade Source, Fixed Points	25 mΩ 50 mΩ 100 mΩ 330 mΩ 500 mΩ 1 Ω 1.8 Ω 5 Ω 10 Ω 18 Ω 50 Ω 100 Ω 180 Ω 500 Ω 1 kΩ 1.8 kΩ	6 mΩ 6.2 mΩ 6.7 mΩ 10 mΩ 12 mΩ 0.014 Ω 0.022 Ω 0.037 Ω 0.1 Ω 0.21 Ω 0.43 Ω 0.82 Ω 1.5 Ω 3.4 Ω 6.3 Ω 30 Ω	Fluke 5320A, HVA, 80k-40 & 5320A- LOAD
Leakage Current ³ – Generate Passive/Differential Active	 (0.1 to 30) mA (0.1 to 30) mA	 2.6 μA + 0.46 % 3.1 μA + 0.45 %	 Fluke 5320A, HVA, 80k-40 & 5320A- LOAD
Residual Current Device ³ – Trip Current Trip Time Range	 (3 to 3000) mA (10 to 5000) ms	 1.2 % 0.29 ms + 0.024 %	 Fluke 5320A, HVA, 80k-40 & 5320A- LOAD
AC/DC Multimeter ³ – DC, 20 Hz to 2 kHz	 (1 to 10) V (10 to 100) V (100 to 1100) V	 6 mV + 0.18 % 59 mV + 0.23 % 0.64 V + 0.24 %	 Fluke 5320A, HVA, 80k-40 & 5320A- LOAD
AC/DC Multimeter ³ – DC, 20 Hz to 400 Hz	 (30 to 300) mA 300 mA to 3 A (3 to 30) A	 0.1 mA + 0.26 % 1.8 mA + 0.18 % 18 mA + 0.35 %	 Fluke 5320A, HVA, 80k-40 & 5320A- LOAD

Parameter/Equipment	Range	CMC ^{2, 5} (±)	Comments
AC/DC Current ³ – Hipot Leakage Current Measurement DC, 20 Hz to 2 kHz	(30 to 300) μA 300 μA to 3 mA (3 to 30) mA (30 to 300) mA	0.15 μA + 0.79 % 2.1 μA + 0.24 % 17 μA + 0.24 % 0.19 mA + 0.23 %	Fluke 5320A, HVA, 80k-40 & 5320A-LOAD
DC Voltage Calibrator ³	(3 to 30) V (30 to 150) V (150 to 600) V	0.01 V + 0.13 % 0.034 V + 0.13 % 0.23 V + 0.12 %	Fluke 5320A, HVA, 80k-40 & 5320A-LOAD
AC Voltage Calibrator ³ – (40 to 400) Hz	(3 to 30) V (30 to 100) V (100 to 300) V (300 to 600) V	0.01 V + 0.14 % 0.022 V + 0.17 % 0.13 V + 0.12 % 0.26 V + 0.11 %	Fluke 5320A, HVA, 80k-40 & 5320A-LOAD
Frequency Calibrator ³	(40 to 400) Hz	0.0062 Hz + 0.06 %	Fluke 5320A, HVA, 80k-40 & 5320A-LOAD
DC Voltage ³ – High Resistance Decade 2000 V Range	<1 MΩ >1 MΩ	2.4 V + 1.3 % 5.7 V + 1.3 %	Fluke 5320A, HVA, 80k-40 & 5320A-LOAD
Test Current – Measure ³ AC + DC rms	(0 to 400) mA	0.36 mA + 10 %	Fluke 5320A, HVA, 80k-40 & 5320A-LOAD
DC High Voltage – Measure ³ (5320A with 10 kV Adapter) (5320A with HV Probe)	>(10 to 40) kV	0.012 kV + 0.62 %	Fluke 5320A, HVA, 80k-40 & 5320A-LOAD

Parameter/Equipment	Range	CMC ^{2,5} (±)	Comments
AC High Voltage – Measure ³ (50 to 60) Hz (5320A with HV Probe)	>(10 to 40) kV	0.016 kV + 0.62 %	Fluke 5320A, HVA, 80k-40 & 5320A- LOAD

