



SCOPE OF ACCREDITATION TO ISO/IEC 17025:2017,
ANSI/NCSL Z540-1-1994 & ANSI/NCSL Z540.3-2006

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CALIBRATION

Valid To: March 31, 2021

Certificate Number: 1877.01

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory to perform the following calibrations^{1, 7}:

I. Acoustics

Parameter/Equipment	Range	CMC ² (±)	Comments
Acoustics Measuring Equipment ⁶ – Microphones (1/8, 1/4, 1/2, 1 in)	250 Hz reference sensitivity	0.50 dB	Modal Shop 9350 calibrator and reference microphone
	Flatness at 20 Hz	0.67 dB	
Acoustics – Measure Pistonphones, Sound Level Generators 250 Hz	114 dB	0.73 dB	Modal Shop 9350 calibrator and reference microphone

II. Chemical

Parameter/Equipment	Range	CMC ^{2,8} (±)	Comments
pH – Measuring Equipment ^{3, 6}	(4, 7, 10) units	0.016 units	Buffer solutions

Parameter/Equipment	Range	CMC ^{2, 8} (±)	Comments
Electrolytic Conductivity – Measuring Equipment ^{3, 6}	≈10 μS/cm ≈100 μS/cm ≈1000 μS/cm ≈10 000 μS/cm	0.53 μS/cm 2.4 μS/cm 23 μS/cm 0.23 mS/cm	Conductivity solutions

III. Dimensional

Parameter/Equipment	Range	CMC ^{2, 5} (±)	Comments
Angle Measuring Equipment ⁶	5°, 15°, 30°, 45°	5.2"	Sine bar and gage blocks
Hand Tools ³ – Calipers, Depth Gages, Height Gages, Indicators, Micrometers (ID/OD)	Up to 40 in	3.6 μin/in + 4.5 μin + 0.6R	Gage blocks
Tape Measure and Steel Ruler ³	(1 to 12) in (12 to 36) in (3 to 100) ft	0.008 in + 0.002 in/in 0.0034 in + 0.002 in/in 0.0002 in + 0.0043 in/ft	Rigid ruler and gage blocks; no tension applied

IV. Electrical – DC/Low Frequency

Parameter/Equipment	Range	CMC ^{2, 4} (±)	Comments
DC Voltage ^{3, 6} – Generate	Up to 220 mV (0.22 to 2.2) V (2.2 to 11) V (11 to 22) V (22 to 220) V (220 to 1100) V	6.8 μV/V + 0.40 μV 3.7 μV/V + 0.80 μV 4.9 μV/V + 3.0 μV 4.9 μV/V + 4.3 μV 3.7 μV/V + 48 μV 4.7 μV/V + 0.48 mV	Fluke 5720A

Parameter/Equipment	Range	CMC ^{2,4} (±)	Comments
DC Voltage ³ – Measure	Up to 200 mV 200 mV to 2 V (2 to 20) V (20 to 200) V (200 to 1000) V	9.1 μV/V + 0.23 μV 4.3 μV/V + 0.4 μV 4.4 μV/V + 0.7 μV 6.7 μV/V + 0.64 μV 7.1 μV/V + 0.01 mV	Fluke 8508A
DC High Voltage ³ – Measure	(1 to 60) kV (60 to 200) kV	0.02 % 2.4 %	Ross VD60 w/ Agilent 34401A Ross VMP200 w/ Fluke 187
DC Current ⁶ – Generate	Up to 220 μA (0.22 to 2.2) mA (2.2 to 22) mA (22 to 220) mA (0.22 to 2.2) A (2.2 to 11) A (11 to 20.5) A (20.5 to 150) A (150 to 1000) A (1000 to 3000) A	35 μA/A + 6.0 nA 31 μA/A + 7.0 nA 30 μA/A + 41 nA 41 μA/A + 0.71 μA 77 μA/A + 12 μA 0.034 % + 0.48 mA 0.10 % + 0.91 A 0.58 % + 0.16 A 0.60 % + 0.58 A 0.04 % 0.06 % 0.9 %	Fluke 5720A Fluke 5520A Fluke 5520A w/ coil Fluke 55120 w/ 2025 coil
DC Current – Measure	Up 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	12 μA/A + 4.0 nA 12 μA/A + 15 nA 14 μA/A + 40 nA 48 μA/A + 0.8 μA 0.019 % + 16 μA 0.042 % + 32 μA	Fluke 8508A

