



## *Accredited Laboratory*

A2LA has accredited

**AMERICAN GAGE**

*Placentia, CA*

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 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 28<sup>th</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 4296.01  
Valid to June 30, 2017

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



SCOPE OF ACCREDITATION TO ISO/IEC 17025:2005

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CALIBRATION

Valid To: June 30, 2017

Certificate Number: 4296.01

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>2,4</sup> (±)	Comments
Calipers	Up to 60 in / 0.0005 in Up to 60 in / 0.001 in	(300 + 4.5L) μin (580 + 3L) μin	Gage blocks
Micrometers – Outside, Depth and Inside	Up to 12 in / 0.00005 in Up to 36 in / 0.0001 in Up to 72 in / 0.001 in	(31 + 6.3L) μin (58 + 7L) μin (580 + 3.4L) μin	Gage blocks
Height Gages	Up to 40 in / 0.00005 in Up to 40 in / 0.0001 in Up to 40 in / 0.0005 in  Up to 60 in / 0.001 in	(120 + 5.7L) μin (130 + 5.6L) μin (320 + 3.5L) μin  (590 + 2.9L) μin	Gage blocks
Indicators	Up to 1 in Up to 2 in Up to 10 in	46 μin 92 μin 590 μin	Gage blocks
Indicator – (Amplified)	Up to 0.002 in	3 μin	Gage blocks
Gage Block Comparators	Up to 0.0003 in x 0.1 μin Up to 0.001 in x 1 μin	2.0 μin 2.5 μin	Gage blocks

Parameter/Equipment	Range	CMC <sup>2,4</sup> (±)	Comments
Master Comparators – Meter	Up to 0.0002 in x 5 µin Up to 0.0004 in x 10 µin Up to 0.002 in x 50 µin Up to 0.004 in x 100 µin Up to 0.02 in x 500 µin	3.6 µin 6.2 µin 29 µin 58 µin 290 µin	Gage blocks
Height Master	Up to 12 in (>12 to 24) in	110 µin 170 µin	Gage blocks, amplifier
Gage blocks	(0.01 to 4) in (5 to 20) in	(3.2 + 1.8L) µin (1.2 + 2.4L) µin	Gage blocks and comparators
Ring Gages	Up to 1 in (>1 to 12) in	20 µin (18 + 3D) µin	Master comparator, gage blocks
Thread Plug Gages (60°) – Pitch Diameter Major Diameter	(0.06 to 1) in (>1 to 6) in (0.06 to 1) in (>1 to 6) in	(58 + 11D) µin (60 + 9D) µin 20 µin (18 + 3D)	P&W Supermicrometer™, thread wires, gage blocks
P& W Supermicrometer™ – Spindle Meter	1 in 0.001 in	15 µin 10 µin	Gage blocks
Thread Ring Gages (60°), Pitch Diameter	Up to 1 in (>1 to 6) in	(58 + 11D) µin (60 + 9D) µin	Comparison to thread set plugs
Plug Gages	Up to 1 in (>1 to 12) in	10 µin (7 + 3D) µin	P&W Supermicrometer™, gage blocks, universal comparator

II. Dimensional Testing/Calibration<sup>1</sup>

Parameter/Equipment	Range	CMC <sup>2,4</sup> (±)	Comments
1D – Length Measure <sup>5</sup>	Up to 72 in	(120 + 6.6L) μin	Gage blocks, amplifier

III. Electrical – DC/Low Frequency

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Electrical Simulation of Thermocouple Indicators and Indicating Systems –			
Type B	600°C to 800°C >800°C to 1000°C >1000°C to 1550°C >1550°C to 1820	0.44 °C 0.34 °C 0.30 °C 0.33 °C	Fluke 5520A
Type C	0 to 150°C >150°C to 650°C >650°C to 1000°C >1000°C to 1800°C >1800°C to 2316°C	0.30 °C 0.26 °C 0.31 °C 0.50 °C 0.84 °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	0.50 °C 0.16 °C 0.14 °C 0.16 °C 0.21 °C	
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	0.27 °C 0.16 °C 0.14 °C 0.17 °C 0.23 °C	
Type K	0 to 150°C >150°C to 650°C >650°C to 1000°C >1000°C to 1800°C >1800°C to 2316°C	0.33 °C 0.18 °C 0.16 °C 0.26 °C 0.40 °C	
Type L	-200°C to -100°C >-100°C to 800°C >800°C to 900°C	0.37 °C 0.26 °C 0.17 °C	



