



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: November 30, 2024

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 calibrations^{1, 7}:

I. Dimensional

Parameter/Equipment	Range	CMC ² (±)	Comments
Micrometers ³ Spindle Linearity	Up to 48 in	16 µin + 5.5 µin/in	Gage blocks
Length Indicators ³ (Drop, Test, LVDTs)	Up to 1 in	74 µin	Starrett 716 dial indicator calibrator
Height Gages ³	Up to 24 in	19 µin + 5.6 µin/in	Gage blocks, surface plate
Calipers ³ Outside Diameter Step & Depth	Up to 48 in	30 µin + 5.2 µin/in 31 µin + 5.2 µin/in	Gage blocks

II. Electrical – DC/Low Frequency

Parameter/Equipment	Range	CMC ^{2, 4, 5, 6} ($\pm$)	Comments
DC Voltage – Generate ³	(0 to 330) mV 330 mV to 3.3 V (3.3 to 33) V (33 to 330) V (330 to 1000) V	0.8 μ V + 16 nV/mV 17 μ V + 5 μ V/V 88 μ V + 7 μ V/V 0.56 mV + 14 μ V/V 2.7 mV + 14 μ V/V	Fluke 5520A
DC Voltage – Measure	Up to 100 mV (0.1 to 1) V (1 to 10) V (10 to 100) V (100 to 1000) V	0.33 μ V + 17 μ V/V 0.52 μ V + 8 μ V/V 8.8 μ V + 8.1 μ V/V 35 μ V + 10 μ V/V 1.2 mV + 11 μ V/V	Agilent 3458A
DC High Voltage – Measure	(1 to 20) kV (20 to 35) kV (35 to 40) kV	2.3 % 1.2 % 2.3 %	Fluke 80K-40, Agilent 34401A
DC Current – Generate ³	(0 to 330) μ A 330 μ A to 3.3 mA (3.3 to 33) mA (33 to 330) mA 330 mA to 1.1 A (1.1 to 3.0) A (3 to 11) A (11 to 20.5) A	16 nA + 0.12 nA/ μ A 41 nA + 80 nA/mA 0.21 μ A + 80 nA/mA 2.1 μ A + 80 nA/mA 33 μ A + 0.16 mA/A 0.37 mA + 0.13 mA/A 0.49 mA + 0.39 mA/A 9.4 mA + 0.8 mA/A	Fluke 5520A
DC Clamp Meters	(10 to 16.5) A (16.5 to 150) A (150 to 1025) A	50 mA + 6.5 mA/A 0.18 A + 3.4 mA/A 0.83 A + 3.3 mA/A	Fluke 5520A w/ 5500 coil
DC Current – Measure	(0 to 100) nA (0.1 to 1) μ A (1 to 10) μ A (10 to 100) μ A (0.1 to 1) mA (1 to 10) mA (10 to 100) mA (0.1 to 1) A (1 to 2) A (2 to 20) A	41 pA + 89 μ A/A 70 pA + 21 μ A/A 0.7 nA + 18 μ A/A 5.8 nA + 9.2 μ A/A 58 nA + 9.7 μ A/A 0.58 μ A + 8 μ A/A 5.8 μ A + 17 μ A/A 59 μ A + 81 μ A/A 30 μ A + 0.17 mA/A 3.9 mA + 0.26 mA/A	Agilent 3458A Fluke 8508A

Parameter/Equipment	Range	CMC ^{2, 6} (±)	Comments
Electrical Calibration of Thermocouple Generate & Measure –			
Type E	(-200 to -100) °C (-100 to -25) °C (-25 to 350) °C (350 to 650) °C (650 to 1000) °C	0.39 °C 0.13 °C 0.12 °C 0.13 °C 0.17 °C	Fluke 5520A
Type J	(-210 to -100) °C (-100 to -30) °C (-30 to 150) °C (150 to 760) °C (760 to 1200) °C	0.21 °C 0.13 °C 0.12 °C 0.14 °C 0.18 °C	
Type K	(-200 to -100) °C (-100 to -25) °C (-25 to 120) °C (120 to 1000) °C (1000 to 1372) °C	0.26 °C 0.15 °C 0.13 °C 0.21 °C 0.31 °C	
Type N	(-200 to -100) °C (-100 to -25) °C (-25 to 120) °C (120 to 410) °C (410 to 1300) °C	0.31 °C 0.18 °C 0.15 °C 0.15 °C 0.21 °C	
Type R	(0 to 250) °C (250 to 400) °C (400 to 1000) °C (1000 to 1767) °C	0.44 °C 0.28 °C 0.26 °C 0.31 °C	
Type S	(0 to 250) °C (250 to 1000) °C (1000 to 1400) °C (1400 to 1767) °C	0.37 °C 0.28 °C 0.29 °C 0.36 °C	
Type T	(-250 to -150) °C (-150 to 0) °C (0 to 120) °C (120 to 400) °C	0.49 °C 0.21 °C 0.15 °C 0.14 °C	

Parameter/Equipment	Range	CMC ^{2,6} (±)	Comments
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	0.057 °C 0.056 °C 0.068 °C 0.081 °C 0.088 °C 0.10 °C 0.19 °C	Fluke 5520A
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 600) °C (600 to 630) °C	0.051 °C 0.051 °C 0.051 °C 0.057 °C 0.10 °C 0.11 °C 0.12 °C 0.13 °C	
Pt 385, 500 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 600) °C (600 to 630) °C	0.051 °C 0.056 °C 0.056 °C 0.062 °C 0.074 °C 0.074 °C 0.081 °C 0.095 °C	
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 400) °C (400 to 600) °C (600 to 630) °C	0.047 °C 0.047 °C 0.051 °C 0.057 °C 0.062 °C 0.068 °C 0.068 °C 0.18 °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	0.20 °C 0.051 °C 0.056 °C 0.062 °C 0.068 °C 0.074 °C 0.081 °C 0.041 °C 0.18 °C	

Parameter/Equipment	Range	CMC ^{2, 6} (±)	Comments
Electrical Simulation of RTD Indicators ³ – (cont)			
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	0.056 °C 0.056 °C 0.068 °C 0.081 °C 0.088 °C 0.10 °C	Fluke 5520A
PtNi 385, 120 Ω	(-80 to 0) °C (0 to 100) °C (100 to 260) °C	0.062 °C 0.062 °C 0.11 °C	
Cu 427, 10 Ω	(-100 to 260) °C	0.23 °C	

