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

CERTIFIED MEASUREMENTS, INC.
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CALIBRATION

Valid to: May 31, 2012 Certificate Number: 1297.01

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory to perform the following calibrations and dimensional inspections[1]:

I. Dimensional

Parameter/Equipment	Range	CMC [2, 4] (±)	Comments
Gage Blocks	Up to 1 in (1 to 4) in (4 to 20) in	(2.4 + 0.78*L*) µin (3.0 + 0.78*L*) µin (6.0 + 0.78*L*) µin	Mechanical comparison
Measuring Wires	(2 to 120) TPI	8 µin	Standard measuring machine
Plain Rings	(0.125 to 0.25) in (0.25 to 11) in (11 to 16) in	(30 + 1.5*L*) µin (20 + 1.5*L*) µin (27 + 1.5*L*) µin	Standard measuring machine, laser micrometer
Plain Plugs	(0.125 to 16) in	(8 + 1.5*L*) µin	Standard measuring machine, laser micrometer
Threaded Plugs – Pitch Diameter Major Diameter	 (0.1 to 10) in (0.1 to 10) in	 (54 + 2.2*D*) µin 22 µin	Laser micrometer, master thread wires

Parameter/Equipment	Range	CMC [2, 4] (±)	Comments
Length Standards	Up to 12 in (12 to 49) in	(19 + 2.9*L*) µin (58 + 3.6*L*) µin	Standard measuring machine
Dial Indicators[3]	Up to 1 in (1 to 4) in	30 µin 250 µin	Indicator calibrator
Micrometers[3] – Digital Vernier	Up to 6 in (1 to 36) in	34 µin (62 + 2.5*L*) µin	Gage blocks
Tape Measures	(6 to 100) ft	(0.002 + 0.00004*L*) in	CMM / master rule
Glass Scales –	Up to 12 in (> 12 to 16) in Up to 3 in	(40 + 1.5*L*) µin (47 + 3*L*) µin 35 µin	Standard measuring machine and microscope
Height Measures	(6 to 24) in (> 24 to 48) in	95 µin 330 µin	Gage amp/probe and gage blocks
Angle Blocks –	Up to 45°	2.0”	Sine bar and gage amp/probe
Protractors, Levels & Clinometers	Up to 359°	6”	Tilt table
Calipers[3] –	Up to 12 in Up to 60 in	380 µin (614 + 18*L*) µin	Gage blocks and ring gages
Indicating Comparators	0.002 in	10 µin	UMM, American SIP 550M
Rigid Rules	Up to 72 in	(0.001 + 0.00003*L*) in	CMM
Optical Flats & Parallels – Flatness Parallelism	Up to 4 in	3 µin 2 µin	Master flat Gage block comparator

II. Dimensional Testing/Calibration[6]

Parameter/Equipment	Range	CMC [2, 4] (±)	Comments
Position	20 in × 16 in × 12 in	(110 + 3.1*L*) μin	CMM & optical comparator
Length –			
1 Dimension	Up to 20 in	(110 + 2.2*L*) μin	CMM & optical comparator
Angle	Up to 360°	0.017°	CMM & optical comparator

III. Electrical – DC/Low Frequency

Parameter/Range	Frequency	CMC [2, 5] (±)	Comments
AC Current[3] – Measure and Generate			
(0.001 to 5) A	50 Hz to 20 kHz	0.02 %	AC current shunts Fluke A40 & 792A
(> 5 to 20) A		0.03 %	Agilent 3458A
AC Voltage[3] – Measure and Generate			
22 mV			
(10, 20) mV	10 Hz to 50 kHz	0.035 %	AC/DC transfer standard 792A with Datron 1271
220 mV			
(20 mV)	10 Hz	0.035 %	
	20 Hz	0.025 %	
	40 Hz to 50 kHz	0.035 %	
(60 mV)	10 Hz	0.025 %	
	20 Hz	0.015 %	
	40 Hz to 20 kHz	0.01 %	
	50 kHz	0.012 %	

