



World Class Accreditation

The American Association for Laboratory Accreditation

Accredited Laboratory

A2LA has accredited

J.A. KING & COMPANY LLC

Greer, SC

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/NCSL Z540-1-1994 and any additional program requirements in the field of calibration. 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 28th day of May 2009.





Peter Meyer

President & CEO
For the Accreditation Council
Certificate Number 1741.04
Valid to May 31, 2011
Revised: January 21, 2010

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

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

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CALIBRATION

Valid To: May 31, 2011

Certificate Number: 1741.04

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 ^{2,4} (±)	Comments
Hand Tools ³ – Micrometers, Calipers, Depth Gages, Snap Gages	(0 to 12) in (12 to 24) in (24 to 40) in	(0.7 + 9.3L + 0.6R) μin (53 + 8L + 0.6R) μin (230 + 6.4L + 0.6R) μin	Master gage blocks 24" check master 40" check master
Height Gages ³	(0 to 12) in (12 to 24) in (24 to 40) in	(0.7 + 9.3L + 0.6R) μin (53 + 8L + 0.6R) μin (230 + 6.4L + 0.6R) μin	Master gage blocks 24" check master 40" check master
Linear Indicators ³ (Dial & Test)	(0 to 2) in	(0.7 + 9.3L + 0.6R) μin	Master gage blocks Indicator calibrators
Angle Indicators and Protractors	15°, 30°, 45°, 60°, 75°, 90° 0°, 15°, 30°, 45°, 60°, 75°, 90°, 105°, 135°	0.05° 0.5°	Angle block set Angle block set and angle master
Pin Gages ³	(0 to 1) in	75 μin	Digimatic micrometer
Metal Tape Measures & Steel Rules	(0.1 to 25) ft	(5.2 + 69L + 0.6R) μin	Gage Blocks

Parameter/Equipment	Range	CMC ² (±)	Comments
Optical Comparator ³			
X-Y Linearity	Up to 12 in.	150 μin	Glass master and scales
Magnification	×10 to ×250	200 μin	
Angle	0° to 90°	0.1°	Angle block set

II. Electrical – DC/Low Frequency

Parameter/Equipment	Range	CMC ^{2,5,6} (±)	Comments
DC Voltage – Measure	(0 to 100) mV 100 mV to 1 V (1 to 10) V (10 to 100) V (100 to 1000) V (1 to 6) kV (6 to 20) kV (20 to 35) kV (35 to 40) kV	11 μV/V + 3 μV 10 μV/V + 0.3 μV 10 μV/V + 0.05 μV 12 μV/V + 0.3 μV 27 μV/V + 0.1 μV 1.2 % 2.4 % 1.2 % 2.4 %	HP 3458A Fluke 80K-6 & DMM Fluke 80K-40 & DMM
DC Voltage – Generate	(0 to 330) mV (0 to 3.3) V (0 to 33) V (30 to 330) V (100 to 1000) V	21 μV/V + 1 μV 12 μV/V + 2 μV 13 μV/V + 15 μV 19 μV/V + 150 μV 19 μV/V + 1.5 mV	Fluke 5520A
DC Current – Measure	(0 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	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	HP 3458A
DC Current – Generate	(0 to 330) μA (0 to 3.3) mA (0 to 33) mA (0 to 330) mA (0 to 1.1) A (1.1 to 3) A (0 to 11) A (11 to 21) A	0.015 % + 0.02 μA 0.01 % + 0.05 μA 0.01 % + 0.25 μA 0.01 % + 2.5 μA 0.02 % + 40 μA 0.038 % + 40 μA 0.05 % + 500 μA 0.1 % + 750 μA	Fluke 5520A

