

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

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CALIBRATION

Valid To: September 30, 2010

Certificate Number: 935.06

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
Conductivity – Measure <sup>3</sup>	111 mS 1015 µS 1408 µS	0.51 µS 0.51 µS 0.51 µS	Comparison to standard solutions
pH – Measure <sup>3</sup>	(4, 7, 10) pH unit	0.02 pH unit	Comparison to standard solutions

II. Dimensional

Parameter/Equipment	Range	CMC <sup>2, 4</sup> (±)	Comments
Calipers & Height Gages <sup>3</sup>	(0.10 to 12) in	(120 + 5L) µin	Gage blocks

Parameter/Equipment	Range	CMC <sup>2,4</sup> (±)	Comments
Micrometers <sup>3</sup> – Outside, Inside, Depth (Length only)  Resolution: 1000 µin 100 µin	(0 to 12) in (0 to 4) in	(55 + 15L) µin (34 + 15L) µin	Gage blocks
Indicators <sup>3</sup> –  Up to 1 in  (1 to 4) in	50 µin resolution 100 µin resolution  50 µin resolution 100 µin resolution	(20 + 0.6R) µin (20 + 0.3R) µin  (4L + 0.5R) µin (4L + 0.5R) µin	Indicator calibrator  Gage blocks
Cylindrical Plug Gages	(0 to 12) in	(12 + 0.34L) µin	Mahr measuring machine
Ring Gauges, Cylindrical & Tapered	(0.02 to 12) in	(11 + 1.5L) µin	Mahr measuring machine
Micrometers/Length Standards	(0 to 12) in  (8 to 54) in	(25+ 0.6L) µin  43 µin	Mahr measuring machine  M8000 Optodyne laser
Thread Ring Gages	(0.10 to 4.00) in	(43 + 10L) µin	Mahr measuring machine
Thread Plug Gages	(0 to 6) in	(20 + 6.5L) µin	Mahr measuring machine
Gage Blocks – Length	(Up to 6) in	(2.4 + 0.5L) µin	Labmaster grade 0.5 gage blocks
Optical Comparators and Visual Systems <sup>3</sup>	Up to 300 mm	150 µm	Glass scales and gage blocks

Parameter/Equipment	Range	CMC <sup>2, 4</sup> (±)	Comments
Surface Plates <sup>3</sup> – Flatness	(6 to 120) in (diagonal)	120 μin	Optodyne laser Planekator
Repeatability	(17 to 43) in (12 x 12 to 72 x 144) in	40 μin	Repeat-o-meter
Steel Rules	Up to 72 in (Up to 1800 mm)	490 μin	Optodyne laser system
Tape Measure	(0 to 12) in (1 to 25) ft	0.02 in 0.041 in	Optodyne laser system
Linear Measurement Length Masters <sup>3</sup>	Up to 20 ft	480 μin	Optodyne laser system
Master Levels	(4 to 18) in	24 μin/in	Surface plate, gage blocks, sine plate
Square and Angle Plates	(0 to 18) in	150 μin	Square checker, electronic indicator, cylindrical square
Thread Wires	(4 to 120) T.P.I.	(19 + 8D) μin	P & W labmaster
Roughness Tester <sup>3</sup>	3 μm Ra	0.090 Ra + R	Roughness Standard  R is the repeatability of the instrument
Straightness and Straight Edges	Up to 40 in	0.6R + 10 μin	Trimos Mestra gage amplifier with probe

III. Dimensional Testing

Parameter/Equipment	Range	CMC <sup>2,4</sup> (±)	Comments
Length – Straight Edges	Up to 24 in	(290 + 16L) μin	Trimos Mestra