Parameter/Equipment	Range	CMC <sup>2,7</sup> (±)	Comments
Electrical Simulation of Thermocouple Indicators and Indicating Systems – (Cont)			
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	0.40 °C 0.22 °C 0.19 °C 0.18 °C 0.27 °C	Fluke 5520A
Type R	0°C to 250°C >250°C to 400°C >400°C to 1000°C >1000°C to 1767°C	0.57 °C 0.35 °C 0.33 °C 0.40 °C	
Type S	0°C to 250°C >250°C to 1000°C >1000°C to 1400°C >1400°C to 1767°C	0.47 °C 0.36 °C 0.37 °C 0.46 °C	
Type T	-250°C to -150°C >-150°C to 0°C >0°C to 120°C >120°C to 400°C	0.63 °C 0.24 °C 0.16 °C 0.14 °C	
Type U	-200°C to 0°C >0°C to 600°C	0.56 °C 0.27 °C	
DC Voltage – Generate	(0 to 219.99) mV 220 mV to 2.19 V (2.2 to 10.99) V (11 to 21.99) V (22 to 219.99) V (220 to 1100) V	7.5 µV/V + 0.4 µV 5 µV/V + 0.7 µV 3.5 µV/V + 2.5 µV 3.5 µV/V + 4 µV 5 µV/V + 40 µV 6.5 µV/V + 400 µV	Fluke 5720A / 5700A
DC Voltage – Measure	0 to 199.99 mV 200 mV to 1.99 V 2 to 19.99 V 20 to 199.99 V 200 to 1050 V	5.0 µV/V + 0.25 µV 3.5 µV/V + 0.4 µV 3.5 µV/V + 4 µV 5.0 µV/V + 40 µV 5.5 µV/V + 500 µV	

Parameter/Equipment	Range	CMC <sup>2,7</sup> (±)	Comments
DC Current – Generate	(0 to 219.99) $\mu$ A 220 $\mu$ A to 2.19 mA (2.2 to 21.99) mA	40 $\mu$ A/A + 6 nA 35 $\mu$ A/A + 7 nA 35 $\mu$ A/A + 40 nA	Fluke 5720A / 5700A
	(22 to 219.99) mA 220 mA to 2.2 A (2.2 to 11) A	45 $\mu$ A/A + 0.7 $\mu$ A 80 $\mu$ A/A + 12 $\mu$ A 360 $\mu$ A/A + 480 $\mu$ A	Fluke 5720A / 5725A Amplifier
	(1.1 to 2.99) A (0 to 10.99) A (11 to 20.5) A	380 $\mu$ A/A + 40 $\mu$ A 500 $\mu$ A/A + 500 $\mu$ A 1.0 mA/A + 750 $\mu$ A	Fluke 5520A
DC Current – Measure	(0 to 199.99) $\mu$ A 200 $\mu$ A to 1.99 mA (2 to 19.99) mA (20 to 199.99) mA 200 mA to 1.99 A (2 to 19.99) A	12 $\mu$ A/A + 0.0004 $\mu$ A 12 $\mu$ A/A + 0.004 $\mu$ A 14 $\mu$ A/A + 0.04 $\mu$ A 48 $\mu$ A/A + 0.8 $\mu$ A 190 $\mu$ A/A + 16 $\mu$ A 400 $\mu$ A/A + 200 $\mu$ A	Fluke 5720A / 5700A

Parameter/Equipment	Range	CMC <sup>2,7</sup> (±)	Comments	
AC Voltage – Generate	0.22 to 21.99999 mV	10 to 20 Hz >20 to 40 Hz >40 to 20 kHz >20 to 50 kHz >50 to 100 kHz >100 to 300 kHz >300 to 500 kHz >500 to 1 MHz	240 $\mu$ V/V + 4 $\mu$ V 90 $\mu$ V/V + 4 $\mu$ V 80 $\mu$ V/V + 4 $\mu$ V 200 $\mu$ V/V + 4 $\mu$ V 500 $\mu$ V/V + 5 $\mu$ V 1.1 mV/V + 10 $\mu$ V 1.4 mV/V + 20 $\mu$ V 2.7 mV/V + 20 $\mu$ V	Fluke 5720A / 5700A
	22 to 219.9999 mV	10 to 20 Hz >20 to 40 Hz >40 to 20 kHz >20 to 50 kHz >50 to 100 kHz >100 to 300 kHz >300 to 500 kHz >500 to 1 MHz	240 $\mu$ V/V + 12 $\mu$ V 90 $\mu$ V/V + 7 $\mu$ V 80 $\mu$ V/V + 7 $\mu$ V 200 $\mu$ V/V + 7 $\mu$ V 460 $\mu$ V/V + 17 $\mu$ V 900 $\mu$ V/V + 20 $\mu$ V 1.4 mV/V + 25 $\mu$ V 2.7 mV/V + 45 $\mu$ V	

