



SCOPE OF ACCREDITATION TO ISO/IEC 17025:2005  
& ANSI/NCSL Z540-1-1994

JOHNSON GAGE AND INSPECTION  
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CALIBRATION

Valid To: March 31, 2019

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<sup>1</sup>:

I. Dimensional

Parameter/Equipment	Range	CMC <sup>2,5</sup> (±)	Comments
Bore Gages & ID Measuring Tools <sup>3</sup> – 3 Point 2 Point	Up to 4 in Up to 12 in	(36 + 2.3D) μin (35 + 2.3D) μin	Ring gages Gage blocks
Countersink & Chamfer Gages <sup>3</sup>	Up to 3.5 in	450 μin	Modified ring gages
Coordinate Measuring Machines (CMM) <sup>3</sup> - Length Measurement Error (E <sub>L</sub> )	Up to 27 in Up to 127 in Up to 240 in	(14 + 4.9L) μin (7.9 + 3.8L) μin (6.2 + 1.2L) μin	ASME B89.4.10360.2 Section 6.3.3 Step gage Gage blocks Laser system

Parameter/Equipment	Range	CMC <sup>2,5</sup> (±)	Comments
Coordinate Measuring Machines (CMM) <sup>3</sup> - (cont)			ASME B89.4.10360.2 Section 6.1.1
Repeatability (R <sub>0</sub> )	(10 to 50) mm	27 μin	Sphere
Spherical CMM (Laser Tracker)			
Length Measurement System Tests	90.5 in	460 μin	Reference length bar
Ranging Tests: IFM Tests IFM Bar	Up to 2.3 m	(0.71 + 0.65L) μin	Reference length bar
Laser	Up to 40 in	0.43 ppm	Reference laser interferometer
ADM Tests	Up to 200 ft (400 ft Dia)	1.2 ppm	Characterized interferometer
Laser Interferometer Length Dependent Error	Up to 40 in	0.43 ppm	ASME B89.1.8 Sec 4 XD1 reference laser
Articulated Arm CMM			
Effective Dia Perf Test	N/A	55 μin	Sphere
Single Point Articulation Test	N/A	90 μin	Trihedral socket
Volumetric Perf Test	Up to 108" radius	(170 + 0.18L) μin	Gage block ref. length



Parameter/Equipment	Range	CMC <sup>2,5</sup> ( $\pm$ )	Comments
CNC, Machine Tools <sup>3</sup> – Repeatability @ 2 Sigma	---	18 $\mu$ in	Laser per ASME B5.54 Sec. 7.3
Linear Displacement Accuracy	Up to 60 ft	(87 + 0.34L) $\mu$ in	Laser per ASME B5.54 Sec. 7.3
Volumetric Performance (By Body Diagonals)			
Bi-Directional System Deviation	Up to 60 ft	85 $\mu$ in	Laser per ASME B5.54 Sec. 7.7
Reversal Deviation	Up to 60 ft	90 $\mu$ in	Laser per ASME B5.54 Sec. 7.7
Bi-Directional Repeatability	Up to 60 ft	80 $\mu$ in	Laser per ASME B5.54 Sec. 7.3
Gage Blocks	Up to 0.1 in (0.1 to 4) in (4 to 20) in	4 $\mu$ in (1.9 + 1.4L) $\mu$ in (6.3 + 1.2L) $\mu$ in	Master gage blocks & amplifier
Micrometers <sup>3</sup>	Up to 42 in	(39 + 2.7L) $\mu$ in	Gage blocks
Micrometer Standards & Length Artifacts	Up to 41 in	(12 + 2.4L) $\mu$ in	Universal LMS
Depth Micrometers & Gages <sup>3</sup>	Up to 9 in	(31 + 1.8L) $\mu$ in	Gage blocks
Thread Micrometers	Up to 4.125	(66 + 6L) $\mu$ in	Thread plugs
Calipers <sup>3</sup> –			
Digital	Up to 72 in	(300 + 1.7L) $\mu$ in	Gage blocks and ring gages
Dial and Vernier	Up to 72 in	(600 + 1.9L) $\mu$ in	

