



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

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CALIBRATION

Valid until: December 31, 2018

Certificate Number: 1570.01

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory to perform the following calibrations<sup>1</sup>:

I. Chemical Quantities

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
pH Meter	(4, 7, 10) pH	0.04 pH	pH buffer solutions

II. Dimensional

Parameter/Equipment	Range	CMC <sup>2, 4, 9</sup> (±)	Comments
Gage Blocks	Up to 3.999 in (4 to 20) in	(1.4 + L) μin (1 + 0.86L) μin	Federal comparator & gage blocks
Micrometers <sup>3</sup>	(1 to 12) in (12 to 24) in (24 to 36) in	(130 + 0.9L) μin (32 + 9L) μin (240 + 5L) μin	GageMaker Mic-Trac gage blocks
Calipers <sup>3</sup>	Up to 12 in (12 to 24) in (24 to 36) in (36 to 80) in	(300 + 1.2L) μin (280 + 4L) μin (300 + 3.5L) μin (210 + 3L) μin	GageMaker Mic-Trac gage blocks  Renishaw laser
2D Height Gages <sup>3</sup>	Up to 36 in	(130 + 1.0L) μin	Surface plate & reference bar

Parameter/Equipment	Range	CMC <sup>2, 4, 9</sup> (±)	Comments
Bore Gages <sup>3</sup>	Up to 2.0 in	74 μin	Indi-Check
Ring Gage <sup>3</sup>	(0.035 to 0.350) in (0.350 to 3) in (3 to 20) in	(14 + 38L) μin (8.1 + 1.1L) μin (4.2 + 2.4L) μin	Zeiss ULM & setting masters
Thread Plugs – Major Diameter Pitch Diameter	Up to 12 in Up to 3.6 in (3.6 to 12) in	(8.4 + 1.8L) μin 68 μin (51 + 1.5L) μin	Zeiss ULM & gage blocks Zeiss ULM, thread wires & gage blocks (2 to 120) TPI & (0.2 to 10) Mm
Tapered Thread Plugs – Pitch Diameter	Up to 2.5 in	130 μin	Super mic, thread wires, tapered sine block & gage blocks
Optical Comparator <sup>3</sup> – Linear Scale (X) Linear Scale (Y) Squareness of Scales	Up to 12 in Up to 6 in Up to 12 in	140 μin 140 μin 110 μin	J&L glass master scale Scale & square
Cylindrical Plug/Disc	(0.05 to 20) in	(8.4 + 1.8L) μin	Zeiss ULM & gage blocks
Thread Wires	(0.003 to 0.25) in	11 μin	Zeiss ULM & master discs
Bench Micrometer <sup>3</sup>	Up to 1 in	15 μin	Gage blocks
Dial Indicators <sup>3</sup>	(0.001 to 1) in (1 to 4) in	82 μin 330 μin	Indi-Check Mic-Trac

Parameter/Equipment	Range	CMC <sup>2, 4, 9</sup> ( $\pm$ )	Comments
Digital Indicators <sup>3</sup>	Up to 0.5 in (0.5 to 1) in (1 to 4) in	47 $\mu$ in 52 $\mu$ in 330 $\mu$ in	Indi-Check Mic-Trac
Test Indicators <sup>3</sup>	Up to 0.03 in (0.03 to 0.06) in	66 $\mu$ in 220 $\mu$ in	Indi-Check
Pin Gages <sup>3</sup>	Up to 2 in	(41 + 5L) $\mu$ in	Laser micrometer & master disks
Indicator Calibrator	Up to 2 in	10 $\mu$ in	Renishaw laser
Mic-Trac <sup>3</sup>	Up to 12 in Up to 24 in Up to 36 in Up to 48 in Up to 60 in	40 $\mu$ in 43 $\mu$ in 71 $\mu$ in 65 $\mu$ in 57 $\mu$ in	Renishaw laser
Datum Balls	Up to 2 in	12 $\mu$ in	Zeiss ULM & gage blocks
Universal Measuring Machine <sup>3</sup>	Up to 20 in	(2.4 + 1.3L) $\mu$ in	Gage blocks
Linear Rule	Up to 80 in	120 $\mu$ in	Renishaw laser
Tape Measure <sup>3</sup>	Up to 16 ft	0.04 in	Master linear rule, surface plate, angle plate
Micrometer Standard <sup>3</sup>	(1 to 72) in	(40 + 5L) $\mu$ in	Renishaw laser & gage blocks
Surface Plate <sup>3</sup> – Flatness Only	Up to 120 in	(18 + 0.9D) $\mu$ in	Federal leveling system
Precision Squares <sup>3</sup>	Up to 18 in	130 $\mu$ in	Amplifier, granite surface plate

