



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

MICRO QUALITY CALIBRATION INC.  
9168 De Soto Ave  
Chatsworth, CA 91311-4408  
Konstantin Gontmaher Phone: 818 701 4969 ext. 218

CALIBRATION

Valid To: November 30, 2022

Certificate Number: 2348.01

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. Acoustical

Parameter/Equipment	Range	CMC <sup>2,8</sup> (±)	Comments
Sound Level Meters <sup>3</sup> –			Bruel & Kjaer 4226
94 dB	31.5 Hz to 12.5 kHz 16 kHz	0.30 dB 0.64 dB	
104 dB	31.5 Hz to 12.5 kHz 16 kHz	0.30 dB 1.0 dB	
114 dB	31.5 Hz to 12.5 kHz 16 kHz	0.30 dB 1.1 dB	

II. Chemical

Parameter/Equipment	Range	CMC <sup>2,8</sup> (±)	Comments
pH – Measuring Equipment <sup>3</sup>	4.00 pH 7.00 pH 10.00 pH	0.012 pH 0.012 pH 0.012 pH	Buffer solutions Fluke 5522A

Parameter/Equipment	Range	CMC <sup>2, 8</sup> ( $\pm$ )	Comments
Conductivity – Measuring Equipment <sup>3</sup>	10 $\mu$ S/cm 100 $\mu$ S/cm 1410 $\mu$ S/cm 10 000 $\mu$ S/cm	0.56 $\mu$ S/cm 2.2 $\mu$ S/cm 4.7 $\mu$ S/cm 41 $\mu$ S/cm	Laboratory standard conductivity solution
Aerosol Particle Counters	(0.3 to 1.0) $\mu$ m	2.9 %	TSI electrostatic classifier 3082 TSI condensation particle counter 3772

### III. Dimensional

Parameter/Equipment	Range	CMC <sup>2, 6</sup> ( $\pm$ )	Comments
Gage Blocks	Up to 4 in (> 4 to 20) in	(2.4 + 1.6L) $\mu$ in (3.1 + 1.6L) $\mu$ in	Electronic comparator, master steel gage blocks
Caliper <sup>3</sup>	Up to 20 in (>20 to 40) in	(4.8L + 0.6R) $\mu$ in (370 + 6L) $\mu$ in	Gage blocks
Micrometer <sup>3</sup>	Up to 12 in (>12 to 36) in	(4.8L + 0.6R) $\mu$ in (43 + 8.8L) $\mu$ in	Gage blocks
Bench Micrometers	Up to 10 in	(12 + 1.3L) $\mu$ in	Gage blocks
Dial, Digital and Test Indicator <sup>3</sup>	Up to 4 in	(4.8L + 0.6R) $\mu$ in	Gage blocks
Height Gages <sup>3</sup>	Up to 40 in	(4.8L + 0.6R) $\mu$ in	Gage blocks

Parameter/Equipment	Range	CMC <sup>2, 6</sup> (±)	Comments
Optical Flats	(1 to 8) in	6.0 μin	Standard optical flat
Measuring Microscopes <sup>3</sup>	Up to 12 in	(95 + 3.0L) μin	Glass scale
Cylindrical Gages –  Plug and Pin Gages  Plain Ring Gages	Up to 1 in (>1 to 4) in (>4 to 16) in  Up to 1 in (>1 to 4) in (>4 to 16) in	(6.8 + 0.7D) μin (5.4 + 2.2D) μin (10 + 1.7D) μin  (13 + 0.9D) μin (13 + 1.2D) μin (12 + 2.2D) μin	Universal measuring standard-Supra-500  Universal measuring standard-Supra-500 w/ID probes
Thread Wires	(4 to 20) TPI (>20 to 80) TPI	17 μin 12 μin	Supermicrometer™ Universal measuring standard-Supra-500
Thread Plug Gage –  Pitch Diameter  Major Diameter	(4 to 20) TPI (>20 to 80) TPI  Up to 16 in	(28 + 1.5D) μin (24 + 0.5D) μin  (11 + 1.5D) μin	Supermicrometer™ Universal measuring standard-Supra-500 w/ thread wires  Universal measuring standard-Supra-500
Thread Plug Gage –  Minor Lead Angle  Major Minor Pitch Flank Angle	(4 to 80) TPI  Up to 6 in	(95 + 5.4D) μin (31 + 2.6D) μin 0.054 °  (80 + 4.5L) μin (84 + 3.8L) μin (50 + 5.5L) μin 0°6'32'	Quest thread view machine  MicroScanner™