Parameter/Range (Input)	Frequency	CMC [2, 5] (±)	Comments
AC Voltage[3] – Measure and Generate			
220 mV			
(100, 200) mV	10 Hz	0.025 %	AC/DC transfer standard 792A with Datron 1271
	20 Hz	0.012 %	
	40 Hz to 20 kHz	0.01 %	
	(50 to 100) kHz	0.012 %	
	(300 to 500) kHz	0.035 %	
	800 kHz to 1 MHz	0.05 %	
700 mV			
(200, 600) mV	10 Hz	0.025 %	
	20 Hz	0.012 %	
	40 Hz to 20 kHz	0.01 %	
	(50 to 100) kHz	0.012 %	
	300 kHz to 1 MHz	0.035 %	
2.2 V			
(0.6, 1, 2) V	10 Hz	0.025 %	
	20 Hz	0.012 %	
	40 Hz to 20 kHz	0.01 %	
	(50 to 100) kHz	0.012 %	
	300 kHz to 1 MHz	0.035 %	
7 V			
(2, 6) V	10 Hz	0.025 %	
	20 Hz	0.012 %	
	40 Hz to 20 kHz	0.01 %	
	(50 to 100) kHz	0.012 %	
	300 kHz to 1 MHz	0.035 %	
22 V			
(6, 10) V	10 Hz	0.025 %	
	20 Hz	0.012 %	
	40 Hz to 20 kHz	0.01 %	
	(50 to 100) kHz	0.012 %	
	300 kHz to 1 MHz	0.035 %	
(20 V)	10 Hz	0.025 %	
	20 Hz	0.012 %	
	40 Hz to 20 kHz	0.01 %	
	50 kHz	0.012 %	

Parameter/Range (Input)	Frequency	CMC [2, 5] (±)	Comments
AC Voltage[3] – Measure and Generate (cont.)			
70 V			AC/DC transfer standard Fluke 792A with Datron 1271
(20, 60) V	10 Hz 20 Hz 40 Hz to 20 kHz 50 kHz	0.025 % 0.012 % 0.01 % 0.012 %	
220 V			
(60, 100, 200) V	10 Hz 20 Hz 40 Hz to 20 kHz 50 kHz	0.025 % 0.012 % 0.01 % 0.012 %	
1000 V			
(200, 600, 1000) V	10 Hz 20 Hz 40 Hz to 20 kHz	0.025 % 0.012 % 0.01 %	
(200, 600, 700) V	50 kHz	0.02 %	
(1 to 3) V	(1 to 13) MHz (13 to 30) MHz (30 to 80) MHz (80 to 100) MHz	0.14 % 0.29 % 0.58 % 1.4 %	Reference thermal converter
(1 to 2) kV	(20 to 100) Hz (100 to 400) Hz	1 % 0.3 %	Kilovoltmeter Valhalla 4600
Measure Only			
(2 to 50) kV	60 Hz	2 %	Hipotronic KV50A

Parameter/Equipment	Range	CMC [2, 5] (±)	Comments
DC Current[3] – Measure and Generate	0.1 μA to 2 A	55 parts in 10^6	Datron 4808, 1271
	(2 to 20) A	0.03 %	Precision shunts, L&N 4300 & Guildline 9711A
	(20 to 100) A	0.07 %	Valhalla 2555A

Parameter/Equipment	Range	CMC [2, 5] (±)	Comments
DC Voltage[3] – Measure and Generate (cont)	100 μV to 100 mV 100 mV to 1 V (1 to 10) V 10 V (10 to 100) V (100 to 1000) V (1 to 10) kV (10 to 20) kV	8 μV/V + 0.4 μV 3.4 μV/V + 0.4 μV 3 μV/V + 3 μV 1 μV/V 5 μV/V + 50 μV 3.9 μV/V + 500 μV 0.02 % 20 V	Kelvin-Varley divider Fluke 720A Fluke 720A/732A 732A Zener reference 752A reference divider Datron 4808 Fluke 80E-10 Valhalla 4600
Measure Only	(20 to 50) kV	1 %	Hipotronic KV50A
Resistance[3] – Measure and Generate, Fixed Values	0.001 Ω 0.01 Ω 0.1 Ω 1 Ω 10 Ω 100 Ω 1 kΩ 10 kΩ 100 kΩ 1 MΩ 10 MΩ 100 MΩ	0.01 % 0.01 % 10 parts in 10^6 7.4 parts in 10^6 7.7 parts in 10^6 7.3 parts in 10^6 7.2 parts in 10^6 7 parts in 10^6 7.3 parts in 10^6 10 parts in 10^6 12 parts in 10^6 32 parts in 10^6	9331-1 and 9331-10k reference standard resistors with Agilent 3458A
Resistance – Measure and Generate, Fixed Values	1 GΩ 10 GΩ 100 GΩ 1 TΩ	0.058 % 0.08 % 0.12 % 0.23 %	Guildline 9520