Parameter/Equipment	Range	CMC <sup>2,5</sup> (±)	Comments
Indicators, Dial and Digital <sup>3</sup> (For Dial, Res. = 0.2 Least Grad.)	Up to 1 in (1 to 4) in	(6.3 + 0.6R) μin (3.3 + 3L + 0.6R) μin	Gage blocks
Height Gages <sup>3</sup>	Up to 40 in	(12 + 1.3L) μin	Gage blocks
Plug / Pin Gages & outside Cylindrical Diameter	Up to 1 in (1 to 10) in	(6.8 + 2.1L) μin (5.2 + 1.7L) μin	Laser scan micrometer P&W Supermicrometer™, gage blocks
Plain Rings & inside Cylindrical Diameter	(0.04 to 11) in	(3.1 + 1.1D) μin	Internal Supermicrometer™, master gage blocks
Straight Threaded Plug Gages – Pitch Diameter Major Diameter	Up to 6 in Up to 5 in	(29 + 1.8D) μin (12 + 1.7D) μin	3 wire method P&W Supermicrometer™, gage blocks
Tapered Threaded Plug Gages – Pitch Diameter Major Diameter	Up to 4 in Up to 4.5 in	95 μin 27 μin	3-wire method, tapered sine block P&W Supermicrometer™, gage blocks

Parameter/Equipment	Range	CMC <sup>2,5</sup> (±)	Comments
Adjustable Threaded Ring Gages	(0.05 to 2) in diameter	(51 + 9D) μin	Setting plugs
Steel Rules <sup>3</sup> – Length Graduations	Up to 72 in ----	(600 + 1.5L) μin (830 + 19L) μin	Gage blocks Glass scale
Surface Plates <sup>3</sup> – Flatness Repeat Reading	Up to 300 in diagonal ----	(8.7 + 1.2L) μin (6.8 + 0.017L) μin	LDDM Repeat reading gage
Optical Comparators <sup>3</sup> – Linearity Angle Magnification Accuracy	12 in travel ±180° 5X to 50X	(56 + 11L) μin 38 arc seconds 0.014 % of magnification	Glass scale, plain plug gages
Measuring Tapes – Length Graduations	Up to 330 ft ----	(0.0061 + 0.0000048L) in 0.0013 in	Test frame Glass scale
Wire Crimpers Cylindrical Crimping Chamber (Wire Crimpers, cont) 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 <sup>2,5</sup> (±)	Comments
Profilometers, Ra	20 μin 120 μin	1.5 μin 2.8 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	(200 + 90L) μin	Optical Comparator

## II. Dimensional Testing<sup>1</sup>

Parameter/Equipment	Range	CMC <sup>2,5</sup> (±)	Comments
Length, 1D <sup>6</sup>	Up to 10 in	(27 + 1.2L) μin	Supermicrometer™
	Up to 56 in	(580 + 4.6L) μin	CMM
	Up to 8.5 in	(90 + 170L) μin	Optical comparator
	Up to 60 ft	(86 + 0.85L) μin	Laser
Length, 2D <sup>6</sup>	Up to 8" X 3"	(310 + 94L) μin	Optical Comparator
Length, 3D <sup>6</sup>	Up to 47" X 32" X 24"	(22 + 16L) μin	CMM