Parameter/Equipment	Range	CMC <sup>2,4</sup> (±)	Comments
Micro Hite STD – Block Size & Parallelism Base Parallelism	Up to 1 in	13 μin 77 μin	Zeiss ULM, ring gage, amplifier & granite surface plate
Sine Plate <sup>3</sup>	Up to 5 in	180 μin	Gage blocks, amplifier & surface plate
Federal Levels <sup>3</sup>	± 1000 arc seconds	3.8 arc seconds	Gage blocks, sine plate, & granite surface plate
Thread Ring Pitch Diameter	Up to 12 in	270 μin	Set plugs
Thread Ring Minor Diameter	(0.061 to 0.275) in (0.275 to 12) in	260 μin 510 μin	Pin gages & caliper
Adjustable Thread Rings <sup>8</sup>	Up to 12 in	(W Class set plug tolerance)	Set using master plug gages. ASME/ANSI B1.2-1983 & ASME/ANSI B1.3 – 2007

### III. Electrical – DC/Low Frequency

Parameter/Equipment	Range	CMC <sup>2,4</sup> (±)	Comments
DC Voltage – Measure <sup>3</sup>	(0 to 100) mV 100 mV to 1 V (1 to 10) V (10 to 100) V (100 to 1000) V	1.8 μV 22 μV 110 μV 1.7 mV 31 mV	HP 3458A w/opt 002

Parameter/Equipment	Range	CMC <sup>2, 4, 5, 6, 7</sup> (±)	Comments
DC Voltage – Generate <sup>3</sup>	(0 to 330) mV 330 mV to 3.3 V (3.3 to 33) V (33 to 330) V (330 to 1000) V	0.0016 % + 0.00081 mV 0.00046 % + 0.021 mV 0.00083 % + 0.067 mV 0.0014 % + 0.12 mV 0.0014 % + 1.9 mV	Fluke 5520A
DC Current – Measure <sup>3</sup>	(10 to 100) µA 100 µA to 1 mA (1 to 10) mA (10 to 100) mA 100 mA to 1 A	0.0041 µA 0.037 µA 0.38 µA 6.1 µA 0.16 mA	HP 3458A
DC Current – Generate <sup>3</sup>	(0 to 330) µA 330 µA to 3.3 mA (3.3 to 33) mA (33 to 330) mA 330 mA to 1.1 A (1.1 to 3) A (3 to 11) A (11 to 20) A	0.012 % + 0.016 µA 0.0075 % + 0.048 µA 0.0074 % + 0.35 µA 0.0062 % + 8.2 µA 0.015 % + 0.037 mA 0.028 % + 0.1 mA 0.036 % + 0.77 mA 0.077 % + 0.94 mA	Fluke 5520A
DC Current <sup>3</sup> – Clamp-On	(20 to 150) A (150 to 550) A (550 to 1000) A	0.058 A 0.076 A 0.34 A	Fluke 5520A w/50 turn coil
Resistance – Measure <sup>3</sup>	Up 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	0.001 Ω 0.003 Ω 0.016 Ω 0.17 Ω 1.7 Ω 26 Ω 1.7 kΩ 84 kΩ 25 MΩ	HP 3458A

