



SCOPE OF ACCREDITATION TO ISO/IEC 17025:2005

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CALIBRATION

Valid To: March 31, 2020

Certificate Number: 1741.13

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>2,6</sup> ( $\pm$ )	Comments
Calipers <sup>3</sup>	Up to 72 in	$(5.7 + 9.4L) \mu\text{in} + 0.6R$	Gage blocks
Micrometers <sup>3</sup>	Up to 72 in	$(5.7 + 9.4L) \mu\text{in} + 0.6R$	Gage blocks
Linear Indicators <sup>3</sup> , Dial and Test	Up to 0.1 in (0.1 to 0.5) in	13 $\mu\text{in} + 0.6R$ 61 $\mu\text{in} + 0.6R$	Federal indicator calibrator
	(0.0001 to 4) in	$(4.3 + 3.3L) \mu\text{in} + 0.6R$	Gage blocks
	Up to 12 in	$(6.9 + 1.5L) \mu\text{in} + 0.6R$	Pratt & Whitney Labmaster™ 1000M
Hand Tools <sup>3</sup> – Depth Gages, Snap Gages, Fixture Gages, Thickness Gages	Up to 12 in	$(6.4 + 3.2L) \mu\text{in} + 0.6R$	Gage blocks
	(12 to 40) in	$(14 + 2.6L) \mu\text{in} + 0.6R$	
Pin Gages Class Z, ZZ <sup>3</sup>	Up to 1 in	41 $\mu\text{in}$	Bench comparator and probe w/ preset gage blocks
Height Gages <sup>3</sup>	Up to 48 in	$(56 + 1.3L) \mu\text{in}$	Gage blocks

Parameter/Equipment	Range	CMC <sup>2,6</sup> ( $\pm$ )	Comments
Gage Blocks	(0.05 to 4) in	$(2.8 + 1.9L) \mu\text{in}$	Federal gage block comparator and master block
	(4 to 20) in	$(6.9 + 1.5L) \mu\text{in}$	Pratt & Whitney Labmaster™ 1000M and master block
Thread Measuring Wires	(0.008 to 1.5) in	$(6.9 + 1.5L) \mu\text{in}$	Pratt & Whitney Labmaster™ 1000M
Micrometer Heads	Up to 2 in	$(4.3 + 3.3L) \mu\text{in} + 0.6R$	Gage blocks
Micrometer / End Standards	Up to 8 in Up to 72 in	$(35 + 0.5L) \mu\text{in}$ $(63 + 8.4L) \mu\text{in}$	Fowler ULM Reference bar w/ lever probe
Cylindrical Measure – Plain Rings	(0.04 to 20) in	$(6.9 + 1.5L) \mu\text{in}$	Pratt & Whitney Labmaster™ 1000M
	Pins, Plain Plugs, Discs, Spheres – External Diameter Up to 20 in	$(6.9 + 1.5L) \mu\text{in}$	
Thread Plugs – Pitch Diameter	(0.05 to 8) in	$(74 + 0.3L) \mu\text{in}$	Fowler ULM w/ thread wire set
	Major Diameter (0.05 to 8) in	$(34 + 0.7L) \mu\text{in}$	
Thread Rings – Simple Pitch Diameter – Solid Rings	(0.05 to 8) in	190 $\mu\text{in}$	Pratt & Whitney Labmaster™ 1000M w/setting plugs
	Adjustable Rings (0.05 to 8) in	220 $\mu\text{in}$	
Spline/Gear Gages – Plugs Diameter (Over Pins)	Up to 8 in	$(34 + 0.7L) \mu\text{in}$	Fowler ULM w/ wire set
	Rings Diameter (Between Pins) Up to 8 in	$(34 + 0.7L) \mu\text{in}$	