Parameter/Equipment	Range	CMC ^{2,4} (±)	Comments
DC Power	(0.01 to 330) W (0.33 to 11) kW (11 to 20.5) kW	0.021 % 0.073 % 0.12 %	Fluke 5520A
Resistance ⁶ – Generate	Up to 10.9999 Ω (11 to 32.9999) Ω (33 to 109.9999) Ω (110 to 329.9999) Ω (0.33 to 1.099999) kΩ (1.1 to 3.299999) kΩ (3.3 to 10.99999) kΩ (11 to 32.99999) kΩ (33 to 109.999) kΩ (110 to 329.999) kΩ	40 μΩ/Ω + 1.0 mΩ 30 μΩ/Ω + 2.0 mΩ 28 μΩ/Ω + 2.0 mΩ 28 μΩ/Ω + 4.0 mΩ 28 μΩ/Ω + 13 mΩ 28 μΩ/Ω + 13 mΩ 28 μΩ/Ω + 30 mΩ 28 μΩ/Ω + 0.30 Ω 28 μΩ/Ω + 0.30 Ω 32 μΩ/Ω + 2.0 Ω	Fluke 5520A, 4-wire
Fixed Points	(0.33 to 1.09999) MΩ (1.1 to 3.29900) MΩ (3.3 to 10.9999) MΩ (11 to 32.9999) MΩ (33 to 109.9999) MΩ (110 to 329.9999) MΩ (330 to 1100) MΩ	32 μΩ/Ω + 2.2 Ω 60 μΩ/Ω + 39 Ω 0.013 % + 63 Ω 0.025 % + 2.5 kΩ 0.050 % + 3.0 kΩ 0.30 % + 0.10 MΩ 1.5 % + 0.50 MΩ	Fluke 5520A, 2-wire
	0 Ω 1 Ω 1.9 Ω 10, 19 Ω 100, 190 Ω 1, 1.9 kΩ 10, 19 kΩ 100, 190 kΩ 1 MΩ 1.9 MΩ 10 MΩ 19 MΩ 100 MΩ	41 μΩ 81 μΩ/Ω 82 μΩ/Ω 23 μΩ/Ω 9.5 μΩ/Ω 8.5 μΩ/Ω 8.5 μΩ/Ω 11 μΩ/Ω 20 μΩ/Ω 30 μΩ/Ω 35 μΩ/Ω 45 μΩ/Ω 0.010 %	Fluke 5720A

Parameter/Equipment	Range	CMC ^{2,4} (±)	Comments
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 (2 to 20) GΩ	12 μΩ/Ω + 0.1 mΩ 7.4 μΩ/Ω + 24 μΩ 7.6 μΩ/Ω + 82 μΩ 8.0 μΩ/Ω + 1.5 mΩ 7.0 μΩ/Ω + 11 mΩ 7.4 μΩ/Ω + 72 mΩ 8.4 μΩ/Ω + 2.0 Ω 10 μΩ/Ω + 0.11 kΩ 30 μΩ/Ω + 11 kΩ 500 μΩ/Ω + 1.4 MΩ 500 μΩ/Ω + 10 MΩ	Fluke 8508A
Electrical Calibration of Thermocouple Indicators –			
Type B	(600 to 800) °C (800 to 1550) °C 1550 to 1820) °C	0.35 °C 0.28 °C 0.22 °C	Fluke 7526A
Type C	(0 to 1000) °C (1000 to 1800) °C (1800 to 2000) °C (2000 to 2316) °C	0.16 °C 0.23 °C 0.26 °C 0.35 °C	
Type E	(-250 to -200) °C (-200 to -100) °C (-100 to 0) °C (0 to 600) °C (600 to 1000) °C	0.25 °C 0.12 °C 0.09 °C 0.08 °C 0.1 °C	
Type J	(-210 to -100) °C (-100 to 800) °C (800 to 1200) °C	0.14 °C 0.09 °C 0.1 °C	
Type K	(-250 to -200) °C (-200 to -100) °C (-100 to 500) °C (500 to 800) °C (800 to 1372) °C	0.46 °C 0.16 °C 0.1 °C 0.1 °C 0.13 °C	

