



SCOPE OF ACCREDITATION TO ISO/IEC 17025:2005

J. A. KING & COMPANY, LLC.
6541 Franz Warner Parkway
Whitsett, NC 27377
Connie Foster Phone: 336 292 0511

CALIBRATION

Valid To: July 31, 2019

Certificate Number: 1741.02

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory to perform the following calibrations¹:

I. Acoustical Quantities

Parameter/Range	Frequency	CMC ² (±)	Comments
Sound Measuring Equipment			
114 dB	(125 to 2000) Hz 4000 Hz	0.35 dB 0.63 dB	Genrad 1986 Omni Cal sound level calibrator
104 dB	(125 to 4000) Hz	0.74 dB	
94 dB	(125 to 4000) Hz	0.74 dB	
84 dB	(125 to 4000) Hz	0.74 dB	
74 dB	(125 to 4000) Hz	0.74 dB	

II. Chemical

Parameter/Equipment	Range	CMC ² (±)	Comments
pH Meters ³	4 pH 7 pH 10 pH	0.03 pH 0.03 pH 0.05 pH	Standard pH solutions

III. Dimensional

Parameter/Equipment	Range	CMC ^{2,6} (±)	Comments
Angle Plates, Parallels and Squares	Up to 18 in	(43 + 5L) μin	Tri square and Mahr Supramess
Bore Gages	Up to 7 in	(15 + 31L) μin + 0.6R	Ring gages
Calipers ³	Up to 12 in (12 to 40) in (40 to 60) in	(4.6 + 2.8L) μin + 0.6R (13 + 2.1L) μin + 0.6R (290 + 6.3L) μin + 0.6R	Gage blocks Micrometer standards
Caliper Master	Up to 12 in	(6.9 + 1.5L) μin	P & W Labmaster™
Feeler Gages ³	Up to 1 in	75 μin	Fowler mini-horizontal
Cylindrical Measure – Plain Rings	Up to 14 in	(6.9 + 1.8L) μin	P & W Labmaster™
Pins, Plain Plugs, Discs, Spheres – External Diameter	Up to 13 in	(6.9 + 1.8L) μin	
Combination Squares/Protractors/Angle Gages	Up to 180°	0.16°	Optical comparator
Gage Blocks	Up to 4 in	(3.1 + 1.1L) μin	Federal gage block comparator
	(4.1 to 12) in	(6.9 + 1.5L) μin	P & W Labmaster™
Hand Tools ³ – Depth Gages, Snap Gages, Fixture Gages, Thickness Gages	Up to 12 in	(4.6 + 2.8L) μin + 0.6R	Gage blocks
	(12 to 40) in	(13 + 2.1L) μin + 0.6R	
Height Gages ³	Up to 48 in	(56 + 1.3L) μin	Gage blocks, surface plate

Parameter/Equipment	Range	CMC ^{2,6} (±)	Comments
Linear Indicators ³ , Dial and Test	Up to 0.1 in (0.1 to 0.5) in	13 μin + 0.6R 61 μin + 0.6R	Federal indicator calibrator
	(Up to 4) in	(4.3 + 3.3L) μin + 0.6R	Gage blocks
	Up to 12 in	(6.9 + 1.5L) μin + 0.6R	P&W Labmaster™
Micrometer Head	Up to 2 in	(4.3 + 3.3L) μin + 0.6R	Gage blocks
Micrometer Master	Up to 12 in	(6.9 + 1.5L) μin	P&W Labmaster™
Pin Gages ³	Up to 1 in	75 μin	Bench micrometer
Protractor & Angle Indicators ³	1°, 2°, 3°, 4°, 5°, 10°, 15°, 20°, 25°, 30°	0.03°	Sine bar & gage blocks Angle block set
	45°, 60°, 75°, 90°	0.03°	
Optical Comparator ³ –			
X-Y Linearity	Up to 6 in	150 μin	Glass master scales
Magnification	10x to 250x	0.014 in	
Angle	0° to 90°	0.1°	Angle block set
Radius Gages	Up to 2 in	480 μin	Optical comparator
Steel Rules ³	Up to 72 in	480 μin	Optical comparator
	Up to 72 in	(66 + 8.8L) μin + 0.6R	Gage blocks
Micrometers ³ –			
Outside	Up to 12 in (12 to 40) in	(4.6 + 2.8L) μin + 0.6R (13 + 2.1L) μin + 0.6R	Gage blocks
Inside	(40 to 60) in Up to 60 in	(290 + 6.3L) μin + 0.6R (63 + 8.4L) μin + 0.6R	Micrometer standards B&S 6' UltraMic

