



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

MASSACHUSETTS METROLOGY AND INSTRUMENT SERVICE
 One Liberty Square
 Rockland, MA 02370
 Richard Rothstein Phone: 781 982 7125

CALIBRATION

Valid To: April 30, 2019

Certificate Number: 1411.01

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

I. Chemical

Parameter/Equipment	Range	CMC ² (±)	Comments
pH Measuring Instruments ³	4, 7, 10 pH	0.01 pH	Precision pH buffer solutions

II. Dimensional

Parameter/Equipment	Range	CMC ^{2,4} (±)	Comments
Calipers ³	Up to 80 in	(4.5L + 0.6R) μin	Gage blocks
Micrometers ³	Up to 80 in	(4.5L + 0.6R) μin	Gage blocks
Height Gages ³	Up to 48 in	(4.5L + 0.6R) μin	Gage blocks
Dial Indicators ³	Up to 4 in	(4.5L + 0.6R) μin	Gage blocks
Depth Gages ³	Up to 12 in	(4.5L + 0.6R) μin	Gage blocks

Parameter/Equipment	Range	CMC ^{2,4,6} (±)	Comments
Pin Gages ³	Up to 1 in	16 μin	Light wave micrometer
Material Length Counters and Totalizers ³	(1 to 99.9) ft Minimum 100 ft	0.02 ft 0.02 %	Linear measurement system
Rulers/Tape Measures ³	Up to 1200 in	(4.5L + 0.6R) μin	Gage blocks
Optical Comparators ³ –			
X Linearity	Up to 2 in Up to 12 in Up to 24 in Up to 30 in	100 μin 140 μin 230 μin 270 μin	Glass scale & gage blocks
Y Linearity	Up to 2 in Up to 12 in	100 μin 140 μin	
Table/Screen Squareness	Variable: X Y	120 μin 160 μin	Gage blocks & precision square
Table Parallelism	Variable	120 μin	Test indicator
Magnification	Up to 12 in image	2000 μin	Caliper and X pins
Screen Protractor Angle	Up to 360°	1.2”	Angle gage blocks
Tool Makers Microscope ³ –			
X-Y Linearity	Up to 2 in Up to 12 in	100 μin 140 μin	Glass scale & gage blocks
Table/Reticle Squareness	Y X	160 μin 120 μin	Gage ball, gage block
Screen Protractor Angle	Up to 360°	1.2”	Angle gage blocks
Surface Plates ³	Up to 36 in x 72 in Up to 36 in x 72 in	20 μin 61 μin	Repeatometer Planakator

III. Electrical – DC/Low Frequency

Parameter/Equipment	Range	CMC ^{2,5} (±)	Comments
DC Voltage – Measure ³	(0 to 110) mV (0.11 to 1.1) V (1.1 to 11) V (11 to 110) V (110 to 300) V	0.025 % + 16 µV 0.025 % + 55 µV 0.025 % + 550 µV 0.05 % + 5.5 mV 0.05 % + 0.01 V	Fluke 743B
DC Voltage – Generate ³	(0 to 110) mV (0.11 to 1.1) V (1.1 to 15) V	0.01 % + 5 µV 0.01 % + 55 µV 0.01 % + 750 µV	Fluke 743B
DC Current – Measure ³	(0 to 30) mA (30 to 110) mA (0 to 300) A 300 A to 2 kA	0.01 % + 4 µA 0.01 % + 16 µA 0.11 % 1.3 % + 0.3 A	Fluke 743B Current shunts Power meter
DC Current – Generate ³	(0.1 to 22) mA	0.01 % + 3 µA	Fluke 743B
AC Voltage - Measure ³ (40 to 500 Hz)	(0 to 1.1) V RMS (1.1 to 11) V RMS (11 to 110) V RMS (110 to 300) V RMS (300 to 400) V RMS (400 to 1000) V RMS	0.5 % + .0005 VAC 0.5 % + .005 VAC 0.5 % + .05 VAC 0.5 % + .5 VAC 0.7 % + 0.2 VAC 0.7 % + 2 VAC	Fluke 743B DMM
AC Current – Measure ³	(0 to 1000) A (1000 to 2000) A	0.5 % 1.3 % + 3 A	Power analyzer Amp probe
DC Current - Measure ³	(20 to 200) A (201 to 2000) A	1.3 % + 0.3 A 1.3 % + 3 A	Amp probe



