



SCOPE OF ACCREDITATION TO ISO/IEC 17025:2005

J. A. KING & COMPANY, LLC.
511 Sparkman Drive NW, Suite 100
Huntsville, AL 35816
Connie Foster Phone: 800 327-7727

CALIBRATION

Valid To: April 30, 2020

Certificate Number: 1741.17

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

I. Dimensional

Parameter/Equipment	Range	CMC ^{2,7} (\pm)	Comments
Angle Measuring Equipment ³ – Protractors, Angle Indicators, Inclinometers	0.25° to 30°	0.11°	Angle block set
Fixed Values	30°, 45°, 60°, 75°, 90°	0.03°	
Calipers ³	Up to 12 in (12 to 48) in	(6 + 9.7L) μ in + 0.6R (10 + 10.2L) μ in + 0.6R	Gage blocks
Crimpers ³ – Functional Diameter	(0.011 to 0.250) in	260 μ in	Pin gages
Cylindrical Measure – Plain Rings	Up to 8 in	(54 + 13L) μ in	Mic Trac™
Pins, Plain Plugs, Discs, Spheres – External Diameter	Up to 8 in	(54 + 13L) μ in	

Parameter/Equipment	Range	CMC ^{2,7} (\pm)	Comments	
Feeler Gages ³	Up to 0.2 in	75 μ in	Micrometer	
Gage Blocks	Up to 4 in	(3.1 + 1.1L) μ in	Gage block comparator	
Hand Tools ³ – Depth Gages, Snap Gages, Fixture Gages, Thickness Gages	Up to 12 in (12 to 48) in	(6 + 9.7 L) μ in + 0.6R (10 + 10.2L) μ in + 0.6R	Gage blocks	
Height Gages ³	Up to 12 in (12 to 48) in	(6 + 9.7L) μ in + 0.6R (10 + 10.2L) μ in + 0.6R	Gage blocks, surface plate	
Length Measure -1D Fixtures, Micrometer Standards	Up to 8 in	640 μ in	Optical comparator	
	Up to 8 in	(54 + 13L) μ in	Mic Trac TM	
	Up to 300 in	(11 + 2.4L) μ in	Renishaw ML10 Gold	
Linear Indicators ³ - Lever Probes, LVDT's, Dial and Test	(0.0001 to 12) in	(6 + 9.7L) μ in + 0.6R	Gage blocks	
Micrometers ³	Up to 12 in (12 to 40) in	(6 + 9.7L) μ in + 0.6R (10 + 10.2L) μ in + 0.6R	Gage blocks	
Optical Comparator ³ –	X-Y Linearity	Up to 12 in	0.0012 in	Glass master scales
	Magnification	10x to 250x	0.014 in	Glass master and Gage Blocks
	Angle	0.25° to 30°	0.11°	Angle block set
Pin Gages ³ - Class Z and ZZ	Up to 1 in	75 μ in	Micrometer	

Parameter/Equipment	Range	CMC ^{2,7} (\pm)	Comments
Radius Gages	Up to 2 in	640 μ in	Optical comparator
Surface Plates ³ – Grades AA, A, and B			
Repeatability/Local Flatness	0.002 in	40 μ in	Repeat-o-meter
Flatness	Up to 60 <i>DL</i> in (>60 to 120) <i>DL</i> in	(31 + 0.2 <i>DL</i>) μ in (30 + 0.3 <i>DL</i>) μ in	Federal level systems
Tape Measures, Rulers and Pi Tapes ³	Up to 144 in Up to 300 in	(66 + 8.8 <i>L</i>) μ in + 0.6 <i>R</i> (11 + 2.4 <i>L</i>) μ in	Gage Blocks Renishaw ML10 Gold
Thread Plugs –			
Major Diameter	Up to 8 in	(54 + 13 <i>L</i>) μ in	Mic Trac TM with thread wires
Pitch Diameter	Up to 8 in	140 μ in	