Parameter/Equipment	Range	CMC <sup>2,7</sup> (±)	Comments
AC Voltage – Generate (cont)			
0.22 to 2.199999 V	10 to 20 Hz >20 to 40 Hz >40 to 20 kHz >20 to 50 kHz >50 to 100 kHz >100 to 300 kHz >300 to 500 kHz >500 to 1 MHz	240 µV/V + 40 µV 90 µV/V + 15 µV 45 µV/V + 8 µV 75 µV/V + 10 µV 110 µV/V + 30 µV 420 µV/V + 80 µV 1.0 mV/V + 200 µV 1.7 mV/V + 300 µV	Fluke 5720A / 5700A
2.2 to 21.99999 V	10 to 20 Hz >20 to 40 Hz >40 to 20 kHz >20 to 50 kHz >50 to 100 kHz >100 to 300 kHz >300 to 500 kHz >500 to 1 MHz	240 µV/V + 400 µV 90 µV/V + 150 µV 45 µV/V + 50 µV 75 µV/V + 100 µV 100 µV/V + 200 µV 280 µV/V + 600 µV 1.0 mV/V + 2000 µV 1.5 mV/V + 3200 µV	
22 to 219.9999 V	10 to 20 Hz >20 to 40 Hz >40 to 20 kHz >20 to 50 kHz >50 to 100 kHz >100 to 300 kHz >300 to 500 kHz >500 to 1 MHz	240 µV/V + 4 mV 90 µV/V + 1.5 mV 52 µV/V + 0.6 mV 80 µV/V + 1 mV 150 µV/V + 2.5 mV 900 µV/V + 16 mV 4.4 mV/V + 40 mV 8.0 mV/V + 80 mV	
220 to 1100.000 V	15 to 50 Hz >50 to 1 kHz	300 µV/V + 16 mV 70 µV/V + 3.5 mV	Fluke 5720A/5700A maximum output 250V @ (15 to 50) Hz
220 to 750.000 V	40 Hz to 1 kHz 1 to 20 kHz 20 to 30 kHz 30 to 50 kHz 50 to 100 kHz	90 µV/V + 4 mV 170 µV/V + 6 mV 600 µV/V + 11 mV 440 µV/V + 11 mV 1.6 mV/V + 45 mV	Fluke 5720A/5700A/ 5725A amplifier

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
AC Voltage – Measure			
0 to 199.9999 mV	1 Hz to 10 Hz >10 Hz to 40 Hz >40 Hz to 100 Hz >100 Hz to 2 kHz >2 kHz to 10 kHz >10 kHz to 30 kHz >30 kHz to 100 kHz	170 μV/V + 14 μV 140 μV/V + 4 μV 120 μV/V + 4 μV 110 μV/V + 2 μV 140 μV/V + 4 μV 340 μV/V + 8 μV 770 μV/V + 20 μV	Fluke 8508A
200 mV to 1.9999 V	1 Hz to 10 Hz >10 Hz to 40 Hz >40 Hz to 100 Hz >100 Hz to 2 kHz >2 kHz to 10 kHz >10 kHz to 30 kHz >30 kHz to 100 kHz >100 kHz to 300 kHz >300 kHz to 1 MHz	150 μV/V + 400 μV 120 μV/V + 20 μV 90 μV/V + 20 μV 75 μV/V + 20 μV 110 μV/V + 20 μV 220 μV/V + 40 μV 570 μV/V + 200 μV 3 mV/V + 6 mV 10 mV/V + 2 mV	
2 V to 19.999 V	1 Hz to 10 Hz >10 Hz to 40 Hz >40 Hz to 100 Hz >100 Hz to 2 kHz >2 kHz to 10 kHz >10 kHz to 30 kHz >30 kHz to 100 kHz >100 kHz to 300 kHz >300 kHz to 1 MHz	150 μV/V + 4000 μV 120 μV/V + 200 μV 90 μV/V + 200 μV 75 μV/V + 200 μV 110 μV/V + 200 μV 220 μV/V + 400 μV 570 μV/V + 2000 μV 3 mV/V + 20 mV 10 mV/V + 200 mV	
20 V to 199.99 V	1 Hz to 10 Hz >10 Hz to 40 Hz >40 Hz to 100 Hz >100 Hz to 2 kHz >2 kHz to 10 kHz >10 kHz to 30 kHz >30 kHz to 100 kHz >100 kHz to 300 kHz >300 kHz to 1 MHz	0.15 mV/V + 40 mV 0.12 mV/V + 2 mV 0.09 mV/V + 2 mV 0.075 mV/V + 2 mV 0.11 mV/V + 2 mV 0.22 μV/V + 4 mV 0.57 μV/V + 20 mV 3 mV/V + 200 mV 10 mV/V + 2000 mV	
200 V to 1050 V	@ 1 Hz to 10 Hz >10 Hz to 40 Hz >40 Hz to 10 kHz >10 kHz to 30 kHz >30 kHz to 100 kHz	0.15 mV/V + 70 mV 0.12 mV/V + 20 mV 0.12 mV/V + 20 mV 0.23 mV/V + 40 mV 0.58 mV/V + 200 mV	



Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
AC Current – Generate			Fluke 5720A
9 to 219.999 µA	@ 10 to 20Hz >20 to 40Hz >40Hz to 1 kHz >1 to 5 kHz >5 to 10kHz	250 µA/A + 16 nA 160 µA/A + 10 nA 120 µA/A + 8 nA 280 µA/A + 12 nA 1.1 mA/A + 65 nA	
220 µA to 2.19999 mA	@ 10 to 20Hz >20 to 40Hz >40Hz to 1 kHz >1 to 5 kHz >5 to 10kHz	250 µA/A + 40 nA 160 µA/A + 35 nA 120 µA/A + 35 nA 200 µA/A + 110 nA 1.1 mA/A + 650 nA	
2.2 mA to 21.9999 mA	10 to 20Hz >20 to 40Hz >40Hz to 1 kHz >1 to 5 kHz >5 to 10kHz	250 µA/A + 4 µA 160 µA/A + 3.5 µA 120 µA/A + 2.5 µA 200 µA/A + 3.5 µA 1.1 mA/A + 10 µA	
22 mA to 219.999 mA	10 to 20Hz >20 to 40Hz >40Hz to 1 kHz >1 to 5 kHz >5 to 10kHz	250 µA/A + 4 µA 160 µA/A + 3.5 µA 120 µA/A + 2.5 µA 200 µA/A + 3.5 µA 1.1 mA/A + 10 µA	
220 mA to 2.20000A	20Hz to 1kHz >1 to 5 kHz >5 to 10kHz	260 µA/A + 35 µA 450 µA/A + 80 µA 7.0 mA/A + 160 µA	Fluke 5720A / 5725A Amplifier
2.2 A to 11.0000 A	40Hz to 1kHz >1 to 5 kHz >5 to 10kHz	460 µA/A + 170 µA 950 µA/A + 380 µA 3.6 mA/A + 750 µA	Fluke 5520A (L Comp off)
29.00 to 329.99 µA	10 to 20Hz >20 to 45Hz >45Hz to 1 kHz >1 to 5 kHz >5 to 10kHz >10 to 30kHz	0.2 % + 0.1 µA 0.15 % + 0.1 µA 0.13 % + 0.1 µA 0.3 % + 0.15 µA 0.8 % + 0.2 µA 1.6 % + 0.4 µA	
0.33 to 3.2999mA	10 to 20Hz >20 to 45Hz >45Hz to 1kHz >1 to 5kHz >5 to 10kHz >10 to 30kHz	0.2 % + 0.15 µA 0.13 % + 0.15 µA 0.1 % + 0.15 µA 0.2 % + 0.2 µA 0.5 % + 0.3 µA 1.0 % + 0.6 µA	

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
AC Current – Generate (continued)			
33 to 329.99 mA	10 to 20Hz >20 to 45Hz >45Hz to 1kHz >1 to 5kHz >5 to 10kHz >10 to 30kHz >5 to 10kHz	0.18 % + 20 µA 0.09 % + 20 µA 0.04 % + 20 µA 0.10 % + 50 µA 0.2 % + 100 µA 0.4 % + 200 µA 2.5 % + 5.0 mA	Fluke 5520A (L Comp off)
0.33 to 1.09999A	@ 10 to 45Hz >45Hz to 1kHz >1 to 5kHz	0.18 % + 100 µA 0.05 % + 100 µA 0.6 % + 1,000 µA	
1.1 to 2.99999A	@ 10 to 45Hz >45Hz to 1kHz >1 to 5kHz >5 to 10kHz	0.18 % + 100 µA 0.06 % + 100 µA 0.6 % + 1,000 µA 2.5 % + 5,000 µA	
3 to 10.9999A	@ 45 to 100Hz >100Hz to 1kHz >1 to 5kHz	0.06 % + 2,000 µA 0.10 % + 2,000 µA 3.0 % + 2,000 µA	
11 to 20.5A	@ 45 to 100Hz >100Hz to 1kHz >1 to 5kHz	0.12 % + 5,000 µA 0.15 % + 5,000 µA 3.0 % + 5,000 µA	
29.00 to 329.99µA	@ 10 to 100Hz >100Hz to 1kHz	0.25 % + 0.2 µA 0.6 % + 0.5 µA	
0.33 to 3.2999mA	@ 10 to 100Hz >100Hz to 1kHz	0.25 % + 0.3 µA 0.6 % + 0.8 µA	
3.3 to 32.999mA	@ 10 to 100Hz >100Hz to 1kHz	0.08 % + 4 µA 0.2 % + 10 µA	
33 to 329.99mA	@ 10 to 100Hz >100 to 1kHz	0.08 % + 40 µA 0.2 % + 100 µA	
0.33 to 2.99999A	@ 10 to 100Hz >100 to 440Hz	0.12 % + 200 µA 0.3 % + 1000 µA	
3 to 20.5A	@ 10 to 100Hz >100Hz to 1kHz	0.12 % + 2000 µA 1.0 % + 5000 µA	

