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

BATTELLE
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CALIBRATION

Valid To: October 31, 2019 Certificate Number: 2110.01

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

I. Electrical – DC/Low Frequency

Parameter/Equipment	Range	CMC[2, 3] (±)	Comments
DC Voltage – Generate & Measure, Fixed Point	10 V	0.6 parts in 10^6 V	Fluke 732A
DC Voltage – 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	8 µV/V + 0.4 µV 5 µV/V + 0.7 µV 3 µV/V + 2.5 µV 2.8 µV/V + 4 µV 4 µV/V + 40 µV 4.9 µV/V + 400 µV	Fluke 5720A
DC Voltage – Measure	(0 to 200) mV 200 mV to 2 V (2 to 20) V (20 to 200) V (200 to 1000) V	8.7 µV/V + 0.1 µV 4.7 µV/V + 0.4 µV 4.5 µV/V + 4 µV 5.9 µV/V + 40 µV 6.2 µV/V + 1 mV	Fluke 8508A

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Parameter/Equipment	Range	CMC[2, 3] (±)	Comments
DC Current – Generate	(0 to 220) µA 220 µA to 2.2 mA (2.2 to 22) mA (22 to 220) mA 220 mA to 2.2 A (2.2 to 11) A	36 µA/A + 6 nA 44 µA/A + 7 nA 31 µA/A + 40 nA 41 µA/A + 0.7 µA 64 µA/A + 12 µA 0.039 % + 480 µA	Fluke 5720A Fluke 5720A w/5725A
DC Current – Measure	(0 to 200) µA 200 µA to 2 mA (2 to 20) mA (20 to 200) mA 200 mA to 2 A (2 to 20) A	16 µA/A + 0.4 nA 17 µA/A + 4 nA 17 µA/A + 0.04 µA 52 µA/A + 0.8 µA 0.02 % + 16 µA 0.04 % + 400 µA	Fluke 8508A
Resistance – Generate, Fixed Points	1 Ω 10 Ω 100 Ω 1 kΩ 10 kΩ 100 kΩ 1 MΩ 10 MΩ	2.1 parts in 10^6 Ω 4 parts in 10^6 Ω 1.1 parts in 10^6 Ω 1.2 parts in 10^6 Ω 1.4 parts in 10^6 Ω 1.9 parts in 10^6 Ω 2.1 parts in 10^6 Ω 6.9 parts in 10^6 Ω	Fluke 742A
Resistance – Generate, Fixed Points	0 Ω (1, 1.9) Ω (10, 19) Ω (100, 190) Ω (1, 1.9, 10, 19) kΩ (100, 190) kΩ 1 MΩ 1.9 MΩ 10 MΩ 19 MΩ 100 MΩ	40 parts in 10^6 Ω 86 parts in 10^6 Ω 22 parts in 10^6 Ω 9.6 parts in 10^6 Ω 7.8 parts in 10^6 Ω 7.9 parts in 10^6 Ω 9.4 parts in 10^6 Ω 16 parts in 10^6 Ω 32 parts in 10^6 Ω 40 parts in 10^6 Ω 98 parts in 10^6 Ω	Fluke 5720A
Resistance – Measure	(0 to 2) Ω (2 to 20) Ω (20 to 200) Ω (200 to 2000) Ω (2 to 20) kΩ (20 to 200) kΩ (200 to 2000) kΩ (2 to 20) MΩ	15 parts in 10^6 Ω 5.5 parts in 10^6 Ω 3.3 parts in 10^6 Ω 3.3 parts in 10^6 Ω 6.2 parts in 10^6 Ω 7.2 parts in 10^6 Ω 14 parts in 10^6 Ω 26 parts in 10^6 Ω	Fluke 742A, Fluke 8508A Fluke 8508A

Parameter/Equipment	Range	CMC[2, 3, 4] (±)	Comments
Resistance – Measure (cont)	(20 to 200) MΩ 200 MΩ to 2 GΩ (2 to 20) GΩ	0.014 % + 10 kΩ 0.038 % + 100 kΩ 0.16 % + 10 MΩ	Fluke 742A, Fluke 8508A

