



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

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CALIBRATION

Valid Until: January 31, 2026

Certificate Number: 2117.01

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 ^{2,5,6} (\pm)	Comments
Micrometers ³ – Inside & Outside Depth	Up to 1 in (1 to 18) in	66 μ in (66 + 4L) μ in	Grade 1 gage blocks
Calipers ³ – Inside & Outside Depth	Up to 1 in (1 to 18) in	160 μ in (160 + 4L) μ in	Grade 1 gage blocks
Pin & Plain Plug Gages	Up to 2.0 in	37 μ in	Trimos THV UMM, grade 1, gage blocks
1D & 2D – Measure Length Diameter Angle	Up to 12 in Up to 6 in (0 to 360) $^{\circ}$	440 μ m 440 μ m 0.14 $^{\circ}$	Starrett HDV300

Parameter/Equipment	Range	CMC ^{2,5,6} (±)	Comments
Accelerometers Vibration – Sensitivity Magnitude	(7 to 10) Hz (10 to 30) Hz (30 to 2000) Hz (2000 to 10 000) Hz	7.2 % 4.8 % 4.0 % 5.5 %	Modal 9110D accelerometer system

II. Electrical – DC/Low Frequency

Parameter/Equipment	Range	CMC ^{2,4,5} (±)	Comments	
DC Voltage – Measure ³	Up to 100 mV 100 mV to 1 V	9.3 μV/V + 0.3 μV 5.5 μV/V + 0.3 μV	HP 3458A opt 002	
	(1 to 10) V (10 to 100) V (100 to 1000) V*	5.6 μV/V + 0.5 μV 8.7 μV/V + 30 μV 11 μV/V + 100 μV	HP 3458A opt 002 <i>*Above 100 V add 12 ppm x (Vin/1000)²</i>	
	100 mV 1 V 10 V 100 V 1000 V	1.6 μV/V 1.2 μV/V 1.0 μV/V 1.2 μV/V 1.3 μV/V	Fluke 732B/752A/8508A	
	(1 to 70) kV	0.10 %	Vitrek 4700 w/ 4710 divider	
DC Voltage – Generate ³	10 V Reference (1.0, 1.018) V	0.61 μV/V 14 μV/V	Fluke 732B Fluke 732A	
	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	7.0 μV/V + 0.4 μV 4.3 μV/V + 0.7 μV 3.1 μV/V + 2.5 μV 3.8 μV/V + 4 μV 4.3 μV/V + 40 μV 5.5 μV/V + 400 μV	Fluke 5730A	
	(1.1 to 25) kV	0.028 %	DC source w/ HP 3458A & Fluke 80D	

Parameter/Equipment	Range	CMC ^{2, 4, 5} (\pm)	Comments
DC Current – Measure ³	(1 to 20) pA (20 to 200) pA 200 pA to 2 nA (2 to 20) nA (20 to 200) nA	1.6 % + 0.003 pA 1.5 % + 0.005 pA 0.35 % + 0.3 pA 0.35 % + 5.1 pA 0.32 % + 6.0 pA	Keithley 6517B
	Up to 1 μ A (1 to 10) μ A (10 to 100) μ A 100 μ A to 1 mA (1 to 10) mA (10 to 100) mA 100 mA to 1 A	24 μ A/A + 0.04 nA 24 μ A/A + 0.1 nA 24 μ A/A + 5 nA 24 μ A/A + 7 nA 24 μ A/A + 70 nA 41 μ A/A + 0.5 μ A 0.013 % + 10 μ A	HP 3458A
	(0.2 to 2) A (2 to 20) A	0.026 % + 8 μ A 0.058 % + 20 μ A	Fluke 8508A
	(1 to 20) A (2.2 to 100) A (50 to 300) A	0.02 % 0.069 % 0.052 %	HP 3458A w/ Fluke Y5020 HP 3458A w/ L&N shunt HP 3458A w/ L&N shunt
DC Current – Generate ³	(2 to 20) pA (20 to 200) pA (0.2 to 2) nA (2 to 20) nA (20 to 200) nA	0.44 % + 0.01 pA 0.29 % + 0.03 pA 0.076 % + 0.1 pA 0.076 % + 1 pA 0.042 % + 10 pA	Keithley 263
	0.2 nA to 200 μ A (0.22 to 2.2) mA (2.2 to 22) mA (22 to 220) mA (0.22 to 2.2) A	48 μ A/A + 6 nA 42 μ A/A + 7 nA 41 μ A/A + 40 nA 54 μ A/A + 0.7 μ A 95 μ A/A + 12 μ A	Fluke 5730A
	(0 to 10.9999) A (11 to 20) A	880 μ A/A + 500 μ A 1800 μ A/A + 750 μ A	Fluke 5522A
Clamp-On	(0 to 1000) A	0.33 % + 0.75 mA	Fluke 5522A w/ 5500A coil
Resistance – Measure ³	Up to 10 Ω (0.1 to 100) Ω (0.1 to 100) k Ω	20 $\mu\Omega/\Omega$ + 500 $\mu\Omega$ 15 $\mu\Omega/\Omega$ + 500 $\mu\Omega$ 12 $\mu\Omega/\Omega$ + 50 $\mu\Omega$	HP 3458A
	(0.1 to 1) M Ω (1 to 10) M Ω	20 $\mu\Omega/\Omega$ + 2 Ω 58 $\mu\Omega/\Omega$ + 100 Ω	

