



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

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CALIBRATION

Valid To: April 30, 2018

Certificate Number: 1894.01

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. Dimensional

Parameter/Equipment	Range	CMC <sup>2,5</sup> ( $\pm$ )	Comments
Plain Ring Gages	(0.125 to 1) in (1 to 3) in (3 to 8) in	(14 + 0.6L) $\mu$ in (14 + 0.5L) $\mu$ in (14 + 0.8L) $\mu$ in	Universal measuring machine
Internal Straight Thread Ring Gages –			
Pitch Diameter	Up to 1.5 in	80 $\mu$ in	Ring is sized to a setting plug, the uncertainty reported is for the plug
Minor Diameter	Up to 1.5 in	(9 + 2.8D) $\mu$ in	Go/NoGo check, the uncertainty reported is for the plug

Parameter/Equipment	Range	CMC <sup>2, 5</sup> (±)	Comments
Micrometers <sup>3</sup> –	Up to 4 in (4 to 24) in (24 to 60) in	(31 + 1.5L) μin (65 + 3L) μin (310 + 2.5L) μin	Gage blocks
Flatness of Anvils	Up to 1 in diameter	9 μin	Optical flat
Anvil Parallelism	Up to 1 in	32 μin	Ball gage
Calipers <sup>3</sup>	Up to 4 in (4 to 24) in (24 to 60) in	(290 + 0.1L) μin (290 + 0.9L) μin (310 + 2.5L) μin	Gage blocks
Gage Blocks	(0.01 to 4) in	(3 + 1.2L) μin	Gage block comparator
Height Gages	Up to 40 in	(35 + 3.7L) μin	Gage blocks
Dial Indicators <sup>3</sup>	Up to 6 in	(10 + 3.2L) μin	Universal measuring machine
Thread Plugs – Pitch Diameter	Up to 6 in	80 μin	Universal measuring machine with thread wires
Plain Plugs, Disks, Thread Wires	Up to 8 in	(9 + 2.8D) μin	Universal measuring machine
Length Standards	Up to 11 in (11 to 21) in (21 to 40) in	(9 + 2.9L) μin (48 + 3.4L) μin (88 + 3.7L) μin	Universal measuring machine Gage blocks
Steel Rules	Up to 40 in (40 to 72) in	0.0024 in 0.0033 in	Glass scale



II. Electrical – DC/Low Frequency

Parameter/Equipment	Range	CMC <sup>2,6</sup> ( $\pm$ )	Comments
DC Voltage – Generate <sup>3</sup>	(0 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	6 $\mu$ V/V + 0.4 $\mu$ V 3.5 $\mu$ V/V + 0.7 $\mu$ V 2.5 $\mu$ V/V + 2.5 $\mu$ V 2.5 $\mu$ V/V + 4 $\mu$ V 3.5 $\mu$ V/V + 40 $\mu$ V 4.5 $\mu$ V/V + 0.4 mV	Fluke 5700A/EP
DC Voltage – Generate Fixed Points	10 V  100 mV 1 V 10 V 100 V 1000 V	0.5 $\mu$ V/V  1.5 $\mu$ V/V 0.5 $\mu$ V/V 0.5 $\mu$ V/V 0.6 $\mu$ V/V 0.7 $\mu$ V/V	Fluke 732A  Fluke 732A/752A
DC Voltage – Measure <sup>3</sup>	(0 to 200) mV (0 to 2) V (0 to 20) V (0 to 200) V (0 to 1050) V  (1 to 2) kV (2 to 40) kV	5.2 $\mu$ V/V + 0.1 $\mu$ V 3.5 $\mu$ V/V + 0.4 $\mu$ V 3.5 $\mu$ V/V + 4 $\mu$ V 5.5 $\mu$ V/V + 40 $\mu$ V 5.5 $\mu$ V/V + 0.5 mV  0.04 % + 0.4 V 0.04 % + 8 V	Fluke 8508A  Vitretek 4640B
DC Voltage – Measure Fixed Points	10 V  100 mV 1 V 10 V 100 V 1000 V	0.3 $\mu$ V/V  1.5 $\mu$ V/V 0.5 $\mu$ V/V 0.5 $\mu$ V/V 0.6 $\mu$ V/V 0.7 $\mu$ V/V	Fluke 732A  Fluke 732A/752A



