



Laboratory  
Accreditation  
Bureau

Certificate of Accreditation

ISO/IEC 17025:2005

Certificate Number L2216.01

Cal Lab Company, Inc.  
3695 N. 126<sup>th</sup> Street  
Brookfield, WI 53005

**has met the requirements set forth in L-A-B's policies and procedures, and all requirements of ANSI Z540-1, ANSI/NCSL Z540.3 and ISO/IEC 17025:2005 "General Requirements for the competence of Testing and Calibration Laboratories." 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 January 2009).**

**Accreditation valid through September 29, 2013**

**R. Douglas Leonard, Jr., Managing Director  
Laboratory Accreditation Bureau  
Presented the 23<sup>rd</sup> of December 2010**

\*Laboratory Accreditation Bureau is found to be in compliance with ISO/IEC 17011:2004 and recognized by ILAC (International Laboratory Accreditation Cooperation) and NACLA (National Cooperation for Laboratory Accreditation).

# Scope of Accreditation

## For

# Cal Lab Company, Inc.

3695 N. 126th Street  
Brookfield, WI 53005  
J. Brent Snoddy  
262-790-1916

In recognition of a successful assessment to ISO/IEC 17025:2005, ANSI Z540-1 and ANSI/NCSL Z540.3, accreditation is granted to **Cal Lab Company, Inc.** to perform the following **Calibrations**:

Accreditation granted through: **September 29, 2013**

## Calibration

### Mass – Pressure

Calibration Parameter/Equipment	Range	Calibration and Measurement Capability (+/-) <sup>2</sup>	Remarks
Pressure – Measure & Generate <sup>1</sup>	(0 to 15) psi	0.01 psig	Pressure Transducers
	(-15 to 30) psi	0.026 psig	
	(0 to 100) psi	0.06 psig	
	(0 to 500) psi	0.3 psig	
	(0 to 1 000) psi	0.66 psig	
	(0 to 10 000) psi	10 psig	

### Mass – Vacuum

Calibration Parameter/Equipment	Range	Calibration and Measurement Capability (+/-) <sup>2</sup>	Remarks
Vacuum – Measure & Generate <sup>1</sup>	(0 to -14) psi	0.013 psig	Pressure Transducer

### Electrical - Voltage

Calibration Parameter/Equipment	Range	Calibration and Measurement Capability (+/-) <sup>2</sup>	Remarks
DC Voltage – Source	(0 to 220) mV	8 nV/mV + 0.61 μV	Fluke 5700A
	(0.22 to 2.2) V	7 μV/V + 1 μV	

Calibration Parameter/Equipment	Range	Calibration and Measurement Capability (+/-) <sup>2</sup>	Remarks
	(2.2 to 11) V	7 $\mu$ V/V + 4 $\mu$ V	
	(11 to 22) V	7 $\mu$ V/V + 6.6 $\mu$ V	
	(22 to 220) V	8 $\mu$ V/V + 81 $\mu$ V	
	(220 to 1000) V	9 $\mu$ V/V + 0.5 mV	
DC Voltage - Source <sup>1</sup>	(0 to 330) mV	0.018 $\mu$ V/mV + 2.1 V	Fluke 5520A/SC1100
	(0.3 to 3.3) V	10.6 $\mu$ V/V + 3.8 $\mu$ V	
	(3.3 to 33) V	12 $\mu$ V/V + 35 $\mu$ V	
	(33 to 330) V	18 $\mu$ V/V + 260 $\mu$ V	
	(330 to 1 000) V	18 mV/V + 1.5 mV	
DC Voltage - Source	(1 to 15) kV	1 mV / V + 85 mV	Hipotronics Source, Ross Divider & Keithley 2000
DC Voltage - Source <sup>1</sup>	(10 to 100) kV	5 V / kV + 2 V	Hipotronics Source & KVM 100
AC Voltage - Source (0.22 to 2.2) mV	(10 to 20) Hz	0.5 $\mu$ V/mV + 4.5 $\mu$ V	Fluke 5700A
	(20 to 40) Hz	0.2 $\mu$ V/mV + 4.5 $\mu$ V	
	40 Hz to 20 kHz	0.11 $\mu$ V/mV + 4.5 $\mu$ V	
	(20 to 50) kHz	0.37 $\mu$ V/mV + 4.5 $\mu$ V	
	(50 to 100) kHz	0.85 $\mu$ V/mV + 7 $\mu$ V	
	(100 to 300) kHz	1.1 $\mu$ V/mV + 13 $\mu$ V	
	(300 to 500) kHz	2.7 $\mu$ V/mV + 23 $\mu$ V	
500 kHz to 1 MHz	3.4 $\mu$ V/mV + 25 $\mu$ V		
AC Voltage - Source (2.2 to 22) mV	(10 to 20) Hz	0.5 $\mu$ V/mV + 5 $\mu$ V	Fluke 5700A
	(20 to 40) Hz	0.2 $\mu$ V/mV + 5 $\mu$ V	