Parameter/Equipment	Range	CMC <sup>2,6</sup> ( $\pm$ )	Comments
Thread Ring Gage –  Major Minor Pitch Flank Angle	(80 to 4.5) TPI  Up to 6 in	(67 + 0.5D) $\mu$ in  (83 + 4.2L) $\mu$ in (81 + 4.9L) $\mu$ in (51 + 7.7L) $\mu$ in 0°6'23'	Universal measuring standard-Supra-500 w/ probe  MicroScanner™
Surface Plate <sup>3</sup> –  Flatness  Repeatability	(18 x 18) in to (36 x 72) in	13 $\mu$ in  28 $\mu$ in	Autocollimator  Repeat-o-meter
Optical Comparator <sup>3</sup> –  X axis Y axis  Angle	Up to 12 in Up to 12 in  Up to 360°	(46 + 4L) $\mu$ in (47 + 3L) $\mu$ in  2.5 min	Gage blocks  Angle blocks
Angle Blocks <sup>3</sup>	Up to 45°	2.1 arc sec	Sine plate, gage blocks and electronic indicator
Crimping Tools <sup>3</sup>	Up to 1 in diameter	160 $\mu$ in	Pin gages, optical comparator, and pull tester
Precision Levels <sup>3</sup>	(2 to 15) in	150 $\mu$ in	Gage blocks
Protractors/Clinometer <sup>3</sup>	Up to 180 °	1.3 + 0.6R arc sec	Sine plate w/ angle blocks
Surface Roughness Specimens	Up to 400 $\mu$ in	0.62 $\mu$ in	SurfTest w/ reference specimen

Parameter/Equipment	Range	CMC <sup>2,6</sup> ( $\pm$ )	Comments
Profilometers	Up to 400 $\mu$ m	0.55 $\mu$ m	Surface roughness specimen
Rotary Table	(1 to 360) °	4.1 arc sec	Renishaw laser
Steel Rules and Tapes – Steel Rules Measuring Tapes	Up to 72 in Up to 1200 in (in 40 in segments)	0.0027 in (6600 + 16L) $\mu$ m	Kudale TSCU

#### IV. Dimensional Testing<sup>1</sup>

Parameter/Equipment	Range	CMC <sup>2,6</sup> ( $\pm$ )	Comments
Length – 1D <sup>9</sup>	Up to 40 in	5.2 $\mu$ m/in	Gage blocks, CMM, Supra 500, etc
	Up to 110 in	(12 + 0.8L) $\mu$ m	Renishaw laser

#### V. Electrical – DC/Low Frequency

Parameter/Equipment	Range	CMC <sup>2,4</sup> ( $\pm$ )	Comments
DC Voltage – Generate <sup>3</sup>	Up to 220 mV 220 mV to 2.2 V (2.2 to 11) V (11 to 22) V (22 to 220) V (220 to 1100) V	8.5 $\mu$ V/V + 0.40 $\mu$ V 5.2 $\mu$ V/V + 0.70 $\mu$ V 3.7 $\mu$ V/V + 2.5 $\mu$ V 3.7 $\mu$ V/V + 4.0 $\mu$ V 5.2 $\mu$ V/V + 40 $\mu$ V 6.7 $\mu$ V/V + 0.40 mV	Fluke 5720A

Parameter/Equipment	Range	CMC <sup>2, 4, 6</sup> (±)	Comments
DC Voltage – Measure <sup>3</sup>	Up to 100 mV (0.1 to 1) V (1 to 10) V (10 to 100) V (100 to 1000) V	8.1 μV/V + 0.45 μV 5.9 μV/V + 0.50 μV 5.9 μV/V + 1.1 μV 8.9 μV/V + 50 μV 9.6 μV/V + 0.16 mV*	HP 3458A, option 002  *Add 12 μV/V × (V <sub>in</sub> /100) <sup>2</sup> for input >100 V
High Voltage	(1000 to 10 000) V (10 000 to 70 000) V	0.042 % + 0.6R 0.048 % + 0.6R	Vitrek 4700/HLV-70
DC Current – Generate <sup>3</sup>	20 nA to 220 μA 220 μA to 2.2 mA (2.2 to 22) mA (22 to 220) mA 220 mA to 2.2 A  (2.2 to 11) A  (11 to 20) A (20 to 700) A	45 μA/A + 6.0 nA 53 μA/A + 7.0 nA 38 μA/A + 40 nA 48 μA/A + 0.70 μA 85 μA/A + 12 A  410 μA/A + 0.48 mA  1.1mA/A + 0.75 mA 1.5 mA/A + 0.52 A	Fluke 5720A  Fluke 5720A/Fluke/5725A  Fluke 5520A/ Keysight 6680A/HP 3458A/current shunts
DC Current – Toroidal – Type Clamp Meter	(20.5 to 150) A (150 to 1025) A	0.37 % + 0.04 A 0.49 % + 0.09 A	Fluke 5520A w/ Fluke 5500 coils
DC Current – Measure <sup>3</sup>	(10 to 20) pA (20 to 200) pA (0.2 to 2) nA (2 to 20) nA  (20 to 100) nA 100 nA to 1 μA (1 to 10) μA (10 to 100) μA 100 μA to 1 mA (1 to 10) mA (10 to 100) mA 100 mA to 1A  (1 to 10) A (10 to 30) A	1.2 % + 3.5 fA 1.2 % + 6 fA 0.27 % + 0.32 pA 0.24 % + 0.6 pA  0.022 % + 60 pA 36 μA/A + 60 pA 27 μA/A + 0.14 nA 33 μA/A + 1.1 nA 32 μA/A + 7.0 nA 31 μA/A + 70 nA 50 μA/A + 0.70 nA 0.014 % + 13 μA  0.028 % + 0.43 mA 0.07 % + 4.4 mA	Keithley 6517A  HP 3458A, option 002  Fluke 8588A

