



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

TRESCAL, INC.  
554 NW 77th St  
Boca Raton, FL 33487  
Nathan Thrasher Phone: 561 999 1896

CALIBRATION

Valid To: February 28, 2023

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<sup>1,7</sup>:

I. Dimensional

Parameter/Equipment	Range	CMC <sup>2,8</sup> (±)	Comments
Micrometers <sup>3</sup> (Outside, Inside, Depth)	Up to 12 in	19 µin + 28 µin/in	Gage blocks
Length Indicators <sup>3</sup> (Drop, Test, LVDTs)	Up to 1 in	66 µin	Starrett 716 dial indicator, calibrator
Height Gages <sup>3</sup>	Up to 24 in	110 µin + 21 µin/in	Gage blocks, surface plate
Calipers <sup>3</sup>	Up to 12 in	19 µin + 27 µin/in	Gage blocks
Flatness – Measure	Up to 1 in Diameter	6 µin	Optical flat

II. Electrical – DC/Low Frequency

Parameter/Equipment	Range	CMC <sup>2,4,6</sup> (±)	Comments
DC Voltage – Generate <sup>3</sup>	(0 to 330) $\mu$ V 330 $\mu$ V to 3.3 V (3.3 to 33) V (33 to 330) V (330 to 1000) V	18 $\mu$ V + 1 $\mu$ V 11 $\mu$ V/V + 2 $\mu$ V 11 $\mu$ V/V + 20 $\mu$ V 17 $\mu$ V/V + 150 $\mu$ V 15 $\mu$ V/V + 1.5 mV	Fluke 5520A
DC Voltage – Measure	Up to 200 mV (0.2 to 2) V (2 to 20) V (20 to 200) V (200 to 1050) V	5.8 $\mu$ V/V + 0.13 $\mu$ V 4.0 $\mu$ V/V + 0.59 $\mu$ V 4.0 $\mu$ V/V + 5.8 $\mu$ V 6.4 $\mu$ V/V + 0.058 mV 6.4 $\mu$ V/V + 0.58 mV	Fluke 8508A
DC Current – Generate <sup>3</sup>	(0 to 330) $\mu$ A 330 $\mu$ 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	0.012 % + 0.02 $\mu$ A 79 $\mu$ A/A + 0.05 $\mu$ A 79 $\mu$ A/A + 0.25 $\mu$ A 87 $\mu$ A/A + 2.5 $\mu$ A 0.026 % + 40 $\mu$ A 0.032 % + 40 $\mu$ A 0.039 % + 500 $\mu$ A 0.077 % + 750 $\mu$ A	Fluke 5520A
DC Clamp Meters	(16.5 to 1000) A	0.34 % + 0.05 A	Fluke 5520A w/ 5500 coil
DC Current – Measure	(1 to 200) $\mu$ A (0.2 to 2) mA (2 to 20) mA (20 to 200) mA (0.2 to 2) A (2 to 20) A	14 $\mu$ A/A + 0.77 nA 14 $\mu$ A/A + 16 nA 16 $\mu$ A/A + 0.074 $\mu$ A 55 $\mu$ A/A + 1.1 $\mu$ A 0.021 % + 19 $\mu$ A 0.046 % + 0.5 mA	Fluke 8508A

Parameter/Equipment	Range	CMC <sup>2,4,6</sup> ( $\pm$ )	Comments
DC Resistance – Generate	0 to 10.9999 $\Omega$ (11 to 32.9999) $\Omega$ (33 to 109.9999) $\Omega$ (110 to 329.9999) $\Omega$ 330 $\Omega$ to 1.099 99 k $\Omega$ (1.1 to 3.299 999) k $\Omega$ (3.3 to 10.999 99) k $\Omega$ (11 to 32.999 99) k $\Omega$ (33 to 109.9999) k $\Omega$	40 $\mu\Omega/\Omega$ + 1.0 m $\Omega$ 30 $\mu\Omega/\Omega$ + 1.5 m $\Omega$ 28 $\mu\Omega/\Omega$ + 1.4 m $\Omega$ 28 $\mu\Omega/\Omega$ + 2.0 m $\Omega$ 28 $\mu\Omega/\Omega$ + 6.8 m $\Omega$ 28 $\mu\Omega/\Omega$ + 21 m $\Omega$ 28 $\mu\Omega/\Omega$ + 25 m $\Omega$ 28 $\mu\Omega/\Omega$ + 0.2 $\Omega$ 28 $\mu\Omega/\Omega$ + 0.22 $\Omega$	Fluke 5522A, 4-wire
	(110 to 329.9999) k $\Omega$ 330 k $\Omega$ to 1.099 999 M $\Omega$ (1.1 to 3.299 999) M $\Omega$ (3.3 to 10.999 99) M $\Omega$ (11 to 32.999 99) M $\Omega$ (33 to 109.9999) M $\Omega$ (110 to 329.9999) M $\Omega$ (330 to 1100) M $\Omega$	32 $\mu\Omega/\Omega$ + 2.0 $\Omega$ 32 $\mu\Omega/\Omega$ + 2.6 $\Omega$ 60 $\mu\Omega/\Omega$ + 42 $\Omega$ 0.013 % + 61 $\Omega$ 0.025 % + 2.7 k $\Omega$ 0.05 % + 5.4 k $\Omega$ 0.3 % + 0.12 M $\Omega$ 1.5 % + 0.56 M $\Omega$	Fluke 5522A, 2-wire
DC Resistance – Generate, Fixed Points	1 $\Omega$  1 $\Omega$ 10 $\Omega$ 25 $\Omega$ 50 $\Omega$ 100 $\Omega$ 200 $\Omega$ 300 $\Omega$ 400 $\Omega$ 10 k $\Omega$	0.013 m $\Omega$  0.015 m $\Omega$ 0.15 m $\Omega$ 0.49 m $\Omega$ 0.72 m $\Omega$ 1.6 m $\Omega$ 2.9 m $\Omega$ 4.2 m $\Omega$ 5.5 m $\Omega$ 140 m $\Omega$	SRL-1  Hart Scientific 3591

Parameter/Equipment	Range	CMC <sup>2,4,6</sup> (±)	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 + 4.6 μΩ 11 μΩ/Ω + 16 μΩ 9.2 μΩ/Ω + 58 μΩ 9.2 μΩ/Ω + 0.58 mΩ 9.2 μΩ/Ω + 5.8 mΩ 9.2 μΩ/Ω + 58 mΩ 10 μΩ/Ω + 1.2 Ω 23 μΩ/Ω + 0.12 kΩ 0.014 % + 12 kΩ 0.17 % + 1.2 MΩ	Fluke 8508A
Electrical Calibration of Thermocouple Generate and 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 0.14 °C 0.12 °C 0.14 °C 0.17 °C	Fluke 5522A
Type J	(-210 to -100) °C (-100 to -30) °C (-30 to 150) °C (150 to 760) °C (760 to 1200) °C	0.22 °C 0.14 °C 0.12 °C 0.14 °C 0.19 °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 0.14 °C 0.21 °C 0.33 °C	

