



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

JOHNSON GAGE AND INSPECTION
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CALIBRATION

Valid To: March 31, 2023

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 4 in	$(39 + 2.2D) \mu\text{in}$	Ring gages
2 Point	Up to 12 in	$(35 + 2.3D) \mu\text{in}$	Gage blocks
Countersink & Chamfer Gages ³	Up to 3.5 in	$(230 + 10D) \mu\text{in}$	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	$(14 + 4.9L) \mu\text{in}$	Step gage
	Up to 127 in	$(7.9 + 3.8L) \mu\text{in}$	Gage blocks
	Up to 240 in	$(6.1 + 1.2L) \mu\text{in}$	Laser system

Parameter/Equipment	Range	CMC ^{2,5} (±)	Comments
Coordinate Measuring Machines (CMM) ³ – (cont)			ASME B89.4.10360.2 Section 6.1.1
Repeatability (R ₀)	(10 to 50) mm	27 μin	Sphere
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	N/A	55 μin	Sphere
Single Point Articulation Test	N/A	90 μin	Trihedral socket
Volumetric Perf Test	Up to 144" radius	(170 + 0.2L) 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 60 ft	(83 + 1.6L) μin	Laser per ASME B5.54 Sec. 7.3
Volumetric Performance (By Body Diagonals)			
Bi-Directional System Deviation	Up to 60 ft	85 μin	Laser per ASME B5.54 Sec. 7.7
Reversal Deviation	Up to 60 ft	90 μin	Laser per ASME B5.54 Sec. 7.7
Bi-Directional Repeatability	Up to 60 ft	80 μin	Laser per ASME B5.54 Sec. 7.3

Parameter/Equipment	Range	CMC ^{2,5} (\pm)	Comments
Gage Blocks	Up to 0.1 in (0.1 to 4) in (4 to 20) in	4 μ in (2 + 1.4 <i>L</i>) μ in (4.9 + 1.4 <i>L</i>) μ in	Master gage blocks & amplifier
Micrometers ³ –			
Linearity	Up to 42 in	(38 + 2.7 <i>L</i>) μ in	Gage blocks
Parallelism	Up to 42 in	(31 + 0.25 <i>L</i>) μ in	
Micrometer Standards & Length Artifacts	Up to 41 in	(12 + 2.4 <i>L</i>) μ in	Universal LMS
Depth Micrometers & Gages ³	Up to 12 in	(30 + 2.3 <i>L</i>) μ in	Gage blocks
Thread Micrometers	Up to 6 in	(74 + 12 <i>L</i>) μ in	Thread plugs
Calipers ³ –			
Digital	Up to 72 in	(300 + 1.7 <i>L</i>) μ in	Gage blocks and ring gages
Dial and Vernier	Up to 72 in	(600 + 1.9 <i>L</i>) μ in	
Indicators, Dial and Digital ³ (For Dial, Res. = 0.2 Least Grad.)	Up to 1 in (1 to 4) in	6.5 μ in + 0.6 <i>R</i> (3.3 + 3 <i>L</i>) μ in + 0.6 <i>R</i>	Gage blocks
Height Gages ³	Up to 40 in	(12 + 1.3 <i>L</i>) μ in	Gage blocks

Parameter/Equipment	Range	CMC ^{2,5} (\pm)	Comments
Plug / Pin Gages & Outside Cylindrical Diameter	Up to 1 in (1 to 10) in	$(4.5 + 0.8L) \mu\text{in}$ $(14 + 1.1L) \mu\text{in}$	Laser scan micrometer P&W Supermicrometer TM , gage blocks
Plain Rings & Inside Cylindrical Diameter	(0.04 to 11) in	$(4.5 + 0.92D) \mu\text{in}$	Internal Supermicrometer TM , master gage blocks
Straight Threaded Plug Gages – Pitch Diameter (TPI 4.5 to 96) Major Diameter	Up to 6 in Up to 5 in	$(70 + 6.4D) \mu\text{in}$ $(24 + 1D) \mu\text{in}$	3 wire method P&W Supermicrometer TM , gage blocks
Tapered Threaded Plug Gages – Pitch Diameter (TPI 4.5 to 96) Major Diameter	Up to 4 in Up to 4.5 in	92 μin 31 μin	3-wire method, tapered sine block P&W Supermicrometer TM , gage blocks
Adjustable Threaded Ring Gages	(0.05 to 2) in diameter	$(87 + 10D) \mu\text{in}$	Setting plugs