Parameter/Equipment	Range	CMC ^{2, 5, 6} (±)	Comments
DC Current – Generate (cont)	1 mA to 100 A	0.055 % of setting	Valhalla 2555A
Resistance – Measure	(0 to 10) Ω (10 to 100) Ω 100 Ω to 1kΩ (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 14 μΩ/Ω + 0.5 mΩ 14 μΩ/Ω + 5 mΩ 13 μΩ/Ω + 50 mΩ 18 μΩ/Ω + 2 Ω 53 μΩ/Ω + 100 Ω 0.051 % + 1 kΩ 0.5 % + 10 kΩ	HP 3458A
Resistance – Generate	(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	41 μΩ/Ω + 0.001 Ω 31 μΩ/Ω + 0.0015 Ω 29 μΩ/Ω + 0.0014 Ω 29 μΩ/Ω + 0.002 Ω 29 μΩ/Ω + 0.02 Ω 29 μΩ/Ω + 0.2 Ω 33 μΩ/Ω + 2 Ω 61 μΩ/Ω + 30 Ω 0.013 % + 50 Ω 0.025 % + 2.5 kΩ 0.05 % + 3 kΩ 0.3 % + 100 kΩ 1.5 % + 500 kΩ	Fluke 5520A
Capacitance	40 pF to 1.2 μF	0.5 % + 3 pF	HP 4440B
(0.19 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 330 μF to 10.999 mF (11 to 110) mF	(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 2) Hz (0 to 0.20) Hz	0.52 % + 0.01 nF 0.28 % + 0.1 nF 0.28 % + 0.3 nF 0.28 % + 1 nF 0.28 % + 3 nF 0.28 % + 10 nF 0.43 % + 30 nF 0.48 % + 100 nF 0.48 % + 300 nF 0.48 % + 10 μF 1.2 % + 100 μF	Fluke 5520A
DC Input Devices ³ — Simulate & Measure	(1 to 24) DCV output (1 to 60) DC mA output (1 to 150) DC mV output	0.07 % 0.1 % 0.05 %	Transmation 1080

Parameter/Range	Frequency	CMC ^{2,5,6} (±)	Comments
AC Voltage – Generate			
(1 to 33) mV	(10 to 45) Hz 45 Hz to 10 kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 500) kHz	0.08 % + 6 μV 0.015 % + 6 μV 0.02 % + 6 μV 0.1 % + 6 μV 0.35 % + 12 μV 0.8 % + 50 μV	Fluke 5520A
(33 to 330) mV	(10 to 45) Hz 45 Hz to 10 kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 500) kHz	0.03 % + 8 μV 0.015 % + 8 μV 0.016 % + 8 μV 0.035 % + 8 μV 0.08 % + 32 μV 0.2 % + 70 μV	
(0.33 to 3.3) V	(10 to 45) Hz 45 Hz to 10 kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 500) kHz	0.03 % + 50 μV 0.015 % + 60 μV 0.019 % + 60 μV 0.03 % + 50 μV 0.07 % + 130 μV 0.24 % + 600 μV	
(3.3 to 33) V	(10 to 45) Hz 45 Hz to 10 kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.03 % + 650 μV 0.015 % + 600 μV 0.024 % + 600 μV 0.035 % + 600 μV 0.09 % + 1.6 mV	
(33 to 330) V	45 Hz to 1 kHz (1 to 10) kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.019 % + 2 mV 0.02 % + 6 mV 0.025 % + 6 mV 0.03 % + 6 mV 0.2 % + 50 mV	
(330 to 1020) V	45 Hz to 10 kHz	0.03 % + 10 mV	

Parameter/Range	Frequency	CMC ^{2, 5, 6} (±)	Comments
AC Voltage – Measure			
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 % of rdg + 0.03 % of rng 0.021 % of rdg + 0.01 % of rng 0.031 % of rdg + 0.01 % of rng 0.11 % of rdg + 0.01 % of rng 0.51 % of rdg + 0.01 % of rng 4.1 % of rdg + 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 % of rdg + 0.004 % of rng 0.008 % of rdg + 0.002 % of rng 0.015 % of rdg + 0.002 % of rng 0.031 % of rdg + 0.002 % of rng 0.081 % of rdg + 0.002 % of rng 0.31 % of rdg + 0.01 % of rng	
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 % of rdg + 0.004 % of rng 0.021 % of rdg + 0.002 % of rng 0.021 % of rdg + 0.002 % of rng 0.036 % of rdg + 0.002 % of rng 0.13 % of rdg + 0.002 % of rng 0.41 % of rdg + 0.01 % of rng	
1000 V	(1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.041 % of rdg + 0.004 % of rng 0.041 % of rdg + 0.002 % of rng 0.061 % of rdg + 0.002 % of rng 0.013 % of rdg + 0.002 % of rng 0.31 % of rdg + 0.002 % of rng	
(1 to 6) kV	(1 to 500) Hz	1.2 %	Fluke 80K-6 & DMM
(6 to 40) kV	(1 to 500) Hz	6.0 %	Fluke 80K-40& DMM
AC Current – Generate			
(0 to 0.33) 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	0.2 % + 0.1 µA 0.15 % + 0.1 µA 0.13 % + 0.1 µA 0.3 % + 0.15 µA 0.8 % + 0.2 µA 1.6 % + 0.4 µA	Fluke 5520A
(0.33 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	0.21 % + 0.15 µA 0.14 % + 0.15 µA 0.11 % + 0.15 µA 0.21 % + 0.2 µA 0.5 % + 0.3 µA 1.0 % + 0.6 µA	