Parameter/Equipment	Range	CMC <sup>2,4,6</sup> (±)	Comments
Electrical Calibration of Thermocouple Generate and Measure – (cont)			
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 0.16 °C 0.15 °C 0.22 °C	Fluke 5522A
Type R	(0 to 250) °C (250 to 400) °C (400 to 1000) °C (1000 to 1767) °C	0.45 °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 0.19 °C 0.14 °C 0.15 °C	
Electrical Simulation of RTD Indicators <sup>3</sup> –			
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	0.039 °C 0.055 °C 0.07 °C 0.078 °C 0.093 °C 0.18 °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	0.044 °C 0.032 °C 0.032 °C 0.039 °C 0.093 °C 0.1 °C 0.11 °C 0.12 °C	

Parameter/Equipment	Range	CMC <sup>2,6</sup> (±)	Comments
Electrical Simulation of RTD Indicators <sup>3</sup> – (cont)			
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	0.032 °C 0.039 °C 0.039 °C 0.047 °C 0.062 °C 0.062 °C 0.07 °C 0.086 °C	Fluke 5520A
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	0.024 °C 0.024 °C 0.032 °C 0.05 °C 0.06 °C 0.07 °C 0.07 °C 0.23 °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	0.19 °C 0.032 °C 0.039 °C 0.047 °C 0.055 °C 0.062 °C 0.07 °C 0.078 °C 0.18 °C	
Pt 3926, 100 Ω	(-200 to 0) °C (0 to 100) °C (100 to 300) °C (300 to 400) °C (400 to 630) °C	0.039 °C 0.055 °C 0.07 °C 0.078 °C 0.093 °C	
PtNi 385, 120 Ω	(-80 to 0) °C (0 to 100) °C (100 to 260) °C	0.069 °C 0.062 °C 0.11 °C	
Cu 427, 10 Ω	(-100 to 260) °C	0.23 °C	

Parameter/Range	Frequency	CMC <sup>2,4,6</sup> (±)	Comments
AC Voltage – Generate <sup>3</sup>			
(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 500) kHz	0.063 % + 6 μV 0.022 % + 6 μV 0.025 % + 6 μV 0.085 % + 6 μV 0.27 % + 12 μV 0.62 % + 50 μV	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 500) kHz	0.023 % + 8 μV 0.012 % + 8 μV 0.013 % + 8 μV 0.028 % + 8 μV 0.062 % + 32 μV 0.16 % + 70 μV	
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 500) kHz	0.023 % + 50 μV 0.012 % + 60 μV 0.016 % + 60 μV 0.024 % + 50 μV 0.055 % + 0.13 mV 0.19 % + 0.6 mV	
(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	0.023 % + 0.65 mV 0.031 % + 0.6 mV 0.019 % + 0.6 mV 0.028 % + 0.6 mV 0.072 % + 1.6 mV	
(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	0.015 % + 2 mV 0.016 % + 6 mV 0.02 % + 6 mV 0.026 % + 6 mV 0.16 % + 50 mV	
(330 to 1020) V	45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.024 % + 10 mV 0.02 % + 10 mV 0.024 % + 10 mV	

Parameter/Range	Frequency	CMC <sup>2,4,6</sup> (±)	Comments
AC Voltage <sup>3</sup> – Measure			
Up to 200 mV	Up 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 % + 4 μV 93 μV/V + 4 μV 0.011 % + 2 μV 0.012 % + 4 μV 0.028 % + 8 μV 0.066 % + 4 μV	Fluke 8508A
(0.2 to 2) V	Up 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	0.01 % + 20 μV 83 μV/V + 20 μV 63 μV/V + 20 μV 90 μV/V + 20 μV 0.019 % + 40 μV 0.047 % + 200 μV 0.1 % + 0.14 % rng 1.0 % + 1.0 % rng	
(2 to 20) V	Up 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	95 μV/V + 200 μV 74 μV/V + 200 μV 64 μV/V + 200 μV 89 μV/V + 200 μV 0.018 % + 400 μV 0.045 % + 2 mV 0.24 % + 20 mV 1.0 % + 1.0 % rng	
(20 to 200) V	Up 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	95 μV/V + 2mV 73 μV/V + 2mV 62 μV/V + 2mV 88 μV/V + 2mV 0.018 % + 4mV 0.046 % + 2mV 0.24 % + 20 mV 1.0 % + 1.0 % rng	
(200 to 1000) V	Up to 40 Hz 40 Hz to 10 kHz (10 to 30) kHz (30 to 100) kHz	0.01 % + 20mV 35 μV/V + 20mV 0.018 % + 20mV 0.046 % + 20mV	



Parameter/Range	Frequency	CMC <sup>2,4,6</sup> (±)	Comments
AC Current – Generate <sup>3</sup>			
(29 to 330) 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	0.15 % + 0.1 μA 0.12 % + 0.1 μA 0.12 % + 0.1 μA 0.23 % + 0.15 μA 0.61 % + 0.2 μA 1.3 % + 0.4 μA	Fluke 5520A
330 μA to 3.3 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	0.16 % + 0.15 μA 0.1 % + 0.15 μA 0.08 % + 0.15 μA 0.16 % + 0.2 μA 0.38 % + 0.3 μA 0.8 % + 0.6 μA	
(3.3 to 33) 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	0.28 % + 2 μA 0.25 % + 2 μA 0.039 % + 2 μA 0.068 % + 2 μA 0.16 % + 3 μA 0.31 % + 4 μA	
(33 to 330) 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	0.14 % + 20 μA 0.073 % + 20 μA 0.032 % + 20 μA 0.082 % + 50 μA 0.16 % + 0.12 mA 0.35 % + 0.2 mA	
330 mA to 1.1 A	(10 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.14 % + 0.1 mA 0.039 % + 0.1 mA 0.46 % + 1 mA 2.0 % + 5 mA	