Parameter/Equipment	Range	CMC <sup>2, 4, 7</sup> ( $\pm$ )	Comments
Resistance – Generate <sup>3</sup>	(0 to 11) $\Omega$ (11 to 33) $\Omega$ (33 to 110) $\Omega$ (110 to 330) $\Omega$ 330 $\Omega$ to 1.1 k $\Omega$ (1.1 to 3.3) k $\Omega$ (3.3 to 11) k $\Omega$ (11 to 33) k $\Omega$ (33 to 110) k $\Omega$ (110 to 330) k $\Omega$ 330 k $\Omega$ to 1.1 M $\Omega$ (1.1 to 3.3) M $\Omega$ (3.3 to 11) M $\Omega$ (11 to 33) M $\Omega$ (33 to 110) M $\Omega$ (110 to 330) M $\Omega$ 330 M $\Omega$ to 1.1 G $\Omega$	0.0014 $\Omega$ 0.0019 $\Omega$ 0.0037 $\Omega$ 0.0092 $\Omega$ 0.027 $\Omega$ 0.095 $\Omega$ 0.28 $\Omega$ 0.94 $\Omega$ 2.8 $\Omega$ 11 $\Omega$ 31 $\Omega$ 0.55 k $\Omega$ 1.8 k $\Omega$ 0.01 M $\Omega$ 0.064 M $\Omega$ 2.5 M $\Omega$ 27 M $\Omega$	Fluke 5520A
DC High Voltage – Measure <sup>3</sup>	(0.5 to 6) kV	0.14 % + 0.001 kVdc	Voltage divider & multimeter
DC High Voltage – Measure <sup>3</sup>	(6 to 60) kV	0.13 % + 0.011 kVdc	Voltage divider & multimeter
DC Current – Measure <sup>3</sup>	(0.1 to 6) mA	0.048 % + 0.0024 mA	Voltage divider & multimeter
AC High Voltage – Measure <sup>3</sup> (60 Hz)	(0.5 to 6) kV	0.84 % + 0.022 kV	Voltage divider & multimeter
AC High Voltage – Measure <sup>3</sup> (60 Hz)	(6 to 42) kV	0.18 % + 1 kV	Voltage divider & multimeter
AC Current – Measure <sup>3</sup> (60 Hz)	(0.1 to 60) mA	1.2 % + 0.024 mA	Decade box & multimeter

Parameter/Range	Frequency	CMC <sup>2, 5</sup> (±)	Comments
AC Voltage – Measure <sup>3</sup>			
(5 to 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	8.1 μV 4.9 μV 8.4 μV 18 μV 72 μV 560 μV	HP 3458A
(10 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 300 kHz to 1 MHz (1 to 2) MHz	16 μV 13 μV 23 μV 45 μV 0.12 mV 0.43 mV 1.4 mV 2.2 mV	
100 mV 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 300 kHz to 1 MHz (1 to 2) MHz	0.1 mV 0.1 mV 0.2 mV 0.4 mV 1.1 mV 4.3 mV 14 mV 21 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 300 kHz to 1 MHz (1 to 2) MHz	1.6 mV 1.3 mV 2.2 mV 4.4 mV 12 mV 43 mV 0.14 V 0.21 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 300 kHz to 1 MHz	33 mV 30 mV 30 mV 51 mV 0.17 V 0.6 V 2.2 V	