III. Electrical - DC/Low Frequency

Parameter/Equipment	Range	CMC <sup>2,7</sup> ( $\pm$ )	Comments
DC Voltage – Measure <sup>3</sup>	Up to 100 mV (0.1 to 1) V (1 to 10) V (10 to 100) V (100 to 1000) V	4.5 $\mu$ V/V + 0.62 $\mu$ V 4.7 $\mu$ V/V + 0.5 $\mu$ V 4.6 $\mu$ V/V + 1.1 $\mu$ V 7 $\mu$ V/V + 36 $\mu$ V 7.1 $\mu$ V/V + 160 $\mu$ V	HP 3458A
DC Voltage – Generate <sup>3</sup>	Up to 100 mV (0.1 to 1) V (1 to 10) V (10 to 100) V (100 to 1000) V	4.5 $\mu$ V/V + 0.62 $\mu$ V 4.7 $\mu$ V/V + 0.5 $\mu$ V 4.6 $\mu$ V/V + 1.1 $\mu$ V 7 $\mu$ V/V + 36 $\mu$ V 7.1 $\mu$ V/V + 160 $\mu$ V	HP 3458A, Wavetek 9100
DC Current – Measure <sup>3</sup>	Up to 100 nA 100 nA to 1 $\mu$ A (1 to 10) $\mu$ A (10 to 100) $\mu$ A (0.1 to 1) mA (1 to 10) mA (10 to 100) mA 100 mA to 1 A  (1 to 20) A	34 $\mu$ A/A + 0.048 nA 22 $\mu$ A/A + 0.049 nA 22 $\mu$ A/A + 0.14 nA 22 $\mu$ A/A + 0.22 nA 23 $\mu$ A/A + 5.9 nA 23 $\mu$ A/A + 61 nA 40 $\mu$ A/A + 0.63 $\mu$ A 130 $\mu$ A/A + 12 $\mu$ A  61 $\mu$ A/A	HP 3458A        EL 7520 current shunt
DC Current – Generate <sup>3</sup>	Up to 100 nA 100 nA to 1 $\mu$ A (1 to 10) $\mu$ A (10 to 100) $\mu$ A (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 1000) A	34 $\mu$ A/A + 0.048 nA 22 $\mu$ A/A + 0.049 nA 22 $\mu$ A/A + 0.14 nA 22 $\mu$ A/A + 0.22 nA 23 $\mu$ A/A + 5.9 nA 23 $\mu$ A/A + 61 nA 40 $\mu$ A/A + 0.63 $\mu$ A 130 $\mu$ A/A + 12 $\mu$ A  61 $\mu$ A/A  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 0.23 % rdg + 32 mA	HP 3458A with Fluke 5502A       With EL 7520 current shunt  Fluke 5502A, 10 turn coil  Fluke 5502A, 50 turn coil



Parameter/Equipment	Range	CMC <sup>2,7</sup> ( $\pm$ )	Comments
Resistance – Generate and Measure <sup>3</sup>	(0 to 1) $\Omega$ (1 to 10) $\Omega$ (10 to 100) $\Omega$ 100 $\Omega$ to 1 k $\Omega$ (1 to 10) k $\Omega$ (10 to 100) k $\Omega$ 100 k $\Omega$ to 1 M $\Omega$ (1 to 10) M $\Omega$ (10 to 100) M $\Omega$ 100 M $\Omega$ to 1 G $\Omega$	81 $\mu\Omega/\Omega$ + 2.9 $\mu\Omega$ 17 $\mu\Omega/\Omega$ + 62 $\mu\Omega$ 14 $\mu\Omega/\Omega$ + 0.58 m $\Omega$ 12 $\mu\Omega/\Omega$ + .59 m $\Omega$ 12 $\mu\Omega/\Omega$ + 5.8 m $\Omega$ 12 $\mu\Omega/\Omega$ + 58 m $\Omega$ 18 $\mu\Omega/\Omega$ + 2.3 $\Omega$ 59 $\mu\Omega/\Omega$ + 120 $\Omega$ 0.058 % rdg + 1.2 k $\Omega$ 0.58 % rdg + 12 k $\Omega$	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) $\mu$ F (1.1 to 3.3) $\mu$ F (3.3 to 11) $\mu$ F (11 to 33) $\mu$ F (33 to 110) $\mu$ F (110 to 330) $\mu$ F (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 $\mu$ F 0.52 % rdg + 3.5 $\mu$ F 0.52 % rdg + 13 $\mu$ F 0.87 % rdg + 35 $\mu$ F 1.3 % rdg + 120 $\mu$ F	Fluke 5502A
Electrical Calibration of Thermocouple Indicators & Simulators <sup>3</sup> –			
Type E	-454 $^{\circ}$ F to 300 $^{\circ}$ F 300 $^{\circ}$ F to 1100 $^{\circ}$ F 1100 $^{\circ}$ F to 1832 $^{\circ}$ F	0.09 $^{\circ}$ F 0.09 $^{\circ}$ F 0.091 $^{\circ}$ F	HP 3458A, HP 34420A, Fluke 8842A, with HP 3245A
Type J	-346 $^{\circ}$ F to 500 $^{\circ}$ F 500 $^{\circ}$ F to 1350 $^{\circ}$ F 1350 $^{\circ}$ F to 2192 $^{\circ}$ F	0.14 $^{\circ}$ F 0.11 $^{\circ}$ F 0.11 $^{\circ}$ F	
Type K	-454 $^{\circ}$ F to -400 $^{\circ}$ F -400 $^{\circ}$ F to 500 $^{\circ}$ F 500 $^{\circ}$ F to 1500 $^{\circ}$ F 1500 $^{\circ}$ F to 2500 $^{\circ}$ F	0.78 $^{\circ}$ F 0.19 $^{\circ}$ F 0.12 $^{\circ}$ F 0.13 $^{\circ}$ F	