Parameter/Equipment	Range	CMC ^{2, 4, 5} (\pm)	Comments
Resistance – Measure ³ (cont)	(10 to 100) M Ω	0.012 %	HP 4339A
	(0.1 to 1) G Ω (1 to 10) G Ω	0.014 % 0.034 %	
	(10 to 200) G Ω (0.2 to 2) T Ω	0.041 % 0.041 %	Keithley 6517B
Resistance – Generate, Fixed Points ³	0.001 Ω	64 $\mu\Omega/\Omega$	L&N 4223
	0.01 Ω	55 $\mu\Omega/\Omega$	L&N 4222
	0.1 Ω	55 $\mu\Omega/\Omega$	L&N 4221
	1 Ω	1.4 $\mu\Omega/\Omega$	L&N 4210
	10 k Ω	1.2 $\mu\Omega/\Omega$	ESI SR-104
	1.9 Ω	0.014 %	Fluke 5730A
	10 Ω	27 $\mu\Omega/\Omega$	
	19 Ω	28 $\mu\Omega/\Omega$	
	100 Ω	12 $\mu\Omega/\Omega$	
	190 Ω	13 $\mu\Omega/\Omega$	
	1 k Ω	7.8 $\mu\Omega/\Omega$	
	1.9 k Ω	9.3 $\mu\Omega/\Omega$	
	10 k Ω	8.3 $\mu\Omega/\Omega$	
	19 k Ω	8.2 $\mu\Omega/\Omega$	
	100 k Ω	11 $\mu\Omega/\Omega$	
	190 k Ω	10 $\mu\Omega/\Omega$	
	1 M Ω	16 $\mu\Omega/\Omega$	
	1.9 M Ω	24 $\mu\Omega/\Omega$	
	10 M Ω	48 $\mu\Omega/\Omega$	
	19 M Ω	66 $\mu\Omega/\Omega$	
	10 Ω	3.8 $\mu\Omega/\Omega$	Fluke 742A
	100 Ω	7.7 $\mu\Omega/\Omega$	
	1 k Ω	3.9 $\mu\Omega/\Omega$	
	10 k Ω	2.2 $\mu\Omega/\Omega$	
	100 k Ω	6.4 $\mu\Omega/\Omega$	
	1 M Ω	6.6 $\mu\Omega/\Omega$	
	10 M Ω	9.1 $\mu\Omega/\Omega$	
	100 M Ω	28 $\mu\Omega/\Omega$	IET SRX
	1 G Ω	93 $\mu\Omega/\Omega$	Fluke 8508A – 7000 K
	1 G Ω	0.13 %	Keithley 263
	10 G Ω	0.27 %	
	100 G Ω	0.45 %	