Parameter/Equipment	Range	CMC <sup>2,6,7</sup> (±)	Comments
DC Current – Generate <sup>3</sup>	(0 to 220) $\mu$ A (0.22 to 2.2) mA (2.2 to 22) mA (22 to 220) mA (0.22 to 2.2) A (2.2 to 11) A (11 to 20.5) A  (20 to 1000) A	35 $\mu$ A/A + 6 nA 30 $\mu$ A/A + 7 nA 30 $\mu$ A/A + 40 nA 40 $\mu$ A/A + 0.7 $\mu$ A 60 $\mu$ A/A + 12 $\mu$ A 0.034 % + 0.48 mA 0.1 % + 750 $\mu$ A  0.26 %	Fluke 5700A/EP   Fluke 5520A  Fluke 5520A with 5500/coil
DC Current – Measure <sup>3</sup>	(0 to 200) $\mu$ A (0 to 2) mA (0 to 20) mA (0 to 200) mA (0 to 2) A (0 to 20) A	12 $\mu$ A/A + 0.4 nA 12 $\mu$ A/A + 4 nA 14 $\mu$ A/A + 40 nA 48 $\mu$ A/A + 0.8 $\mu$ A 0.019 % + 16 $\mu$ A 0.04 % + 0.4 mA	Fluke 8508A
Resistance – Generate <sup>3</sup>	(0 to 11) $\Omega$ (11 to 33) $\Omega$ (33 to 110) $\Omega$ 110 $\Omega$ to 1.1 k $\Omega$ (1.1 to 11) k $\Omega$ (11 to 110) k $\Omega$ 110 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 to 1100) M $\Omega$	40 $\mu\Omega/\Omega$ + 1 m $\Omega$ 30 $\mu\Omega/\Omega$ + 1.5 m $\Omega$ 28 $\mu\Omega/\Omega$ + 1.4 m $\Omega$ 28 $\mu\Omega/\Omega$ + 2 m $\Omega$ 28 $\mu\Omega/\Omega$ + 20 m $\Omega$ 28 $\mu\Omega/\Omega$ + 200 m $\Omega$ 32 $\mu\Omega/\Omega$ + 2 $\Omega$ 60 $\mu\Omega/\Omega$ + 30 $\Omega$ 0.013 % + 50 $\Omega$ 0.025 % + 2.5 k $\Omega$ 0.05 % + 3 k $\Omega$ 0.3 % + 100 k $\Omega$ 1.5 % + 500 k $\Omega$	Fluke 5520A



Parameter/Equipment	Range	CMC <sup>2,7</sup> ( $\pm$ )	Comments
Resistance – Generate <sup>3</sup> (cont)			
Fixed Points	0 $\Omega$ 1 $\Omega$ 1.9 $\Omega$ 10 $\Omega$ 19 $\Omega$ 100 $\Omega$ 190 $\Omega$ 1.9 k $\Omega$ 19 k $\Omega$ 100 k $\Omega$ 190 k $\Omega$ 1 M $\Omega$ 1.9 M $\Omega$ 10 M $\Omega$ 19 M $\Omega$ 100 M $\Omega$	40 $\mu\Omega$ 80 $\mu\Omega/\Omega$ 80 $\mu\Omega/\Omega$ 21 $\mu\Omega/\Omega$ 21 $\mu\Omega/\Omega$ 7.5 $\mu\Omega/\Omega$ 7.5 $\mu\Omega/\Omega$ 7.5 $\mu\Omega/\Omega$ 7.5 $\mu\Omega/\Omega$ 9 $\mu\Omega/\Omega$ 9 $\mu\Omega/\Omega$ 15 $\mu\Omega/\Omega$ 16 $\mu\Omega/\Omega$ 31 $\mu\Omega/\Omega$ 39 $\mu\Omega/\Omega$ 95 $\mu\Omega/\Omega$	Fluke 5700A/EP
Resistance – Measure/Generate	(0.0001 to 0.001) $\Omega$ (0.001 to 0.01) $\Omega$ (0.01 to 0.1) $\Omega$ (0.1 to 1) $\Omega$	1.5 $\mu\Omega/\Omega$ 1.1 $\mu\Omega/\Omega$ 0.7 $\mu\Omega/\Omega$ 0.4 $\mu\Omega/\Omega$	MIL 6010B/6011A or 6000B
Fixed Point	1 $\Omega$ (1 to 10) $\Omega$ (10 to 100) $\Omega$ 100 $\Omega$ to 1 k $\Omega$	0.13 $\mu\Omega/\Omega$ 0.17 $\mu\Omega/\Omega$ 0.24 $\mu\Omega/\Omega$ 0.28 $\mu\Omega/\Omega$	Thomas-type resistors
Fixed Point	10 k $\Omega$  (1 to 13) k $\Omega$ (10 to 100) k $\Omega$ 100 k $\Omega$ to 1 M $\Omega$  (1 to 10) M $\Omega$ (10 to 100) M $\Omega$ 100 M $\Omega$ 1 G $\Omega$ (1 to 10) G $\Omega$ (10 to 100) G $\Omega$ 100 G $\Omega$ to 1 T $\Omega$ (1 to 10) T $\Omega$	0.15 $\mu\Omega/\Omega$  0.33 $\mu\Omega/\Omega$ 0.45 $\mu\Omega/\Omega$ 0.56 $\mu\Omega/\Omega$  3.8 $\mu\Omega/\Omega$ 5 $\mu\Omega/\Omega$ 10 $\mu\Omega/\Omega$ 20 $\mu\Omega/\Omega$ 50 $\mu\Omega/\Omega$ 0.01 % 0.035 %	Evanohm-type resistors     Guarded dual source bridge