Parameter/Equipment	Range	CMC ^{2, 6, 7} (\pm)	Comments
Micrometer Standards	Up to 60 in	$(63 + 8.4L) \mu\text{in}$	B&S 6' UltraMic
Tape Measures ³	Up to 25 ft	$(66 + 8.8L) \mu\text{in} + 0.6R$	Gage blocks
Thread Plugs – Major Diameter Pitch Diameter	Up to 7 in Up to 7 in	$(6.9 + 1.8L) \mu\text{in}$ $(98 + 0.2L) \mu\text{in}$	P & W Labmaster™ universal w/ thread wires
Gage Block Comparators ³ – Amplifier Gain Contact Force	0.002 in (0 to 150) g	2.1 μin 5.2 g	Master gage block Force gage
Interim Verification of Coordinate Measuring Machines ³ – X,Y, Z Linearity Volumetric Performance	Up to 36 in Up to 10 in	$(30 + 2.9L) \mu\text{in}$ 120 μin	Gage blocks Ball bar
Surface Plates ³ – Grades AA, A, and B Repeatability/Local Flatness Flatness	0.002 in Up to 60 <i>DL</i> in (>60 to 120) <i>DL</i> in	40 μin $(31 + 0.2DL) \mu\text{in}$ $(30 + 0.3DL) \mu\text{in}$	Repeat-o-meter Federal level systems
Crimpers ³ – Functional Diameter Crimp Pull force Crimp Handle Force	(0.011 to 0.060) in (0.061 to 0.250) in Up to 50 lb Up to 100 lb	260 μin 260 μin 0.05 % 0.32 lbs	Pin gages Test weights Force Gauge

Parameter/Equipment	Range	CMC ^{2,6} (±)	Comments
Bench Micrometers, Universal Length Measuring Machines ³ –			
Linearity	Up to 4 in	$(3.9 + 1.5L) \mu\text{in} + 0.6R$	Gage blocks
Flatness & Parallelism	Up to 12 in	5 μin	Reference sphere
Force	Up to 80 oz	0.32 oz	Futek load cell

IV. Dimensional Testing/Calibration¹

Parameter/Equipment	Range	CMC ^{2,6} (±)	Comments
Length ⁸ –			
X Axis	Up to 29 in (750 mm)	$(230 + 8.4L) \mu\text{in}$	CMM
Y Axis	Up to 39 in (1000 mm)	$(230 + 8.4L) \mu\text{in}$	
Z Axis	Up to 25 in (500 mm)	$(230 + 8.4L) \mu\text{in}$	
Volumetric ³	39 in (1000 mm)	$(510 + 3.2L) \mu\text{in}$	CMM
X-Y Measurements	6 in x 10 in	$(120 + 1.6L) \mu\text{in}$	Vision system

V. Electrical – DC/Low Frequency

Parameter/Equipment	Range	CMC ^{2,4} (±)	Comments
DC Voltage – Measure ³	(0 to 100) mV	11 $\mu\text{V/V} + 3 \mu\text{V}$	HP 3458A
	100 mV to 1 V	10 $\mu\text{V/V} + 0.3 \mu\text{V}$	
	(1 to 10) V	10 $\mu\text{V/V} + 0.05 \mu\text{V}$	
	(10 to 100) V	12 $\mu\text{V/V} + 0.3 \mu\text{V}$	
	(100 to 1000) V	27 $\mu\text{V/V} + 0.1 \mu\text{V}$	
	(1 to 10) kV	0.03 % + 0.03 V	Vitretek 4700 w/ HVL-100
(10 to 100) kV	0.05 % + 0.3 V		