Parameter/Equipment	Range	CMC ² (±)	Comments
Electrical Calibration of Thermocouple Indicators – (cont)			
Type L	(-200 to -100) °C (-100 to 900) °C	0.1 °C 0.09 °C	Fluke 7526A
Type N	(-250 to -200) °C (-200 to -100) °C (-100 to 0) °C (0 to 100) °C (100 to 800) °C (800 to 1300) °C	0.73 °C 0.23 °C 0.12 °C 0.11 °C 0.1 °C 0.12 °C	
Type R	(50 to -25) °C (-25 to 0) °C (0 to 100) °C (100 to 400) °C (400 to 600) °C (600 to 1000) °C (1000 to 1600) °C (1600 to 1767) °C	0.55 °C 0.45 °C 0.39 °C 0.28 °C 0.22 °C 0.21 °C 0.19 °C 0.23 °C	
Type S	(-50 to -25) °C (-25 to 0) °C (0 to 100) °C (100 to 400) °C (400 to 600) °C (600 to 1000) °C (1000 to 1600) °C (1600 to 1767) °C	0.51 °C 0.43 °C 0.38 °C 0.29 °C 0.23 °C 0.22 °C 0.22 °C 0.26 °C	
Type T	(-250 to -200) °C (-200 to -100) °C (-100 to 0) °C (0 to 200) °C (200 to 400) °C	0.35 °C 0.16 °C 0.11 °C 0.09 °C 0.09 °C	
Type U	(-200 to 0) °C (0 to 200) °C (200 to 600) °C	0.16 °C 0.1 °C 0.1 °C	

Parameter/Equipment	Range	CMC ² (±)	Comments
Electrical Calibration of RTDs ³ Indicating Systems –			
Pt 385, 100 Ω	(-200 to 80) °C (-80 to 100) °C (100 to 300) °C (300 to 400) °C (400 to 600) °C (600 to 800) °C	0.013 °C 0.02 °C 0.024 °C 0.026 °C 0.033 °C 0.038 °C	Fluke 7526A
Pt 3926, 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	0.013 °C 0.015 °C 0.017 °C 0.022 °C 0.026 °C 0.032 °C	
Pt 3916, 100 Ω	(-200 to -190) °C (-190 to -80) °C (-80 to 0) °C (0 to 100) °C (100 to 300) °C (300 to 400) °C (400 to 600) °C (600 to 630) °C	0.01 °C 0.013 °C 0.015 °C 0.017 °C 0.022 °C 0.026 °C 0.031 °C 0.033 °C	
Pt 385, 200 Ω	(-200 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 630) °C	0.053 °C 0.056 °C 0.06 °C 0.06 °C 0.069 °C 0.071 °C 0.088 °C	
Pt 385, 500 Ω	(-200 to 0) °C (0 to 100) °C (100 to 300) °C (300 to 400) °C (400 to 630) °C	0.026 °C 0.028 °C 0.034 °C 0.038 °C 0.045 °C	
Pt 385, 1000 Ω	(-200 to 0) °C (0 to 100) °C (100 to 300) °C (300 to 400) °C (400 to 630) °C	0.015 °C 0.018 °C 0.024 °C 0.026 °C 0.033 °C	

Parameter/Equipment	Range	CMC ² (±)	Comments
Electrical Calibration of RTDs ³ Indicating Systems – (cont)			
Ni 120, 120 Ω	(-80 to 260) °C	0.009 °C	Fluke 7526A
Cu 427, 10 Ω	(-100 to 260) °C	0.11 °C	
SPRT	(-200 to 660) °C	0.06 °C	

Parameter/Range	Frequency	CMC ^{2, 4} (±)	Comments
AC Voltage ^{3, 6} – Generate			
Up to 2.2 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	0.022 % + 4.0 μV 85 μV/V + 4.0 μV 75 μV/V + 4.0 μV 0.018 % + 4.0 μV 0.046 % + 5.0 μV 0.090 % + 10 μV 0.12 % + 20 μV 0.25 % + 20 μV	Fluke 5720A
(2.2 to 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	0.022 % + 4.0 μV 85 μV/V + 4.0 μV 75 μV/V + 4.0 μV 0.018 % + 4.0 μV 0.046 % + 5.0 μV 0.090 % + 10 μV 0.12 % + 20 μV 0.25 % + 20 μV	
(22 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 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz	0.022 % + 12 μV 85 μV/V + 7.0 μV 75 μV/V + 7.0 μV 0.018 % + 7.0 μV 0.042 % + 17 μV 0.075 % + 20 μV 0.12 % + 25 μV 0.25 % + 45 μV	