Parameter/Range	Frequency	CMC ^{2, 4, 5} (\pm)	Comments
Inductance – Generate, Fixed Points 100 μ H to 10 H	1 kHz	0.13 %	GenRad 1482 inductors
Inductance – Measure 1 μ H to 10 H	1 kHz	0.059 %	HP 4284A
AC Voltage – Generate ³ (0.22 to 2.2) mV (2.2 to 22) mV (22 to 220) mV (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 (0.5 to 1) MHz (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) MHz (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) MHz (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) MHz	0.043 % + 4 μ V 0.034 % + 4 μ V 0.034 % + 4 μ V 0.048 % + 4 μ V 0.077 % + 5 μ V 0.14 % + 10 μ V 0.19 % + 20 μ V 0.41 % + 20 μ V 0.029 % + 4 μ V 0.013 % + 4 μ V 0.012 % + 4 μ V 0.025 % + 4 μ V 0.060 % + 5 μ V 0.13 % + 10 μ V 0.17 % + 20 μ V 0.32 % + 20 μ V 0.028 % + 12 μ V 0.011 % + 7 μ V 69 μ V/V + 7 μ V 0.015 % + 7 μ V 0.037 % + 17 μ V 0.077 % + 20 μ V 0.17 % + 25 μ V 0.32 % + 45 μ V 0.028 % + 40 μ V 0.011 % + 15 μ V 50 μ V/V + 8 μ V 80 μ V/V + 10 μ V 0.011 % + 30 μ V 0.040 % + 80 μ V 0.12 % + 200 μ V 0.21 % + 300 μ V	Fluke 5730A

Parameter/Range	Frequency	CMC ^{2, 4, 5} (\pm)	Comments
AC Voltage – Generate ³ (cont)			
(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) MHz	0.028 % + 0.4 mV 0.011 % + 0.15 mV 50 μ V/V + 0.05 mV 80 μ V/V + 0.1 mV 0.011 % + 0.2 mV 0.031 % + 0.6 mV 0.12 % + 2 mV 0.18 % + 3.2 mV	Fluke 5730A
(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	0.028 % + 4 mV 0.011 % + 1.5 mV 62 μ V/V + 0.6 mV 95 μ V/V + 1 mV 0.018 % + 3.5 mV	
(220 to 1100) V	(15 to 50) Hz 50 Hz to 1 kHz	0.035 % + 16 mV 83 μ V/V + 3.5 mV	
(1 to 15) kV	60 Hz	0.13 %	Hipotronics 140 HV power supply w/ Vitrek 4700 w/ 4710 divider
AC Voltage – Measure ³			
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 (1 to 2) MHz (2 to 10) MHz (10 to 20) MHz (20 to 30) MHz	0.27 % + 1.3 μ V 0.11 % + 1.3 μ V 0.058 % + 1.3 μ V 0.1 % + 2 μ V 0.17 % + 2.5 μ V 0.33 % + 4 μ V 0.35 % + 8 μ V 0.61 % + 8 μ V 0.091 % (Flatness) 0.24 % (Flatness) 0.38 % (Flatness) 0.85 % (Flatness)	Fluke 5790A/03
(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	0.13 % + 1.3 μ V 0.064 % + 1.3 μ V 0.048 % + 1.3 μ V 0.081 % + 2 μ V 0.12 % + 2.5 μ V 0.19 % + 4 μ V 0.25 % + 8 μ V	

Parameter/Range	Frequency	CMC ^{2, 4, 5} (\pm)	Comments
AC Voltage – Measure ³ (cont)			
(2.2 to 7) mV	500 kHz to 1 MHz (1 to 2) MHz (2 to 10) MHz (10 to 20) MHz (20 to 30) MHz	0.46 % + 8 μ V 0.089 % (Flatness) 0.15 % (Flatness) 0.25 % (Flatness) 0.47 % (Flatness)	Fluke 5790A/03
(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 500 kHz to 1 MHz (1 to 2) MHz (2 to 10) MHz (10 to 20) MHz (20 to 30) MHz	0.041 % + 1.3 μ V 0.029 % + 1.3 μ V 0.02 % + 1.3 μ V 0.035 % + 2 μ V 0.044 % + 2.5 μ V 0.091 % + 4 μ V 0.12 % + 8 μ V 0.18 % + 8 μ V 0.097 % (Flatness) 0.15 % (Flatness) 0.24 % (Flatness) 0.47 % (Flatness)	
(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 500 kHz to 1 MHz (1 to 2) MHz (2 to 10) MHz (10 to 20) MHz (20 to 30) MHz	0.032 % + 1.5 μ V 0.018 % + 1.5 μ V 99 μ V/V + 1.5 μ V 0.018 % + 2 μ V 0.036 % + 2.5 μ V 0.071 % + 4 μ V 0.091 % + 8 μ V 0.16 % + 8 μ V 0.071 % (Flatness) 0.15 % (Flatness) 0.22 % (Flatness) 0.44 % (Flatness)	
(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 500 kHz to 1 MHz (1 to 2) MHz (2 to 10) MHz (10 to 20) MHz (20 to 30) MHz	0.028 % + 1.5 μ V 0.012 % + 1.5 μ V 56 μ V/V + 1.5 μ V 97 μ V/V + 2 μ V 0.022 % + 2.5 μ V 0.047 % + 4 μ V 0.062 % + 8 μ V 0.15 % + 8 μ V 0.074 % (Flatness) 0.15 % (Flatness) 0.24 % (Flatness) 0.44 % (Flatness)	

