



World Class Accreditation

The American Association for Laboratory Accreditation

# Accredited Laboratory

A2LA has accredited

## MICRO PRECISION CALIBRATION DE MEXICO

*Guadalajara, Jalisco, Mexico*

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 8<sup>th</sup> day of April, 2009.



  
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Peter Meyer

President & CEO  
For the Accreditation Council  
Certificate Number 0935.03  
Valid to January 31, 2011  
Revised on March 24, 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: January 31, 2011

Certificate Number: 0935.03

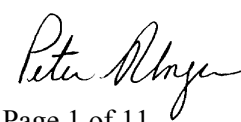
In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory to perform the following calibrations<sup>1</sup>:

I. Chemical Quantities

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Conductivity – Measure	(111 to 1285) mS (1015 to 1408) µS	0.7 µS 0.7 µS	Comparison to standard solutions
pH – Measure	(4, 7, 10) pH unit	0.02 pH unit	Comparison to standard solutions

II. Dimensional

Parameter/Equipment	Range	CMC <sup>2,6</sup> (±)	Comments
Calipers & Height Gages	(0.10 to 24) in	(67 + 0.6L) µin/in	Grade ASME 0



Parameter/Equipment	Range	CMC <sup>2,6</sup> ( $\pm$ )	Comments
Micrometers	(0.10 to 12) in	$(32 + 0.6L) \mu\text{in/in}$	Grade ASME 0
Surface Plates Repeatability (Flatness Only)	12 in $\times$ 12 in to 72 in $\times$ 144 in	40 $\mu\text{in}$	Repeat-o-meter
Pitch Diameter, External Threads	(0.10 to 4.00) in	$(26 + 10L) \mu\text{in}$	Supermicrometer and thread wires (three wire method)

### III. Electrical – DC/Low Frequency

Parameter/Equipment	Range	CMC <sup>2,4,5,7</sup> ( $\pm$ )	Comments
DC Voltage <sup>3</sup> – Generate	(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 $\mu\text{V/V} + 0.6 \mu\text{V}$ 10 $\mu\text{V/V} + 1.0 \mu\text{V}$ 11 $\mu\text{V/V} + 3.5 \mu\text{V}$ 10 $\mu\text{V/V} + 6.5 \mu\text{V}$ 11 $\mu\text{V/V} + 80 \mu\text{V}$ 13 $\mu\text{V/V} + 500 \mu\text{V}$	Fluke 5700A w/option 03
DC Voltage <sup>3</sup> – Measure	(0 to 100) mV 100 mV to 1V (1 to 10) V (10 to 100) V (100 to 1000) V	13 $\mu\text{V/V} + 3.0 \mu\text{V}$ 17 $\mu\text{V/V} + 0.3 \mu\text{V}$ 13 $\mu\text{V/V} + 0.5 \mu\text{V}$ 15 $\mu\text{V/V} + 30 \mu\text{V}$ 27 $\mu\text{V/V} + 100 \mu\text{V}$	HP 3458A
High Voltage	(1 to 20) kV	0.10 %	Vitrek 4600A
DC Current <sup>3</sup> – Generate	(0 to 220) mA 220 mA to 22 mA (22 to 220) mA 220 mA to 2.2 A (2.2 to 11) A  (11 to 20.5) A	50 mA/A + 8 nA 50 mA/A + 8 nA 50 mA/A + 80 nA 60 mA/A + 0.8 $\mu\text{A}$ 80 mA/A + 25 $\mu\text{A}$  0.12 %	Fluke 5700A w/option 03  Fluke 5500A