Parameter/Equipment	Range	CMC <sup>2, 6</sup> (±)	Comments
Resistance – Measure <sup>3</sup>	(0 to 2) Ω (2 to 20) Ω (20 to 200) Ω 200 Ω to 2 kΩ (2 to 20) kΩ (20 to 200) kΩ 200 kΩ to 2 MΩ (2 to 20) MΩ (20 to 200) MΩ 200 MΩ to 2 GΩ (2 to 20) GΩ	17 μΩ/Ω + 4 μΩ 9.5 μΩ/Ω + 14 μΩ 8 μΩ/Ω + 50 μΩ 8 μΩ/Ω + 0.5 mΩ 8 μΩ/Ω + 5 mΩ 8 μΩ/Ω + 50 mΩ 9 μΩ/Ω + 1 Ω 17 μΩ/Ω + 10 Ω 65 μΩ/Ω + 1 kΩ 0.018 % + 100 kΩ 0.16 % + 10 MΩ	Fluke 8508A
Electrical Calibration of RTD Indicators & Indicating Systems <sup>3</sup> –			
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	0.05 °C 0.05 °C 0.07 °C 0.09 °C 0.1 °C 0.12 °C 0.23 °C	Fluke 5520A
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	0.05 °C 0.05 °C 0.07 °C 0.09 °C 0.1 °C 0.12 °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	0.25 °C 0.04 °C 0.05 °C 0.06 °C 0.07 °C 0.08 °C 0.09 °C 0.1 °C 0.23 °C	



Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Electrical Calibration of RTD Indicators & Indicating Systems <sup>3</sup> – (cont)			
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	0.04 °C 0.04 °C 0.04 °C 0.05 °C 0.12 °C 0.13 °C 0.14 °C 0.16 °C	Fluke 5520A
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	0.04 °C 0.05 °C 0.05 °C 0.06 °C 0.08 °C 0.08 °C 0.09 °C 0.11 °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	0.03 °C 0.03 °C 0.04 °C 0.05 °C 0.06 °C 0.07 °C 0.07 °C 0.23 °C	
PtNi 385, 120 Ω (Ni 120)	(-80 to 0) °C (0 to 100) °C (100 to 260) °C	0.08 °C 0.08 °C 0.14 °C	
Cu 427, 10 Ω	(-100 to 260) °C	0.3 °C	



Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Electrical Calibration of Thermocouple Indicators & Indicating Systems <sup>3</sup> –			
Type B	(600 to 800) °C (800 to 1000) °C (1000 to 1550) °C (1550 to 1820) °C	0.44 °C 0.34 °C 0.3 °C 0.33 °C	Fluke 5520A
Type C	(0 to 150) °C (150 to 650) °C (650 to 1000) °C (1000 to 1800) °C (1800 to 2316) °C	0.3 °C 0.26 °C 0.31 °C 0.5 °C 0.84 °C	
Type E	(-250 to -100) °C (-100 to -25) °C (-25 to 350) °C (350 to 650) °C (650 to 1000) °C	0.5 °C 0.16 °C 0.14 °C 0.16 °C 0.21 °C	
Type J	(-210 to -100) °C (-100 to -30) °C (-30 to 150) °C (150 to 760) °C (760 to 1200) °C	0.27 °C 0.16 °C 0.14 °C 0.17 °C 0.23 °C	
Type K	(-200 to -100) °C (-100 to -25) °C (-25 to 120) °C (120 to 1000) °C (1000 to 1372) °C	0.33 °C 0.18 °C 0.16 °C 0.26 °C 0.4 °C	
Type L	(-200 to -100) °C (-100 to 800) °C (800 to 900) °C	0.37 °C 0.26 °C 0.17 °C	
Type N	(-200 to -100) °C (-100 to -25) °C (-25 to 120) °C (120 to 410) °C (410 to 1300) °C	0.4 °C 0.22 °C 0.19 °C 0.18 °C 0.27 °C	