Parameter/Equipment	Range	CMC <sup>2, 4, 5</sup> (±)	Comments
DC Current – Measure <sup>3</sup> (cont)	(30 to 100) A (100 to 700) A	0.026 % 0.038 %	HP 3458A /current shunts
Resistance – Generate, Fixed Points <sup>3</sup>	(1, 1.9) Ω (10, 19) Ω (100, 190) Ω (1, 1.9) kΩ (10, 19) kΩ (100, 190) kΩ (1, 1.9) MΩ 10 MΩ 19 MΩ 100 MΩ	0.011 % 37 μΩ/Ω 12 μΩ/Ω 11 μΩ/Ω 9.5 μΩ/Ω 24 μΩ/Ω 43 μΩ/Ω 43 μΩ/Ω 71 μΩ/Ω 0.015 %	Fluke 5720A
Resistance – Measure <sup>3</sup>	(0 to 10) Ω (10 to 100) Ω 100 Ω to 1 kΩ (1 to 10) kΩ (10 to 100) kΩ (0.1 to 1) MΩ (1 to 10) MΩ (10 to 100) MΩ  (0.1 to 2) GΩ (2 to 20) GΩ (20 to 200) GΩ (0.2 to 2) TΩ (2 to 10) TΩ	21 μΩ/Ω + 60 μΩ 20 μΩ/Ω + 0.60 mΩ 14 μΩ/Ω + 0.60 mΩ 14 μΩ/Ω + 6.0 mΩ 14 μΩ/Ω + 60 mΩ 20 μΩ/Ω + 3.0 Ω 71 μΩ/Ω + 0.30 kΩ 0.064 % + 1.2 kΩ  0.27 % + 20 kΩ 0.27 % + 0.2 MΩ 0.44 % + 2 MΩ 0.44 % + 20 MΩ 1.3 % + 0.2 GΩ	HP 3458A, option 002  Keithley 6517A
Electrical Simulation of Thermocouple <sup>3</sup> –			
Type J	(-210 to 1200) °C	0.13 °C	Fluke 5720A w/ zero reference junction and SPRT
Type K	(-200 to 1372) °C	0.13 °C	
Type T	(-250 to 400) °C	0.13 °C	
Type N	(-200 to 1300) °C	0.14 °C	
Type E	(-250 to 1000) °C	0.14 °C	

Parameter/Equipment	Range	CMC <sup>2, 4</sup> (±)	Comments
Electrical Simulation of Thermocouple <sup>3</sup> – (cont)			
Type B	(600 to 1820) °C	0.15 °C	Fluke 5720A w/ zero reference junction and SPRT
Type S	(0 to 1767) °C	0.15 °C	
Type R	(0 to 1767) °C	0.15 °C	
Capacitance – Generate <sup>3</sup> , (20 to 1000) Hz	(0.22 to 0.4) nF (0.40 to 1.1) nF (1.1 to 3.3) nF (3.3 to 11) nF (11 to 33) nF (33 to 110) nF	0.54 % + 0.010 nF 0.54 % + 0.010 nF 0.51 % + 0.010 nF 0.26 % + 0.010 nF 0.26 % + 0.10 nF 0.26 % + 0.10 nF	Fluke 5520A
Capacitance – Generate <sup>3</sup>			
(20 to 1000) Hz	(0.11 to 0.33) μF	0.26 % + 0.30 nF	Fluke 5520A
(20 to 600) Hz	(0.33 to 1.1) μF	0.26 % + 1.0 nF	
(20 to 300) Hz	(1.1 to 3.3) μF	0.26 % + 30 nF	
(20 to 150) Hz	(3.3 to 11) μF	0.26 % + 10 nF	
(20 to 120) Hz	(11 to 33) μF	0.41 % + 30 nF	
(20 to 80) Hz	(33 to 110) μF	0.47 % + 0.10 μF	
(20 to 50) Hz	(0.11 to 0.33) mF	0.47 % + 0.30 μF	
20 Hz	(0.33 to 1.1) mF	0.46 % + 1.0 μF	