Parameter/Range	Frequency	CMC <sup>2, 4, 5, 6, 7</sup> (±)	Comments
AC Voltage – Measure <sup>3</sup> (cont)  (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	0.4 V 0.4 V 0.5 V 1.0 V 2.5 V	HP 3458A
AC Voltage – Generate <sup>3</sup>  (1 to 33) mV  (33 to 330) mV  (0.33 to 3.3) V  (3.3 to 33) V  (33 to 330) V  (330 to 1020) 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  (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  (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  (10 to 45) Hz 45 Hz to 10 kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz  45 Hz to 1 kHz (1 to 10) kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz  45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.054 % + 0.0081 mV 0.0084 % + 0.0078 mV 0.0069 % + 0.011 mV 0.059 % + 0.013 mV 0.27 % + 0.012 mV 0.13 % + 0.33 mV  0.015 % + 0.047 mV 0.01 % + 0.01 mV 0.012 % + 0.01 mV 0.026 % + 0.012 mV 0.061 % + 0.03 mV 0.15 % + 0.083 mV  0.015 % + 0.43 mV 0.011 % + 0.072 mV 0.014 % + 0.066 mV 0.021 % + 0.11 mV 0.052 % + 0.17 mV 0.18 % + 0.87 mV  0.015 % + 4.4 mV 0.011 % + 0.78 mV 0.018 % + 0.74 mV 0.027 % + 0.48 mV 0.07 % + 1.3 mV  0.013 % + 7.4 mV 0.014 % + 9.1 mV 0.018 % + 8.7 mV 0.018 % + 26 mV 0.14 % + 100 mV  0.022 % + 20 mV 0.019 % + 20 mV 0.022 % + 19 mV	Fluke 5520A



Parameter/Range	Frequency	CMC <sup>2, 4, 5, 7</sup> ( $\pm$ )	Comments
AC Current – Measure <sup>3</sup>			
(5 to 100) $\mu$ A	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 1 kHz	0.61 $\mu$ A 0.25 $\mu$ A 0.12 $\mu$ A 0.12 $\mu$ A	HP 3458A
100 $\mu$ A to 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	0.0059 mA 0.0024 mA 0.0011 mA 0.00067 mA 0.0011 mA 0.0062 mA 0.0096 mA	
(1 to 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	0.06 mA 0.024 mA 0.011 mA 0.0067 mA 0.011 mA 0.062 mA 0.096 mA	
(10 to 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	0.6 mA 0.24 mA 0.11 mA 0.067 mA 0.11 mA 0.62 mA 0.96 mA	
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	0.029 A 0.026 A 0.025 A 0.025 A 0.028 A 0.06 A	
AC Current – Generate <sup>3</sup>			
(29 to 330) $\mu$ 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	0.15 % + 0.091 $\mu$ A 0.12 % + 0.091 $\mu$ A 0.097 % + 0.089 $\mu$ A 0.23 % + 0.4 $\mu$ A 0.62 % + 0.44 $\mu$ A 1.2 % + 2.2 $\mu$ A	Fluke 5520A

Parameter/Range	Frequency	CMC <sup>2, 4, 7</sup> (±)	Comments
AC Current – Generate <sup>3</sup> (cont)			
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	0.15 % + 0.0002 mA 0.089 % + 0.00045 mA 0.076 % + 0.00018 mA 0.15 % + 0.00057 mA 0.39 % + 0.00064 mA 0.78 % + 0.003 mA	Fluke 5520A
(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 % + 0.0032 mA 0.067 % + 0.0026 mA 0.028 % + 0.0031 mA 0.059 % + 0.003 mA 0.15 % + 0.0033 mA 0.31 % + 0.0064 mA	
(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 % + 0.028 mA 0.065 % + 0.034 mA 0.029 % + 0.023 mA 0.077 % + 0.042 mA 0.15 % + 0.08 mA 0.31 % + 0.16 mA	
33 mA to 1.1 A	(10 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.074 % + 0.0012 A 0.0087 % + 0.0011 A 0.45 % + 0.0011 A 1.9 % + 0.004 A	
(1.1 to 3) A	(10 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.14 % + 0.00014 A 0.045 % + 0.00014 A 0.47 % + 0.00078 A 1.9 % + 0.0039 A	
(3 to 11) A	(45 to 100) Hz 100 Hz to 1 kHz (1 to 5) kHz	0.044 % + 0.0021 A 0.077 % + 0.0017 A 2.3 % + 0.0019 A	
(11 to 21) A	(45 to 100) Hz 100 Hz to 1 kHz (1 to 5) kHz	0.091 % + 0.0046 A 0.11 % + 0.0045 A 2.3 % + 0.0056 A	