Parameter/Equipment	Range	CMC <sup>2, 4, 5, 7</sup> ( $\pm$ )	Comments
DC Current <sup>3</sup> – Measure	Up to 100 nA 100 nA to 1 $\mu$ A (1 to 10) $\mu$ A (10 to 100) $\mu$ A 100 $\mu$ A to 10 mA (10 to 100) mA 100 mA to 1 A	35 $\mu$ A/A + 400 $\mu$ A 25 $\mu$ A/A + 40 $\mu$ A 25 $\mu$ A/A + 10 $\mu$ A 25 $\mu$ A/A + 5 $\mu$ A 25 $\mu$ A/A + 5 $\mu$ A 40 $\mu$ A/A + 5 $\mu$ A 0.012 % + 10 $\mu$ A	HP 3458A
	(1 to 500) A	1.3 %	Fluke 5700A with current coil hall effect
	(1 to 10) A (1 to 100) A (100 to 300) A	0.12 % 0.12 % 0.12 %	Shunt monitored with multimeter
Resistance <sup>3</sup> – Generate	Up to 11 $\Omega$ (11 to 33) $\Omega$ (33 to 110) $\Omega$ (110 to 330) $\Omega$ (0.33 to 1.1) k $\Omega$ (1.1 to 3.3) k $\Omega$ (3.3 to 11) k $\Omega$ (11 to 33) k $\Omega$ (33 to 110) k $\Omega$ (110 to 330) k $\Omega$ 0.33 k $\Omega$ to 1.1 M $\Omega$ (1.1 to 3.3) M $\Omega$ (3.3 to 11) M $\Omega$ (11 to 33) M $\Omega$ (33 to 110) M $\Omega$ (110 to 330) M $\Omega$ 330 M $\Omega$ to 1.1 G $\Omega$	0.12 % + 0.008 $\Omega$ 0.17 % 0.02 % 0.02 % 90 $\mu\Omega/\Omega$ + 0.06 $\Omega$ 0.02 % 90 $\mu\Omega/\Omega$ + 0.6 $\Omega$ 0.1 % 0.011 % + 6 $\Omega$ 0.1 % 0.015 % + 55 $\Omega$ 0.02 % 0.02 % 0.04 % 0.06 % 0.37 % 1.8 %	Fluke 5500A
	100 M $\Omega$ to 1 G $\Omega$	0.57 %	HRRS-B decade resistance
Fixed Points	1 $\Omega$ 10 $\Omega$ 100 $\Omega$ 1 k $\Omega$ 10 k $\Omega$ 100 k $\Omega$ 1 M $\Omega$ 10 M $\Omega$ 100 M $\Omega$	0.01 % 39 $\mu\Omega/\Omega$ 24 $\mu\Omega/\Omega$ 18 $\mu\Omega/\Omega$ 17 $\mu\Omega/\Omega$ 19 $\mu\Omega/\Omega$ 27 $\mu\Omega/\Omega$ 54 $\mu\Omega/\Omega$ 0.02 %	Fluke 5700A w/ option 03

Parameter/Equipment	Range	CMC <sup>2, 5, 7</sup> ( $\pm$ )	Comments
Resistance <sup>3</sup> – Measure	(0 to 10) $\Omega$ (10 to 100) $\Omega$ 100 $\Omega$ to 100 k $\Omega$ 100 k $\Omega$ to 1 M $\Omega$ (1 to 10) M $\Omega$ (10 to 100) M $\Omega$ 100 M $\Omega$ to 1 G $\Omega$	19 $\mu\Omega/\Omega$ + 0.06 m $\Omega$ 15 $\mu\Omega/\Omega$ + 0.6 m $\Omega$ 13 $\mu\Omega/\Omega$ + 0.6 m $\Omega$ 18 $\mu\Omega/\Omega$ + 2.4 $\Omega$ 59 $\mu\Omega/\Omega$ + 120 $\Omega$ 0.058 % + 1.2 k $\Omega$ 1.8 % + 10 k $\Omega$	HP 3458A
Capacitance <sup>3</sup> – Generate	(0.33 to 0.49) nF (0.50 to 1.09) nF (1.10 to 3.29) nF (3.30 to 10.9) nF (11.0 to 32.9) nF (33 to 109.9) $\mu$ F (110 to 329.9) $\mu$ F (0.33 to 1.09) $\mu$ F (1.10 to 3.29) $\mu$ F  (1 to 10) $\mu$ F	3.3 % 1.4 % 0.73 % 0.51 % 0.54 % 0.32 % 0.32 % 0.29 % 0.37 %  0.1 %	Fluke 5500A          HPCS-Z-A capacitance decade box
Inductance – Generate  Fixed Points	1.0 mH 10 mH 100 mH 1 H	0.06 % 0.06 % 0.06 % 0.08 %	Genrad 1482
Electrical Calibration of Thermocouple Indicators <sup>3</sup> –  Type E  Type J  Type K	-250 $^{\circ}$ C to -100 $^{\circ}$ C -100 $^{\circ}$ C to 650 $^{\circ}$ C 650 $^{\circ}$ C to 1000 $^{\circ}$ C  -210 $^{\circ}$ C to -100 $^{\circ}$ C -100 $^{\circ}$ C to 760 $^{\circ}$ C 760 $^{\circ}$ C to 1200 $^{\circ}$ C  -200 $^{\circ}$ C to -100 $^{\circ}$ C -100 $^{\circ}$ C to 120 $^{\circ}$ C 120 $^{\circ}$ C to 1000 $^{\circ}$ C 1000 $^{\circ}$ C to 1372 $^{\circ}$ C	0.5 $^{\circ}$ C 0.16 $^{\circ}$ C 0.21 $^{\circ}$ C  0.27 $^{\circ}$ C 0.17 $^{\circ}$ C 0.23 $^{\circ}$ C  0.33 $^{\circ}$ C 0.18 $^{\circ}$ C 0.26 $^{\circ}$ C 0.04 $^{\circ}$ C	Fluke 5500A