Parameter/Equipment	Range	CMC <sup>2,6</sup> (±)	Comments
Electrical Calibration of Thermocouple Indicators & Indicating Systems <sup>3</sup> (cont) –			
Type R	(0 to 250) °C (250 to 400) °C (400 to 1000) °C (1000 to 1767) °C	0.57 °C 0.35 °C 0.33 °C 0.4 °C	Fluke 5520A
Type S	(0 to 250) °C (250 to 1000) °C (1000 to 1400) °C (1400 to 1767) °C	0.47 °C 0.36 °C 0.37 °C 0.46 °C	
Type T	(-250 to -150) °C (-150 to 0) °C (0 to 120) °C (120 to 400) °C	0.63 °C 0.24 °C 0.16 °C 0.14 °C	
Type U	(-200 to 0) °C (0 to 600) °C	0.56 °C 0.27 °C	
AC Power <sup>3</sup> –			
(45 to 65) Hz:			
(3.3 to 330) mA	33 mV to 1020 V	0.05 %	Fluke 5520A
330 mA to 11 A	33 mV to 1020 V	0.06 %	
(11 to 20.5) A	33 mV to 1020 V	0.15 %	



Parameter/Range	Frequency	CMC <sup>2, 6</sup> ( $\pm$ )	Comments
Capacitance – Generate <sup>3</sup> (0.19 to 0.4) nF (0.4 to 1.1) nF (1.1 to 3.3) nF (3.3 to 11) nF (11 to 33) nF (33 to 110) nF (110 to 330) nF 330 nF to 1.1 $\mu$ F (1.1 to 3.3) $\mu$ F (3.3 to 11) $\mu$ F (11 to 33) $\mu$ F (33 to 110) $\mu$ F (110 to 330) $\mu$ F 330 $\mu$ F to 1.1 mF (1.1 to 3.3) mF (3.3 to 11) mF (11 to 33) 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	0.5 % + 0.01 nF 0.5 % + 0.01 nF 0.5 % + 0.01 nF 0.25 % + 0.01 nF 0.25 % + 0.1 nF 0.25 % + 0.1 nF 0.25 % + 0.3 nF 0.25 % + 1 nF 0.25 % + 3 nF 0.25 % + 10 nF 0.4 % + 30 nF 0.45 % + 100 nF 0.45 % + 300 nF 0.45 % + 1 $\mu$ F 0.45 % + 3 $\mu$ F 0.45 % + 10 $\mu$ F 0.75 % + 30 $\mu$ F 1.1 % + 100 $\mu$ F	Fluke 5520A
AC Voltage – Generate <sup>3</sup> Up to 2.2 mV (2.2 to 22) mV (22 to 220) mV	(10 to 20) Hz (20 to 40) Hz (0.04 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (0.5 to 1) MHz (10 to 20) Hz (20 to 40) Hz (0.04 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (0.5 to 1) MHz (10 to 20) Hz (20 to 40) Hz (0.04 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz	0.022 % + 4 $\mu$ V 85 $\mu$ V/V + 4 $\mu$ V 75 $\mu$ V/V + 4 $\mu$ V 0.018 % + 4 $\mu$ V 0.046 % + 5 $\mu$ V 0.09 % + 10 $\mu$ V 0.12 % + 20 $\mu$ V 0.25 % + 20 $\mu$ V 0.022 % + 4 $\mu$ V 85 $\mu$ V/V + 4 $\mu$ V 75 $\mu$ V/V + 4 $\mu$ V 0.018 % + 4 $\mu$ V 0.046 % + 5 $\mu$ V 0.09 % + 10 $\mu$ V 0.12 % + 20 $\mu$ V 0.25 % + 20 $\mu$ V 0.022 % + 12 $\mu$ V 85 $\mu$ V/V + 7 $\mu$ V 75 $\mu$ V/V + 7 $\mu$ V 0.018 % + 7 $\mu$ V 0.042 % + 17 $\mu$ V 0.075 % + 20 $\mu$ V	Fluke 5700A/EP

Parameter/Range	Frequency	CMC <sup>2, 4, 6</sup> ( $\pm$ )	Comments
AC Voltage – Generate <sup>3</sup> (cont)			
(22 to 220) mV	(300 to 500) kHz (0.5 to 1) MHz	0.12 % + 25 $\mu$ V 0.25 % + 45 $\mu$ V	Fluke 5700A/EP
(0.22 to 2.2) V	(10 to 20) Hz (20 to 40) Hz (0.04 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (0.5 to 1) MHz	0.022 % + 40 $\mu$ V 80 $\mu$ V/V + 15 $\mu$ V 40 $\mu$ V/V + 8 $\mu$ V 70 $\mu$ V/V + 10 $\mu$ V 0.011 % + 30 $\mu$ V 0.034 % + 80 $\mu$ V 0.09 % + 200 $\mu$ V 0.15 % + 300 $\mu$ V	
(2.2 to 22) V	(10 to 20) Hz (20 to 40) Hz (0.04 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (0.5 to 1) MHz	0.022 % + 400 $\mu$ V 80 $\mu$ V/V + 150 $\mu$ V 40 $\mu$ V/V + 50 $\mu$ V 70 $\mu$ V/V + 100 $\mu$ V 95 $\mu$ V/V + 200 $\mu$ V 0.026 % + 600 $\mu$ V 0.09 % + 2 mV 0.13 % + 3.2 mV	
(22 to 220) V	(10 to 20) Hz (20 to 40) Hz (0.04 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (0.5 to 1) MHz	0.022 % + 4 mV 80 $\mu$ V/V + 1.5 mV 47 $\mu$ V/V + 0.6 mV 75 $\mu$ V/V + 1 mV 0.013 % + 2.5 mV 0.08 % + 16 mV 0.42 % + 40 mV 0.7 % + 80 mV	
(220 to 250) V	(15 to 40) Hz	0.026 % + 16 mV	
(220 to 1100) V	(40 to 50) Hz	80 $\mu$ V/V + 4 mV	Fluke 5700A/EP w/5725A
	(0.05 to 1) kHz	60 $\mu$ V/V + 3.5 mV	Fluke 5700A/EP
	(1 to 20) kHz (20 to 30) kHz	0.013% + 6 mV 0.036 % + 11 mV	Fluke 5700A/EP w/5725A
(220 to 750) V	(30 to 50) kHz (50 to 100) kHz	0.036 % + 11 mV 0.13 % + 45 mV	