IV. Electrical – DC/Low Frequency

Parameter/Equipment	Range	CMC <sup>2,5,6</sup> (±)	Comments
DC Voltage <sup>3</sup> – Generate	(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 1100V	12 μV/V + 0.5 μV/V 9 μV/V + 0.8 μV 4 μV/V + 3.0 μV 4 μV/V + 5.0 μV 6 μV/V + 50 μV 8 μV/V + 500 μV	Fluke 5720A
Fixed Points	1.018 V 10 V	4 μV/V 4 μV/V	Wavetek 7001
DC Voltage – Measure <sup>3</sup>	(0 to 100) mV 100 mV to 1V (1 to 10) V (10 to 100) V (100 to 1000) V	13 μV/V + 3.0 μV 17 μV/V + 0.3 μV 13 μV/V + 0.05 μV 15 μV/V + 0.3 μV 15 μV/V + 0.1 μV	HP 3458A
DC Current <sup>3</sup> – Generate	(0 to 220) μA 220 μA to 2.2 mA (2.2 to 22.0) mA 22.0 mA to 220 mA (220mA to 2.2) A 2.2A to 11A	42 μA/A + 6 nA 36 μA/A + 7 nA 37 μA/A + 40 nA 46 μA/A + 0.7 μA 82 μA/A + 12 μA 0.036 % + 480 μA	Fluke 5720A and 5725A
DC Current – Measure <sup>3</sup>	Up to 100 nA 100 nA to 1 μA (1 to 10) μA (10 to 100) μA 100 μA to 10 mA (10 to 100) mA 100 mA to 1 A	35 μA/A + 400 μA 25 μA/A + 40 μA 25 μA/A + 10 μA 25 μA/A + 5 μA 25 μA/A + 5 μA 40 μA/A + 5 μA 0.012 % + 10 μA	HP 3458A

Parameter/Equipment	Range	CMC <sup>2, 5, 6</sup> (±)	Comments
DC Current – Measure <sup>3</sup> (cont)			
High DC Current	(1 to 10) A (10 to 300) A (300 to 1000) A (1000 to 2000) A  (50 to 500) A	0.12 % of rdg 0.22 % of rdg 0.28 % of rdg 0.28 % of rdg  0.3 % of rdg	Shunt monitored w/ multimeter  Fluke 5500A w/ Fluke coil
Resistance <sup>3</sup> – Generate	Up to 11 Ω (11 to 33) Ω (33 to 110) Ω (110 to 330) Ω (0.33 to 1.1) kΩ (1.1 to 3.3) kΩ (3.3 to 11) kΩ (11 to 33) kΩ (33 to 110) kΩ (110 to 330) kΩ 330 kΩ to 1.1 MΩ (1.1 to 3.3) MΩ (3.3 to 11) MΩ (11 to 33) MΩ (33 to 110) MΩ (110 to 330) MΩ	0.12 % + 0.008 Ω 0.53 % + 0.015 Ω 0.02 % + 0.015 Ω 0.014 % + 0.015 Ω 0.017 % + 0.06 Ω 0.013 % + 0.06 Ω 0.017 % + 0.6 Ω 0.013 % + 0.6 Ω 0.02 % + 6 Ω 0.016 % + 6 Ω 0.024 % + 55 Ω 0.02 % + 55 Ω 0.076 % + 550 Ω 0.12 % + 550 Ω 0.58 % + 5.5 kΩ 0.58 % + 17 kΩ	Fluke 5500A
Resistance <sup>3</sup> – Generate, Fixed Points	(1 to 1.9) Ω (10 to 19) Ω (100 to 190) Ω (1 to 19) kΩ (100 to 190) kΩ 1 MΩ 1.9 MΩ 10 MΩ 19 MΩ 100 MΩ  1 Ω 10 kΩ (100 to 10 000) MΩ	95 μΩ/Ω 25 μΩ/Ω 11 μΩ/Ω 9 μΩ/Ω 14 μΩ/Ω 24 μΩ/Ω 25 μΩ/Ω 43 μΩ/Ω 52 μΩ/Ω 120 μΩ/Ω  6 parts in 10 <sup>6</sup> 3 parts in 10 <sup>6</sup> 0.52 %	Fluke 5720A  Fluke 742A and Toa Electronics SR-1 standard

Parameter/Equipment	Range	CMC <sup>2, 5, 6</sup> (±)	Comments
Resistance <sup>3</sup> – Measure	(0 to 10) Ω (10 to 100) Ω 100 Ω to 100 kΩ 100 k Ω to 1 MΩ (1 to 10) MΩ (10 to 100) MΩ 100 MΩ to 1 GΩ	19 μΩ/Ω + 0.06 mΩ 15 μΩ/Ω + 0.6 mΩ 13 μΩ/Ω + 0.6 mΩ 18 μΩ/Ω + 2.4 Ω 59 μΩ/Ω + 120 Ω 0.058 % + 1.2 kΩ 1.8 % + 10 kΩ	HP 3458A