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Electrical Calibration of Thermocouple Indicators <sup>3</sup> – (cont)			
Type S	0 °C to 250 °C 250 °C to 1400 °C 1400 °C to 1767 °C	0.47 °C 0.37 °C 0.46 °C	Fluke 5500A
Type T	-250 °C to -150 °C -150 °C to 0 °C 0 °C to 400 °C	0.63 °C 0.24 °C 0.16 °C	
Electrical Calibration of RTD Indicating Systems <sup>3</sup> –			
Pt 385, 100 Ω	-200 °C to 0 °C 0 °C to 100 °C 100 °C to 400 °C 400 °C to 630 °C 630 °C to 800 °C	0.05 °C 0.07 °C 0.10 °C 0.12 °C 0.23 °C	Fluke 5500A
Pt 3926, 100 Ω	-200 °C to 0 °C 0 °C to 100 °C 100 °C to 400 °C 400 °C to 630 °C	0.05 °C 0.07 °C 0.10 °C 0.12 °C	
Pt 3916, 100 Ω	-200 °C to -190 °C -190 °C to 0 °C 0 °C to 300 °C 300 °C to 600 °C 600 °C to 630 °C	0.25 °C 0.05 °C 0.08 °C 0.10 °C 0.23 °C	
Pt 385, 200 Ω	-200 °C to 100 °C 100 °C to 260 °C 260 °C to 600 °C 600 °C to 630 °C	0.04 °C 0.05 °C 0.14 °C 0.16 °C	
Pt 385, 500 Ω	-200 °C to 100 °C 100 °C to 260 °C 260 °C to 600 °C 600 °C to 630 °C	0.05 °C 0.06 °C 0.09 °C 0.11 °C	
Pt 385, 1 kΩ	-200 °C to 100 °C 100 °C to 260 °C 260 °C to 600 °C 600 °C to 630 °C	0.03 °C 0.05 °C 0.07 °C 0.23 °C	

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Electrical Calibration of RTD Indicating Systems <sup>3</sup> – (cont)			
PtNi 385, 100 Ω	-80 °C to 100 °C 100 °C to 260 °C	0.08 °C 0.14 °C	Fluke 5500A
Cu 427, 10 Ω	-100 °C to 260 °C	0.3 °C	

Parameter/Range	Frequency	CMC <sup>2,4</sup> (±)	Comments
AC Voltage <sup>3</sup> – Generate			
(0 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 kHz to 1 MHz	0.055 % + 13 μV 0.021 % + 8 μV 0.011 % + 8 μV 0.037 % + 8 μV 0.085 % + 25 μV 0.34 % + 80 μV	Fluke 5700A w/ option 03
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 kHz to 1 MHz	0.05 % + 80 μV 0.016 % + 25 μV 75 μV/V + 6 μV 0.012 % + 16 μV 0.025 % + 70 μV 0.22 % + 850 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 kHz to 1 MHz	0.05 % + 0.8 mV 0.016 % + 0.25 mV 75 μV/V + 0.06 mV 0.012 % + 0.16 mV 0.025 % + 0.35 mV 0.34 % + 8.5 mV	
(22 to 220) V	(10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz	0.05 % + 8 mV 0.016 % + 2.5 mV 80 μV/V + 0.8 mV	
(22 to 220) V	(20 to 50) kHz (50 to 100) kHz 100 kHz to 1 MHz	0.022 % + 3.5 mV 0.05 % + 8 mV 1.6 % + 190 mV	
(220 to 750) V	(30 to 50) kHz (50 to 100) kHz	0.06 % + 11 mV 0.23 % 45 mV	

