



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

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CALIBRATION

Valid to: January 31, 2017

Certificate Number: 2724.01

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory to perform the following calibrations¹:

I. Acoustical Quantities

Parameter/Range	Frequency	CMC ² (±)	Comments
Sound Level – Generate (94 to 114) dB	(125 to 1000) Hz	0.4 dB	GenRad 1986
Measure (84 to 114) dB	(50 to 2000) Hz	0.4 dB	Bruel & Kjaer 2610/ 4160

II. Chemical Quantities

Parameter/Equipment	Range	CMC ^{2,6} (±)	Comments
Conductivity	(100 to 100 000) µS	0.3 %	Standard conductivity solutions
pH	(4, 7) pH units 10 pH units	0.02 pH units 0.03 pH units	Standard buffer solutions

Parameter/Equipment	Range	CMC ² (±)	Comments
Gas Detection Equipment – Including, But Not Limited to:			
CO	0.01 % 0.006 % 0.001 %	2.5 % 3 % 7 %	Calibration gases
CO ₂	10 % 5 % 0.1 % 0.05 %	2.5 % 0.12 % 2.5 % 3 %	
CH ₄	2.5 % 1.45 % 1 %	0.076 % 5 % 0.061 %	
C ₂ H ₆	0.005 %	1.1 %	
C ₅ H ₁₂	0.35 %	0.76 %	
H	2 %	1.2 %	
H ₂ S	0.0025 % 0.0020 %	0.76 % 11 %	
O ₂	20 % 19 % 15 % 5 % 0.4 % 0.1 %	0.5 % 0.5 % 0.35 % 2.5 % 0.61 % 2.5 %	

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III. Dimensional

Parameter/Equipment	Range	CMC ^{2, 6} (\pm)	Comments
UMM, Supermic ^{TM, 10}	Up to 11.5 in	$(10 + 0.7L) \mu\text{in}$	Gage blocks
Bore Mic (Intramic)	$(0.10 \text{ to } 8.0)''$	$40 \mu\text{in} + 0.6R$	Ring gauges
Calipers ³	Up to 40 in	$20 \mu\text{in} + 0.6R$	Gage blocks
Cylindrical Square – Squareness, Straightness, Roundness	Up to 12 in	24 μin	Federal comparator 232, surface plate
Dial Indicator ³	$(0.01 \text{ to } 2) \text{ in}$	170 μin	Dial indicator checker
End Standards	Up to 50 in	$(10 + 2.0L) \mu\text{in}$	Laser measurement machine (LMM)
Feeler Gages	Up to 0.06 in	$0.1 \% \text{ IV} + 20 \mu\text{in}$	Gage blocks, or LMM and gage blocks
Height Gages	Up to 48 in	$61 \mu\text{in} + 9.6 \mu\text{in/in}$	Gage blocks, Federal comparator 232

Parameter/Equipment	Range	CMC ^{2,6} (\pm)	Comments
Micrometers ³ – Inside Outside Depth	Up to 1 in (1 to 4) in (4 to 6) in (6 to 24) in (24 to 36) in Up to 36 in Up to 12 in	11 $\mu\text{in} + 0.6R$ 26 $\mu\text{in} + 0.6R$ 37 $\mu\text{in} + 0.6R$ 85 $\mu\text{in} + 0.6R$ 120 $\mu\text{in} + 0.6R$ 12 $\mu\text{in}/\text{in} + 0.6R$ 12 $\mu\text{in}/\text{in} + 0.6R$	Gage blocks, LMM
Stage Micrometer Standard	(0.004 to 2) in	20 $\mu\text{in} + 10 \mu\text{in}/\text{in}$	LMM/Agilent 5519A Laser
Optical Comparator ³ – Length Magnification Angle	Up to 11 in 10 \times to 100 \times Up to 45 $^\circ$	100 μin 0.6R 0.033 $^\circ$	Gage blocks, magnification balls
Outside Diameter – Pins/Plugs/Balls	Up to 10 in	15 μin	Pratt & Whitney Supermic ^{TM, 8}
Protractors	Up to 90 $^\circ$	0.01 $^\circ$	Sine plate, gage blocks, cylindrical square
Paint Coat Thickness – Thin Film Shims Paint Thickness Gauge	(0.001 to 0.060) in	0.1 % IV + 20 μin 100 $\mu\text{in} + 0.6R$	LMM, gage blocks Calibrated shims
Roughness ³	(7 to 9) μin (12 to 20) μin 120 n	1.7 μin 1.6 μin 4.6 μin	Roughness standards
Ultrasonic Thickness Gauges	Up to 5 in	100 $\mu\text{in} + 0.6R$	LMM, gage blocks