II. Electrical – DC/Low Frequency

Parameter/Equipment	Range	CMC ^{2,4,5,8} (\pm)	Comments
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/Equipment	Range	CMC ^{2, 4, 5, 8} (\pm)	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	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 % 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	
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 μ V 0.12 % + 4 μ V 0.086 % + 4 μ V 0.15 % + 4 μ V 0.21 % + 5 μ V 0.37 % + 10 μ V 0.53 % + 20 μ V 0.69 % + 20 μ V	Fluke 5700A/5725A
(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 μ V 0.014 % + 4 μ V 0.013 % + 4 μ V 0.03 % + 4 μ V 0.066 % + 5 μ V 0.14 % + 10 μ V 0.18 % + 20 μ V 0.35 % + 20 μ V	
(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 μ V 0.011 % + 7 μ V 0.0073 % + 7 μ V 0.015 % + 7 μ V 0.038 % + 17 μ V 0.08 % + 20 μ V 0.17 % + 25 μ V 0.34 % + 45 μ V	

Parameter/Equipment	Range	CMC ^{2, 4, 5, 8} (\pm)	Comments
AC Voltage – Generate ³ (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 μ V 0.024 % + 15 μ V 53 μ V/V + 8 μ V 83 μ V/V + 10 μ V 0.011 % + 30 μ V 0.041 % + 80 μ V 0.12 % + 200 μ V 0.21 % + 300 μ V	Fluke 5700A/5725A
(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 μ V 0.12 % + 150 μ V 55 μ V/V + 50 μ V 86 μ V/V + 100 μ V 0.011 % + 200 μ V 0.032 % + 600 μ V 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 μ V/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 μ V/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	
(220 to 750) V	(30 to 50) kHz (50 to 100) kHz	0.073 % + 11 mV 0.28 % + 45 mV	
(330 to 1020) V	45 Hz to 10 kHz	0.036 % + 10 mV	Fluke 5522A

Parameter/Equipment	Range	CMC ^{2, 4, 8} (±)	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 %	Empro Shunt w/ DMM
AC Current – Generate ³			
(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 5700A/5725A
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/Equipment	Range	CMC ^{2, 4, 8} (±)	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 5700A/5725A
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	
(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	
AC Clamp-On Meters ³ (Up to 1000A)			
(Toroidal)	(50 to 400) Hz	0.43 % + 0.5 A	Fluke 5522A w/ 5500 coil
(Non-Toroidal)	(50 to 400) Hz	0.68 % + 0.5 A	
AC Power – Generate ³ (45 to 65) Hz; PF=1 33 to 330mV Range			Fluke 5522A
3.3 to 8.99 mA	110 µW to 3 mW	0.17%	
9 to 32.99 mA	3 mW to 11 mW	0.12%	
33 to 89.99mA	1.1 to 30 mW	0.17%	
90 to 329.99 mA	3 to 110 mW	0.12%	
0.33 to 0.8999A	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 1.5W	0.16%	
4.5 to 20.5 A	150 mW to 6.8 W	0.14%	

Parameter/Equipment	Range	CMC ^{2, 4, 8} (±)	Comments
AC Power – Generate ³ (cont.) (45 to 65) Hz; PF=1 330mV to 1020V Range			
3.3 to 8.99 mA	1.1mW to 9 W	0.15%	Fluke 5522A
9 to 32.99 mA	3 mW to 33 W	0.1%	
33 to 89.99mA	11 mW to 90W	0.15%	
90 to 329.99 mA	30 mW to 330W	0.1%	
0.33 to 0.8999A	110 mW to 900W	0.14%	
0.9 to 2.1999 A	300 mW to 2200W	0.11%	
2.2 to 4.4999 A	730 mW to 4500W	0.15%	
4.5 to 20.5 A	1.5 kW to 20.9kW	0.12%	
DC Voltage – Measure ³	(0 to 100) mV 100 mV to 1 V (1 to 10) V (10 to 100) V (100 to 1000) V (Up to 100) kV	11 µV/V + 0.3 µV 10 µV/V + 0.3 µV 10 µV/V + 0.5 µV 12 µV/V + 30 µV 27 µV/V + 100 µV 0.6 %	HP 3458A Spellman HV Divider
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 5700A
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 Up to 100A	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 0.13 %	HP 3458A Empro Shunt w/ DMM

