



SCOPE OF ACCREDITATION TO ISO/IEC 17025:2005,
ANSI/NCSL Z540-1-1994 & ANSI/NCSL Z540.3-2006

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CALIBRATION

Valid To: July 31, 2018

Certificate Number: 1877.02

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 (±)	Comments
Hand Tools ^{3,7} – Calipers Indicators Micrometers Height Gages Depth Gages	Up to 1 in (>1 to 12) in (>1 to 4) in (>1 to 12) in (>1 to 24) in (>1 to 12) in	15 µin 14 µin/in + 1 µin 14 µin/in + 1 µin 14 µin/in + 1 µin 14 µin/in + 1 µin 14 µin/in + 1 µin	Gage blocks
Flatness	Up to 1 in Diameter	6 µin	Optical flat

II. Electrical – DC/Low Frequency

Parameter/Equipment	Range	CMC ^{2, 4, 6} (±)	Comments
DC Voltage – Generate, Fixed Points	1 V 10 V	8.9 µV 12 µV	Fluke 732A

Parameter/Equipment	Range	CMC ^{2,4,6} (\pm)	Comments
DC Voltage – Measure/Generate	Up to 200 mV (0.2 to 2) V (2 to 20) V (20 to 200) V (200 to 1050) V	5.8 μ V/V + 0.8 μ V 4.0 μ V/V + 3.8 μ V 4.0 μ V/V + 42 μ V 6.4 μ V/V + 0.4 mV 6.4 μ V/V + 4.6 mV	Fluke 8508A and 5520A
DC Current – Measure/Generate	(1 to 200) μ A (0.2 to 2) mA (2 to 20) mA (20 to 200) mA (0.2 to 2) A (2 to 20) A	14 μ A/A + 9.2 nA 14 μ A/A + 32 nA 17 μ A/A + 0.3 μ A 56 μ A/A + 5 μ A 0.022 % + 0.064 mA 0.046 % + 0.54 mA	Fluke 8508A and 5520A
DC Resistance – Generate	(0 to 10.9999) Ω (11 to 32.9999) Ω (33 to 109.9999) Ω (110 to 329.9999) Ω (0.33 to 1.099999) k Ω (1.1 to 3.299999) k Ω (3.3 to 10.99999) k Ω (11 to 32.99999) k Ω (33 to 109.9999) k Ω (110 to 329.9999) k Ω (0.33 to 1.09999) M Ω (1.1 to 3.299999) M Ω (3.3 to 10.99999) M Ω (11 to 32.99999) M Ω (33 to 109.9999) M Ω (110 to 329.9999) M Ω (330 to 1100) M Ω	40 $\mu\Omega/\Omega$ + 0.001 Ω 30 $\mu\Omega/\Omega$ + 0.0018 Ω 28 $\mu\Omega/\Omega$ + 0.0024 Ω 28 $\mu\Omega/\Omega$ + 0.0043 Ω 28 $\mu\Omega/\Omega$ + 0.013 Ω 28 $\mu\Omega/\Omega$ + 0.024 Ω 28 $\mu\Omega/\Omega$ + 0.025 Ω 28 $\mu\Omega/\Omega$ + 0.25 Ω 28 $\mu\Omega/\Omega$ + 0.25 Ω 32 $\mu\Omega/\Omega$ + 2.0 Ω 32 $\mu\Omega/\Omega$ + 2.2 Ω 60 $\mu\Omega/\Omega$ + 0.039 k Ω 0.013 % + 0.063 k Ω 0.025 % + 2.5 k Ω 0.05 % + 3.0 k Ω 0.30 % + 100 k Ω 1.5 % + 500 k Ω	Fluke 5520A
DC Resistance – Generate, Fixed Points	1 Ω 1 Ω 10 Ω 25 Ω 50 Ω 100 Ω 200 Ω 300 Ω 400 Ω 10 k Ω	9.0 $\mu\Omega$ 12 $\mu\Omega$ 0.12 m Ω 0.30 m Ω 0.60 m Ω 1.2 m Ω 2.4 m Ω 3.6 m Ω 4.8 m Ω 0.12 Ω	SRL-1 Hart 3591