Parameter/Range	Frequency	CMC ^{2, 4, 5} (\pm)	Comments
AC Voltage – Measure ³ (cont)			
(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 500 kHz to 1 MHz (1 to 2) MHz (2 to 10) MHz (10 to 20) MHz (20 to 30) MHz	0.025 % + 1.5 μ V 93 μ V/V + 1.5 μ V 49 μ V/V + 1.5 μ V 69 μ V/V + 2 μ V 0.011 % + 2.5 μ V 0.027 % + 4 μ V 0.043 % + 8 μ V 0.14 % + 8 μ V 0.074 % (Flatness) 0.15 % (Flatness) 0.26 % (Flatness) 0.45 % (Flatness)	Fluke 5790A/03
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 500 kHz to 1 MHz (1 to 2) MHz (2 to 10) MHz (10 to 20) MHz (20 to 30) MHz	0.024 % 83 μ V/V 40 μ V/V 62 μ V/V 93 μ V/V 0.023 % 0.041 % 0.15 % 0.074 % (Flatness) 0.15 % (Flatness) 0.22 % (Flatness) 0.44 % (Flatness)	
(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 500 kHz to 1 MHz (1 to 2) MHz (2 to 10) MHz (10 to 20) MHz (20 to 30) MHz	0.024 % 83 μ V/V 35 μ V/V 63 μ V/V 0.011 % 0.028 % 0.058 % 0.18 % 0.074 % (Flatness) 0.15 % (Flatness) 0.22 % (Flatness) 0.44 % (Flatness)	

Parameter/Range	Frequency	CMC ^{2, 4, 5} (±)	Comments
AC Voltage – Measure ³ (cont)			
(7 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 % 84 μV/V 40 μV/V 74 μV/V 0.012 % 0.031 % 0.059 % 0.18 %	Fluke 5790A/03
(22 to 70) 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 % 86 μV/V 49 μV/V 84 μV/V 0.014 % 0.031 % 0.063 % 0.18 %	
(70 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	0.024 % 86 μV/V 51 μV/V 0.011 % 0.015 % 0.033 % 0.084 %	
(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	0.024 % 0.013 % 64 μV/V 0.019 % 0.099 %	
(700 to 1100) V	(10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz	0.024 % 0.013 % 58 μV/V 0.021 % 0.11 %	
(1 to 70) kV	60 Hz	0.13 %	

Parameter/Range	Frequency	CMC ^{2, 4, 5} (\pm)	Comments
AC Current – Generate ³			
(9 to 220) μ A	(10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.030 % + 16 nA 0.020 % + 10 nA 0.014 % + 8 nA 0.035 % + 12 nA 0.14 % + 65 nA	Fluke 5730A
(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	0.030 % + 40 nA 0.019 % + 35 nA 0.012 % + 35 nA 0.023 % + 110 nA 0.13 % + 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 0.013 % + 350 nA 0.025 % + 550 nA 0.14 % + 5 μ A	
(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	0.030 % + 4 μ A 0.019 % + 3.5 μ A 0.013 % + 3.5 μ A 0.025 % + 3.5 μ A 0.13 % + 10 μ A	
(0.22 to 2.2) A	20 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.029 % + 35 μ A 0.057 % + 80 μ A 0.81 % + 160 μ A	
(2.2 to 20) A	30 Hz to 5 kHz	0.042 %	Fluke Y5020 shunt
(20 to 300) A	60 Hz	0.069 %	EIL current source w/ L&N shunt
Clamp-On (10 to 1000) A	(45 to 65) Hz	0.87 %	Fluke 5522A w/ 5500A coil