Parameter/Range	Frequency	CMC <sup>2, 4</sup> (±)	Comments
AC Voltage – Generate <sup>3</sup>			
300 μV 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 (0.5 to 1.0) MHz	0.15 % + 4.0 μV 0.11 % + 4.0 μV 0.09 % + 4.0 μV 0.14 % + 4.0 μV 0.17 % + 5.0 μV 0.23 % + 10 μV 0.51 % + 20 μV 0.59 % + 20 μV	Fluke 5720A/Fluke 5725A
(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 (0.5 to 1.0) MHz	0.040 % + 4.0 μV 0.019 % + 4.0 μV 0.015 % + 4.0 μV 0.034 % + 4.0 μV 0.059 % + 5.0 μV 0.12 % + 10 μV 0.19 % + 20 μV 0.30 % + 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 (0.5 to 1.0) MHz	0.026 % + 12 μV 0.010 % + 7.0 μV 0.016 % + 7.0 μV 0.024 % + 7.0 μV 0.049 % + 17 μV 0.095 % + 20 μV 0.14 % + 25 μV 0.29 % + 45 μV	
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 (0.5 to 1.0) MHz	0.025 % + 40 μV 0.010 % + 15 μV 0.0051 % + 8.0 μV 0.0087 % + 10 μV 0.013 % + 30 μV 0.043 % + 80 μV 0.10 % + 0.20 mV 0.18 % + 0.30 mV	
(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 (0.5 to 1.0) MHz	0.025 % + 0.40 mV 0.010 % + 0.15 mV 0.005 % + 50 μV 0.086 % + 0.10 mV 0.012 % + 0.20 mV 0.030 % + 0.60 mV 0.10 % + 2.0 mV 0.16 % + 3.2 mV	

Parameter/Range	Frequency	CMC <sup>2, 4</sup> (±)	Comments
AC Voltage – Generate <sup>3</sup> (cont)			
(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	0.026 % + 4.0 mV 0.010 % + 1.5 mV 0.0058 % + 0.60 mV 0.011 % + 1.0 mV 0.019 % + 2.5 mV	Fluke 5720A/Fluke 5725A
(220 to 750) V	(15 to 50) Hz 50 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.031 % + 16 mV 0.008 % + 3.5 mV 0.017 % + 6.0 mV 0.06% + 11 mV 0.23% + 45 mV	
(750 to 1100) V	(15 to 50) Hz 50 Hz to 1 kHz (1 to 20) kHz (20 to 30) kHz	0.031 % + 16 mV 0.008 % + 3.5 mV 0.017 % + 6.0 mV 0.06 % + 11 mV	
AC Voltage – Measure <sup>3</sup>			
Up to 10 mV	40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz	0.037 % + 3.1 μV 0.045 % + 3.1 μV 0.15 % + 3.1 μV 0.58 % + 3.0 μV 4.7 % + 4.0 μV	HP 3458A, option 002
(10 to 100) mV	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	0.10 % + 2.1 μV 0.018 % + 2.1 μV 0.051 % + 2.1 μV 0.10 % + 2.1 μV 0.35 % + 10 μV 1.2 % + 10 μV	
100 mV to 1 V	40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (0.2 to 1) MHz	0.010 % + 21 μV 0.018 % + 21 μV 0.037 % + 21 μV 0.095 % + 21 μV 0.35 % + 0.10 mV 1.2 % + 0.10 mV	

Parameter/Range	Frequency	CMC <sup>2,4,6</sup> (±)	Comments
AC Voltage – Measure <sup>3</sup> (cont)			
(1 to 10) V	(10 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	0.010 % + 0.40 mV 0.010 % + 0.21 mV 0.018 % + 0.21 mV 0.037 % + 0.21 mV 0.094 % + 0.21 mV 0.35 % + 1.0 mV 1.7 % + 1.0 mV	HP 3458A, option 002
(10 to 100) V	40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.025 % + 2.1 mV 0.026 % + 2.1 mV 0.043 % + 2.1 mV 0.14 % + 2.1 mV	
(100 to 700) V	40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.047 % + 21 mV 0.070 % + 21 mV 0.14 % + 21 mV 0.35 % + 21 mV	
(700 to 1000) V	Up to 2 kHz (2 to 10) kHz (10 to 30) kHz	0.012 % + 0.026 V 0.012 % + 0.026 V 0.026 % + 0.026 V	Fluke 8588A
High Voltage (1000 to 10 000) V (10 000 to 70 000) V	60 Hz 60 Hz	0.18 % + 0.6R 0.14 % + 0.6R	Vitrek 4700/HLV-70
AC Current – Generate <sup>3</sup>			
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	0.028 % + 16 nA 0.019 % + 10 nA 0.016 % + 8.0 nA 0.032 % + 12 nA 0.12 % + 65 nA	Fluke 5720A/Fluke 5725A
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	0.027 % + 40 nA 0.018 % + 35 nA 0.013 % + 35 nA 0.025 % + 0.11 µA 0.11 % + 0.65 µA	
(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	0.028 % + 0.40 µA 0.018 % + 0.35 µA 0.015 % + 0.35 µA 0.024 % + 0.55 µA 0.11 % + 5.0 µA	