Parameter/Range	Frequency	CMC ^{2, 4, 6} ($\pm$)	Comments
AC Voltage – Generate ³			
(1 to 33) mV	(10 to 45) Hz 45 Hz to 10 kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 200) kHz (200 to 500) kHz	5.5 μ V + 0.64 μ V/mV 5 μ V + 0.12 μ V/mV 5 μ V + 0.16 μ V/mV 5.6 μ V + 0.8 μ V/mV 12 μ V + 2.8 μ V/mV 47 μ V + 6.4 μ V/mV 47 μ V + 6.4 μ V/mV	Fluke 5520A
(33 to 330) mV	(10 to 45) Hz 45 Hz to 10 kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 200) kHz (200 to 500) kHz	14 μ V + 0.24 μ V/mV 24 μ V + 87 nV/mV 11 μ V + 0.13 μ V/mV 35 μ V + 0.28 μ V/mV 47 μ V + 0.64 μ V/mV 0.11 mV + 1.6 μ V/mV 0.11 mV + 1.6 μ V/mV	
330 mV to 3.3 V	(10 to 45) Hz 45 Hz to 10 kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 200) kHz (200 to 500) kHz	0.12 mV + 0.24 mV/V 88 μ V + 0.12 mV/V 99 μ V + 0.15 mV/V 0.12 mV + 0.24 mV/V 0.29 mV + 0.56 mV/V 1.1 mV + 1.9 mV/V 1.1 mV + 1.9 mV/V	
(3.3 to 33) V	(10 to 45) Hz 45 Hz to 10 kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz	1.3 mV + 0.24 mV/V 0.94 mV + 0.12 mV/V 1.6 mV + 0.18 mV/V 1.4 mV + 0.28 mV/V 3.7 mV + 0.72 mV/V	
(33 to 330) V	(10 to 45) Hz 45 Hz to 10 kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz	6.8 mV + 0.15 mV/V 10 mV + 0.16 mV/V 12 mV + 0.2 mV/V 13 mV + 0.24 mV/V 93 mV + 1.6 mV/V	
(330 to 1020) V	45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	87 mV + 0.24 mV/V 74 mV + 0.2 mV/V 88 mV + 0.24 mV/V	

Parameter/Range	Frequency	CMC ^{2, 4, 6} ($\pm$)	Comments
AC Voltage ³ – Measure			
Up to 100 mV	(1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz	6.1 μ V + 0.0003 mV/mV 4.1 μ V + 0.0002 mV/mV 4.2 μ V + 0.0003 mV/mV 4.9 μ V + 0.001 mV/mV 9 μ V + 0.005 mV/mV 45 μ V + 0.04 mV/mV	Agilent 3458A
(0.1 to 1) V	(1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (0.3 to 1) MHz (1 to 2) MHz	12 μ V + 0.000 07 mV/mV 2.7 μ V + 0.000 07 mV/mV 11 μ V + 0.000 14 mV/mV 012 μ V + 0.0003 mV/mV 17 μ V + 0.0008 mV/mV 47 μ V mV + 0.003 mV/mV 0.12 mV + 0.01 mV/mV 3.8 mV + 0.01 mV/mV	
(1 to 10) V	(1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (0.3 to 1) MHz (1 to 2) MHz	0.12 mV + 0.000 07 V/V 0.1 mV + 0.000 07 V/V 0.11 mV + 0.000 14 V/V 0.12 mV + 0.0003 V/V 0.17 mV + 0.0008 V/V 0.47 mV + 0.003 V/V 1.2 mV + 0.010 V/V 38 mV + 0.015 V/V	
(10 to 100) V	(1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (0.3 to 1) MHz (1 to 2) MHz	1.2 mV + 0.000 07 V/V 1 mV + 0.000 07 V/V 1 mV + 0.000 14 V/V 1.2 mV + 0.0003 V/V 1.7 mV + 0.0008 V/V 4.7 mV + 0.003 V/V 12 mV + 0.01 V/V 0.38 V + 0.015 V/V	
(100 to 1000) V	(1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (0.3 to 1) MHz	13 mV + 0.0002 V/V 11 mV + 0.0002 V/V 11 mV + 0.0002 V/V 13 mV + 0.000 35 V/V 21 mV + 0.0012 V/V 57 mV + 0.004 V/V 0.17 V + 0.015 V/V	
	(1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz	98 mV + 0.0004 V/V 84 mV + 0.0004 V/V 98 mV V + 0.0006 V/V 0.14 V + 0.0012 V/V 0.27 V + 0.003 V/V	

Parameter/Range	Frequency	CMC ^{2, 4, 5, 6} (±)	Comments
AC High Voltage – Measure	(1 to 40) kV	5.8 %	Fluke 80K-40, Agilent 34401A
AC Current – Generate ³			Fluke 5520A
(29 to 329.99) µA	(10 to 20) Hz (20 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (10 to 30) kHz	0.13 µA + 1.6 nA/µA 0.12 µA + 1.2 nA/µA 0.11 µA + 1 nA/µA 0.19 µA + 2.4 nA/µA 0.35 µA + 6.4 nA/µA 0.70 µA + 13 nA/µA	
330 µA to 3.2999 mA	(10 to 20) Hz (20 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (10 to 30) kHz	0.65 µA + 1.6 µA/mA 0.45 µA + 1 µA/mA 0.39 µA + 0.8 µA/mA 0.69 µA + 1.6 µA/mA 2.9 µA + 1.6 µA/mA 3.4 µA + 8 µA/mA	
(3.3 to 32.999) mA	(10 to 20) Hz (20 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (10 to 30) kHz	6.4 µA + 1.4 µA/mA 4 µA + 0.72 µA/mA 2.7 µA + 0.32 µA/mA 3.7 µA + 0.64 µA/mA 7.7 + 1.6 µA/mA 14 µA + 3.2 µA/mA	
(33 to 329.99) mA	(10 to 20) Hz (20 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (10 to 30) kHz	65 µA + 1.4 µA/mA 42 µA + 0.72 µA/mA 29 µA + 0.31 µA/mA 68 µA + 0.8 µA/mA 0.13 mA + 1.6 µA/mA 0.27 mA + 3.2 µA/mA	
330 mA to 1.099 99 A	(10 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.56 mA + 1.4 mA/A 0.22 mA + 0.4 mA/A 2.4 mA + 4.8 mA/A 11 mA + 20 mA/A	
(1.1 to 2.999 99) A	(10 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	1.7 mA + 1.4 mA/A 0.61 mA + 0.48 mA/A 6.1 mA + 4.8 mA/A 26 mA + 20 mA/A	
(3 to 10.9999) A	(45 to 100) Hz 100 Hz to 1 kHz (1 to 5) kHz	3.1 mA + 0.48 mA/A 4 mA + 0.8 mA/A 74 mA + 24 mA/A	
(11 to 20.5) A	(45 to 100) Hz 100 Hz to 1 kHz (1 to 5) kHz	15 mA + 0.96 mA/A 17 mA + 1.2 mA/A 0.27 A + 24 mA/A	