Parameter/Equipment	Range	CMC ^{2,5} (±)	Comments
Plating Rectifiers and DC Power Supplies ³	(0 to 300) A	0.11 %	Fluke 743B & current shunts
	(20 to 200) A (201 to 2000) A	1.3 % + 0.3 A 1.3 % + 3 A	Amp probe
Resistance – Measure ³	Up to 11 Ω (11 to 110) Ω (110 to 1100) Ω (1100 to 11 000) Ω	0.05 % + 0.05 Ω 0.05 % + 0.05 Ω 0.05 % + 0.5 Ω 0.1 % + 10 Ω	Fluke 743B
	(0 to 20) Ω (21 to 400) Ω	0.0005 Ω 0.0025 %	Hart 1502A
Resistance – Generate ³	Up to 11 Ω (11 to 110) Ω (110 to 1100) Ω (1100 to 11 000) Ω	0.01 % + 0.02 Ω 0.01 % + 0.04 Ω 0.02 % + 0.5 Ω 0.03 % + 5 Ω	Fluke 743B
Electrical Calibration of Thermocouple Indicators and Indicating Systems – mV Simulation ³			
Type B	(800 to 1820) °C	0.82 °C	Fluke 743B
Type C	(0 to 800) °C	0.6 °C	
	(800 to 1200) °C	0.7 °C	
	(1200 to 1800) °C	0.9 °C	
	(1800 to 2316) °C	1.3 °C	
Type E	(-200 to -100) °C	0.3 °C	
	(-100 to 600) °C	0.3 °C	
	(600 to 1000) °C	0.2 °C	
Type J	(-100 to 1200) °C	0.2 °C	
Type K	(-100 to 1372) °C	0.3 °C	
Type L	(-100 to 900) °C	0.2 °C	

Parameter/Equipment	Range	CMC ² (±)	Comments
Electrical Calibration of Thermocouple Indicators and Indicating Systems – mV Simulation ³ (cont)			
Type N	(-100 to 900) °C (900 to 1300) °C	0.5 °C 0.3 °C	Fluke 743B
Type R	(100 to 1767) °C	0.9 °C	
Type S	(200 to 1400) °C (1400 to 1767) °C	0.9 °C 1 °C	
Type T	(-200 to 0) °C (0 to 400) °C	0.4 °C 0.3 °C	
Type U	(0 to 600) °C	0.3 °C	
Electrical Calibration of RTD Indicators and Indicating Systems ³ –			
Pt 385, 1000 Ω	(-200 to 0) °C (0 to 400) °C (400 to 630) °C	0.1 °C 0.2 °C 0.4 °C	Fluke 743B
Pt 385, 100 Ω	(-200 to 0) °C (0 to 400) °C (400 to 800) °C	0.1 °C 0.2 °C 0.4 °C	
Pt 3926, 100 Ω	(-200 to 0) °C (0 to 630) °C	0.1 °C 0.2 °C	



IV. Fluid Quantities

Parameter/Equipment	Range	CMC ^{2, 4, 6} (±)	Comments
Gas Flow Measuring Devices ³ –			
Standardized Flow	(5 to 50 000) sccm (0.005 to 50) slpm (0 to 250) slpm	0.44 % + 0.6R 0.41 % + 0.6R 0.40 % + 0.5 slpm + 0.6R	Bois Drycal ML500 primary flow standard and precision MFC
Volumetric Flow	(5 to 50 000) ccm (0.005 to 50) lpm (0 to 250) lpm	0.26 % + 0.6R 0.26 % + 0.6R 0.40 % + 0.5 lpm + 0.6R	
Pipettes, Burettes Dilutors, Dispensers ³	(10 to 20) µL (21 to 40) µL (41 to 100) µL (101 to 200) µL (201 to 300) µL (301 to 500) µL (501 to 1000) µL (1001 to 2000) µL (2001 to 5000) µL (5001 to 10 000) µL (10 000 to 20 000) µL (20 001 to 60 000) µL	0.1 µL 0.2 µL 0.25 µL 0.51 µL 0.76 µL 1.1 µL 2.1 µL 4.2 µL 11 µL 21 µL 42 µL 130 µL	Gravimetric method using analytical balance and ASTM Class 1 mass standards

