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

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CALIBRATION

Valid To: March 31, 2025 Certificate Number: 2820.01

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory to perform the following calibrations[1, 8]:

I. Dimensional

Parameter/Equipment	Range	CMC[2, 5] (±)	Comments
Bore Gages & ID Measuring Tools[3] –			
3-Point	Up to 9 in	(36 + 3.3*D*) µin	Ring gages
2-Point	Up to 12 in	(35 + 2.3*D*) µin	Gage blocks
Countersink & Chamfer Gages[3]	Up to 3.5 in	(230 + 10*D*) µin	Modified ring gages
Coordinate Measuring Machines (CMM)[3] –			ASME B89.4.10360.2 Section 6.3.3
Length Measurement Error (E_L)	Up to 27 in	(14 + 5.1*L*) µin	Step gage
	Up to 127 in	(7.8 + 3.8*L*) µin	Gage blocks
	Up to 240 in	(6.1 + 1.2*L*) µin	Laser system
Repeatability (R_0)	(10 to 50) mm	27 µin	ASME B89.4.10360.2 Section 6.1.1; sphere

Parameter/Equipment	Range	CMC[2, 5] (±)	Comments
Spherical CMM (Laser Tracker)[3]	Up to 600 in	600 µin	Reference length bar
Laser Interferometer Length Dependent Error	Up to 40 in	0.43 parts in 10^6	ASME B89.1.8 Sec 4 XD1 reference laser
Articulated Arm CMM[3] –			
Effective Dia Perf Test	---	55 µin	Sphere
Single Point Articulation Test	---	90 µin	Trihedral socket
Volumetric Perf Test	Up to 144 in radius	(83 + 1.7L) µin	Gage block ref. length
CNC, Machine Tools[3] –			
Repeatability @ 2 Sigma	---	18 µin	Laser per ASME B5.54 Sec. 7.3
Linear Displacement Accuracy	Up to 260 ft	(83 + 1.7L) µin	Laser per ASME B5.54 Sec. 7.3
Volumetric Performance (By Body Diagonals)			
Bi-Directional System Deviation	Up to 260 ft	85 µin	Laser per ASME B5.54 Sec. 7.7
Reversal Deviation	Up to 260 ft	90 µin	Laser per ASME B5.54 Sec. 7.7
Bi-Directional Repeatability	Up to 260 ft	80 µin	Laser per ASME B5.54 Sec. 7.3

Parameter/Equipment	Range	CMC[2, 5] (±)	Comments
Gage Blocks	Up to 0.1 in (0.1 to 4) in (4 to 20) in	4 µin (2 + 1.4*L*) µin (4.3 + 1.4*L*) µin	Master gage blocks & amplifier
Micrometers[3] –			
Linearity	Up to 42 in	(38 + 2.7*L*) µin	Gage blocks
Parallelism	Up to 42 in	(31 + 0.25*L*) µin	
Micrometer Standards & Length Artifacts	Up to 10 in (10 to 41) in	(8.8 + 1.1*L*) µin (12 + 2.4*L*) µin	Universal Supermicrometer™ Universal LMS
Depth Micrometers & Gages[3]	Up to 12 in	(30 + 2.5*L*) µin	Gage blocks
Thread Micrometers	Up to 6 in	(92 + 7.4*L*) µin	Thread plugs
Thread Wires	(4.5 to 96) TPI	15 µin	Supermicrometer™,
Calipers[3] –			
Digital	Up to 72 in	(300 + 1.7*L*) µin	Gage blocks and ring gages
Dial & Vernier	Up to 72 in	(600 + 1.9*L*) µin	
Indicators, Dial & Digital[3] (For Dial, Res. = 0.2 Least Grad.)	Up to 1 in (1 to 4) in	6.5 µin + 0.6*R* (3.3 + 3*L*) µin + 0.6*R*	Gage blocks
Height Gages[3]	Up to 40 in	(7.1 + 1.1*L*) µin	Gage blocks

Parameter/Equipment	Range	CMC[2, 5] (±)	Comments
Plug / Pin Gages & Outside Cylindrical Diameter	Up to 1 in (1 to 10) in	(6.7 + 1.8*L*) µin (13 + 1.1*L*) µin	Laser scan micrometer P&W Supermicrometer™, gage blocks
Plain Rings & Inside Cylindrical Diameter	(0.04 to 11) in	(4.6 + 0.91*D*) µin	Internal Supermicrometer™, master gage blocks
Straight Threaded Plug Gages – Pitch Diameter (TPI 4.5 to 96) Major Diameter	 Up to 6 in Up to 5 in	 (76 + 6.0*D*) µin (24 + 1*D*) µin	 3-wire method P&W Supermicrometer™, gage blocks
Tapered Threaded Plug Gages – Pitch Diameter (8 to 27) TPI Major Diameter	 Up to 4 in Up to 4.5 in	 92 µin 22 µin	 3-wire method, tapered sine block P&W Supermicrometer™, gage blocks
Adjustable Threaded Ring Gages	(0.05 to 2) in diameter	(84 + 10*D*) µin	Setting plugs