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Parameter/Equipment	Range	CMC ^{2, 6} (\pm)	Comments
Rulers ³	(1 to 120) in	0.005 % IV + 0.6R	LMM
Sine Plate, Sine Bar, Fixed Points	5 in 10 in 20 in	190 μ in 160 μ in 450 μ in	Angle blocks, gage blocks, Federal comparator 232
Levels – Digital Bubble	120 in 96 in	0.25" 0.6R	Sine plate, gage blocks
Tape Measure	Up to 300 ft	0.01 % + 0.6R	LMM
Flatness ³	(2 to 6) in	3 μ in	Optical flat
Surface Plate ³	72 in \times 240 in	100 μ in	Autocollimator
Thread Rings	(Up to 1.5) in (1.5 to 4) in (4 to 6) in Minor Diameter	220 μ in 270 μ in 320 μ in 200 μ in	Master thread plugs Plain pins/plugs, bore plugs, optical comparator
Thread Wires	(4 to 80) tpi	13 μ in	LMM, Pratt & Whitney Supermic ^{TM, 8} , gage blocks
Thread Plugs	(0.1 to 4) in (4 to 80) tpi	75 μ in 75 μ in	Pratt & Whitney Supermic ^{TM, 8} , gage blocks, master thread wires
Ring Gages	(0.25 to 8.0) in	25 μ in	Pratt & Whitney Supermic ^{TM, 8} , gage blocks, master ring gages

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IV. Electrical – DC/Low Frequency

Parameter/Equipment	Range ⁴	CMC ^{2,6} (\pm)	Comments
DC Voltage ³ – Generate	(0 to 220) mV	7 μ V/V + 0.5 μ V	Fluke 5720A
	(0.22 to 2.2) V	4 μ V/V + 0.8 μ V	
	(2.2 to 11) V	3 μ V/V + 5 μ V	
	(11 to 22) V	3 μ V/V + 5 μ V	
	(22 to 220) V	4 μ V/V + 50 μ V	
	(220 to 1100) V	6 μ V/V + 0.5 mV	Fluke 732A array Fluke 732A, 752A
	10.00 V	0.5 μ V/V	
	100.0 mV	0.9 μ V/V	
	1.0 V	0.8 μ V/V	
	10.0 V	0.75 μ V/V	
100.0 V	0.8 μ V/V		
1000.0 V	0.9 μ V/V		
DC Voltage ³ – Measure	(0 to 120) mV	5 μ V/V + 1 μ V	Agilent 3458A
	(0.1 to 1.2) V	4 μ V/V + 1 μ V	
	(1.0 to 12) V	4 μ V/V + 2 μ V	
	(10 to 120) V	6 μ V/V + 30 μ V	
	(100 to 1050) V	18 μ V/V + 100 μ V	Vitretek 4670A w/ HVL-100
	(0.5 to 10) kV	0.04 % IV + 0.03 V	
(10 to 100) kV	0.075 % IV + 0.3 V		
DC Current ³ – Measure	(2 to 20) A	0.01 % IV	Fluke Y5020, HP 3458A
	(10 to 100) A	0.05 % IV	Guildline 9211A, Agilent 3458A
	(30 to 300) A	0.1 % IV	
	(12 to 120) μ A	20 μ A/A + 800 pA	Agilent 3458A
	(0.12 to 1.2) mA	20 μ A/A + 5.0 nA	
	(1.2 to 12) mA	20 μ A/A + 50 nA	
	(12 to 120) mA	35 μ A/A + 500 nA	
	(0.12 to 1.2) A	0.011 % IV + 10 μ A	