Parameter/Equipment	Range	CMC <sup>2,4</sup> (±)	Comments
Electrical Calibration of RTD Indicators and Indicating Systems <sup>3</sup> – (cont)			
Pt 3926, 100 Ω	-200 °C to -80 °C -80 °C to 0 °C 0 °C to 100 °C 100 °C to 300 °C 300 °C to 400 °C 400 °C to 630 °C	0.039 °C 0.039 °C 0.055 °C 0.070 °C 0.078 °C 0.094 °C	Fluke 5520A
Pt 3916, 100 Ω	-200 °C to -190 °C -190 °C to -80 °C -80 °C to 0 °C 0 °C to 100 °C 100 °C to 260 °C 260 °C to 300 °C 300 °C to 400 °C 400 °C to 630 °C	0.20 °C 0.031 °C 0.039 °C 0.047 °C 0.055 °C 0.063 °C 0.070 °C 0.094 °C	
Pt 385, 200 Ω	-200 °C to 100 °C 100 °C to 260 °C 260 °C to 300 °C 300 °C to 400 °C 400 °C to 600 °C 600 °C to 630 °C	0.031 °C 0.039 °C 0.093 °C 0.11 °C 0.11 °C 0.13 °C	
Pt 385, 500 Ω	-200 °C to -80 °C -80 °C to 100 °C 100 °C to 300 °C 300 °C to 400 °C 400 °C to 600 °C 600 °C to 630 °C	0.031 °C 0.039 °C 0.047 °C 0.063 °C 0.071 °C 0.18 °C	
Pt 385, 1000 Ω	-200 °C to 0 °C 0 °C to 100 °C 100 °C to 260 °C 260 °C to 300 °C 300 °C to 600 °C 600 °C to 630 °C	0.023 °C 0.032 °C 0.040 °C 0.048 °C 0.055 °C 0.18 °C	
Ni 120, 120 Ω	-80 °C to 100 °C 100 °C to 260 °C	0.062 °C 0.11 °C	
Cu 427, 10 Ω	-100 °C to 260 °C	0.24 °C	

Parameter/Equipment	Range	CMC <sup>2,4</sup> (±)	Comments
Electrical Calibration of Thermocouple Indicators & Indicating Systems <sup>3</sup> –			
Type B	600 °C to 800 °C 800 °C to 1000 °C 1000 °C to 1550 °C 1550 °C to 1820 °C	0.37 °C 0.29 °C 0.28 °C 0.30 °C	Fluke 5520A
Type N	-200 °C to -100 °C -100 °C to -25 °C -25 °C to 120 °C 120 °C to 410 °C 410 °C to 1300 °C	0.34 °C 0.23 °C 0.19 °C 0.20 °C 0.26 °C	
Type R	0 °C to 250 °C 250 °C to 400 °C 400 °C to 1000 °C 1000 °C to 1767 °C	0.46 °C 0.30 °C 0.30 °C 0.34 °C	
Type S	0 °C to 250 °C 250 °C to 1000 °C 1000 °C to 1400 °C 1400 °C to 1767 °C	0.39 °C 0.31 °C 0.33 °C 0.39 °C	
Type T	-250 °C to -150 °C -150 °C to 0 °C 0 °C to 120 °C 120 °C to 400 °C	0.51 °C 0.22 °C 0.18 °C 0.18 °C	
Type U	-200 °C to 0 °C 0 °C to 600 °C	0.56 °C 0.26 °C	
Type C	0 °C to 150 °C 150 °C to 650 °C 650 °C to 1000 °C 1000 °C to 1800 °C 1800 °C to 2316 °C	0.27 °C 0.25 °C 0.28 °C 0.42 °C 0.67 °C	
Type E	-250 °C to -100 °C -100 °C to -25 °C -25 °C to 350 °C 350 °C to 650 °C 650 °C to 1000 °C	0.41 °C 0.18 °C 0.17 °C 0.19 °C 0.22 °C	