Parameter/Equipment	Range	CMC[2, 5] (±)	Comments
Steel Rules[3] –			
Length	Up to 72 in	(590 + 1.5*L*) µin	Gage blocks
Graduations	----	(670 + 16*L*) µin	Glass scale
Surface Plates[3] –			
Flatness	Up to 300 in diagonal	(8.7 + 1.2*L*) µin	LDDM
Repeat Reading	----	(6.8 + 0.017*L*) µin	Repeat reading gage
Optical Comparators[3] –			
Linearity	12 in travel	(12 + 3.4*L*) µin	Glass scale
Angle	±180º	40 arc seconds	
Magnification Accuracy	5X to 100X	0.013 % of magnification	
Measuring Tapes –			
Length	Up to 330 ft	(0.0073 + 0.000 0069*L*) in	Test frame
Graduations	----	0.0018 in	Glass scale
Wire Crimpers –			
Cylindrical Crimping Chamber	(0.011 to 0.500) in	650 µin	Pin gages
Shaped Crimping Chamber	Up to 1 in	280 µin	Optical comparator
Crimp Height	Up to 1 in	190 µin	Crimp height micrometer
Air Gages[3]	(-0.0015 to +0.0015) in	14 µin	Certified Rings

Parameter/Equipment	Range	CMC[2, 5] (±)	Comments
Profilometers, Ra	20 µin 120 µin	1.5 µin 3.1 µin	Surface roughness masters
Surface Roughness Standards, Ra	(16 to 132) µin	(1.3 + 0.017) µin	Comparison with surface roughness masters
Radius Standard	(0.01 to 3) in	(190 + 62*L*) µin	Optical comparator
Bench Micrometer –			
Linearity	Up to 1 in	(2.1 + 1.3*L*) µin	Gage blocks
Anvil Parallelism	---	1.4 µin	Ball test
Force Error	(2 to 40) ozf	0.13 ozf	Load cell
ID Functionality	---	11 µin	Setting rings
Coating Thickness Meter	Up to 80 mils	0.11 % rdg + 0.023 mils	Coating thickness standards
Coating Thickness Standard	Up to 750 mils	0.014 mils	Universal LMS
Ultrasonic Thickness Meter	Up to 10 in (Ferrous) Up to 0.65 in (Alum)	80 µin 100 µin	Steel gage blocks Aluminum thickness Standards

II. Dimensional Testing[1]

Parameter/Equipment	Range	CMC[2, 5] (±)	Comments
Length, 1D[6]	Up to 41 in Up to 56 in Up to 8.5 in Up to 60 ft	(12 + 2.4*L*) µin (590 + 2.1*L*) µin (410 + 96*L*) µin (83 + 1.6*L*) µin	Universal LMS CMM Optical comparator Laser
Length, 2D[6]	Up to 8″ X 3″	(370 + 120*L*) µin	Optical comparator
Length, 3D[6]	Up to 47″ X 32″ X 24″	700 µin	CMM

III. Electrical – DC/Low Frequency

Parameter/Equipment	Range	CMC[2, 7] (±)	Comments
DC Voltage – Measure[3]	Up to 100 mV (0.1 to 1) V (1 to 10) V (10 to 100) V (100 to 1000) V	4.4 µV/V + 0.62 µV 4.7 µV/V + 0.5 µV 4.6 µV/V + 1.1 µV 6.9 µV/V + 39 µV 7.2 µV/V + 120 µV	HP 3458A
DC Voltage – Generate[3]	Up to 100 mV (0.1 to 1) V (1 to 10) V (10 to 100) V (100 to 1000) V	4.4 µV/V + 0.62 µV 4.7 µV/V + 0.5 µV 4.6 µV/V + 1.1 µV 6.9 µV/V + 39 µV 7.2 µV/V + 120 µV	Fluke 5502A monitored by HP3458A

Parameter/Equipment	Range	CMC[2, 7] (±)	Comments
DC Current – Measure[3]	Up to 100 nA 100 nA to 1 µA (1 to 10) µA (10 to 100) µA (0.1 to 1) mA (1 to 10) mA (10 to 100) mA 100 mA to 1 A (1 to 20) A	34 µA/A + 0.047 nA 23 µA/A + 0.048 nA 23 µA/A + 0.12 nA 23 µA/A + 0.11 nA 23 µA/A + 5.9 nA 23 µA/A + 59 nA 40 µA/A + 0.63 µA 130 µA/A + 12 µA 4.7 µA/A + 110 µA	HP 3458A EL 7520 current shunt
DC Current – Generate[3]	Up to 100 nA 100 nA to 1 µA (1 to 10) µA (10 to 100) µA (0.1 to 1) mA (1 to 10) mA (10 to 100) mA 100 mA to 1 A (1 to 20) A (11 to 30) A (30 to 110) A (110 to 205) A (55 to 150) A (150 to 550) A (525 to 1025) A	34 µA/A + 0.047 nA 23 µA/A + 0.048 nA 23 µA/A + 0.12 nA 23 µA/A + 0.11 nA 23 µA/A + 5.9 nA 23 µA/A + 59 nA 40 µA/A + 0.63 µA 130 µA/A + 12 µA 4.7 µA/A + 110 µA 0.2 % rdg + 1.6 mA 0.21 % rdg + 3.9 mA 0.23 % rdg + 6.4 mA 0.2 % rdg + 7.7 mA 0.22 % rdg + 19 mA 0.23 % rdg + 32 mA	Fluke 5502A monitored by HP3458A With EL 7520 current shunt Fluke 5502A, 10 turn coil Fluke 5502A, 50 turn coil