Parameter/Equipment	Range	CMC <sup>2,7</sup> (±)	Comments
Electrical Calibration of Thermocouple Indicators & Simulators <sup>3</sup> – (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	HP 3458A, HP 34420A, Fluke 8842A, with HP 3245A
Type R	(-58 to 32) °F (32 to 1100) °F (1100 to 2200) °F (2200 to 3214) °F	0.27 °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	0.23 °F 0.18 °F 0.17 °F 0.17 °F	
Type T	(-454 to -400) °F (-400 to 200) °F (200 to 752) °F	0.42 °F 0.18 °F 0.11 °F	
Electrical Calibration of RTD Indicators & Simulators <sup>3</sup> –			
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 <sup>2,7</sup> ( $\pm$ )	Comments
AC Voltage – Measure <sup>3</sup>			
(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	0.035 % + 3.6 $\mu$ V 0.023 % + 1.4 $\mu$ V 0.033 % + 1.6 $\mu$ V 0.11 % + 1.9 $\mu$ V 0.57 % + 2.1 $\mu$ V 4.6 % + 4.2 $\mu$ V 4.6 % + 7.8 $\mu$ V 8.1 % + 8.7 $\mu$ V 23 % + 20 $\mu$ 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 $\mu$ V/V + 4.7 $\mu$ V 84 $\mu$ V/V + 2.4 $\mu$ V 0.016 % + 2.8 $\mu$ V 0.035 % + 2.5 $\mu$ V 0.093 % + 2.5 $\mu$ V 0.35 % + 12 $\mu$ V 1.2 % + 12 $\mu$ V 1.7 % + 48 $\mu$ V 4.6 % + 110 $\mu$ V 4.6 % + 120 $\mu$ V 17 % + 450 $\mu$ 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 $\mu$ V/V + 47 $\mu$ V 82 $\mu$ V/V + 24 $\mu$ V 0.016 % + 26 $\mu$ V 0.035 % + 24 $\mu$ V 0.092 % + 28 $\mu$ V 0.35 % + 120 $\mu$ V 1.2 % + 120 $\mu$ V 1.7 % + 470 $\mu$ V 4.6 % + 1.1 mV 4.6 % + 1.2 mV 17 % + 4.5 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 $\mu$ V/V + 0.47 mV 82 $\mu$ 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 % + 4.5 mV 4.6 % + 11 mV 4.6 % + 12 mV 17 % + 44 mV	