Parameter/Equipment	Range ⁴	CMC ^{2, 6} (±)	Comments
DC Current ³ – Generate	(0 to 220) μ A (0.22 to 2.2) mA (2.2 to 22) mA (22 to 220) mA (0.22 to 2.2) A (2.0 to 11) A	42 μ A/A + 7 nA 35 μ A/A + 8 nA 35 μ A/A + 50 nA 45 μ A/A + 0.8 μ A 70 μ A/A + 15 μ A 0.034 % + 480 μ A	Fluke 5720A Fluke 5720A w/ Fluke 5725A
Resistance ³ – Measure	(0.0 to 12) Ω (10 to 120) Ω (0.10 to 1.2) k Ω (1.0 to 12) k Ω (10 to 120) k Ω (0.10 to 1.2) M Ω (1.0 to 12) M Ω (10 to 120) M Ω	15 $\mu\Omega/\Omega$ + 50 $\mu\Omega$ 12 $\mu\Omega/\Omega$ + 500 $\mu\Omega$ 10 $\mu\Omega/\Omega$ + 500 $\mu\Omega$ 10 $\mu\Omega/\Omega$ + 5 m Ω 10 $\mu\Omega/\Omega$ + 50 m Ω 15 $\mu\Omega/\Omega$ + 2 Ω 50 $\mu\Omega/\Omega$ + 100 Ω 0.05 % IV + 1000 Ω	Agilent 3458A
Resistance ³ – Generate	10 000.00 Ω 1.0 Ω 1.0 Ω (Nominal) 1.9 Ω 10.0 Ω 19.0 Ω 100.0 Ω 190.0 Ω 1.0 k Ω 1.9 k Ω 10.0 k Ω 19.0 k Ω 100.0 k Ω 190.0 k Ω 1.0 M Ω 1.9 M Ω 10.0 M Ω 19.0 M Ω 100.0 M Ω	0.5 $\mu\Omega/\Omega$ 0.5 $\mu\Omega/\Omega$ 95 $\mu\Omega/\Omega$ 95 $\mu\Omega/\Omega$ 25 $\mu\Omega/\Omega$ 25 $\mu\Omega/\Omega$ 11 $\mu\Omega/\Omega$ 11 $\mu\Omega/\Omega$ 9 $\mu\Omega/\Omega$ 9 $\mu\Omega/\Omega$ 9 $\mu\Omega/\Omega$ 9 $\mu\Omega/\Omega$ 11 $\mu\Omega/\Omega$ 11 $\mu\Omega/\Omega$ 18 $\mu\Omega/\Omega$ 19 $\mu\Omega/\Omega$ 37 $\mu\Omega/\Omega$ 47 $\mu\Omega/\Omega$ 0.011 % IV	ESI SR-104 Leeds & Northrup 4210 Fluke 5720A

Parameter/Equipment	Range ⁴	CMC ² (±)	Comments
Resistance – Ratio Measurement	1:1 0.1:1 to 10:1 > 10:1 to 100:1	1.0 parts in 10 ⁶ 1.4 parts in 10 ⁶ 2.0 parts in 10 ⁶	MI 6010, MI 6000

Parameter/Range ⁴	Frequency	CMC ^{2, 6} (±)	Comments
AC Voltage ³ – Generate			
(0 to 2.2) mV	(10 to 19.99) Hz (20 to 39.99) 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	0.027 % IV + 5 μV 0.011 % IV + 5 μV 90 μV/V + 5 μV 0.023 % IV + 5 μV 0.054 % IV + 6 μV 0.12 % IV + 12 μV 0.15 % IV + 25 μV 0.31 % IV + 25 μV	Fluke 5720A
(2.0 to 22) mV	(10 to 19.99) Hz (20 to 39.99) 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	0.027 % IV + 5 μV 0.011 % IV + 5 μV 90 μV/V + 5 μV 0.023 % IV + 5 μV 0.054 % IV + 6 μV 0.12 % IV + 12 μV 0.15 % IV + 25 μV 0.31 % IV + 25 μV	
(20 to 220) mV	(10 to 19.99) Hz (20 to 39.99) 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	0.027 % IV + 50 μV 0.01 % IV + 20 μV 50 μV/V + 10 μV 90 μV/V + 12 μV 0.013 % IV + 40 μV 0.042 % IV + 100 μV 0.11 % IV + 250 μV 0.18 % IV + 400 μV	
(0.20 to 2.2) V	(10 to 19.99) Hz (20 to 39.99) 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	0.027 % IV + 500 μV 0.01 % IV + 200 μV 50 μV/V + 70 μV 90 μV/V + 120 μV 0.012 % IV + 250 μV 0.031% IV + 800 μV 0.11 % IV + 2.5 mV 0.16 % IV + 4 mV	