Parameter/Range	Frequency	CMC <sup>2, 5</sup> (±)	Comments
DC Power <sup>3</sup> – @ 1000 V	Up to 11 A at 1000 V	0.14 % rdg + 0.45 μW	Fluke 5500A

Parameter/Equipment	Range	CMC <sup>2, 5</sup> (±)	Comments
AC Voltage – Generate Up 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 500 kHz to 1 MHz	0.022 % + 4 μV 85 μV/V + 4 μV 75 μV/V + 4 μV 0.018 % + 4 μV 0.046 % + 5 μV 0.11 % + 10 μV 0.14 % + 20 μV 0.27 % + 20 μV	Fluke 5720A
(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 500 kHz to 1 MHz	0.24 % + 4 μV 90 μV/V + 4 μV 80 μV/V + 4 μV 0.02 % + 4 μV 0.05 % + 5 μV 0.11 % + 10 μV 0.14 % + 20 μV 0.27 % + 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 500 kHz to 1 MHz	0.024 % + 12 μV 90 μV/V + 7 μV 80 μV/V + 7 μV 0.02 % + 7 μV 0.046 % + 17 μV 0.09 % + 20 μV 0.14 % + 25 μV 0.27 % + 45 μV	

Parameter/Range	Frequency	CMC <sup>2</sup> (±)	Comments
AC Voltage <sup>5</sup> – Generate (cont)			
220 mV to 2.20 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 500 kHz to 1 MHz	0.024 % + 40 μV 90 μV/V + 15 μV 45 μV/V + 8 μV 75 μV/V + 10 μV 0.11 % + 30 μV 0.042 % + 80 μV 0.1 % + 200 μV 0.17 % + 300 μV	Fluke 5720A
(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 (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz	0.024 % + 400 μV 90 μV/V + 150 μV 45 μV/V + 50 μV 75 μV/V + 100 μV 0.01 % + 200 μV 0.028 % + 600 μV 0.1 % + 2 mV 0.15 % + 3.2 mV	
(220 to 1100) V	(15 to 50) Hz 50 kHz to 1 kHz	0.03 % + 16 mV 70 μV/V + 3.5 mV	
AC Voltage <sup>3,6</sup> – Measure			
Up 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	0.03 % + 3 μV 0.02 % + 2 μV 0.03 % + 2 μV 0.12 % + 2 μV 0.58 % + 2 μV 4.6 % + 2 μV	HP 3458A
10 mV 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	80 μV/V + 0.4 mV 80 μV/V + 0.2 mV 0.02 % + 0.2 mV 0.03 % + 0.2 mV 0.09 % + 0.2 mV 0.35 % + 2 mV 1.2 % + 1 mV 1.7 % + 2 mV	
(10 to 100) V	(1 to 40) Hz 40 Hz to 1 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz 300 kHz to 1 MHz	0.02 % + 4 mV 0.02 % + 2 mV 0.04 % + 2 mV 0.14 % + 2 mV 0.46 % + 10 mV 1.7 % + 10 mV	

Parameter/Range	Frequency	CMC <sup>2</sup> (±)	Comments
AC Voltage <sup>3, 5</sup> – Measure (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	0.05 % + 40 mV 0.05 % + 20 mV 0.07 % + 20 mV 0.14 % + 20 mV 0.35 % + 20 mV	Fluke 5790A
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 500 kHz to 1 MHz	0.17 % + 1.3 μV 0.071 % + 1.3 μV 0.042 % + 1.3 μV 0.079 % + 2.0 μV 0.012 % + 2.5 μV 0.023 % + 4.0 μV 0.024 % + 8.0 μV 0.35 % + 8.0 μV	
7.0 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 500 kHz to 1 MHz	0.086 % + 1.3 μV 0.038 % + 1.3 μV 0.024 % + 1.3 μV 0.046 % + 2.0 μV 0.065 % + 2.5 μV 0.13 % + 4.0 μV 0.15 % + 8.0 μV 0.24 % + 8.0 μV	
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 500 kHz to 1 MHz	0.033 % + 1.3 μV 0.021 % + 1.3 μV 0.012 % + 1.3 μV 0.023 % + 2.0 μV 0.035 % + 2.5 μV 0.082 % + 4.0 μV 0.097 % + 8.0 μV 0.19 % + 8.0 μV	
70 mV	(9.5 to 10) Hz (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 500 kHz to 1 MHz	0.099 % + 1.8 μV 0.029 % + 1.8 μV 0.013 % + 1.8 μV 0.0071 % + 1.8 μV 0.016 % + 2.9 μV 0.031 % + 4.8 μV 0.056 % + 6.4 μV 0.080 % + 9.5 μV 0.13 % + 9.5 μV	