V. Mechanical

Parameter/Equipment	Range	CMC ^{2, 6} (±)	Comments
Force Gages/Load Cells – Tension/Compression ³	Up to 100 lbf (101 to 500) lbf (501 to 1000) lbf (1001 to 2000) lbf	0.01 % + 0.007 lbf 0.015 % + 0.011 lbf 0.015 % + 0.02 lbf 0.015 % + 0.027 lbf	Class F weights
	Up to 100 gf (101 to 500) gf (501 to 1000) gf (1001 to 4000) gf (4001 to 7000) gf (7001 to 10 000) gf (10 001 to 12 000) gf	0.01 % + 0.007 gf 0.015 % + 0.011 gf 0.015 % + 0.02 gf 0.015 % + 0.1 gf 0.015 % + 0.15 gf 0.015 % + 0.23 gf 0.015 % + 0.27 gf	Class 1 metric weights

Parameter/Equipment	Range	CMC ^{2,6} (±)	Comments
Tachometer ³ – Optical/Electrical	Up to 99 999 rpm	0.01 % + 1 SG	Fluke 743B frequency output
Digital/Mechanical	Up to 1000 rpm (1001 to 2000) rpm (2001 to 3000) rpm (3001 to 4000) rpm (4001 to 5000) rpm (5001 to 6000) rpm	0.93 rpm 1.1 rpm 1.1 rpm 1.2 rpm 1.3 rpm 1.4 rpm	Variable speed drive tachometer standard
Pressure – Measuring Equipment ³	(0 to 5) in H ₂ O (4 to 1114) in H ₂ O (10 to 1000) psig (0 to 15) psia (-415 to 1660) in H ₂ O (0 to 60) psig (10 to 13 950) psig (13 950 to 20 000) psig	0.003 in H ₂ O 0.025 % 0.025 % 0.0037 psia 1 in H ₂ O 0.037 psig 0.025 % 20 psig	Heise PTE1 & module Ametek RK-1100WG pneumatic dead weight tester Pneumatic dead weight tester Heise PTE1 & module Heise PTE1 & module Heise PTE1 & module Ametek T-50-01 dead hydraulic weight tester Heise 20 000 psig test gauge and pump
Vacuum – Measuring Equipment ³	Up to 30 in Hg	0.0076 in Hg	Heise PTE1 and module

Parameter/Equipment	Range	CMC ^{2, 4, 6} (±)	Comments
Precision and Analytical Scales and Balances ³	Up to 2000 lb	0.01 % + 0.6R	Class F weights (stacks of 25 and 50's)
	Up to 100 kg	0.005 % + 0.6R	OIML M1 weights (5 to 20) kg
	0.001 lb	0.12 % + 0.6R	Class F 30 pound mixed weight set
	0.002 lb	0.072 % + 0.6R	
	0.005 lb	0.04 % + 0.6R	
	0.010 lb	0.024 % + 0.6R	
	0.02 lb	0.015 % + 0.6R	
	0.05 lb	0.015 % + 0.6R	
	0.1 lb	0.015 % + 0.6R	
	0.2 lb	0.015 % + 0.6R	
	0.5 lb	0.015 % + 0.6R	
	1 lb	0.011 % + 0.6R	
	2 lb	0.007 % + 0.6R	
	5 lb	0.007 % + 0.6R	
	10 lb	0.007 % + 0.6R	
	0.001 g	0.0007 mg + 0.6R	ASTM Class 1 weights
	0.002 g	0.0006 mg + 0.6R	
	0.005 g	0.0007 mg + 0.6R	
	0.01 g	0.0011 mg + 0.6R	
	0.02 g	0.0024 mg + 0.6R	
	0.05 g	0.0008 mg + 0.6R	
	0.10 g	0.0014 mg + 0.6R	
	0.20 g	0.0016 mg + 0.6R	
	0.50 g	0.0023 mg + 0.6R	
	1 g	0.0065 mg + 0.6R	
	2 g	0.0077 mg + 0.6R	
	5 g	0.014 mg + 0.6R	
	10 g	0.022 mg + 0.6R	
	20 g	0.038 mg + 0.6R	
	50 g	0.042 mg + 0.6R	
	100 g	0.11 mg + 0.6R	
	200 g	0.039 mg + 0.6R	
	300 g	0.15 mg + 0.6R	
	500 g	0.043 mg + 0.6R	
1000 g	0.3 mg + 0.6R		
2000 g	0.62 mg + 0.6R		
3000 g	0.81 mg + 0.6R		
5000 g	1.4 mg + 0.6R		