Parameter/Equipment	Range	CMC <sup>2,4</sup> (±)	Comments
Electrical Calibration of Thermocouple Indicators & Indicating Systems <sup>3</sup> – (cont)			
Type J	-210 °C to -100 °C -100 °C to -30 °C -30 °C to 150 °C 150 °C to 760 °C 760 °C to 1200 °C	0.25 °C 0.18 °C 0.17 °C 0.20 °C 0.23 °C	Fluke 5520A
Type K	-200 °C to -100 °C -100 °C to -25 °C -25 °C to 120 °C 120 °C to 1000 °C 1000 °C to 1372 °C	0.29 °C 0.21 °C 0.18 °C 0.25 °C 0.34 °C	

#### IV. Mechanical

Parameter/Equipment	Range	CMC <sup>2,4,9</sup> (±)	Comments
Pressure <sup>3</sup>	(0 to 100) psi (100 to 1000) psi (1000 to 3000) psi (3000 to 10 000) psi	0.015 psi + 0.6R 0.15 psi + 0.6R 4.8 psi + 0.6R 5.5 psi	Mensor CPC6000 Mensor CPC6000 Fluke pressure module Fluke pressure module
Torque	(0 to 300) in·lbf (0 to 1000) ft·lbf	2.7 in·lbf 1.5 ft·lbf	AKO torque calibrator
Analytical Balances	Up to 2 kg	17 mg	ASTM Class 1 weights, method per NIST handbook 44
Bench & Floor Scales	Up to 250 lb Up to 600 lb Up to 2000 lb	0.10 lb 0.60 lb 2 lb	ASTM Class 6 and NIST 105-1 Class F weights per NIST handbook 44

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Indirect Verification of Rockwell Hardness Testers <sup>3</sup>	HRA:		Indirect verification method per ASTM E18
	Low	0.58 HRA	
	Medium	0.40 HRA	
	High	0.35 HRA	
	HRC:		
	Low	0.81 HRC	
	Medium	0.86 HRC	
	High	0.78 HRC	
	HRBW:		
	Low	0.78 HRBW	
	Medium	0.79 HRBW	
	High	0.78 HRBW	
	HR15N:		
	Low	0.80 HR15N	
	Medium	0.79 HR15N	
	High	0.79 HR15N	
	HR30N:		
	Low	0.86 HR30N	
	Medium	0.78 HR30N	
	High	0.78 HR30N	
	HR45N:		
	Low	0.78 HR45N	
	Medium	0.82 HR45N	
	High	0.79 HR45N	
HR15TW:			
Low	0.79 HR15TW		
Medium	0.80 HR15TW		
High	0.91 HR15TW		
HR30TW:			
Low	0.80 HR30TW		
Medium	0.88 HR30TW		
High	0.84 HR30TW		
HR45TW:			
Low	0.82 HR45TW		
Medium	0.85 HR45TW		
High	0.83 HR45TW		



V. Thermodynamics

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Temperature – Measure	(-38 to 420) °C	0.062 °C	PRT w/indicator
Temperature – Measuring Equipment <sup>3</sup>	-38 °C to 100 °C	0.09 °C	PRT w/ASL temperature indicator & fluid bath
	-15 °C to 110 °C	0.16 °C	PRT w/ASL temperature indicator & Hart 9009 block
	50 °C to 350 °C	0.35 °C	
Relative Humidity – Measuring Equipment <sup>3</sup>	(3 to 20) % RH	1.9 % RH	Vapatron relative humidity chamber
	(20 to 35) % RH	1.6 % RH	
	(35 to 50) % RH	1.2 % RH	
	(50 to 70) % RH	1.6 % RH	
	(70 to 97) % RH	1.9 % RH	
Relative Humidity – Measure	(3 to 95) % RH At (15 to 60) °C	0.21 % RH + 0.014 % RH	General Eastern Optica chilled mirror

VI. Time & Frequency

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Frequency – Measure <sup>3</sup>	1 Hz to 1 MHz	5 Hz	HP 53131A counter
	(1 to 225) MHz	1.2 kHz	
Frequency – Measuring Equipment <sup>3</sup>	0.01 Hz to 2 MHz	4.2 Hz	Fluke 5520A