Parameter/Equipment	Range	CMC[2, 7] (±)	Comments
Resistance – Generate & Measure[3]	(0 to 1) Ω (1 to 10) Ω (10 to 100) Ω 100 Ω to 1 kΩ (1 to 10) kΩ (10 to 100) kΩ 100 kΩ to 1 MΩ (1 to 10) MΩ (10 to 100) MΩ 100 MΩ to 1 GΩ	81 µΩ/Ω + 2.7 µΩ 17 µΩ/Ω + 62 µΩ 14 µΩ/Ω + 0.58 mΩ 12 µΩ/Ω + 0.59 mΩ 12 µΩ/Ω + 5.9 mΩ 12 µΩ/Ω + 58 mΩ 17 µΩ/Ω + 2.8 Ω 58 µΩ/Ω + 120 Ω 0.058 % rdg + 1.2 kΩ 0.58 % rdg + 12 kΩ	HP34420A, HP3458A
Capacitance – Generate	(0.22 to 3.3) nF (3.3 to 11) nF (11 to 33) nF (33 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	0.58 % rdg + 12 pF 0.29 % rdg + 12 pF 0.29 % rdg + 120 pF 0.29 % rdg + 120 pF 0.29 % rdg + 350 pF 0.29 % rdg + 1.2 nF 0.29 % rdg + 3.5 nF 0.29 % rdg + 12 nF 0.46 % rdg + 36 nF 0.52 % rdg + 120 nF 0.52 % rdg + 350 nF 0.52 % rdg + 1.2 µF 0.52 % rdg + 3.5 µF 0.52 % rdg + 13 µF 0.87 % rdg + 35 µF 1.3 % rdg + 120 µF	Fluke 5502A
Electrical Calibration of Thermocouple Indicators & Simulators[3] –			
Type B	(1000 to 1200) °F (1200 to 1600) °F (1600 to 2400) °F (2400 to 3200) °F	0.37 °F 0.32 °F 0.26 °F 0.21 °F	Fluke 5502A or HP 3245A, monitored by HP 3458A
Type E	(-454 to 300) °F (300 to 1100) °F (1100 to 1832) °F	0.17 °F 0.11 °F 0.11 °F	
Type J	(-346 to -120) °F (-120 to 500) °F (500 to 1350) °F (1350 to 2192) °F	0.28 °F 0.17 °F 0.13 °F 0.13 °F	
Type K	(-454 to -400) °F (-400 to -120) °F (-120 to 500) °F (500 to 1500) °F (1500 to 2500) °F	5.4 °F 0.79 °F 0.22 °F 0.18 °F 0.20 °F	

Parameter/Equipment	Range	CMC[2] (±)	Comments
Electrical Calibration of Thermocouple Indicators & Simulators[3] – (cont)			
Type N	(-400 to -300) °F	1.7 °F	Fluke 5502A or HP 3245A, monitored by HP 3458A
	(-300 to -150) °F	0.54 °F	
	(-150 to -50) °F	0.35 °F	
	(-50 to 700) °F	0.29 °F	
	(700 to 1500) °F	0.21 °F	
	(1500 to 2372) °F	0.22 °F	
Type R	(-58 to 32) °F	0.65 °F	
	(32 to 400) °F	0.38 °F	
	(400 to 1100) °F	0.27 °F	
	(1100 to 2200) °F	0.24 °F	
	(2200 to 3214) °F	0.24 °F	
Type S	(-58 to 32) °F	0.51 °F	
	(32 to 400) °F	0.33 °F	
	(400 to 1100) °F	0.27 °F	
	(1100 to 2200) °F	0.24 °F	
	(2200 to 3214) °F	0.24 °F	
Type T	(-400 to -300) °F	0.69 °F	
	(-300 to 120) °F	0.34 °F	
	(-120 to 200) °F	0.23 °F	
	(200 to 752) °F	0.16 °F	
Electrical Calibration of RTD Indicators & Simulators[3] –			
Pt 385, 100 Ω	(-320 to 32) °F	0.013 °F	HP 3458A
	(32 to 400) °F	0.016 °F	
	(400 to 800) °F	0.02 °F	
	(800 to 1200) °F	0.027 °F	
	(1200 to 1562) °F	0.035 °F	
Pt 385, 1000 Ω	(-320 to 32) °F	0.009 °F	
	(32 to 400) °F	0.016 °F	
	(400 to 800) °F	0.020 °F	
	(800 to 1200) °F	0.027 °F	
	(1200 to 1562) °F	0.033 °F	