Parameter/Range	Frequency	CMC[2, 3] (±)	Comments
AC Voltage – Generate			
(2.2, 22) mV	(10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz	0.023 % + 4 µV 87 µV/V + 4 µV 77 µV/V + 4 µV 0.018 % + 4 µV 0.047 % + 5 µV 0.092 % + 10 µV 0.12 % + 20 µV 0.26 % + 20 µV	Fluke 5720A
220 mV	(10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz	0.023 % + 12 µV 87 µV/V + 7 µV 77 µV/V + 7 µV 0.018 % + 7 µV 0.043 % + 17 µV 0.077 % + 20 µV 0.12 % + 25 µV 0.25 % + 45 µV	
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 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz	0.022 % + 40 µV 82 µV/V + 15 µV 41 µV/V + 8 µV 71 µV/V + 10 µV 0.011 % + 30 µV 0.035 % + 80 µV 0.092 % + 200 µV 0.15 % + 300 µV	
22 V	(10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz	0.023 % + 0.4 mV 82 µV/V + 0.15 mV 41 µV/V + 0.05 mV 77 µV/V + 0.1 mV 95 µV/V + 0.2 mV 0.026 % + 0.6 mV 0.09 % + 2 mV 0.13 % + 3.2 mV	

Parameter/Range	Frequency	CMC[2, 3] (±)	Comments
AC Voltage – Generate (cont)			
220 V	(10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz	0.022 % + 4 mV 80 µV/V + 1.5 mV 47 µV/V + 0.6 mV 75 µV/V + 1 mV 0.013 % + 2.5 mV 0.08 % + 16 mV 0.42 % + 40 mV 0.7 % + 80 mV	Fluke 5720A
1100 V	(15 to 50) Hz 50 Hz to 1 kHz 40 Hz to 1 kHz (1 to 20) kHz (10 to 30) kHz	0.026 % + 16 mV 60 µV/V + 3.5 mV 80 µV/V + 4 mV 0.013 % + 6 mV 0.036 % + 11 mV	Fluke 5720A w/ 5725A
750 V	(30 to 50) kHz (50 to 100) kHz	0.036 % + 11 mV 0.13 % + 45 mV	Fluke 5720A w/ 5725A
1.1 mV 3 mV 11 mV 33 mV 110 mV 330 mV 1.1 V 3.5 V	30 Hz to 500 kHz	0.5 % + 0.4 µV 0.45 % + 1 µV 0.35 % + 4 µV 0.3 % + 10 µV 0.3 % + 40 µV 0.25 % + 100 µV 0.25 % + 400 µV 0.2 % + 500 µV	Fluke 5720A/opt 03
AC Voltage – Measure			
200 mV	(1 to 10) Hz (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	0.017 % + 14 µV 0.014 % + 4 µV 0.012 % + 4 µV 0.011 % + 2 µV 0.014 % + 4 µV 0.034 % + 8 µV 0.077 % + 20 µV	Fluke 8508A

Parameter/Range	Frequency	CMC[2, 3] (±)	Comments
AC Voltage – Measure (cont)			
2 V	(1 to 10) Hz (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	0.015 % + 120 µV 0.012 % + 20 µV 90 µV/V + 20 µV 75 µV/V + 20 µV 0.011 % + 20 µV 0.022 % + 40 µV 0.057 % + 200 µV 0.6 % + 2 mV 2 % + 20 mV	Fluke 8508A
20 V	(1 to 10) Hz (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	0.015 % + 1.2 mV 0.012 % + 200 µV 90 µV/V + 200 µV 75 µV/V + 200 µV 0.011 % + 200 µV 0.022 % + 400 µV 0.057 % + 2 mV 0.6 % + 20 mV 2 % + 200 mV	
200 V	(1 to 10) Hz (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	0.015 % + 12 mV 0.012 % + 2 mV 90 µV/V + 2 mV 75 µV/V + 2 mV 0.011 % + 2 mV 0.022 % + 400 mV 0.057 % + 20 mV 0.6 % + 200 mV 2 % + 2 V	
1000 V	(1 to 10) Hz (10 to 40) Hz 40 Hz to 10 kHz (10 to 30) kHz (30 to 100) kHz	0.015 % + 70 mV 0.012 % + 20 mV 0.012 % + 20 mV 0.023 % + 40 mV 0.058 % + 200 mV	