Parameter/Range	Frequency	CMC ^{2,4} (±)	Comments
AC Voltage ^{3,6} – Generate (cont)			
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 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz	0.022 % + 82 µV 85 µV/V + 82 µV 40 µV/V + 82 µV 70 µV/V + 82 µV 0.011 % + 82 µV 0.034 % + 82 µV 0.090 % + 0.20 mV 0.15 % + 0.32 mV	Fluke 5720A
(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 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz	0.022 % + 0.40 mV 80 µV/V + 0.15 mV 40 µV/V + 50 µV 70 µV/V + 0.10 mV 95 µV/V + 0.20 mV 0.026 % + 0.60 mV 0.090 % + 2.0 mV 0.13 % + 3.2 mV	
(22 to 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 % + 4.0 mV 80 µV/V + 1.5 mV 47 µV/V + 0.61 mV 75 µV/V + 1.0 mV 0.013 % + 2.5 mV 0.080 % + 16 mV 0.42 % + 40 mV 0.70 % + 80 mV	* 220 V range subject to 2.2E7 V- Hz limitation
(220 to 750) V	(30 to 50) kHz (50 to 100) kHz	0.036 % + 11 mV 0.13 % + 45 mV	w/ 5725A
(220 to 1100) V	40 Hz to 1 kHz (1 to 20) kHz (20 to 30) kHz	80 µV/V + 4.1 mV 0.013 % + 6.1 mV 0.036 % + 11 mV	
AC Voltage – Measure			
Up to 200 mV	(1 to 10) Hz (10 to 45) Hz 45 Hz to 10 kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.012 % + 4.6 µV 91 µV/V + 4.6 µV 0.011 % + 4.6 µV 0.028 % + 4.6 µV 0.064 % + 4.6 µV 0.066 % + 4.6 µV	Fluke 8508A

Parameter/Range	Frequency	CMC ^{2,4} (±)	Comments
AC Voltage – Measure (cont)			
200 mV to 2 V	(1 to 10) Hz (10 to 45) Hz 45 Hz to 10 kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz	0.02 % + 23 μV 0.011 % + 23 μV 0.013 % + 23 μV 0.027 % + 23 μV 0.077 % + 23 μV 0.077 % + 23 μV 0.46 % + 23 μV	Fluke 8508A
(2 to 20) V	(1 to 10) Hz (10 to 45) Hz 45 Hz to 10 kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz	0.026 % + 0.24 mV 0.011 % + 0.24 mV 0.013 % + 0.24 mV 0.027 % + 0.24 mV 0.076 % + 0.24 mV 0.077 % + 0.24 mV 0.46 % + 0.24 mV	
(20 to 200) V	(1 to 10) Hz (10 to 45) Hz 45 Hz to 10 kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz	0.019 % + 4.2 mV 0.010 % + 4.2 mV 0.012 % + 4.2 mV 0.026 % + 4.2 mV 0.075 % + 4.2 mV 0.076 % + 4.2 mV 0.46 % + 4.2 mV	
(200 to 1050) V	(1 to 10) Hz (10 to 45) Hz 45 Hz to 10 kHz (10 to 30) kHz (30 to 100) kHz	0.023 % + 23 mV 0.014 % + 23 mV 0.013 % + 23 mV 0.033 % + 23 mV 0.033 % + 23 mV	
AC High Voltage ⁶ – Measure			
(1 to 42) kVrms	60 Hz	0.26 %	Ross VD60 w/ Agilent 34401A
(42 to 142) kVrms	60 Hz	4.4 %	Ross VMP200 w/ Fluke 187

Parameter/Range	Frequency	CMC ^{2,4} (±)	Comments
AC Current ⁶ – Generate			
Up to 220 µA	(10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (10 to 30) MHz	0.023 % + 16 nA 0.014 % + 10 nA 0.011 % + 8.0 nA 0.025 % + 12 nA 0.090 % + 65 nA 1.8 % + 0.46 µA	Fluke 5720A Fluke 5520A
220 µA to 2.2 mA	(10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (10 to 30) MHz	0.023 % + 40 nA 0.014 % + 36 nA 0.011 % + 36 nA 0.025 % + 0.11 µA 0.090 % + 0.65 µA 1.1 % + 2.9 µA	Fluke 5720A Fluke 5520A
(2.2 to 22) mA	(10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (10 to 30) MHz	0.023 % + 0.41 µA 0.014 % + 0.36 µA 0.011 % + 0.36 µA 0.025 % + 0.56 µA 0.090 % + 5.0 µA 0.35 % + 21 µA	Fluke 5720A Fluke 5520A
(22 to 220) mA	(10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (10 to 30) MHz	0.023 % + 4.0 µA 0.014 % + 4.0 µA 0.011 % + 3.0 µA 0.018 % + 4.0 µA 0.090 % + 10 µA 0.43 % + 0.36 mA	Fluke 5720A Fluke 5520A
220 mA to 2.2 A	20 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.024 % + 35 µA 0.039 % + 80 µA 0.60 % + 0.16 mA	Fluke 5720A
(2.2 to 11) A	40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.040 % + 0.19 mA 0.085 % + 0.39 mA 0.33 % + 0.75 mA	
(11 to 20.5) A	(45 to 100) Hz 100 Hz to 1 kHz (1 to 5) kHz	0.13 % + 7.4 mA 0.071 % + 7.4 mA 3.4 % + 8.6 mA	Fluke 5520A
(20.5 to 150) A (150 to 350) A	(45 to 65) Hz (45 to 65) Hz	0.38 % + 0.029 A 1.0 % + 0.031 A	Fluke 5520A w/ coil
(20.5 to 150) A (150 to 1000) A	(65 to 440) Hz (65 to 440) Hz	1.0 % + 30 mA 1.0 % + 0.12 A	