Calibration Parameter/Equipment	Range	Calibration and Measurement Capability (+/-) <sup>2</sup>	Remarks
	40 Hz to 20 kHz	0.1 $\mu\text{V}/\text{mV}$ + 5 $\mu\text{V}$	
	(20 to 50) kHz	0.4 $\mu\text{V}/\text{mV}$ + 5 $\mu\text{V}$	
	(50 to 100) kHz	0.8 $\mu\text{V}/\text{mV}$ + 7 $\mu\text{V}$	
	(100 to 300) kHz	1 $\mu\text{V}/\text{mV}$ + 12 $\mu\text{V}$	
	(300 to 500) kHz	2 $\mu\text{V}/\text{mV}$ + 25 $\mu\text{V}$	
	500 kHz to 1 MHz	3 $\mu\text{V}/\text{mV}$ + 25 $\mu\text{V}$	
AC Voltage - Source (22 to 220) mV	(10 to 20) Hz	0.5 $\mu\text{V}/\text{mV}$ + 13 $\mu\text{V}$	Fluke 5700A
	(20 to 40) Hz	0.2 $\mu\text{V}/\text{mV}$ + 12 $\mu\text{V}$	
	40 Hz to 20 kHz	0.1 $\mu\text{V}/\text{mV}$ + 8 $\mu\text{V}$	
	(20 to 50) kHz	0.3 $\mu\text{V}/\text{mV}$ + 8 $\mu\text{V}$	
	(50 to 100) kHz	0.8 $\mu\text{V}/\text{mV}$ + 25 $\mu\text{V}$	
	(100 to 300) kHz	1 $\mu\text{V}/\text{mV}$ + 25 $\mu\text{V}$	
	(300 to 500) kHz	2 $\mu\text{V}/\text{mV}$ + 35 $\mu\text{V}$	
	500 kHz to 1 MHz	3 $\mu\text{V}/\text{mV}$ + 80 $\mu\text{V}$	
AC Voltage - Source (0.22 to 2.2) V	(10 to 20) Hz	0.5 mV/V + 80 $\mu\text{V}$	Fluke 5700A
	(20 to 40) Hz	0.2 mV/V + 0.25 mV	
	40 Hz to 20 kHz	70 $\mu\text{V}/\text{V}$ + 6.5 $\mu\text{V}$	
	(20 to 50) kHz	0.1 mV/V + 16 $\mu\text{V}$	
	(50 to 100) kHz	0.2 mV/V + 70 $\mu\text{V}$	
	(100 to 300) kHz	0.4 mV/V + 0.13 mV	
	(300 to 500) kHz	1 mV/V + 0.35 mV	
	500 kHz to 1 MHz	2 mV/V + 0.85 mV	

Calibration Parameter/Equipment	Range	Calibration and Measurement Capability (+/-) <sup>2</sup>	Remarks
AC Voltage - Source (2.2 to 22) V	(10 to 20) Hz	0.5 mV/V + 0.80 mV	Fluke 5700A
	(20 to 40) Hz	0.2 mV/V + 0.25 mV	
	40 Hz to 20 kHz	70 $\mu$ V/V + 62 $\mu$ V	
	(20 to 50) kHz	0.1 mV/V + 0.16 mV	
	(50 to 100) kHz	0.2 mV/V + 0.35 mV	
	(100 to 300) kHz	0.5 mV/V + 1.5 mV	
	(300 to 500) kHz	1 mV/V + 4.3 mV	
	500 kHz to 1 MHz	3 mV/V + 8.5 mV	
AC Voltage - Source (22 to 220) V	(10 to 20) Hz	0.5 mV/V + 8 mV	Fluke 5700A
	(20 to 40) Hz	0.2 mV/V + 2.5 mV	
	40 Hz to 20 kHz	80 $\mu$ V/V + 0.83 mV	
	(20 to 50) kHz	0.2 mV/V + 3.5 mV	
	(50 to 100) kHz	0.5 mV/V + 8 mV	
	(100 to 300) kHz	1 mV/V + 90 mV	
	(300 to 500) kHz	5 mV/V + 90 mV	
	500 kHz to 1 MHz	10 mV/V + 190 mV	
AC Voltage - Source (220 to 1100) V	(15 to 50) Hz	80 $\mu$ V/V + 1.8 mV	Fluke 5700A
	50 Hz to 1 kHz	0.4 mV/V + 16 mV	
AC Voltage - Source <sup>1</sup> (1 to 33) mV	(10 to 45) Hz	0.8 $\mu$ V/mV + 6 $\mu$ V	Fluke 5520A/SC1100
	45 Hz to 10 kHz	0.15 $\mu$ V/mV + 6.3 $\mu$ V	
	(10 to 20) kHz	0.2 $\mu$ V/mV + 6.3 $\mu$ V	
	(20 to 50) kHz	1 $\mu$ V/mV + 6.2 $\mu$ V	

Calibration Parameter/Equipment	Range	Calibration and Measurement Capability (+/-) <sup>2</sup>	Remarks
	(50 to 100) kHz	3.5 $\mu$ V/mV + 12 $\mu$ V	
	(100 to 500) kHz	8 $\mu$ V/mV + 50 $\mu$ V	
AC Volts, Source <sup>1</sup> (33 to 330) mV	(10 to 45) Hz	0.3 $\mu$ V/mV + 8.1 $\mu$ V	Fluke 5520A/SC1100
	45 Hz to 10 kHz	0.15 $\mu$ V/mV + 8.1 $\mu$ V	
	(10 to 20) kHz	0.16 $\mu$ V/mV + 8.1 $\mu$ V	
	(20 to 50) kHz	0.35 $\mu$ V/mV + 8.1 $\mu$ V	
	(50 to 100) kHz	0.8 $\mu$ V/mV + 32 $\mu$ V	
	(100 to 500) kHz	2 $\mu$ V/mV + 70 $\mu$ V	
AC Voltage - Source <sup>1</sup> (0.33 to 3.3) V	(10 to 45) Hz	300 $\mu$ V/V + 50 $\mu$ V	Fluke 5520A/SC1100
	45 Hz to 10 kHz	150 $\mu$ V/V + 60 $\mu$ V	
	(10 to 20) kHz	190 $\mu$ V/V + 60 $\mu$ V	
	(20 to 50) kHz	300 $\mu$ V/V + 50 $\mu$ V	
	(50 to 100) kHz	700 $\mu$ V/V + 130 $\mu$ V	
	(100 to 500) kHz	2.4 mV/V + 0.6 mV	
AC Voltage - Source <sup>1</sup> (3.3 to 33) V	(10 to 45) Hz	0.3 mV/V + 0.65 mV	Fluke 5520A/SC1100
	45 Hz to 10 kHz	0.3 mV/V + 0.65 mV	
	(10 to 20) kHz	0.24 mV/V + 0.6 mV	
	(20 to 50) kHz	0.35 mV/V + 0.6 mV	
	(50 to 100) kHz	0.9 mV/V + 1.6 mV	
AC Voltage - Source <sup>1</sup> (33 to 330) V	45 Hz to 1 kHz	0.19 mV/V + 2 mV	Fluke 5520A/SC1100
	(1 to 10) kHz	0.2 mV/V + 6 mV	
	(10 to 20) kHz	0.25 mV/V + 6 mV	