Parameter/Equipment	Range	CMC <sup>2, 6</sup> ( $\pm$ )	Comments
Caliper Masters	Up to 20 in	(6.9 + 1.5L) $\mu$ in	Pratt & Whitney Labmaster™ 1000M
Micrometer Master	Up to 20 in	(6.9 + 1.5L) $\mu$ in	Pratt & Whitney Labmaster™ 1000M
Protractor, Angle Indicators and Combination Squares <sup>3</sup>	1°, 2°, 3°, 4°, 5°, 10° 20°, 25°, 30°, 45°, 60°, 75°, 90°	0.03°	Angle block set
Angle Gages	Up to 180°	0.16°	Optical comparator or protractor
Steel Rules <sup>3</sup>	Up to 120 in	(5 + 10L) $\mu$ in + 0.6R	Gage blocks
Tape Measures <sup>3</sup>	Up to 25 ft	(5 + 10L) $\mu$ in + 0.6R	Gage blocks
Optical Comparator <sup>3</sup> – X-Y Linearity Magnification Angle	(0 to 12) in 10x to 250x 0° to 90°	85 $\mu$ in + 0.6R 0.014 in 0.1°	Glass master scales Angle block set
Length – 1D	Up to 6 in Up to 24 in	140 $\mu$ in 360 $\mu$ in + 12 $\mu$ in/in	O.D. micrometer, height gage
Surface Plates <sup>3</sup> – Grades AA, A, and B – Repeatability Flatness	0.002 in Up to 60 DL in (>60 to 120) DL in	40 $\mu$ in (31 + 0.2 DL) $\mu$ in (30 + 0.3 DL) $\mu$ in	Repeat-o-Meter Federal level system

Parameter/Equipment	Range	CMC <sup>2,6</sup> (±)	Comments
Gage Block Comparators <sup>3</sup> – Amplifier Gain Contact Force	0.002 in Up to 150 g	2.1 μin 5.2 g	Master gage block, force gage
Bench Micrometers, Universal Length Measuring Machines <sup>3</sup>  Linearity Flatness & Parallelism Force	Up to 4 in Up to 12 in Up to 80 oz	(3.9 + 1.5L) μin + 0.6R 5 μin 0.32 oz	Gage blocks Reference sphere Futek load cell
Feeler/Thickness Shims and Thickness Standards <sup>3</sup>	Up to 1 in	8.4 μin	Pratt & Whitney Labmaster™ 1000M
Coating Thickness Gages <sup>3</sup> (Film, Ultrasonic)	Up to 20 mils	0.1 mils	Coating thickness standards
Radius Gages	Up to 2 in	480 μin	Optical comparator
Surface Roughness Meters and Profilometers <sup>3</sup>	Ra (10 to 200) μin	1.1 μin	Precision roughness standard
Linear Displacement Transducers, LVDT, String Potentiometers, Encoders <sup>3</sup>	Up to 12 in	(6.4 + 3.2L) μin + 0.6R	Gage blocks
Interim Verification of Coordinate Measuring Machines <sup>3</sup>  X,Y, Z Linearity Volumetric Performance	Up to 36 in (1 to 11.5) in	(30 + 2.9L) μin 85 μin	Gage blocks CMM Quik-Chek

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

Parameter/Equipment	Range	CMC <sup>2,6,7</sup> ( $\pm$ )	Comments
Length <sup>8</sup>			
X-Axis	Up to 27 in (700 mm)	(82 + 8.5L) $\mu$ in	Zeiss Contura G2 CMM
Y-Axis	Up to 27 in (700 mm)	(82 + 8.5L) $\mu$ in	
Z-Axis	Up to 24 in (600 mm)	(82 + 8.5L) $\mu$ in	
Volumetric <sup>8</sup>	Up to 36 in (600 mm)	(150 + 10L) $\mu$ in	
Surface Finish <sup>8</sup>	Ra (10 to 200) $\mu$ in	2.7 $\mu$ in	Reference standard & mechanical comparison

## III. Electrical – DC/Low Frequency

Parameter/Equipment	Range	CMC <sup>2,4,5,7</sup> ( $\pm$ )	Comments
DC Voltage – Measure <sup>3</sup>	(0 to 100) mV	11 $\mu$ V/V + 3 $\mu$ V	HP 3458A
	100 mV to 1 V	10 $\mu$ V/V + 0.3 $\mu$ V	
	(1 to 10) V	10 $\mu$ V/V + 0.05 $\mu$ V	
	(10 to 100) V	12 $\mu$ V/V + 0.3 $\mu$ V	Vitretek 4700
	(100 to 1000) V	27 $\mu$ V/V + 0.1 $\mu$ V	
	(1 to 10) kV	0.05 % + 0.3 V	
	(10 to 70) kV	0.06 % + 0.2 V	Vitretek 4700 w/ HVL-70
DC Voltage – Generate <sup>3</sup>	(0 to 220) mV	11 $\mu$ V/V + 0.4 $\mu$ V	Fluke 5720A
	220 mV to 2.2 V	6.7 $\mu$ V/V + 0.7 $\mu$ V	
	(2.2 to 11) V	5 $\mu$ V/V + 2.5 $\mu$ V	
	(11 to 22) V	5.1 $\mu$ V/V + 4 $\mu$ V	
	(22 to 220) V	6.7 $\mu$ V/V + 40 $\mu$ V	
	(220 to 1100) V	8.5 $\mu$ V/V + 400 $\mu$ V	