Parameter/Range	Frequency	CMC ^{2,4} (±)	Comments
AC Current – Generate (cont)			
20 A	(10 to 65) Hz	0.62 %	Fluke 55120 w/2025 coil
20 A	(65 to 300) Hz	0.49 %	
20 A	(0.3 to 1) kHz	0.38 %	
100 A	10 Hz to 1 kHz	0.29 %	
1000 A	10 Hz to 1 kHz	0.95 %	
2000 A	(10 to 65) Hz (65 to 300) Hz (0.3 to 1) kHz	0.97 % 0.95 % 0.94 %	
AC Current – Measure			
Up to 200 µA	(1 to 10) Hz 10 Hz to 10 kHz (10 to 30) kHz	0.040 % + 23 nA 0.039 % + 23 nA 0.084 % + 23 nA	Fluke 8508A
200 µA to 2 mA	(1 to 10) Hz 10 Hz to 10 kHz (10 to 30) kHz	0.036 % + 230 nA 0.033 % + 0.29 µA 0.082 % + 230 nA	
(2 to 20) mA	(1 to 10) Hz 10 Hz to 10 kHz (10 to 30) kHz	0.038 % + 2.0 µA 0.031 % + 2.0 µA 0.072 % + 2.0 µA	
(20 to 200) mA	(1 to 10) Hz 10 Hz to 10 kHz (10 to 30) kHz	0.042 % + 23 µA 0.034 % + 23 µA 0.072 % + 23 µA	
200 mA to 2 A	(1 to 10) Hz 10 Hz to 10 kHz (10 to 30) kHz	0.072 % + 0.23 mA 0.086 % + 0.23 mA 0.35 % + 0.23 mA	
(2 to 20) A	10 Hz to 2 kHz (2 to 10) kHz	0.036 % + 23 mA 0.29 % + 23 mA	

Parameter/Equipment	Range	CMC ^{2,4} (±)	Comments
AC Power – (45 to 65) Hz; PF=1			Fluke 5520A
330 mV Range:			
330 mA Range	(0.01 to 0.99) W	0.12 %	
3.3 A Range	(0.99 to 1.1) W	0.21 %	
10.5 A Range	(1.1 to 3.5) W	0.11 %	
20.5 A Range	(3.5 to 6.8) W	0.16 %	
1020 V Range:			
33 mA Range	(6.8 to 34) W	0.11 %	
330 mA Range	(34 to 337) W	0.11 %	
1.1 A Range	337 W to 1.1 kW	0.22 %	
3.3 A Range	(1.1 to 3.3) kW	0.21 %	
10.5 A Range	(3.3 to 11) kW	0.09 %	
20.5 A Range	(11 to 20.9) kW	0.17 %	

Parameter/Range	Frequency	CMC ^{2,4} (±)	Comments
Capacitance ⁶ – Generate			Fluke 5520A
(0.10 to 3.299) nF	10 Hz to 10 kHz	0.52 % + 12 pF	
(0.33 to 10.999) nF	(10 to 1000) Hz	0.26 % + 12 pF	
(11 to 109.999) nF	(10 to 1000) Hz	0.26 % + 0.12 nF	
(110 to 329.99) nF	(10 to 1000) Hz	0.26 % + 0.31 nF	
(0.33 to 1.0999) μF	(10 to 600) Hz	0.26 % + 1.2 nF	
(1.1 to 3.2999) μF	(10 to 300) Hz	0.26 % + 3.1 nF	
(3.3 to 10.999) μF	(10 to 150) Hz	0.26 % + 12 nF	
(11 to 32.999) μF	(10 to 120) Hz	0.42 % + 31 nF	
(33 to 109.99) μF	(10 to 80) Hz	0.46 % + 0.12 μF	
(110 to 329.99) μF	Up to 50 Hz	0.46 % + 0.31 μF	
(0.33 to 1.0999) mF	Up to 20 Hz	0.46 % + 1.2 μF	
(1.1 to 3.2999) mF	Up to 6 Hz	0.46 % + 3.1 μF	
(3.3 to 10.999) mF	Up to 2 Hz	0.46 % + 12 μF	
(11 to 32.999) mF	Up to 0.6 Hz	0.78 % + 31 μF	
(33 to 110) mF	Up to 0.2 Hz	1.2 % + 0.12 mF	