Parameter/Range	Frequency	CMC ^{2,5,6} (±)	Comments
AC Current – Generate (cont)			
(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	0.18 % + 2 µA 0.09 % + 2 µA 0.04 % + 2 µA 0.08 % + 2 µA 0.2 % + 3 µA 0.4 % + 4 µA	Fluke 5520A
(33 to 330) mA	(10 to 20) Hz (20 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (10 to 30) kHz	0.18 % + 20 µA 0.09 % + 20 µA 0.04 % + 20 µA 0.1 % + 50 µA 0.2 % + 100 µA 0.4 % + 200 µA	
(0.33 to 1.1) A	(10 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.18 % + 100 µA 0.05 % + 100 µA 0.6 % + 1 mA 2.5 % + 5 mA	
(1.1 to 3.0) A	(10 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.18 % + 100 µA 0.06 % + 100 µA 0.6 % + 1 mA 2.5 % + 5 mA	
(3.0 to 11) A	45 Hz to 1 kHz (1 to 5) kHz	0.11 % + 2 mA 3 % + 2 mA	
(11 to 20.5) A	45 Hz to 1 kHz (1 to 5) kHz	0.16 % + 5 mA 3 % + 5 mA	
1 mA to 100 A	100 Hz 400 Hz 1 kHz	0.23 % of setting 0.35 % of setting 0.52 % of setting	

Parameter/Range	Frequency	CMC ^{2,5,6} (±)	Comments
AC Current – Measure			
(0 to 100) µA	(10 to 20) Hz (20 to 45) Hz 45 Hz to 1 kHz 100 Hz to 5 kHz	0.41 % of rdg + 0.03 % of rng 0.16 % of rdg + 0.03 % of rng 0.07 % of rdg + 0.03 % of rng 0.07 % of rdg + 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 % of rdg + 0.02 % of rng 0.16 % of rdg + 0.02 % of rng 0.07 % of rdg + 0.02 % of rng 0.04 % of rdg + 0.02 % of rng 0.07 % of rdg + 0.02 % of rng 0.41 % of rdg + 0.04 % of rng 0.56 % of rdg + 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 % of rdg + 0.02 % of rng 0.17 % of rdg + 0.02 % of rng 0.09 % of rdg + 0.02 % of rng 0.11 % of rdg + 0.02 % of rng 0.31 % of rdg + 0.02 % of rng 1.1 % of rdg + 0.04 % of rng	
Oscilloscopes –			
Square Wave Amplitude: 50 Ω at 1 kHz	(1 to 556) mV pk – pk 556 mV to 5.56 V pk – pk	0.12 % + 15 µV 0.08 % + 1 µV	Wavetek 9500
1 MΩ at 1 kHz	(1 to 556) mV pk – pk 556 mV to 210 V pk – pk	0.12 % + 15 µV 0.08 % + 1 µV	
DC Volt Amplitude: 50 Ω Load	(0 to 5.56) V	0.026 % + 25 µV	
1 MΩ Load	(0 to 222.4) V	0.026 % + 25 µV	
Level Sine Wave:			
Frequency	(0 to 550) MHz	13 µHz/Hz	
Amplitude	50 kHz Reference 50 kHz to 100 MHz (100 to 550) MHz (550 to 600) MHz	1.6 % of output 1.6 % of output 3.1 % of output 4.1 % of output	
Flatness (Bandwidth)	50 kHz to 100 MHz (100 to 550) MHz (550 to 600) MHz	1.6 % of output 3.1 % of output 4.1 % of output	
Time Marker:	450.5 ps to 55 s	10 µs/s + 10 ps	
Rise Time: 10 Hz to 2 MHz	150 ps	27 ps	

III. Mechanical

Parameter/Equipment	Range	CMC ^{2,4,6} (±)	Comments
Scales and balances ³	(1 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 (Above 1000) g	0.041 mg + 0.6R 0.06 mg + 0.6R 0.089 mg + 0.6R 0.14 mg + 0.6R 0.3 mg + 0.6R 0.6 mg + 0.6R 0.9 mg + 0.6R 1.4 mg + 0.6R 3 mg + 0.6R 3 mg per 1000 g + 0.6R	ASTM Class 1 weights (Applied Load)
	(1 to 20 000) g (Above 20 000) g	0.017 % + 0.6R 0.017 % per 20 000 g + 0.6R	Class F weights (Applied Load)
	Up to 1000 lb (1000 to 63 000) lb	0.017 % + 0.6R 0.017 % per 1000 lb + 0.6R	Class F weights (Applied Load)
Force Gages	(1 to 20 000) g (Above 20 000) g Up to 500 lb	0.017 % + 0.6R 0.017 % per 20 000 g + 0.6R 0.017 % + 0.6R	Class F weights (Applied load)
Vacuum ³	(0 to 30) in Hg	0.04 % full scale	Mensor DPG 210
Torque Wrenches	4 in·lb to 600 ft·lb	0.65 %	CDI suretest 5000-ST
Torque Testers	4 in·lb to 600 ft·lb	0.065 %	Class F weights and torque arms
Barometric Pressure ³	(22 to 34) in Hg	0.004 in Hg	Druck DPI-740
Speed/RPM/Rate ³ – Simulation	(2.5 to 100 000) RPM	0.004 %	Agilent 33220A
Speed/RPM/Rate ³ – Non-Contact	(6 to 60 000) RPM	0.02 %	Monarch tachometer