Parameter/Range	Frequency	CMC ^{2, 4, 6} ($\pm$)	Comments
AC Current – Generate ³ (cont)			
Toroidal			
(10 to 16.5) A (16.5 to 150) A (150 to 1025) A	(45 to 65) Hz	26 mA + 2.1 mA/A 50 mA + 1.9 mA/A 0.34 A + 1.9 mA/A	Fluke 5520A w/ 5500coil
(10 to 16.5) A (16.5 to 150) A (150 to 1025) A	(65 to 440) Hz	60 mA + 6 mA/A 0.11 A + 5.3 mA/A 0.86 A + 5.3 mA/A	
Non-Toroidal			
(10 to 16.5) A (16.5 to 150) A (150 to 1025) A	(45 to 65) Hz	60 mA + 3.8 mA/A 0.23 A + 3.7 mA/A 1.2 A + 3.7 mA/A	
(10 to 16.5) A (16.5 to 150) A (150 to 1025) A	(65 to 440) Hz	90 mA + 7.2 mA/A 0.28 A + 6.7 mA/A 1.6 A + 6.7 mA/A	

Parameter/Range	Frequency	CMC ^{2, 4, 6} ($\pm$)	Comments
AC Current ³ – Measure			
(5 to 100) μ A	(10 to 20) Hz (20 to 45) Hz 45 Hz to 5 kHz	57 nA + 4 mA/A 45 nA + 1.5 mA/A 40 nA + 0.64 mA/A	Agilent 3458A
(0.1 to 1) mA	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz (0.1 to 5) kHz (5 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.43 μ A + 0.0041 mA/mA 0.31 μ A + 0.0016 mA/mA 0.26 μ A + 0.000 67 mA/mA 0.25 μ A + 0.000 37 mA/mA 0.26 μ A + 0.000 67 mA/mA 0.63 μ A + 0.0042 mA/mA 1.8 μ A + 0.0056 mA/mA	
(1 to 10) mA	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz (0.1 to 5) kHz (5 to 20) kHz (20 to 50) kHz (50 to 100) kHz	2.4 μ A + 0.0041 mA/mA 2.3 μ A + 0.0016 mA/mA 2.3 μ A + 0.000 67 mA/mA 2.3 μ A + 0.000 37 mA/mA 2.3 μ A + 0.000 67 mA/mA 4.5 μ A + 0.0041 mA/mA 16 μ A + 0.0056 mA/mA	
(10 to 100) mA	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz (0.1 to 5) kHz (5 to 20) kHz (20 to 50) kHz (50 to 100) kHz	42 μ A + 0.004 mA/mA 30 μ A + 0.0015 mA/mA 25 μ A + 0.0006 mA/mA 24 μ A + 0.0003 mA/mA 25 μ A + 0.0006 mA/mA 62 μ A + 0.004 mA/mA 0.18 mA + 0.0055 mA/mA	
(0.1 to 1) A	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz (0.1 to 5) kHz (5 to 20) kHz (20 to 50) kHz	0.42 mA + 0.0041 A/A 0.3 mA + 0.0017 A/A 0.26 mA + 0.0009 A/A 0.27 mA + 0.0011 A/A 0.37 mA + 0.0031 A/A 0.92 mA + 0.01 A/A	
(1 to 2) A	10 Hz to 2 kHz (2 to 10) kHz (10 to 30) kHz	0.42 mA + 0.5 mA/A 0.3 mA + 0.66 mA/A 0.96 mA + 2.1 mA/A	Fluke 8508A
(2 to 20) A	10 Hz to 2 kHz (2 to 10) kHz	2.4 mA + 0.71 mA/A 2.7 mA + 1.9 mA/A	

Parameter/Equipment	Range	CMC ^{2, 4, 5, 6} (±)	Comments
AC Power ³ – Generate (45 to 65) Hz, PF=1	Up to 1020 V: Up to 33 W (33 to 330) W 330 W to 1.1 kW (1.1 to 3) kW (3 to 11) kW (11 to 20.9) kW	0.1 % 0.062 % 0.072 % 0.075 % 0.087 % 0.14 %	Fluke 5520A
DC Power ³ – Generate	Up to 1020 V: Up to 3 W (3 to 30) W (30 to 300) W 300 W to 3 kW (3 to 20.9) kW	0.017 % 0.014 % 0.014 % 0.033 % 0.085 %	Fluke 5520A

Parameter/Range	Frequency	CMC ^{2, 4, 5, 6} (±)	Comments
Phase Generate ³ – (0 to 360)°	(10 to 65) Hz (65 to 500) Hz 500 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (10 to 30) kHz	0.1° 0.26° 0.51° 2.6° 5.1° 10°	Fluke 5520A
Capacitance ³ – Generate (0.19 to 0.3999) nF (0.4 to 1.0999) nF (1.1 to 3.2999) nF (3.3 to 10.9999) nF (11 to 32.9999) nF (33 to 109.999) nF (110 to 329.999) nF (0.33 to 1.099 99) µF (1.1 to 3.299 99) µF (3.3 to 10.9999) µF (11 to 32.9999) µF (33 to 109.999) µF (110 to 329.999) µF (0.33 to 1.099 99) mF (1.1 to 3.299 99) mF (3.3 to 10.9999) mF (11 to 32.9999) mF (33 to 110) mF	10 Hz to 10 kHz 10 Hz to 10 kHz 10 Hz to 3 kHz 10 Hz to 1 kHz 10 Hz to 1 kHz 10 Hz to 1 kHz 10 Hz to 1 kHz (10 to 600) Hz (10 to 300) Hz (10 to 150) Hz (10 to 120) Hz (10 to 80) Hz (0 to 50) Hz (0 to 20) Hz (0 to 6) Hz (0 to 2) Hz (0 to 0.6) Hz (0 to 0.2) Hz	8.8 pF + 4 pF/nF 9.7 pF + 4 pF/nF 13 pF + 4 pF/nF 15 pF + 2 pF/nF 0.1 nF + 2 pF/nF 0.15 nF + 2 pF/nF 0.46 nF + 2 pF/nF 1.5 nF + 2 nF/µF 4.6 nF + 2 nF/µF 15 nF + 2 nF/µF 59 nF + 3.2 nF/µF 0.2 µF + 3.6 nF/µF 0.64 µF + 3.6 nF/µF 2 µF + 3.6 µF/mF 7 µF + 3.5 µF/mF 38 µF + 2.6 µF/mF 90 µF + 6 µF/mF 0.37 mF + 8.8 µF/mF	Fluke 5520A

Parameter/Equipment	Range	CMC ^{2, 4, 5, 6} ($\pm$)	Comments
Oscilloscopes ³ –			
Volts – DC Signal Into 50 Ω Into 1 M Ω	± 0 mV to 6.6 V ± 0 mV to 130 V	33 μ V + 2 mV/V 33 μ V + 0.39 mV/V	Fluke 5520A
Volts – Squarewave Into 50 Ω Into 1 M Ω	1 mVpp to 6.6 Vpp; 1 mVpp to 130 Vpp; 10 Hz to 1 kHz (1 to 100) kHz	91 μ V + 4.3 mV/V 0.2 mV + 0.8 mV/V 0.24 mV + 2 mV/V	
Edge Into 50 Ω	≤ 300 ps (Up to 2 MHz) ≤ 350 ps (Above 2 MHz)	82 ps 82 ps	
Leveled Sine Wave	50 kHz Reference 50 kHz to 100 MHz (100 to 300) MHz (300 to 600) MHz (600 to 1100) MHz	0.33 mV + 17 mV/V 0.4 mV + 31 mV/V 0.43 mV + 36 mV/V 0.53 mV + 57 mV/V 0.58 mV + 67 mV/V	
Time Marker	5 s to 50 ms 50 ms to 1 ns	0.000 63 % + $T \times 0.1$ % 0.000 52 %	
			$T = \text{time in seconds}$