Parameter/Range	Frequency	CMC ^{2,4} (±)	Comments
Capacitance – Measure			
1 pF (expand range)	500 Hz to 5 kHz (5 to 100) kHz	12 % 1.2 %	Fluke PM6304
10 pF (expand range)	(150 to 500) Hz 500 Hz to 5 kHz (5 to 20) kHz (20 to 100) kHz	12 % 1.2 % 0.12 % 0.46 %	
100 pF (expand range)	(50 to 250) Hz 250 Hz to 1 kHz (1 to 20) kHz (20 to 100) kHz	12 % 1.2 % 0.12 % 0.46 %	
1 nF (expand range)	(50 to 250) Hz 250 Hz to 20 kHz (20 to 100) kHz	1.2 % 0.12 % 0.46 %	
10 nF (expand range)	(50 to 500) Hz 500 Hz to 2 kHz (2 to 20) kHz (20 to 100) kHz	0.12 % 0.06 % 0.12 % 0.46 %	
100 nF (expand range)	(50 to 150) Hz 150 Hz to 2 kHz (2 to 20) kHz (20 to 100) kHz	0.12 % 0.06 % 0.12 % 0.46 %	
1 μF (expand range)	50 Hz to 2 kHz (2 to 20) kHz (20 to 100) kHz	0.06 % 0.12 % 0.46 %	
10 μF (expand range)	(50 to 1500) Hz (1.5 to 15) kHz (15 to 50) kHz (50 to 100) kHz	0.06 % 0.12 % 1.2 % 12 %	
100 μF (expand range)	(50 to 1500) Hz (1.5 to 15) kHz (15 to 50) kHz	0.12 % 1.2 % 12 %	
(100 to 200) μF (200 to 330) μF (0.33 to 110) mF	Direct Current Direct Current Direct Current	0.065 % 0.048 % 0.042 %	

Inductance – Generate & Measure^{3,4} w/ General Radio 1491-G and Fluke PM6304

Frequency (kHz)	100 μH	1 mH	10 mH	100 mH	1 H	10 H
0.1	2.6 %	2.3 %	1.2 %	1.2 %	0.70 %	0.70 %
0.2	2.6 %	2.3 %	1.2 %	1.2 %	0.70 %	0.70 %
0.5	2.6 %	2.3 %	1.2 %	1.2 %	0.70 %	0.70 %
1	2.6 %	2.3 %	1.2 %	1.2 %	0.70 %	0.70 %
2	2.6 %	2.3 %	1.2 %	1.2 %	1.3 %	7.1 %
5	2.6 %	2.3 %	1.2 %	1.4 %	6.2 %	
10	2.6 %	2.3 %	1.2 %	3.3 %		
20	2.4 %	2.3 %	2.0 %	10 %		
50	2.4 %	2.6 %	8.2 %			
100	2.4 %	4.3 %				
200	3.2 %					

Parameter/Range	Frequency	CMC ^{2,4} (±)	Comments
Phase – Generate (0 to 360)°	(1 to 65) Hz (65 to 500) Hz 500 Hz to 1 kHz (1 to 5) kHz	0.13° 0.30° 0.58° 2.9°	Fluke 5520A
Phase – Measure (0 to 360)°	20 Hz to 10 kHz (>10 to 40) kHz (>40 to 100) kHz	0.088° 0.17° 0.92°	Krohn-Hite 6500A
Distortion ^{3,6}	20 Hz to 20 kHz (20 to 100) kHz	1.0 dB 2.0 dB	Agilent 8903A

Parameter/Range	Frequency	CMC ^{2,4} (\pm)	Comments
Oscilloscopes ³ – Line Sine Wave			Fluke 5520A
Amplitude	50 kHz ref 50 K to 100 MHz (300 to 600) MHz (600 to 1100) MHz	2.3 % + 0.35 mV 5 % + 0.36 mV 6.5 % + 0.57 mV 7.5 % + 400 mV	
Rise Time Tunnel Diode Pulse 5520 into 50 Ω	125 ps 2 ns	15 ps/ns 33 %	
Time Markers	5 s to 50 ms 50 ms to 20 ns (20 to 1) ns	0.6 % + 3 ns 0.006 % + 50 ps 50 ps	