Parameter/Range	Frequency	CMC <sup>2,7</sup> ( $\pm$ )	Comments
AC Voltage – Measure <sup>3</sup> – (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 0.069 % + 27 mV 0.14 % + 24 mV 0.35 % + 24 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 $\mu$ V 0.022 % + 1.5 $\mu$ V 0.033 % + 1.7 $\mu$ V 0.11 % + 1.9 $\mu$ V 0.57 % + 2.1 $\mu$ V 4.6% + 4.2 $\mu$ V 4.6% + 7.8 $\mu$ V	HP 3458A, Fluke 5502A
(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 $\mu$ V/V + 4.7 $\mu$ V 83 $\mu$ V/V + 2.5 $\mu$ V 0.016 % + 2.8 $\mu$ V 0.035 % + 2.5 $\mu$ V 0.092 % + 3.0 $\mu$ V 0.35 % + 12 $\mu$ V 1.2 % + 12 $\mu$ 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	82 $\mu$ V/V + 47 $\mu$ V 82 $\mu$ V/V + 24 $\mu$ V 0.016 % + 26 $\mu$ V 0.035 % + 24 $\mu$ V 0.092 % + 28 $\mu$ V 0.35 % + 120 $\mu$ V 1.2 % + 120 $\mu$ V	

Parameter/Range	Frequency	CMC <sup>2,7</sup> (±)	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 % + 0.23 mV 0.092 % + 0.28 mV 0.35 % + 1.2 mV 1.2 % + 1.2 mV	HP 3458A, Fluke 5502A
(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 0.023 % + 2.5 mV 0.04 % + 2.8 mV 0.14 % + 2.4 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 0.069% + 25 mV 0.14 % + 24 mV 0.35 % + 24 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 0.069 % + 27 mV	



Parameter/Range	Frequency	CMC <sup>2, 7</sup> (±)	Comments
AC Current – Generate and Measure <sup>3</sup>			
Up to 100 µA	(10 to 20) Hz (20 to 45) Hz 45 Hz to 5 kHz	0.42 % + 0.077 µA 0.16 % + 0.051 µA 0.063 % + 0.042 µA	HP 3458A with HP 3245A or 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 % + 0.26 µA 0.17 % + 0.27 µA 0.07 % + 0.24 µA 0.035 % + 0.24 µA 0.07 % + 0.24 µA 0.46 % + 0.49 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 % + 2.6 µA 0.17 % + 2.7 µA 0.07 % + 2.4 µA 0.035 % + 2.4 µA 0.07 % + 2.4 µA 0.46 % + 4.9 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 % + 26 µA 0.17 % + 27 µA 0.07 % + 24 µA 0.035 % + 24 µA 0.07 % + 24 µA 0.46 % + 49 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 % + 0.26 mA 0.19 % + 0.24 mA 0.093 % + 0.24 mA 0.12 % + 0.24 mA 0.35 % + 0.24 mA 1.2 % + 0.47 mA	HP 3458A with Fluke 5502A and current shunt
(1 to 10) A	(1 to 50) Hz 40 Hz to 1 kHz (1 to 5) kHz	0.016 % + 0.51 mA 91 µA/A + 0.49 mA 0.017 % + 0.51 mA	
(10 to 20) A	(1 to 50) Hz 40 Hz to 1 kHz (1 to 5) kHz	0.016 % + 4.1 mA 91 µA/A + 2.3 mA 0.017 % + 2.4 mA	