Parameter/Range	Frequency	CMC ^{2, 4, 5} (\pm)	Comments
AC Current – Measure ³			
(2 to 20) mA	(10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 100) kHz	0.022 % 0.021 % 0.021 % 0.022 %	Fluke 5790A w/ A40 Shunt
(20 to 200) mA	(10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 100) kHz	0.022 % 0.021 % 0.021 % 0.022 %	
(200 to 500) mA	(10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 100) kHz	0.022 % 0.021 % 0.021 % 0.022 %	
(0.5 to 2) A	(10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 100) kHz	0.022 % 0.021 % 0.021 % 0.023 %	
(2.0 to 5.0) A	(10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 100) kHz	0.022 % 0.021 % 0.021 % 0.023 %	
(5.0 to 20.0) A	(10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 100) kHz	0.026 % 0.024 % 0.027 % 0.043 %	
(0 to 100) μ A (0.1 to 100) mA (0.1 to 1) A	45 Hz to 5 kHz 45 Hz to 5 kHz 45 Hz to 5 kHz	0.06 % + 30 nA 0.07 % + 20 nA 0.13 % + 200 μ A	HP 3458A
(0.2 to 2) A	10 Hz to 2 kHz (2 to 10) kHz (10 to 30) kHz	0.085 % + 240 μ A 0.10 % + 240 μ A 0.35 % + 240 μ A	Fluke 8508A
(2 to 20) A	10 Hz to 2 kHz (2 to 10) kHz	0.11 % + 2.4 mA 0.29 % + 2.4 mA	
(1 to 20) A	60 Hz to 5 kHz	0.042 %	HP 3458A w/ Fluke Y5020
(20 to 300) A	60 Hz	0.070 %	HP 3458A w/ L&N shunt

Parameter/Range	Frequency	CMC ^{2, 4, 5} (±)	Comments
Capacitance – Measure			
1 pF to 1 μF	50 Hz to 1 kHz	0.013 %	GenRad 1620A
1 pF to 1 nF	1 kHz to 1 MHz	0.059 %	HP 4284A
1 nF to 1 μF	(1 to 100) kHz	0.059 %	
1 μF to 1 mF	50 Hz to 1 kHz	0.12 %	
(1 to 10) mF	(50 to 120) Hz	0.12 %	
Capacitance – Generate ³			
(0.19 to 3.3) nF	10 Hz to 3 kHz	0.6 % + 0.01 nF	Fluke 5522A
(3.3 to 11) nF	10 Hz to 1 kHz	0.33 % + 0.1 nF	
(11 to 330) nF	10 Hz to 1 kHz	0.32 % + 0.3 nF	
(0.33 to 3.3) μF	(10 to 300) Hz	0.29 % + 3 nF	
(3.3 to 11) μF	(10 to 150) Hz	0.31 % + 10 nF	
(11 to 33) μF	(10 to 120) Hz	0.47 % + 30 nF	
(33 to 110) μF	(10 to 80) Hz	0.54 % + 100 nF	
(110 to 330) μF	Up to 50 Hz	0.53 % + 300 nF	
(0.33 to 1.1) mF	Up to 20 Hz	0.53 % + 1 μF	
(1.1 to 3.3) mF	Up to 6 Hz	0.54 % + 3 μF	
(3.3 to 11) mF	Up to 2 Hz	0.53 % + 10 μF	
(11 to 33) mF	Up to 0.6 Hz	0.88 % + 30 μF	
(33 to 110) mF	Up to 0.2 Hz	1.4 % + 100 μF	
Fixed Points:			
1000 pF	1 kHz	29 μF/F	GenRad 1404
(10, 100) pF	100 Hz to 1 MHz	0.035 %	GenRad 1409 Series
(0.001, 0.01, 0.1, 1) μF	(50 to 1000) Hz	0.068 %	