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Parameter/ Range ⁴	Frequency	CMC ^{2, 6} (±)	Comments
AC Voltage ³ – Generate (cont)			
(2.0 to 22) V	(10 to 19.99) Hz (20 to 39.99) 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	0.027 % IV + 5 mV 0.01 % IV + 2 mV 60 μV/V + 7 mV 0.01 % IV + 1.2 mV 0.017 % IV + 3 mV 0.1 % IV + 20 mV 0.52 % IV + 50 mV 0.9 % IV + 100 mV	Fluke 5720A
(20 to 220) V	(10 to 19.99) Hz (20 to 39.99) Hz (0.04 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.027 % IV + 5 mV 0.01 % IV + 2 mV 60 μV/V + 700 μV 0.01 % IV + 12 mV 0.017 % IV + 3 mV	
(200 to 1100) V	(0.05 to 1) kHz	80 μV/V + 4 mV	
(200 to 750) V	(30 to 50) kHz (50 to 100) kHz	0.036 % IV + 11 mV 0.13 % IV + 45 mV	Fluke 5720A w/ Fluke 5725A
(200 to 1100) V	(0.04 to 1) kHz (1 to 20) kHz (20 to 30) kHz	80 μV/V + 4 mV 0.013 % IV + 6 mV 0.036 % IV + 11 mV	
AC Voltage ^{3, 5} – Measure			
(0 to 2.2) mV	(10 to 19.99) Hz (20 to 39.99) Hz (0.040 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 % IV + 1.3 μV 0.074 % IV + 1.3 μV 0.042 % IV + 1.3 μV 0.081 % IV + 2.0 μV 0.12 % IV + 2.5 μV 0.23 % IV + 4.0 μV 0.24 % IV + 8.0 μV 0.35 % IV + 8.0 μV	Fluke 5790A
(2.2 to 7.0) mV	(10 to 19.99) Hz (20 to 39.99) Hz (0.040 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 % IV + 1.3 μV 0.037 % IV + 1.3 μV 0.021 % IV + 1.3 μV 0.04 % IV + 2.0 μV 0.06 % IV + 2.5 μV 0.12 % IV + 4.0 μV 0.13 % IV + 8.0 μV 0.23 % IV + 8.0 μV	

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Parameter/ Range ⁴	Frequency	CMC ^{2,6} (\pm)	Comments
AC Voltage ^{3,5} – Measure (cont)			
(7.0 to 22.0) mV	(10 to 19.99) Hz (20 to 39.99) Hz (0.040 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 % IV + 1.3 μ V 0.019 % IV + 1.3 μ V 0.011 % IV + 1.3 μ V 0.021 % IV + 2.0 μ V 0.031 % IV + 2.5 μ V 0.081 % IV + 4.0 μ V 0.089 % IV + 8.0 μ V 0.17 % IV + 8.0 μ V	Fluke 5790A
(22 to 70) mV	(10 to 19.99) Hz (20 to 39.99) Hz (0.040 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 % IV + 1.5 μ V 0.012 % IV + 1.5 μ V 65 μ V/V + 1.5 μ V 0.013 % IV + 2.0 μ V 0.026 % IV + 2.5 μ V 0.051 % IV + 4.0 μ V 0.067 % IV + 8.0 μ V 0.11 % IV + 8.0 μ V	
(70 to 220) mV	(10 to 19.99) Hz (20 to 39.99) Hz (0.040 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 % IV + 1.5 μ V 85 μ V/V + 1.5 μ V 38 μ V/V + 1.5 μ V 69 μ V/V + 2.0 μ V 0.016 % IV + 2.5 μ V 0.025 % IV + 4.0 μ V 0.038 % IV + 8.0 μ V 0.1 % IV + 8.0 μ V	
(220 to 700) mV	(10 to 19.99) Hz (20 to 39.99) Hz (0.040 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 % IV + 1.5 μ V 76 μ V/V + 1.5 μ V 33 μ V/V + 1.5 μ V 51 μ V/V + 2.0 μ V 79 μ V/V + 2.5 μ V 0.018 % IV + 4.0 μ V 0.03 % IV + 8.0 μ V 0.096 % IV + 8.0 μ V	
(0.7 to 2.2) V	(10 to 19.99) Hz (20 to 39.99) Hz (0.040 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 % IV 66 μ V/V 24 μ V/V 46 μ V/V 71 μ V/V 0.016 % IV 0.026 % IV 0.09 % IV	

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Parameter/ Range ⁴	Frequency	CMC ^{2,6} (±)	Comments
AC Voltage ^{3,5} – Measure (cont)			
(2.2 to 7.0) V	(10 to 19.99) Hz (20 to 39.99) Hz (0.040 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 % IV 67 μV/V 24 μV/V 48 μV/V 81 μV/V 0.019 % IV 0.04 % IV 0.12 % IV	Fluke 5790A
(70 to 220) V	(10 to 19.99) Hz (20 to 39.99) Hz (0.04 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz	0.02 % IV 68 μV/V 31 μV/V 69 μV/V 98 μV/V 0.021 % IV 0.05 % IV	
(220 to 700) V	(10 to 19.99) Hz (20 to 39.99) Hz (0.04 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.02 % IV 96 μV/V 39 μV/V 0.012 % IV 0.04 % IV	
(700 to 1000) V	(10 to 19.99) Hz (20 to 39.99) Hz (0.040 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.02 % IV 96 μV/V 37 μV/V 0.012 % IV 0.04 % IV	
(0 to 10) kV	60 Hz	0.15 % IV + 0.1 V	Vitrek 4700A w/ HVL-100
(10 to 75) kV	60 Hz	0.15 % IV + 0.6 V	