III. Electrical – RF/Microwave

Parameter/Range	Frequency	CMC ^{2,4,5} (±)	Comments
Turned RF Level ³ – (+16 to -129) dB (+16 to -134) dB (+16 to -140) dB (+16 to -135) dB (+16 to -129) dB (+16 to -121) dB	100 kHz to 2 MHz (2 to 10) MHz 10 MHz to 6.6 GHz (6.6 to 13.2) GHz (13.2 to 19.2) GHz (19.2 to 26.5) GHz	0.08 dB + 0.005 dB/10 dB Step	Keysight E4440A, add 0.031dB each time you switch between ranges
Amplitude Modulation ³ – Measure Rate: 20 Hz to 10 kHz Depth: (5 to 99) % Rate: 50 Hz to 100 kHz Depth: (20 to 99) % Rate: 50 Hz to 100 kHz Depth: (5 to 20) % Rate: 50 Hz to 100 kHz Depth: (20 to 99) % Rate: 50 Hz to 100 kHz Depth: (5 to 20) %	100 kHz to 10 MHz 10 MHz to 3 GHz 10 MHz to 3 GHz (3 to 26.5) GHz (3 to 26.5) GHz	0.98 % 0.71 % 3.0 % 1.8 % 5.4 %	Keysight E4440A

Parameter/Range	Frequency	CMC ^{2,4,5} (±)	Comments
<p>Frequency Modulation³ – Measure</p> <p>Rates: 20 Hz to 10 kHz Deviations: 200 Hz to 40 kHz peak</p> <p>Rates: 50 Hz to 200 kHz Deviations: 250 Hz to 400 kHz peak</p> <p>Rates: 50 Hz to 200 kHz Deviations: 250 Hz to 400 kHz peak</p> <p>Rates: 50 Hz to 200 kHz Deviations: 250 Hz to 400 kHz peak</p> <p>Rates: 50 Hz to 200kHz Deviations: 250 Hz to 400 kHz peak</p>	<p>250 kHz to 10 MHz</p> <p>10 MHz to 6.6 GHz</p> <p>(6.6 to 13.2) GHz</p> <p>(13.2 to 26.5) GHz</p> <p>250 kHz to 26.5 GHz</p>	<p>1.8 %</p> <p>1.8 %</p> <p>3.0 %</p> <p>4.6 %</p> <p>1.2 %</p>	<p>Keysight E4440A</p>
<p>Phase Modulation³ – Measure</p> <p>>0.7 Radians Rate: 200 Hz to 20 kHz</p> <p>>0.3 Radians Rate: 200 Hz to 20 kHz</p> <p>>2.0 Radians Rate: 200 Hz to 20 kHz</p> <p>>0.6 Radians Rate: 200 Hz to 20 kHz</p> <p>>4.0 Radians Rate: 200 Hz to 20 kHz</p> <p>>1.2 Radians Rate: 200 Hz to 20 kHz</p>	<p>100 kHz to 6.6 GHz</p> <p>100 kHz to 6.6 GHz</p> <p>(6.6 to 13.2) GHz</p> <p>(6.6 to 13.2) GHz</p> <p>(13.2 to 26.5) GHz</p> <p>(13.2 to 26.5) GHz</p>	<p>1.3 %</p> <p>3.5 %</p> <p>1.3 %</p> <p>3.5 %</p> <p>1.3 %</p> <p>3.5 %</p>	<p>Keysight E4440A</p>

Parameter/Range	Frequency	CMC ^{2, 5} (±)	Comments
Modulation Rate ³ – Measure			
Amplitude Modulation Rate: 20 Hz to 10 kHz Depth: >20 %	100 kHz to 10 MHz	72 mHz	Keysight E4440A
Rate: 20 Hz to 100 kHz Depth: >20 %	10 MHz to 26.5 GHz	72 mHz	
Frequency & Phase Modulation Rate: 20 Hz to 10 kHz	100 kHz to 10 MHz	72 mHz	
Rate: 20 Hz to 200 kHz	10 MHz to 26.5 GHz	72 mHz	
Total Harmonic Distortion – Measure	3 Hz to 3 GHz	0.49 dB	Keysight E4440A