Parameter/Equipment	Range	CMC ^{2, 4, 8} (\pm)	Comments
DC Current – Generate ³	(0.22 to 220) μ A 220 μ A 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 μ A/A + 6 nA 44 μ A/A + 7 nA 44 μ A/A + 40 nA 55 μ A/A + 0.7 μ A 0.011 % + 12 μ A 0.044 % + 480 μ A 0.12 % + 750 μ A	Fluke 5700A w/ 5725A Fluke 5522A
DC Clamp-On Meters ³ (Toroidal) (Non Toroidal)	(20.5 to 1000) A (20.5 to 1000) A	0.39 % + 0.5A 0.65 % + 0.5A	Fluke 5522A w/5500 Coil
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 5522A
Resistance – Measure ³	(0 to 10) Ω (10 to 100) Ω 100 Ω to 1 k Ω (1 to 10) k Ω (10 to 100) k Ω 100 k Ω to 1M Ω (1 to 10) M Ω (10 to 100) M Ω 100 M Ω to 1 G Ω	18 $\mu\Omega/\Omega$ + 50 $\mu\Omega$ 15 $\mu\Omega/\Omega$ + 0.5 m Ω 13 $\mu\Omega/\Omega$ + 0.5 m Ω 13 $\mu\Omega/\Omega$ + 5 m Ω 13 $\mu\Omega/\Omega$ + 50 m Ω 18 $\mu\Omega/\Omega$ + 2 Ω 53 $\mu\Omega/\Omega$ + 100 Ω 0.062 % + 1 k Ω 0.51 % + 10 k Ω	HP 3458A
Resistance – Generate ³	(0 to 11) Ω (11 to 33) Ω (33 to 110) Ω 110 Ω to 1.1 k Ω (1.1 to 11) k Ω (11 to 110) k Ω 110 k Ω to 1.1 M Ω (1.1 to 3.3) M Ω (3.3 to 11) M Ω (11 to 33) M Ω (33 to 110) M Ω (110 to 330) M Ω (330 to 1100) M Ω	49 $\mu\Omega/\Omega$ + 0.001 Ω 37 $\mu\Omega/\Omega$ + 0.0015 Ω 34 $\mu\Omega/\Omega$ + 0.0014 Ω 34 $\mu\Omega/\Omega$ + 0.002 Ω 34 $\mu\Omega/\Omega$ + 0.02 Ω 34 $\mu\Omega/\Omega$ + 0.2 Ω 39 $\mu\Omega/\Omega$ + 2 Ω 73 $\mu\Omega/\Omega$ + 30 Ω 0.016 % + 50 Ω 0.03 % + 2.5 k Ω 0.06 % + 3 k Ω 0.36 % + 100 k Ω 1.8 % + 500 k Ω	Fluke 5522A

Parameter/Equipment	Range	CMC ^{2, 4, 8} (±)	Comments
Resistance – Generate ³ (cont)	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 5700A/5725A
Capacitance – Generate ³ (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 5522A
Capacitance – Generate ³ Fixed Points 10 pF 100 pF 1000 pF	1 kHz	0.036% 0.036% 0.036%	Genrad 1403 Series
Capacitance – Measure	10 pF 100 pF 1nF to 10 μF 10 to 100 μF 100 μF to 1mF	0.5% 0.067% 0.036% 0.064% 0.5%	GenRad 1689 Digibridge