Parameter/Range	Frequency	CMC <sup>2,4,6</sup> (±)	Comments
AC Current – Generate <sup>3</sup> (cont)			
(1.1 to 3) A	(10 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.15 % + 0.1 mA 0.070 % + 0.1 mA 0.46 % + 1 mA 1.9 % + 5 mA	Fluke 5520A
(3 to 11) A	(45 to 100) Hz 100 Hz to 1 kHz (1 to 5) kHz	0.048 % + 5 mA 0.089 % + 2 mA 2.4 % + 2 mA	
(11 to 20.5) A	(45 to 100) Hz 100 Hz to 1 kHz (1 to 5) kHz	0.095 % + 5 mA 0.12 % + 5 mA 2.4 % + 5 mA	
20.5 A to 1 kA	(45 to 65) kHz (65 to 440) kHz	0.39 % 0.94 %	Fluke 5520A w/ 5500A coil
AC Current <sup>3</sup> – Measure			
(0 to 200) μA	(1 to 10) Hz 10 Hz to 10 kHz (10 to 30) kHz (30 to 100) kHz	0.02 % + 0.02 μA 0.03 % + 0.02 μA 0.06 % + 0.02 μA 0.31 % + 0.02 μA	Fluke 8508A
(0.2 to 2) mA	(1 to 10) Hz 10 Hz to 10 kHz (10 to 30) kHz (30 to 100) kHz	0.02 % + 0.2 μA 0.03 % + 0.2 μA 0.06 % + 0.2 μA 0.31 % + 0.2 μA	
(2 to 20) mA	(1 to 10) Hz 10 Hz to 10 kHz (10 to 30) kHz (30 to 100) kHz	0.02 % + 2 μA 0.03 % + 2 μA 0.06 % + 2 μA 0.31 % + 2 μA	
(20 to 200) mA	(1 to 10) Hz 10 Hz to 10 kHz (10 to 30) kHz	0.02 % + 20 μA 0.02 % + 20 μA 0.05 % + 20 μA	
(0.2 to 2) A	10 Hz to 2 kHz (2 to 10) kHz (10 to 30) kHz	0.05 % + 200 μA 0.06 % + 200 μA 0.23 % + 200 μA	
(2 to 20) A	10 Hz to 2 kHz (2 to 10) kHz	0.06 % + 2 mA 0.19 % + 2 mA	

Parameter/Range	Frequency	CMC <sup>2,4,5,6</sup> (±)	Comments
AC Power <sup>3</sup> – Generate 109 μW to 20.91 kW; PF=1	(45 to 65) Hz	0.11 %	Fluke 5520A
Phase Generate <sup>3</sup> – (0 to 360)°	(10 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 <sup>3</sup> – 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	0.40 % + 0.013 nF 0.42 % + 0.014 nF 0.44 % + 0.017 nF 0.21 % + 0.021 nF 0.22 % + 0.14 nF 0.21 % + 0.21 nF 0.22 % + 0.62 nF 0.22 % + 0.002 μF 0.22 % + 0.01 μF 0.23 % + 0.02 μF 0.35 % + 0.08 μF 0.40 % + 0.26 μF 0.40 % + 0.83 μF 0.38 % + 0.0026 mF 0.38 % + 0.01 mF 0.39 % + 0.025 mF 0.77 % + 0.14 mF 0.9 % + 0.76 mF	Fluke 5520A

Parameter/Equipment	Range	CMC <sup>2,4,6</sup> (±)	Comments
Oscilloscopes <sup>3</sup> –			
Amplitude – DC Signal			
50 Ω Load	0 mV to 6.6 V	0.000 046 V + 0.58 mV/V	Fluke 5522A/SC11 00
1 MΩ Load	0 mV to 130 V		
Amplitude – Square Wave	1 mVpp to 6.6 Vpp; 10 Hz to 10 kHz	0.000 046 vpp	
50 Ω Load	1 mVpp to 130 Vpp; 10 Hz to 10 kHz		
1 MΩ Load	5 mV to 5.5 V 50 kHz ref 50 kHz to 100 MHz (100 to 300) MHz (300 to 600) MHz	0.000 12 Vpp + 0.019 Vpp/Vpp 0.000 12 Vpp + 0.019 Vpp/Vpp 0.000 12 Vpp + 0.025 Vpp/Vpp 0.000 12 Vpp + 0.047 Vpp/Vpp	
Bandwidth	4 mV to 3.5 V (600 to 1100) MHz	0.000 12 Vpp + 0.054 Vpp/Vpp	
Time Markers	(1 to 100) ns (1 to 20) ms	0.055 ns + 0.000 0083 ps/ns 0.0013 ms + 0.065 ps/ms	

### III. Electrical – RF/Microwave

Parameter/Range	Frequency	CMC <sup>2,5</sup> (±)	Comments
Power Meter <sup>3</sup> – Power Reference, @ 1 mW	50 MHz	1.9 %	Agilent 432A w/ 478A

Parameter/Range	Frequency	CMC <sup>2, 5, 8</sup> (±)	Comments
RF Microwave – Absolute Power – Measure <sup>3</sup>			Power meter w/:
(-60 to -30) dBm	9 kHz to 18 GHz	2.0 %	E9304A, N-type
(-30 to 10) dBm	100 kHz to 4.2 GHz (4.2 to 18) GHz (18 to 30) GHz (30 to 40) GHz (40 to 50) GHz	1.4 % 1.9 % 2.7 % 3.5 % 5.3 %	8482A H85, N-type 8481A H85, N-type 8487A H85, N-Type
(10 to 20) dBm	100 kHz to 4.2 GHz (4.2 to 18) GHz (18 to 30) GHz (30 to 40) GHz (40 to 50) GHz	3.3 % 3.5 % 3.9 % 4.1 % 5.0 %	8482A H85, N-type 8481A H85, N-type 8487A H85, N-Type
Relative Power <sup>3</sup> – Measure			
(0 to -10) dB	10 MHz to 26.5 GHz	0.046 dB	Agilent 8902A
(-10 to -20) dB	10 MHz to 26.5 GHz	0.053 dB	
(-20 to -30) dB	10 MHz to 26.5 GHz	0.080 dB	
(-30 to -40) dB	10 MHz to 26.5 GHz	0.098 dB	
(-40 to -50) dB	10 MHz to 26.5 GHz	0.11 dB	
(-50 to -60) dB	10 MHz to 26.5 GHz	0.12 dB	
(-60 to -70) dB	10 MHz to 26.5 GHz	0.13 dB	
(-70 to -80) dB	10 MHz to 26.5 GHz	0.17 dB	
(-80 to -90) dB	10 MHz to 26.5 GHz	0.18 dB	
(-90 to -100) dB	10 MHz to 26.5 GHz	0.19 dB	
(-100 to -110) dB	10 MHz to 26.5 GHz	0.19 dB	
(-110 to -120) dB	10 MHz to 26.5 GHz	0.21 dB	