IV. Fluid Quantities

Parameter/Equipment	Range	CMC ^{2, 5, 6, 8} ($\pm$)	Comments
Liquid Flow – Measure ³	(0.7 to 180) GPM	1.2 %	Blancett 110-500 (lin)/B2800 turbine flow meter

V. Mechanical

Parameter/Equipment	Range	CMC ^{2, 5, 6, 8} (±)	Comments
Mass – Measure, Fixed Points	1 mg 2 mg 3 mg 5 mg 10 mg 20 mg 30 mg 50 mg 100 mg 200 mg 300 mg 500 mg 1 g 2 g 3 g 5 g 10 g 20 g 30 g 50 g 100 g 200 g 300 g 500 g 1 kg 2 kg 3 kg 4 kg 5 kg 10 kg 20 kg	2.9 µg 2.9 µg 3.4 µg 2.9 µg 2.9 µg 2.9 µg 3.4 µg 2.9 µg 2.9 µg 2.9 µg 3.4 µg 2.9 µg 6.5 µg 6.5 µg 9 µg 6.5 µg 9.4 µg 14 µg 17 µg 24 µg 46 µg 96 µg 0.15 mg 0.32 mg 0.48 mg 0.66 mg 1.3 mg 1.3 mg 3.9 mg 7.3 mg 0.11 g	Substitution method using mass standards with mass comparators
Mass – Measure, Direct Weigh	Up to 5.1 g (> 5.1 to 520) g (> 0.52 to 2.3) kg (> 2.3 to 5.1) kg (> 5.1 to 32) kg	0.43 µg + 0.000 28 % 0.33 mg 1.7 mg 5.4 mg 66 mg	UMX5 comparator XP505 comparator XP2004S comparator XP5003S comparator XPE32003LC comparator

VI. Thermodynamic

Parameter/Equipment	Range	CMC ^{2, 5, 6, 8} ($\pm$)	Comments
Infrared Temperature – Measuring Equipment	(-15 to 12) °C (-12 to -9) °C (-9 to -6) °C (-6 to -2) °C (-2 to 0) °C (0 to 120) °C	0.51 °C 0.5 °C 0.49 °C 0.48 °C 0.47 °C 0.6 °C + 0.0017 °C/°C	Fluke 4180
	(35 to 500) °C	0.54 °C + $\Delta T_{\text{Change from 35 °C}} \times 0.0042$	Fluke 4181
Temperature – Measure	(-197 to 660) °C	0.027 °C	Fluke 2560, 5628 PRT
Temperature Measuring Equipment	(-80 to 100) °C	0.018 °C + $\Delta T_{\text{Change from -40 °C}} \times 0.00001$	Fluke 5628 w/reference baths/blocks
	(100 to 300) °C	0.020 °C + $\Delta T_{\text{Change from 100 °C}} \times 0.000079$	
	(300 to 400) °C	0.032 °C + $\Delta T_{\text{Change from 300 °C}} \times 0.0001$	
	(400 to 660) °C	0.078 °C + $\Delta T_{\text{Change from 400 °C}} \times 0.000034$	
Relative Humidity – Measuring Equipment	(10 to 80) % RH	0.63 % RH	Thunder Scientific 2500LT
Relative Humidity Measuring Equipment – Calibration of Humidity Probes ³	(10 to 70) % RH (> 70 to 100) % RH	1.9 % RH 3.5 % RH	Fluke DewK 1620

VII. Time & Frequency

Parameter/Equipment	Range	CMC ^{2, 5, 8} ($\pm$)	Comments
Frequency – Generate	100 μ Hz to 15 MHz	0.0024 %	HP 33120A function generator
Frequency – Measure	1 Hz to 225 MHz	0.000 59 %	HP 53132A counter
Stopwatches & Timers ³	0 s to 24 hr	0.047 s	Witschi QT6000
Optical Tachometers ³	(1 to 100 000) rpm	0.00035 rpm + 0.000 038 rpm/rpm	Fluke 5520A, LED

SATELLITE LOCATION

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I. Device Specific Parameters

Parameter/Equipment	Range	CMC ^{2, 5, 6, 8} ($\pm$)	Comments
Ionizing Fans, Blowers & Guns			
Ion Balance	Up to 50 V	0.28 V	Ion System 210 charge plate monitor, HP 34401A
Discharge Time	Up to 30 sec	0.039 s	
Electrostatic Discharge			
Mats – Resistance	Up to 1 G Ω	12 %	Desco 19787 surface resistance meter
Soldering Systems – Measure			
Leak Voltage	Up to 40 mV	0.7 mV	Hakko FG-101 solder tester
Tip-to-Ground Ω	Up to 40 Ω	0.7 Ω	
Temperature Stability	(32 to 1300) °F	7 °F	

II. Dimensional

Parameter/Equipment	Range	CMC ² (±)	Comments
Micrometers ³			
Spindle Linearity	Up to 20 in	16 µin + 5.9 µin/in	Gage blocks
Anvil Flatness	50 µin	6.2 µin	Optical flat
Parallelism	50 µin	11 µin	Optical flat
Depth Micrometer Base Flatness	Up to 200 µin	31 µin	Gage blocks
Calipers ³			
Outside Diameter	Up to 20 in	30 µin + 5.2 µin/in	Gage blocks
Inside Diameter	Up to 20 in	34 µin + 5.1 µin/in	
Step & Depth	Up to 20 in	31 µin + 5.2 µin/in	
Height Gages ³	Up to 24 in	18 µin + 5.7 µin/in	Gage blocks
Gage Amp w/ Probe ³	Up to 0.005 in	30 µin	Gage blocks, Tesa TT-80 electronic length measuring instrument
Length & Plain Diameter ³ (Length Standards, Cylindrical Plugs & Pins, Feeler Gages)	Up to 4 in Steel Aluminum	 34 µin + 1.2 µin/in 34 µin + 1.4 µin/in	Trimos TULM210 length measuring instrument
Length ³	Up to 20 in	33 µin + 4.2 µin/in	Gage blocks, Tesa TT-80 electronic length measuring instrument
Dial & Digital Indicators ³	Up to 1 in (1 to 2) in	39 µin 18 µin + 5.2 µin/in	Itall 700 dial indicator calibrator Gage blocks

Parameter/Equipment	Range	CMC ² ($\pm$)	Comments
Threaded Plug Gages, Go & NoGo ³			
60° Pitch Diameter	Up to 4 in (4.5 to 80 TPI)	82 μ in	Trimos TULM210 length measuring instrument, Vermont gage thread wire set
Major Diameter	Up to 4 in	34 μ in + 1.2 μ in/in	
Protractors ³	(0 to 180)°	0.0077°	Sine bar, gage blocks, surface plate