Parameter/Range	Frequency	CMC <sup>2,7</sup> ( $\pm$ )	Comments
AC Current – Generate <sup>3</sup>			
(29 to 330) $\mu$ A	(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 % + 0.12 $\mu$ A 0.17 % + 0.13 $\mu$ A 0.14 % + 0.13 $\mu$ A 0.35 % + 0.18 $\mu$ A 0.92 % + 0.25 $\mu$ A 1.8 % + -.62 $\mu$ A	Fluke 5502A
330 $\mu$ A 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 % + 0.21 $\mu$ A 0.14 % + 0.32 $\mu$ A 0.12 % + 0.18 $\mu$ A 0.23 % + 0.27 $\mu$ A 0.58 % + 0.35 $\mu$ A 1.2 % + 0.7 $\mu$ A	
(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 $\mu$ A 0.1 % + 3.7 $\mu$ A 0.046 % + 2.4 $\mu$ A 0.092 % + 2.5 $\mu$ A 0.23 % + 3.8 $\mu$ A 0.46 % + 5.3 $\mu$ A	
(323 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 % + 24 $\mu$ A 0.1 % + 37 $\mu$ A 0.046 % + 24 $\mu$ A 0.12 % + 58 $\mu$ A 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 <sup>2,7</sup> (±)	Comments
AC Current – Generate <sup>3</sup>			
(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 0.25 % + 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 <sup>2</sup> (±)	Comments
DC Power – Generate	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 (.33 to 3) kW (3 to 11) kW (11 to 20.5) kW	0.36 % rdg 0.035 % rdg 0.023 % rdg 0.019 % rdg 0.023 % rdg 0.023 % rdg 0.023 % rdg 0.023 % rdg 0.015 % rdg 0.06 % rdg 0.089 % rdg 0.13 % rdg	Fluke 5502A
AC Power – Generate (45 to 65 Hz, PF=1)	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 0.16 % rdg 0.13 % rdg 0.078 % rdg 0.078 % rdg 0.13 % rdg 0.087 % rdg 0.12 % rdg 0.10 % rdg 0.21 % rdg 0.16 % rdg 0.21% rdg	Fluke 5502A
Electrical Calibration of Phase Indicators – Source Only	(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 <sup>2</sup> (±)	Comments
Electrical Conductivity – Measuring Equipment	Up to 35 % IACS (35 to 62) % IACS >62 % IACS	0.95 % rdg + .018 % IACS 0.36 % IACS 0.4 % rdg + 0.12 % IACS	ASTM E1004 electrical conductivity by eddy current
Electrical Conductivity Standards	Up to 35 % IACS (35 to 62) % IACS >62 % IACS	0.95 % rdg + 0.018 % IACS 0.36 % IACS 0.4 % rdg + 0.12 % IACS	ASTM E1004 electrical conductivity by eddy current

#### IV. Mechanical

Parameter/Equipment	Range	CMC <sup>2,5</sup> (±)	Comments
Torque Wrenches <sup>3</sup>	(0.5 to 4) in·ozf	0.017 in·ozf	Torque arm and deadweights
	(4 to 20) in·ozf	0.77 % setting	Torque transducers
	20 in·ozf to 2000 ft·lbf	0.37 % setting	
Torque Transducers	(1.25 to 40) in·ozf (2.5 to 200) in·lbf (8.3 to 150) ft·lbf (150 to 1200) ft·lbf	0.09 % rdg + 0.0006 in·ozf 0.062 % 0.044 % 0.029 %	Torque wheel/arms and weights
Air Gages <sup>3</sup>	-----	18 μin	Magnification test kit
Scales and Balances <sup>3</sup>	(0.5 to 1800) g	(0.062 + 0.00019W) mg	Ultra Class weights, Class 1 Weights
	(0 to 200) g (200 to 1000) g (1 to 8.2) kg	(0.67 + 0.0054W) mg (2.1 + 0.011W) mg (12 + 0.0024W) mg	Class F and 6 weights
	(0.1 to 300) lb, ((0.044 to 136) kg)	(340 + 0.003W) mg	