Parameter/Range	Frequency	CMC <sup>2, 5, 8</sup> (±)	Comments
Amplitude Modulation Measure –			
Rate: 50 Hz to 10 kHz Depths: (5 to 99) %	150 kHz to 10 MHz	2.4 % + 1.0 digit	HP 8902A w/ 11793A
Rate: 20 Hz to 10 kHz Depths: (5 to 99) %	150 kHz to 10 MHz	3.5 % + 1.0 digit	
Rate: 50 Hz to 50 kHz Depths: (5 to 99) %	10 MHz to 1.3 GHz	1.2 % + 1.0 digit	
Rate: 20 Hz to 100 kHz Depths: (5 to 99) %	10 MHz to 1.3 GHz	3.5 % + 1.0 digit	
Rate: 50 Hz to 50 kHz Depths: (5 to 99) %	(1.3 to 26.5) GHz	1.8 % + 1.0 digit	
Rate: 20 Hz to 100 kHz Depths: (5 to 99) %	(1.3 to 26.5) GHz	3.6 % + 1.0 digit	
Frequency Modulation – Measure			
Rate: 20 Hz to 10 kHz Dev.: ≤ 40 kHz Peak	250 kHz to 10 MHz	2.3 % + 1.0 digit	HP 8902A w/ 11793A
Rate: 50 Hz to 100 kHz Dev.: ≤ 400 kHz Peak	10 MHz to 1.3 GHz	1.2 % + 1.0 digit	
Rate: 20 Hz to 200 kHz Dev.: ≤ 400 kHz Peak	10 MHz to 1.3 GHz	5.8 % + 1.0 digit	
Rate: 50 Hz to 100 kHz Dev.: ≤ 400 kHz Peak	(1.3 to 26.5) GHz	1.2 % + 1.0 digit	
Rate: 20 Hz to 200 kHz Dev.: ≤ 400 kHz Peak	(1.3 to 26.5) GHz	5.8 % + 1.0 digit	

Parameter/Range	Frequency	CMC <sup>2, 5, 8</sup> (±)	Comments
Phase Modulation – Measure  Rate: 200 Hz to 10 kHz (0 to 100) rad  Rate: 200 Hz to 20 kHz (0 to 100) rad  Rate: 200 Hz to 20 kHz (0 to 100) rad	Carrier: 150 kHz ≤ <i>f</i> < 10 MHz  10 MHz ≤ <i>f</i> < 1.3 GHz  10 MHz ≤ <i>f</i> < 26.5 GHz	4.7 % + 1.0 digit  3.6 % + 1.0 digit  3.5 % + 1.0 digit	HP 8902A w/ 11793A
Distortion <sup>3</sup> – Measure	20 Hz to 20 kHz (20 to 100) kHz  100 kHz to 2.5 GHz (2.5 to 26.5) GHz	1.2 dB 2.3 dB  1.8 dB 2.6 dB	HP 8903B  HP 8566A HP 8563E

#### IV. Fluid Quantities

Parameter/Equipment	Range	CMC <sup>2, 5, 6, 8</sup> (±)	Comments
Gas Flow – Measure	(10 to 100) sccm (100 to 1000) sccm (1 to 10) slm (10 to 50) slm	0.58 % 0.58 % 0.58 % 0.58 %	Fluke 5E2-VCR-V-Q and 3E4-VCR-V-Q Molbloc-L laminar elements, Fluke Molbox RFM-M reference flow monitor
Liquid Flow – Measure <sup>3</sup>	(0.7 to 180) GPM	1.1 %	Blancett 110-500 (lin)/B2800 turbine flow meter

V. Mechanical

Parameter/Equipment	Range	CMC <sup>2, 6, 8</sup> (±)	Comments
Mass – Measure, Fixed Points			
Mass Measure, ABBA Substitution, ASTM 0 to 4, OIML E1 to F2	1 mg	1.4 µg	Comparison to ASTM 0 mass standards with mass comparators
	2 mg	1.4 µg	
	3 mg	2.8 µg	
	5 mg	1.4 µg	
	10 mg	1.4 µg	
	20 mg	1.4 µg	
	30 mg	2.8 µg	
	50 mg	1.4 µg	
	100 mg	1.4 µg	
	200 mg	1.4 µg	
	300 mg	2.8 µg	
	500 mg	1.4 µg	
	1 g	4.7 µg	
	2 g	4.7 µg	
	3 g	9.3 µg	
	5 g	4.7 µg	
	10 g	12 µg	
	20 g	14 µg	
	30 g	20 µg	
	50 g	20 µg	
100 g	36 µg		
200 g	70 µg		
300 g	110 µg		
500 g	230 µg		
1 kg	360 µg		
2 kg	700 µg		
Mass Measure, ABBA Substitution, ASTM 1 to 4, OIML E2 to F2	3 kg	1.3 mg	Comparison to ASTM 1 mass standards with mass comparators
	4 kg	1.6 mg	
	5 kg	3.0 mg	
	10 kg	11 mg	
Mass Measure, Direct Weigh, ASTM 5 to 7, OIML M1 to M3, NIST 105-1 F	(1 to 510) mg	0.0061 mg	UMX5 comparator
	(0.52 to 5.1) g	0.02 mg	
	(5.2 to 520) g	0.71 mg	XP505 comparator XP2004S comparator XP5003S comparator XPE32003LC comparator
	(0.53 to 2.3) kg	1.5 mg	
	(2.4 to 5.1) kg	14 mg	
(5.2 to 32) kg	57 mg		



Parameter/Equipment	Range	CMC <sup>2, 5, 6, 8</sup> (±)	Comments
Scales and Balances	(1 to 500) mg (1 to 5) g (5 to 10) g (10 to 20) g (20 to 50) g (50 to 100) g (100 to 200) g (200 to 500) g (500 to 1000) g (1000 to 5000) g	0.0061 mg 0.02 mg 0.029 mg 0.043 mg 0.07 mg 0.15 mg 0.29 mg 0.71 mg 1.5 mg 14 mg	Troemner ultra class mass pieces
Pipettes	(0.1 to 50) µL  10 µL to 50 mL	0.082 µL  0.41 µL	Mettler Toledo XP56  XS205DU, hygrometer, barometer
Pressure – Measuring Equipment <sup>3</sup>			
Pneumatic Gage Pressure	Up to 10 000 psi	0.023 %	DH instruments RPM4/HPMS A70MS/A20MS-AF reference pressure monitor
Hydraulic Gage Pressure	(-14.7 to 15) psi (15 to 300) psi (300 to 750) psi (750 to 1500) psi  Up to 36 000 psi	0.023 % 0.011 % 0.011 % 0.011 %  42 psi	Mensor CPC6000  Additel ADT681-10-GP2500-BAR pressure gage
Torque Tools	4 lbf·in to 600 lbf·ft	0.29 %	CDI 200-400-02, 2000-12-02 torque transducers and loader