III. Dimensional Testing/Calibration

Parameter/Equipment	Range	CMC ² ($\pm$)	Comments
Dimensional Measurements ³ –			
Checking Angle Plates, V-Blocks, Fixtures & Workpieces	Flatness: Up to 2000 μ in Parallelism: Up to 2000 μ in	33 μ in + 3 μ in/in 33 μ in + 3 μ in/in	Tesa TT-80 electronic length measuring instrument

IV. Electrical – DC/Low Frequency

Parameter/Equipment	Range	CMC ^{2, 4, 6} ($\pm$)	Comments
DC Voltage – Generate ³	(0 to 330) mV 330 mV to 3.3 V (3.3 to 33) V (33 to 330) V (330 to 1000) V	0.8 μ V + 16 nV/mV 17 μ V + 5 μ V/V 88 μ V + 7 μ V/V 0.56 mV + 14 μ V/V 2.7 mV + 14 μ V/V	Fluke 5520A
DC Voltage – Measure	Up to 100 mV (0 to 1) V (0 to 10) V (0 to 100) V (0 to 1000) V	0.33 μ V + 17 μ V/V 0.52 μ V + 8 μ V/V 8.8 μ V + 8.1 μ V/V 35 μ V + 10 μ V/V 1.2 mV + 11 μ V/V	Agilent 3458A

Parameter/Equipment	Range	CMC ^{2, 4, 5, 6} (±)	Comments
DC Current – Generate	(0 to 330) μ A 330 μ A to 3.3 mA (3.3 to 33) mA (33 to 330) mA 330 mA to 1.1 A (1.1 to 3.0) A (3 to 11) A (11 to 20.5) A	16 nA + 0.12 nA/ μ A 41 nA + 80 nA/mA 0.21 μ A + 80 nA/mA 2.1 μ A + 80 nA/mA 33 μ A + 0.16 mA/A 0.37 mA + 0.13 mA/A 0.49 mA + 0.39 mA/A 9.4 mA + 0.8 mA/A	Fluke 5520A
DC Current – Measure	(0 to 100) nA (0.1 to 1) μ A (1 to 10) μ A (10 to 100) μ A (0.1 to 1) mA (1 to 10) mA (10 to 100) mA (0.1 to 1) A (1 to 200) A (200 to 1000) A	41 pA + 89 μ A/A 70 pA + 21 μ A/A 0.7 nA + 18 μ A/A 5.8 nA + 9.2 μ A/A 58 nA + 9.7 μ A/A 0.58 μ A + 8 μ A/A 5.8 μ A + 17 μ A/A 59 μ A + 81 μ A/A 0.0046 % 0.18 %	HP 3458A Ohm-Lab CS-200 shunt, HP 34401A Empro B-1000-100 shunt, HP 34401A
Resistance – Generate	(0 to 10.9999) Ω (11 to 32.9999) Ω (33 to 109.9999) Ω (110 to 329.9999) Ω (330 to 1099.999) Ω (1.1 to 3.299 999) k Ω (3.3 to 10.999 99) k Ω (11 to 32.999 99) k Ω (33 to 109.9999) k Ω (110 to 329.9999) k Ω (330 to 1099.999) k Ω (1.1 to 3.299 999) M Ω (3.3 to 10.999 99) M Ω (11 to 32.999 99) M Ω (33 to 109.9999) M Ω (110 to 329.9999) M Ω (330 to 1100) M Ω	1.2 m Ω + 24 $\mu\Omega/\Omega$ 1.5 m Ω + 24 $\mu\Omega/\Omega$ 1.9 m Ω + 22 $\mu\Omega/\Omega$ 4.1 m Ω + 22 $\mu\Omega/\Omega$ 9.1 m Ω + 22 $\mu\Omega/\Omega$ 41 m Ω + 22 $\mu\Omega/\Omega$ 92 m Ω + 22 $\mu\Omega/\Omega$ 0.41 Ω + 22 $\mu\Omega/\Omega$ 0.9 Ω + 22 $\mu\Omega/\Omega$ 8.4 Ω + 26 $\mu\Omega/\Omega$ 14 Ω + 26 $\mu\Omega/\Omega$ 93 Ω + 48 $\mu\Omega/\Omega$ 0.4 k Ω + 0.1 m Ω/Ω 4.4 k Ω + 0.2 m Ω/Ω 16 k Ω + 0.4 m Ω/Ω 0.35 M Ω + 2.4 m Ω/Ω 4.4 M Ω + 12 m Ω/Ω	Fluke 5520A

Parameter/Equipment	Range	CMC ^{2, 4, 6} (±)	Comments
Resistance – Measure	(0 to 10) Ω (10 to 100) Ω (1.1 to 1) k Ω (1 to 10) k Ω (10 to 100) k Ω (1.1 to 1) M Ω (1 to 10) M Ω (10 to 100) M Ω (1.1 to 1) G Ω	55 $\mu\Omega$ + 15 $\mu\Omega/\Omega$ 0.52 m Ω + 13 $\mu\Omega/\Omega$ 0.53 m Ω + 10 $\mu\Omega/\Omega$ 5.3 m Ω + 10 $\mu\Omega/\Omega$ 53 m Ω + 11 $\mu\Omega/\Omega$ 2.3 Ω + 17 $\mu\Omega/\Omega$ 0.1 k Ω + 55 $\mu\Omega/\Omega$ 1 k Ω + 0.52 m Ω/Ω 10 k Ω + 5.1 m Ω/Ω	HP 3458A

Parameter/Range	Frequency	CMC ^{2, 4, 6} (±)	Comments
AC Voltage – Generate ³			
(1 to 33) mV	(10 to 45) Hz 45 Hz to 10 kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 200) kHz (200 to 500) kHz	5.5 μV + 0.64 $\mu\text{V}/\text{mV}$ 5 μV + 0.12 $\mu\text{V}/\text{mV}$ 5 μV + 0.16 $\mu\text{V}/\text{mV}$ 5.6 μV + 0.8 $\mu\text{V}/\text{mV}$ 12 μV + 2.8 $\mu\text{V}/\text{mV}$ 47 μV + 6.4 $\mu\text{V}/\text{mV}$ 47 μV + 6.4 $\mu\text{V}/\text{mV}$	Fluke 5520A
(33 to 330) mV	(10 to 45) Hz 45 Hz to 10 kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 200) kHz (200 to 500) kHz	14 μV + 0.24 $\mu\text{V}/\text{mV}$ 24 μV + 87 nV/mV 11 μV + 0.13 $\mu\text{V}/\text{mV}$ 35 μV + 0.28 $\mu\text{V}/\text{mV}$ 47 μV + 0.64 $\mu\text{V}/\text{mV}$ 0.11 mV + 1.6 $\mu\text{V}/\text{mV}$ 0.11 mV + 1.6 $\mu\text{V}/\text{mV}$	
330 mV to 3.3 V	(10 to 45) Hz 45 Hz to 10 kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 200) kHz (200 to 500) kHz	0.12 mV + 0.24 mV/V 88 μV + 0.12 mV/V 99 μV + 0.15 mV/V 0.12 mV + 0.24 mV/V 0.29 mV + 0.56 mV/V 1.1 mV + 1.9 mV/V 1.1 mV + 1.9 mV/V	