Parameter/Range	Frequency	CMC <sup>2,4</sup> (±)	Comments
AC Current – Generate <sup>3</sup> (cont)			
(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	0.028 % + 4.0 µA 0.018 % + 3.5 µA 0.017 % + 2.5 µA 0.026 % + 3.5 µA 0.12 % + 10 µA	Fluke 5720A
220 mA to 2.2 A	20 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.030 % + 35 µA 0.051 % + 80 µA 0.73 % + 0.16 mA	
(2.2 to 11) A	40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.50 % + 0.17 mA 0.10 % + 0.38 mA 0.36 % + 0.75 mA	
(11 to 20.5) A	(45 to 100) Hz 100 Hz to 1 kHz (1 to 5) kHz	0.14 % + 5 mA 0.17 % + 5 mA 3.4 % + 0.75 mA	Fluke 5520A
AC Current – Toroidal – Type Clamp Meter			
(20.5 to 150) A	(45 to 65) Hz (65 to 400) Hz	0.48 % + 0.035 A 0.79 % + 0.077 A	Fluke 5520A w/5500 coil
(150 to 1025) A	(45 to 65) Hz (65 to 400) Hz	0.58 % + 0.19 A 1.5 % + 0.35 A	
AC Current – Measure <sup>3</sup>			
Up to 100 µA	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz	0.46 % + 0.33 mA 0.18 % + 31 nA 0.072 % + 31 nA 0.072 % + 31 nA	HP 3458A, option 002
100 µA to 1 mA	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz	0.46 % + 0.21 mA 0.18 % + 0.21 mA 0.07 % + 0.21 mA 0.038 + 0.21 mA	
(1 to 10) mA	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz	0.46 % + 2.1 µA 0.17 % + 2.1 µA 0.07 % + 2.1 µA 0.04 % + 2.1 µA	

Parameter/Range	Frequency	CMC <sup>2, 4, 5</sup> (±)	Comments
AC Current – Measure <sup>3</sup> (cont)			
(10 to 100) mA	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz	0.46 % + 21 µA 0.07 % + 21 µA 0.17 % + 21 µA 0.04 % + 21 µA	HP 3458A, option 002
100 mA to 1 A	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz	0.46 % + 0.21 mA 0.19 % + 0.21 mA 0.10 % + 0.21 mA 0.12 % + 0.21 mA	
Oscilloscopes <sup>3</sup> –			
Amplitude DC Signal Into 50 Ω Load Into 1 MΩ Load	(-6.6 to 6.6) V (-130 to 130) V	0.25 % + 40 µV 0.050 % + 40 µV	Fluke 5520A/SC1100
Rise Time	< 300 ps	+0 ps/-100 ps	
Leveled Sine Wave Flatness, Relative to 50 kHz 5 mV <sub>(p-p)</sub> to 5.5 V <sub>(p-p)</sub>	50 Hz to 100 MHz (100 to 300) MHz (300 to 600) MHz 600 MHz to 1.1 GHz	1.5 % + 100 µV 2.0 % + 100 µV 4.0 % + 100 µV 5.0 % + 100 µV	
Time Marker Into 50 Ω Load	(5 to 50) ms 20 ms to 2 ns	(25 + 1000t) parts in 10 <sup>6</sup> 2.5 parts in 10 <sup>6</sup>	t is time in seconds
Tachometers <sup>3</sup>	(6 to 99 999) RPM	0.004 %	Frequency standard w/LED