Parameter/Equipment	Range	CMC ^{2,5} (±)	Comments
Steel Rules ³ – Length Graduations	Up to 72 in ----	(590 + 1.6L) μin (670 + 16L) μin	Gage blocks Glass scale
Surface Plates ³ – Flatness Repeat Reading	Up to 300 in diagonal ----	(8.7 + 1.2L) μin (6.8 + 0.017L) μin	LDDM Repeat reading gage
Optical Comparators ³ – Linearity Angle Magnification Accuracy	12 in travel ±180° 5X to 100X	(13 + 4.4L) μin 40 arc seconds 0.013 % of magnification	Glass scale
Measuring Tapes – Length Graduations	Up to 330 ft ----	(0.0073 + 0.000 0069L) in 0.0013 in	Test frame Glass scale
Wire Crimpers – Cylindrical Crimping Chamber Shaped Crimping Chamber Crimp Height	(0.011 to 0.250) in Up to 1 in Up to 1 in	590 μin 280 μin 190 μin	Pin gages Optical comparator Crimp height micrometer

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	(16 to 132) µin	(1.2 + 0.014Ra) µin	Comparison with surface roughness masters
Radius Standard	(0.01 to 3) in	(190 + 62L) µin	Optical comparator
Bench Micrometer – Linearity Anvil Parallelism Force Error ID Functionality	Up to 1 in N/A (2 to 40) ozf N/A	(2.1 + 1.3L) µin 1.4 µin 0.13 ozf 11 µin	Gage blocks Ball test Load cell 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	14 µin	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 Testing¹

Parameter/Equipment	Range	CMC ^{2,5} (\pm)	Comments
Length, 1D ⁶	Up to 10 in	$(27 + 1.2L) \mu\text{in}$	Supermicrometer TM
	Up to 56 in	$(590 + 2.1L) \mu\text{in}$	CMM
	Up to 8.5 in	$(410 + 96L) \mu\text{in}$	Optical comparator
	Up to 60 ft	$(83 + 1.6L) \mu\text{in}$	Laser
Length, 2D ⁶	Up to 8" X 3"	$(370 + 120L) \mu\text{in}$	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} (\pm)	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	8 $\mu\text{V/V} + 0.62 \mu\text{V}$ 6 $\mu\text{V/V} + 0.44 \mu\text{V}$ 5.3 $\mu\text{V/V} + 1.2 \mu\text{V}$ 7.8 $\mu\text{V/V} + 33 \mu\text{V}$ 8.7 $\mu\text{V/V} + 110 \mu\text{V}$	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	8 $\mu\text{V/V} + 0.62 \mu\text{V}$ 6 $\mu\text{V/V} + 0.44 \mu\text{V}$ 5.3 $\mu\text{V/V} + 1.2 \mu\text{V}$ 7.8 $\mu\text{V/V} + 36 \mu\text{V}$ 8.7 $\mu\text{V/V} + 160 \mu\text{V}$	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	35 μA/A + 0.047 nA 25 μA/A + 0.047 nA 26 μA/A + 0.12 nA 23 μA/A + 0.17 nA 24 μA/A + 6.8 nA 24 μA/A + 58 nA 41 μA/A + 0.58 μA 130 μA/A + 12 μA 9.6 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 + 0.048 nA 25 μA/A + 0.047 nA 26 μA/A + 0.12 nA 23 μA/A + 0.17 nA 24 μA/A + 5.8 nA 24 μA/A + 58 nA 41 μA/A + 0.58 μA 130 μA/A + 12 μA 3.6 μA/A + 68 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 and 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 + 5.8 mΩ 12 μΩ/Ω + 58 mΩ 17 μΩ/Ω + 2.7 Ω 58 μΩ/Ω + 120 Ω 0.058 % rdg + 1.2 kΩ 0.58 % rdg + 12 kΩ	HP34420A, HP3458A
Capacitance – Measuring Equipment	(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 E	(-454 to 300) °F (300 to 1100) °F (1100 to 1832) °F	0.12 °F 0.09 °F 0.092 °F	Fluke 5502A or HP 3245A, monitored by HP 3458A
Type J	(-346 to 500) °F (500 to 1350) °F (1350 to 2192) °F	0.14 °F 0.11 °F 0.11 °F	
Type K	(-454 to -400) °F (-400 to 500) °F (500 to 1500) °F (1500 to 2500) °F	0.77 °F 0.19 °F 0.12 °F 0.13 °F	