Parameter/Range	Frequency	CMC <sup>2, 4, 6</sup> ( $\pm$ )	Comments
AC Voltage – Measure <sup>3</sup>			
(0.6 to 2.2) mV	(10 to 20) Hz (20 to 40) Hz (0.04 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (0.5 to 1) MHz	0.17 % + 1.3 $\mu$ V 0.074 % + 1.3 $\mu$ V 0.042 % + 1.3 $\mu$ V 0.081 % + 2 $\mu$ V 0.12 % + 2.5 $\mu$ V 0.23 % + 4 $\mu$ V 0.24 % + 8 $\mu$ V 0.35 % + 8 $\mu$ V	Fluke 5790A
(2.2 to 7) mV	(10 to 20) Hz (20 to 40) Hz (0.04 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (0.5 to 1) MHz	0.085 % + 1.3 $\mu$ V 0.037 % + 1.3 $\mu$ V 0.021 % + 1.3 $\mu$ V 0.04 % + 2 $\mu$ V 0.06 % + 2.5 $\mu$ V 0.12 % + 4 $\mu$ V 0.13 % + 8 $\mu$ V 0.23 % + 8 $\mu$ V	
(7 to 22) mV	(10 to 20) Hz (20 to 40) Hz (0.04 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (0.5 to 1) MHz	0.029 % + 1.3 $\mu$ V 0.019 % + 1.3 $\mu$ V 0.011 % + 1.3 $\mu$ V 0.021 % + 2 $\mu$ V 0.031 % + 2.5 $\mu$ V 0.081 % + 4 $\mu$ V 0.089 % + 8 $\mu$ V 0.17 % + 8 $\mu$ V	
(22 to 70) mV	(10 to 20) Hz (20 to 40) Hz (0.04 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (0.5 to 1) MHz	0.024 % + 1.5 $\mu$ V 0.012 % + 1.5 $\mu$ V 65 $\mu$ V/V + 1.5 $\mu$ V 0.013 % + 2 $\mu$ V 0.026 % + 2.5 $\mu$ V 0.051 % + 4 $\mu$ V 0.067 % + 8 $\mu$ V 0.11 % + 8 $\mu$ V	
(70 to 220) mV	(10 to 20) Hz (20 to 40) Hz (0.04 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (0.5 to 1) MHz	0.021 % + 1.5 $\mu$ V 85 $\mu$ V/V + 1.5 $\mu$ V 38 $\mu$ V/V + 1.5 $\mu$ V 69 $\mu$ V/V + 2 $\mu$ V 0.016 % + 2.5 $\mu$ V 0.025 % + 4 $\mu$ V 0.038 % + 8 $\mu$ V 0.1 % + 8 $\mu$ V	



Parameter/Range	Frequency	CMC <sup>2, 4, 6, 7</sup> (±)	Comments
AC Voltage – Measure <sup>3</sup> (cont)			
(220 to 700) mV	(10 to 20) Hz (20 to 40) Hz (0.04 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (0.5 to 1) MHz	0.021 % + 1.5 μV 76 μV/V + 1.5 μV 33 μV/V + 1.5 μV 51 μV/V + 2 μV 79 μV/V + 2.5 μV 0.018 % + 4 μV 0.03 % + 8 μV 0.096 % + 8 μV	Fluke 5790A
(0.7 to 2.2) V	(10 to 20) Hz (20 to 40) Hz (0.04 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (0.5 to 1) MHz	0.02 % 66 μV/V 24 μV/V 46 μV/V 71 μV/V 0.016 % 0.026 % 0.09 %	
(2.2 to 7) V	(10 to 20) Hz (20 to 40) Hz (0.04 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (0.5 to 1) MHz	0.02 % 67 μV/V 24 μV/V 48 μV/V 81 μV/V 0.019 % 0.04 % 0.12 %	
(7 to 22) V	(10 to 20) Hz (20 to 40) Hz (0.04 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (0.5 to 1) MHz	0.02 % 67 μV/V 27 μV/V 48 μV/V 81 μV/V 0.019 % 0.04 % 0.12 %	
(22 to 70) V	(10 to 20) Hz (20 to 40) Hz (0.04 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (0.5 to 1) MHz	0.02 % 68 μV/V 32 μV/V 57 μV/V 94 μV/V 0.02 % 0.041 % 0.12 %	