IV. Mechanical

Parameter/Equipment	Range	CMC ^{2, 4, 6} (±)	Comments
Scales & Balances ³	(1 to 500) mg (1 to 600) g 200 g to 20 kg (1/32 to 64) oz (0.5 to 50) lb (0.5 to 1000) lb	0.73 % + 0.6R (260 + 2M) µg + 0.6R 22 µg/g + 0.6R 0.17 % + 0.6R 0.04 % + 0.6R 0.16 lb + 0.6R	Class 0 weights Class 0 weights Class 2 weights Class F weights Class F weights Class F weights
Pressure ³ – Measure/Measuring Equipment	(0 to 50) psia (-14.5 to 500) psig (0 to 1500) psig (1500 to 4000) psig	0.032 psi 0.24 psi 0.23 psi + 0.004 % 0.04 psi + 0.04 % + 0.6R	Fluke 271A/PM500- A350K/PM500- BG10M Fluke M1900/3 deadweight tester
Torque – Watches & Transducers	(6 to 250) gf·cm (1 to 80) ozf·in (5 to 400) lbf·in (30 to 300) lbf·ft (300 to 4000) lbf·ft	0.11 gf·cm + 0.002 % 0.026 ozf·in + 0.02 % 0.027 lbf·in + 0.01 % 0.027 lbf·ft + 0.01 % 0.006 lbf·ft + 0.02 %	Calibrated weights, torque wheels & arms

Parameter/Equipment	Range	CMC ^{2,4,6} (±)	Comments
Torque – Wrenches & Drivers	(4 to 20) ozf·in (2 to 10) lbf·in	0.88 % 1.1 %	BMX LTT10I
	(5 to 50) lbf·in (25 to 250) lbf·in (100 to 1000) lbf·in (25 to 250) lbf·ft	1.0 % 1.0 % 1.0 % 1.0 %	TTPM-41, 2000-400-02
	(1 to 500) gf (0.5 to 200) kgf	0.04 % + 1 digit 0.05 % + 1 digit	Calibrated weights
	(1 to 921) lbf	0.08 % + 1 digit	
Force – Measure, Tension/Compression	(0 to 250) kgf	370 µg/g	Morehouse ultra-precision loadcell
Speed Measuring Devices ³ – Radar X, K, KA Bands			
Measure	(10.5 to 36.1) GHz	0.11 GHz	VOCAR HR
Tuning Forks – Measure	(200 to 15 000) Hz	0.12 %	
Speed – Simulate	(15 to 140) MPH	1.0 %	
Accelerometers			The Modal Shop
	(0.5 to 10) Hz	1.3 %	Long stroke
	(5 to 9) Hz	2.2 %	9155D
	(10 to 99) Hz	1.3 %	
	100 Hz	1.1 %	
	(101 to 920) Hz	1.2 %	
	921 Hz to 5 kHz	1.5 %	
	(5 to 10) kHz	2.1 %	
	(10 to 15) kHz	2.6 %	
	(15 to 20) kHz	3.6 %	

V. Thermodynamics

Parameter/Equipment	Range	CMC ^{2, 4, 6} (\pm)	Comments
Humidity ³ – Measure	(10 to 90) % RH	1.0 % RH	HMI41/HMP46
Humidity – Generate	(10 to 95) % RH	0.36 % RH	Thunder Scientific 2500S Software, Fluke 2271A/PM500- A350K/PM500- BG10M, SPRT, RTD, DMM, WIKA CTB9100
Temperature ³ – Measure and Measuring Equipment	(-196 to 0) °C (0 to 420) °C	40 mK 50 mK	SPRT 5614, WIKA dry well, liquid well

VI. Time & Frequency

Parameter/Equipment	Range	CMC ^{2, 6} (\pm)	Comments
Frequency – Measuring Equipment, Fixed Point	10 MHz	1.6 parts in 10^{12}	Fluke 910R
Frequency – Measure	1 mHz to 26.5 GHz	1.6 parts in 10^{12} + 1 LSD	Agilent 53131A, Keysight E4440A, Fluke 910R
Frequency – Measuring Equipment	1 μ Hz to 30 MHz 30 MHz to 3 GHz (3 to 26.5) GHz	0.64 μ Hz 23 mHz 0.2 Hz	33519B, N5181B, 8340A, Fluke 910R

¹ This laboratory offers commercial calibration services 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 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 percentage refers to percent of reading unless stated otherwise, L is the numerical value of the nominal length in inches, M is the applied mass in grams and R is the numerical value of the resolution of the device under test; for analog indicating devices R is considered to be equal to $\frac{1}{2}$ the division width provided the ratio of needle width to division width does not interfere with reporting the reading to the nearest half-increment.

⁵ 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.

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.

⁷ This scope meets A2LA's *P112 Flexible Scope Policy*.



Accredited Laboratory

A2LA has accredited

CASCADE ENGINEERING SERVICES, INC.

Redmond, WA

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/NCCL 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 20th day of September 2021.

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

Vice President, Accreditation Services
For the Accreditation Council
Certificate Number 2560.01
Valid to September 30, 2023

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