Parameter/Equipment	Range	CMC ^{2,4,6} (±)	Comments
DC Resistance – Measure	Up to 2 Ω (2 to 20) Ω (20 to 200) Ω 200 Ω to 2 kΩ (2 to 20) kΩ (20 to 200) kΩ 200 kΩ to 2 MΩ (2 to 20) MΩ (20 to 200) MΩ 200 MΩ to 2 GΩ	20 μΩ/Ω + 5.2 μΩ 11 μΩ/Ω + 30 μΩ 9.2 μΩ/Ω + 0.3 mΩ 9.2 μΩ/Ω + 3.8 mΩ 9.2 μΩ/Ω + 32 mΩ 9.2 μΩ/Ω + 0.56 Ω 11 μΩ/Ω + 11 Ω 24 μΩ/Ω + 0.32 kΩ 0.014 % + 24 kΩ 0.18 % + 1.2 MΩ	Fluke 8508A
Electrical Calibration of Thermocouple Generate and Measure –			
Type B	(600 to 800) °C (800 to 1000) °C (1000 to 1550) °C (1550 to 1820) °C	0.44 °C 0.34 °C 0.30 °C 0.33 °C	Fluke 5520A
Type C	(0 to 150) °C (150 to 650) °C (650 to 1000) °C (1000 to 1800) °C (1800 to 2316) °C	0.30 °C 0.26 °C 0.31 °C 0.50 °C 0.84 °C	
Type E	(-200 to -100) °C (-100 to -25) °C (-25 to 350) °C (350 to 650) °C (650 to 1000) °C	0.50 °C 0.16 °C 0.14 °C 0.16 °C 0.21 °C	
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 0.40 °C	



Parameter/Equipment	Range	CMC ^{2,4,6} (±)	Comments
Electrical Calibration of Thermocouple Generate and Measure – (cont)			
Type L	(-200 to -100) °C (-100 to 800) °C (800 to 900) °C	0.37 °C 0.26 °C 0.17 °C	Fluke 5520A
Type N	(-200 to -100) °C (-100 to -25) °C (-25 to 120) °C (120 to 410) °C (410 to 1300) °C	0.40 °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 0.40 °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	
Type U	(-200 to 0) °C (0 to 600) °C	0.56 °C 0.27 °C	
Electrical Simulation of RTD Indicators ³			
Pt 385 - 100 Ω	(-200 to -80) °C (-80 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 0.05 °C 0.07 °C 0.09 °C 0.10 °C 0.12 °C 0.23 °C	Fluke 5520A



Parameter/Equipment	Range	CMC ^{2,4,6} (±)	Comments
Electrical Simulation of RTD Indicators ³ (cont)			
Pt 385 - 200 Ω	(-200 to -80) °C	0.04 °C	Fluke 5520A
	(-80 to 0) °C	0.04 °C	
	(0 to 100) °C	0.04 °C	
	(100 to 260) °C	0.05 °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	0.04 °C	
	(-80 to 0) °C	0.05 °C	
	(0 to 100) °C	0.05 °C	
	(100 to 260) °C	0.06 °C	
	(260 to 300) °C	0.08 °C	
	(300 to 400) °C	0.08 °C	
	(400 to 600) °C	0.09 °C	
	(600 to 630) °C	0.11 °C	
Pt 385 - 1000 Ω	(-200 to -80) °C	0.03 °C	
	(-80 to 0) °C	0.03 °C	
	(0 to 100) °C	0.04 °C	
	(100 to 260) °C	0.05 °C	
	(260 to 300) °C	0.06 °C	
	(300 to 400) °C	0.07 °C	
	(400 to 600) °C	0.07 °C	
	(600 to 630) °C	0.23 °C	
Pt 3916 - 100 Ω	(-200 to -190) °C	0.25 °C	
	(-190 to -80) °C	0.04 °C	
	(-80 to 0) °C	0.05 °C	
	(0 to 100) °C	0.06 °C	
	(100 to 260) °C	0.07 °C	
	(260 to 300) °C	0.08 °C	
	(300 to 400) °C	0.09 °C	
	(400 to 600) °C	0.10 °C	
(600 to 630) °C	0.23 °C		
Pt 3926 - 100 Ω	(-200 to -80) °C	0.05 °C	
	(-80 to 0) °C	0.05 °C	
	(0 to 100) °C	0.07 °C	
	(100 to 300) °C	0.09 °C	
	(300 to 400) °C	0.10 °C	
	(400 to 630) °C	0.12 °C	