Parameter/Range	Frequency	CMC[2, 7] (±)	Comments
AC Voltage – Measure[3]			
(1 to 10) mV	(1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (0.3 to 1) MHz (1 to 4) MHz (4 to 8) MHz	0.034 % + 3.6 µV 0.023 % + 1.4 µV 0.034 % + 1.4 µV 0.011 % + 1.9 µV 0.58 % + 1.4 µV 4.6 % + 4.2 µV 4.6 % + 7.7 µV 8.1 % + 8.8 µV 23 % + 19 µV	HP 3458A
(10 to 100) mV	(1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz 300 kHz to 1 MHz (1 to 2) MHz (2 to 4) MHz (4 to 8) MHz (8 to 10) MHz	83 µV/V + 4.7 µV 83 µV/V + 2.4 µV 0.016 % + 2.7 µV 0.035 % + 2.4 µV 0.092 % + 2.8 µV 0.35 % + 12 µV 1.2 % + 12 µV 1.7 % + 45 µV 4.6 % + 100 µV 4.6 % + 120 µV 17 % + 440 µV	
100 mV to 1 V	(1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz 300 kHz to 1 MHz (1 to 2) MHz (2 to 4) MHz (4 to 8) MHz (8 to 10) MHz	82 µV/V + 47 µV 82 µV/V + 24 µV 0.016 % + 26 µV 0.035 % + 24 µV 0.092 % + 28 µV 0.35 % + 120 µV 1.2 % + 120 µV 1.7 % + 450 µV 4.6 % + 1.1 mV 4.6 % + 1.2 mV 17 % + 4.4 mV	
(1 to 10) V	(1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz 300 kHz to 1 MHz (1 to 2) MHz (2 to 4) MHz (4 to 8) MHz (8 to 10) MHz	83 µV/V + 0.47 mV 82 µV/V + 0.24 mV 0.016 % + 0.26 mV 0.035 % + 0.24 mV 0.092 % + 0.28 mV 0.35 % + 1.2 mV 1.2 % + 1.2 mV 1.7 % + 4.6 mV 4.6 % + 11 mV 4.6 % + 12 mV 17 % + 44 mV	

Parameter/Range	Frequency	CMC[2, 7] (±)	Comments
AC Voltage – Measure[3] (cont)			
(10 to 100) V	(1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz 300 kHz to 1 MHz	0.023 % + 4.8 mV 0.023 % + 2.5 mV 0.023 % + 2.5 mV 0.04 % + 2.8 mV 0.14 % + 2.4 mV 0.46 % + 14 mV 1.7 % + 44 mV	HP 3458A
(100 to 1000) V	(1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.046 % + 49 mV 0.046 % + 26 mV 0.07 % + 23 mV 0.14 % + 23 mV 0.35 % + 23 mV	
AC Voltage – Generate			
(1 to 10) mV	(1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz 300 kHz to 1 MHz	0.034 % + 3.6 µV 0.022 % + 1.5 µV 0.033 % + 1.5 µV 0.11 % + 1.9 µV 0.58 % + 1.5 µV 4.6 % + 4.2 µV 4.6 % + 7.7 µV	Fluke 5502A or HP 3245A, monitored by HP 3458A
(10 to 100) mV	(1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz 300 kHz to 1 MHz	83 µV/V + 4.7 µV 83 µV/V + 2.4 µV 0.016 % + 2.7 µV 0.035 % + 2.4 µV 0.092 % + 2.8 µV 0.35 % + 12 µV 1.2 % + 12 µV	
100 mV to 1 V	(1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz 300 kHz to 1 MHz	82 µV/V + 47 µV 82 µV/V + 24 µV 0.016 % + 26 µV 0.035 % + 24 µV 0.092 % + 28 µV 0.35 % + 120 µV 1.2 % + 120 µV	

Parameter/Range	Frequency	CMC[2, 7] (±)	Comments
AC Voltage – Generate (cont)			
(1 to 10) V	(1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz 300 kHz to 1 MHz	83 µV/V + 0.47 mV 82 µV/V + 0.24 mV 0.016 % + 0.26 mV 0.035 % + 0.24 mV 0.092 % + 0.28 mV 0.35 % + 1.2 mV 1.2 % + 1.2 mV	Fluke 5502A or HP 3245A, monitored by HP 3458A
(10 to 20) V	(1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz 300 kHz to 1 MHz	0.023 % + 4.7 mV 0.023 % + 2.4 mV 0.023 % + 2.4 mV 0.004 % + 2.5 mV 0.14 % + 2.4 mV 0.46 % + 12 mV 1.7 % + 19 mV	
(20 to 100) V	(1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.023 % + 4.8 mV 0.023 % + 2.5 mV 0.021 % + 4.9 mV 0.036 % + 6.8 mV 0.12 % + 21 mV	
(100 to 330) V	(1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.046 % + 47 mV 0.046 % + 24 mV 0.07 % + 23 mV 0.14 % + 23 mV 0.35 % + 23 mV	
(330 to 1000) V	(1 to 40) Hz 40 Hz to 1 kHz (1 to 10) kHz	0 046 % + 49 mV 0.046 % + 26 mV 0.07 % + 23 mV	