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
AC Current – Measure			
0 to 199.99 µA	1 to 10 Hz >10 Hz to 10 kHz >10 to 30 kHz >30 to 100 kHz	500 µA/A + 0.02 µA 500 µA/A + 0.02 µA 710 µA/A + 0.02 µA 4000 µA/A + 0.02 µA	Fluke 5520A (L Comp off)
200 µA to 1.9999 µA	1 to 10 Hz >10 Hz to 10 kHz >10 to 30 kHz >30 to 100 kHz	310 µA/A + 0.2 µA 300 µA/A + 0.2 µA 710 µA/A + 0.2 µA 4000 µA/A + 0.2 µA	
2 to 19.999 99mA	1 to 10 Hz >10 Hz to 10 kHz >10 to 30 kHz >30 to 100 kHz	310 µA/A + 2 µA 300 µA/A + 2 µA 710 µA/A + 2 µA 4000 µA/A + 2 µA	
20 mA to 199.99 mA	1 to 10 Hz >10 Hz to 10 kHz >10 to 30 kHz	310 µA/A + 20 µA 290 µA/A + 20 µA 630 µA/A + 20 µA	
200mA to 1.999 999A	10 Hz to 2 kHz >2 to 10 kHz >10 to 30 kHz	620 µA/A + 200 µA 740 µA/A + 200 µA 3000 µA/A + 200 µA	
2A to 19.999 99A	10 Hz to 2 kHz >2 to 10 kHz	820 µA/A + 2000 µA 2500 µA/A + 2000 µA	

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Resistance – Generate (Fixed Points)	0 Ω 1 Ω, 1.9 Ω 10 Ω, 19 Ω 100 Ω, 190 Ω 1 kΩ, 1.9 kΩ 10 kΩ, 19 kΩ 100 kΩ, 190 kΩ 1 MΩ 1.9 MΩ 10 MΩ 19 MΩ 100 MΩ	40 µΩ 95 µΩ/Ω 23 µΩ/Ω 10 µΩ/Ω 8.5 µΩ/Ω 8.5 µΩ/Ω 11 µΩ/Ω 20 µΩ/Ω 21 µΩ/Ω 40 µΩ/Ω 47 µΩ/Ω 100 µΩ/Ω	Fluke 5720A

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments	
Resistance – Generate	0 to 10.999 9 Ω 11 to 32.999 9 Ω 33 to 109.999 9 Ω 110 to 329.999 9 Ω 330Ω to 1.099 999 kΩ 1.1 to 3.299 999 kΩ 3.3 to 10.999 99 kΩ 11 to 32.999 99 Ω 33 to 109.9999 kΩ 110 to 329.999 9 kΩ 330kΩ to 1.099 999 MΩ 1.1 to 3.299 999 MΩ 3.3 to 10.999 99 MΩ 11 to 32.999 99 MΩ 33 to 109.999 9 MΩ 110 to 329.9999 MΩ 330 to 1100 MΩ	40 μΩ/Ω + 0.01 Ω 30 μΩ/Ω + 0.015 Ω 28 μΩ/Ω + 0.015 Ω 28 μΩ/Ω + 0.02 Ω 28 μΩ/Ω + 0.02 Ω 28 μΩ/Ω + 0.2 Ω 28 μΩ/Ω + 0.1 Ω 28 μΩ/Ω + 1 Ω 28 μΩ/Ω + 1 Ω 32 μΩ/Ω + 10 Ω 32 μΩ/Ω + 10 Ω 60 μΩ/Ω + 150 Ω 130 μΩ/Ω + 250 Ω 250 μΩ/Ω + 2.5 kΩ 500 μΩ/Ω + 3 kΩ 3.0 mΩ/Ω + 100 kΩ 15 mΩ/Ω + 500 kΩ	Fluke 5720A	
Resistance – Measure	0 to 1.999 9 Ω 2 to 19.999 Ω 20 to 199.999 Ω 200 Ω to 1.9999 kΩ 2 kΩ to 19.9999 kΩ 20 kΩ to 199.99 kΩ 200 kΩ to 1.999 9 MΩ 2 MΩ to 19.999 MΩ 20 MΩ to 199.99 MΩ 200 MΩ to 1.999 9 GΩ 2 GΩ to 19.999 GΩ	17 μΩ/Ω + 4 μΩ 9.5 μΩ/Ω + 28 μΩ 8.0 μΩ/Ω + 50 μΩ 8.0 μΩ/Ω + 500 μΩ 8.0 μΩ/Ω + 5 mΩ 8.0 μΩ/Ω + 50 mΩ 9.0 μΩ/Ω + 1 Ω 20 μΩ/Ω + 100 Ω 120 μΩ/Ω + 10 kΩ 1.6 mΩ/Ω + 100 kΩ 1.6 mΩ/Ω + 1 MΩ	Fluke 8508A	
Capacitance – Generate	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 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	(0.19 to 1.0999 nF (1.1 to 3.2999 nF (3.3 to 10.9999 nF (11 to 109.999 nF (110 to 329.999 nF (0.33 to 1.09999) μF (1.1 to 3.29999) μF (3.3 to 10.9999) μF (11 to 32.9999) μF (33 to 109.999) μF (110 to 329.999) μF (0.33 F to 1.09999) mF (1.1 to 3.2999) mF (3.3 to 10.9999) mF (11 to 32.9999) mF (33 to 110) mF	0.5 % + 0.01 nF 0.5 % + 0.01 nF 0.25 % + 0.01 nF 0.25 % + 0.1 nF 0.25 % + 0.3 nF 0.25 % + 1 nF 0.25 % + 3 nF 0.25 % + 10 nF 0.40 % + 30 nF 0.45 % + 10 nF 0.45 % + 300 nF 0.45 % + 1 F 0.45 % + 3 F 0.45 % + 10 F 0.75 % + 30 F 1.1 % + 100 F	Fluke 5520A



Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Phase – Generate	(1 to 65) Hz (>65 to 500) Hz >500 Hz to 1 kHz (>1 to 5) kHz (>5 to 10) kHz (>10 to 30) kHz	0.10° 0.25° 0.5° 2.5° 5° 10°	Fluke 5520A

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Electrical Calibration of RTD Indicators –			
Pt 385,100Ω	-200 °C to 0 °C >0 °C to 100 °C >100 °C to 300 °C >300 °C to 400 °C >400 °C to 630 °C >630 °C to 800 °C	0.05 °C 0.07 °C 0.09 °C 0.10 °C 0.12 °C 0.23 °C	Fluke 5520A
Pt 3926,100Ω	-200 °C to 0 °C >0 °C to 100 °C >100 °C to 300 °C >300 °C to 400 °C >400 °C to 630 °C	0.05 °C 0.07 °C 0.09 °C 0.10 °C 0.12 °C	
Pt 3916,100Ω	-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 600 °C >600 °C to 630 °C	0.25 °C 0.04 °C 0.05 °C 0.06 °C 0.07 °C 0.08 °C 0.09 °C 0.10 °C 0.23 °C	
Pt 385, 200Ω	-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	0.04 °C 0.05 °C 0.12 °C 0.13 °C 0.14 °C 0.16 °C	



Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Electrical Calibration of RTD Indicators – (cont)			
Pt 385, 500 Ω	-200 °C to -80 °C >-80 °C to 100 °C >100 °C to 260 °C >260 °C to 400 °C >400 °C to 600 °C >600 °C to 630 °C	0.04 °C 0.05 °C 0.06 °C 0.08 °C 0.09 °C 0.11 °C	Fluke 5520A
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	0.03 °C 0.04 °C 0.05 °C 0.06 °C 0.07 °C 0.23 °C	
PtNi 385,120 Ω	-80 °C to 100 °C >100 °C to 260 °C	0.08 °C 0.14 °C	
Cu 427,10 Ω	-100 °C to 260 °C	0.3 °C	



Parameter/Equipment	Range	CMC <sup>2, 7</sup> ( $\pm$ )	Comments
Oscilloscopes –			
DC Signal Into 1 M $\Omega$ load Into 50 $\Omega$ load	Up to 130 V Up to 6.6 V	0.25 % + 40 $\mu$ V 0.05 % + 40 $\mu$ V	Fluke 5520A /SC1100
Square Wave Signal Into 1 M $\Omega$ load Into 50 $\Omega$ load	1 mV to 130 Vp-p 1 mV to 6.6 Vp-p	0.1 % + 40 $\mu$ V 0.25 % + 40 $\mu$ V	$t$ = time in seconds
Square Wave Frequency		2.5 $\mu$ Hz/Hz	
Edge – Rise Time (50 $\Omega$ )	$\leq$ 300 ps	+0 ps / -100ps	
Amplitude Range (p-p) Frequency Range	5.0 mV to 2.5 V 1 kHz to 10 MHz	2 % +200 $\mu$ V 2.5 $\mu$ Hz/Hz	
Leading Edge Aberrations	<2 ns >2 to 5 ns >5 to 15 ns > 15 ns	3 % +2 mV 2 % +2 mV 1 % +2 mV 0.5 % +2 mV	
Leveled Sine Wave 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 $\mu$ V 3.5 % + 300 $\mu$ V 4 % + 300 $\mu$ V 6 % + 300 $\mu$ V	
5 mV to 3.5 V	>50 kHz to 100 MHz >100 to 300 MHz >300 to 600 MHz >600 to 1100 MHz	7 % + 300 $\mu$ V 1.5 % + 100 $\mu$ V 2 % + 100 $\mu$ V 4 % + 100 $\mu$ V	
Flatness (Relative 50 kHz)	50 kHz to 1100 MHz	5 % + 100 $\mu$ V	
Time Marker	5s to 50 ms 20 ms to 100 ns 50 ns to 20 ns 10 ns 5 ns to 1 ns	25 + $t$ *1000 $\mu$ s/s 2.5 $\mu$ s/s 2.5 $\mu$ s/s 2.5 $\mu$ s/s 2.5 $\mu$ s/s	
Wave - Square, Sine, Triangle	1.8 mV to 2.5 V p-p 1.8 mV to 55 V p-p 10 Hz to 100 Hz	3 % + 100 $\mu$ V 3 % + 100 $\mu$ V 25 $\mu$ Hz + 15 mHz	Into 50 $\Omega$ Into 1 M $\Omega$