Parameter/Equipment	Range	CMC ^{2, 4, 7} (±)	Comments
DC Voltage – Generate ³	(0 to 220) mV 220 mV to 2.2 V (2.2 to 11) V (11 to 22) V (22 to 220) V (220 to 1100) V	11 μV/V + 0.4 μV 6.7 μV/V + 0.7 μV 5 μV/V + 2.5 μV 5.1 μV/V + 4 μV 6.7 μV/V + 40 μV 8.5 μV/V + 400 μV	Fluke 5730A
DC Power - Generate ³ 33 mV to 1020 V (0.33 to 329.99) mA (0.33 to 2.9999) A (3 to 20.5) A	(0.01 to 330) W (0.33 to 3.3) kW (3.3 to 20.5) kW	0.03 % 0.03 % 0.09 %	Fluke 5520A
DC Current – Measure ³	Up to 100 nA 100 nA to 1 μA (1 to 10) μA (10 to 100) μA 100 μA to 1 mA (1 to 10) mA (10 to 100) mA 100 mA to 1 A (1 to 100) A	35 μA/A + 0.04 nA 25 μA/A + 0.04 nA 25 μA/A + 0.1 nA 25 μA/A + 0.8 nA 25 μA/A + 5 nA 25 μA/A + 50 nA 40 μA/A + 0.5 μA 0.012 % + 10 μA 0.07 %	HP 3458A GL 9230A/100 shunt with HP 3458A
DC Current – Generate ³	(0 to 220) μA 220 μA to 2.2 mA (2.2 to 22) mA (22 to 220) mA 220 mA to 2.2 A (2.2 to 11) A (11 to 20.5) A	50 μA/A + 6 nA 44 μA/A + 7 nA 44 μA/A + 40 nA 55 μA/A + 0.7 μA 0.011 % + 12 μA 0.044 % + 480 μA 0.12 % + 750 μA	Fluke 5730A * ± (200 I ²) μA/A for I > 100 mA ± (10 I ²) μA/A for I > 1 A Fluke 5730A with Fluke 5725A Fluke 5520A

Parameter/Equipment	Range	CMC ^{2, 4, 7} (±)	Comments
DC Current – Generate			
Clamp-On Meters (Toroidal)	(20.5 to 1000) A	0.39 % + 0.5 A	Fluke 5520A w/5500 coil
(Non Toroidal)	(20.5 to 1000) A	0.65 % + 0.5 A	
Resistance – Measure ³	(0 to 10) Ω (10 to 100) Ω 100 Ω to 1 kΩ (1 to 10) kΩ (10 to 100) kΩ 100 kΩ to 1MΩ (1 to 10) MΩ (10 to 100) MΩ 100 MΩ to 1 GΩ	18 μΩ/Ω + 50 μΩ 15 μΩ/Ω + 0.5 mΩ 13 μΩ/Ω + 0.5 mΩ 13 μΩ/Ω + 5 mΩ 13 μΩ/Ω + 50 mΩ 18 μΩ/Ω + 2 Ω 53 μΩ/Ω + 100 Ω 0.062 % + 1 kΩ 0.51 % + 10 kΩ	HP 3458A
Resistance – Generate ³	(0 to 11) Ω (11 to 33) Ω (33 to 110) Ω 110 Ω to 1.1 kΩ (1.1 to 11) kΩ (11 to 110) kΩ 110 kΩ to 1.1 MΩ (1.1 to 3.3) MΩ (3.3 to 11) MΩ (11 to 33) MΩ (33 to 110) MΩ (110 to 330) MΩ (330 to 1100) MΩ	49 μΩ/Ω + 0.001 Ω 37 μΩ/Ω + 0.0015 Ω 34 μΩ/Ω + 0.0014 Ω 34 μΩ/Ω + 0.002 Ω 34 μΩ/Ω + 0.02 Ω 34 μΩ/Ω + 0.2 Ω 39 μΩ/Ω + 2 Ω 73 μΩ/Ω + 30 Ω 0.016 % + 50 Ω 0.03 % + 2.5 kΩ 0.06 % + 3 kΩ 0.36 % + 100 kΩ 1.8 % + 500 kΩ	Fluke 5520A
Fixed Points	0 Ω (1, 1.9) Ω (10, 19) Ω (100, 190) Ω (1, 1.9, 10, 19) kΩ (100, 190) kΩ 1 MΩ 1.9 MΩ 10 MΩ 19 MΩ 100 MΩ	50 μΩ 0.012 % 31 μΩ/Ω 13 μΩ/Ω 8.2 μΩ/Ω 11 μΩ/Ω 16 μΩ/Ω 22 μΩ/Ω 50 μΩ/Ω 59 μΩ/Ω 0.013 %	Fluke 5730A
	0.001 Ω 0.01 Ω	0.012 % 0.01 %	Yokogawa 2792