Parameter/Equipment	Range	CMC <sup>2,7</sup> (±)	Comments
Oscilloscopes <sup>3</sup> – Square Wave Signal			
10 Hz to 10 kHz			
50 Ω Impedance	1 mV to 6.6 V <sub>pk-pk</sub>	2.2 % of value + 0.0038 V <sub>pk-pk</sub>	Fluke 5520A w/SC600
1 MΩ Impedance	1 mV to 130 V <sub>pk-pk</sub>	2.2 % of value + 0.047 V <sub>pk-pk</sub>	
Rise Time – 50 Ω	≥ 300 ps	260 ps	
Time Marker – 50 Ω	2 ns	0.74 %	
	5 ns	0.40 %	
	10 ns	0.29 %	
	20 ns	0.15 %	
	50 ns	0.13 %	
	100 ns	0.14 %	
	200 ns	0.11 %	
	500 ns	0.099 %	
	1 μs	0.12 %	
	2 μs	0.090 %	
	5 μs	0.080 %	
	10 μs	0.12 %	
	20 μs	0.054 %	
	50 μs	0.018 %	
	100 μs	0.058 %	
	200 μs	0.029 %	
	500 μs	0.012 %	
	1 ms	0.058 %	
	2 ms	0.029 %	
	5 ms	0.012 %	
	10 ms	0.058 %	
	20 ms	0.029 %	
	50 ms	0.013 %	
	100 ms	0.059 %	
	200 ms	0.034 %	
	500 ms	0.043 %	
	1 s	0.11 %	
	2 s	0.17 %	
	5 s	0.41 %	

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Oscilloscopes <sup>3</sup> – Leveled Sine Wave			
5 mV to 5.5 V	50 kHz	0.091 V <sub>pk - pk</sub>	Fluke 5520A w/SC600
Absolute	50 kHz to 100 MHz (100 to 300) MHz (300 to 600) MHz	0.16 V <sub>pk - pk</sub> 0.18 V <sub>pk - pk</sub> 0.27 V <sub>pk - pk</sub>	
Flatness	50 kHz to 100 MHz (100 to 300) MHz (300 to 600) MHz	0.068 V <sub>pk - pk</sub> 0.090 V <sub>pk - pk</sub> 0.18 V <sub>pk - pk</sub>	

<sup>1</sup> This laboratory offers commercial calibration service and field 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 this calibration and this laboratory meets A2LA R104 – *General Requirements: Accreditation of Field Testing and Field Calibration Laboratories* for these calibrations. Please note the actual measurement uncertainties achievable on a customer's site can normally be expected to be larger than the CMC 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> Based on using the standard at the temperature the HP 3458A was calibrated (tcal) within  $\pm 5$  °C and an auto-calibration (ACAL) was performed within the previous 24 hours ( $\pm 1$  °C of ambient temperature). CMC is based upon 1-year specifications and using the standard at ambient temperature that is within  $\pm 5$  °C of tcal.

<sup>6</sup> For  $V_{IN} > 100$  V add  $12 \mu V/V (V_{IN}/1000)^2$ .

<sup>7</sup> In the statement of CMC, percentage (%) refers to percent of reading unless otherwise noted.

<sup>8</sup> Adjustable thread rings are set to applicable specification using calibrated master set plug gages.

<sup>9</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.  $D$  is the diagonal length in inches.



## Accredited Laboratory

A2LA has accredited

### CINCINNATI PRECISION INSTRUMENTS

*Cincinnati, OH*

for technical competence in the field of

### Calibration

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005 *General requirements for the competence of testing and calibration laboratories*. This laboratory also meets the requirements of ANSI/NCCL Z540-1-1994 and R205 – *Specific Requirements: Calibration Laboratory Accreditation Program*. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated 8 January 2009).



Presented this 2<sup>nd</sup> day of March 2017.

A handwritten signature in black ink, written over a horizontal line.

President and CEO  
For the Accreditation Council  
Certificate Number 1570.01  
Valid to December 31, 2018  
Revised February 1, 2018

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