Parameter/ Range	Frequency	CMC ^{2,6} (±)	Comments
AC Current ³ – Measure			
(0 to 120) μA	(10 to 19.99) Hz (20 to 44.99) Hz (45 to 100) Hz (0.1 to 1) kHz	0.4 % IV + 30 pA 0.15 % IV + 30 pA 0.06 % IV + 30 pA 0.06 % IV + 30 pA	Agilent 3458A
(0.12 to 1.2) mA	(10 to 19.99) Hz (20 to 44.99) Hz (45 to 100) Hz (0.1 to 5) kHz	0.4 % IV + 200 pA 0.15 % IV + 200 pA 0.06 % IV + 200 pA 0.03 % IV + 200 pA	
(1.2 to 12) mA	(10 to 19.99) Hz (20 to 44.99) Hz (45 to 100) Hz (0.1 to 5) kHz	0.4 % IV + 2 μA 0.15 % IV + 2 μA 0.06 % IV + 2 μA 0.03 % IV + 2 μA	
(12 to 120) mA	(10 to 19.99) Hz (20 to 44.99) Hz (45 to 100) Hz (0.1 to 5) kHz	0.15 % IV + 20 μA 0.06 % IV + 20 μA 0.03 % IV + 20 μA 0.06 % IV + 20 μA	
(0.12 to 2.2) A	(10 to 19.99) Hz (20 to 44.99) Hz (45 to 100) Hz (0.1 to 5) kHz	0.4 % IV + 200 μA 0.16 % IV + 200 μA 0.08 % IV + 200 μA 0.1 % IV + 200 μA	
(2 to 20) A	(50 to 100) Hz 300 Hz 1 kHz 3 kHz 4 kHz 5 kHz	0.016 % IV 0.019 % IV 0.027 % IV 0.051 % IV 0.063 % IV 0.075 % IV	Fluke Y5020, HP 3458A
(20 to 1200) A	60 Hz 400 Hz	0.05 % IV 0.09 % IV	Weston 327 current transformer, Fluke Y5020, HP 3458A

Parameter/ Range	Frequency	CMC ^{2,6} (\pm)	Comments
AC Current ³ – Generate			
(0 to 220) μ A	(10 to 19.99) Hz (20 to 39.99) Hz (0.04 to 1) kHz (1 to 5) kHz (5 to 10) kHz	0.036 % IV + 2.1 μ A 0.023 % IV + 2.1 μ A 0.017 % IV + 2.1 μ A 0.042 % IV + 2.1 μ A 0.15 % IV + 2.1 μ A	Fluke 5720A
(0.2 to 2.2) mA	(10 to 19.99) Hz (20 to 39.99) Hz (0.04 to 1) kHz (1 to 5) kHz (5 to 10) kHz	0.036 % IV + 2.1 μ A 0.023 % IV + 2.1 μ A 0.017 % IV + 2.1 μ A 0.029 % IV + 2.2 μ A 0.15 % IV + 3.1 μ A	
(2.0 to 22) mA	(10 to 19.99) Hz (20 to 39.99) Hz (0.04 to 1) kHz (1 to 5) kHz (5 to 10) kHz	0.028 % IV + 0.5 μ A 0.018 % IV + 0.4 μ A 0.013 % IV + 0.4 μ A 0.022 % IV + 0.7 μ A 0.11 % IV + 6 μ A	
(20 to 220) mA	(10 to 19.99) Hz (20 to 39.99) Hz (0.04 to 1) kHz (1 to 5) kHz (5 to 10) kHz	0.028 % IV + 5 μ A 0.018 % IV + 4 μ A 0.013 % IV + 3 μ A 0.022 % IV + 4 μ A 0.11 % IV + 12 μ A	
(0.20 to 2.2) A	(0.02 to 1) kHz (1 to 5) kHz (5 to 10) kHz	0.03 % IV + 40 μ A 0.046 % IV + 100 μ A 0.7 % IV + 200 μ A	
(2.0 to 11) A	(0.04 to 1) kHz (1 to 5) kHz (5 to 10) kHz	0.04 % IV + 170 μ A 0.085 % IV + 380 μ A 0.33 % + 750 μ A	Fluke 5720A w/ Fluke 5725A
(2 to 20) A	50 to 100 Hz 300 Hz 1 kHz 3 kHz 4 kHz 5 kHz	0.016 % IV 0.019 % IV 0.027 % IV 0.051 % IV 0.063 % IV 0.075 % IV	Fluke Y5020, HP 3458A, Fluke 5725A
(20 to 100) A	60 Hz	0.05 % IV	Fluke Y5020, HP 3458A, Weston 327 CT, Vahalla 2555A