Parameter/Range	Frequency	CMC <sup>2</sup> (±)	Comments
AC Voltage <sup>3,5</sup> – Measure (cont)			
220 mV	(9.5 to 10) Hz (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 500 kHz to 1 MHz	0.098 % + 1.8 μV 0.025 % + 1.8 μV 0.0092 % + 1.8 μV 0.0046 % + 1.8 μV 0.011 % + 2.9 μV 0.024 % + 4.8 μV 0.035 % + 6.4 μV 0.060 % + 9.5 μV 0.12 %	Fluke 5790A
700 mV	(9.5 to 10) Hz (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 500 kHz to 1 MHz	0.091 % + 11 μV 0.024 % + 11 μV 0.0082 % + 5.3 μV 0.0042 % + 1.9 μV 0.057 % + 2.9 μV 0.011 % + 4.8 μV 0.022 % + 16 μV 0.038 % + 41 μV 0.12 % + 0.11 mV	
2.2 V	(9.5 to 10) Hz (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 500 kHz to 1 MHz	0.098 % + 10 μV 0.024 % + 10 μV 0.0078 % + 5.0 μV 0.0032 % + 1.0 μV 0.0055 % + 2.0 μV 0.010 % + 4.0 μV 0.020 % + 15 μV 0.036 % + 40 μV 0.11 % + 0.10 mV	
7.0 V	(9.5 to 10) Hz (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 500 kHz to 1 MHz	0.098 % + 0.10 mV 0.024 % + 0.10 mV 0.0078 % + 0.03 mV 0.0032 % + 0.01 mV 0.0056 % + 0.02 mV 0.011 % + 0.04 mV 0.025 % + 0.15 mV 0.048 % + 0.30 mV 0.13 % + 0.50 mV	

Parameter/Range	Frequency	CMC <sup>2</sup> (±)	Comments
AC Voltage <sup>3, 5</sup> – Measure (cont)			
22 V	(9.5 to 10) Hz	0.098 % + 0.10 mV	Fluke 5790A
	(10 to 20) Hz	0.024 % + 0.10 mV	
	(20 to 40) Hz	0.0078 % + 0.03 mV	
	40 Hz to 20 kHz	0.0033 % + 0.01 mV	
	(20 to 50) kHz	0.0056 % + 0.02 mV	
	(50 to 100) kHz	0.011 % + 0.04 mV	
	(100 to 300) kHz	0.024 % + 0.15 mV	
	(300 to 500) kHz	0.048 % + 0.30 mV	
70 V	(9.5 to 10) Hz	0.098 % + 1.0 mV	
	(10 to 20) Hz	0.024 % + 1.0 mV	
	(20 to 40) Hz	0.0078 % + 0.30 mV	
	40 Hz to 20 kHz	0.0041 % + 0.08 mV	
	(20 to 50) kHz	0.0081 % + 0.10 mV	
	(50 to 100) kHz	0.015 % + 0.50 mV	
	(100 to 300) kHz	0.032 % + 0.60 mV	
	(300 to 500) kHz	0.062 % + 0.80 mV	
220 V	(10 to 20) Hz	0.023 % + 1.0 mV	
	(20 to 40) Hz	0.0078 % + 0.30 mV	
	40 Hz to 20 kHz	0.0041 % + 0.08 mV	
	(20 to 50) kHz	0.0090 % + 0.10 mV	
	(50 to 100) kHz	0.016 % + 0.50 mV	
	(100 to 300) kHz	0.033 % + 0.60 mV	
700 V	(10 to 20) Hz	0.022 %	
	(20 to 40) Hz	0.014 %	
	40 Hz to 20 kHz	0.0099 %	
	(20 to 50) kHz	0.046 %	
1000 V	(50 to 100) kHz	0.21 %	
	(10 to 20) Hz	0.023 %	
	(20 to 40) Hz	0.014 %	
	40 Hz to 20 kHz	0.0099 %	
	(20 to 50) kHz	0.046 %	
	(50 to 100) kHz	0.21 %	