Parameter/Equipment	Range	CMC ^{2,4,6} (±)	Comments
Electrical Simulation of RTD Indicators ³ (cont)			
PtNi 385 - 120 Ω	(-80 to 0) °C (0 to 100) °C (100 to 260) °C	0.08 °C 0.08 °C 0.14 °C	Fluke 5520A
Cu 427 - 10 Ω	(-100 to 260) °C	0.30 °C	

Parameter/Range	Frequency	CMC ^{2,4,6} (±)	Comments
AC Voltage ³ – Generate & Measure			
Up to 200 mV	(10 to 40) Hz (40 to 100) Hz 100 Hz to 2 kHz (2 to 10) kHz (10 to 30) kHz (30 to 100) kHz	0.014 % + 23 μV 0.012 % + 15 μV 0.011 % + 14 μV 0.014 % + 15 μV 0.034 % + 25 μV 0.077 % + 60 μV	Fluke 5520A with 8508A CMC is expressed as percent of reading plus percent of range; 2, 20 & 200 V ranges
(> 0.2 to 200) V	(10 to 40) Hz (40 to 100) Hz 100 Hz to 2 kHz (2 to 10) kHz (10 to 30) kHz (30 to 100) kHz (100 to 300) kHz 300 kHz to 1 MHz	0.012 % + 0.0025 % 0.009 % + 0.0025 % 0.008 % + 0.0025 % 0.011 % + 0.0025 % 0.022 % + 0.0078 % 0.057 % + 0.015 % 0.3 % + 0.14 % 1.0 % + 1.0 %	
(> 200 to 1050) V	(10 to 40) Hz 40 Hz to 10 kHz (10 to 30) kHz (30 to 100) kHz	0.012 % + 0.052 V 0.012 % + 0.052 V 0.023 % + 0.21 V 0.058 % + 0.54 V	



Parameter/Range	Frequency	CMC ^{2,4,6} (±)	Comments
AC Current ^{3,8} – Generate/Measure			Fluke 5520A & 8508A CMC is expressed as percent of reading plus percent of range; 200 μA, 2 mA & 20 mA ranges
Up to 20 mA	10 Hz to 1 kHz (> 1 to 5) kHz (> 5 to 10) kHz	0.030 % + 0.022% 0.030 % + 0.037 % 0.030 % + 0.15 %	
(> 20 to 200) mA	10 Hz to 1 kHz (> 1 to 5) kHz (> 5 to 10) kHz	0.029 % + 0.024 mA 0.029 % + 0.029 mA 0.029 % + 0.092 mA	
(> 0.2 to 2) A	10 Hz to 1 kHz (> 1 to 5) kHz (> 5 to 10) kHz	0.062 % + 0.34 mA 0.073 % + 0.47 mA 0.073 % + 5.2 mA	
(> 2 to 20) A	10 Hz to 2 kHz (2 to 10) kHz	0.082 % + 2.0 mA 0.25 % + 2.1 mA	
(20 to 150) A (150 to 1025) A	(45 to 65) Hz (45 to 65) Hz	0.38 % + 0.068 A 0.53 % + 0.31 A	Fluke 5520A w/ coil
(20 to 150) A (150 to 1025) A	(65 to 440) Hz (65 to 440) Hz	1 % + 0.061 A 1 % + 0.32 A	
AC Power ³ – Generate			Fluke 5520A
(45 to 65) Hz; PF=1	(0.11 to 0.3) mW (0.3 to 1.1) mW (1.1 to 3) mW (3 to 11) mW (11 to 30) mW (30 to 110) mW (110 to 300) mW (300 to 725) mW (0.73 to 1.5) W (1.5 to 6.77) W (6.77 to 9.18) W (9.18 to 33.66) W (33.66 to 91.8) W (92 to 337) W (337 to 918) W (0.92 to 2.24) kW (2.24 to 4.59) kW (4.59 to 20.91) kW	0.14 % 0.10 % 0.14 % 0.10 % 0.14 % 0.10 % 0.14 % 0.12 % 0.14 % 0.12 % 0.12 % 0.08 % 0.12 % 0.08 % 0.12 % 0.08 % 0.12 % 0.10 %	