Parameter/Range	Frequency	CMC <sup>2, 4, 6, 7</sup> (±)	Comments
AC Voltage – Measure <sup>3</sup> (cont)			
(70 to 220) V	(10 to 20) Hz (20 to 40) Hz (0.04 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz	0.02 % 68 µV/V 31 µV/V 69 µV/V 98 µV/V 0.021 % 0.05 %	Fluke 5790A
(220 to 700) V	(10 to 20) Hz (20 to 40) Hz (0.04 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.02 % 99 µV/V 41 µV/V 0.013 % 0.05 %	
(700 to 1000) V	(10 to 20) Hz (20 to 40) Hz (0.04 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.02 % 99 µV/V 38 µV/V 0.013 % 0.05 %	
(1 to 2) kV	(20 to 100) Hz (100 to 400) Hz	0.07 % + 2 V 0.4 % + 4 V	Vitrek 4640B
(2 to 30) kV	(50 to 60) Hz	0.4 % + 45 V	
AC Current – Generate <sup>3</sup>			
(9 to 220) µA	(10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.023 % + 16 nA 0.014 % + 10 nA 0.011 % + 8 nA 0.025 % + 0.12 nA 0.09 % + 65 nA	Fluke 5700A/EP
(0.22 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	0.023 % + 40 nA 0.014 % + 35 nA 0.011 % + 35 nA 0.018 % + 110 nA 0.09 % + 650 nA	
(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	0.023 % + 400 nA 0.014 % + 350 nA 0.011 % + 350 nA 0.018 % + 550 nA 0.09 % + 5 µA	

Parameter/Range	Frequency	CMC <sup>2, 6, 7</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	0.023 % + 4 μA 0.014 % + 3.5 μA 0.011 % + 2.5 μA 0.018 % + 3.5 μA 0.09 % + 10 μA	Fluke 5700A/EP
(0.22 to 2.2) A	20 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.024 % + 35 μA 0.039 % + 80 μA 0.6 % + 160 μA	
(2.2 to 11) A	40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.04 % + 170 μA 0.085 % + 380 μA 0.33 % + 750 μA	Fluke 5700A/EP w/5725A
(11 to 20.5) A	(45 to 100) Hz 100 Hz to 1 kHz (1 to 5) kHz	0.12 % + 5 mA 0.15 % + 5 mA 3 % + 5 mA	Fluke 5520A
(20 to 1000) A	(45 to 65) Hz	0.3 %	Fluke 5520A w/5500A coil
Clamp Meters	(65 to 440) Hz	0.81 %	
AC Current – Measure <sup>3</sup>			
(2 to 200) μA 200 μA to 2 mA (2 to 20) mA (20 to 200) mA 200 mA to 2 A	10 Hz to 10 kHz 10 Hz to 10 kHz 10 Hz to 10 kHz 10 Hz to 10 kHz 10 Hz to 2 kHz (2 to 10) kHz	0.05 % + 0.02 μA 0.03 % + 0.2 μA 0.03 % + 2 μA 0.05 % + 20 μA 0.062 % + 200 μA 0.073 % + 200 μA	Fluke 8508A
(2 to 20) A	10 Hz to 2 kHz (2 to 10) kHz	0.082 % + 2 mA 0.25 % + 2 mA	
Oscilloscope – Leveled Sine Wave <sup>3</sup>			
Absolute 5 mV to 5.5 V	50 kHz reference 50 kHz to 100 MHz (100 to 300) MHz (300 to 600) MHz (600 to 1100) MHz	2 % + 300 μV 3.5 % + 300 μV 4 % + 300 μV 6 % + 300 μV 7 % + 300 μV	Fluke 5520A w/SC1100 option. CMCs do not include loading effect of UUT