Parameter/Equipment	Range	CMC <sup>2, 4, 5, 7</sup> ( $\pm$ )	Comments
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 100 $\mu$ A to 1 mA (1 to 10) mA (10 to 100) mA 100 mA to 1 A	35 $\mu$ A/A + 0.04 nA 25 $\mu$ A/A + 0.04 nA 25 $\mu$ A/A + 0.1 nA 25 $\mu$ A/A + 0.8 nA 25 $\mu$ A/A + 5 nA 25 $\mu$ A/A + 50 nA 40 $\mu$ A/A + 0.5 $\mu$ A 0.012 % + 10 $\mu$ A	HP 3458A
	(1 to 100) A	0.073 %	GL 9230A/300 shunt w/ HP 3458A
DC Current – Generate <sup>3</sup>	(0 to 220) $\mu$ A 220 $\mu$ A to 2.2 mA (2.2 to 22) mA (22 to 220) mA	50 $\mu$ A/A + 6 nA 44 $\mu$ A/A + 7 nA 44 $\mu$ A/A + 40 nA 55 $\mu$ A/A + 0.7 $\mu$ A	Fluke 5720A  $\pm (200 I^2) \mu$ A/A for $I > 100$ mA
	220 mA to 2.2 A	0.011 % + 12 $\mu$ A	$\pm (10 I^2) \mu$ A/A for $I > 1$ A
	(1.1 to 3) A (3 to 11) A (11 to 20.5) A	0.046 % + 40 $\mu$ A 0.06 % + 500 $\mu$ A 0.12 % + 750 $\mu$ A	Fluke 5520A
	(1 to 100) A	0.073 %	GL 9230A/300 shunt w/ HP 3458A and power supply
Clamp-On Meters Toroidal	(Up to 1000) A	0.39 % + 0.5A	Fluke 5520A w/5500 coil
Non-Toroidal	(Up to 1000) A	0.65 % + 0.5A	

Parameter/Equipment	Range	CMC <sup>2, 4, 5, 7</sup> ( $\pm$ )	Comments
Resistance – Measure <sup>3</sup>	(0 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 1M $\Omega$ (1 to 10) M $\Omega$ (10 to 100) M $\Omega$ 100 M $\Omega$ to 1 G $\Omega$	18 $\mu\Omega/\Omega$ + 50 $\mu\Omega$ 15 $\mu\Omega/\Omega$ + 0.5 m $\Omega$ 13 $\mu\Omega/\Omega$ + 0.5 m $\Omega$ 13 $\mu\Omega/\Omega$ + 5 m $\Omega$ 13 $\mu\Omega/\Omega$ + 50 m $\Omega$ 18 $\mu\Omega/\Omega$ + 2 $\Omega$ 53 $\mu\Omega/\Omega$ + 100 $\Omega$ 0.062 % + 1 k $\Omega$ 0.51 % + 10 k $\Omega$	HP 3458A
Resistance – Generate <sup>3</sup>	(0 to 11) $\Omega$ (11 to 33) $\Omega$ (33 to 110) $\Omega$ 110 $\Omega$ to 1.1 k $\Omega$ (1.1 to 11) k $\Omega$ (11 to 110) k $\Omega$ 110 k $\Omega$ to 1.1 M $\Omega$ (1.1 to 3.3) M $\Omega$ (3.3 to 11) M $\Omega$ (11 to 33) M $\Omega$ (33 to 110) M $\Omega$ (110 to 330) M $\Omega$ (330 to 1100) M $\Omega$	49 $\mu\Omega/\Omega$ + 0.001 $\Omega$ 37 $\mu\Omega/\Omega$ + 0.0015 $\Omega$ 34 $\mu\Omega/\Omega$ + 0.0014 $\Omega$ 34 $\mu\Omega/\Omega$ + 0.002 $\Omega$ 34 $\mu\Omega/\Omega$ + 0.02 $\Omega$ 34 $\mu\Omega/\Omega$ + 0.2 $\Omega$ 39 $\mu\Omega/\Omega$ + 2 $\Omega$ 73 $\mu\Omega/\Omega$ + 30 $\Omega$ 0.016 % + 50 $\Omega$ 0.03 % + 2.5 k $\Omega$ 0.06 % + 3 k $\Omega$ 0.36 % + 100 k $\Omega$ 1.8 % + 500 k $\Omega$	Fluke 5520A
Resistance – Generate <sup>3</sup>  Fixed Points	0 $\Omega$ (1, 1.9) $\Omega$ (10, 19) $\Omega$ (100, 190) $\Omega$ (1, 1.9, 10, 19) k $\Omega$ (100, 190) k $\Omega$ 1 M $\Omega$ 1.9 M $\Omega$ 10 M $\Omega$ 19 M $\Omega$ 100 M $\Omega$	50 $\mu\Omega$ 0.012 % 31 $\mu\Omega/\Omega$ 13 $\mu\Omega/\Omega$ 8.2 $\mu\Omega/\Omega$ 11 $\mu\Omega/\Omega$ 16 $\mu\Omega/\Omega$ 22 $\mu\Omega/\Omega$ 50 $\mu\Omega/\Omega$ 59 $\mu\Omega/\Omega$ 0.013 %	Fluke 5720A