Parameter/Range (Input)	Frequency	CMC [2, 5] (±)	Comments
Capacitance[3] – Measure and Generate (1 to 100) μF 100 μF to 1 mF	 50 Hz to 1 kHz	 0.1 % 0.15 %	 1689 capacitance bridge
Capacitance[3] – Measure and Generate @ 1 kHz	11 aF to 1.1 μF	0.017 % + 0.00003 pF	1615 capacitance bridge
Inductance[3] – Generate 100 μH to 10 mH (10 to 100) mH 100 mH to 1 H (1 to 10) H Fixed Point 200 mH	 @ 1 kHz @ 500 Hz @ 200 Hz @ 100 Hz @ 100 Hz, 200 Hz, 400 Hz, 1 kHz, & 10 kHz	 2 % 1.6 % 0.8 % 0.8% 0.1 %	 1491G decade inductor 1482M std inductor
Inductance[3] – Measure 100 μH to 10 H	 @ 100 Hz, 200 Hz, 400 Hz, 1 kHz, & 10 kHz	 0.2 %	 GenRad 1689 RLC Digibridge

Parameter/Equipment	Range	CMC [2] (±)	Comments
Electrical Calibration of Thermocouple Indicators[3] –			
Type E	(-250 to -100) °C (-100 to -25) °C (-25 to 350) °C (350 to 650) °C (650 to 1000) °C	0.12 °C 0.16 °C 0.14 °C 0.16 °C 0.2l °C	Fluke 5500A
Type J	(-210 to -100) °C (-100 to -30) °C (-30 to 150) °C (150 to 760) °C (760 to 1200) °C	0.27 °C 0.16 °C 0.14 °C 0.17 °C 0.23 °C	
Type K	(-200 to 100) °C (-100 to -25) °C (-25 to 120) °C (120 to 1000) °C (1000 to 1372) °C	0.33 °C 0.18 °C 0.16 °C 0.26 °C 0.4 °C	
Type N	(-200 to -100) °C (-100 to -25) °C (-25 to 120) °C (120 to 410) °C (410 to 1300) °C	0.4 °C 0.22 °C 0.19 °C 0.18 °C 0.27 °C	
Type R	(0 to 250) °C (250 to 400) °C (400 to 1000) °C (1000 to 1767) °C	0.57 °C 0.35 °C 0.33 °C 0.4 °C	
Type S	(0 to 250) °C (250 to 1000) °C (1000 to 1400) °C (1400 to 1767) °C	0.47 °C 0.36 °C 0.37 °C 0.46 °C	
Type T	(-250 to -150) °C (-150 to 0) °C (0 to 120) °C (120 to 400) °C	0.63 °C 0.24 °C 0.16 °C 0.14 °C	

Parameter/Equipment	Range	CMC [2] (±)	Comments
Electrical Calibration of RTD Indicating Systems & Measure[3] –			
Pt 385, 100 Ω	(-200 to 0) °C (0 to 100) °C (100 to 300) °C (300 to 400) °C (400 to 630) °C (630 to 800) °C	0.05 °C 0.07 °C 0.09 °C 0.1 °C 0.12 °C 0.23 °C	Decade resistors and Datron 1271
Pt 3926, 100 Ω	(-200 to 0) °C (0 to 100) °C (100 to 300) °C (300 to 400) °C (400 to 630) °C	0.05 °C 0.07 °C 0.09 °C 0.1 °C 0.12 °C	
Pt 3916, 100 Ω	(-200 to -190) °C (-190 to -80) °C (-80 to 0) °C (0 to 100) °C (100 to 260) °C (260 to 300) °C (300 to 400) °C (400 to 600) °C (600 to 630) °C	0.25 °C 0.04 °C 0.05 °C 0.06 °C 0.07 °C 0.08 °C 0.09 °C 0.1 °C 0.23 °C	
Pt 385, 200 Ω	(-200 to 100) °C (100 to 260) °C (260 to 300) °C (300 to 400) °C (400 to 600) °C (600 to 630) °C	0.04 °C 0.05 °C 0.12 °C 0.13 °C 0.14 °C 0.16 °C	
Pt 385, 500 Ω	(-200 to -80) °C (-80 to 100) °C (100 to 260) °C (260 to 400) °C (400 to 600) °C (600 to 630) °C	0.04 °C 0.05 °C 0.06 °C 0.08 °C 0.09 °C 0.11 °C	
Pt 385, 1000 Ω	(-200 to 0) °C (0 to 100) °C (100 to 260) °C (260 to 300) °C (300 to 600) °C (600 to 630) °C	0.03 °C 0.04 °C 0.05 °C 0.06 °C 0.07 °C 0.23 °C	
Ni 120, 120 Ω	(-80 to 100) °C (100 to 260) °C	0.08 °C 0.14 °C	
Cu 427, 10 Ω	(-100 to 260) °C	0.3 °C	