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Parameter/ Range ⁴	Frequency	CMC ^{2,6} (±)	Comments
Capacitance ³ – Generate 1000 pF (330 to 500) pF (0.5 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 (0.330 to 1.10) μF (1.1 to 3.3) μF (3.3 to 11) μF (11 to 33) μF (33 to 110) μF (110 to 330) μF (0.330 to 1.1) mF	1000 Hz (50 to 1000) Hz (50 to 400) Hz (50 to 200) Hz (50 to 100) Hz	5.0 μF/F 0.5 % IV + 10 pF 0.5 % IV + 10 pF 0.5 % IV + 10 pF 0.5 % IV + 10 pF 0.25 % IV + 100 pF 0.25 % IV + 100 pF 0.25 % IV + 300 pF 0.25 % IV + 1 nF 0.35 % IV + 3 nF 0.35 % IV + 10 nF 0.4 % IV + 30 nF 0.5 % IV + 100 nF 0.7 % IV + 300 nF 1 % IV + 300 nF	GenRad 1404A Fluke 5500A
Capacitance ³ – Measure (0.1 to 1000) pF (0 to 1) nF (1 to 10) nF (10 to 100) nF (0.1 to 1) μF (1 to 10) μF (10 to 100) μF (0.1 to 1) mF (1 to 10) mF (10 to 100) mF (0.1 to 1) F (1 to 10) F (10 to 31.8) F	1 kHz (0.050 to 2) kHz	0.01 % IV + 30 fF 0.1 % IV + 10 fF 0.1 % IV + 100 fF 0.1 % IV + 1 pF 0.1 % IV + 10 pF 0.1 % IV + 100 pF 0.1 % IV + 1 nF 0.1 % IV + 10 nF 0.1 % IV + 100 nF 0.1 % IV + 1 μF 0.1 % IV + 10 μF 0.1 % IV + 100 μF 0.1 % IV + 1 mF	GenRad 1620A Fluke PM6304C

Parameter/ Range	Frequency	CMC ^{2,6} (\pm)	Comments
Inductance ³ – Measure (0.00 to 1.00) mH (1.00 to 10) mH (10 to 100) mH (0.100 to 1.00) mH (1 to 9.9999) H (10 to 99.999) H (100 to 999.99) H	(0.050 to 2) kHz	0.1 % IV + 10 nH 0.1 % IV + 100 nH 0.1 % IV + 1 μ H 0.1 % IV + 10 μ H 0.1 % IV + 100 μ H 0.1 % IV + 1 mH 0.1 % IV + 10 mH	Fluke PM6304C
Oscilloscopes ³ – Amplitude DC – DC Signal 50 Ω Load 1 M Ω Load Amplitude – Square Wave (Peak to Peak) – 50 Ω Load Amplitude – Square Wave 1 M Ω Load – (10 to 100) Hz (0.1 to 10) kHz Leveled Sine Wave – (Into 50 Ω Load) Flatness @ 50 kHz Reference Time Marker – (Into 50 Ω Load) Edge Spec (Rise Time) Amplitude Flatness	(0 to \pm 2.2) V (0 to \pm 33) V \pm 1.8 mV to \pm 2.2 V \pm 1.8 mV to \pm 55 V (95 to 105) V 50 kHz reference 50 kHz to 100 MHz (100 to 300) MHz (300 to 600) MHz 50 kHz to 100 MHz (100 to 300) MHz (300 to 600) MHz 5 s to 50 ms 20 ms to 1 ns \leq 1000 ps 0.1 Hz to 50 kHz (0.050 to 100) MHz (100 to 250) MHz (250 to 550) MHz	0.25 % IV + 100 μ V 0.25 % IV + 100 μ V 0.25 % IV + 100 μ V 0.25 % IV + 100 μ V 1.5 % IV \pm 100 μ V 0.5 % IV \pm 100 μ V 2 % IV + 300 μ V 3.5 % IV + 300 μ V 4 % IV + 300 μ V 6 % IV + 300 μ V 1.5 % IV + 100 μ V 2 % IV + 100 μ V 4 % IV + 100 μ V (25 + 1000 <i>t</i>) μ s/s 2.5 μ s/s (+0ps / -900ps) 1.5 % IV 1.5 % IV 3 % IV 4 % IV	Fluke 5500A w/ SC600 scope option <i>t</i> is the numerical value of the time in seconds Referenced to 50 kHz

Peter Noyce

Parameter/ Range	Range	CMC ² (±)	Comments
Thermocouple Simulation – Generate and Measure			
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	Fluke 5500A
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 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	
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	

V. Fluid Quantities

Parameter/Equipment	Range	CMC ² (±)	Comments
Specific Gravity	(1.00 to 1.43) SPG	0.0011 SPG	Hydrometer set