Parameter/Equipment	Range	CMC <sup>2, 4, 5, 7</sup> (±)	Comments
Insulation Resistance <sup>3</sup> –  Fixed Points	10 Ω, 100 Ω, 1 K, 10 KΩ, 100 KΩ, 1 MΩ, 10 MΩ, 100 MΩ, 1 GΩ, 10 GΩ, 100 GΩ	1.2 %	Standard resistor set
Capacitance – Generate <sup>3</sup>  (220 to 399.9) pF (0.4 to 1.0999) nF (1.1 to 3.2999) nF (3.3 to 10.9999) nF (11 to 109.999) nF (110 to 329.999) nF (0.33 to 1.09999) μF (1.1 to 3.29999) μF (3.3 to 10.9999) μF (11 to 32.9999) μF (33 to 109.999) μF (110 to 329.999) μF (0.33 to 1.09999) mF (1.1 to 3.29999) mF (3.3 to 10.9999) mF (11 to 32.9999) mF (33 to 110) mF	(10 to 10 000) Hz (10 to 10 000) Hz (10 to 3000) Hz (10 to 1000) Hz (10 to 1000) Hz (10 to 1000) Hz (10 to 600) Hz (10 to 300) Hz (10 to 150) Hz (10 to 120) Hz (10 to 80) Hz (0 to 50) Hz (0 to 20) Hz (0 to 6) Hz (0 to 2) Hz (0 to 0.6) Hz (0 to 0.2) Hz	0.88 % + 10 pF 0.6 % + 0.01 nF 0.6 % + 0.01 nF 0.31 % + 0.1 nF 0.31 % + 0.1 nF 0.31 % + 0.3 nF 0.31 % + 1 nF 0.31 % + 3 nF 0.31 % + 10 nF 0.49 % + 30 nF 0.55 % + 100 nF 0.55 % + 300 nF 0.55 % + 1 μF 0.55 % + 3 μF 0.56 % + 10 μF 0.91 % + 30 μF 1.4 % + 100 μF	Fluke 5520A

Parameter/Range	Frequency	CMC <sup>2, 4, 5, 7</sup> (±)	Comments
AC Voltage – Measure <sup>3</sup>  Up to 10 mV  10 mV 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  (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	0.031 % + 0.03 % rng 0.022 % + 0.01 % rng 0.031 % + 0.01 % rng 0.11 % + 0.01 % rng 0.51 % + 0.01 % rng 4.1 % + 0.02 % rng  0.008 % + 0.004 % rng 0.008 % + 0.002 % rng 0.015 % + 0.002 % rng 0.031 % + 0.002 % rng 0.081 % + 0.002 % rng 0.31 % + 0.01 % rng	HP 3458A