Parameter/Equipment	Range	CMC ^{2,4,6} (±)	Comments
Torque Wrenches, Drivers, Indicators and Watches ³	(0 to 3) in·lbf (3 to 20) in·lbf (20 to 100) in·lbf (100 to 200) in·lbf (200 to 1800) in·lbf	(0.017 + 0.6R) in·lbf 1 % + (0.1 + 0.6R) in·lbf 0.5 % + (0.1 + 0.6R) in·lbf (2 + 0.6R) in·lbf 1 % + 0.6R in·lbf	Torque analyzers
Torque Transducers	Up to 200 in·lbf (0.01 to 1000) ft·lbf	0.04 % + 0.6R in·lbs 0.18 % + 0.6R ft·lbs	Torque wheel, arms, hangers and weights

VI. Thermodynamics

Parameter/Equipment	Range	CMC ² (±)	Comments
Temperature Calibration of Thermocouples ³ –			
Ice Point Reference	0.00 °C	0.006 °C	Using Temperature baths, blocks, environmental chamber or high temperature furnace monitored by PRT & indicator or thermocouple & indicator
Type B	(600 to 1100) °C (1101 to 1200) °C	1.7 °C 1.8 °C	
Type C	(0 to 661) °C (662 to 1100) °C (1101 to 1200) °C	0.75 °C 1.5 °C 1.7 °C	
Type E	(-80 to 550) °C (551 to 661) °C (662 to 1000) °C	0.31 °C 0.41 °C 1.4 °C	
Type J	(-80 to 550) °C (551 to 661) °C (662 to 1100) °C (1101 to 1200) °C	0.31 °C 0.41 °C 1.4 °C 1.6 °C	
Type K	(-80 to 550) °C (551 to 661) °C (662 to 1100) °C (1101 to 1200) °C	0.31 °C 0.41 °C 1.4 °C 1.6 °C	

Parameter/Equipment	Range	CMC ² (±)	Comments
Temperature Calibration of Thermocouples ³ – (cont)			
Type L	(-80 to 550) °C (551 to 661) °C (662 to 900) °C	0.31 °C 0.41 °C 1.4 °C	Using Temperature baths, blocks, environmental chamber or high temperature furnace monitored by PRT & indicator or thermocouple & indicator Output measured by Fluke 743B
Type N	(-80 to 550) °C (551 to 661) °C (662 to 1100) °C (1101 to 1200) °C	0.58 °C 0.65 °C 1.5 °C 1.6 °C	
Type R	(100 to 550) °C (551 to 661) °C (662 to 1100) °C (1101 to 1200) °C	1 °C 1.1 °C 1.7 °C 1.8 °C	
Type S	(100 to 550) °C (551 to 661) °C (662 to 1100) °C (1101 to 1200) °C	0.9 °C 0.94 °C 1.6 °C 1.7 °C	
Type T	(-80 to 550) °C	0.31 °C	
Type U	(-80 to 550) °C (551 to 600) °C	0.31 °C 0.42 °C	
Temperature Calibration of RTDs ³ –			
Pt 385, 1000 Ω	(-80 to 550) °C (551 to 660) °C	0.038 °C 0.29 °C	Temperature baths, blocks, environmental chamber or high temperature furnace monitored by PRT & indicator or thermocouple & indicator RTD output measured w/ precision resistance meter
Pt 3916, 100 Ω	(-80 to 550) °C	0.038 °C	
Pt 385, 100 Ω	(-80 to 550) °C (551 to 661) °C (662 to 800) °C	0.038 °C 0.29 °C 1.6 °C	
Pt 3926, 100 Ω	(-80 to 550) °C (551 to 660) °C	0.038 °C 0.29 °C	