Parameter/Equipment	Range	CMC ^{2,7} (±)	Comments
Electrical Calibration of Thermocouple Indicators & Simulators ³ – (cont)			
Type N	(-454 to -400) °F (-400 to -150) °F (-150 to 700) °F (700 to 1500) °F (1500 to 2372) °F	1.5 °F 0.24 °F 0.14 °F 0.12 °F 0.13 °F	Fluke 5502A or HP 3245A, monitored by HP 3458A
Type R	(-58 to 32) °F (32 to 1100) °F (1100 to 2200) °F (2200 to 3214) °F	0.26 °F 0.19 °F 0.16 °F 0.17 °F	
Type S	(-58 to 32) °F (32 to 1100) °F (1100 to 2200) °F (2200 to 3214) °F	0.22 °F 0.18 °F 0.17 °F 0.17 °F	
Type T	(-454 to -400) °F (-400 to 200) °F (200 to 752) °F	0.41 °F 0.18 °F 0.11 °F	
Electrical Calibration of RTD Indicators & Simulators ³ –			
Pt 385, 100 Ω	(-320 to 32) °F (32 to 400) °F (400 to 800) °F (800 to 1200) °F (1200 to 1562) °F	0.013 °F 0.016 °F 0.021 °F 0.027 °F 0.034 °F	HP 3458A
Pt 385, 1000 Ω	(-320 to 32) °F (32 to 400) °F (400 to 800) °F (800 to 1200) °F (1200 to 1562) °F	0.009 °F 0.016 °F 0.020 °F 0.027 °F 0.033 °F	

Parameter/Range	Frequency	CMC ^{2,7} (\pm)	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	0.031 % + 4.4 μ V 0.016 % + 3 μ V 0.024 % + 3.2 μ V 0.084 % + 5.6 μ V 0.50 % + 9.8 μ V 4.6 % + 4.2 μ V 4.5 % + 18 μ V 8.1 % + 8.5 μ V 23 % + 20 μ V	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 μ V/V + 5.4 μ V 81 μ V/V + 3.5 μ V 0.015 % + 3.8 μ V 0.033 % + 4.7 μ V 0.089 % + 6.2 μ V 0.35 % + 12 μ V 1.2 % + 12 μ V 1.7 % + 48 μ V 4.6 % + 110 μ V 4.6 % + 120 μ V 17 % + 440 μ V	
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 μ V/V + 47 μ V 80 μ V/V + 24 μ V 0.016 % + 26 μ V 0.035 % + 24 μ V 0.092 % + 28 μ V 0.35 % + 120 μ V 1.2 % + 120 μ V 1.7 % + 450 μ V 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	85 μ V/V + 0.46 mV 82 μ V/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	85 μV/V + 0.46 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 0.041 % + 2.4 mV 0.14 % + 2.4 mV 0.46 % + 12 mV 1.7 % + 18 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 and 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	0.012 % + 0.55 mA 0.017 % + 0.44 mA 0.017 % + 0.71 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	0.049 % + 0.92 mA 0.050 % 0.095 %	

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	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 0.091 % rdg 0.14 % rdg	Fluke 5502A
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	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	Fluke 5502A