Parameter/Equipment	Range	CMC ^{2,4} (±)	Comments
Electrical Calibration of Thermocouple Indicators ³ –			
Type E	(-250 to -100) °C (-100 to 650) °C (650 to 1000) °C	0.59 °C 0.2 °C 0.25 °C	Fluke 5522A
Type J	(-210 to -100) °C (-100 to 760) °C (760 to 1200) °C	0.32 °C 0.21 °C 0.28 °C	
Type K	(-200 to -100) °C (-100 to 120) °C (120 to 1000) °C (1000 to 1372) °C	0.39 °C 0.22 °C 0.27 °C 0.5 °C	
Type S	(0 to 250) °C (250 to 1400) °C (1400 to 1767) °C	0.55 °C 0.46 °C 0.56 °C	
Type T	(-250 to -150) °C (-150 to 0) °C (0 to 400) °C	0.73 °C 0.29 °C 0.18 °C	
Electrical Calibration of RTD Indicators ³ –			
Pt 385, 100 Ω	(-200 to 0) °C (0 to 100) °C (100 to 400) °C (400 to 630) °C (630 to 800) °C	0.06 °C 0.083 °C 0.12 °C 0.14 °C 0.27 °C	Fluke 5522A
Pt 3926, 100 Ω	(-200 to 0) °C (0 to 100) °C (100 to 400) °C (400 to 630) °C	0.061 °C 0.083 °C 0.12 °C 0.14 °C	
Pt 3916, 100 Ω	(-200 to -190) °C (-190 to 0) °C (0 to 300) °C (300 to 600) °C (600 to 630) °C	0.29 °C 0.061 °C 0.094 °C 0.12 °C 0.27 °C	

Parameter/Equipment	Range	CMC ^{2,4} (±)	Comments
Electrical Calibration of RTD Indicators ³ – (cont)			
Pt 385, 200 Ω	(-200 to 100) °C (100 to 260) °C (260 to 600) °C (600 to 630) °C	0.049 °C 0.06 °C 0.17 °C 0.19 °C	Fluke 5522A
Pt 385, 500 Ω	(-200 to 100) °C (100 to 260) °C (260 to 600) °C (600 to 630) °C	0.061 °C 0.072 °C 0.11 °C 0.13 °C	
Pt 385, 1 kΩ	(-200 to 0) °C (0 to 260) °C (260 to 600) °C (600 to 630) °C	0.039 °C 0.061 °C 0.083 °C 0.27 °C	
PtNi 385, 120 Ω	(-80 to 100) °C (100 to 260) °C	0.094 °C 0.17 °C	
Cu 427, 10 Ω	(-100 to 260) °C	0.35 °C	
Oscilloscopes ³ –			
Amplitude – Square Wave 50 Ω load	1 mV _{p-p} to 6.6 V _{p-p} 10 Hz to 10 kHz	0.46 % + 40 μV	Fluke 5522A w/ SC 1100
1 MΩ load	1 mV _{p-p} to 130 V _{p-p} 10 Hz to 10 kHz	0.37 % + 40 μV	
Leveled Sine Wave – Amplitude	5 mV _{p-p} to 5.5 V _{p-p} 50 kHz reference 50 kHz to 100 MHz (100 to 300) MHz (300 to 600) MHz	2.4 % + 300 μV 4.2 % + 300 μV 4.8 % + 300 μV 7.1 % + 300 μV	
Leveled Sine Wave – Flatness	5 mV _{p-p} to 3.5 V _{p-p} (600 to 1100) MHz 5 mV _{p-p} to 5.5 V _{p-p} 50 kHz to 100 MHz (100 to 300) MHz (300 to 600) MHz	8.2 % + 300 μV 2 % + 100 μV 2.6 % + 100 μV 4.8 % + 100 μV	

Parameter/Equipment	Range	CMC ^{2,4} (±)	Comments
Oscilloscopes ³ – (cont)			
Leveled Sine Wave – Flatness	5 mV _{p-p} to 3.5 V _{p-p} (600 to 1100) MHz	6 % + 100 μV	Fluke 5522A w/ SC 1100
Time Marker @ 50 Ω	1 ns to 20 ms 50 ms to 5 s	24 μs/s 27 μs/s	
Rise Time @ 50 Ω	1 kHz to 2 MHz (200 to 300) ps (2 to 10) MHz (200 to 350) ps	120 ps 120 ps	

III. Electrical – RF/ Microwave

Parameter/Range	Frequency	CMC ^{2,4} (±)	Comments
RF Power – Measure			
Power Reference 1 mW, Type-N(f) 50 Ω	50 MHz 5 MHz to 1 GHz	0.026 dB (5.8 μW) 0.027 dB	HP 432A w/ 478A-H76 power sensor
1 μW to 1 mW	Up to 500 MHz	0.22 dB	Bird 8322 VSWR<1.1:1
500 W	0.1 MHz to 6 GHz	0.18 dB	HP 4418B, E9304A, VSWR <1.18:1
(+20 to -70) dBm	(6 to 26.5) GHz	0.23 dB	HP E4413A VSWR <1.27:1
	(26.5 to 50) GHz	0.25 dB	HP 8487A VSWR <1.30:1
Tuned RF Power, Relative – Measure			
(0 to -30) dB (-30 to -70) dB (-70 to -120) dB	2.5 MHz to 18 GHz	0.24 dB 0.24 dB 0.5 dB	HP 8902A w/ HP 11722A & 11792A