Parameter/Range	Frequency	CMC ^{2, 4, 6} ($\pm$)	Comments
AC Voltage – Generate ³ (cont)			Fluke 5520A
(3.3 to 33) V	(10 to 45) Hz 45 Hz to 10 kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz	1.3 mV + 0.24 mV/V 0.94 mV + 0.12 mV/V 1.6 mV + 0.18 mV/V 1.4 mV + 0.28 mV/V 3.7 mV + 0.72 mV/V	
(33 to 330) V	(10 to 45) Hz 45 Hz to 10 kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz	6.8 mV + 0.15 mV/V 10 mV + 0.16 mV/V 12 mV + 0.2 mV/V 13 mV + 0.24 mV/V 93 mV + 1.6 mV/V	
(330 to 1020) V	45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	87 mV + 0.24 mV/V 74 mV + 0.2 mV/V 88 mV + 0.24 mV/V	
AC Voltage ³ – Measure			Agilent 3458A
Up to 100 mV	(1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz	6.1 μ V + 0.0003 mV/mV 4.1 μ V + 0.0002 mV/mV 4.2 μ V + 0.0003 mV/mV 4.9 μ V + 0.001 mV/mV 9 μ V + 0.005 mV/mV 45 μ V + 0.04 mV/mV	
(0.1 to 1) V	(1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (0.3 to 1) MHz (1 to 2) MHz	12 μ V + 0.000 07 mV/mV 2.7 μ V + 0.000 07 mV/mV 11 μ V + 0.000 14 mV/mV 0.12 μ V + 0.0003 mV/mV 17 μ V + 0.0008 mV/mV 47 μ V mV + 0.003 mV/mV 0.12 mV + 0.01 mV/mV 3.8 mV + 0.01 mV/mV	
(1 to 10) V	(1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (0.3 to 1) MHz (1 to 2) MHz	0.12 mV + 0.000 07 V/V 0.1 mV + 0.000 07 V/V 0.11 mV + 0.000 14 V/V 0.12 mV + 0.0003 V/V 0.17 mV + 0.0008 V/V 0.47 mV + 0.003 V/V 1.2 mV + 0.01 V/V 38 mV + 0.015 V/V	

Parameter/Range	Frequency	CMC ^{2, 4, 6} ($\pm$)	Comments
AC Voltage ³ – Measure (cont)			
(10 to 100) V	(1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (0.3 to 1) MHz (1 to 2) MHz	1.2 mV + 0.000 07 V/V 1 mV + 0.000 07 V/V 1 mV + 0.000 14 V/V 1.2 mV + 0.0003 V/V 1.7 mV + 0.0008 V/V 4.7 mV + 0.003 V/V 12 mV + 0.01 V/V 0.38 V + 0.015 V/V	Agilent 3458A
(100 to 1000) V	(1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (0.3 to 1) MHz	13 mV + 0.0002 V/V 11 mV + 0.0002 V/V 11 mV + 0.0002 V/V 13 mV + 0.000 35 V/V 21 mV + 0.0012 V/V 57 mV + 0.004 V/V 0.17 V + 0.015 V/V	
	(1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz	98 mV + 0.0004 V/V 84 mV + 0.0004 V/V 98 mV V + 0.0006 V/V 0.14 V + 0.0012 V/V 0.27 V + 0.003 V/V	

Parameter/Range	Frequency	CMC ^{2, 4, 6} ($\pm$)	Comments
AC Current – Generate ³			
(29 to 329.99) μ A	(10 to 20) Hz (20 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (10 to 30) kHz	0.13 μ A + 1.6 nA/ μ A 0.12 μ A + 1.2 nA/ μ A 0.11 μ A + 1 nA/ μ A 0.19 μ A + 2.4 nA/ μ A 0.35 μ A + 6.4 nA/ μ A 0.70 μ A + 13 nA/ μ A	Fluke 5520A
330 μ A to 3.2999 mA	(10 to 20) Hz (20 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (10 to 30) kHz	0.65 μ A + 1.6 μ A/mA 0.45 μ A + 1 μ A/mA 0.39 μ A + 0.8 μ A/mA 0.69 μ A + 1.6 μ A/mA 2.9 μ A + 1.6 μ A/mA 3.4 μ A + 8 μ A/mA	
(3.3 to 32.999) mA	(10 to 20) Hz (20 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (10 to 30) kHz	6.4 μ A + 1.4 μ A/mA 4 μ A + 0.72 μ A/mA 2.7 μ A + 0.32 μ A/mA 3.7 μ A + 0.64 μ A/mA 7.7 + 1.6 μ A/mA 14 μ A + 3.2 μ A/mA	
(33 to 329.99) mA	(10 to 20) Hz (20 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (10 to 30) kHz	65 μ A + 1.4 μ A/mA 42 μ A + 0.72 μ A/mA 29 μ A + 0.31 μ A/mA 68 μ A + 0.8 μ A/mA 0.13 mA + 1.6 μ A/mA 0.27 mA + 3.2 μ A/mA	
330 mA to 1.099 99 A	(10 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.56 mA + 1.4 mA/A 0.22 mA + 0.4 mA/A 2.4 mA + 4.8 mA/A 11 mA + 20 mA/A	
(1.1 to 2.999 99) A	(10 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	1.7 mA + 1.4 mA/A 0.61 mA + 0.48 mA/A 6.1 mA + 4.8 mA/A 26 mA + 20 mA/A	
(3 to 10.9999) A	(45 to 100) Hz 100 Hz to 1 kHz (1 to 5) kHz	3.1 mA + 0.48 mA/A 4 mA + 0.8 mA/A 74 mA + 24 mA/A	
(11 to 20.5) A	(45 to 100) Hz 100 Hz to 1 kHz (1 to 5) kHz	15 mA + 0.96 mA/A 17 mA + 1.2 mA/A 0.27 A + 24 mA/A	