VI. Electrical – RF/Microwave

Parameter/Range	Frequency	CMC <sup>2, 4, 5</sup> (±)	Comments
<p>Power Sensor – Calibration Factors</p> <p>(-30 to 20) dBm (-30 to 20) dBm</p>	<p>0.1 MHz to 4.2 GHz 50 MHz to 26.5 GHz</p>	<p>2.8 % <i>CF</i> 3.5 % <i>CF</i></p>	<p>Agilent power sensors 8482A &amp; 8485A</p> <p><i>CF</i> is calibration factor</p>
<p>Amplitude Modulation<sup>3</sup> –</p> <p>Carrier: (0.15 to 10) MHz Depth: Up to 99 %</p> <p>Carrier: 10 MHz to 1.3 GHz Depth: Up to 99 %</p>	<p>(20 to 50) Hz 50 Hz to 10 kHz</p> <p>(20 to 50) Hz 50 Hz to 50 kHz (50 to 100) kHz</p>	<p>3.8 % 2.7 %</p> <p>3.8 % 1.6 % 3.8 %</p>	<p>HP 8902A measuring receiver w/ 11722A power sensor</p>
<p>Frequency Modulation<sup>3</sup> –</p> <p>Carrier: 250 kHz to 10 MHz Dev: Up to 40 kHz</p> <p>Carrier: 10 MHz to 1.3 GHz Dev: Up to 400 kHz</p>	<p>20 Hz to 10 kHz</p> <p>(20 to 50) Hz 50 Hz to 100 kHz (100 to 200) kHz</p>	<p>2.9 %</p> <p>5.9 % 1.3 % 5.9 %</p>	<p>HP 8902A measuring receiver w/ 11722A power sensor</p>
<p>Phase Modulation<sup>3</sup> –</p> <p>Carrier: 150 kHz to 10 MHz</p> <p>Carrier: 10 MHz to 1.3 GHz</p>	<p>200 Hz to 10 kHz</p> <p>200 Hz to 20 kHz</p>	<p>4.8 %</p> <p>3.7 %</p>	<p>HP 8902A measuring receiver w/ 11722A power sensor</p>
<p>Absolute Power – Measure<sup>3</sup></p> <p>(0 to -10) dBm (-10 to -20) dBm (-20 to -30) dBm (-30 to -40) dBm (-40 to -50) dBm (-50 to -60) dBm</p>	<p>10 MHz to 26.5 GHz</p>	<p>0.08 dB 0.10 dB 0.12 dB 0.13 dB 0.15 dB 0.17 dB</p>	<p>HP 8902A measuring receiver w/ 11722A and 11792A power sensors</p>

Parameter/Range	Frequency	CMC <sup>2, 4</sup> (±)	Comments
Absolute Power – Measure <sup>3</sup> (cont)			
(-60 to -70) dBm	10 MHz to 26.5 GHz	0.20 dB	HP 8902A measuring receiver w/ 11722A and 11792A power sensors
(-70 to -80) dBm		0.23 dB	
(-80 to -90) dBm		0.28 dB	
(-90 to -100) dBm		0.33 dB	
(-100 to -110) dBm		0.39 dB	
(-110 to -120) dBm		0.43 dB	

#### VII. Fluid Quantities

Parameter/Equipment	Range	CMC <sup>2, 5, 8</sup> (±)	Comments
Flow – Gas <sup>3</sup>	(0.5 to 5) sccm	1.2 %	DH instruments flow meter calibrator Molbox1
	(5 to 50) sccm	1.2 %	
	(0.05 to 0.5) lpm	0.28 %	
	(0.5 to 5) lpm	0.26 %	
	(3 to 30) lpm	0.42 %	
	(30 to 100) lpm	0.65 %	
	(100 to 2500) lpm	1.2 %	Alicat MCR2500SLM
Flow – Liquid <sup>3</sup>	(0.02 to 3) gpm	0.11 %	Flow technology turbine meter
	(0.5 to 60.0) gpm	0.09 %	
	(1.5 to 160) gpm	0.09 %	

VIII. Magnetic Quantities

Parameter/Equipment	Range	CMC <sup>2,5</sup> (±)	Comments
Gauss Meter <sup>3</sup>	(1 to 200) Gauss	0.88 %	Helmholtz coil/zero gauss chamber

IX. Optical Quantities

Parameter/Equipment	Range	CMC <sup>2,5,8</sup> (±)	Comments
Illuminance –  Light meters	(5 to 200) fc (200 to 2000) fc	2.8 % 3.1 %	Hoffman light source w/ PCS 600 light meter

X. Mechanical

Parameter/Equipment	Range	CMC <sup>2,5,6,8</sup> (±)	Comments
Pressure Gauges and Transducer / Vacuum <sup>3</sup>  Pneumatic	(0 to 17) psia Up to 600 psig Up to 3000 psig Up to 6000 psig  Up to 10000 psig	0.002 % + 0.6R 0.010 % + 0.6R 0.010 % + 0.6R 0.011 % + 0.6R  0.021 % + 0.6R	Mensor CPC 8000  DH Instruments pressure calibrator, PPCH-G
Hydraulic	(5 to 40 000) psig  (725 to 72 500) psi	0.030 %  0.030 %	Ruska Model 2450-701  DH-Budenberg 5306
Torque Analyzers <sup>3</sup>	(4 to 50) in·lbf (30 to 400) in·lbf (80 to 1000) in·lbf (20 to 250) ft·lbf (200 to 2000) ft·lbf	0.065 % 0.025 % 0.026 % 0.017 % 0.086 %	Torque arms w/ Class F weights