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Parameter/Equipment	Range	CMC ^{2,6} (±)	Comments
Gas Flow	(0.3 to 100) SCFM	0.5 % IV	DHI Molbloc sonic nozzle system
	(0 to 60 000) SCCM	0.5 % IV or 0.04 SCCM	DHI Molbloc flow calibrator
Leak Rate ³	(Down to 1.0 ⁻⁸) ATM cc/s He at 21°C	6.0 % IV	Leak detector standard
Volume – Measuring Equipment (e.g. Flasks, Graduated Cylinders)	(1 to 10 000) ml	0.065 % IV	Mass comparators

VI. Mechanical

Parameter/Equipment	Range	CMC ^{2,6} (±)	Comments
Indirect Verification of Rockwell Hardness ³	HRBW: (30 to 59.9) HRBW (60 to 79.9) HRBW (80 to 100) HRBW HRC: (20 to 34.9) HRC (35 to 59.9) HRC (60 to 70) HRC	1.2 HRBW 1.5 HRBW 1.3 HRBW 0.75 HRC 0.75 HRC 0.75 HRC	Hardness blocks
Verification of Durometer Spring – Type A, A-2, B, 306L, 1600, O, OO, D0, C, PTC 411&412	(10 to 100) Duro Units	0.15D + 0.6R	Weight scale

Parameter/Equipment	Range	CMC ^{2, 6} (±)	Comments
Pressure Gages, Controllers, Transducers ³ –			
Pneumatic	(0 to 3) in (> 3 to 30) in	0.00027 in H ₂ O 0.009 % IV	Ruska 7250LP
Pneumatic	(0.2 to 1000) psig (0.2 to 1000) psia	0.005 % IV 0.005 % IV + 0.0005 psia	Ruska 2465 dead weight tester
Hydraulic	(0 to 10 000) psig (40 to 20 000) psig	0.08 % FS 0.01 % IV	Fluke 700P31DH Instruments 50316 dead weight tester
Vacuum –			
Gages	(10 to 1000) mmHg	0.005 % IV ± 0.03 mmHg	Ruska 2465 dead weight tester
Controllers & Transducers	(0.1 to 100) mmHg	0.1 % IV	MKS vacuum system
Force ³ – Tension & Compression	(0 to 1000) lbf (0 to 100 000) lbf	0.01 % IV 0.06 % IV	Dead weight Load cells
Scales and Balances ³	Up to 5 g Up to 100 g Up to 500 g Up to 5000 g Up to 26 100 g	0.023 mg 0.048 mg 0.3 mg 3.0 mg 3.0 mg	Weights or weight sets

Parameter/Equipment	Range	CMC ^{2,6} (±)	Comments
Mass ³ – Fixed Points	1 mg 2 mg 2 mg 5 mg 10 mg 20 mg 20 mg 50 mg 0.1 m 0.2 g 0.2 g 0.5 g 1 g 2 g 2 g 5 g 10 g 20 g 20 g 50 g 100 g 200 g 200 g 500 g 1000 g 2000 g 2000 g 5000 g	2.2 µg 2.2 µg 2.2 µg 2.2 µg 2.3 µg 2.3 µg 2.3 µg 2.4 µg 2.7 µg 2.7 µg 2.7 µg 2.7 µg 4.6 µg 5.4 µg 5.4 µg 7.4 µg 16 µg 20 µg 20 µg 26 µg 45 µg 0.14 mg 0.14 mg 0.16 mg 1.0 mg 1.2 mg 1.2 mg 2.4 mg	Class S mass set
	(0 to 2500) lb	0.01 % IV	Class F weights
Tachometer ³ –			
Optical Pickup	(1 to 30 000) rpm	0.012 % IV + 0.6R	Agilent 33250A
Mechanical (Contact)	(30 to 18 000) rpm	0.25 % IV	Shimpo DT 315A

Parameter/Equipment	Range	CMC ^{2,6} (±)	Comments
Torque Cell	(0 to 10 000) ft·lbf	0.11% IV	Dead weight, torque arms
Torque Arms	(5 to 120) in	0.01 in (Maximum)	Gage blocks, LMM
Torque Wrench ³	(0.2 to 6500) ft·lbf	0.5 % IV	Torque cells
Vibration – Sensitivity Measurement & Frequency Response	(20 to < 100) Hz (0.1 to 1) kHz (> 1 to 10) kHz	1.8 % IV 1.3 % IV 2.8 % IV	Bouche Labs 1000AD/2133F shaker/accelerometer system