Parameter/Range	Frequency	CMC <sup>2, 4, 5, 7</sup> ( $\pm$ )	Comments
AC Voltage <sup>3</sup> – Generate (cont)  (220 to 1100) V	(15 to 50) Hz 50 Hz to 1 kHz	0.04 % + 16 mV 90 $\mu$ V/V + 4 mV	Fluke 5700A w/ option 03
AC Voltage <sup>3</sup> – Measure  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	0.03 % + 3 $\mu$ V 0.02 % + 2 $\mu$ V 0.03 % + 2 $\mu$ V 0.12 % + 2 $\mu$ V 0.58 % + 2 $\mu$ V 4.6 % + 2 $\mu$ V	HP 3458A, synchronous sub- sampled mode
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 300 kHz to 1 MHz (1 to 2) MHz	80 $\mu$ V/V + 0.4 mV 80 $\mu$ V/V + 0.2 mV 0.02 % + 0.2 mV 0.03 % + 0.2 mV 0.09 % + 0.2 mV 0.35 % + 1 mV 1.2 % + 1 mV 1.7 % + 1 mV	
(10 to 100) V	(1 to 40) Hz 40 Hz to 1 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz 300 kHz to 1 MHz	0.02 % + 4 mV 0.02 % + 2 mV 0.04 % + 2 mV 0.14 % + 2 mV 0.46 % + 10 mV 1.7 % + 10 mV	
(100 to 1000) V	(1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz	0.05 % + 40 mV 0.05 % + 20 mV 0.07 % + 20 mV	
(1 to 20) kV	(20 to 50) kHz (50 to 100) kHz  (50 to 70) Hz	0.14 % + 20 mV 0.35 % + 20 mV  0.32 %	Vitrek 4600A
AC Current <sup>3</sup> – Generate  (1 to 220) $\mu$ A 220 $\mu$ A to 22 mA (22 to 220) mA 220 mA to 2.2 A	40 Hz to 1 kHz	0.09 % 0.024 % 0.026 % 0.093 %	Fluke 5700A w/ option 03

Parameter/Range	Frequency	CMC <sup>2, 5, 7</sup> (±)	Comments
AC Current <sup>3</sup> – Measure			
Up to 100 µA	(10 to 20) Hz (20 to 45) Hz 45 Hz to 1 kHz	0.46 % + 0.03 µA 0.18 % + 0.03 µA 0.078 % + 0.03 µA	HP 3458A
100 µA to 100 mA	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz	0.46 % + 20 µA 0.17 % + 20 µA 0.073 % + 20 µA 0.042 % + 20 µA	
100 mA to 1 A	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz	0.46 % + 200 µA 0.19 % + 200 µA 0.10 % + 200 µA 0.12 % + 200 µA	
(1 to 500) A	(50 to 70) Hz	0.32 %	Fluke 5500 with Fluke coil

IV. Electrical – RF/Microwave

Parameter/Range	Frequency	CMC <sup>2</sup> (±)	Comments
RF Tuned Power – Generate			
(0 to -100) dB	Up to 1.3 GHz Up to 18 GHz	0.40 dB 0.72 dB	HP 8902A, HP 11722A, HP 11793A
RF Absolute Power – Generate			
50 MHz to 18 GHz	(-30 to -20) dB (-20 to 10) dB (10 to 20) dB	0.06 dB 0.068 dB 1.2 dB	HP 537B, 8484A, 8482A

Parameter/Range	Frequency	CMC <sup>2,7</sup> (±)	Comments
Amplitude Modulation – Measure			
Rate: 150 kHz to 10 MHz Depth: (5 to 99) %	50 Hz to 10 kHz 20 Hz to 10 kHz	2 % + 1 digit 3 % + 1 digit	HP 8902A
Rate: 10 MHz to 1.3 GHz Depth: (5 to 99) %	50 Hz to 10 kHz 20 Hz to 10 kHz	1 % + 1 digit 3 % + 1 digit	
Frequency Modulation – Measure			
Rate: 250 kHz to 10 MHz Dev: ≤ 40 kHz	50 Hz to 10 kHz	2 % + 1 digit	HP 8902A
Rate: 10 MHz to 1.3 GHz Dev: ≤ 400 kHz	50 Hz to 100 kHz 20 Hz to 200 kHz	1 % + 1 digit 5 % + 1 digit	
Phase Modulation – Generate			
Rate: 10 MHz to 1.3 GHz	200 Hz to 20 kHz	3.5 % + 1 digit	HP 8902A