Parameter/Range	Frequency	CMC[2, 7] (±)	Comments
AC Current – Generate & Measure[3]			
Up to 100 µA	(10 to 20) Hz (20 to 45) Hz 45 Hz to 5 kHz	0.42 % + 0.077 µA 0.17 % + 0.038 µA 0.069 % + 0.036 µA	HP 3458A with Fluke 5502A
100 µA 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	0.46 % + 0.25 µA 0.17 % + 0.27 µA 0.069 % + 0.24 µA 0.035 % + 0.24 µA 0.07 % + 0.24 µA 0.47 % + 0.47 µA 0.64 % + 1.8 µA	
(1 to 10) mA	(10 Hz to 20) Hz (20 Hz to 45) Hz (45 Hz to 100) Hz 100 Hz to 5 kHz (5 kHz to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.46 % + 2.5 µA 0.17 % + 2.7 µA 0.069 % + 2.4 µA 0.035 % + 2.4 µA 0.07 % + 2.4 µA 0.47 % + 4.7 µA 0.64 % + 18 µA	
(10 to 100) 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	0.46 % + 25 µA 0.17 % + 27 µA 0.069 % + 24 µA 0.035 % + 24 µA 0.07 % + 24 µA 0.47 % + 47 µA 0.64 % + 0.18 mA	
100 mA to 1 A	(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	0.46 % + 0.25 mA 0.18 % + 0.28 mA 0.092 % + 0.24 mA 0.12 % + 0.24 mA 0.35 % + 0.24 mA 1.2 % + 0.47 mA	
(1 to 10) A	(1 to 50) Hz 50 Hz to 1 kHz (1 to 5) kHz	0.0093 % + 0.46 mA 0.012 % + 0.45 mA 0.067 % + 1.2 mA	HP 3458A with Fluke 5502A and current shunt
(10 to 20) A	(1 to 50) Hz 50 Hz to 1 kHz (1 to 5) kHz	0.0083 % + 0.47 mA 0.012 % + 2.2 mA 0.066 % + 1.1 mA	

Parameter/Range	Frequency	CMC[2, 7] (±)	Comments
AC Current – Generate[3]			
(29 to 330) 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	0.23 % + 0.13 µA 0.17 % + 0.13 µA 0.14 % + 0.14 µA 0.35 % + 0.18 µA 0.92 % + 0.25 µA 1.8 % + 0.62 µA	Fluke 5502A
330 µA to 3.3 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	0.23 % + 0.23 µA 0.14 % + 0.32 µA 0.12 % + 0.18 µA 0.23 % + 0.27 µA 0.58 % + 0.35 µA 1.2 % + 0.7 µA	
(3.3 to 33) 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	0.21 % + 2.4 µA 0.1 % + 3.8 µA 0.047 % + 2.4 µA 0.093 % + 2.4 µA 0.23 % + 3.8 µA 0.46 % + 5.3 µA	
(33 to 330) 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	0.21 % + 23 µA 0.1 % + 38 µA 0.047 % + 24 µA 0.12 % + 58 µA 0.23 % + 0.12 mA 0.46 % + 0.24 mA	
330 mA to 1.1 A	(10 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.21 % + 0.12 mA 0.058 % + 0.12 mA 0.69 % + 1.2 mA 2.9 % + 5.8 mA	
(1.1 to 3) A	(10 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.21 % + 0.12 mA 0.069 % + 0.13 mA 0.69 % + 1.3 mA 2.9 % + 5.8 mA	
(3 to 11) A	(45 to 100) Hz 100 Hz to 1 kHz (1 to 5) kHz	0.069 % + 2.4 mA 0.12 % + 2.4 mA 3.5 % + 2.4 mA	

Parameter/Range	Frequency	CMC[2, 7] (±)	Comments
AC Current – Generate[3] (cont)			
(11 to 20.5) A	(45 to 100) Hz 100 Hz to 1 kHz (1 to 5) kHz	0.14 % + 5.8 mA 0.17 % + 6.5 mA 3.5 % + 5.8 mA	Fluke 5502A
(11 to 30) A	(10 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.29 % + 0.87 mA 0.21 % + 0.9 mA 0.72 % + 12 mA 2.9 % + 58 mA	Fluke 5502A with 10 turn coil
(30 to 110) A	(45 to 100) Hz 100 Hz to 1 kHz (1 to 5) kHz	0.21 % + 12 mA 0.23 % + 15 mA 3.5 % + 24 mA	
(110 to 205) A	(45 to 100) Hz 100 Hz to 1 kHz (1 to 5) kHz	0.24 % + 42 mA 0.26 % + 49 mA 3.5 % + 58 mA	
(60 to 220) A	45 to 100) Hz 100 Hz to 1 kHz (1 to 5) kHz	0.21 % + 24 mA 0.23 % + 30 mA 3.5 % + 47 mA	Fluke 5502A with 20 turn coil
(220 to 410) A	(45 to 100) Hz 100 Hz to 1 kHz (1 to 5) kHz	0.24 % + 84 mA 0.26 % + 98 mA 3.5 % + 0.12 A	
(150 to 550) A	(45 to 100) Hz 100 Hz to 1 kHz (1 to 5) kHz	0.21 % + 59 mA 0.23 % + 74 mA 3.5 % + 0.12 A	Fluke 5502A with 50 turn coil
(550 to 1025) A	(45 to 100) Hz 100 Hz to 1 kHz (1 to 5) kHz	0.24 % + 0.21 A 0.26 % + 0.25 A 3.5 % + 0.29 A	