Parameter/Equipment	Range	CMC <sup>2,6</sup> (±)	Comments
Oscilloscope – Leveled Sine Wave <sup>3</sup> (cont)			
Flatness (Relative to 50 kHz) 5 mV to 5.5 V	50 kHz to 100 MHz (100 to 300) MHz (300 to 600) MHz (600 to 1100) MHz	1.5 % + 100 μV 2 % + 100 μV 4 % + 100 μV 5 % + 100 μV	Fluke 5520A w/SC1100 option. CMC's do not include loading effect of UUT
Amplitude DC Signal 50 Ω load 1 MΩ load	(-6.6 to 6.6) V (-130 to 130) V	0.25 % + 40 μV 0.05 % + 40 μV	
Time Marker, 50 Ω Load	5 s to 50 ms 20 ms to 1 ns	(25 + 1000 <i>t</i> ) μs/s 2.5 μs/s	<i>t</i> is the time in seconds
Edge – Rise Time 50 Ω load	≤ 300 ps	+0 ps/-100 ps	Markers in a 5-2-1 sequence
≤ 2 MHz > 2 MHz	≤ 300 ps > 350 ps	+0 ps/-100 ps +0 ps/-100 ps	

### III. Fluid Quantities

Parameter/Equipment	Range	CMC <sup>2,7</sup> (±)	Comments
Gas Flow <sup>3</sup>	(0 to 100) slm	0.2 %	DHI molbox1/molbloccs





IV. Mechanical

Parameter/Equipment	Range	CMC <sup>2,7</sup> (±)	Comments
Torque –			
Wrenches, Screwdrivers, Watches	(15 to 200) in·ozf (4 to 1000) in·lbf (20 to 2000) ft·lbf	0.25 % 0.25 % 0.25 %	CDI 2000-610-2
Analyzers, Transducers	Up to 200 in·ozf Up to 1000 in·lbf Up to 2000 ft·lbf	0.05 % 0.05 % 0.05 %	Torque arms w/Class F weights
Pressure <sup>3</sup> –			
Gauge Pressure			
Gas	(0 to 9) psig (0.2 to 1) psig (1 to 25) psig (25 to 100) psig	$7.2 \times 10^{-4}$ psig $2.2 \times 10^{-5}$ psig 0.0013 % + $8.6 \times 10^{-6}$ psig 0.0013 % + $1.9 \times 10^{-5}$ psig	Fluke PPC4/RPM4 Ruska 2465
	(0.72 to 50) psig (5.8 to 1000) psig	0.0012 % + $1 \times 10^{-5}$ psig 0.0018 % + $1.7 \times 10^{-4}$ psig	DHI PG7601
Oil	(50 to 1000) psig (1000 to 10 000) psig	0.0022 % + $1.6 \times 10^{-5}$ psig 0.0034 % + $2.8 \times 10^{-4}$ psig	DH 5201 DH 5203
	(20 to 6000) psig (6 000 to 30 000) psig (30 000 to 40 000) psig	0.0020 % + $2.4 \times 10^{-3}$ psig 0.0035 % + $5.1 \times 10^{-3}$ psig 0.0073 % + $4.5 \times 10^{-3}$ psig	Fluke PG7302 Ruska 2450
Absolute Pressure			
Gas	(0 to 9) psia (0.2 to 1) psia (1 to 25) psia (25 to 100) psia (100 to 1000) psia	$7.2 \times 10^{-4}$ psia $2.5 \times 10^{-5}$ psia 0.0013 % + $1.2 \times 10^{-5}$ psia 0.0013 % + $2.1 \times 10^{-5}$ psia 0.0028 % + $1.7 \times 10^{-4}$ psia	Fluke PPC4/RPM4 Ruska 2465
	(0.72 to 50) psia (14.5 to 1000) psia	0.0012 % + $1.1 \times 10^{-5}$ psia 0.0018 % + $1.7 \times 10^{-4}$ psia	DHI PG7601

Parameter/Equipment	Range	CMC <sup>2,7</sup> (±)	Comments
Pressure <sup>3</sup> – (cont)			
Absolute Pressure			
Oil	(1000 to 10 000) psia (20 to 6000) psia (6 000 to 30 000) psia (30 000 to 40 000) psia	0.0034 % + 1.5 x 10 <sup>-3</sup> psia 0.0020 % + 2.8 x 10 <sup>-3</sup> psia 0.0035 % + 5.3 x 10 <sup>-3</sup> psia 0.0073 % + 4.7 x 10 <sup>-3</sup> psia	DH 5203 Fluke PG7302  Ruska 2450
Differential Pressure			
Gas	(0.018 to 5) psig	0.0013 % + 1.2 x 10 <sup>-5</sup> psig	Ruska 2465
Mass – Measure	1 mg to 0.1 g (0.1 to 5) g (5 to 20) g (20 to 50) g 100 g (200 to 300) g 500 g 1 kg 2 kg 3 kg 4 kg 5 kg (6 to 15) kg	0.04 mg 0.04 mg 0.05 mg 0.11 mg 0.36 mg 0.5 mg 3.3 mg 3.7 mg 5.6 mg 7.2 mg 9 mg 11 mg 310 mg	Mettler AT250, PM1200 and Sartorius MSE5203S, direct comparison to Class 2 masses  Mettler PM16, direct comparison to Class P masses
Force Gages <sup>3</sup>	(0 to 600) lbf	0.02 %	Class F weights