#### V. Fluid Quantities

Parameter/Equipment	Range	CMC <sup>2,7</sup> (±)	Comments
Viscosity – @ 25 °C	(17 to 2000) cst	0.68 %	Cannon series N viscosity standards
	(1990 to 200 400) cP	0.52 %	
Flow – Air	(30 to 5000) ml/min	1.3 %	Bios flow system with flow cells, Bios DC-LC-1
	(2000 to 9500) ml/min	2.2 %	Bios CC-MC-1
	(5000 to 50 000) ml/min	1.7 %	Bios DC-HC-1

VI. Mechanical

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Pressure – Measure	(-15 to + 15) psig Up to 1000 psig Up to 10 000 psig	0.098 % of rdg 0.85 % of rdg 0.92 % of rdg	Fluke 744 with various pressure modules
Torque	(0 to 400) in·oz (0 to 5) in·lb (0 to 400) in·lb (0 to 250) ft·lb (250 to 600) ft·lb	0.83 % of rdg 0.92 % of rdg 0.7 % of rdg 0.66 % of rdg 0.68 % of rdg	DCI torque system
Tension & Compression	Up to 10 000 lb	0.073 % of FS	Load cell comparison Rice Lake
Mass	(5 to 500) mg  (0 to 500) g  Up to 600 lb	1.2 mg  1.2 g  0.30 % of rdg	NIST handbook 44 using class 1 weights   NIST handbook 44 using class F weights

VII. Optical Quantities

Parameter/Equipment	Range	CMC <sup>2,7</sup> (±)	Comments
Fiber Optics – Measure			
1310 nm	(6 to -60) dB	4.9 %	EXFO optical calibration system
1550 nm		4.9 %	
Optical Comparators and Visual Systems	Up to 200 mm	210 µm	Glass scale and gage blocks

VII. Thermodynamics

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Humidity Measuring Equipment	11 % RH 33 % RH 75.4 % RH 97 % RH	1.6 % RH 1.7 % RH 1.5 % RH 2 % RH	Saturated salt solutions
Temperature Measuring Equipment	(0 to 300) °C	0.33 °C	Hart 9100
Temperature – Measure	(-20 to 200) °C	1.0 °C	DP 97

<sup>1</sup> This laboratory offers commercial calibration service and field calibration service.

<sup>2</sup> 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.

<sup>3</sup> Field calibration service is available for this calibration and this laboratory meets A2LA R104 – *General Requirements: Accreditation of Field Testing and Field Calibration Laboratories* for these calibrations. Please note the actual measurement uncertainties achievable on a customer's site can normally be expected to be larger than the CMC found on the A2LA Scope. Allowance must be made for aspects such as the environment at the place of calibration and for other possible adverse effects such as those caused by transportation of the calibration equipment. The usual allowance for the actual uncertainty introduced by the item being calibrated, (e.g. resolution) must also be considered and this, on its own, could result in the actual measurement uncertainty achievable on a customer's site being larger than the CMC.

<sup>4</sup> The measurands stated are generated with the Fluke 5500A, Fluke 5700A series of instruments. This capability is suitable for the calibration of the devices intended to measure the stated measurand in the ranges indicated. CMCs are expressed as either a specific value that covers the full range or as a fraction of the reading plus a fixed floor specification.

<sup>5</sup> The measurands stated are measured with the HP 3458A series of instruments. This capability is suitable for the calibration of the devices intended to generate the measurand in the ranges indicated. CMCs are expressed as either a specific value that covers the full range or as a combination of the fraction of the reading/output plus a range specification.

<sup>6</sup> In the statement of CMC,  $L$  is the numerical value of the nominal length of the device measured in inches. Pitch diameter is measured by the three-wire method.

<sup>7</sup> In the statement of CMC, the value is defined as the percentage of reading.