Parameter/Equipment	Range	CMC ^{2,4,7} (±)	Comments
Resistance – Generate ³ , Fixed Points (cont)	0.1 Ω 1 Ω 10 Ω 100 Ω 1k Ω 10 kΩ 100 kΩ 1 MΩ 10 MΩ	14 x 10 ⁻⁶ Ω 13 x 10 ⁻⁶ Ω 13 x 10 ⁻⁶ Ω 13 x 10 ⁻⁶ Ω 13 x 10 ⁻⁶ Ω 13 x 10 ⁻⁶ Ω 16 x 10 ⁻⁶ Ω 22 x 10 ⁻⁶ Ω 28 x 10 ⁻⁶ Ω	Guildline 9330 series standard resistors
Insulation Resistance ³ – Fixed Points Decade Steps	10 Ω 100 Ω 1 kΩ 10 kΩ 100 kΩ 1 MΩ 10 MΩ 100 MΩ 1 GΩ 10 Ω 100 Ω 1 kΩ 10 kΩ 100 kΩ 1 MΩ 10 MΩ 100 MΩ	1.2 % 1.2 % 1.2 % 1.2 % 1.2 % 1.2 % 1.2 % 1.2 % 1.2 % 0.026 % 0.026 % 0.026 % 0.026 % 0.026 % 0.026 % 0.044 % 0.13 %	Standard resistor set IET decade resistors 1433- 22-K and HRRS-5Q
Capacitance – Generate ³	50 pF to 1.2 μF (3.3 to 11) nF (11 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 330 μF to 1.1 mF (1.1 to 3.3) mF (3.3 to 11) mF	0.61 % + 5 pF 0.34 % + 0.01 nF 0.32 % + 0.1 nF 0.32 % + 0.3 nF 0.32 % + 1 nF 0.32 % + 3 nF 0.32 % + 10 nF 0.5 % + 30 nF 0.57 % + 100 nF 0.57 % + 300 nF 0.58 % + 300 nF 0.56 % + 3 μF 0.56 % + 10 μF	GenRad 1412-BC Fluke 5520A

Parameter/Equipment	Range	CMC ^{2, 4, 7} (±)	Comments
Capacitance – Generate ³ (cont)	(11 to 33) mF (33 to 110) mF	0.9 % + 30 μF 2.2 % + 100 μF	Fluke 5520A
Fixed Values	1 nF 10 nF 100 nF 1 μF	0.036 % 0.032 % 0.033 % 0.034 %	Genrad 1409 Series Capacitors
Inductance – Generate	100 mH 100 μH steps 1 mH steps 10 mH steps 100 mH steps 1 H steps	0.14 % 2.4 % per step 2.4 % per step 1.9 % per step 0.97 % per step 0.97 % per step	GenRad 1482-L GenRad 1491-G decade inductor
AC Voltage – Measure ³			
Up 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	0.031 % + 0.03 % of rng 0.022 % + 0.01 % of rng 0.031 % + 0.01 % of rng 0.11 % + 0.01 % of rng 0.51 % + 0.01 % of rng 4.1 % + 0.02 % of rng	HP 3458A
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	0.008 % + 0.004 % of rng 0.008 % + 0.002 % of rng 0.015 % + 0.002 % of rng 0.031 % + 0.002 % of rng 0.081 % + 0.002 % of rng 0.31 % + 0.01 % of rng	

Parameter/Range	Frequency	CMC ^{2,4,7} (±)	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	0.021 % + 0.004 % of rng 0.021 % + 0.002 % of rng 0.021 % + 0.002 % of rng 0.036 % + 0.002 % of rng 0.13 % + 0.002 % of rng 0.41 % + 0.01 % of rng	
(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 % of rng 0.041 % + 0.002 % of rng 0.061 % + 0.002 % of rng 0.13 % + 0.002 % of rng 0.31 % + 0.002 % of rng	
(1 to 10) kV	45 to 60 Hz	0.1 %	Vitretek 4700
(10 to 100) kV	45 to 60 Hz	0.1 %	Vitretek 4700 w/ HVL-100
AC Voltage – Generate ³			
(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 5730A
(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	

Parameter/Range	Frequency	CMC ^{2, 4, 7} (±)	Comments
AC Voltage – Generate ³ (cont)			Fluke 5730A
(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 0.0073 % + 7 μV 0.015 % + 7 μV 0.038 % + 17 μV 0.08 % + 20 μV 0.17 % + 25 μV 0.34 % + 45 μV	
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 53 μV/V + 8 μV 83 μV/V + 10 μV 0.011 % + 30 μV 0.041 % + 80 μV 0.12 % + 200 μV 0.21 % + 300 μV	
(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 55 μV/V + 50 μV 86 μV/V + 100 μV 0.011 % + 200 μV 0.032 % + 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 (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz	0.029 % + 4 mV 0.012 % + 1.5 mV 66 μV/V + 0.6 mV 0.011 % + 1 mV 0.019 % + 2.5 mV 0.11 % + 16 mV 0.53 % + 40 mV 0.97 % + 80 mV	
(220 to 1100) V	(15 to 50) Hz 50 Hz to 1 kHz	0.037 % + 16 mV 90 μV/V + 3.5 mV	
(220 to 1100) V	40 Hz to 1 kHz (1 to 20) kHz (20 to 30) kHz	0.012 % + 4 mV 0.02 % + 6 mV 0.073 % + 11 mV	Fluke 5730A w/5725A
(220 to 750) V	(30 to 50) kHz (50 to 100) kHz	0.073 % + 11 mV 0.28 % + 45 mV	