Parameter/Range	Frequency	CMC ^{2,4,6} (±)	Comments
Phase Generate ³ – (0 to 360)°	(1 to 65) Hz (65 to 500) Hz 500 Hz to 1 kHz (1 to 5) kHz	0.14° 0.30° 0.58° 2.9 °	Fluke 5520A
Capacitance ³ – Generate (0.19 to 3.299) nF (3.3 to 10.999) nF (11 to 109.999) nF (110 to 329.99) nF (0.33 to 1.0999) μF (1.1 to 3.2999) μF (3.3 to 10.999) μF (11 to 32.999) μF (33 to 109.99) μF (110 to 329.99) μF (0.33 to 1.0999) mF (1.1 to 3.2999) mF (3.3 to 10.999) mF (11 to 32.999) mF (33 to 110) mF	10 Hz to 10 kHz (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 Up to 50 Hz Up to 20 Hz Up to 6 Hz Up to 2 Hz Up to 0.6 Hz Up to 0.2 Hz	0.52 % + 12 pF 0.26 % + 12 pF 0.26 % + 0.12 nF 0.26 % + 0.31 nF 0.26 % + 1.2 nF 0.26 % + 3.1 nF 0.26 % + 12 nF 0.42 % + 31 nF 0.46 % + 0.12 μF 0.46 % + 0.31 μF 0.46 % + 1.2 μF 0.46 % + 3.1 μF 0.46 % + 12 μF 0.78 % + 31 μF 1.2 % + 0.12 mF	Fluke 5520A

Parameter/Equipment	Range	CMC ^{2,4,6} (±)	Comments
Oscilloscopes ³ – Bandwidth Rise Time Tunnel Diode Pulsar 5520A into 50 Ω Time Markers	50 kHz ref 50 kHz to 100 MHz (100 to 300) MHz (300 to 600) MHz (600 to 1100) MHz < 150 ps < 300 ps (> 2 to 5) s > 50 ms to 2 s (> 20 to 50) ms 1 ns to 20 ms	2.4 % + 0.35 mV 1.8 % + 0.12 mV 2.4 % + 0.12 mV 4.7 % + 0.12 mV 5.9 % + 0.12 mV 12 ps 12 ps 0.59 % 0.24 % 0.0089 % 0.0003 %	Fluke 5500A SC600



III. Fluid Quantities

Parameter/Equipment	Range	CMC ^{2,6} (±)	Comments
Gas Flow	(10 to 100) sccm (100 to 1000) sccm (1 to 10) slm (10 to 50) slm	0.26 % + 0.02 sccm 0.26 % + 0.2 sccm 0.26 % + 0.002 slm 0.28% + 0.01 slm	Fluke Molbloc
Liquid Flow Meters	(0.7 to 180) GPM	1.2 %	Volumetric flow meter

IV. Mechanical

Parameter/Equipment	Range	CMC ^{2,6} (±)	Comments
Mass – Measure ASTM Class 1, OIML E2	1 mg 2 mg 5 mg 10 mg 20 mg 50 mg 100 mg 200 mg 300 mg 500 mg 1 g 2 g 5 g 10 g 20 g 50 g 100 g 200 g 500 g 1 kg 2 kg 5 kg	1.7 µg 1.9 µg 2.2 µg 2.4 µg 2.5 µg 2.5 µg 2.6 µg 2.6 µg 2.8 µg 3.0 µg 6.2 µg 6.3 µg 5.5 µg 13 µg 14 µg 25 µg 46 µg 67 µg 0.19 mg 0.28 mg 0.66 mg 1.4 mg	Mettler Toledo UMX5 with ASTM Class 0 mass standards NISTIR 6969, Handbook 145, MGP Guide 71 ASTM Class 1 weights ASTM Class 4 weights
ASTM Class 6, OIML M2	10 kg	4.3 mg	