Parameter/Equipment	Range	CMC ^{2,6} (±)	Comments
Totalizer/Rate Meters ³ – Contact	(1 to 99 999.99) counts	0.25 %	Shimpo tachometer
Non-Contact		0.004 %	Agilent 33220A
Totalizer/Rate Meters ³ – Simulation	(1 to 99 999.99) counts	0.004 %	Agilent 33220A
Pressure ³ –	(0.2 to 1000) psi	0.0084 %	Ruska 2465-753
	(1 to 100) psi	0.05 %	Ametek RK-100
	(5 to 10 000) psi	0.056 %	Ametek DMTQ-100

IV. Thermodynamic

Parameter/Equipment	Range	CMC ² (±)	Comments	
Thermocouple – Simulation & Measure ³	Type J, K, T, E, N	0.37 °C	Applied resources AK-20A	
	Type R, S, B	0.77 °C		
Thermocouple Simulation –	Type B	600 °C to 800 °C	0.45 °C	Fluke 5520A
		800 °C to 1820 °C	0.35 °C	
	Type E	-250 °C to -100 °C	0.51 °C	
		-100 °C to 650 °C	0.18 °C	
		650 °C to 1000 °C	0.23 °C	
	Type J	-210 °C to -100 °C	0.28 °C	
		-100 °C to 760 °C	0.18 °C	
		760 °C to 1200 °C	0.24 °C	
	Type K	-200 °C to -100 °C	0.34 °C	
		-100 °C to 1000 °C	0.27 °C	
		1000 °C to 1372 °C	0.41 °C	

Parameter/Equipment	Range	CMC ² (±)	Comments
Thermocouple Simulation (cont) –			
Type N	-200 °C to -100 °C -100 °C to 410 °C 410 °C to 1300 °C	0.41 °C 0.23 °C 0.28 °C	Fluke 5520A
Type R	0 °C to 250 °C 250 °C to 1000 °C 1000°C to 1767 °C	0.64 °C 0.46 °C 0.5 °C	
Type S	0 °C to 250 °C 250 °C to 1400 °C 1400 °C to 1767 °C	0.48 °C 0.38 °C 0.47 °C	
Type T	-250 °C to -150 °C -150 °C to 0 °C 0 °C to 400 °C	0.64 °C 0.25 °C 0.17 °C	
Humidity ³	(10 to 90) % RH	1.4 % RH	Vaisala HMP-233
Temperature – Measure	-40 °C to 250 °C 251 °C to 400 °C	0.075 °C 0.14 °C	ASL F250 with matching RTD system
RTD – Simulation & Measure ³	-195.5 °C to 815.6 °C	0.43 °C	Fluke 712

V. Time & Frequency

Parameter/Equipment	Range	CMC ² (±)	Comments
Frequency – Generate	0.01 Hz to 2 MHz (Above 2 to 600) MHz	0.23 µHz/Hz + 5 µHz 0.23 µHz/Hz	Fluke 5520A with HP 53131A Wavetek 9500 with HP 53131A
Frequency – Measure	Up to 225 MHz	0.23 µHz/Hz	HP 53131A

Parameter/Equipment	Range	CMC ² (±)	Comments
Timers and Stop Watches, In Laboratory Only –	(2 to 3600) s	0.1 s	HP 53131A with Agilent 33220A
Timers and Stop Watches, In Field Only ³ –	(2 to 3600) s	0.2 s	Monarch tachometer and timer

¹ This laboratory offers commercial and field calibration services.

² Calibration and Measurement Capability (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. Calibration and Measurement Capabilities 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 In the statement of CMC, L is the numerical value of the nominal length of the device measured in inches, and R is the numerical value of the resolution of the device in microinches.

⁵ The measurands stated are measured with the HP 3458A, Fluke 5520A and Wavetek 9500. This capability is suitable for the calibration of the devices intended to generate the measurand in the ranges indicated. 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 Unless otherwise noted, percentage refers to percent of reading.