Parameter/Range	Frequency	CMC ^{2, 4, 7} (±)	Comments
AC Current – Measure ³			
(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 % of rng 0.16 % + 0.03 % of rng 0.07 % + 0.03 % of rng 0.07 % + 0.03 % of 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 % of rng 0.16 % + 0.02 % of rng 0.07 % + 0.02 % of rng 0.04 % + 0.02 % of rng 0.07 % + 0.02 % of rng 0.41 % + 0.04 % of rng 0.56 % + 0.15 % of rng	
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 % of rng 0.17 % + 0.02 % of rng 0.09 % + 0.02 % of rng 0.11 % + 0.02 % of rng 0.31 % + 0.02 % of rng 1.1 % + 0.04 % of rng	
(1 to 100) A	60 Hz	0.25 %	HP 3458A with Empro shunt
AC Current – Generate			
(0 to 220) µA	(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 0.02 % + 10 nA 0.014 % + 8 nA 0.029 % + 12 nA 0.14 % + 65 nA	Fluke 5730A
220 µA 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 0.02 % + 35 nA 0.013 % + 35 nA 0.025 % + 110 nA 0.14 % + 650 nA	
(2.2 to 22) mA	(10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.033 % + 400 nA 0.02 % + 350 nA 0.013 % + 350 nA 0.025 % + 550 nA 0.14 % + 5 µA	

Parameter/Range	Frequency	CMC ^{2, 4, 7} (±)	Comments
AC Current – Generate ³ (cont)			
(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 μA 0.02 % + 3.5 μA 0.013 % + 2.5 μA 0.025 % + 3.5 μA 0.14 % + 10 μA	Fluke 5730A
220 mA to 2.2 A	20 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.03 % + 35 μA 0.055 % + 80 μA 0.85 % + 160 μA	Fluke 5520A
(2.2 to 11) A	40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.056 % + 170 μA 0.12 % + 380 μA 0.44 % + 750 μA	
(11 to 20.5) A	45 Hz to 1 kHz	0.19 % + 5 mA	
Clamp-On Meters –			
(20.5 to 1000) A (Toroidal)	(50 to 400) Hz	0.43 % + 0.5 A	Fluke 5520A w/ 5500 coil
(Non Toriodal)	(50 to 400) Hz	0.68 % + 0.5 A	
AC Power – Generate ³ (45 to 65) Hz; PF=1 (33 to 330) mV Range:			Fluke 5520A
(3.3 to 8.99) mA	110 μW to 3 mW	0.17 %	
(9 to 32.99) mA	(3 to 11) mW	0.12 %	
(33 to 89.99) mA	(1.1 to 30) mW	0.17 %	
(90 to 329.99) mA	(3 to 110) mW	0.12 %	
(0.33 to 0.8999) A	(11 to 300) mW	0.16 %	
(0.9 to 2.1999) A	(30 to 730) mW	0.14 %	
(2.2 to 4.4999) A	73 mW to 1.5 W	0.16 %	
(4.5 to 20.5) A	150 mW to 6.8 W	0.14 %	

Parameter/Range	Frequency	CMC ^{2,7} (±)	Comments
AC Power – Generate ³ (cont) (45 to 65) Hz; PF=1 330 mV to 1020 V Range: (3.3 to 8.99) mA (9 to 32.99) mA (33 to 89.99) mA (90 to 329.99) mA (0.33 to 0.8999) A (0.9 to 2.1999) A (2.2 to 4.4999) A (4.5 to 20.5) A	 1.1 mW to 9 W 3 mW to 33 W 11 mW to 90 W 30 mW to 330 W 110 mW to 900 W 300 mW to 2200 W 730 mW to 4500 W 1.5 kW to 20.9 kW	 0.15 % 0.1 % 0.15 % 0.1 % 0.14 % 0.11 % 0.15 % 0.12 %	Fluke 5522A
Oscilloscopes ³ – Square Wave Amplitude: 50 Ω at 1 kHz 1 MΩ at 1 kHz DC Voltage Amplitude: 50 Ω Load 1 MΩ Load Level Sine Wave: Frequency Amplitude Flatness (Bandwidth)	 1.0 mV to 6.6 V _{pk - pk} 1.0 mV to 130 V _{pk - pk} (0 to ± 6.6) V (0 to ± 130) V Up to 600 MHz 50 kHz Reference 50 kHz to 100 MHz (100 to 300) MHz (300 to 600) MHz 50 kHz to 100 MHz (100 to 300) MHz (300 to 600) MHz	 0.32 % + 40 μV 0.16 % + 40 μV 0.3 % + 40 μV 0.07 % + 40 μV 3.3 μHz/Hz 2.4 % + 300 μV 4.4 % + 300 μV 4.9 % + 300 μV 7.3 % + 300 μV 2.1 % + 100 μV 2.6 % + 100 μV 4.9 % + 100 μV	Fluke 5520A SC600