Parameter/Equipment	Range	CMC <sup>2, 5, 6, 8</sup> (±)	Comments
Torque Tools <sup>3</sup>	(1 to 10) in·ozf (10 to 100) in·ozf (4 to 50) in·lbf (30 to 400) in·lbf (80 to 1000) in·lbf (20 to 250) ft·lbf	0.11 % 0.01 % 0.19 % 0.51 % 0.34 % 0.34 %	Mountz MTX10Z AWS: QC10-100  CDI torque, force and tension calibration system, Model: 200-400-02
Air Velocity Instruments	(25 to 1000) fpm (1000 to 8000) fpm	2.1 % 2.4 %	Omega WT4401-D petit tube
Force Gages and Transducers <sup>3</sup>	(1 to 100) lbf (1 to 1000) lbf  (350 to 1000) lbf (1000 to 30 000) lbf  (5000 to 60 000) lbf	0.049 % 0.037 %  0.12 % 0.026 % + 1.5 lbf  0.99 %	Dead weights  Morehouse force machine w/ load cell  Baldwin hydraulic
Durometer Calibrator –  A-Scale  D-Scale	  (56.08 to 820.87) g  (0 to 4.53) kg	  2.6 g  0.012 kg	  25 lbf load cell
Pipettes	≤10 µL ≤100 µL ≤1000 µL ≤ 5 mL ≤ 10 mL	0.015 µL 0.017 µL 0.040 µL 0.045 µL 0.066 µL	Sartorius CC111, Sartorius WZA 225-CW mass comparator
Durometers –  Type A, B, O Type C, D, DO  Indenter Geometry Length Diameter Angle Radius	  (0 to 100) DUROS (0 to 100) DUROS  Up to 0.2 in Up to 1 in (0 to 90) ° Up to 1 in	  0.52 DUROS 0.46 DUROS  0.58 m·in 0.41 m·in 0.049 ° 0.18 m·in	  REX-1 durometer calibrator  Optical comparator

Parameter/Equipment	Range	CMC <sup>2, 8</sup> (±)	Comments
Indirect Verification of Rockwell Hardness Testers <sup>3</sup>	HRA		ASTM E18
	Low	0.31 HRA	
	Mid	0.22 HRA	
	High	0.19 HRA	
	HRBW		
	Low	0.60 HRBW	
	Mid	0.50 HRBW	
	High	0.68 HRBW	
	HRC		
	Low	0.56 HRC	
	Mid	0.46 HRC	
	High	0.40 HRC	
	HR15N		
	Low	0.54 HR15N	
	Mid	0.47 HR15N	
	High	0.61 HR15N	
	HR15TW		
	Low	0.29 HR15TW	
	Mid	0.29 HR15TW	
	High	0.47 HR15TW	
	HR30N		
	Low	0.35 HR30N	
	Mid	0.52 HR30N	
	High	0.57 HR30N	
	HR30TW		
	Low	0.40 HR30TW	
	Mid	0.38 HR30TW	
	High	0.34 HR30TW	
HR45N			
Low	0.56 HR45N		
Mid	0.35 HR45N		
High	0.29 HR45N		
HR45TW			
Low	0.89 HR45TW		
Mid	0.62 HR45TW		
High	0.61 HR45TW		

Parameter/Equipment	Range	CMC <sup>2,8</sup> (±)	Comments
Direct Verification of Rockwell Hardness Testers <sup>3</sup>			
Verification of Test Force	(15 to 150) kgf	0.08 % + 0.01 kgf	Load cell
Verification of Depth-Measuring Device	(0 to 260) µm	0.17 µm	Digital indicator system
Accelerometers –			
Vibration Sensitivity / Frequency Response	(0.5 to 10) Hz (5 to 10 000) Hz (10 000 to 15 000) Hz	1.7 % 1.9 % 2.2 %	Modal Shop 9155 w/ PCB accelerometers
Shock - Linearity	Up to 10 000 g	2.3 %	
Dynamic Pressure - Linearity	Up to 15 000 psi	3.1 %	
Balances <sup>3</sup>	Up to 310 g Up to 4100 g Up to 15 kg	0.3 mg + 0.6R 48 mg + 0.6R 0.52 g + 0.6R	Class 1 master weights
Scales <sup>3</sup>	Up to 100 lb Up to 1000 lb  Up to 7200 lb	7.7 g + 0.6R 0.12 kg + 0.6R  0.051 % + 0.6R	Class 4 master weights  Standard weights