Parameter/Range	Frequency	CMC <sup>2</sup> (±)	Comments
AC Resistance <sup>3</sup> – Measure 1 Ω to 1 MΩ	12 Hz to 100 kHz	0.091 % of reading	Genrad 1689-6500
AC Current <sup>3,5</sup> – Generate Up to 220 μA  (0.22 to 2.2) mA  (2.2 to 22) mA  (22 to 220) mA  (0.22 to 2.2) A	(10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz  (10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz  (10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz  (10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz  20 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.025 % + 16 nA 0.016 % + 10 nA 0.012 % + 8 nA 0.028 % + 12 nA 0.11 % + 65 nA  0.025 % + 40 nA 0.016 % + 35 nA 0.012 % + 35 nA 0.022 % + 110 nA 0.11 % + 650 nA  0.025 % + 400 nA 0.016 % + 350 nA 0.012 % + 350 nA 0.022 % + 550 nA 0.11 % + 5 μA  0.025 % + 4 μA 0.016 % + 3.5 μA 0.012 % + 2.5 μA 0.028 % + 3.5 μA 0.11 % + 10 μA  0.026 % + 35 μA 0.044 % + 80 μA 0.7 % + 160 μA	Fluke 5720A
AC Current <sup>3,6</sup> – Measure Up to 100 μA  100 μA to 100 mA	(10 to 20) Hz (20 to 45) Hz 45 Hz to 1 kHz  (10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz	0.46 % + 0.03 μA 0.18 % + 0.03 μA 0.078 % + 0.03 μA  0.46 % + 20 μA 0.17 % + 20 μA 0.073 % + 20 μA 0.042 % + 20 μA	HP 3458A

Parameter/Range	Frequency	CMC <sup>2</sup> (±)	Comments
AC Current <sup>3, 5, 6</sup> – Measure (cont)			
100 mA to 1 A	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 Hz	0.46 % + 200 µA 0.19 % + 200 µA 0.10 % + 200 µA 0.12 % + 200 µA	HP 3458A
(110 to 550) A Up to 110 A	(45 to 65) Hz (65 to 440) Hz	0.50 % + 0.50 A 0.51 % + 0.51 A	Fluke 5500A/ 50- turn Coil
High Voltage – Measure <sup>3</sup>	(0 to 10) kV	0.52 % of rdg	CHROMA 900A
AC Power <sup>3, 5</sup> – Generate			
Up to 11 A	Up to 1000 V @ 60 Hz	0.18 % rdg + 0.16 mW 0.45 % rdg + 0.16 mW	Fluke 5500A PF = 1 PF = 0.8
Electrical Calibration of Thermocouple Indicators <sup>3</sup> –			
Type E	(-250 to -100) °C (-100 to 650) °C (650 to 1000) °C	0.56 °C 0.54 °C 0.53 °C	Fluke 5500A
Type J	(-210 to -100) °C (-100 to 760) °C (760 to 1200) °C	0.52 °C 0.51 °C 0.45 °C	
Type K	(-200 to -100) °C (-100 to 120) °C (120 to 1000) °C (1000 to 1372) °C	0.43 °C 0.48 °C 0.46 °C 0.46 °C	
Type S	(0 to 250) °C (250 to 1400) °C (1400 to 1767) °C	0.45 °C 0.47 °C 0.55 °C	
Type T	(-250 to -150) °C (-150 to 0) °C (0 to 400) °C	0.58 °C 0.59 °C 0.53 °C	