Parameter/Range	Frequency	CMC <sup>2, 4, 5, 7</sup> (±)	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	0.021 % + 0.004 % rng 0.021 % + 0.002 % rng 0.021 % + 0.002 % rng 0.036 % + 0.002 % rng 0.13 % + 0.002 % rng 0.41 % + 0.01 % rng	HP 3458A
(100 to 600) V	(1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.041 % + 0.004 % rng 0.041 % + 0.002 % rng 0.061 % + 0.002 % rng 0.13 % + 0.002 % rng 0.31 % + 0.002 % rng	
(1 to 10) kV	60 Hz	0.13 % + 0.1 V	Vitretek 4670
(10 to 70) kV	60 Hz	0.13 % + 0.4 V	Vitretek 4670 w/ HVL-70
AC Voltage – Generate <sup>3</sup>			
(0.22 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	0.19 % + 4 μV 0.12 % + 4 μV 0.086 % + 4 μV 0.15 % + 4 μV 0.21 % + 5 μV 0.37 % + 10 μV 0.53 % + 20 μV 0.69 % + 20 μV	Fluke 5720A
(2.2 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	0.031 % + 4 μV 0.014 % + 4 μV 0.013 % + 4 μV 0.03 % + 4 μV 0.066 % + 5 μV 0.14 % + 10 μV 0.18 % + 20 μV 0.35 % + 20 μV	
(22 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	0.03 % + 12 μV 0.011 % + 7 μV 0.01 % + 7 μV 0.025 % + 7 μV 0.056 % + 17 μV 0.11 % + 20 μV 0.17 % + 25 μV 0.34 % + 45 μV	

Parameter/Range	Frequency	CMC <sup>2, 4, 5, 7</sup> (±)	Comments
AC Voltage – Generate <sup>3</sup> (cont)			
220 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	0.062 % + 40 μV 0.024 % + 15 μV 56 μV/V + 8 μV 93 μV/V + 10 μV 0.014 % + 30 μV 0.051 % + 80 μV 0.12 % + 200 μV 0.21 % + 300 μV	Fluke 5720A
(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 500 kHz to 1 MHz	0.029 % + 400 μV 0.12 % + 150 μV 58 μV/V + 50 μV 95 μV/V + 100 μV 0.013 % + 200 μV 0.035 % + 600 μV 0.12 % + 2 mV 0.19 % + 3.2 mV	
(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	0.029 % + 4 mV 0.012 % + 1.5 mV 66 μV/V + 0.6 mV 0.011 % + 1 mV 0.019 % + 2.5 mV	
(220 to 1100) V	(15 to 50) Hz 50 Hz to 1 kHz	0.037 % + 16 mV 58 μV/V + 3.5 mV	
AC Current – Measure <sup>3</sup>			
(0 to 100) μA	(10 to 20) Hz (20 to 45) Hz 45 Hz to 1 kHz 100 Hz to 5 kHz	0.41 % + 0.03 % rng 0.16 % + 0.03 % rng 0.07 % + 0.03 % rng 0.07 % + 0.03 % rng	HP 3458A
(1 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	0.41 % + 0.02 % rng 0.16 % + 0.02 % rng 0.07 % + 0.02 % rng 0.04 % + 0.02 % rng 0.07 % + 0.02 % rng 0.41 % + 0.04 % rng 0.56 % + 0.15 % rng	

Parameter/Range	Frequency	CMC <sup>2, 4, 5, 7</sup> ( $\pm$ )	Comments
AC Current – Measure <sup>3</sup> (cont.)			
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	0.41 % + 0.02 % rng 0.17 % + 0.02 % rng 0.09 % + 0.02 % rng 0.11 % + 0.02 % rng 0.31 % + 0.02 % rng 1.1 % + 0.04 % rng	HP 3458A
(1 to 3) A	10 Hz to 5 kHz	0.26 %	HP 34410A
AC Current – Generate <sup>3</sup>			
(10 to 220) $\mu$ A	(10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.031 % + 16 nA 0.020 % + 10 nA 0.014 % + 8 nA 0.029 % + 12 nA 0.14 % + 65 nA	Fluke 5720A
(33 to 330) $\mu$ A	(10 to 30) kHz	2 % + 0.4 $\mu$ A	Fluke 5522A
220 $\mu$ A 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	0.031 % + 40 nA 0.020 % + 35 nA 0.013 % + 35 nA 0.025 % + 110 nA 0.14 % + 650 nA	Fluke 5720A
(0.33 to 3.3) mA	(10 to 30) kHz	1.2 % + 0.6 $\mu$ A	Fluke 5522A
(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	0.033 % + 400 nA 0.020 % + 350 nA 0.013 % + 350 nA 0.025 % + 550 nA 0.14 % + 5 $\mu$ A	Fluke 5720A
(3.3 to 33) mA	(10 to 30) kHz	0.5 % + 4 $\mu$ A	Fluke 5522A
(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	0.033 % + 4 $\mu$ A 0.020 % + 3.5 $\mu$ A 0.013 % + 2.5 $\mu$ A 0.025 % + 3.5 $\mu$ A 0.14 % + 10 $\mu$ A	Fluke 5720A
(33 to 330) mA	(10 to 30) kHz	0.5 % + 200 $\mu$ A	Fluke 5522A