Parameter/Equipment	Range	CMC <sup>2, 5, 8</sup> (±)	Comments
Mass – Measure (Metric)	30 kg 25 kg 20 kg 10 kg 5 kg 3 kg 2 kg 1 kg 500g 300 g 200 g 100 g 50 g 30 g 20 g 10 g 5 g 3 g 2 g 1 g 500 mg 300 mg 200 mg 100 mg 50 mg 30 mg 20 mg 10 mg 5 mg 3 mg 2 mg 1 mg	15 mg 13 mg 10 mg 5.3 mg 2.3 mg 4.9 mg 2.3 mg 1.6 mg 0.57 mg 0.36 mg 0.19 mg 0.19 mg 73 µg 64 µg 6.8 µg 6.1 µg 4.3 µg 4.2 µg 4.5 µg 2.9 µg 2.7 µg 3.2 µg 2.5 µg 2.5 µg 2.4 µg 3.0 µg 2.4 µg 2.4 µg 2.5 µg 2.9 µg 2.5 µg 2.4 µg	Single substitution
Mass – Measure (Avoirdupois)	1 lb 5 lb 10 lb 25 lb 50 lb  500 lb 1000 lb	2.4 mg 2.4 mg 9.5 mg 4.8 mg 15 mg  12 g 31 g	Single substitution  Load cell

XI. Thermodynamics

Parameter/Equipment	Range	CMC <sup>2, 5, 6, 8</sup> (±)	Comments
Temperature – Measure & Measuring Equipment	(-197 to 0) °C	7.4 mK	Fluke 1560 w/SPRT, TempSens cal-sys -196/-80 and Fluke 7380
	(0 to 660) °C	5.0 mK	Type R TC w/ Tempsens cal-sys 1700
	(400 to 1600) °C	0.27 % + 0.6R	
Infrared / Pyrometers <sup>3</sup>	(50 to 1000) °C	1.4 °C + 0.6R	Fluke 9132
	(500 to 1600) °C	0.48 % + 0.6R	Tempsens cal-sys1700
Humidity – Measuring Equipment			
(5 to 55) °C	(5 to 15) % RH (5 to 25) % RH (25 to 35) % RH (35 to 50) % RH (50 to 65) % RH (65 to 80) % RH (80 to 95) % RH	0.40 % 0.49 % 0.52 % 0.59 % 0.62 % 0.66 % 0.83 %	Rotronic HC2-SH & GEO 1000
Temperature – Measuring Equipment, Fixed Point	Triple Point of Water	0.72 mK	Pond Engineering TPW
	Liquid Nitrogen	7.5 mK	
Humidity – Measure <sup>3</sup>	(-50 to 90) °C		Chilled mirror
		(Frost Point)	
		(Dew Point)	0.14 °C
(5 to 50) °C	(5 to 15) % RH (5 to 25) % RH (25 to 35) % RH	0.20 % 0.35 % 0.40 %	Rotronic HC2-SH

Parameter/Equipment	Range	CMC <sup>2, 5, 6, 8</sup> (±)	Comments
Humidity – Measure <sup>3</sup> (cont)  (5 to 50) °C	(35 to 50) % RH (50 to 65) % RH (65 to 80) % RH (80 to 95) % RH	0.47 % 0.51 % 0.56 % 0.75 %	Rotronic HC2-SH
Dew Point	(100 to -65) °C	0.32 °C	Edge tech 1500
Environmental Chambers, Ovens, Furnaces, Freezers, Temperature Baths and Dry Wells <sup>10</sup>	(-80 to 1000) °C	2.0 °C	Type K TCs and Vaisala RH probe

## XII. Time & Frequency

Parameter/Equipment	Range	CMC <sup>2, 8</sup> (±)	Comments
Frequency – Measuring Equipment	10 MHz Reference Signal	2.0 parts in 10 <sup>10</sup> Hz	Datum 9390-6000 w/ GPS
Frequency – Measure	1 MHz to 40 GHz	9.3 parts in 10 <sup>9</sup> Hz 1.4 part in 10 <sup>7</sup> Hz	10 MHz signal from Datum 9390-6000 w/GPS to: 53131 counter 5352B counter
Stopwatches	Up to 24 hrs	0.048 s/day	Timometer 4500

<sup>1</sup> This laboratory offers commercial dimensional testing and calibration service.

- <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 these calibrations. Please note the actual measurement uncertainties achievable on a customer's site can normally be expected to be larger than the CMC 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.
- <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, percentages are to be read as percent of reading, unless noted otherwise.
- <sup>6</sup> In the statement of CMC,  $L$  is the numerical value of the nominal length of the device measured in inches,  $R$  is the numerical value of the resolution of the device under test in microinches,  $D$  is the numerical value of the nominal diameter of the device measured in inches.
- <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.
- <sup>9</sup> This laboratory meets *R205 – Specific Requirements: Calibration Laboratory Accreditation Program* for the types of dimensional tests listed above and is considered equivalent to that of a calibration.
- <sup>10</sup> The contributions from the "best existing device" are not included in the CMC claim.



## Accredited Laboratory

A2LA has accredited

**MICRO QUALITY CALIBRATION, INC.**

Chatsworth, CA

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/NC SL Z540-1-1994 and the requirements of ANSI/NC SL 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 22<sup>nd</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 2348.01  
Valid to November 30, 2022

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