Parameter/Equipment	Range	CMC[2, 7] (±)	Comments
DC Power – Generate[3]	Up to 109 µW (0.109 to 1.09) mW (1.09 to 10.9) mW (10.9 to 109) mW (0.109 to 1.09) W (1.09 to 10.9) W (10.9 to 109) W (109 to 330) W (0.33 to 3) kW (3 to 11) kW (11 to 20.5) kW (3.3 to 30) kW (30 to 110) kW (110 to 205) kW (60 to 220) kW (220 to 410) kW (150 to 550) kW (550 to 1025) kW	0.36 % rdg 0.035 % rdg 0.024 % rdg 0.019 % rdg 0.023 % rdg 0.023 % rdg 0.023 % rdg 0.015 % rdg 0.06 % rdg 0.092 % rdg 0.14 % rdg 0.21 % rdg 0.22 % rdg 0.24 % rdg 0.22 % rdg 0.24 % rdg 0.22 % rdg 0.24 % rdg	Fluke 5502A Fluke 5502A with 10 turn coil Fluke 5502A with 20 turn coil Fluke 5502A with 50turn coil
AC Power – Generate (45 to 65 Hz, PF=1) [3]	Up to 10.9 µW (10.9 to 109) µW (0.109 to 1.09) mW (1.09 to 10.9) mW (10.9 to 109) mW (0.109 to 1.09) W (1.09 to 10.9) W (10.9 to 109) W (109 to 363) W (363 to 990) W (0.99 to 3.63) kW (3.63 to 11.2) kW (11.2 to 20.9) kW (9.9 to 36.3) kW (30 to 110) kW (110 to 205) kW (60 to 220.) kW (220 to 410) kW (150 to 550) kW (550 to 1025) kW	2.5 % rdg 0.26 % rdg 0.17 % rdg 0.13 % rdg 0.078 % rdg 0.078 % rdg 0.13 % rdg 0.088 % rdg 0.12 % rdg 0.10 % rdg 0.21 % rdg 0.16 % rdg 0.21% rdg 0.26% rdg 0.26% rdg 0.29% rdg 0.26% rdg 0.29% rdg 0.25% rdg 0.29% rdg	Fluke 5502A Fluke 5502A with 10 turn coil Fluke 5502A with 20 turn coil Fluke 5502A with 50turn coil

Parameter/Equipment	Range	CMC[2, 7] (±)	Comments
Electrical Calibration of Phase Indicators – Source Only[3]	(10 to 65) Hz (65 to 500) Hz 500 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (10 to 30) kHz	0.19° phase 1.1° phase 2.4° phase 7.0° phase 12° phase 18° phase	Fluke 5502A
Electrical Conductivity – Secondary Standards	Up to 13 % IACS (13 to 62) % IACS > 62 % IACS	0.07 % IACS 0.35 % rdg + 0.05 % IACS 0.3 % rdg + 0.05 % IACS	ASTM E1004 electrical conductivity by eddy current
Electrical Conductivity – Working Standards	Up to 13 % IACS (13 to 62) % IACS > 62 % IACS	0.12 % IACS 0.4 % rdg + 0.07 % IACS 0.35 % rdg + 0.11 % IACS	ASTM E1004 electrical conductivity by eddy current
Electrical Conductivity – Measuring Equipment	Up to 16 % IACS (16 to 62) % IACS > 62 % IACS	0.13 % IACS 0.4 % rdg + 0.07 % IACS 0.42 % rdg + 0.05 % IACS	ASTM E1004 electrical conductivity by eddy current

IV. Mechanical

Parameter/Equipment	Range	CMC[2, 5] (±)	Comments
Torque Wrenches[3]	(0.5 to 15) ozf·in 15 ozf·in to 2000 lbf·ft	0.082 % setting + 0.017 ozf·in 0.66 % setting	Torque arm and deadweights Torque transducers
Torque Transducers	(1.25 to 40) ozf·in (2.5 to 100) lbf·in (8.3 to 50) lbf·ft (50 to150) lbf·ft (150 to 1200) lbf·ft	0.17 % rdg + 0.0003 ozf·in 0.12 % rdg 0.11 % rdg 0.10 % rdg 0.11 % rdg	Torque wheel/arms and weights
Scales and Balances[3]	(0.5 to 380) g (380 to 1800) g (0 to 200) g (200 to 1000) g (1 to 16.2) kg (0.1 to 700) lb, ((0.045 to 318) kg)	(0.037 + 0.000 23*W*) mg (0.12 + 0.0001*W*) mg (0.69 + 0.0094*W*) mg (0.51 + 0.012*W*) mg (26 + 0.0048*W*) mg (260 + 3.5*W*) mg	Ultra Class weights, Class 1 weights Class F and 6 weights (This instance, "*W*" = weight in lbs)