Calibration Parameter/Equipment	Range	Calibration and Measurement Capability (+/-) <sup>2</sup>	Remarks
	(20 to 50) kHz	0.3 mV/V + 6 mV	
	(50 to 100) kHz	2 mV/V + 50 mV	
AC Voltage - Source <sup>1</sup> (330 to 1 000) V	(45 to 1) kHz	0.3 mV/V + 10 mV	Fluke 5520A/SC1100
	(1 to 5) kHz	0.25 mV/V + 10 mV	
	(5 to 10) kHz	0.3 mV/V + 10 mV	
DC Voltage – Measure	(0 to 200) mV	4 μV / V + 0.11 μV	Fluke 8508A
	(0.2 to 2) V	4 μV + 3 μV / V	
	(2 to 20) V	4 μV + 3 μV / V	
	(20 to 200) V	0.04 mV + 4.5 μV / V	
	(200 to 1000) V	0.53 mV + 4.5 μV / V	
	(1 to 15) kV	1 mV / V + 85 mV	Ross Divider & Keithley 2000
DC Voltage – Measure <sup>1</sup>	(1 to 100) kV	5 V / kV + 2 V	KVM 100
	(20 to 200) kV	5 V / kV + 20 V	KVM 200
pH Calibrators	± 120 mV	0.027 mV	Fluke 8508
AC Voltage – Measure Up to 200 mV	(1 to 10) Hz	14 μV + 160 μV / V	Fluke 8508A
	(10 to 40) Hz	4 μV + 0.13 mV / V	
	(40 to 100) Hz	4 μV + 0.11 mV / V	
	100 Hz to 2 kHz	2 μV + 0.1 mV / V	
	(2 to 10) kHz	4 μV + 0.1 mV / V	
	(10 to 30) kHz	8 μV + 0.3 mV / V	
	(30 to 100) kHz	20 μV + 0.7 mV / V	
(0.2 to 2) V	(1 to 10) Hz	120 μV + 0.140 mV / V	Fluke 8508A

Calibration Parameter/Equipment	Range	Calibration and Measurement Capability (+/-) <sup>2</sup>	Remarks
	(10 to 40) Hz	20 $\mu$ V + 0.1 mV / V	
	(40 to 100) Hz	20 $\mu$ V + 85 $\mu$ V / V	
	100 Hz to 2 kHz	20 $\mu$ V + 65 $\mu$ V / V	
	(2 to 10) kHz	20 $\mu$ V + 85 $\mu$ V / V	
	(10 to 30) kHz	40 $\mu$ V + 0.20 mV / V	
	(30 to 100) kHz	0.2 mV + 0.5 mV / V	
	(100 to 300) kHz	2 mV + 3 mV / V	
	300 kHz to 1 MHz	20 mV + 10 mV / V	
(2 to 20) V	(1 to 10) Hz	1.2 mV + 0.14 mV / V	Fluke 8508A
	(10 to 40) Hz	0.2 mV + 0.11 mV / V	
	(40 to 100) Hz	0.19 mV + 0.09 mV / V	
	100 Hz to 2 kHz	0.19 mV + 0.07 mV / V	
	(2 to 10) kHz	0.19 mV + 0.09 mV / V	
	(10 to 30) kHz	0.38 mV + 0.22 mV / V	
	(30 to 100) kHz	1.9 mV + 0.53 mV / V	
	(100 to 300) kHz	20 mV + 3.2 mV / V	
	300 kHz to 1 MHz	0.2 V + 11 mV / V	
(20 to 200) V	(10 to 40) Hz	12 mV + 0.15 mV / V	Fluke 8508A
	(10 to 40) Hz	2 mV + 0.11 mV / V	
	(40 to 100) Hz	2 mV + 90 $\mu$ V / V	
	100 Hz to 2 kHz	2 mV + 16 $\mu$ V / V	
	(2 to 10) kHz	2 mV + 89 $\mu$ V / V	

Calibration Parameter/Equipment	Range	Calibration and Measurement Capability (+/-) <sup>2</sup>	Remarks	
	(10 to 30) kHz	4 mV + 0.22 mV / V		
	(30 to 100) kHz	20 mV + 0.53 mV / V		
	(100 to 300) kHz	0.2 V + 3.2 mV / V		
	300 kHz to 1 MHz	2 V + 11 mV / V		
(200 to 1000) V	(1 to 10) Hz	0.38 mV / V + 21 mV	Fluke 8508A 300 V, add 0.00004 (reading - 300) <sup>2</sup> μV/V	
	(10 to 40) Hz	0.12 mV / V + 20 mV		
	40 Hz to 10 kHz	0.3 mV / V + 10 mV		
	(10 to 30) kHz	0.2 mV / V + 40 mV		
	(30 to 100) kHz	0.0005 mV / V + 0.21 mV		
AC Voltage – Measure	(1 to 10) kV @ 60Hz	10 mV / V + 17 mV	Ross Divider & Keithley 2000	
AC Voltage – Measure <sup>1</sup>	(1 to 100) kV	5 V / kV + 2 V	KVM 100	
	(20 to 200) kV	5 V / kV + 20 V	KVM 200	
Electrical Simulation of RTD Indicating Devices 1	(-200 to -80) °C	0.052 °C	Fluke 5520A/SC1100	
	(-80 to 0) °C	0.052 °C		
	(0 to 100) °C	0.07 °C		
	(100 to 300) °C	0.091 °C		
	Pt 385, 100 Ω	(300 to 400) °C		0.1 °C
		(400 to 630) °C		0.12 °C
		(630 to 800) °C		0.23 °C
Pt 385, 200 Ω		(-200 to -80) °C	0.043 °C	Fluke 5520A/SC1100
	(-80 to 0) °C	0.043 °C		
	(0 to 100) °C	0.043 °C		