Parameter/Range	Frequency	CMC ^{2,7} (±)	Comments
Oscilloscopes ³ – (cont)			Fluke 5520A SC 600
Time Markers:			
Into a 50 Ω Load	5 s to 50 ms 20 ms to 1 ns	(30 + 1000t) μs/s 3.5 μs/s	t = time in seconds
Rise Time:	1 kHz to 10 MHz < 300 ps	120 pS 120 pS	
Distortion – Measure			
20 Hz to 100 kHz Fundamental Frequency			
Input: 50 mV to 300 V (0 to 99.9) dB Dist. (0 to 99.9) dB Dist.	20 Hz to 20 kHz (20 to 100) kHz	2.5 % 2.5 %	HP 8903B
Electrical Simulation of RTD's ³ , Pt 385, 100 Ω	(-200 to 100) °C (100 to 300) °C (300 to 400) °C (400 to 630) °C (630 to 800) °C	0.1 °C 0.11 °C 0.13 °C 0.15 °C 0.28 °C	Fluke 5520A
Electrical Simulation of Thermocouples ³			
Type B	(600 to 800) °C (800 to 1820) °C	0.18 °C 0.15 °C	Fluke 5730A with ice point reference
Type E	(-270 to 1000) °C	0.13 °C	
Type N	(-270 to 1300) °C	0.13 °C	
Type S	(-50 to 0) °C (0 to 1767) °C	0.17 °C 0.15 °C	
Type R	(-50 to 0) °C (0 to 1767) °C	0.17 °C 0.14 °C	
Type T	(-270 to 400) °C	0.13 °C	
Type J	(-210 to 1200) °C	0.13 °C	
Type K	(-270 to 1372) °C	0.13 °C	

VI. Electrical – RF/Microwave

Parameter/Frequency	Range	CMC ^{2,7} (±)	Comments
RF Power – Measure			
10 MHz to 18 GHz	(-70 to -20) dBm 100 pW to 10 µW	1.2 %	HP437B/8484A/ 11708A
100 kHz to 4.2 GHz	(-20 to 30) dBm 1 µW to 100 mW	1.1 %	HP437B/8482A
10 MHz to 18 GHz	(-20 to 30) dBm 1 µW to 100 mW	1.1 %	HP437B/8481A
Relative Power – Measure, 10 MHz to 1.3 GHz	(0 to -10) dB (-10 to -20) dB (-20 to -30) dB (-30 to -40) dB (-40 to -50) dB (-50 to -60) dB (-60 to -70) dB (-70 to -80) dB (-80 to -90) dB (-90 to -100) dB (-100 to -110) dB (-110 to -120) dB	0.24 dB 0.24 dB 0.24 dB 0.24 dB 0.24 dB 0.24 dB 0.24 dB 0.24 dB 0.24 dB 0.24 dB 0.24 dB 0.24 dB	Agilent 8902A w/ 11722A
Amplitude Modulation –			
Carrier: (0.15 to 10) MHz Depth: Up to 5 % Depth: 5 to 99 %	(20 to 50) Hz 50 Hz to 100 kHz	3.7 % 2.5 %	Agilent 8902A w/ 11722A
Carrier: 10 MHz to 1.3 GHz Depth: Up to 5 % Depth: 5 to 99 %	(20 to 50) Hz 50 Hz to 100 kHz	3.7 % 2.5 %	

Parameter/Equipment	Range	CMC ^{2, 6} (±)	Comments
Frequency Modulation – Carrier: 250 kHz to 10 MHz Dev: Up to 40 kHz Carrier: 10 MHz to 1.3 GHz Dev: Up to 100 kHz Dev: 100 to 400 kHz	20 Hz to 10 kHz (20 to 50) Hz 50 Hz to 100 kHz (100 to 200) kHz	2.4 % 6 % 1.3 % 6 %	Agilent 8902A w/11722A
Phase Modulation – Carrier: 150 kHz to 10 MHz Carrier: 10 MHz to 1.3 GHz	(200 to 10) kHz (200 to 20) kHz	3.6 % 3.6 %	Agilent 8902A w/11722A