Parameter/Range	Frequency	CMC ^{2, 4, 5} (±)	Comments
Phase Modulation – Measure Carrier Frequency: 10 MHz to 1.3 GHz	200 Hz to 20 kHz (0 to 85) radians	3.7 %	HP 8902A w/ HP 11793A
RF Attenuation/ Insertion Loss – Measure (0 to -120) dB (0 to 70) dB Dynamic Range	5 Hz to 3 GHz 0.1 MHz to 6 GHz (6 to 26.5) GHz (26.5 to 40) GHz	0.48 dB 0.18 dB 0.24 dB 0.27 dB	HP E5061B w/ HP 85032B HP 4418B, E9340A VSWR <1.18:1, HP 4418B, E4413A VSWR <1.27:1 HP 4418B w/ HP 8487A/D SWR <1.30:1
Amplitude Modulation – Measure Rate: 50 Hz to 10 kHz Depths: (5 to 99) % Rate: 20 Hz to 10 kHz Depths: (5 to 99) % Rate: 50 Hz to 50 kHz Depths: (5 to 99) % Rate: 20 Hz to 100 kHz Depths: (5 to 99) %	150 kHz to 10 MHz 150 kHz to 10 MHz 10 MHz to 18 GHz 10 MHz to 18 GHz	2.4 % 3.5 % 1.3 % 3.5 %	HP 8902A w/ HP 11722A or HP 11793A
Frequency Modulation – Measure Rate: 20 Hz to 10 kHz Rate: 50 Hz to 100 kHz	250 kHz to 10 MHz 10 MHz to 18 GHz	2.4 % 1.2 %	HP 8902A w/ HP 11722A or HP 11793A

Parameter/Range	Frequency	CMC ^{2,4,5} (±)	Comments
LISN –			
Insertion Loss	(0 to 110) dB 5 Hz to 3 GHz	0.48 dB	HP E5061B w/ HP 85032B
Impedance	(Up to 5) kΩ 5 Hz to 3 GHz	3.7 %	ANSI C63.4, CISPR 16-1-2
Phase	(0 to 360)° 5 Hz to 3 GHz	0.87°	
Isolation	(0 to 110) dB 5 Hz to 3 GHz	0.54 dB	
AC Resistance – Measure			
1 Ω to 1 kΩ	5 Hz to 1 MHz (1 to 13) MHz	0.15 % 0.41 %	HP 4192A
(1 to 100) kΩ	5 Hz to 1 MHz (1 to 13) MHz	0.48 % 0.83 %	
100 kΩ to 1 MΩ	5 Hz to 1 MHz	1.8 %	
(10 to 100) Ω 100 Ω to 1 kΩ (1 to 10) kΩ	(10 to 110) MHz (10 to 110) MHz (10 to 40) MHz	3.1 % + 0.037 <i>F</i> (MHz) 3.2 % + 0.11 <i>F</i> (MHz) 1.3 % + 0.53 <i>F</i> (MHz)	HP 4193A
Distortion – Measure			
(0.001 to 100) %	20 Hz to 20 kHz (20 to 100) kHz	0.2 % 0.28 %	HP 8903B

IV. Mechanical

Parameter/Equipment	Range	CMC ^{2,6} (±)	Comments
Pressure – Measuring Equipment ³			
Pneumatic Gage	(-14 to 15) psig	0.0035 psi	Druck DPI150