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Indirect Verification of Rockwell Hardness Testers <sup>3</sup>	HRA		Indirect verification per ASTM E18
	< 70	0.31 HRA	
	≥ 70 and < 80	0.32 HRA	
	≥ 80	0.20 HRA	
	HRBW		
	< 60	0.36 HRBW	
	≥ 60 and < 80	0.26 HRBW	
	≥ 80	0.39 HRBW	
	HRC		
	< 35	0.39 HRC	
	≥ 35 and < 60	0.34 HRC	
	≥ 60	0.32 HRC	
	HREW		
	< 84	0.39 HREW	
	≥ 84 and < 93	0.49 HREW	
	≥ 93	0.49 HREW	
HRFW			
< 80	0.28 HRFW		
≥ 80 and < 94	0.47 HRFW		
≥ 94	0.45 HRFW		
HRHW			
< 96	0.45 HRHW		
≥ 96	0.36 HRHW		
HR15N			
< 78	0.42 HR15N		
≥ 78 and < 90	0.42 HR15N		
≥ 90	0.51 HR15N		
HR30N			
< 55	0.30 HR30N		
≥ 55 and < 77	0.47 HR30N		
≥ 77	0.54 HR30N		
HR45N			
< 37	0.50 HR45N		
≥ 37 and < 66	0.25 HR45N		
≥ 66	0.20 HR45N		
HR15TW			
< 81	0.45 HR15TW		
≥ 81 and < 87	0.39 HR15TW		
≥ 87	0.24 HR15TW		



Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Indirect Verification of Rockwell Hardness Testers <sup>3</sup> (cont)	HR30TW < 57 ≥ 57 and < 70 ≥ 70  HR45TW < 33 ≥ 33 and < 53 ≥ 53	0.58 HR30TW 0.64 HR30TW 0.22 HR30TW  0.70 HR45TW 0.41 HR45TW 0.39 HR45TW	Indirect verification per ASTM E18
Direct Verification of Rockwell Hardness Testers <sup>3</sup> –			ASTM E18
Verification of Test Force	(3 to 15) kgf (30 to 150) kgf	(0.005 + 0.03 % rdg) kgf (0.042 + 0.02 % rdg) kgf	Verification of test force by load cell
Verification of Depth-Measuring Device	(0 to 260) μm	0.37 μm	Per Direct Verification method of ASTM E18
Verification of Hysteresis	N/A	0.25 Rockwell Points	Per Direct Verification method of ASTM E18
Indirect Verification of Brinell Hardness Testers at Test Condition(s) <sup>3</sup> --			
10 mm/3000 kg/15 s	Repeatability: ≤ 225 HBW (> 225 to 650) HBW  Error:	0.024D 0.013D  1.5 %	<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
10 mm/500 kg/15 s	Repeatability: (40 to 109) HBW  Error	0.024D  1.9%	



Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Indirect Verification of Microindentation Hardness Testers <sup>3</sup> (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 <sup>3</sup> –  Absolute & Barometric Pressure  Differential & gage Pressure	(0 to 900) mm Hg  (-150 to +150) in H <sub>2</sub> O  (0 to 30) psi  (10 to 500) psi (200 to 10 000) psi	0.21 mm Hg  0.039 in H <sub>2</sub> O  0.0062 psi + 0.1 % rdg  0.0081 psi + 0.008 % rdg 0.029 psi + 0.009 % rdg	Meriam M202-AI0017  Additel 681  30PSIXP2i  Deadweight tester
Vacuum <sup>3</sup>	(0 to 28.4) in Hg	0.0072 in Hg	Meriam M202-AI0017

#### V. Thermodynamics

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Thermometers <sup>3</sup>	(-112 °F to 32) °F (32 °F to 212) °F (212 °F to 392) °F (392 to 752) °F	0.047 °F 0.040 °F 0.047 °F 0.097 °F	PRT, Fluke 1502A
Thermocouples –  Type E	(-112 to -22) °F (-22 to 392) °F (392 to 1200) °F (1200 to 1832) °F	0.15 °F 0.14 °F 1.3 °F 1.7 °F	Type "S" platinum standard T/C above 392°F, PRT below 392°F, Fluke 1502A, Fluke 8846A



Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments	
Thermocouples – (cont)				
Type J	(-112 to -22) °F (-22 to 392) °F (392 to 1200) °F (1200 to 2000) °F (2000 to 2192) °F	0.16 °F 0.16 °F 1.3 °F 1.7 °F 2.5 °F	Type "S" platinum standard T/C above 392°F, PRT below 392°F, Fluke 1502A, Fluke 8846A	
Type K	(-112 to -22) °F (-22 to 392) °F (392 to 1200) °F (1200 to 2000) °F (2000 to 2500) °F	0.19 °F 0.19 °F 1.3 °F 1.4 °F 3.2 °F		
Type N	(-112 to -22) °F (-22 to 392) °F (392 to 1200) °F (1200 to 2000) °F (2000 to 2372) °F	0.25 °F 0.20 °F 1.3 °F 1.6 °F 2.9 °F		
Type R	(32 to 392) °F (392 to 1200) °F (1200 to 2000) °F (2000 to 2500) °F	0.81 °F 1.3 °F 1.6 °F 3.2 °F		
Type S	(32 to 392) °F (392 to 1200) °F (1200 to 2000) °F (2000 to 2500) °F	0.81 °F 1.4 °F 2.1 °F 3.2 °F		
Type T	(-112 to -22) °F (-22 to 392) °F (392 to 752) °F	0.20 °F 0.16 °F 1.2 °F		
Type R	(32 to 392) °F (392 to 1200) °F (1200 to 2000) °F (2000 to 2500) °F	0.53 °F 0.55 °F 1.1 °F 3.2 °F		Comparison with NIST ref. standard
Type S	(32 to 392) °F (392 to 1200) °F (1200 to 2000) °F (2000 to 2500) °F	0.51 °F 0.54 °F 1.1 °F 3.2 °F		



Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Temperature Uniformity Survey <sup>3, 4</sup> (per AMS 2750)	(-112 to 392) °F (392 to 1200) °F (1200 to 1800) °F (1800 to 2372) °F	1.3 °F 1.9 °F 2.8 °F 4.5 °F	IoTech DaqBook, with expendable and non-expendable thermocouples
Temperature Probe <sup>3, 4</sup> ("SAT" per AMS 2750)	(-112 to 392) °F (392 to 1200) °F (1200 to 2000) °F (1800 to 2372) °F	0.62 °F 1.5 °F 1.9 °F 3.4 °F	Fluke 726 or equivalent, expendable and non-expendable thermocouples
Infrared Thermometers	(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
Relative Humidity <sup>3</sup> – Measuring Equipment	(10 to 95) % RH	0.9 % RH	EdgeTech chilled mirror hygrometer
Dewpoint <sup>3</sup> -- Measuring Equipment	(-20 to 65) °C	0.49 °C	EdgeTech chilled mirror hygrometer

#### VI. Time & Frequency

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Frequency – Measure	(1 to 40) Hz 40 Hz to 10 MHz	0.06 % rdg 0.012 % rdg	HP3458A



Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Frequency – Measuring Equipment	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 µHz/Hz + 0.006 Hz 9.5 µHz/Hz + 0.058 Hz 9.1 µHz/Hz + 0.58 Hz 28 µHz/Hz + 19 Hz 16 µHz/Hz + 61 Hz 0.013% rdg + 440 Hz	Fluke 5502A
Timers, Stopwatches <sup>3</sup>	15 s to 10 min  10 min to 24 hrs  (2 to 24) hrs	0.013 s + 0.0025 % of timed interval  0.016 s + 0.0041 % of timed interval  0.012 s	Reference stopwatch   WWV signal

<sup>1</sup> This laboratory offers commercial dimensional testing, calibration, and field calibration service.

<sup>2</sup> 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.

<sup>3</sup> Field calibration service is available for this calibration and this laboratory meets A2LA R104 – *General Requirements: Accreditation of Field Testing and Field Calibration Laboratories* for these calibrations. 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.

<sup>4</sup> The CMC is stated for calibrations performed in the field only.

<sup>5</sup> 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.

<sup>6</sup> This test is not equivalent to that of a calibration.

<sup>7</sup> 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.

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## *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 17025:2005 *General requirements for the competence of testing and calibration laboratories*. This laboratory also meets the requirements of ANSI/NCSLI 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 8 January 2009).



Presented this 3<sup>rd</sup> day of May 2017.

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President and CEO  
For the Accreditation Council  
Certificate Number 2820.01  
Valid to March 31, 2019

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