Parameter/Range	Frequency	CMC[2, 3] (±)	Comments
AC Current – Generate			
220 µA	(10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.023 % + 16 nA 0.014 % + 10 nA 0.011 % + 8 nA 0.025 % + 12 nA 0.09 % + 65 nA	Fluke 5720A
2.2 mA	(10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.023 % + 40 nA 0.014 % + 35 nA 0.011 % + 35 nA 0.018 % + 110 nA 0.09 % + 650 nA	
22 mA	(10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.023 % + 400 nA 0.014 % + 350 nA 0.011 % + 350 nA 0.018 % + 550 nA 0.09 % + 5 µA	Fluke 5720A
220 mA	(10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.023 % + 4 µA 0.014 % + 3.5 µA 0.011 % + 2.5 µA 0.018 % + 3.5 µA 0.09 % + 10 µA	
2.2 A	20 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.024 % + 35 µA 0.039 % + 80 µA 0.6 % + 160 µA	
11 A	40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.04 % + 170 µA 0.085 % + 380 µA 0.33 % + 750 µA	Fluke 5720A w/ 5725A
AC Current – Measure			
200 µA	(1 to 10) Hz 10 Hz to 10 kHz (10 to 30) kHz (30 to 100) kHz	0.33 % + 20 nA 0.032 % + 20 nA 0.087 % + 20 nA 0.41 % + 20 nA	Fluke 8508A
2 mA	(1 to 10) Hz 10 Hz to 10 kHz (10 to 30) kHz (30 to 100) kHz	0.032 % + 200 nA 0.031 % + 200 nA 0.087 % + 200 nA 0.41 % + 200 nA	

Parameter/Range	Frequency	CMC[2, 3] (±)	Comments
AC Current – Measure (cont)			
20 mA	(1 to 10) Hz 10 Hz to 10 kHz (10 to 30) kHz (30 to 100) kHz	0.033 % + 2 µA 0.032 % + 2 µA 0.087 % + 2 µA 0.41 % + 2 µA	Fluke 8508A
200 mA	(1 to 10) Hz 10 Hz to 10 kHz (10 to 30) kHz	0.033 % + 20 µA 0.03 % + 20 µA 0.064 % + 20 µA	
2 A	(1 to 10) Hz 10 Hz to 10 kHz (10 to 30) kHz	0.068 % + 200 µA 0.078 % + 200 µA 0.31 % + 200 µA	
20 A	10 Hz to 2 kHz (2 to 10) kHz	0.089 % + 2 mA 0.26 % + 2 mA	

Parameter/Equipment	Range	CMC[2] (±)	Comments
Electrical Calibration of Thermocouples – Generate & Measure			
Type B	(600 to 800) °C (800 to 1000) °C (1000 to 1550) °C (1550 to 1820) °C	0.34 ºC 0.26 ºC 0.23 ºC 0.26 ºC	Fluke 5500A
Type C	(0 to 150) °C (150 to 650) °C (650 to 1000) °C (1000 to 1800) °C (1800 to 2316) °C	0.23 ºC 0.2 ºC 0.24 ºC 0.39 ºC 0.65 ºC	
Type E	(-250 to -100) °C (-100 to -25) °C (-25 to 350) °C (350 to 650) °C (650 to 1000) °C	0.39 ºC 0.12 ºC 0.11 ºC 0.12 ºC 0.16 ºC	