Parameter/Equipment	Range	CMC ² (±)	Comments
Temperature – Measure ³	(-200 to 200) °C (201 to 400) °C (401 to 660) °C	0.013 °C 0.02 °C 0.029 °C	Hart 5628 PRT Hart 1502A indicator
Calibration of Temperature Chambers – Profiling at One Internal Chamber Location ³	(-200 to 661) °C (662 to 800) °C (801 to 1100) °C (1100 to 1200) °C (1201 to 1450) °C	0.029 °C 0.87 °C 1.3 °C 1.4 °C 2.1 °C	PRT or thermocouples with indicator
Calibration of Ovens – Profiling at Multiple Internal Chamber Locations ³	(-80 to -20) °C (-20 to 20) °C (20 to 300) °C (301 to 550) °C (551 to 661) °C (662 to 1100) °C (1100 to 1200) °C	0.2 °C 0.22 °C 0.18 °C 0.23 °C 0.45 °C 1.6 °C 1.8 °C	Temperature data acquisition system & thermocouples calibrated as a set ASTM E145, ASTM D5374, ASTM D5423, and similar standards
Thermal Lag Time (Time Constants) ³	5 s to 60 min	18 s	Chronometer, ASTM E145, ASTM D5374, ASTM D5423, and similar standards
Rate of Ventilation ³	(2 to 300) air changes/hr	3.3 % of air changes/hr	Power Meter, ASTM E145, ASTM D5374, ASTM D5423, and similar standards
Thermometers and Temperature Sensors with Attached Indicators ³	(-80 to -20) °C (-20 to 20) °C (20 to 300) °C (301 to 550) °C (551 to 661) °C (662 to 1100) °C (1100 to 1200) °C	0.036 °C 0.059 °C 0.02 °C 0.063 °C 0.29 °C 1.4 °C 1.6 °C	Hart 5628 PRT and 1502A indicator and type STC and Fluke 743B and temperature baths, dry blocks, ovens and furnaces

Parameter/Equipment	Range	CMC ^{2, 6} (±)	Comments
Infrared Thermometers ³	(20 to 50) °C (50 to 310) °C	0.28 °C 0.55 %	Hart 5628 PRT, Hart 1502A indicator and Raytek black body
Relative Humidity – Measure ³	Up to 90 % RH (91 to 95) % RH	1 % RH 2 % RH	Direct measurement with a Vaisala humidity reference standard
Humidity – Measuring Equipment, Calibration of Hygrometers and RH Indicators, Transmitters and Transducers ³	Up to 90 % RH (91 to 95) % RH	1.1 % RH 2 % RH	RH chamber monitored by a Vaisala humidity reference standard

VII. Time & Frequency

Parameter/Equipment	Range	CMC ² (±)	Comments
Timers and Stopwatches ³	5 s to 24 hr	0.48 s	NIST time
	Up to 24 hr	0.25 s	NIST SP 960-12 time base method

¹ This laboratory offers commercial calibration service and field calibration service.

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 In the statement of CMC, *L* is the numerical value of the nominal length of the device measured in inches. In the statement of CMC, *R* is the numerical value of the resolution of the device in microinches.

⁵ The stated measured values are determined using the indicated instrument (see Comments). This capability is suitable for the calibration of the devices intended to measure or generate the measured value in the ranges indicated. CMCs are expressed as either a specific value that covers the full range or as a fraction/percentage of the reading plus a fixed floor specification.

⁶ In the statement of CMC, percentages are percentages of reading, unless otherwise indicated.



Accredited Laboratory

A2LA has accredited

MASSACHUSETTS METROLOGY AND INSTRUMENT SERVICE

Rockland, MA

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/NCSLI Z540-1-1994 and 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 8 January 2009).



Presented this 2nd day of May 2017.

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

President & CEO
For the Accreditation Council
Certificate Number 1411.01
Valid to April 30, 2019

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