V. Electrical – RF/Microwave

Parameter/Range	Frequency	CMC ^{2,4} (\pm)	Comments
Return Loss ³ (VSWR)	5 MHz to 2 GHz (2 to 12.5) GHz (12.5 to 18) GHz	0.11 dB 0.53 dB 0.85 dB	Agilent 8902A w/ Wiltron 60NF50 Wiltron 58A50
Power Meter ³ – Power Reference @ 1 mW	50 MHz	1.9 %	Power transfer using Agilent 432A, 478A-H76
Power Accuracy	3 μ W to 100 mW	0.29 %	Range calibrator

Parameter/Range	Frequency	CMC ^{2,4} (±)	Comments
Relative Power³ – Measure (0 to -10) dB (-10 to -20) dB (-20 to -30) dB (-30 to -40) dB (-40 to -50) dB (-50 to -60) dB (-60 to -70) dB (-70 to -80) dB (-80 to -90) dB (-90 to -100) dB (-100 to -110) dB (-110 to -120) dB	10 MHz to 26.5 GHz 10 MHz to 26.5 GHz 10 MHz to 26.5 GHz 10 MHz to 26.5 GHz 10 MHz to 26.5 GHz 10 MHz to 26.5 GHz 10 MHz to 26.5 GHz 10 MHz to 26.5 GHz 10 MHz to 26.5 GHz 10 MHz to 26.5 GHz 10 MHz to 26.5 GHz 10 MHz to 26.5 GHz 10 MHz to 26.5 GHz	0.046 dB 0.053 dB 0.080 dB 0.098 dB 0.11 dB 0.12 dB 0.13 dB 0.17 dB 0.18 dB 0.19 dB 0.19 dB 0.21 dB	Agilent 8902A
Absolute Power³ – Measure (-70 to -30) dBm (-30 to +10) dBm (+10 to +20) dBm	10 MHz to 18 GHz 100 kHz to 4.2 GHz (4.2 to 18) GHz (18 to 26.5) GHz 100 kHz to 4.2 GHz (4.2 to 18) GHz (18 to 26.5) GHz	2.7 % 1.4 % 1.9 % 2.4 % 3.3 % 3.5 % 3.8 %	Agilent 437B/E4418B: Agilent 8484A, N-type Agilent 8482A, N-type Agilent 8481A, N-type Agilent 8485A, 3.5 mm Agilent 8482A, N-type Agilent 8481A, N-type Agilent 8485A, 3.5 mm
Amplitude Modulation³	(20 to 50) kHz (50 to 100) kHz	1.4 % 3.6 %	Agilent 8902A
Frequency Modulation³ Dev: Up to 400 kHz	(20 to 50) Hz 50 Hz to 100 kHz (100 to 200) kHz	5.8 % 1.4 % 5.8 %	Agilent 8902A

Parameter/Range	Frequency	CMC ^{2, 4} (±)	Comments
Phase Modulation ³	200 Hz to 10 kHz	4.7 %	Agilent 8902A
	200 Hz to 20 kHz	3.5 %	

VI. Fluid Quantities

Parameter/Equipment	Range	CMC ^{2, 5} (±)	Comments
Air Velocity – Anemometers and Flow Meters ⁶	Up to 15 m/s	2.8 %	Fluke 743 DMM w/ WTM-1000 and 8455-03 anemometer

VII. Mechanical

Parameter/Equipment	Range	CMC ^{2, 5, 8} (±)	Comments
Accelerometers ⁶ – (1 to 10) g	(20 to 99) Hz 100 Hz (101 to 500) Hz 501 Hz to 3 kHz (3 to 10) kHz	2.2 % 2 % 2.1 % 2.3 % 2.7 %	VR9500 w/accelerometers
Mass ⁶	Up to 200 g (200 to 750) g (750 to 6000) g (10 to 50) lb	0.14 mg 2.4 mg 40 mg 0.014 lb	Multiple substitution method
Balances ^{3, 6}	(1 to 10) mg (10 to 100) mg 100 mg to 1 g (1 to 10) g (10 to 3200) g (3.2 to 15) kg	0.045 % 0.089 % 0.02 % 0.004 % 0.00028 % 0.0002 %	Class 1 weights