Parameter/Equipment	Range	CMC ^{2,4,8} (±)	Comments
Inductance – Generate	1 mH	0.14 %	GenRad 1482-E Standard inductors
	100 μH	0.16 %	
	1 mH	0.16 %	
	10 mH	0.16 %	
	100 mH	0.16 %	
	1 H	0.16 %	
	10 H	0.16 %	
Inductance - Measure	100 μH	0.2 %	GenRad 1689 Digibridge
	1 mH to 10H	0.072 %	
Electrical Simulation of Thermocouples ³			Fluke 5700A with ice point reference
Type B	(600 to 800) °C (800 to 1820) °C	0.15 °C 0.11 °C	
Type E	(-270 to 1000) °C	0.08 °C	
Type N	(-270 to 1300) °C	0.08 °C	
Type S	(-50 to 0) °C (0 to 1767) °C	0.13 °C 0.1 °C	
Type R	(-50 to 0) °C (0 to 1767) °C	0.13 °C 0.1 °C	
Type T	(-270 to 400) °C	0.08 °C	
Type J	(-210 to 1200) °C	0.08 °C	
Type K	(-270 to 1372) °C	0.08 °C	
Electrical Simulation of RTDs ³			Fluke 5522A
Pt 385, 100Ω	(-200 to 0) °C	0.08 °C	
	(0 to 100) °C	0.10 °C	
	(100 to 300) °C	0.11 °C	
	(300 to 400) °C	0.13 °C	
	(400 to 630) °C	0.15 °C	
	(630 to 800) °C	0.28 °C	

Parameter/Range	Frequency	CMC ^{2,4,8} (±)	Comments
Oscilloscopes ³ –			
Square Wave Signal:			
50 Ω Load @ 1 kHz	1 mV to 6.6 V _{pk-pk}	0.31 % + 40 μV	Fluke 5522A w/ SC1100
1 MΩ Load @ 1 kHz	1 mV to 130 V _{pk-pk}	0.14 % + 40 μV	
DC Volt Amplitude:			
50 Ω Load	(0 to 6.6) V	0.3 % + 40 μV	<i>t</i> = time in seconds
1 MΩ Load	(0 to 130) V	0.06 % + 40 μV	
Level Sine Wave:			
Frequency	(0 to 1100) MHz	3.3 μHz/Hz	
Amplitude	50 kHz Reference	2.4 % + 300 μV	
	50 kHz to 100 MHz	4.2 % + 300 μV	
	(100 to 300) MHz	4.8 % + 300 μV	
	(300 to 600) MHz	7.2 % + 300 μV	
	(300 to 1100) MHz	8.4 % + 300 μV	
Flatness (Bandwidth)	0 kHz to 100 MHz	1.8 % + 100 μV	
	(100 to 300) MHz	2.4 % + 100 μV	
	(300 to 600) MHz	4.8 % + 100 μV	
	(300 to 1100) MHz	6 % + 100 μV	
Time Markers:			
Into a 50 Ω load	5 s to 50 ms	(30 + 1000 <i>t</i>) μs/s	
	20 ms to 2 ns	3.5 μs/s	
Rise Time:			
1 kHz to 2 MHz	≤ 300 ps	130 ps	
(2 to 10) MHz	≤ 350 ps	130 ps	

III. Electrical – RF/Microwave

Parameter/Frequency	Range	CMC ^{2,8} (±)	Comments
Power Meters – Range Calibration	3 μW to 100 mW	0.3%	HP 11683A , 8477A Range Calibrators

Parameter/Frequency	Range	CMC ^{2, 8} (±)	Comments
RF Power – Measure			
10 MHz to 18 GHz	(-70 to -20) dBm 100 pW to 10 μW	2.0 %	HP437B/8484A/ 11708A
100 kHz to 4.2 GHz	(-20 to 30) dBm 1 μW to 100 mW	2.5 %	HP437B/8482A
10 MHz to 18 GHz	(-20 to 30) dBm 1 μW to 100 mW	1.8 %	HP437B /8481A
Relative Power – Measure ³ , 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	Agilent 8902A w/ 11722A
Amplitude Modulation ³ –			
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 %	
Frequency Modulation ³ –			
Carrier: 250 kHz to 10 MHz Dev: Up to 40 kHz	20 Hz to 10 kHz	2.4 %	Agilent 8902A w/ 11722A
Carrier: 10 MHz to 1.3 GHz Dev: Up to 100 kHz Dev: 100 to 400 kHz	(20 to 50) Hz 50 Hz to 100 kHz (100 to 200) kHz	6 % 1.3 % 6 %	