Calibration Parameter/Equipment	Range	Calibration and Measurement Capability (+/-) <sup>2</sup>	Remarks
	(100 to 260) °C	0.052 °C	
	(260 to 300) °C	0.12 °C	
	(300 to 400) °C	0.13 °C	
	(400 to 600) °C	0.14 °C	
	(600 to 630) °C	0.16 °C	
Pt 385, 500 Ω	(-200 to -80) °C	0.043 °C	Fluke 5520A/SC1100
	(-80 to 0) °C	0.052 °C	
	(0 to 100) °C	0.052 °C	
	(100 to 260) °C	0.062 °C	
	(260 to 300) °C	0.081 °C	
	(300 to 400) °C	0.081 °C	
	(400 to 600) °C	0.091 °C	
	(600 to 630) °C	0.11 °C	
Pt 385, 1000 Ω	(-200 to -80) °C	0.034 °C	Fluke 5520A/SC1100
	(-80 to 0) °C	0.034 °C	
	(0 to 100) °C	0.043 °C	
	(100 to 260) °C	0.052 °C	
	(260 to 300) °C	0.062 °C	
	(300 to 400) °C	0.072 °C	
	(400 to 600) °C	0.072 °C	
Pt 3916, 100 Ω	(-200 to -190) °C	0.25 °C	Fluke 5520A/SC1100

Calibration Parameter/Equipment	Range	Calibration and Measurement Capability (+/-) <sup>2</sup>	Remarks
	(-190 to -80) °C	0.043 °C	
	(-80 to 0) °C	0.053 °C	
	(0 to 100) °C	0.062 °C	
	(100 to 260) °C	0.072 °C	
	(260 to 300) °C	0.082 °C	
	(300 to 400) °C	0.092 °C	
	(400 to 600) °C	0.1 °C	
	(600 to 630) °C	0.23 °C	
Pt 3926, 100 Ω	(-200 to -80) °C	0.053 °C	Fluke 5520A/SC1100
	(-80 to 0) °C	0.053 °C	
	(0 to 100) °C	0.072 °C	
	(100 to 300) °C	0.092 °C	
	(300 to 400) °C	0.1 °C	
	(400 to 630) °C	0.12 °C	
PtNi 385, 120 Ω	(-80 to 0) °C	0.083 °C	Fluke 5520A/SC1100
	(0 to 100) °C	0.083 °C	
	(100 to 260) °C	0.14 °C	
Cu 427, 10 Ω	(-100 to 260) °C	0.3 °C	Fluke 5520A/SC1100
Electrical Simulation of Thermocouple Indicating Devices 1  Type B	(600 to 800) °C	0.44 °C	Fluke 5520A/SC1100
	(800 to 1 000) °C	0.34 °C	
	(1 000 to 1 550) °C	0.3 °C	
	(1 550 to 1 820) °C	0.33 °C	

Calibration Parameter/Equipment	Range	Calibration and Measurement Capability (+/-) <sup>2</sup>	Remarks
Type C	(0 to 150) °C	0.3 °C	Fluke 5520A/SC1100
	(150 to 650) °C	0.26 °C	
	(650 to 1 000) °C	0.31 °C	
	(1 000 to 1 800) °C	0.5 °C	
	(1 800 to 2 316) °C	0.84 °C	
Type E	(-250 to -100) °C	0.5 °C	Fluke 5520A/SC1100
	(-100 to -25) °C	0.16 °C	
	(-25 to 350) °C	0.14 °C	
	(350 to 650) °C	0.16 °C	
	(650 to 1 000) °C	0.21 °C	
Type J	(-210 to -100) °C	0.27 °C	Fluke 5520A/SC1100
	(-100 to -30) °C	0.16 °C	
	(-30 to 150) °C	0.14 °C	
	(150 to 760) °C	0.17 °C	
	(760 to 1 200) °C	0.23 °C	
Type K	(-200 to -100) °C	0.33 °C	Fluke 5520A/SC1100
	(-100 to -25) °C	0.18 °C	
	(-25 to 120) °C	0.16 °C	
	(120 to 1 000) °C	0.26 °C	
	(1 000 to 1 372) °C	0.4 °C	
Type N	(-200 to -100) °C	0.4 °C	Fluke 5520A/SC1100
	(-100 to -25) °C	0.22 °C	

Calibration Parameter/Equipment	Range	Calibration and Measurement Capability (+/-) <sup>2</sup>	Remarks
	(-25 to 120) °C	0.19 °C	
	(120 to 410) °C	0.18 °C	
	(410 to 1 300) °C	0.27 °C	
Type R	(0 to 250) °C	0.57 °C	Fluke 5520A/SC1100
	(250 to 400) °C	0.57 °C	
	(400 to 1 000) °C	0.33 °C	
	(1 000 to 1 767) °C	0.4 °C	
Type S	(0 to 250) °C	0.47 °C	Fluke 5520A/SC1100
	(250 to 1 000) °C	0.36 °C	
	(1 000 to 1 400) °C	0.37 °C	
	(1 400 to 1 767) °C	0.46 °C	
Type T	(-250 to -150) °C	0.63 °C	Fluke 5520A/SC1100
	(-150 to 0) °C	0.24 °C	
	(0 to 120) °C	0.16 °C	
	(120 to 400) °C	0.14 °C	