Parameter/Range	Frequency	CMC ^{2, 5, 6} ($\pm$)	Comments
AC Current ³ – Measure			Agilent 3458A
(5 to 100) μ A	(10 to 20) Hz (20 to 45) Hz 45 Hz to 5 kHz	57 nA + 4 mA/A 45 nA + 1.5 mA/A 40 nA + 0.64 mA/A	
(0.1 to 1) mA	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz (0.1 to 5) kHz (5 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.43 μ A + 0.0041 mA/mA 0.31 μ A + 0.0016 mA/mA 0.26 μ A + 0.000 67 mA/mA 0.25 μ A + 0.000 37 mA/mA 0.26 μ A + 0.000 67 mA/mA 0.63 μ A + 0.0042 mA/mA 1.8 μ A + 0.0056 mA/mA	
(1 to 10) mA	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz (0.1 to 5) kHz (5 to 20) kHz (20 to 50) kHz (50 to 100) kHz	2.4 μ A + 0.0041 mA/mA 2.3 μ A + 0.0016 mA/mA 2.3 μ A + 0.000 67 mA/mA 2.3 μ A + 0.000 37 mA/mA 2.3 μ A + 0.000 67 mA/mA 4.5 μ A + 0.0041 mA/mA 16 μ A + 0.0056 mA/mA	
(10 to 100) mA	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz (0.1 to 5) kHz (5 to 20) kHz (20 to 50) kHz (50 to 100) kHz	42 μ A + 0.004 mA/mA 30 μ A + 0.0015 mA/mA 25 μ A + 0.0006 mA/mA 24 μ A + 0.0003 mA/mA 25 μ A + 0.0006 mA/mA 62 μ A + 0.004 mA/mA 0.18 mA + 0.0055 mA/mA	
(0.1 to 1) A	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz (0.1 to 5) kHz (5 to 20) kHz (20 to 50) kHz	0.42 mA + 0.0041 A/A 0.3 mA + 0.0017 A/A 0.26 mA + 0.0009 A/A 0.27 mA + 0.0011 A/A 0.37 mA + 0.0031 A/A 0.92 mA + 0.01 A/A	

Parameter/Equipment	Range	CMC ^{2, 4, 6} ($\pm$)	Comments
Capacitance ³ – Generate			
(0.19 to 0.3999) nF	10 Hz to 10 kHz	8.8 pF + 4 pF/nF	Fluke 5520A
(0.4 to 1.0999) nF	10 Hz to 10 kHz	9.7 pF + 4 pF/nF	
(1.1 to 3.2999) nF	10 Hz to 3 kHz	13 pF + 4 pF/nF	
(3.3 to 10.9999) nF	10 Hz to 1 kHz	15 pF + 2 pF/nF	
(11 to 32.9999) nF	10 Hz to 1 kHz	0.1 nF + 2 pF/nF	
(33 to 109.999) nF	10 Hz to 1 kHz	0.15 nF + 2 pF/nF	
(110 to 329.999) nF	10 Hz to 1 kHz	0.46 nF + 2 pF/nF	
(0.33 to 1.099 99) μ F	(10 to 600) Hz	1.5 nF + 2 nF/ μ F	
(1.1 to 3.299 99) μ F	(10 to 300) Hz	4.6 nF + 2 nF/ μ F	
(3.3 to 10.9999) μ F	(10 to 150) Hz	15 nF + 2 nF/ μ F	
(11 to 32.9999) μ F	(10 to 120) Hz	59 nF + 3.2 nF/ μ F	
(33 to 109.999) μ F	(10 to 80) Hz	0.2 μ F + 3.6 nF/ μ F	
(110 to 329.999) μ F	(0 to 50) Hz	0.64 μ F + 3.6 nF/ μ F	
(0.33 to 1.099 99) mF	(0 to 20) Hz	2 μ F + 3.6 μ F/mF	
(1.1 to 3.299 99) mF	(0 to 6) Hz	7 μ F + 3.5 μ F/mF	
(3.3 to 10.9999) mF	(0 to 2) Hz	38 μ F + 2.6 μ F/mF	
(11 to 32.9999) mF	(0 to 0.6) Hz	90 μ F + 6 μ F/mF	
(33 to 110) mF	(0 to 0.2) Hz	0.37 mF + 8.8 μ F/mF	

Parameter/Equipment	Range	CMC ^{2, 6} (±)	Comments
Electrical Simulation of Thermocouple –			
Type J	(-210 to -100) °C (-100 to -30) °C (-30 to 150) °C (150 to 760) °C (760 to 1200) °C	0.21 °C 0.13 °C 0.12 °C 0.14 °C 0.18 °C	Fluke 5520A
Type K	(-200 to -100) °C (-100 to -25) °C (-25 to 120) °C (120 to 1000) °C (1000 to 1372) °C	0.26 °C 0.15 °C 0.13 °C 0.21 °C 0.31 °C	
Type R	(0 to 250) °C (250 to 400) °C (400 to 1000) °C (1000 to 1767) °C	0.44 °C 0.28 °C 0.26 °C 0.31 °C	
Type S	(0 to 250) °C (250 to 1000) °C (1000 to 1400) °C (1400 to 1767) °C	0.37 °C 0.28 °C 0.29 °C 0.36 °C	
Type T	(-250 to -150) °C (-150 to 0) °C (0 to 120) °C (120 to 400) °C	0.49 °C 0.21 °C 0.15 °C 0.14 °C	

Parameter/Equipment	Range	CMC ^{2, 4, 5, 6} ($\pm$)	Comments
Oscilloscopes ³ –			
Volts – DC Signal Into 50 Ω Into 1 M Ω	$\pm$ 0 mV to 6.6 V $\pm$ 0 mV to 130 V	33 μ V + 2 mV/V 33 μ V + 0.39 mV/V	Fluke 5520A
Volts – Squarewave Into 50 Ω Into 1 M Ω	1 mVpp to 6.6 Vpp; 1 mVpp to 130 Vpp; 10 Hz to 1 kHz (1 to 100) kHz	91 μ V + 4.3 mV/V 0.2 mV + 0.8 mV/V 0.24 mV + 2 mV/V	
Edge into 50 Ω	$\leq$ 300 ps (Up to 2 MHz) $\leq$ 350 ps (Above 2 MHz)	82 ps 82 ps	
Leveled Sine Wave	50 kHz Reference 50 kHz to 100 MHz (100 to 300) MHz (300 to 600) MHz (600 to 1100) MHz	0.33 mV + 17 mV/V 0.4 mV + 31 mV/V 0.43 mV + 36 mV/V 0.53 mV + 57 mV/V 0.58 mV + 67 mV/V	
Time Marker	5 s to 50 ms 50 ms to 1 ns	0.000 63 % + $T \times 0.1$ % 0.000 52 %	$T = \text{time in seconds}$

V. Electrical – RF/Microwave

Parameter/Equipment	Range	CMC ^{2, 5, 6, 8} ($\pm$)	Comments
RF Microwave, Absolute Power – Generate	0.05 to 10V pk-pk Up to 100 kHz 100 kHz to 1 MHz (1 to 15) MHz (-100 to 15) dBm 100 kHz to 3.2 GHz	0.4 % 0.42 % 0.55 % 1.7 dB	HP 33120A HP 8648C
RF Microwave, Absolute Power – Measure ³	(-30 to 20) dBm 100 kHz to 4.2 GHz	3.7 %	Agilent E4419B w/ HP 8482A

Parameter/Equipment	Range	CMC ^{2, 6, 8} (±)	Comments
Distortion – Measure	20 Hz to 50 kHz	1.2 dB	HP 8903B
	(50 to 100) kHz	2.3 dB	
	100 kHz to 2.9 GHz	2.7 dB	HP 8594E