IV. Electrical – RF/Microwave

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Tuned RF Power Absolute – Measure			
2.5 MHz to 26.5 GHz	(≤ +10 to ≥ -22) dBm (< -22 to ≥ -42) dBm (< -42 to ≥ -50) dBm (< -50 to ≥ -60) dBm (< -60 to ≥ -72) dBm (< -72 to ≥ -80) dBm (< -80 to ≥ -92) dBm (< -92 to ≥ -102) dBm (< -102 to ≥ -110) dBm (< -110 to ≥ -120) dBm (< -120 to ≥ -127) dBm	0.14 dBm 0.15 dBm 0.17 dBm 0.17 dBm 0.19 dBm 0.20 dBm 0.21 dBm 0.27 dBm 0.32 dBm 0.37 dBm 0.43 dBm	HP 8902 with 11722A or 11792A
100 kHz to 2.6 GHz	(30 to -20) dBm, 50 Ω SWR 1.15:1	0.099 dBm	HP 8902 with 11722A
50 MHz to 1.3 GHz	(30 to -20) dBm, 50 Ω SWR 1.15:1	0.12 dBm	HP 8902 with 11792A
1.3 GHz to 18 GHz	SWR 1.25:1	0.13 dBm	
18 GHz to 26.5 GHz	SWR 1.40:1	0.14 dBm	
Tuned RF Power Relative – Measure			
2.5 MHz to 26.5 GHz	(≤ +10 to ≥ +2) dB (< + 2 to ≥ -12) dB (< -12 to ≥ -22) dB (< -22 to ≥ -31) dB (< -31 to ≥ -40) dB (< -40 to ≥ -50) dB (< -50 to ≥ -61) dB (< -61 to ≥ -71) dB (< -71 to ≥ -80) dB (< -80 to ≥ -90) dB (< -90 to ≥ -100) dB (< -100 to ≥ -110) dB (< -110 to ≥ -120) dB (< -120 to ≥ -127) dB	0.081 dBm 0.070 dBm 0.081 dBm 0.081 dBm 0.093 dBm 0.10 dBm 0.11 dBm 0.12 dBm 0.15 dBm 0.16 dBm 0.16 dBm 0.20 dBm 0.22 dBm 0.34 dBm	HP 8902 with 11722A or 11792A





Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Amplitude Modulation – Measure			
Rate: 50 Hz to 10 kHz Depth 5% to 99%	(0.15 to 10) MHz (5% to < 40%) AM	0.033 % + 1 % display unit of measure	HP 8902A
	(40% to 99%) AM	0.02 % + 0.41 % display unit of measure	
Rate: 20 Hz to 10 kHz Depth 5% to 99%	(5% to < 10%) AM (10% to 99%) AM	3.5 % 3.6 %	
Rate: 50 Hz to 10 kHz Depth 5% to 99%	(10 to 1300) MHz (5% to < 10%) AM (10% to 99%) AM	1.2 % 1.2 %	
Rate: 20 Hz to 10 kHz Depth to 99%	(5% to < 10%) AM (10% to 99%) AM	3.5 % 3.5 %	
Rate: 50 Hz to 10 kHz Depth 5% to 99%	(1.3 to 26) GHz (5% to < 10%) AM (40% to 99%) AM	2.0 % 2.0 %	
Rate: 20 Hz to 10 kHz Depth 5% to 99%	(.010 to 26.5) GHz (5% to < 40%) AM	3.8 % 3.8 %	

Parameter/Equipment	Range	CMC <sup>2,6</sup> (±)	Comments
Frequency Modulation – Measure			
Rate: 20 Hz to 10 kHz, ≤40 kHz	(0.25 to 10) MHz (0 to <4) kHz Peak FM (≥ 4 to < 40) kHz Peak FM	2.3 % Reading + 1 Hz 1.2 % Reading + 1 Hz	
Rate: 50 Hz to 100 kHz, ≤400 kHz	(10 to 1300) MHz (0 to <4) kHz Peak FM (≥ 4 to < 40) kHz Peak FM (≥ 40 to < 400) kHz Peak FM	5.8 % Reading + 1 Hz 2.3 % Reading + 1 Hz 2.3 % Reading	
Rate: 20 Hz to 200 kHz, ≤400 kHz	(10 to 1300) MHz (0 to <4) kHz Peak FM (≥ 4 to < 40) kHz Peak FM (≥ 40 to < 400) kHz Peak FM	1.2 % Reading + 1 Hz 1.2 % Reading 1.2 % Reading	
Rate: 50 Hz to 100 kHz, ≤400 kHz	10 MHz to 26.5 GHz (0 to <4) kHz Peak FM (≥ 4 to < 40) kHz Peak FM (≥ 40 to < 400) kHz Peak FM	5.8 % Reading 5.8 % Reading 5.8 % Reading	
Rate: 20 Hz to 200 kHz, ≤400 kHz	10 MHz to 26.5 GHz (0 to <4) kHz Peak FM (≥ 4 to < 40) kHz Peak FM (≥ 40 to < 400) kHz Peak FM	1.2 % Reading 1.2 % Reading 1.2 % Reading	



Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
RF Attenuation – Measure			
100 kHz to 1.3 GHz	(0 to 10) dB (>10 to 20) dB (>20 to 30) dB (>30 to 40) dB (>40 to 50) dB (>50 to 60) dB (>60 to 70) dB (>70 to 80) dB (>80 to 90) dB (>90 to 100) dB (>100 to 110) dB	0.064 dB 0.068 dB 0.079 dB 0.094 dB 0.12 dB 0.14 dB 0.16 dB 0.20 dB 0.22 dB 0.24 dB 0.33 dB	HP 8902A Measuring Receiver w/ 11722A Sensor
(>1.3 to 18) GHz	(0 to 10) dB (>10 to 20) dB (>20 to 30) dB (>30 to 40) dB (>40 to 50) dB (>50 to 60) dB (>60 to 70) dB (>70 to 80) dB (>80 to 90) dB (>90 to 100) dB	0.078 dB 0.089 dB 0.090 dB 0.10 dB 0.13 dB 0.15 dB 0.17 dB 0.20 dB 0.32 dB 0.33 dB	HP 8902A Measuring Receiver w/ 11792A Sensor
(>18 to 26.5) GHz	(0 to 10) dB (>10 to 20) dB (>20 to 30) dB (>30 to 40) dB (>40 to 50) dB (>50 to 60) dB (>60 to 70) dB (>70 to 80) dB (>80 to 90) dB (>90 to 100) dB (>100 to 110) dB	0.094 dB 0.097 dB 0.10 dB 0.12 dB 0.14 dB 0.16 dB 0.17 dB 0.21 dB 0.23 dB 0.32 dB 0.34 dB	



V. Fluid Quantities

Parameter/Equipment	Range	CMC <sup>2,6</sup> (±)	Comments
Pipettes and Fluid Dispensers –			
Gravimetric Method	2 to 50 µL >50 µL to 15 mL >15 to 50 mL	0.89 % of reading 0.25 % of reading 0.4 % of reading	Laboratory Balance, Deionized Water
Photometric Method	Up to 2 µL >2 to 20 µL	0.06 µL 0.13 µL	Artel Pipette Calibration System, Reagents

VI. Mechanical

Parameter/Equipment	Range	CMC <sup>2,6</sup> (±)	Comments
Torque Wrenches and Drivers	Up to 250 lbf/ft	0.35% of reading	Torque Tester
Pressure	10 to 10,000 psig  0 – 3000 psia 3000 – 6000 psia 6000 – 10000 psia  0 to 116 psia 116 to 2330 psia	0.017 % of reading + 0.3R  0.5 psia 1.0 psia 1.7 psia  0.015 psia 0.00065 psia + 0.012 %	Pressurements M2200: R = Resolution  Ruska 7615  Ruska 7215Xi
Vacuum	(0 to 30) psia (0 to -14.6) psia	0.004 psia 0.003 psia	Ruska 7215i



## VII. Thermodynamics

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Humidity – Measure	(10 to 95) % RH	1.8 % RH	Hygrometer
Humidity – Generate	10 to 95 %RH	0.58 % RH	Thunder Scientific 2500
Temperature – Measure	-190°C to <0°C 0°C >0°C to 660°C	0.011 °C 0.007 °C 0.009 °C	Fluke 8508A/1590 and Rosemount 162C/CE (Baths, Dry Wells)
Temperature – Measuring Equipment	-60°C to 250°C	0.05 °C	Fluke 8508A/1590 and Rosemount 162C/CE (Baths, Dry Wells)

## VIII. Time & Frequency

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Frequency – Measuring Equipment	0.01 Hz to 2.000 MHz	2.5 µHz/Hz + 5 µHz	Fluke 5520A

<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> In the statement of CMC,  $L$  is the numerical value of the nominal length of the device measured in inches.  $R$  is the resolution of the unit under test.  $D$  is the numerical value of the nominal diameter of the device measured in inches.

<sup>5</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>6</sup> In the statement of CMC, a percent refers to a percentage of reading unless otherwise noted.

<sup>7</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.

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