**Electrical -Resistance**

Calibration Parameter/Equipment	Range	Calibration and Measurement Capability (+/-) <sup>2</sup>	Remarks
Resistance – Source Fixed Points	0 Ω	50 μΩ	Fluke 5700A
	1 Ω	95 μΩ	
	1.9 Ω	0.18 mΩ	
	10 Ω	0.28 mΩ	
	19 Ω	0.51 mΩ	

Calibration Parameter/Equipment	Range	Calibration and Measurement Capability (+/-) <sup>2</sup>	Remarks
	100 Ω	1.7 mΩ	
	190 Ω	2.5 mΩ	
	1 kΩ	13 mΩ	
	1.9 kΩ	25 mΩ	
	10 kΩ	120 mΩ	
	19 kΩ	230 mΩ	
	100 kΩ	1.4 Ω	
	190 kΩ	2.7 Ω	
	1 MΩ	21 Ω	
	1.9 MΩ	40 Ω	
	10 MΩ	400 Ω	
	19 MΩ	890 Ω	
	100 MΩ	11 kΩ	
Resistance – Measure	(0.1 to 2) Ω	10 μΩ / Ω + 4 μΩ	Fluke 8508A
	(2 to 20) Ω	9 μΩ / Ω + 14 μΩ	
	(20 to 200) Ω	7.5 μΩ / Ω + 50 μΩ	
	200 Ω to 2 kΩ	7.5 μΩ / Ω + 0.5 mΩ	
	(2 to 20) kΩ	8 μΩ / Ω + 5 mΩ	
	(20 to 200) kΩ	7.5 μΩ / Ω + 50 mΩ	
	200 kΩ to 2 MΩ	8.9 μΩ / Ω + 0.9 Ω	
	(2 to 20) MΩ	15 Ω / MΩ + 110 Ω	Fluke 8508A HV mode
	(20 to 200) MΩ	10 kΩ + 65 Ω / MΩ	

Calibration Parameter/Equipment	Range	Calibration and Measurement Capability (+/-) <sup>2</sup>	Remarks
	200 MΩ to 2 GΩ	1 MΩ + 0.51 MΩ / Ω	
	(2 to 20) GΩ	10 MΩ + 0.53 MΩ / Ω	
Resistance – Source <sup>1</sup>	(0 to 11) Ω	40 μΩ / Ω + 1 mΩ	Fluke 5520A/SC1100
	(11 to 33) Ω	30 μΩ / Ω + 1.5 mΩ	
	(33 to 110) Ω	28 μΩ / Ω + 1.4 mΩ	
	(110 to 330) Ω	28 μΩ / Ω + 2.1 mΩ	
	(330 to 1 100) Ω	28 μΩ / Ω + 2 mΩ	
	(1.1 to 3.3) kΩ	28 μΩ / Ω + 200 mΩ	
	(3.3 to 11) kΩ	30 μΩ / Ω + 200 mΩ	
	(11 to 33) kΩ	30 μΩ / Ω + 210 mΩ	
	(33 to 110) kΩ	28 μΩ / Ω + 240 mΩ	
	(110 to 330) kΩ	32 μΩ / Ω + 2 Ω	
	(0.33 to 1.1) MΩ	32 μΩ / Ω + 2 Ω	
	(1.1 to 3.3) MΩ	69 μΩ / Ω + 21 Ω	
	(3.3 to 11) MΩ	130 μΩ / Ω + 50 Ω	
	(11 to 33) MΩ	250 μΩ / Ω + 2.5 kΩ	
	(33 to 110) MΩ	0.5 mΩ / Ω + 3 kΩ	
(110 to 330) MΩ	3 mΩ / Ω + 100 kΩ		
(330 to 1 100) MΩ	15 mΩ / Ω + 0.5 MΩ		

**Electrical -Current**

Calibration Parameter/Equipment	Range	Calibration and Measurement Capability (+/-) <sup>2</sup>	Remarks
AC Current - Source (22 to 220) uA	(10 to 20) Hz	0.7 nA/A + 25 nA	Fluke 5700A

Calibration Parameter/Equipment	Range	Calibration and Measurement Capability (+/-) <sup>2</sup>	Remarks
	(20 to 40) Hz	0.36 nA/A + 20 nA	
	40 Hz to 1 kHz	0.14 nA/A + 16 nA	
	(1 to 5) kHz	0.6 nA/A + 40 nA	
	(5 to 10) kHz	1.6 nA/A + 80 nA	
AC Current - Source (0.22 to 2.2) mA	(10 to 20) Hz	0.7 nA/μA + 41 nA	Fluke 5700A
	(20 to 40) Hz	0.35 nA/μA + 37 nA	
	40 Hz to 1 kHz	0.14 nA/μA + 39 nA	
	(1 to 5) kHz	0.6 nA/μA + 40 nA	
	(5 to 10) kHz	1.6 nA/μA + 80 nA	
AC Current - Source (2.2 to 22) mA	(10 to 20) Hz	0.7 nA/μA + 0.4 μA	Fluke 5700A
	(20 to 40) Hz	0.35 nA/μA + 0.35 μA	
	40 Hz to 1 kHz	0.17 nA/μA + 0.3 μA	
	(1 to 5) kHz	0.6 nA/μA + 4 μA	
	(5 to 10) kHz	1.6 nA/μA + 8 μA	
AC Current - Source (22 to 220) mA	(10 to 20) Hz	0.7 nA/μA + 4.1 μA	Fluke 5700A
	(20 to 40) Hz	0.38 nA/μA + 2.8 μA	
	40 Hz to 1 kHz	0.14 nA/μA + 3.8 μA	
	(1 to 5) kHz	0.6 nA/μA + 40 μA	
	(5 to 10) kHz	1.6 nA/μA + 80 μA	
AC Current - Source (0.22 to 2.2) A	20 Hz to 1 kHz	0.35 nA/μA + 36 μA	Fluke 5700A
	(1 to 5) kHz	0.75 nA/μA + 81 μA	
	(5 to 10) kHz	8.5 nA/μA + 160 μA	