Parameter/Equipment	Range	CMC ^{2, 5, 8} (±)	Comments
Scales ^{3, 6}	(1 to 2000) lb	0.012 %	Class 6 weights
Force Measuring Equipment ^{3, 6} – Tension & Compression	(0 to 500) lbf	0.06 %	Class F weights
Cable Tensiometers ⁶	(10 to 600) lbf	0.32 %	Transducer
Pressure – Precision Measuring Equipment ⁶			
Pneumatic	(-14 to 25) psia (0 to 25) psi (700) psia (700) psi (>700 to 1000) psi	9.5 parts in 10 ⁶ 9.8 parts in 10 ⁶ 10 parts in 10 ⁶ 10 parts in 10 ⁶ 60 parts in 10 ⁶	Ruska 2465
Pneumatic ³	15 psia (0 to 15) psi vacuum (0.1 to 10) in·H ₂ O	0.0081 psia 0.013 psi 0.03 in·H ₂ O	Pressure transducer Fluke 700P01
Hydraulic ³	(0.14 to 31) psi (10 to 1000) psi (50 to 500) psi (500 to 7500) psi (7500 to 15 000) psi	0.01 % 0.01 % 0.017 % 0.018 % 0.024 %	Pneumatic DWT Hydraulic DWT
Pressure – Measure, Dead Weight Testers ⁶	Up to 10 000 psi	0.017 %	Transfer method
Torque Tools ^{3, 6}	5 ozf·in to 2000 lbf·ft	0.30 %	Torque transducers and loader
Torque Transducers ^{3, 6}	5 ozf·in to 2000 lbf·ft	0.057 %	Dead weights and torque arms

VIII. Optical Quantities

Parameter/Equipment	Range	CMC ^{2, 5} (±)	Comments
Illuminance Meters	(50 to 10 000) Lux	2.4 %	Transfer method using reference lamps and photometer
Luminance Meters	(5 to 1000) cd/m ²	2.8 %	Transfer method using reference spheres and precision meter

IX. Thermodynamic

Parameter/Equipment	Range	CMC ^{2, 5, 8} (±)	Comments
Temperature –Measuring Equipment ³	(-30 to 661) °C	0.015 °C + 0.0036 %	Fluke 518 w/ 5628, 8508A
Temperature – Measure ³	(-197 to 661) °C	0.009 °C + 0.0011 %	Hart 5628 w/ 8508A
Infrared Temperature Measuring Equipment ^{3, 6}	(-35 to 150) °C (150 to 500) °C	0.51 °C 0.84 °C + 0.14 m°C/°C	Hart 9133 Hart 9132
Humidity Measuring Equipment	(10 to 95) % RH	0.73 % RH	Thunder 1200
Humidity – Measure ³	(10 to 80) % RH (80 to 90) % RH	1.4 % RH 2.4 % RH	Vaisala HMI

X. Time & Frequency

Parameter/Equipment	Range	CMC ^{2, 8} (±)	Comments
Frequency – Measuring Equipment ³	0.01 Hz to 26.5 GHz	5 parts in 10 ¹² Hz	Agilent 33220A w/ E4432B
Frequency – Measure ³	DC to 300 MHz (300 to 3000) MHz	5 parts in 10 ¹² Hz	HP 53132A
Stopwatches ³	0.1 s to 24 hr	0.13 s	HP 53132A w/ 33220A
Tachometers ³	(40 to 99 999) rpm	(0.29 + 0.00023x) rpm	Fluke 5520A; x equals measured rpm

XI. Thermodynamic Testing/Calibration

Parameter/Equipment	Range	CMC ² (±)	Comments
Climatic – Freezers, Refrigerators, Incubators, Ovens, Furnaces			
Temperature Uniformity Survey (TUS)	(-270 to 400) °C (400 to 1372) °C	1.2 °C 2.5 °C	AMS 2750E w/ DMM, DAQ scanner and precision thermocouples

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 In the statement of CMC, *R* is the resolution of the unit under test; 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.
- ⁷ This scope meets A2LA's *P112 Flexible Scope Policy*.
- ⁸ The type of instrument or material being calibrated is defined by the parameter. This indicates the laboratory is capable of calibrating instruments that measure or generate the values in the ranges indicated for the listed measurement parameter.



Accredited Laboratory

A2LA has accredited

TRESCAL, INC.

Cornelius, NC

for technical competence in the field of

Calibration

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017 *General requirements for the competence of testing and calibration laboratories*. This laboratory also meets the requirements of ANSI/NCSLI Z540-1-1994 and the requirements of ANSI/NCSLI Z540.3-2006 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 April 2017*).



Presented this 1st day of October 2019.

A blue ink signature of the Vice President of Accreditation Services.

Vice President, Accreditation Services
For the Accreditation Council
Certificate Number 1877.01
Valid to March 31, 2021

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