Parameter	Range	CMC <sup>2</sup> (±)	Comments
Electrical Calibration of RTD's <sup>3</sup> –			
Pt 395, 100 Ω	(-200 to 0) °C (0 to 100) °C (100 to 400) °C (400 to 630) °C (630 to 800) °C	0.05 °C 0.07 °C 0.10 °C 0.12 °C 0.23 °C	Fluke 5500A
Pt 3926, 100 Ω	(-200 to 0) °C (0 to 100) °C (100 to 400) °C (400 to 630) °C	0.05 °C 0.07 °C 0.10 °C 0.12 °C	
Pt 3916, 100 Ω	(-200 to -190) °C (-190 to 0) °C (0 to 300) °C (300 to 600) °C (600 to 630) °C	0.25 °C 0.05 °C 0.08 °C 0.10 °C 0.23 °C	
Pt 385, 200 Ω	(-200 to 100) °C (100 to 260) °C (260 to 600) °C (600 to 630) °C	0.04 °C 0.05 °C 0.14 °C 0.16 °C	
Pt 385, 500 Ω	(-200 to 100) °C (100 to 260) °C (260 to 600) °C (600 to 630) °C	0.05 °C 0.06 °C 0.09 °C 0.11 °C	
Pt 385, 1 kΩ	(-200 to 100) °C (100 to 260) °C (260 to 600) °C (600 to 630) °C	0.03 °C 0.05 °C 0.07 °C 0.23 °C	
PtNi 385, 100 Ω	(-80 to 100) °C (100 to 260) °C	0.08 °C 0.14 °C	
Cu 427, 10 Ω	(-100 to 260) °C	0.3 °C	
Inductance <sup>3</sup> – Measure and Generate	100 μH to 10 H	0.12 % of rdg	
Fixed Values	1.0 mH 10 mH 100 mH 1 H	0.054 % IV 0.065 % IV 0.059 % IV 0.075 % IV	Genrad 1482E Genrad 1482H Genrad 1482L Genrad 1482P

Parameter	Range	CMC <sup>2</sup> (±)	Comments
Capacitance <sup>3,5</sup> – Generate @ 1 kHz	(0.33 to 0.49) nF (0.50 to 1.09) nF (1.10 to 3.29) nF (3.30 to 10.9) nF (11.0 to 32.9) nF (33 to 109.9) nF (110 to 329.9) nF (0.33 to 1.09) µF (1.10 to 3.29) µF	3.3 % 1.7 % 0.93 % 0.69 % 0.64 % 0.40 % 0.40 % 0.40 % 0.51 %	Fluke 5500A
Capacitance <sup>3</sup> – Measure	1 µf to 1 mf	0.10 % IV	Genrad 1689-6500

V. Electrical – RF/Microwave

Parameter/Range	Frequency	CMC <sup>2</sup> (±)	Comments
RF Tuned Power <sup>3</sup> – (0 to -127) dB	Up to 1.3 GHz  2.5 MHz to 26.5 GHz	0.04 dB  0.72 dB	HP 8902A AR9302 HP11722A AR5068  HP 11793A, HP 11792A I2454
RF Absolute Power <sup>3</sup> – Generate  (Connector Type N) 10 MHz to 50 GHz	(-70 to -30) dB (-30 to -20) dB (-20 to -10) dB (10 to 20) dB	0.64 dB 0.06 dB 0.068 dB 1.2 % of rdg	HP 438A, 8484A, 8481A, 8487A
Amplitude Modulation <sup>3</sup> – Measure  Rate: 150 kHz to 10 MHz Depth: (5 to 99) %  Rate: 10 MHz to 1.3 GHz Depth: (5 to 99) %	50 Hz to 10 kHz 20 Hz to 10 kHz  50 Hz to 10 kHz 20 Hz to 10 kHz	4 % IV 4.6 % IV  3.6 % IV 4.6 % IV	HP 8902A

Parameter/Range	Frequency	CMC <sup>2</sup> (±)	Comments
Frequency Modulation <sup>3</sup> – Measure			
Rate: 250 kHz to 10 MHz Dev: ≤ 40 kHz	50 Hz to 10 kHz	3.1 % IV	HP 8902A
Rate: 10 MHz to 1.3 GHz Dev: ≤ 400 kHz	50 Hz to 100 kHz 20 Hz to 200 kHz	7.7 % IV 1.6 % IV	
Phase Modulation <sup>3</sup> –			
Rate: 10 MHz to 1.3 GHz	200 Hz to 20 kHz	7 % IV	HP 8902A

#### VI. Fluid Quantities

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Flow – Air	(10 to 300) ml/min 100 ml/min to 10 L/min 500 ml/min to 50 L/min	1.3 % of rdg 2.2 % of rdg 1.7 % of rdg	Bios DC-LC-1 Bios DC-MC-1 Bios DC-HC-1
Particle – Air	0.1, 0.2, 0.4 µm	100 efficiency	Comparison to standard filter
Air Velocity	Up to 80.0 MPH	2.3 % of rdg	Interactive Instruments JS 500