Parameter/Equipment	Range	CMC ^{2,7,8} (±)	Comments
Torque Testers ³	Up to 250 ft·lbf	0.1 %	Class F weights & torque arms
Indirect Verification of Rockwell Hardness Testers ^{3,10}	HRC: Low Medium High HRBW: Low Medium High	0.39 HRC 0.34 HRC 0.32 HRC 0.52 HRBW 0.38 HRBW 0.57 HRBW	Indirect Verification Per ASTM E18
Force ³ – Measuring Equipment	Up 500 lbf Up to 15 000 lbf Up to 50 000 lbf	0.04% 47 lbf 140 lbf	Class F Weights Load cells w/indicator
Pressure ³ – Measuring Equipment			
Hydraulic	10 to 10 000 psig	0.05%	Ametek DM-TQ-100-2-ALC
Pneumatic	0 to 300 psig 300 to 3000 psig	0.06% + .02 PSI 0.06%	Crystal Engineering IS33-300/3000
Vacuum Gauges ³	(0.01 to 28) in Hg	0.088 In Hg	Crystal Engineering XP2i

V. Thermodynamics

Parameter/Equipment	Range	CMC ² (±)	Comments
Temperature – Measuring Instruments ³	(-196 to 300) °C (300 to 500) °C	0.043 °C 0.11 °C	Temperature sources monitored with Instrulab 4201C/840

Parameter/Equipment	Range	CMC ² (±)	Comments
Temperature – Measure ³	(-196 to 300) °C (300 to 500) °C	0.043 °C 0.11 °C	Instrulab 4201C/840
Plate Temperature – Infrared Devices ³	35 °C (35 to 100) °C (100 to 200) °C (200 to 350) °C (350 to 500) °C (500 to 1100) °C (1100 to 1500) °C	0.84 °C 1.0 °C 1.2 °C 1.7 °C 2.3 °C 15 °C 18 °C	Fluke 4181 Infrared Calibrator Heitronics KT19 with Infrared Source
Relative Humidity – Measure ³	(10 to 90) % RH	1.0 % RH	Rotronic HC2-SH

VI. Time & Frequency

Parameter/Equipment	Range	CMC ² (±)	Comments
Frequency – Measuring Equipment	0.001 Hz to 20MHz 10MHz to 2.1 GHz	6 parts in 10 ¹¹ 6 parts in 10 ¹¹	HP 3325A and Agilent 8642M with ext. GPS timebase
Frequency – Measure	Up to 26.5 GHz	6 parts in 10 ¹¹	HP 5351B Frequency counter with ext. GPS timebase
Timers and Stopwatches ³	(60 to 3600) s	0.05 s	Electronic Counter

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 Based on using the standard at the temperature the Fluke 5700A, Fluke 5522A 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 ± 1 °C of use. CMC is based upon one-year floor specifications and is read as output plus range. CMC is expressed as either a specific value that covers the full range or as a combination of the percent or portion of the reading plus a fixed floor specification (for measure parameters).
- ⁵ Based on using the standard at the temperature the HP 3458A was calibrated ($t_{cal} \pm 5$ °C) and an auto-calibration (ACAL) was performed within the previous 24 hours (± 1 °C of ambient temperature). CMC is based upon one-year floor specifications and is read as output plus range. CMC is expressed as either a specific value that covers the full range or as a combination of the percent or portion of the reading plus a fixed floor specification (for measure parameters).
- ⁶ The standards used don't include the individual load cells calibrated using ASTM standards & methods.
- ⁷ 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.
- ⁸ In the statement of CMC a percentage refers to percent of reading unless otherwise noted.
- ⁹ 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.
- ¹⁰ Contributions from the "best existing device" are not included in the CMC claim.



Accredited Laboratory

A2LA has accredited

J.A. KING & COMPANY, LLC

Huntsville, AL

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 April 2017)*.



Presented this 17th day of April 2018.

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

President and CEO
For the Accreditation Council
Certificate Number 1741.17
Valid to April 30, 2020

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