Parameter/Equipment	Range	CMC[2] (±)	Comments
Indirect Verification of Rockwell Hardness Testers[3]	HRA Low Medium High HRBW Low Medium High HRC Low Medium High HREW Low Medium High HRFW Low Medium High HRHW Low High HR15N Low Medium High HR30N Low Medium High HR45N Low Medium High HR15TW Low Medium High	 0.31 HRA 0.32 HRA 0.20 HRA 0.36 HRBW 0.26 HRBW 0.39 HRBW 0.39 HRC 0.33 HRC 0.32 HRC 0.38 HREW 0.49 HREW 0.49 HREW 0.28 HRFW 0.46 HRFW 0.45 HRFW 0.42 HRHW 0.36 HRHW 0.42 HR15N 0.42 HR15N 0.51 HR15N 0.30 HR30N 0.47 HR30N 0.53 HR30N 0.50 HR45N 0.25 HR45N 0.20 HR45N 0.44 HR15TW 0.39 HR15TW 0.32 HR15TW	Indirect verification per ASTM E18

Parameter/Equipment	Range	CMC[2, 5] (±)	Comments
Indirect Verification of Rockwell Hardness Testers[3] (cont)	HR30TW Low Medium High HR45TW Low Medium High	 0.58 HR30TW 0.64 HR30TW 0.22 HR30TW 0.70 HR45TW 0.40 HR45TW 0.39 HR45TW	Indirect verification per ASTM E18
Direct Verification of Rockwell Hardness Testers[3] – Verification of Test Force Verification of Depth-Measuring Device Verification of Hysteresis	 (3 to 15) kgf (30 to 150) kgf (0 to 260) µm ---	 0.005 kgf + 0.03 % rdg 0.049 kgf + 0.02 % rdg 0.31 µm 0.25 Rockwell Points	ASTM E18 Verification of test force by load cell Per direct verification method of ASTM E18 Per direct verification method of ASTM E18
Indirect Verification of Brinell Hardness Testers at Test Condition(s)[3] – 10/3000/15 10/500/15	 Repeatability: ≤ 225 HBW (> 225 to 650) HBW Error: Repeatability: (40 to 126) HBW Error:	 0.024*D* 0.013*D* 1.5 % 0.024*D* 1.9 %	ATSM E10 *D* is the mean of the *n* mean test diameters in millimeters Error uncertainty is stated as a percentage of the standardized test block value

Parameter/Equipment	Range	CMC[2, 9] (±)	Comments
Indirect Verification of Microindentation Hardness Testers[3] (Knoop and Vickers)	Vickers: < 240 HV (240 to 600) HV > 600 HV Knoop: < 250 HK (250 to 650) HK > 650 HK	 4.3 HV 10 HV 13 HV 5.2 HK 12 HK 15 HK	ASTM E384 and E92
Pressure[3] – Absolute & Barometric Pressure Differential & Gage Pressure	 (0 to 35) in·Hg (0 to 30) in·H_2O (0 to 5) psi (5 to 15) psi (10 to 500) psi (200 to 10 000) psi	 0.0034 in·Hg 0.0029 in·H_2O 0.000 47 psi 0.0015 psi 0.002 psi + 0.018 % rdg 0.034 psi + 0.018 % rdg	 Mensor CPG system Deadweight tester
Vacuum[3] – Measure and Measuring Equipment	(0 to 28.5) in·Hg	0.0033 in·Hg	Mensor CPG system

V. Thermodynamics

Parameter/Equipment	Range	CMC[2] (±)	Comments
Thermometers[3]	(-112 °F to 32) °F (32 °F to 212) °F (212 °F to 392) °F (392 to 752) °F	0.048 °F 0.041 °F 0.047 °F 0.098 °F	PRT, Fluke 1502A