VI. Thermodynamic

Parameter/Equipment	Range	CMC <sup>2, 5, 6, 8</sup> ( $\pm$ )	Comments
Radiation Thermometry – Measuring Equipment	(-35 to 150) °C	0.026 °C + 0.000 03 °C/°C	Fluke 4180 precision infrared calibrator
	(150 to 500) °C	0.034 °C + 0.000 21 °C/°C	Fluke 4181 precision infrared calibrator
Temperature – Measuring Equipment, Fixed Points	-196 °C	0.0075 °C	Fluke 2560 SPRT module; Fluke PRT models 5683, 5627-9, 5628 and 5627A; Fluke bath models 5916, 5901D-G, 5900E and 5945
	-38.8344 °C	0.0072 °C	
	0.01 °C	0.0075 °C	
	231.928 °C	0.78 °C	
	419.527 °C	0.0079 °C	
Temperature – Measure <sup>3</sup>	(-196 to 0) °C	0.14 %	Additel 286 multifunction reference thermometer, Additel PRT models ADT280-RS-100 and ADT280-RS-25
	(0 to 420) °C	0.14 %	
	(420 to 960) °C	0.14 %	
Relative Humidity – Measuring Equipment	(10 to 80) % RH	0.57 % + 0.0018 % RH	Thunder Scientific 2500-LT
Relative Humidity Measuring Equipment – Calibration of Humidity Probes <sup>3</sup>	(10 to 90) % RH	2.6 % RH	Vaisala HMP231 humidity data processor w/ HMP36E probe
	(>90 to 95) % RH	3.2 % RH	

VII. Time & Frequency

Parameter/Equipment	Range	CMC <sup>2, 5, 8</sup> (±)	Comments
Frequency – Generate	Up to 15 MHz	0.000 044 Hz + 0.000 000 057 %/Hz	HP 33120A function generator
	10 MHz to 26.5 GHz	0.000 012 μHz/Hz	HP 83650B signal generator, HP 58503A GPS receiver
	10 MHz	9.8E-08 Hz	Datum rubidium standard
Frequency – Measure	1 Hz to 225 MHz	0.57 Hz	HP 53132 Opt 2
	10 Hz to 26.5 GHz	0.58 Hz	EIP 548A
	10 MHz	9.8E-08 Hz	HP 53132A w/ rubidium standard
Stopwatches <sup>3</sup> – Digital Stopwatch/Timer	0 s to 24 hr	0.047 s	Witschi QT6000
	Offset per 24 hours	0.047 s	
Optical Tachometers <sup>3</sup>	(40 to 60 000) rpm (60 000 to 99 999) rpm	0.68 rpm 0.7 rpm	Fluke 5520A

Satellite Location

TRESCAL, INC.  
 100 N. Babcock St  
 Melborne, FL 33935  
 Nathan Thrasher Phone: 321 622 1553

I. Device Specific Parameters

Parameter/Equipment	Range	CMC <sup>2, 5, 6, 8</sup> (±)	Comments
Ionizing Fans, Blowers and Guns – Measuring Equipment			
Ion Balance	Up to 50 V	0.1 V	Ion System 210 charge plate monitor, HP 34401A
Discharge Time	Up to 30 sec	0.039 sec	
Electrostatic Discharge			
Mats – Resistance	Up to 1 GΩ	11 %	Desco 19787 surface resistance meter
Soldering Systems – Measure			
Leak Voltage	Up to 40 mV	0.69 mV	Hakko FG-101 solder tester
Tip-to-Ground Ω	Up to 40 Ω	0.69 Ω	
Temperature Stability	(32 to 1300) °F	7.4 °F	



## II. Dimensional

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Hand Tool Linearity <sup>3</sup>			
Calipers	Up to 20 in	280 μin + 9.6 μin/in	Gage blocks
Micrometers and Depth Micrometers	Up to 20 in	29 μin + 16 μin/in	
Height Gages	Up to 20 in	100 μin + 37 μin/in	
Hand Tool Flatness			
Micrometer Anvil/Spindle	Up to 50 μin	11 μin	Optical Flat
Depth Micrometer Base	Up to 200 μin	73 μin	Gage blocks
Gage Amp w/ Probe <sup>3</sup>	Up to 0.005 in	290 μin	Gage blocks, Tesa TT-80 electronic length measuring instrument
End Standards <sup>3</sup>			
Using Length Measuring Instrument	Up to 4 in Steel Aluminum	38 μin + 3.5 μin/in 38 μin + 4.9 μin/in	Trimos TULM210 length measuring instrument
Using Gage Amplifier and Gage Blocks	Up to 20 in	18 μin + 19 μin/in	Gage blocks, Tesa TT-80 electronic length measuring instrument
Dial and Digital Indicators <sup>3</sup>	Up to 1 in	46 μin	Itall 700 dial indicator calibrator
	(1 to 2) in	62 μin + 2.9 μin/in	Gage blocks
Plain Ring Gages <sup>3</sup>	Up to 4 in	38 μin + 2.7 μin/in	Trimos TULM210 length measuring instrument

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Cylindrical Plug Gages and Pins <sup>3</sup>	Up to 4 in	38 μin + 3.5 μin/in	Trimos TULM210 length measuring instrument
Threaded Plug Gages, Go and NoGo <sup>3</sup>			
60° Pitch Diameter	Up to 4 in (4.5 to 80 TPI)	50 μin + 11 μin/in	Trimos TULM210 length measuring instrument, Vermont gage thread wire set
Major Diameter	Up to 4 in	38 μin + 3.5 μin/in	
Feeler Gages <sup>3</sup>	(0.001 to 0.200) in	38 μin + 3.5 μin/in	Trimos TULM210 length measuring instrument
Optical Comparators –			
Squareness	(0 to 360)°	1.9°	Calibration sphere
Linear	Up to 12 in	110 μin	Glass scale
Magnification	10x, 20x, 50x, 62.5x, 100x	120 μin	Calibration sphere w/ overlay
Protractors <sup>3</sup>	(0 to 180)°	0.0068°	Sine bar, gage blocks
Surface Plate–			
Flatness	24 in × 24 in to 72 in × 144 in	32 μin	Electronic levels
Local Area Flatness	6 in × 6 in to 72 in x 144 in	37 μin	Repeat-O-Meter level meters

### III. Dimensional Testing/Calibration

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Dimensional Measurements <sup>3</sup> –  Checking Angle Plates, V-Blocks, Fixtures and Workpieces	Flatness up to 2000 µin  Parallelism up to 2000 µin  Perpendicularity and Squareness up to 2000 µin	87 µin + 10 µin/in  87 µin + 10 µin/in  93 µin + 9.1 µin/in	Tesa TT-80 electronic length measuring instrument, angle blocks