Calibration Parameter/Equipment	Range	Calibration and Measurement Capability (+/-) <sup>2</sup>	Remarks
DC Current - Source	(0 to 220) $\mu$ A	50 $\mu$ A/A + 8.7 nA	Fluke 5700A
	(0.22 to 2.2) mA	50 $\mu$ A/A + 8.3 nA	
	(2.2 to 22) mA	50 $\mu$ A/A + 80 nA	
	(22 to 220) mA	69 $\mu$ A/A + 0.6 $\mu$ A	
	(0.22 to 2.2) A	0.12 mA/A + 0.24 mA	
DC Current – Source <sup>1</sup>	0 $\mu$ A to 330 $\mu$ A	0.14 nA/ $\mu$ A + 27 nA	Fluke 5520A/SC1100
	0.3 mA to 3.3 mA	0.1 $\mu$ A/ $\mu$ A + 52 nA	
	3.3 mA to 33 mA	0.1 $\mu$ A/ $\mu$ A + 0.28 $\mu$ A	
	33 mA to 330 mA	0.1 $\mu$ A/ $\mu$ A + 2.5 $\mu$ A	
	0.33 A to 1.1 A	0.2 mA/A + 40 $\mu$ A	
	1.1 A to 3 A	0.38 mA/A + 40 $\mu$ A	
	3.0 A to 11 A	0.5 mA/A + 0.5 mA	
	11 A to 20 A	1 mA/A + 0.75 mA	
	(20 to 100) A	0.4 mA / A + 22 mA	Ballantine 1620 Transconductance Amplifier
DC Source – Current Clamps <sup>1</sup>	(10 to 150) A	3.6 mA / A + 1.5 mA	Fluke 5520A/SC1100 with Fluke 50-turn coil
	(150 to 1025) A	3.4 mA / A + 0.11 A	
AC Current – Source <sup>1</sup> (30 to 330) $\mu$ A	(10 to 20) Hz	2 nA/ $\mu$ A + 0.1 $\mu$ A	Fluke 5520A/SC1100
	(20 to 45) Hz	1.5 nA/ $\mu$ A + 0.1 $\mu$ A	
	45 Hz to 1 kHz	1.2 nA/ $\mu$ A + 0.1 $\mu$ A	
	(1 to 5) kHz	3 nA/ $\mu$ A + 0.15 $\mu$ A	
	(5 to 10) kHz	8 nA/ $\mu$ A + 0.2 $\mu$ A	

Calibration Parameter/Equipment	Range	Calibration and Measurement Capability (+/-) <sup>2</sup>	Remarks
	(10 to 30) kHz	16 nA/μA + 0.4 μA	
(0.33 to 3.3) mA	(10 to 20) Hz	2 μA/mA + 0.15 μA	Fluke 5520A/SC1100
	(20 to 45) Hz	1.2 μA/mA + 0.15 μA	
	45 Hz to 1 kHz	1 μA/mA + 0.15 μA	
	(1 to 5) kHz	2 μA/mA + 0.2 μA	
	(5 to 10) kHz	5 μA/mA + 0.3 μA	
	(10 to 30) kHz	10 μA/mA + 0.6 μA	
(3.3 to 33) mA	(10 to 20) Hz	1.8 μA/mA + 2 μA	Fluke 5520A/SC1100
	(20 to 45) Hz	0.9 μA/mA + 2 μA	
	45 Hz to 1 kHz	0.4 μA/mA + 2 μA	
	(1 to 5) kHz	0.8 μA/mA + 2 μA	
	(5 to 10) kHz	2 μA/mA + 3 μA	
	(10 to 30) kHz	4 μA/mA + 4 μA	
(33 to 330) mA	(10 to 20) Hz	1.8 μA/mA + 20 μA	Fluke 5520A/SC1100
	(20 to 45) Hz	0.9 μA/mA + 20 μA	
	45 Hz to 1 kHz	0.4 μA/mA + 20 μA	
	(1 to 5) kHz	1 μA/mA + 50 μA	
	(5 to 10) kHz	2 μA/mA + 0.1 mA	
	(10 to 30) kHz	4 μA/mA + 0.2 mA	
(0.33 to 1.1) A	(10 to 45) Hz	1.6 μA/mA + 0.18 mA	Fluke 5520A/SC1100
	45 Hz to 1 kHz	0.44 μA/mA + 0.12 mA	
	(1 to 5) kHz	5.2 μA/mA + 1.3 mA	

Calibration Parameter/Equipment	Range	Calibration and Measurement Capability (+/-) <sup>2</sup>	Remarks
	(5 to 10) kHz	2.2 $\mu$ A/mA + 0.61 mA	
(1.1 to 3) A	(10 to 45) Hz	1.8 mA/A + 0.1 mA	Fluke 5520A/SC1100
	45 Hz to 1 kHz	0.6 mA/A + 0.1 mA	
	(1 to 5) kHz	6 mA/A + 1 mA	
	(5 to 10) kHz	25 mA/A + 5 mA	
(3 to 11) A	(45 to 100) Hz	0.6 mA/A + 2 mA	Fluke 5520A/SC1100
	100 Hz to 1 kHz	1 mA/A + 2 mA	
	(1 to 5) kHz	30 mA/A + 2 mA	
(11 to 20) A	(45 to 100) Hz	1.2 mA/A + 5 mA	Fluke 5520A/SC1100
	100 Hz to 1 kHz	1.5 mA/A + 5 mA	
	(1 to 5) kHz	30 mA/A + 5 mA	
(20 to 100) A	45 Hz to 1 kHz	1.8 mA / A + 0.12 A	Ballantine 1620 Transconductance Amplifier
AC Current Source – Current Clamps <sup>1</sup>  (45 to 65) Hz	(10 to 16.5) A	0.2 mA / A + 0.3 A	Fluke 5520A/SC1100 with Fluke 50-turn coil
	(16.5 to 150) A	2.7 mA / A + 0.25 A	
	(150 to 1025) A	3.8 mA / A + 0.15 A	
(65 to 440) Hz	(10 to 16.5) A	0.27 mA / A + 0.28 A	Fluke 5520A/SC1100 with Fluke 50-turn coil
	(16.5 to 150) A	8.7 mA / A + 0.18 A	
	(150 to 1025) A	9.5 mA / A + 0.14 A	
DC Current – Measure	(0 to 200) $\mu$ A	40 nA / $\mu$ A + 17 nA	Fluke 8508A
	200 $\mu$ A to 2 mA	10 nA / $\mu$ A + 6 nA	
	(2 to 20) mA	0.01 $\mu$ A / mA + 6 nA	