Parameter/Equipment	Range	CMC ^{2,5,6} (±)	Comments
Pressure – Measuring Equipment ³ – (cont)			
Pneumatic Gage	(0 to 2) in·H ₂ O (-1 to 1) psig (-15 to 30) psig (-12 to 300) psig (-12 to 1000) psig	0.000 87 in·H ₂ O 0.000 75 psi 0.012 psi 0.082 psi 0.26 psi	Ashcroft AQS-1 Druck DPI800/UPM-P Fluke 2700G-BG200K Fluke 2700G-BG2M Fluke 2700G-BG7M
Hydraulic Gage	(0 to 5000) psig (0 to 10 000) psig	3.1 psi 2.6 psi	Druck DPI104 Fluke 2700G-G70M
Differential Pressure Gages – Barometers ³	(750 to 1150) mbar	0.37 mbar	Druck DPI150
Scales & Balances ³	0.5 lb (0.23 kg) 1 lb (0.46 kg) 2 lb (0.91 kg) 5 lb (2.3 kg) 10 lb (4.6 kg) 20 lb (9.1 kg) 50 lb (23 kg) (1 to 5) g 10 g 20 g 50 g 100 g 200 g 500 g 1000 g 2000 g 20 000 g	0.052 g 0.12 g 0.16 g 0.38 g 0.75 g 1.6 g 3.1 g 0.044 mg 0.17 mg 0.16 mg 0.21 mg 0.33 mg 0.62 mg 1.4 mg 3.2 mg 6 mg 58 mg	Class F weights Class 1 weights
Mass – Measure	(1 to 500) g (500 to 1000) g (1000 to 5000) g (5000 to 12 000) g	0.31 g 0.39 g 1.2 g 2.8 g	Rice Lake TP-12K
Torque – Measuring Equipment ³ (Analyzers & Transducers)	(2.5 to 25) lbf·in (10 to 100) lbf·in (50 to 500) lbf·in (10 to 100) lbf·ft	0.33 % 0.26 % 0.23 % 0.34 %	Ref weights/torque arm

Parameter/Equipment	Range	CMC ^{2,5} (±)	Comments
Torque Wrenches & Screwdrivers ³	(1 to 10) ozf·in	0.69 %	AWS MTM
	(10 to 100) ozf·in	0.99 %	
	(1 to 10) lbf·in	0.48 %	
	(5 to 50) lbf·in	0.51 %	
	(50 to 500) lbf·in	0.79 %	
	(25 to 250) lbf·ft	0.95 %	

V. Thermodynamics

Parameter/Equipment	Range	CMC ^{2,6} (±)	Comments
Thermocouples – Type E, J, K, T	(-40 to 120) °C	0.27 °C	Liquid bath, Hart 5626 PRT & Fluke 5520A
	(100 to 425) °C	0.31 °C	Metrology well, Hart 5626 PRT & Fluke 5520A
	(425 to 600) °C	0.32 °C	
Thermometers	(-40 to 120) °C	0.023 °C	Liquid bath & Hart 5626 PRT
	(50 to 100) °C	0.024 °C	Metrology well calibrator & Hart 5626 PRT
	(100 to 425) °C	0.044 °C	
	(425 to 600) °C	0.073 °C	
Temperature – Measure ³ (Ovens, Freezers, Chambers)	(-100 to 0) °C	0.015 °C	Hart 5626 PRT/9173
	(0 to 425) °C	0.03 °C	
	(425 to 600) °C	0.033 °C	
Relative Humidity – Measure ³ Measuring Equipment	(5 to 95) % RH	1.4 % RH	Rotronic HP21/22
	(11, 33, 75) % RH (23 ± 5) °C	1.4 % RH	Rotronic HP21/22 humidity chamber

VI. Time & Frequency

Parameter/Equipment	Range	CMC ^{2, 6} (\pm)	Comments
Frequency – Measuring Equipment (Frequency Counters)	10 MHz	2.2 parts in 10^{12}	Symmetricom XLi
	0.01 Hz to 20 MHz 10 MHz to 40 GHz	0.013 Hz 1.3 Hz	3325A 83640L & Symmetricom XLi
Frequency – Measure	(1, 5, 10) MHz	2.5 parts in 10^{12} Hz	Symmetricom XLi
	0.01 Hz to 500 MHz	5.3 parts in 10^{10} Hz	5345A
	10 MHz to 40 GHz	1.7 Hz	5352B & Symmetricom XLi
Stopwatches & Timers ³	Up to 24 h	0.063 sec/day	Cas-Ker 4500

¹ This laboratory offers commercial calibration service and field 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. 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 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 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's, L is the numerical value of the nominal length of the device measured in inches; F is the frequency; percentages are to be read as percent of reading unless otherwise noted.

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

HAYES INSTRUMENT SERVICE, INC.

Billerica, MA

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 22nd day of January 2024.

A blue ink signature of Mr. Trace McInturff.

Mr. Trace McInturff, Vice President, Accreditation Services
For the Accreditation Council
Certificate Number 2117.01
Valid to January 31, 2026

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