### IV. Electrical – DC/Low Frequency

Parameter/Equipment	Range	CMC <sup>2, 4, 6</sup> (±)	Comments
DC Voltage – Generate	(0 to 330) mV 330 mV to 3.3 V (3.3 to 33) V (33 to 330) V (330 to 1000) V	1.2 µV + 0.023 µV/mV 2.3 µV + 13 µV/V 25 µV + 14 µV/V 180 µV + 21 µV/V 1.8 mV + 21 µV/V	Fluke 5520A
DC Voltage – Measure	Up to 100 mV 100 mV to 1V (1 to 10) V (10 to 100) V (100 to 1000) V	9.5 µV/V + 0.37 µV 6.1 µV/V + 0.37 µV 5.8 µV/V + 0.59 µV 8.7 µV/V + 37 µV 8.6 µV/V + 120 µV	HP 3458A

Parameter/Equipment	Range	CMC <sup>2, 4, 5, 6(±)</sup>	Comments
DC Current – Generate	(0 to 330) $\mu$ A 330 $\mu$ 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	0.023 $\mu$ A + 0.000 17 $\mu$ A/ $\mu$ A 0.058 $\mu$ A + 0.12 $\mu$ A/mA 0.3 $\mu$ A + 0.12 $\mu$ A/mA 3 $\mu$ A + 0.12 $\mu$ A/mA 46 $\mu$ A + 230 $\mu$ A/A 76 $\mu$ A + 430 $\mu$ A/A 580 $\mu$ A + 580 $\mu$ A/A 0.87 mA + 1.2 mA/A	Fluke 5520A
DC Current – Measure	(0.2 to 100) A 100 A to 1 mA (1 to 10) mA (10 to 100) mA 100 mA to 1 A  (1 to 10) A: 0.01 $\Omega$  (1 to 30) A: 0.001 $\Omega$  (30 to 200) A: 0.001 $\Omega$  (200 to 1000) A: 0.001 $\Omega$	17 $\mu$ A/A + 0.8 nA 17 $\mu$ A/A + 5 nA 17 $\mu$ A/A + 50 $\mu$ A 31 $\mu$ A/A + 0.5 $\mu$ A 100 $\mu$ A/A + 10 $\mu$ A  0.33 %  0.37 %  0.16 %  0.33 %	HP 3458A  Empro 3020-01107-0 shunt, HP 34401A  HP 34330A shunt, HP 34401A  Ohm-Lab CS-200 shunt, HP 34401A  Empro B-1000-100 shunt, HP 34401A



Parameter/Equipment	Range	CMC <sup>2, 4, 6</sup> (±)	Comments
Resistance – Generate	(0 to 10.9999) Ω (11 to 32.9999) Ω (33 to 109.9999) Ω (110 to 329.9999) Ω 330 Ω to 1.099 999 kΩ (1.1 to 3.299 999) kΩ (3.3 to 10.999 99) kΩ (11 to 32.999 99) kΩ (33 to 109.999 99) kΩ (110 to 329.9999) kΩ 330 kΩ to 1.099 999 MΩ (1.1 to 3.2999 99) MΩ (3.3 to 10.999 99) MΩ (11 to 32.999 99) MΩ (33 to 109.999 99) MΩ (110 to 329.9999) MΩ 330 MΩ to 1.1 GΩ	40 μΩ/Ω + 0.0011 Ω 28 μΩ/Ω + 0.0018 Ω 28 μΩ/Ω + 0.0027 Ω 28 μΩ/Ω + 0.0043 Ω 28 μΩ/Ω + 0.013 Ω 28 μΩ/Ω + 0.013 Ω 28 μΩ/Ω + 0.025 Ω 28 μΩ/Ω + 0.25 Ω 28 μΩ/Ω + 0.25 Ω 32 μΩ/Ω + 2.0 Ω 32 μΩ/Ω + 2.2 Ω 60 μΩ/Ω + 0.039 kΩ 130 μΩ/Ω + 0.062 kΩ 250 μΩ/Ω + 2.5 kΩ 500 μΩ/Ω + 3 kΩ 3000 μΩ/Ω + 100 kΩ 15 000 μΩ/Ω + 500 kΩ	Fluke 5520A
Resistance – Measure	(0 to 10) Ω (10 to 100) Ω 100 Ω to 1 kΩ (1 to 10) kΩ (10 to 100) kΩ 100 kΩ to 1 MΩ (1 to 10) MΩ (10 to 100) MΩ 100 MΩ to 1 GΩ	17 μΩ/Ω + 57 μΩ 12 μΩ/Ω + 0.58 μΩ 9.4 μΩ/Ω + 5.8 μΩ 9.5 μΩ/Ω + 57 μΩ 9.7 μΩ/Ω + 0.58 Ω 15 μΩ/Ω + 2.3 Ω 58 μΩ/Ω + 0.12 kΩ 580 μΩ/Ω + 1.2 kΩ 5.9 mΩ/Ω + 12 kΩ	HP 3458A

Parameter/Range	Frequency	CMC <sup>2, 4, 6</sup> (±)	Comments
AC Voltage – Generate			
(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 500) kHz	0.007 mV + 0.000 92 mV/mV 0.0071 mV + 0.000 17 mV/mV 0.0069 mV + 0.000 23 mV/mV 0.0069 mV + 0.0012 mV/mV 0.014 mV + 0.004 mV/mV 0.072 mV + 0.009 mV/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 500) kHz	0.0095 mV + 0.000 35 mV/mV 0.0095 mV + 0.000 17 mV/mV 0.013 mV + 0.000 18 mV/mV 0.0098 mV + 0.0004 mV/mV 0.049 mV + 0.000 89 mV/mV 0.081 mV + 0.0023 mV/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 500) kHz	0.061 mV + 0.35 mV/V 0.085 mV + 0.17 mV/V 0.1 mV + 0.21 mV/V 0.059 mV + 0.35 mV/V 0.16 mV + 0.81 mV/V 0.69 mV + 2.8 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	0.76 mV + 0.35 mV/V 0.75 mV + 0.17 mV/V 0.71 mV + 0.28 mV/V 0.71 mV + 0.4 mV/V 1.9 mV + 1.04 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	2.5 mV + 0.22 mV/V 7.2 mV + 0.23 mV/V 7.0 mV + 0.29 mV/V 7.1 mV + 0.35 mV/V 58 mV + 2.31 mV/V	
(330 to 1020) V	45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	13 mV + 0.35 mV/V 12 mV + 0.29 mV/V 12 mV + 0.35 mV/V	