V. Thermodynamics

Parameter/Equipment	Range	CMC <sup>2,7</sup> (±)	Comments
Infrared Pyrometry <sup>3</sup> –  Measuring Equipment	(-30 to 140) °C (35 to 100) °C (100 to 200) °C (200 to 350) °C (350 to 500) °C	0.2 % + 1 °C 0.55 °C 0.79 °C 1.4 °C 1.8 °C	Isotech Venus 2140 Hart 4181
Measure	(150 to 1200) °C (600 to 2300) °C  (-50 to 1200) °C (600 to 1500) °C (1500 to 2300) °C	0.2 % + 2 °C 0.25 % + 2 °C  0.16 % + 1 °C 0.16 % + 1 °C 0.25 %	Isotech Pegasus R Mikron M390  Heitronics TRT4.82 IMPAC IS 12-TSP
Optical Pyrometry	(800 to 1100) °C (1100 to 1500) °C (1500 to 1900) °C (1900 to 2300) °C	1.8 °C 1.9 °C 2 °C 3 °C	Tungsten ribbon filament lamp
Humidity –  Measuring Equipment	11.3 %, 43.2 %, 75.3 %	1.1 % RH	Vaisala HMI41/HMP46
Measure <sup>3</sup>	(0 to 90) % RH	1.1 % RH	
Temperature –  Measuring Equipment & Measure <sup>3</sup>	(-30 to 140) °C (140 to 420) °C (420 to 660) °C	0.14 °C 0.4 °C 0.6 °C	Dry block



Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Temperature –  Measuring Equipment & Measure – (cont)	(-80 to 0) °C (0 to 300) °C  (300 to 500) °C  -196 °C  273.16 K  302.9146 K  429.7485 K  505.078 K  692.677 K  (0 to 1250) °C	0.009 °C 0.006 °C  0.011 °C  0.004 °C  0.7 mK  1.1 mK  2.1 mK  2.1 mK  3.2 mK  0.8 °C	Comparison to SPRT in liquid bath  Salt bath  Liquid nitrogen comparison  Triple point of water  Melting point of gallium  Freezing point of indium  Freezing point of tin  Freezing point of zinc  Comparison to noble metal thermocouple

#### VI. Time & Frequency

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Frequency – Counters, Generators			
Fixed Points	(5 and 10) MHz  (0.01 to 225) MHz	2 parts in 10 <sup>12</sup>  3 parts in 10 <sup>11</sup>	Fluke 910  Fluke PM6680B externally clocked to Fluke 910
Timers	6 ns to 1 x 10 <sup>6</sup> s	5.8 parts in 10 <sup>7</sup>	



Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Frequency – (cont)			
Counters, Generators <sup>3</sup>	(0.01 to 225) MHz	1 part in 10 <sup>7</sup>	Fluke PM6680B
Time Intervals, Timers	6 ns to 1 x 10 <sup>6</sup> s	6 part in 10 <sup>7</sup>	

<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> Based on using the standard at the temperature the HP 3458A was calibrated ( $t_{cal} \pm 5 \text{ }^\circ\text{C}$ ) and an auto-calibration (ACAL) was performed within the previous 24 hours ( $\pm 1 \text{ }^\circ\text{C}$  of ambient temperature). CMC is based upon 1-year specifications and is read as parts in 10<sup>6</sup> or percent output plus floor specification or as parts in 10<sup>6</sup> or percent of reading plus parts in 10<sup>6</sup> or percent of range.

<sup>5</sup> In the statement of CMC,  $L$  is the numerical value of the nominal length of the device measured in inches. In the statement of CMC,  $D$  is the numerical value of the nominal diameter of the device measured in inches.

<sup>6</sup> Based on using the standard at the temperature the Fluke 5520A was calibrated ( $t_{cal} \pm 5 \text{ }^\circ\text{C}$ ) and assuming the instrument is zeroed at least every seven days or when the ambient temperature changes more than 5 °C. For resistance, a zero calibration is performed at least every 12 hours within  $\pm 1 \text{ }^\circ\text{C}$  of use. For AC Current, CMCs are determined with LCOMP Off. CMC is based upon 1-year specifications and is read as ppm or percent output plus floor specification.

<sup>7</sup> In the statement of CMC, the value is defined as the percentage of reading.





## *Accredited Laboratory*

A2LA has accredited

### **PROCESS INSTRUMENTS INC.**

*Pittsburgh, PA*

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/NCSL 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 11<sup>th</sup> day of April 2016.

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

President and CEO  
For the Accreditation Council  
Certificate Number 1894.01  
Valid to April 30, 2018  
Revised on April 11, 2017

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