VII. Mechanical

Parameter/Equipment	Range	CMC ^{2, 6} (±)	Comments
Scales & Balances ³	(1 to 500) mg Up to 5 g Up to 10 g Up to 30 g Up to 50 g Up to 100 g Up to 200 g Up to 300 g Up to 500 g Up to 1000 g (> 1 to 35) kg (5 to 10) g (10 to 500) g 501 g to 20 kg (> 20 to 5000) kg Up to 1000 lb (1000 to 120 000) lb	0.013 mg + 0.6R 0.043 mg + 0.6R 0.062 mg + 0.6R 0.096 mg + 0.6R 0.17 mg + 0.6R 0.31 mg + 0.6R 0.63 mg + 0.6R 0.92 mg + 0.6R 1.5 mg + 0.6R 3.1 mg + 0.6R 3.1 mg per 1000 g + 0.6R 0.04 % + 0.6R 0.025 % + 0.6R 0.017 % + 0.6R 0.017 % per 20 kg + 0.6R 0.017 % + 0.6R 0.017 % per 1000 lb + 0.6R	ASTM Class 1 weights (applied load) Class F weights (applied load) Class F weights (applied load)

Parameter/Equipment	Range	CMC ^{2,7} (±)	Comments
Mass – Fixed Points	1 mg	0.0022 mg	By comparison with ultra class weights
	2 mg	0.0031 mg	
	3 mg	0.0030 mg	
	5 mg	0.0018 mg	
	10 mg	0.0018 mg	
	20 mg	0.0018 mg	
	30 mg	0.0023 mg	
	50 mg	0.0019 mg	
	100 mg	0.0018 mg	
	200 mg	0.0027 mg	
	300 mg	0.0036 mg	
	500 mg	0.0029 mg	
	1 g	0.009 mg	
	2 g	0.011 mg	
	3 g	0.009 mg	
	5 g	0.011 mg	
	10 g	0.016 mg	
	20 g	0.015 mg	
	25 g	0.020 mg	
	30 g	0.017 mg	
	40 g	0.022 mg	
	50 g	0.019 mg	
	100 g	0.043 mg	
	200 g	0.094 mg	
	300 g	0.1 mg	
	500 g	0.17 mg	
	1 kg	0.35 mg	
	2 kg	2.4 mg	
	3 kg	2.5 mg	
	4 kg	2.8 mg	
5 kg	2.9 mg		
10 kg	4.3 mg		
20 kg	17 mg	Class 1 mass standards	
25 kg	20 mg		



Parameter/Equipment	Range	CMC ^{2, 7} (±)	Comments
Mass – Fixed Points (cont)	1/32 oz 1/16 oz 1/8 oz 1/4 oz 1/2 oz 1 oz 2 oz 4 oz	6.1 μoz (180 μg) 6.1 μoz (180 μg) 6.1 μoz (180 μg) 6.1 μoz (180 μg) 6.1 μoz (180 μg) 6.1 μoz (180 μg) 6.1 μoz (180 μg) 6.1 μoz (180 μg)	Class 1 mass standards
	0.001 lb 0.002 lb 0.005 lb 0.01 lb 0.02 lb 0.05 lb 0.1 lb 0.2 lb 0.5 lb 1 lb 2 lb 3 lb 4 lb 5 lb 10 lb 20 lb 25 lb 50 lb	2.4 μlb (1.1 mg) 2.4 μlb (1.1 mg) 2.4 μlb (1.1 mg) 2.4 μlb (1.1 mg) 2.4 μlb (1.1 mg) 2.4 μlb (1.1 mg) 2.4 μlb (1.1 mg) 2.4 μlb (1.1 mg) 2.7 μlb (1.2 mg) 2.4 μlb (1.1 mg) 2.8 μlb (1.3 mg) 3.1 μlb (1.4 mg) 4.2 μlb (1.9 mg) 2.8 μlb (1.3 mg) 600 μlb (270 mg) 600 μlb (270 mg) 670 μlb (310 mg) 610 μlb (280 mg)	
Field Check Weight Comparison ³ – Load Fixtures, Hangers, Package & Check Weights	Up to 1000 g	5.4 mg	Balance w / Class 1 mass standards
	Up to 70 lb	0.022 %	Scale w/ Class F weights
Torque – Measuring Equipment (Wrenches) ³	5 in·lbf to 600 ft·lbf	0.65 %	CDI Suretest 5000-ST
	(600 to 1000) ft·lbf	0.93 %	Sturtevant TT-1000
Torque Testers ³	Up to 2000 ft·lbf	0.13 %	Class F weights & torque arms