Calibration Parameter/Equipment	Range	Calibration and Measurement Capability (+/-) <sup>2</sup>	Remarks
	(20 to 200) mA	0.03 $\mu$ A / mA + 0.9 $\mu$ A	
	200 mA to 2 A	200 $\mu$ A / A + 17 $\mu$ A	
	(2 to 20) A	0.4 mA / A + 0.41 mA	
AC Current – Measure (20 to 200) $\mu$ A	10 Hz to 10 kHz	0.3 nA / $\mu$ A + 0.025 $\mu$ A	
	(10 to 30) kHz	0.6 nA / $\mu$ A + 0.024 $\mu$ A	
	(30 to 100) kHz	4 nA / $\mu$ A + 0.021 $\mu$ A	
(0.2 to 2) mA	10 Hz to 10 kHz	0.28 $\mu$ A / mA + 0.2 $\mu$ A	
	(10 to 30) kHz	0.65 $\mu$ A / mA + 0.2 $\mu$ A	
	(30 to 100) kHz	4 $\mu$ A / mA + 0.2 $\mu$ A	
(2 to 20) mA	10 Hz to 10 kHz	0.28 $\mu$ A / mA + 2 $\mu$ A	Fluke 8508A
	(10 to 30) kHz	0.65 $\mu$ A / mA + 2 $\mu$ A	
	(30 to 100) kHz	4 $\mu$ A / mA + 2 $\mu$ A	
(20 to 200) mA	10 Hz to 10 kHz	0.25 $\mu$ A / mA + 20 $\mu$ A	
	(10 to 30) kHz	0.6 $\mu$ A / mA + 20 $\mu$ A	
200 mA to 2 A	10 Hz to 2 kHz	0.6 mA / A + 0.2 mA	
	(2 to 10) kHz	0.7 mA / A + 0.2 mA	
	(10 to 30) kHz	3 mA / A + 0.2 mA	
(2 to 20) A	10 Hz to 2 kHz	0.8 mA / A + 2 mA	
	(2 to 10) kHz	2.5 mA / A + 2 mA	

**Electrical -Inductance**

Calibration Parameter/Equipment	Range	Calibration and Measurement Capability (+/-) <sup>2</sup>	Remarks
Inductance – Measure and Generate <sup>1</sup>	(10 to 100) $\mu$ H	2 nH / $\mu$ H + 8 nH	Stanford Research SR720

Calibration Parameter/Equipment	Range	Calibration and Measurement Capability (+/-) <sup>2</sup>	Remarks
1 kHz	(0.1 to 1) mH	0.8 μH / mH + 0.2 μH	
	(1 to 10) mH	0.5 μH / mH + 0.5 μH	
	(10 to 100) mH	0.5 μH / mH + 3 mH	
	(0.1 to 1) H	0.3 mH / H + 0.3 mH	
	1 H to 10 kH	0.5 mH / H + 0.3 mH	

**Electrical -Capacitance**

Calibration Parameter/Equipment	Range	Calibration and Measurement Capability (+/-) <sup>2</sup>	Remarks
Capacitance – Source	(0.19 to 0.4) nF	0.005 nF / nF + 0.01 nF	Fluke 5520A/SC1100
	(0.4 to 1.1) nF	0.005 nF / nF + 0.01 nF	
	(1.1 to 3.3) nF	0.005 nF / nF + 0.01 nF	
	(3.3 to 11) nF	0.002 nF / nF + 0.1 nF	
	(11 to 33) nF	0.002 nF / nF + 0.1 nF	
	(33 to 110) nF	0.003 nF / nF + 0.088 nF	
	(110 to 330) nF	0.002 nF / nF + 0.3 nF	
	(0.33 to 1.1) μF	0.003 μF / μF + 0.98 nF	
	(1.1 to 3.3) μF	0.003 μF / μF + 3 nF	
	(3.3 to 11) μF	0.003 μF / μF + 10 nF	
	(11 to 33) μF	0.004 μF / μF + 30 nF	
	(33 to 110) μF	0.005 μF / μF + 0.1 μF	
	(110 to 330) μF	0.005 μF / μF + 0.3 μF	
	(0.33 to 1.1) mF	0.005 μF / μF + 1 μF	
(1.1 mF to 3.3) mF	0.9 mF / mF + 57 μF		

Calibration Parameter/Equipment	Range	Calibration and Measurement Capability (+/-) <sup>2</sup>	Remarks
	(3.3 to 11) mF	3 $\mu$ F / mF + 55 $\mu$ F	
	(11 to 33) mF	7 $\mu$ F / mF + 48 $\mu$ F	
	(33 to 110) mF	10 $\mu$ F / mF + 0.1 mF	