Parameter/Range	Frequency	CMC <sup>2, 4, 5, 7</sup> ( $\pm$ )	Comments
AC Current – Generate <sup>3</sup> (cont)			
220 mA to 2.2 A	20 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.03 % + 35 $\mu$ A 0.055 % + 80 $\mu$ A 0.85 % + 160 $\mu$ A	Fluke 5720A
(2.2 to 11) A	40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.056 % + 170 $\mu$ A 0.12 % + 380 $\mu$ A 0.44 % + 750 $\mu$ A	
(11 to 20.5) A	45 Hz to 1 kHz	0.19 % + 5 mA	
AC Current – Generate <sup>3</sup> Clamp-On Meters			
(Up to 1000) A Toroidal	(50 to 400) Hz	0.43 % + 0.025A	Fluke 5520A w/ 5500 coil
Non-Toroidal	(50 to 400) Hz	0.68 % + 0.025A	
Oscilloscopes <sup>3</sup> –			
Square Wave Amplitude:			Fluke 5520A SC1100
50 $\Omega$ at 1 kHz 1 M $\Omega$ at 1 kHz	1.0 mV to 6.6 V <sub>pk-pk</sub> 1.0 mV to 130 V <sub>pk-pk</sub>	0.32 % + 40 $\mu$ V 0.16 % + 40 $\mu$ V	
DC Voltage Amplitude:			
50 $\Omega$ Load 1 M $\Omega$ Load	(0 to $\pm$ 6.6) V (0 to $\pm$ 130) V	0.30 % + 40 $\mu$ V 0.07 % + 40 $\mu$ V	
Level Sine Wave:			
Frequency	Up to 1100 MHz	3.3 $\mu$ Hz/Hz	
Amplitude	50 kHz Reference 50 kHz to 100 MHz (100 to 300) MHz (300 to 600) MHz (600 to 1100) MHz	2.4 % + 300 $\mu$ V 4.4 % + 300 $\mu$ V 4.9 % + 300 $\mu$ V 7.3 % + 300 $\mu$ V 8.4 % + 300 $\mu$ V	

Parameter/Range	Frequency	CMC <sup>2, 4, 5, 7</sup> ( $\pm$ )	Comments
Oscilloscopes <sup>3</sup> – (cont)			
Flatness (Bandwidth)	50 kHz to 100 MHz (100 to 300) MHz (300 to 600) MHz (600 to 1100) MHz	2.1 % + 100 $\mu$ V 2.6 % + 100 $\mu$ V 4.9 % + 100 $\mu$ V 6 % + 100 $\mu$ V	Fluke 5520A SC1100
Time Markers:			
Into a 50 $\Omega$ load	5 s to 50 ms 20 ms to 2 ns	(30 + 1000 <i>t</i> ) $\mu$ s/s 3.5 $\mu$ s/s	<i>t</i> = time in seconds
Rise Time:			
1 kHz to 2 MHz (2 to 10) MHz	$\leq$ 300 ps $\leq$ 350 ps	130 ps 130 ps	
Thermocouple Simulation <sup>3</sup> –			
Type E	(-270 to -100) $^{\circ}$ C (-100 to 650) $^{\circ}$ C (650 to 1000) $^{\circ}$ C	0.092 $^{\circ}$ C 0.092 $^{\circ}$ C 0.092 $^{\circ}$ C	Fluke 5520A w/ ice point reference
Type J	(-210 to -100) $^{\circ}$ C (-100 to 760) $^{\circ}$ C (760 to 1200) $^{\circ}$ C	0.092 $^{\circ}$ C 0.092 $^{\circ}$ C 0.092 $^{\circ}$ C	
Type K	(-270 to -100) $^{\circ}$ C (-100 to 1000) $^{\circ}$ C (1000 to 1372) $^{\circ}$ C	0.092 $^{\circ}$ C 0.090 $^{\circ}$ C 0.092 $^{\circ}$ C	
Type T	(-270 to -150) $^{\circ}$ C (-150 to 0) $^{\circ}$ C (0 to 400) $^{\circ}$ C	0.091 $^{\circ}$ C 0.091 $^{\circ}$ C 0.091 $^{\circ}$ C	
Type R	(-50 to 250) $^{\circ}$ C (250 to 1000) $^{\circ}$ C (1000 to 1768) $^{\circ}$ C	0.095 $^{\circ}$ C 0.095 $^{\circ}$ C 0.095 $^{\circ}$ C	
Type S	(-50 to 250) $^{\circ}$ C (250 to 1400) $^{\circ}$ C (1400 to 1768) $^{\circ}$ C	0.097 $^{\circ}$ C 0.097 $^{\circ}$ C 0.097 $^{\circ}$ C	