Parameter/Equipment	Range	CMC ^{2, 6} (±)	Comments
Scales and Balances	(1 to 500) mg (> 0.5 to 100) g (> 100 to 1000) g (1 to 1000) kg	0.007 mg 1.5 µg/g + 21 µg 1.7 µg/g + 9.3 µg 0.024 %	Troemner Ultra Class masses Class F/6 weights
Pipettes	(0.1 to 1) µL (1 to 10) µL (10 to 50) µL (50 to 100) µL (100 to 500) µL (500 to 1 000) µL (1 to 5) mL (5 to 10) mL	0.033 µL 0.063 µL 0.19 µL 0.33 µL 0.41 µL 1.3 µL 11 µL 49 µL	ASTM Class 1 weights
Pressure – Measure and Generate ³			
Pneumatic Differential	Up to 2.5 kPa (2.5 to 25) kPa	0.25 Pa 0.0096 %	Fluke 7250LP
Pneumatic Gage	(-14.7 to 15) psi (15 to 300) psi (300 to 750) psi (750 to 3000) psi (3000 to 75000) psi	0.012 % + 0.001 psi 0.012 % + 0.002 psi 0.012 % + 0.02 psi 0.01 % 0.01 %	Mensor CPC6000
Hydraulic Gage	(>7500 to 10 000) psi Up to 600 psi (600 to 3000) psi Up to 2000 psi (2000 to 10 000) psi	0.031 % 0.0077 % + 1.6 psi 0.23 % + 0.2 psi 0.0077 % + 2.3 psi 0.23 % + 0.2 psi	Crystal Eng. M1 Crystal Eng. XP2i
Torque Tools	4 lbf·in to 600 lbf·ft	0.26 %	Torque transducers and loader



V. Thermodynamic

Parameter/Equipment	Range	CMC ^{2,6} (±)	Comments
Infrared Measuring Equipment	(-18 to 149) °C (150 to 200) °C (>200 to 300) °C	1.4 °C 2 °C 2.2 °C	Blackbody sources
Temperature – Measuring Equipment ³	(-80 to 300) °C (300 to 960) °C	0.02 °C 1.2 °C	Hart 1590 & SPRT
Temperature – Measuring Equipment, Fixed Points	-196 °C -38.8344 °C 0.01 °C 231.928 °C 419.527 °C	0.007 °C 0.005 °C 0.003 °C 0.007 °C 0.004 °C	Hart 1590 w/SPRT in Liquid N ₂ Hg TP cell H ₂ O TP cell Sn FP cell Zn FP cell
Temperature – Measure ³	(-196 to 0) °C (0 to 420) °C (420 to 960) °C	0.008 °C 0.022 °C 0.058 °C	Hart 1590 & SPRT
Relative Humidity – Measuring Equipment	(10 to 95) % RH	0.65 % RH	Thunder 2500
Relative Humidity Measuring Equipment – Calibration of Humidity Probes ³	(10 to 97.4) % RH (>90 to 95) % RH	1.4 % RH 2.4 % RH	Vaisala HMP238



VI. Time & Frequency

Parameter/Equipment	Range	CMC ^{2, 6} (\pm)	Comments
Frequency – Generate	0.01 Hz to 1 kHz 1 kHz to 1100 MHz	2.9 μ Hz/Hz + 6 μ Hz 2.9 μ Hz/Hz	Fluke 5520A
Frequency – Measure	1 Hz to 225 MHz 10 Hz to 26.5 GHz	2.4 μ Hz/Hz + 10 μ Hz 5.0 μ Hz/Hz + 20 μ Hz	HP 53132 Opt 2 EIP 548A
Frequency – Generate & Measure	1 mHz to 26 GHz	590 pHz/Hz + 0.6R	Rubidium standard w/ HP 53132A, R stands for the resolution of the unit under test
Stopwatches ³	0.1 s to 24 hr	0.13 s	HP 53132A w/ Agilent 33220A
Digital Stopwatch/Timer	Offset per 24 hours	0.039 s/day	Witschi Qtest 6000
Tachometers ³	(40 to 99 999) rpm	(0.29 + 0.00023X) rpm	Fluke 5520A; X equals measured rpm

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

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 uncertainty 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 uncertainty.

⁴ 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. CMC's are expressed as either a specific value that covers the full range or as a percent or fraction of the reading plus a fixed floor specification.



⁵ All percentages are percent of reading unless otherwise indicated.

⁶ Uncertainty components that can be reasonably attributed to the Unit Under Test have not been utilized in the calculation of the CMC value for this measurement parameter.

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Accredited Laboratory

A2LA has accredited

QSL CALIBRATION, A TRESICAL COMPANY

Boca Raton, FL

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 R205 – Specific Requirements: Calibration Laboratory Accreditation Program and ANSI/NCSL Z540-1-1994 and ANSI/NCSL Z540.3-2006. 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 16th day of January 2017.

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

President and CEO
For the Accreditation Council
Certificate Number 1877.02
Valid to July 31, 2018
Revised May 18, 2018

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