VI. Mechanical

Parameter/Equipment	Range	CMC ^{2, 5, 6, 8} (±)	Comments
Accelerometers (1 to 10) g	(0.5 to 1) Hz (> 1 to 10) Hz (11 to 99) Hz 100 Hz (101 to 920) Hz 921 Hz to 5 kHz (5 to 10) kHz	1.6 % 1.3 % 1.6 % 1.3 % 1.7 % 2 % 2.4 %	VR9500, PCB 301A11 reference sensor
Force– Measuring Equipment Crimpers/Banding Tools Force Gages	(0 to 120) lbf (0 to 100) lbf	0.62 lb 0.0023 %	DMC PT-100A pull tester Class F weights
Pneumatic Pressure – Measuring Equipment	(> 0 to 5) psiv (> 0 to 60) psia (> 0 to 30) psig (> 0 to 100) psig (> 0 to 500) psig (> 0 to 250) inH ₂ O (> 0 to 500) mmHg	0.06 % 0.06 % 0.061 % 0.061 % 0.061 % 0.06 % 0.033 %	Ashcroft AQS & HQS pressure modules
Scales	Up to 200 lbs	0.82 x R	Class F weights <i>R = Unit under test resolution</i>

Parameter/Equipment	Range	CMC ^{2, 5, 6, 8} ($\pm$)	Comments
Balances			
Resolution 0.0001 g	≤ 500 mg > 500 mg to 1 g $(> 1$ to 2) g $(> 2$ to 5) g $(> 5$ to 10) g > 10 g to 2 kg	$1.2 \times R$ $1.4 \times R$ $1.7 \times R$ $2.2 \times R$ $3.0 \times R$ $4.1 \times R$	Class S-1 weights <i>R = Unit under test resolution</i>
Resolution 0.001 g	≤ 20 g $(> 20$ to 50) g $(> 50$ to 100) g $(> 100$ to 200) g > 200 g to 2 kg	$0.91 \times R$ $1.1 \times R$ $1.4 \times R$ $2.5 \times R$ $3.6 \times R$	
Resolution 0.01 g	≤ 100 g $(> 100$ to 200) g $(> 200$ to 500) g > 500 g to 2 kg	$0.82 \times R$ $0.85 \times R$ $1.0 \times R$ $1.4 \times R$	
Resolution 0.1 g, 1 g, & 10 g	≤ 2 kg	$0.82 \times R$	
Torque Transducers	Up to 250 lbf-ft	0.012 %	Class F weights, calibration arms
Torque – Measuring Equipment	(1 to 10) ozf-in (10 to 50) ozf-in	1.2 % 0.58 %	AWS torque transducers & CDI torque calibration system
Snap-Action & Breakover Wrenches, Screwdrivers, Electronic, Digital & Dial Indicating	50 ozf-in to 250 lbf-ft	0.31 %	

VII. Optical Quantities

Parameter/Equipment	Range	CMC ^{2, 5} ($\pm$)	Comments
Luminance Meters	(0.5 to 1700) fL	2.6 %	Hoffman Engineering LS-65-8C

VIII. Thermodynamics

Parameter/Equipment	Range	CMC ^{2, 6, 8} ($\pm$)	Comments
Temperature – Measuring Equipment	(-80 to 350) °C	0.13 °C	Fluke 1523, 5626 PRT, calibration bath
	(-80 to 350) °C	0.14 °C + $\Delta T_{\text{Change from -80 °C}}$ x 0.0002	Fluke 1523, 5618B PRT, calibration bath
Temperature – Measure	(-196 to 661) °C	0.018 °C + $\Delta T_{\text{Change from -196 °C}}$ x 0.000 033	Fluke 1523, 5626 PRT
	(-196 to 500) °C	0.029 °C + $\Delta T_{\text{Change from -196 °C}}$ x 0.000 28	Fluke 1523, 5618B PRT
	(662 to 1000) °C	3.2 °C + $\Delta T_{\text{Change from 662 °C}}$ x 0.011	TC probe
Relative Humidity – Measure & Generate	(20 to 85) % RH (85 to 90) % RH	1.5 % RH 2.2 % RH	Vaisala M170 w/ HMP- 77(B) probe
Temperature – Environmental Chambers, Temperature Uniformity Survey	(-50 to 100) °C	0.86 °C	Fluke 2635A Hydrabucket w/Type T SLE thermocouple

Radiation Thermometry Source using CI Systems & SBIR calibration standards & contact thermometry method		
	CI Systems SR800N, SR800R Sources	Santa Barbara IR Sources
Temperature	CMC ^{2, 6, 8} (±)	CMC ^{2, 6, 8} (±)
-40 °C	0.024 °C	
-30 °C	0.024 °C	
-20 °C	0.024 °C	
-10 °C	0.025 °C	
0 °C	0.025 °C	0.019 °C
10 °C	0.026 °C	0.022 °C
20 °C	0.026 °C	0.025 °C
30 °C	0.026 °C	0.028 °C
40 °C	0.027 °C	0.03 °C
50 °C	0.027 °C	0.033 °C
60 °C	0.028 °C	0.036 °C
70 °C	0.028 °C	0.039 °C
80 °C	0.028 °C	0.042 °C
90 °C	0.029 °C	0.045 °C
100 °C	0.029 °C	0.048 °C
110 °C	0.3 °C	
120 °C	0.03 °C	
130 °C	0.03 °C	
140 °C	0.031 °C	
150 °C	0.031 °C	

IX. Time & Frequency

Parameter/Equipment	Range	CMC ^{2, 6, 8} (±)	Comments
Frequency – Measuring Equipment			
Time Base	10 MHz	0.59 mHz	58305A GPS receiver, HP 53132A frequency counter
Frequency – Measure	0.1 Hz to 225 MHz	74 nHz + 0.1 µHz/Hz	HP 53132A frequency counter

Parameter/Equipment	Range	CMC ^{2, 6, 8} ($\pm$)	Comments
Frequency – Generate	Up to 15 MHz	44 μ Hz + 0.12 μ Hz/Hz	HP 33120A function generator
	100 kHz to 3.2 GHz	5.8 Hz + 0.1 μ Hz/Hz	HP 8648C signal generator
Stopwatch	Up to 24 Hr	0.039 s	58305A GPS receiver, HP 53132A frequency counter

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. 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, all percentages are percent of reading unless otherwise indicated. In the statement of CMC, R represent the resolution of the unit under test.

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.

Boca Raton, FL

for technical competence in the field of

Calibration

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017 *General requirements for the competence of testing and calibration laboratories*. This laboratory also meets the requirements of ANSI/NCSL Z540-1-1994, ANSI/NCSL 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 31st day of May 2023.

A blue ink signature of Mr. Trace McInturff, written in a cursive style.

Mr. Trace McInturff, Vice President, Accreditation Services
For the Accreditation Council
Certificate Number 1877.02
Valid to November 30, 2024

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