Parameter/Equipment	Range	CMC <sup>2, 4, 5, 7</sup> (±)	Comments
Electrical Calibration of RTD Indicators and Indicating Systems <sup>3</sup> –  Pt 385, 100 Ω	(-200 to 0) °C (0 to 100) °C (100 to 300) °C (300 to 400) °C (400 to 630) °C (630 to 800) °C	0.07 °C 0.092 °C 0.11 °C 0.13 °C 0.15 °C 0.28 °C	Fluke 5520A

#### IV. Mechanical

Parameter/Equipment	Range	CMC <sup>2, 6, 7</sup> (±)	Comments
Scales & Balances <sup>3</sup>	(1 to 20 000) g	0.017 per 20 000 g % + 0.6R	Class F weights (applied load)
	(Above 20 to 5000) kg	0.017 % + 0.6R	
	Up to 1000 lbs	0.017 % + 0.6R	
	(1000 to 120 000) lbs	0.017 % per 20 000 lb + 0.6R	Class 1 weights
	(1 to 500) mg	0.013 mg + 0.6R	
	(Up to 5) g	0.043 mg + 0.6R	
	(Up to 10) g	0.062 mg + 0.6R	
	(Up to 30) g	0.092 mg + 0.6R	
	(Up to 50) g	0.17 mg + 0.6R	
	(Up to 100) g	0.31 mg + 0.6R	
	(Up to 200) g	0.63 mg + 0.6R	
	(Up to 300) g	0.93 mg + 0.6R	
	(Up to 500) g	1.5 mg + 0.6R	
	(Up to 1000) g	3.1 mg + 0.6R	
	(Above 1000) g	3.1 mg per 1000 g + 0.6R	

Parameter/Equipment	Range	CMC <sup>2, 6, 7</sup> (±)	Comments
Verification of Force in Tension and Compression <sup>3</sup>	(0 to 500) lbf (0 to 10 000) lbf (0 to 25 000) lbf (0 to 50 000) lbf	1.5 lbf 35 lbf 75 lbf 150 lbf	ASTM E74 using load cell
Verification of Force in Compression <sup>3</sup> – Field Only	(0 to 500 000) lbf	0.12 %	ASTM E74 using load cell
Torque Wrenches <sup>3</sup>	Up to 250 ft·lbf 250 to 2000 ft·lbf	0.65 % 1.0 %	CDI torque tester
Torque Transducers and Analyzers	Up to 2000 ft·lbf	0.13 %	Torque arms and weights
Durometer Calibration – (Type A, B, C, D, DO, O, OO)			ASTM D2240
Indentor Extension and Shape –			
Diameter	Up to 0.105 in	120 μin	Vision System
Radius	Up to 0.125 in	120 μin	
Angle	25° to 40°	0.16°	
Extension	Up to 0.105 in	70 μin	Gage blocks
Indentor Display	(0 to 100) durometer units	0.7 durometer units	Gage blocks
Spring Calibration – Force	Up to 45 N	0.032 N	Durometer calibrator
Pressure <sup>3</sup>	(-14.5 to 0) psi (0 to 10) psi (0 to 500) psi  (0 to 3000) psi (0 to 30 000) psi	(7.5 × 10 <sup>-3</sup> ) psig (9.8 × 10 <sup>-3</sup> ) psig (3.1 × 10 <sup>-3</sup> ) psig  0.025 % 0.025 %	Fluke 7252i  Fluke RPM4-E-DWT

Parameter/Equipment	Range	CMC <sup>2,7</sup> (±)	Comments
Atmospheric Pressure (Vacuum) <sup>3</sup>	(0.01 to 30) in·Hg	0.016 in·Hg	Fluke 7252i
Air Velocity	(70 to 3000) fpm	3.5 %	Anemometer standard
Indirect Verification of Rockwell Hardness Testers <sup>3</sup>	HRA Low Medium High  HRBW Low Medium High  HRC Low Medium High  HREW Low Medium High  HR15N Low Medium High  HR30N Low Medium High  HR45N Low Medium High  HR15TW Low Medium High	0.75 HRA 0.73 HRA 0.8 HRA  0.4 HRBW 0.45 HRBW 0.38 HRBW  0.43 HRC 0.43 HRC 0.38 HRC  0.77 HREW 0.77 HREW 0.77 HREW  0.42 HR15N 0.42 HR15N 0.42 HR15N  0.58 HR30N 0.5 HR30N 0.6 HR30N  0.48 HR45N 0.48 HR45N 0.49 HR45N  0.4 HR15TW 0.4 HR15TW 0.42 HR15TW	Indirect verification per ASTM E18