#### VII. Mechanical

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Indirect Verification of Rockwell Hardness Testers <sup>3</sup>	HRC: 26.09 45.57 60.87	1.0 HRC 1.0 HRC 1.0 HRC	ASTM E18-05e1

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Torque <sup>3</sup> – Measure	(0 to 25) in·lb (0 to 500) in·lb (0 to 1000) in·lb (0 to 750) ft·lb	0.92 % of rdg 0.66 % of rdg 0.68 % of rdg 0.68 % of rdg	AWS torque system MTMDP-4L
Torque Testers – Measuring Equipment	(15 to 80) in·oz 5 in·lb to 50 ft·lb (>50 to 500) ft·lb	0.23 % of rdg 0.2 % of rdg 0.14 % of rdg	Mountz wheel torque standard, calibration arms, weights
Mass	Up to 10 kg	0.0015 % of rdg	Class 1 weights and balance
Scales (Platform & Spring) & Balances <sup>3</sup>	Up to 300 kg	1.0 LSVD	Class 1 & F weights LSVD = least significant value digit
Force – Compression and Tension	(3 to 20 000) lbf (20 000 to 112 000) lbf	0.4 % of rdg 0.4 % of rdg	Load cell
Pressure Indication	(6 to 2400) psi (30 to 12 000) psi	0.0055 % of rdg 0.0070 % of rdg	Ruska 2400
Pressure <sup>3</sup>	(0 to 5) psi (-15 to 30) psi Up to 10 000 psi	0.06 % of rdg 0.10 % of rdg 0.10 % of rdg	Fluke 700P03 Fluke 71730G Fluke 700P31

#### VIII. Optical Quantities

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Optical Power – Measure <sup>3</sup>			
850 nm	(6 to -60) dB	4.9 % of rdg	Agilent 81654, 81533B, 8156A, 81532, 81551MM
1310 nm	(10 to -110) dB	4.9 % of rdg	
1550 nm	(10 to -110) dB	4.7 % of rdg	

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Optical Wavelength – Measure <sup>3</sup>	(700 to 1650) nm	3.9 % of rdg	Burleigh WA-1500
Fiber Optics Wavelength – Measuring Equipment <sup>3</sup>	(1510 to 1540) nm	1.5 parts in 10 <sup>6</sup>	NIST SRM 2517A

IX. Thermodynamics

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Humidity – Measuring Equipment <sup>3</sup>	11 % RH 33 % RH 70 % RH 97 % RH	1.6 % RH 1.7 % RH 1.4 % RH 2.0 % RH	Saturated salt solutions
Temperature – Measure <sup>3</sup>	(-50 to 350) °C	0.2 °C	Rosemont 162C
IR Temperature <sup>3</sup>	(10 to 300) °C	1.0 °C	Black Body Calibrator

X. Time & Frequency

Parameter/Range	Frequency	CMC <sup>2</sup> (±)	Comments
Frequency – Measuring Equipment <sup>3</sup>	1 MHz 10 MHz	5 × 10 <sup>-12</sup> 5 × 10 <sup>-12</sup>	HP 58503A, GPS

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

- <sup>2</sup> Calibration and Measurement Capability (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. Calibration and Measurement Capabilities 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 and  $R$  is the numerical value of the resolution of the device in micrometers,  $D$  is the numerical value of the nominal diameter of the device measured in inches.
- <sup>5</sup> The measurands stated are generated with the Fluke 5500 & 5700 series of instruments. This capability is suitable for the calibration of the devices intended to measure the stated measurand in the ranges indicated. CMCs are expressed as either a specific value that covers the full range or as a fraction of the reading plus a fixed floor specification.
- <sup>6</sup> The measurands stated are measured with the HP 3458A. This capability is suitable for the calibration of the devices intended to generate the measurand in the ranges indicated. CMCs are expressed as either a specific value that covers the full range or as a combination of the fraction of the reading/output plus a range specification.



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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 any additional program requirements in the field of calibration. 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 19th day of February 2008.

  
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Peter Meyer

President & CEO  
For the Accreditation Council  
Certificate Number 0935.06  
Valid to September 30, 2010  
Revised July 20, 2010

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