Parameter/Equipment	Range	CMC ^{2,7} (±)	Comments
Rotary Torque Tools ³ – Pneumatic, DC, Pulse	(02 to 20) N·m (0.75 to 75) N·m (18 to 180) N·m (50 to 500) N·m	1.3 % Full Scale 1.3 % Full Scale 1.3 % Full Scale 1.3 % Full Scale	Crane-Torque Star w/ rotary transducers
Force ³	(0.002 to 3000) lbf (200 to 50 000) lbf (50 001 to 100 000) lbf	0.05 % 0.04 % 0.06 %	Class F weights Morehouse universal 100K
Durometer Calibration – (Type A, B, C, D, DO, O, OO)			ASTM D2240
Indenter 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
Indenter Display	0 to 100 durometer units	0.7 durometer units	Gage blocks
Spring Calibration – Force	Up to 45 N	0.032 N	Precision bench scale
Pressure ³ –			
Absolute	(0 to 100) psia	0.08 psi	Fluke 754 with 750PA6
Differential	(0 to 28) in H ₂ O	0.03 % of Full Scale	Merriam M200-LS
Pneumatic	(0.5 to 300) psig	0.07 %	Beamex MC5
Hydraulic	(5 to 7500) psig	0.2 %	Ametek Type 10/ Ametek HL-36
	(100 to 1000) psig (1000 to 10 000) psig	0.07 % of Full Scale 0.07 % of Full Scale	Druck DPI 104
Vacuum ³	(0.01 to 28) inHg	0.09 %	Beamex MC5

Parameter/Equipment	Range	CMC ^{2, 7} (±)	Comments
Speed ³ – Measure Optic/Non-Contact: RPM Totalizer/Rate Meters Contact: RPM Totalizer/Rate Meters	(5 to 200 000) rpm (2 to 3300) fpm (0.5 to 12 000) rpm (2 to 3300) fpm	0.017 % 0.017 % 0.22 % 0.22 %	Monarch PLT200
Speed/RPM/Rate ³ – Simulation	(2.5 to 100 000) rpm	0.002 %	HP 3325A
Indirect Verification of Rockwell Hardness Testers ³	HRC: Low Medium High HRBW: Low Medium High	0.92 HRC 0.92 HRC 0.87 HRC 1.6 HRBW 1.2 HRBW 1 HRBW	Indirect verification per ASTM E18

VIII. Optical Quantities

Parameter/Equipment	Range	CMC ² (±)	Comments
Illuminance – Light Meters 360 to 780 nm	(0.1 to 10 000) Lux	2.7 %	Comparison by standard light meter

IX. Thermodynamics

Parameter/Equipment	Range	CMC ² (±)	Comments
Temperature – Measuring Equipment ³	(-15 to 100) °C	0.3 °C	Fluke 9009
	(101 to 420) °C	0.65 °C	Fluke 9144
	(421 to 650) °C	0.9 °C	
Temperature – Measure ³	(-196 to 300) °C (300 to 670) °C	0.05 °C 0.1 °C	Fluke 1524 w/PRT
Plate Temperature – Infrared Devices ³	Ambient to 100 °C (100 to 250) °C (250 to 500) °C	0.65 °C 0.85 °C 1.1 °C	Hart Scientific 9132 HDRC
Relative Humidity – Measure ³	(10 to 90) % RH	1.0 % RH	Rotronic HC2-SH

X. Time & Frequency

Parameter/Equipment	Range	CMC ² (±)	Comments
Frequency – Measuring Equipment	0.01 Hz to 5 kHz 5 kHz to 3 GHz	0.06 µHz/Hz 0.06 µHz/Hz	Agilent 3325A R&S Model SME03 w/ external time base
Frequency – Measure	Up to 15 GHz	0.06 µHz/Hz	Keysight 53230A
Timers and Stopwatches ³	(1 to 3600) s	0.026 s	Keysight 53230A

¹ This laboratory offers commercial calibration and field calibration services, where noted.

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 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.
- ⁴ The stated measured values are determined using the indicated instrument (see Comments). This capability is suitable for the calibration of the devices intended to measure or generate the measured value in the ranges indicated. CMC's are expressed as either a specific value that covers the full range or as a percent or fraction of the reading plus a fixed floor specification.
- ⁵ The standards used don't include the individual load cells calibrated using ASTM standards & methods.
- ⁶ In the statement of CMC, 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.
- ⁷ In the statement of CMC a percentage refers to percent of reading unless otherwise noted.
- ⁸ 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

Whitsett, NC

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 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 8th day of May 2017.

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

Vice President, Accreditation Services
For the Accreditation Council
Certificate Number 1741.02
Valid to July 31, 2019
Revised on May 16, 2019

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