Parameter/Range	Frequency	CMC <sup>2,4,6</sup> (±)	Comments
AC Voltage – Measure			
10 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	0.0041 mV + 0.000 33 mV/mV 0.0026 mV + 0.000 19 mV/mV 0.0026 mV + 0.000 29 mV/mV 0.0023 mV + 0.0011 mV/mV 0.0017 mV + 0.0057 mV/mV 0.0024 mV + 0.046 mV/mV	HP 3458A
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 300 kHz to 1 MHz	0.0048 mV + 0.000 084 mV/mV 0.0023 mV + 0.000 085 mV/mV 0.0023 mV + 0.000 16 mV/mV 0.0023 mV + 0.000 35 mV/mV 0.0023 mV + 0.000 92 mV/mV 0.012 mV + 0.0035 mV/mV 0.012 mV + 0.0035 mV/mV	
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 300 kHz to 1 MHz	0.000 047 V + 0.000 084 V/V 0.000 024 V + 0.000 087 V/V 0.000 024 V + 0.000 16 V/V 0.000 023 V + 0.000 35 V/V 0.000 023 V + 0.000 92 V/V 0.000 12 V + 0.0035 V/V 0.000 12 V + 0.016 V/V	
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 300 kHz to 1 MHz	0.000 46 V + 0.000 084 V/V 0.000 23 V + 0.000 085 V/V 0.000 23 V + 0.000 16 V/V 0.000 23 V + 0.000 35 V/V 0.000 23 V + 0.000 92 V/V 0.012 V + 0.0035 V/V 0.012 V + 0.016 V/V	
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 300 kHz to 1 MHz	0.0046 V + 0.000 23 V/V 0.0023 V + 0.000 23 V/V 0.0023 V + 0.000 23 V/V 0.0023 V + 0.000 41 V/V 0.0023 V + 0.0014 V/V 0.012 V + 0.0046 V/V 0.012 V + 0.017 V/V	
1000 V	(1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.046 V + 0.000 46 V/V 0.023 V + 0.000 46 V/V 0.023 V + 0.000 69 V/V 0.023 V + 0.0014 V/V 0.023 V + 0.0035 V/V	

Parameter/Range	Frequency	CMC <sup>2,4,6</sup> (±)	Comments
AC Current – Generate			
(29 to 330) uA	(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	0.16 % + 0.1 µA 0.12 % + 0.1 µA 0.1 % + 0.1 µA 0.24 % + 0.15 µA 0.62 % + 0.2 µA 1.3 % + 0.4 µA	Fluke 5520A
(0.33 to 3.3) 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	0.16 % + 0.15 µA 0.1 % + 0.15 µA 0.08 % + 0.15 µA 0.16 % + 0.2 µA 0.38 % + 0.3 µA 0.8 % + 0.6 µA	
(3.3 to 33) 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	0.14 % + 2 µA 0.07 % + 2 µA 0.031 % + 2 µA 0.062 % + 2 µA 0.16 % + 3 µA 0.31 % + 4 µA	
(33 to 330) 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	0.14 % + 20 µA 0.07 % + 20 µA 0.032 % + 20 µA 0.08 % + 50 µA 0.16 % + 100 µA 0.31 % + 200 µA	
(0.33 to 1.1) A	(10 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.14 % + 100 µA 0.039 % + 100 µA 0.46 % + 1000 µA 1.9 % + 5000 µA	
(1.1 to 3) A	(10 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.14 % + 100 µA 0.047 % + 100 µA 0.46 % + 1000 µA 1.9 % + 5000 µA	
(3 to 11) A	(45 to 100) Hz 100 Hz to 1 kHz (1 to 5) kHz	0.048 % + 5000 µA 0.081 % + 2000 µA 2.4 % + 2000 µA	
(11 to 20) A	(45 to 100) Hz 100 Hz to 1 kHz (1 to 5) kHz	0.095 % + 5000 µA 0.12 % + 5000 µA 2.4 % + 5000 µA	

Parameter/Range	Frequency	CMC <sup>2,5,6</sup> (±)	Comments
AC Current – Measure			
100 uA	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz	0.4 % + 30 nA 0.15 % + 30 nA 0.06 % + 30 nA 0.06 % + 30 nA	HP 3458A
1 mA	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz (5 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.4 % + 200 nA 0.15 % + 200 nA 0.06 % + 200 nA 0.03 % + 200 nA 0.06 % + 200 nA 0.4 % + 400 nA 0.55 % + 1500 nA	
10 mA	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz (5 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.4 % + 2 µA 0.15 % + 2 µA 0.06 % + 2 µA 0.03 % + 2 µA 0.06 % + 2 µA 0.4 % + 4 µA 0.55 % + 15 µA	
100 mA	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz (5 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.4 % + 20 µA 0.15 % + 20 µA 0.06 % + 20 µA 0.03 % + 20 µA 0.06 % + 20 µA 0.4 % + 40 µA 0.55 % + 150 µA	
1 A	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz (5 to 20) kHz (20 to 50) kHz	0.4 % + 200 µA 0.16 % + 200 µA 0.08 % + 200 µA 0.1 % + 200 µA 0.3 % + 200 µA 1 % + 400 µA	

Parameter/Equipment	Range	CMC <sup>2,4,6</sup> (±)	Comments
Capacitance – Generate	(0.19 to 3.3) nF (3.3 to 11) nF (11 to 110) nF (110 to 330) nF 330 nF to 1.1 μF (1.1 to 3.3) μF (3.3 to 11) μF (11 to 33) μF (33 to 110) μF (110 to 330) μF 330 μF to 1.1 mF (1.1 to 3.3) mF (3.3 to 11) mF (11 to 33) mF (330 to 110) mF	0.52 % + 0.012 nF 0.26 % + 0.012 nF 0.26 % + 0.116 nF 0.26 % + 0.116 nF 0.26 % + 0.31 nF 0.26 % + 3.1 nF 0.26 % + 12 nF 0.42 % + 31 nF 0.46 % + 120 nF 0.46 % + 310 nF 0.46 % + 1200 nF 0.46 % + 3 μF 0.46 % + 12 μF 0.78 % + 31 μF 1.1 % + 120 μF	Fluke 5520A
Electrical Simulation of Thermocouple–			
Type J	(-210 to 1200) °C	1.3 °C + 0.003 °C/°C	Fluke 5520A
Type K	(-210 to 1372) °C	1.3 °C + 0.003 °C/°C	
Type R	(0 to 1767) °C	0.95 °C + 0.001 °C/°C	
Type S	(0 to 1767) °C	0.95 °C + 0.001 °C/°C	
Type T	(-250 to 400) °C	0.92 °C + 0.001 °C/°C	