Parameter/Equipment	Range	CMC[2] (±)	Comments
Electrical Calibration of Thermocouples – Generate & Measure (cont)			
Type J	(-210 to -100) °C (-100 to -30) °C (-30 to 150) °C (150 to 760) °C (760 to 1200) °C	0.21 ºC 0.12 ºC 0.11 ºC 0.13 ºC 0.18 ºC	Fluke 5500A
Type K	(-200 to -100) °C (-100 to -25) °C (-25 to 120) °C (120 to 1000) °C (1000 to 1372) °C	0.26 ºC 0.14 ºC 0.12 ºC 0.20 ºC 0.31 ºC	
Type L	(-200 to -100) °C (-100 to 800) °C (800 to 900) °C	0.29 ºC 0.2 ºC 0.13 ºC	
Type N	(-200 to -100) °C (-100 to -25) °C (-25 to 120) °C (120 to 410) °C (410 to 1300) °C	0.31 ºC 0.17 ºC 0.15 ºC 0.14 ºC 0.21 ºC	
Type R	(0 to 250) °C (250 to 400) °C (400 to 1000) °C (1000 to 1767) °C	0.44 ºC 0.27 ºC 0.26 ºC 0.31 ºC	
Type S	(0 to 250) °C (250 to 1000) °C (1000 to 1400) °C (1400 to 1767) °C	0.37 ºC 0.28 ºC 0.29 ºC 0.36 ºC	
Type T	(-250 to -150) °C (-150 to 0) °C (0 to 120) °C (120 to 400) °C	0.49 ºC 0.19 ºC 0.12 ºC 0.11 ºC	
Type U	(-200 to 0) °C (0 to 600) °C	0.43 ºC 0.21 ºC	

Parameter/Equipment	Range	CMC[2] (±)	Comments
Electrical Calibration of RTD – Generate & Measure			
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	0.04 °C 0.05 °C 0.07 °C 0.08 °C 0.09 °C 0.018 ºC	Fluke 5500A
Pt 3926, 100 Ω	(-200 to 0) °C (0 to 100) °C (100 to 300) °C (300 to 400) °C (400 to 630) °C	0.04 ºC 0.05 °C 0.07 ºC 0.08 ºC 0.09 ºC	
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	0.19 °C 0.03 °C 0.02 °C 0.05 °C 0.05 °C 0.06 °C 0.06 °C 0.08 °C 0.18 °C	
Pt 385, 200 Ω	(-200 to -80) °C (-80 to 100) °C (100 to 260) °C (260 to 300) °C (300 to 400) °C (400 to 600) °C (600 to 630) °C	0.03 °C 0.03 °C 0.04 °C 0.09 °C 0.1 °C 0.11 °C 0.12 °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	0.03 °C 0.04 °C 0.05 °C 0.06 °C 0.07 °C 0.09 °C	

Parameter/Equipment	Range	CMC[2] (±)	Comments
Electrical Calibration of RTD – Generate & Measure (cont)			
Pt 385, 1000 Ω	(-200 to -80) °C (-80 to 0) °C (0 to 100) °C (100 to 260) °C (260 to 300) °C (300 to 600) °C (600 to 630) °C	0.02 °C 0.02 °C 0.03 °C 0.04 °C 0.05 °C 0.05 °C 0.18 °C	Fluke 5500A
PtNi 385, 120 Ω	(-80 to 100) °C (100 to 260) °C	0.06 °C 0.11 °C	
Cu 427, 10 Ω	(-100 to 260) °C	0.23 ºC	

II. Fluid Quantities

Parameter/Equipment	Range	CMC[2, 4] (±)	Comments
Gas Flow	0.04 sccm to 5 slm (5 to 40) slm (40 to 100) slm	0.26 % 0.24 % 0.52 %	DH Molbox1-AG with molblocs Nitrogen gas

III. Mechanical

Parameter/Equipment	Range	CMC[2, 4] (±)	Comments
Mass – Measuring Equipment	(1 to 500) mg (1 to 5) g 10 g 20 g 30 g 50 g	0.006 mg + 0.58*R* 0.013 mg + 0.58*R* 0.021 mg + 0.58*R* 0.028 mg + 0.58*R* 0.051 mg + 0.58*R* 0.094 mg + 0.58*R*	ASTM Class 0 weights