**Electrical– Oscilloscopes**

Calibration Parameter/Equipment	Range	Calibration and Measurement Capability (+/-) <sup>2</sup>	Remarks
Amplitude – Square Wave (peak to peak) <sup>1</sup> 50 $\Omega$	(1 mV to 6.6 V)	2.5 $\mu$ V / V + 0.04 $\mu$ V	Fluke 5520A/SC1100
1 M $\Omega$ (1 mV to 130 Vpp)	(0.01 to 1) kHz	1 $\mu$ V / V + 0.04 $\mu$ V	
	(1 to 10) kHz	2.5 $\mu$ V / V + 0.04 $\mu$ V	
Leveled Sine Wave Amplitude <sup>1</sup> (@ 50 kHz ref.)	50 kHz to 100 MHz	20 $\mu$ V / V + 0.33 $\mu$ V	Fluke 5520A/SC1100
	(100 to 300) MHz	40 $\mu$ V / V + 0.31 $\mu$ V	
	(300 to 600) MHz	60 $\mu$ V / V + 0.31 $\mu$ V	
	(600 to 1100) MHz	70 $\mu$ V / V + 0.3 $\mu$ V	
Flatness <sup>1</sup> (@ 50 kHz ref.)	50 kHz to 100 MHz	15 $\mu$ V / V + 0.1 $\mu$ V	Fluke 5520A/SC1100
	(100 to 300) MHz	20 $\mu$ V / V + 0.1 $\mu$ V	
	(300 to 600) MHz	40 $\mu$ V / V + 0.1 $\mu$ V	
	(600 to 1050) MHz	50 $\mu$ V / V + 0.1 $\mu$ V	
Time Marker <sup>1</sup>	1 ns to 20 ms	5 ps / $\mu$ s	Fluke 5520A/SC1100
	50 ms	75 $\mu$ s	
	0.1 s	0.13 $\mu$ s	
	0.2 s	0.23 ms	
	0.5 s	0.53 ms	
	1 s	1 ms	

Calibration Parameter/Equipment	Range	Calibration and Measurement Capability (+/-) <sup>2</sup>	Remarks
	2 s	2 ms	
	5 s	5 ms	
Rise Time – Voltage <sup>1</sup>	5 mV to 2.5 V	321 ps	Fluke 5520A/SC1100

**Electrical – Other**

Calibration Parameter/Equipment	Range	Calibration and Measurement Capability (+/-) <sup>2</sup>	Remarks
DC Power <sup>1</sup>	(0 to 336) W	0.04% of output	Fluke 5520A/SC1100
	(336 to 3 060) W	0.054% of output	
	(3 060 to 20 910) W	0.13% of output	
AC Power (45 to 65) Hz <sup>1</sup>	(0.11 to 3) mW	0.14% of output	Fluke 5520A/SC1100
	(3 to 11) mW	0.1% of output	
	(11 to 30) mW	0.16% of output	
	(30 to 110) mW	0.12% of output	
	(110 to 300) mW	0.15% of output	
	(300 to 730) mW	0.13% of output	
	(0.73 to 1.5) W	0.15% of output	
	(1.5 to 6.8) W	0.14% of output	
	(6.8 to 9.2) W	0.14% of output	
	(9.2 to 34) W	0.1% of output	
	(34 to 92) W	0.14% of output	
	(92 to 337) W	0.1% of output	
	(337 to 918) W	0.13% of output	
(918 to 2 244) W	0.11% of output		

Calibration Parameter/Equipment	Range	Calibration and Measurement Capability (+/-) <sup>2</sup>	Remarks
	(2 244 to 4 590) W	0.14% of output	
	(4 590 to 11 220) W	0.12% of output	

**Time and Frequency – Frequency / Period**

Calibration Parameter/Equipment	Range	Calibration and Measurement Capability (+/-) <sup>2</sup>	Remarks
Frequency – Measure	Up to 1.3 GHz	6.9 parts in 10 <sup>11</sup>	Counter & Rubidium Oscillator
Frequency Measuring Equipment	10 MHz	5 parts in 10 <sup>12</sup>	WWV Receiver
	10 MHz	2.3 parts in 10 <sup>11</sup>	Rubidium Oscillator
Tachometers <sup>1</sup> (Contact Type)	(1 to 4 000) rpm	0.88 rpm	Tachometer Calibrator
Tachometers <sup>1</sup> (Non-Contact Type)	(25 to 90 000) rpm	0.29 rpm + 3 µrpm / rpm	Frequency Counter

**Time and Frequency – Time Dissemination**

Calibration Parameter/Equipment	Range	Calibration and Measurement Capability (+/-) <sup>2</sup>	Remarks
Stopwatches & Timers	Up to 24 hr	0.42 s + 6 µs / s	Universal Counter

**Thermodynamic – IR Temperature**

Calibration Parameter/Equipment	Range	Calibration and Measurement Capability (+/-) <sup>2</sup>	Remarks
IR Thermometers <sup>1</sup>	(50 to 500) °C	0.49 °C + 0.001 °C / °C	Blackbody ( ε = 0.95 ) and RTD

**Thermodynamic – Thermodynamic Sources**

Calibration Parameter/Equipment	Range	Calibration and Measurement Capability (+/-) <sup>2</sup>	Remarks
Temperature Generate <sup>1,3</sup>	Ice Point	0.073 °C	Ice Point Well & RTD
	(33° to 300) °C	0.35°C + 0.003 °C / °C	Dry-well & RTD
Temperature Measure <sup>1</sup>	(-196 to 420) °C	0.037 °C	RTD

**Thermodynamic – Humidity**

<b>Calibration Parameter/Equipment</b>	<b>Range</b>	<b>Calibration and Measurement Capability (+/-) <sup>2</sup></b>	<b>Remarks</b>
Humidity – Measure <sup>1,4</sup>	(10 to 80) %	1.4% RH	Thermo-hygrometer

Notes:

- 1) Laboratory offers calibration services at the laboratory's own facilities and at the client or other agreed upon facilities.
- 2) Calibration and Measurement Capabilities represent expanded uncertainties at approximately a 95% confidence level using a coverage factor of k=2.
- 3) Includes Liquid-in-Glass Thermometers, RTDs, Thermocouples, Bi-metallic Thermometers, etc.
- 4) Includes calibration of Relative Humidity instruments in an aqueous salt solution chamber.