Parameter/Range	Frequency	CMC <sup>2, 4, 6</sup> ( $\pm$ )	Comments
Oscilloscopes –			
Amplitude – DC Signal 50 $\Omega$ Load 1 M $\Omega$ Load	0 mV to 6.6 V 0 mV to 130 V	0.000 046 V + 0.58 mV/V	Fluke 5520A/ SC1100
Amplitude – Square Wave 50 $\Omega$ Load	1 mVpp to 6.6 Vpp; 10 Hz to 10 kHz	0.000 046 Vpp	
1 M $\Omega$ Load	1 mVpp to 130 Vpp; 10 Hz to 10 kHz		
Bandwidth	5 mV to 5.5 V 50 kHz ref 50 kHz to 100 MHz (100 to 300) MHz (300 to 600) MHz	0.000 12 Vpp + 0.019 Vpp/Vpp 0.000 12 Vpp + 0.019 Vpp/Vpp 0.000 12 Vpp + 0.025 Vpp/Vpp 0.000 12 Vpp + 0.047 Vpp/Vpp	
	4 mV to 3.5 V (600 to 1100) MHz	0.00012 Vpp + 0.054 Vpp/Vpp	
Time Markers	(1 to 100) ns (1 to 20) ms	0.055 ns + 0.000 0083 ps/ns 0.0013 ms + 0.065 ps/ms	

#### V. Electrical – RF/Microwave

Parameter/Range	Range	CMC <sup>2, 5, 6, 8</sup> ( $\pm$ )	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	0.36 % 0.38 % 0.52 %	HP 33120A function generator
	(-100 to 15) dBm 100 kHz to 3.2 GHz	1.7 dB	HP 8648C signal generator
RF Microwave, Absolute Power – Measure <sup>3</sup>	(-30 to 20) dBm 100 kHz to 4.2 GHz	3.6 %	Agilent E4419B power meter w/ HP 8482A power sensor

Parameter/Equipment	Range	CMC <sup>2, 6, 8</sup> (±)	Comments
Distortion – Measure	20 Hz to 50 kHz (50 to 100) kHz	1.1 dB 2.3 dB	HP 8903B audio analyzer
	100 kHz to 2.9 GHz	2.2 dB + 0.005 dB/dBc	HP 8594E spectrum analyzer

## VI. Mechanical

Parameter/Equipment	Range	CMC <sup>2, 5, 6, 8</sup> (±)	Comments
Force– Measuring Equipment			
Crimpers/Banding Tools	(0 to 120) lbf	2.7 lb	DMC PT-100A pull tester
Force Gages	(0 to 100) lbf	0.0083 lb	Class F and 7 weights
Pneumatic Pressure – Measuring Equipment	(0 to 5) psiv (0 to 60) psia (0 to 500) psig (0 to 30) psig (0 to 100) psig (0 to 250) inH <sub>2</sub> O  (0 to 500) mmHg	0.06 % 0.06 % 0.06 % 0.06 % 0.06 % 0.06 %  0.033 %	Ashcroft AQS and HQS pressure modules
Scales	Up to 200 lbs	0.0009 lb	Class F weights
Balances	Up to 2000 g	0.056 g	Class S-1 weights
Torque Transducers	Up to 100 lbf ft	0.012 %	Class F and 7 weights, calibration kit (wheels)



Parameter/Equipment	Range	CMC <sup>2,5,6,8</sup> (±)	Comments
Torque – Measuring Equipment  Snap-Action and Breakover Wrenches, Screwdrivers, Electronic, Digital and Dial Indicating	Up to 250 lbf ft	0.31 %	CDI torque calibration system

#### VII. Optical Quantities

Parameter/Equipment	Range	CMC <sup>2,5</sup> (±)	Comments
Luminance Meters	(0.5 to 10) fL (10 to 1700) fL	6.6 % 2.5 %	Hoffman Engineering LS-65-8C

#### VIII. Thermodynamics

Parameter/Equipment	Range	CMC <sup>2,6,8</sup> (±)	Comments
Temperature – Measuring Equipment	(-80 to 350) °C	0.2 °C	Fluke 1523 reference thermometer w/5626 platinum resistance thermometer, calibration baths
Temperature – Measure	(-196 to 661) °C	0.018 °C + 0.000 05 °C/°C	Fluke 1523 reference thermometer w/5626 platinum resistance thermometer, calibration baths
	(662 to 1000) °C	4 °C + 0.0044 °C/°C	TC probe
Relative Humidity – Measure	(0 to 85) % RH (90 to 100) % RH	1.8 % RH 2.4 % RH	Vaisala M170 w/ HMP-77(B) probe

Parameter/Equipment	Range	CMC <sup>2, 6, 8</sup> ( $\pm$ )	Comments
Radiation Thermometry Sources			
CI System	(-40 to 150) °C	0.026 °C + 0.000 03 °C/°C	CI Systems and SBIR calibration standards
Santa Barbara IR (SBIR)	(-40 to 150) °C	0.034 °C + 0.000 21 °C/°C	Contact thermometry method
Temperature – Environmental Chambers, Temperature Uniformity Survey	(-50 to 100) °C	1.2 °C	Fluke 2635A Hydrabucket w/Type T SLE thermocouple

#### IX. Time & Frequency

Parameter/Equipment	Range	CMC <sup>2, 6, 8</sup> ( $\pm$ )	Comments
Frequency – Measuring Equipment			
Time Base	10 MHz	58 pHz/Hz	58305A GPS receiver, HP 53132A frequency counter
Sensitivity	(-21 to +10) dBm [(20 to 707) mV] 10 Hz to 100 kHz	0.73 mV	33120A function generator, HP 34401A
	(-21 to +10) dBm 100 kHz to 225 MHz	0.28 dB	HP 8648C signal generator, HP E4419B power sensor w/ HP 8482A power sensor, HP 11667A power splitter
Frequency – Measure	0.1 Hz to 225 MHz	0.57 $\mu$ Hz/Hz	HP 53132A frequency counter
Frequency – Generate	Up to 15 MHz	0.000 044 Hz + 3.4 $\mu$ Hz/Hz	HP 33120A function generator
	100 kHz to 3.2 GHz	6.6 Hz + 3.4 $\mu$ Hz/Hz	HP 8648C signal generator

Parameter/Equipment	Range	CMC <sup>2, 6, 8</sup> ( $\pm$ )	Comments
Stopwatch	Up to 24 Hr	0.039 sec	58305A GPS receiver, HP 53132A frequency counter

<sup>1</sup> This laboratory offers commercial calibration services and field calibration services.

<sup>2</sup> 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.

<sup>3</sup> 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.

<sup>4</sup> 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.

<sup>5</sup> 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.

<sup>6</sup> 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.

<sup>7</sup> This scope meets A2LA's *P112 Flexible Scope Policy*.

<sup>8</sup> 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 6<sup>th</sup> day of April 2021.

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

Vice President, Accreditation Services  
For the Accreditation Council  
Certificate Number 1877.02  
Valid February 28, 2023  
Revised on January 30, 2023

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