Parameter/Equipment	Range	CMC[2, 4] (±)	Comments
Mass – Measuring Equipment, Fixed Points (cont)	100 g 200 g 300 g 500 g 1 kg 2 kg 3 kg 5 kg 10 kg 30 kg	0.13 mg + 0.58*R* 0.18 mg + 0.58*R* 0.34 mg + 0.58*R* 0.51 mg + 0.58*R* 1.1 mg + 0.58*R* 4.1 mg + 0.58*R* 4.7 mg + 0.58*R* 6.5 mg + 0.58*R* 9.3 mg + 0.58*R* 290 mg + 0.58*R*	ASTM Class 0 weights ASTM Class 2 weights
Mass – Measure, Fixed Points	(1 to 500) mg (1 to 5) g 10 g 20 g 30 g 50 g 100 g 200 g 300 g 500 g 1 kg 2 kg 3 kg 5 kg 10 kg 30 kg	0.005 mg 0.005 mg 0.01 mg 0.011 mg 0.033 mg 0.075 mg 0.074 mg 0.16 mg 0.14 mg 0.15 mg 0.27 mg 3.2 mg 3 mg 3.6 mg 6.9 mg 180 mg	Double substitution, ASTM Class 0 weights Double substitution, ASTM Class 2 weights
Pressure – Pneumatic	(0 to 0.8) psig (0.8 to 1.5) psig (1.5 to 2.2) psig (0.5 to 50) psig (50 to 100) psig (100 to 200) psig (200 to 300) psig (300 to 600) psig (600 to 1000) psig	0.000 14 psi 0.000 26 psi 0.000 38 psi 0.013 psi 0.019 psi 0.032 psi 0.094 psi 0.27 psi 0.15 psi	DH low pressure calibrator DH PPC2 pressure controller Nitrogen gas

Parameter/Equipment	Range	CMC[2, 4] (±)	Comments
Pipettes	(1 to 10) µL (10.01 to 20) µL (20.01 to 50) µL (50.1 to 500) µL (501 to 1000) µL (1001 to 5000) µL (5001 to 10 000) µL	0.033 µL 0.042 µL 0.21 µL 1.2 µL 1.2 µL 5.8 µL 12 µL	Gravimetric method using ASTM Class 0 weights and XP26PC, XP205, and MCP105 balances
Digital/Mechanical Centrifuge/Tachometer	(6 to 8299) rpm (8300 to 24 999) rpm (25 000 to 99 000) rpm	2.1 rpm 2.1 rpm 2.1 rpm + 0.006 % · R	Direct reflective pickup tachometer

IV. Thermodynamics

Parameter/Equipment	Range	CMC[2] (±)	Comments
Temperature – Measuring Equipment			Direct comparison with reference thermometer and probe in precision bath
Digital Thermometers	(-60 to 660) ºC	0.01 °C	
Liquid-in-glass Thermometers	(-60 to 660) ºC	0.58 °C	
Temperature – Measure	(-200 to 0) ºC (0 to 100) ºC (100 to 420) ºC (420 to 660) ºC	14 mK 15 mK 24 mK 34 mK	Hart 1502A and 5628
Relative Humidity – Measuring Equipment	(10 to 95) % RH	0.5 % RH	Thunder Scientific 2500

V. Time & Frequency

Parameter/Equipment	Frequency	CMC[2] (±)	Comments
Frequency – Measuring Equipment	10 MHz 0.1 Hz to 3.2 GHz	1.4 parts in 10^{12} Hz 9 parts in 10^{7} Hz	Fluke 910R Wavetek 9500A with 9530A Active Head
Frequency – Measure	0.001 Hz to 3 GHz	1.2 parts in 10^{10} Hz	CNT-91

[1] This laboratory is not normally available for commercial 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] Calibration and Measurement Capability (CMC) for calibrations performed with the Fluke 5720A or Fluke 8508A is based upon 90 day specifications and is read as a portion or percent of output plus floor specification.

[4] In the statement of CMC, percentages are percentages of reading, unless otherwise indicated; *R* is the numerical value of the resolution of the device in its respective units

Accredited Laboratory

A2LA has accredited

BATTELLE

Columbus, OH

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 31st day of October 2017.

President and CEO
For the Accreditation Council
Certificate Number 2110.01
Valid to October 31, 2019

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