Parameter/Equipment	Range	CMC[2] (±)	Comments
Thermocouples –			
Type B	(800 to 1100) °F (1100 to 1600) °F (1600 to 2000) °F (2000 to 2200) °F (2200 to 2500) °F	1.2 °F 1.8 °F 2.2 °F 2.3 °F 3.1 °F	Type "S" platinum standard T/C above 752 °F, PRT below 752 °F, Fluke 1502A, Fluke 8846A
Type E	(-112 to -22) °F (-22 to 752) °F (752 to 1200) °F (1200 to 1832) °F	0.19 °F 0.18 °F 2.0 °F 2.2 °F	
Type J	(-112 to -22) °F (-22 to 752) °F (752 to 1200) °F (1200 to 2000) °F (2000 to 2192) °F	0.20 °F 0.21 °F 1.5 °F 2.0 °F 2.7 °F	
Type K	(-112 to -22) °F (-22 to 752) °F (752 to 1200) °F (1200 to 2000) °F (2000 to 2500) °F	0.22 °F 0.24 °F 1.5 °F 2.0 °F 3.2 °F	
Type N	(-112 to -22) °F (-22 to 752) °F (752 to 1200) °F (1200 to 2000) °F (2000 to 2372) °F	0.28 °F 0.26 °F 1.6 °F 2.1 °F 2.9 °F	
Type R	(32 to 752) °F (752 to 1200) °F (1200 to 2000) °F (2000 to 2500) °F	0.81 °F 1.6 °F 2.0 °F 3.3 °F	
Type S	(32 to 752) °F (752 to 1200) °F (1200 to 2000) °F (2000 to 2500) °F	0.81 °F 1.6 °F 2.0 °F 3.2 °F	
Type T	(-112 to -22) °F (-22 to 752) °F	0.23 °F 0.20 °F	
Type R	(32 to 752) °F (752 to 1200) °F (1200 to 2000) °F (2000 to 2500) °F	0.81 °F 1.0 °F 1.2 °F 3.2 °F	Above 752 °F, comparison with NIST ref. standard below 752 °F, PRT, Fluke 1502A, Fluke 8846A

Parameter/Equipment	Range	CMC[2, 9] (±)	Comments
Thermocouples – (cont) Type S	(32 to 752) °F (752 to 1200) °F (1200 to 2000) °F (2000 to 2500) °F	0.81 °F 1.0 °F 1.2 °F 3.2 °F	Above 752 °F, comparison with NIST ref. standard below 752 °F, PRT, Fluke 1502A, Fluke 8846A
Temperature Uniformity Survey[3, 4] (Per AMS 2750)	(-100 to 392) °F (392 to 752) °F (752 to 1200) °F (1200 to 1800) °F (1800 to 2300) °F	1.4 °F 3.1 °F 3.1 °F 3.7 °F 4.1 °F	IoTech DaqBook, with expendable and non-expendable thermocouples
Temperature Probe[3, 4] ("SAT" per AMS 2750)	(-112 to 392) °F (392 to 752) °F (752 to 1200) °F (1200 to 2000) °F (1800 to 2372) °F	0.64 °F 0.76 °F 1.8 °F 2.4 °F 3.2 °F	Fluke 726 or equivalent, expendable and non-expendable thermocouples
Infrared Thermometers[3]	(95 to 212) °F (212 to 392) °F (392 to 662) °F (662 to 932) °F	1.2 °F 1.6 °F 2.7 °F 3.7 °F	Hart 4181 black body Emissivity- 0.95
Relative Humidity[3] – Measuring Equipment	(10 to 95) % RH	0.85 % RH	EdgeTech chilled mirror hygrometer
Dewpoint[3] – Measuring Equipment	(-20 to 65) °C	0.14 °C	EdgeTech chilled mirror hygrometer

VI. Time & Frequency

Parameter/Equipment	Range	CMC[2, 9] (±)	Comments
Frequency – Measure	(1 to 40) Hz 40 Hz to 10 MHz	0.06 % rdg 0.012 % rdg	HP3458A
Frequency – Measuring Equipment[3]	Up to 120 Hz (0.12 to 1.2) kHz (1.2 to 12) kHz (12 to 120) kHz (0.12 to 1.2) MHz (1.2 to 2) MHz	28 µHz/Hz + 0.0016 Hz 25 µHz/Hz + 0.0077 Hz 25 µHz/Hz + 0.071 Hz 29 µHz/Hz + 18 Hz 29 µHz/Hz + 20 Hz 0.020 % rdg	Fluke 5502A
Timers, Stopwatches[3]	15 s to 10 min 10 min to 24 hrs (2 to 24) hrs	0.038 s + 0.0025 % of timed interval 0.038 s + 0.0041 % of timed interval 0.038 s	Reference stopwatch WWV signal

[1] This laboratory offers commercial dimensional testing, calibration, 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. 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] The CMC is stated for calibrations performed in the field only.

[5] In the statement of the CMC, L is the numerical value of the nominal length of the device measured in

inches. In the statement of best uncertainty, *D* is the numerical value of the nominal diameter of the device measured in inches; *W* is numerical value of the nominal applied mass in grams; and, *R* is the resolution of the device under test.

[6] This laboratory meets *R205 – Specific Requirements: Calibration Laboratory Accreditation Program* for the types of dimensional tests listed above and is considered equivalent to that of a calibration.

[7] 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 are expressed as either a specific value that covers the full range or as a fraction or percentage of the reading plus a fixed floor specification.

[8] This scope meets A2LA's *P112 Flexible Scope Policy*.

[9] 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

JOHNSON GAGE AND INSPECTION

Wichita, KS

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 27th day of March 2023.

Mr. Trace McIntruff, Vice President, Accreditation Services
For the Accreditation Council
Certificate Number 2820.01
Valid to March 31, 2025
Revised March 4, 2024

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