Parameter/Equipment	Range	CMC <sup>2,7</sup> (±)	Comments
Indirect Verification of Rockwell Hardness Testers <sup>3</sup> (cont)	HR30TW Low Medium High  HR45TW Low Medium High	0.41 HR30TW 0.42 HR30TW 0.42 HR30TW  0.93 HR45TW 0.5 HR45TW 0.6 HR45TW	Indirect verification per ASTM E18
Indirect Verification of Brinell Hardness Testers at Test Condition <sup>3</sup> —  HBW 10/3000	(95.5 to 650) HBW	5.6 HBW	Indirect verification per ASTM E10
Pipettes <sup>3</sup>	(1 to 10) µL (10 to 100) µL (100 to 1000) µL (1000 to 10 000) µL	0.11 µL 0.17 µL 0.63 µL 12 µL	Gravimetric method
Mass – Fixed Points	10 kg 20 kg  25 lb 50 lb	12 mg 31 mg  110 µlb (48 mg) 220 µlb (97 mg)	By comparison w/ Class 1 weights

#### V. Thermodynamics

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Temperature – Measure <sup>3</sup>	(-196 to 660) °C	0.06 °C	Fluke 1502A w/5626 PRT

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Plate Temperature –  Infrared Devices <sup>3</sup>	Up to 100 °C Up to 200 °C  Up to 350 °C Up to 500 °C	1 °C 1.2 °C  1.7 °C 2.3 °C	Fluke 4181
Temperature – Measuring Equipment <sup>3</sup>	(30 to 250) °C (250 to 400) °C (50 to 700) °C	0.15 °C 0.53 °C 0.61 °C	Calisto w/probe Hart 9141 w/probe Hart 9173
Relative Humidity <sup>3</sup>	(10 to 80) % RH	1.4 % RH	Vaisala HMI41 w/ HMP- 46

#### VI. Time & Frequency

Parameter/Equipment	Range	CMC <sup>2,7</sup> (±)	Comments
Timers/Stopwatches <sup>3</sup>	15 s to 24 hr	0.091 s	Reference Timer
Photo Tachometer <sup>3</sup>	(1 to 50 000) rpm	0.003 % + 1.2 rpm	Stroboscope
Stroboscopes <sup>3</sup>	Up to 250 000 rpm	0.001%	Electronic Counter w/ photo diode
Frequency – Measuring Equipment <sup>3</sup>	Up to 1100 MHz	3.3 µHz/Hz	Fluke 5522A w/ SC1100
Frequency – Measure	Up to 225 MHz	9.8 µHz/Hz	HP 53132A

<sup>1</sup> This laboratory offers commercial calibration and field calibration services, where noted.

- <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> Based on using the standard at the temperature the Fluke 5720A, Fluke 5520A was calibrated ( $t_{cal} \pm 5$  °C) and assuming the instrument is zeroed at least every seven days or when the ambient temperature changes more than 5 °C. For resistance, a zero calibration is performed at least every 12 hours within  $\pm 1$  °C of use.
- <sup>5</sup> Based on using the standard at the temperature the HP 3456A, 3457A, or 3458A was calibrated ( $t_{cal} \pm 5$  °C) and an auto-calibration (ACAL) was performed within the previous 24 hours ( $\pm 1$  °C of ambient temperature).
- <sup>6</sup> In the statement of Calibration and Measurement Capability,  $L$  is the numerical value of the nominal length of the device measured in microinches;  $R$  is the numerical value of the resolution of the device in microinches.  $DL$  is the diagonal length of the device in inches.
- <sup>7</sup> Unless otherwise noted, percentage refers to percent of reading.
- <sup>8</sup> 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.



## *Accredited Laboratory*

A2LA has accredited

**J.A. KING & COMPANY, LLC**

*Oklahoma City, OK*

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 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 27<sup>th</sup> day of February 2018.

A handwritten signature in black ink, written over a horizontal line.

President and CEO  
For the Accreditation Council  
Certificate Number 1741.13  
Valid to March 31, 2020

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