Parameter/Equipment	Range	CMC [2, 5] (±)	Comments
Oscilloscopes[3] –			
Squarewave Signal			
50Ω @ 1 kHz	1 mV to 6.6 V_{p-p}	0.25 % + 40 µV	Fluke 5500A/SC600
1 MΩ @ 1 kHz	1 mV to 130 V_{p-p}	0.1 % + 40 µV	
Leveled Sine Wave	50 kHz reference	2 % + 300 µV	
Amplitude (50 kHz ref)	50 kHz to 100 MHz (100 to 300) MHz (300 to 600) MHz	3.5 % + 300 µV 4 % + 300 µV 6 % + 300 µV	
Flatness (50 kHz ref)	50 kHz to 100 MHz (100 to 300) MHz (300 to 600) MHz	1.5 % + 100 µV 2 % + 100 µV 4 % + 100 µV	
Time Marker – Measuring Equipment & Period @ 50Ω	5 s to 50 ms 20 ms to 2 ns	$(25 + 1000t)$ parts in 10^6 2.5 parts in 10^6	*t* is the numerical value of the time of the device measured in seconds.
Rise Time	≤ 300 ps	+0 / -100 ps	

IV. Electrical – Microwave/RF

Parameter/Range	Frequency	CMC [2, 5] (±)	Comments
RF Power –			Coaxial power standard
(1 to 10) mW	(10 to 20) MHz (20 to 50) MHz 50 MHz to 8 GHz (8 to 18) GHz	1.6 % 1.5 % 1.4 % 1.5 %	Tegam F1109
RF Attenuation –			
(0 to -10) dB -20 dB -30 dB -40 dB -50 dB -60 dB -70 dB -80 dB -90 dB -100 dB	10 MHz to 18 GHz	0.065 dB 0.076 dB 0.092 dB 0.12 dB 0.14 dB 0.16 dB 0.18 dB 0.20 dB 0.47 dB 0.58 dB	Weinschel VM-4B attenuation calibrator

V. Fluid Quantities

Parameter/Equipment	Range	CMC [2] (±)	Comments
Hydrometers	(0.7 to 2.0) g/cm^3 (sg)	0.0004 g/cm^3 (sg)	Verification of hydrometers in accordance with ASTM E126 by hydrostatic weighing using Westphall balance
Volumetrics –			
(To contain or deliver)	(1.0 to 10) cm^3 25 cm^3 50 cm^3 100 cm^3 200 cm^3 250 cm^3 500 cm^3 1000 cm^3	0.0053 cm^3 0.0061 cm^3 0.0085 cm^3 0.015 cm^3 0.025 cm^3 0.03 cm^3 0.055 cm^3 0.11 cm^3	NIST Handbook 145, SOP #13 and SOP #14 by gravimetric determination

VI. Mechanical

Parameter/Equipment	Range	CMC [2, 5] (±)	Comments
Torque[3] –			
Wrenches, Screwdrivers	(0.4 to 1000) ft·lb	0.45 %	Torque transducers indicator
Watches	(0.6 to 100) in·oz	0.05 %	Torque arms with class 4 dead weight
Torque Analyzers, Transducers	(1 to 100) in·oz (5 to 50) in·lb (50 to 1200) in·lb (100 to 600) ft·lb (600 to 1000) ft·lb	0.04 % 0.049 % 0.046 % 0.049 % 0.068 %	Torque arms with class 4 dead weight
Force – Tension & Compression	(5 to 1800) lbf (500 to 5000) lbf (5000 to 50 000) lbf	0.029 % 0.065 % 0.072 %	Class F dead weights, hydraulic loading, load cell comparison