Parameter/Range	Frequency	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

Parameter/Equipment	Range	CMC ^{2,9} (±)	Comments
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) in·ozf	0.08 % setting + 0.018 in·ozf	Torque arm and deadweights
	15 in·ozf to 2000 ft·lbf	0.65 % setting	Torque transducers
Torque Transducers	(1.25 to 40) in·ozf (2.5 to 100) in·lbf (8.3 to 150) ft·lbf (150 to 1200) ft·lbf	0.09 % rdg + 0.0006 in·ozf 0.062 % rdg 0.042 % rdg 0.029 % rdg	Torque wheel/arms and weights
Scales and Balances ³	(0.5 to 380) g (380 to 1800) g	(0.05 + 0.000 05 <i>W</i>) mg (0.12 + 0.000 16 <i>W</i>) mg	Ultra Class weights, Class 1 weights
	(0 to 200) g (200 to 1000) g (1 to 16.2) kg	(0.8 + 0.0088 <i>W</i>) mg (2.4 + 0.011 <i>W</i>) mg (26 + 0.0048 <i>W</i>) mg	Class F and 6 weights
	(0.1 to 700) lb, (0.045 to 318) kg)	(11 + 8.3 <i>W</i>) mg (This instance, “ <i>W</i> ” = weight in lbs)	

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

Parameter/Equipment	Range	CMC ^{2,5} (\pm)	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) μ m N/A	 0.005 kgf + 0.03 % rdg 0.042 kgf + 0.02 % rdg 0.31 μ m 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: \leq 225 HBW ($>$ 225 to 650) HBW Error: Repeatability: (40 to 126) HBW Error	0.024D 0.013D 1.5 % 0.024D 1.9 %	ATSM E10 <i>D</i> is the mean of the <i>n</i> mean test diameters in millimeters Error uncertainty is stated as a percentage of the standardized test block value

Parameter/Equipment	Range	CMC ² (±)	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 – Measure and Measuring Equipment			
Absolute & Barometric Pressure	(0 to 16) psia	0.0095 psia	16PSIAXP2i
Differential & Gage Pressure	(-150 to +150) in H ₂ O	0.038 in H ₂ O	Additel 681
	(0 to 30) psi	0.0074 psi + 0.1 % rdg	30PSIXP2i
	(10 to 500) psi	0.0024 psi + 0.011 % rdg	Deadweight tester
	(200 to 10 000) psi	0.043 psi + 0.011 % rdg	
Vacuum ³ – Measure and Measuring Equipment	(0 to 28.5) in Hg	0.018 in Hg	16PSIAXP2i

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 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 "S" platinum standard T/C above 752 °F, PRT below 752 °F, Fluke 1502A, Fluke 8846A	
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
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		

Parameter/Equipment	Range	CMC ^{2,9} (±)	Comments
Temperature Uniformity Survey ^{3, 4} (per AMS 2750)	(-112 to 392) °F (392 to 752) °F (752 to 1200) °F (1200 to 1800) °F (1800 to 2372) °F	1.3 °F 1.5 °F 2.1 °F 3.2 °F 4.6 °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	0.62 °F 0.64 °F 1.7 °F 2.4 °F 3.5 °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 70) % RH (70 to 95) % RH	0.6 % RH 0.7 % RH	EdgeTech chilled mirror hygrometer
Dewpoint ³ – Measuring Equipment	(-20 to 65) °C	0.17 °C	EdgeTech chilled mirror hygrometer

VI. Time & Frequency

Parameter/Equipment	Range	CMC ^{2,9} (±)	Comments
Frequency – Measure	(1 to 40) Hz	0.06 % rdg	HP3458A
	40 Hz to 10 MHz	0.012 % rdg	

Parameter/Equipment	Range	CMC ^{2,9} (\pm)	Comments
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	13 μ Hz/Hz + 0.006 Hz 9.5 μ Hz/Hz + 0.058 Hz 9.1 μ Hz/Hz + 0.58 Hz 28 μ Hz/Hz + 19 Hz 16 μ Hz/Hz + 60 Hz 0.013 % rdg + 730 Hz	Fluke 5502A
Timers, Stopwatches ³	15 s to 10 min	0.038 s + 0.0025 % of timed interval	Reference stopwatch
	10 min to 24 hrs	0.038 s + 0.0041 % of timed interval	
	(2 to 24) hrs	0.038 s	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/NC SL 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 6th day of April 2021.

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

Vice President, Accreditation Services
For the Accreditation Council
Certificate Number 2820.01
Valid to March 31, 2023

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