Parameter/Equipment	Range	CMC [2, 5] (±)	Comments
Direct Verification of Durometers –			
Scale Accuracy			
Type A, B, C, D, DO, E, M, O, OOO, OOO-S, R	(0 to 100) duros	0.3 duro points	ASTM D2240
Type OO	(0 to 100) duros	0.6 duro points	
Indenter Geometry			
Length		0.0001 in	
Diameter		0.0002 in	
Angle		0.1° (6 arc min)	
Cable Tensiometers / Wire Tension Meters	(5 to 1000) lb	0.74 %	Class F dead weights
Pressure – Measure and Generate	(0.2 to 4) inH_2O	0.01 %	Micrometer w/ std barometer
	(0.2 to 25) psi	17 parts in 10^6	Dead weight piston gages
	(25 to 100) psi	19 parts in 10^6	
	(100 to 1000) psi	21 parts in 10^6	
	(1000 to 20 000) psi	49 parts in 10^6	
Pressure Gages[3]	(10 to 2000) psi	0.3 %	Druck DPI310B
Vacuum	(0.04 to 0.40) inHg	0.06 %	Pressure sensor with vacuum gage
	(0.5 to 30) inHg	19 parts in 10^6	Dead weight piston gage

Parameter/Equipment	Range	CMC [2, 5] (±)	Comments
Mass	1 mg 2 mg 3 mg 5 mg 10 mg 20 mg 30 mg 50 mg 0.10 g 0.20 g 0.30 g 0.50 g 1.0 g 2.0 g 3.0 g 5.0 g 10.0 g 20.0 g 30.0 g 50.0 g 100 g 200 g 300 g 500 g 1.0 kg 2.0 kg 3.0 kg 5.0 kg 10 kg 1 oz 2 oz 4 oz 8 oz 1 lb 2 lb 3 lb 5 lb 10 lb 20 lb 30 lb 50 lb	0.60 µg 0.58 µg 0.60 µg 0.7 µg 0.80 µg 0.75 µg 0.80 µg 0.90 µg 1.1 µg 1.2 µg 1.2 µg 1.5 µg 2.2 µg 2.5 µg 3.4 µg 4.0 µg 6.3 µg 7.8 µg 11 µg 17 µg 29 µg 40 µg 60 µg 90 µg 0.17 mg 0.73 mg 2.0 mg 2.9 mg 6.5 mg 4.2×10^{-7} oz (0.012 mg) 5.6×10^{-7} oz (0.016 mg) 8.1×10^{-7} oz (0.023 mg) 3.9×10^{-6} oz (0.11 mg) 3.3×10^{-7} lb (0.15 mg) 4.4×10^{-7} lb (0.2 mg) 2.6×10^{-6} lb (1.2 mg) 4.6×10^{-6} lb (2.1 mg) 7.7×10^{-6} lb (3.5 mg) 2.9×10^{-5} lb (13 mg) 3.7×10^{-5} lb (17 mg) 4.9×10^{-5} lb (22 mg)	NIST Handbook 145 with Class E1 weights, balances

VII. Thermodynamic

Parameter/Equipment	Range	CMC [2] (±)	Comments
Relative Humidity –	(10 to 90) % RH	1 % RH	Thunder Scientific 1200
Temperature – Measure and Measuring Equipment	0.01 °C	0.006 °C	Triple point of water cell
	-40 °C to 0 °C 0 °C to 200 °C 200 °C to 300 °C 300 °C to 400 °C 400 °C to 600 °C	0.01 °C 0.01 °C 0.02 °C 0.03 °C 0.2 °C	SPRT/1 E-6 superthermometer
	600 °C to 800 °C	0.71 °C	S-Type thermocouple standard Pt-Rh thermocouple

VIII. Time & Frequency

Parameter/Equipment	Range	CMC [2] (±)	Comments
Frequency Dissemination	10 Hz to 18 GHz	2.5 parts in 10^{11}	Cesium beam frequency standards, GPS

[1] This laboratory offers commercial and on-site calibration service.

[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; *D* is the numerical value of the nominal diameter of the device measured in inches.

[5] Unless otherwise noted, in the statement of CMC, % is the uncertainty percentage of the relative value of the reading, or the relative value of the reading plus floor specification.

[6] This laboratory meets R205 – *Specific Requirements: Calibration Laboratory Accreditation Program* for the types of dimensional calibrations listed above. Accredited test reports issued containing appropriate statements of measurement results, measurement uncertainty, and traceability are considered equivalent to a "calibration" certificate.

The American Association for Laboratory Accreditation

World Class Accreditation

Accredited Laboratory

A2LA has accredited

CERTIFIED MEASUREMENTS, INC.

Centerville, GA

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 3rd day of May 2010.

President & CEO
For the Accreditation Council
Certificate Number 1297.01
Valid to May 31, 2012

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