VII. Optical Quantities

Parameter/Equipment	Range	CMC ^{2,6} (±)	Comments
Light	(2 to 500) fc	2.7 % IV	Optronic OL 220P
Step Tablets	(0.2 to 4) density unit	0.015 density unit	NIST SRM 38120C photographic step tablet
Densitometers	(0.2 to 4) density unit	0.015 density unit	

VIII. Thermodynamics

Parameter/Equipment	Range	CMC ² (±)	Comments
Dew Point	(-90 to 10) °C dp	0.25 °C dp	Thunder Scientific 3900
Temperature – Measuring Equipment			
Triple Point Cell	0.010 °C	0.00012 °C	Fluke (Hart) 5901A-G

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Parameter/Equipment	Range	CMC ² (±)	Comments
Temperature ³ – Measure	(0 to 100) °C	0.01 °C	Hart Black Stack w/ thermistor
	(0 to 250) °C	0.74 °C	Hart Scientific 5650 Type “S” thermocouple w/ Fluke 525A
	(250 to 1000) °C	0.76 °C	
	(1000 to 1400) °C	3.7 °C	
	(1400 to 1450) °C	4.1 °C	
	(-200 to 660) °C	0.016 °C	Rosemount 162CE PRT w/ Hart Scientific 1575 super thermometer
Humidity	(10 to 95) % RH	0.75 % RH	Thunder Scientific 1200 Thunder Scientific 2500
Temperature – Measuring Equipment Dry Blocks	(-40 to 140) °C	0.056 °C	Hart Scientific 9107 monitored w/ Rosemount 162CE PRT & Hart Scientific 1575
	(35 to 99) °C	0.075 °C	Hart Scientific 9122, monitored w/ Rosemount 162CE PRT & Hart Scientific 1575
	(100 to 299) °C	0.15 °C	
	(300 to 600) °C	0.46 °C	
	(600 to 1200) °C	2.7 °C	Hart Scientific 9150, monitored w/ Hart Scientific 5650 Type “S” TC & Fluke 525A ⁸
Temperature IR – Measuring Equipment Black Body	(-15 °C to 120) °C	1.0 °C	Hart Scientific 4180 IR target
	(35 to 200) °C	1.0 °C	Hart Scientific 4181 IR target
	(> 200 to 350) °C	2.0 °C	
	(> 350 to 500) °C	3.0 °C	

Parameter/Equipment	Range	CMC ² (±)	Comments
Temperature – Measuring Equipment Calibration Bath	(-40 to 102) °C	0.016 °C	Hart Scientific 7040 (oil) monitored w/ Rosemount 162CE PRT & Hart Scientific 1575
	(0.0 to 100) °C	0.01 °C	Hart Scientific 7040 (oil) monitored w/ Hart Blackstack & thermistor
	(100 to 180) °C	0.017 °C	Hart Scientific 6045 (oil) monitored w/ Rosemount 162CE PRT & Hart Scientific 1575
	(170 to 500) °C	0.023 °C	Hart Scientific 6050 (salt) monitored w/ Rosemount 162CE PRT & Hart Scientific 1575

IX. Time & Frequency

Parameter/Equipment	Range	CMC ² (±)	Comments
Stop Watches & Timers ³	(0.2 to 10 000) s	1.8 parts in 10 ⁷ + trigger error	HP 53131A
	(+10 to -10) s/day	0.05 s/day	Vibrograph TM4500
Frequency – Measuring Equipment	10 000 000 Hz	50 pHz/Hz	TrueTime XL-DC GPS receiver
	0.01 Hz to 80 MHz	2 μHz/Hz	Agilent 33250A
		10 nHz/Hz	33250A synchronized w/ GPS
	(0.1 to 3000) MHz	2 μHz/Hz	Agilent 8648C
10 nHz/Hz		8648C synchronized w/ GPS	

Parameter/Equipment	Range	CMC ² (±)	Comments
Frequency – Measure	10 MHz	100 pHz/Hz	TrueTime XL-DC GPS receiver
	0.1 Hz to 225 MHz	0.19 µHz/Hz	Agilent 53131A frequency counter
		1 nHz/Hz	53131A synchronized w/ GPS
	(0.1 to 3000) MHz	0.19 µHz/Hz	Agilent 53131A channel 3
		1 nHz/Hz	53131A synchronized w/ GPS

¹ This laboratory offers commercial calibration service and field calibration service where noted.

² 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.

³ 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.

⁴ Where ranges are not specified, the CMC stated is for the cardinal points only. This calibration performed in Absolute Measure Mode.

⁵ This calibration is performed in Absolute Measure Mode.

⁶ In the statement of CMC, percentages are to be read as percent of reading unless noted otherwise, IV is defined as the indicated value, FS is defined as full scale, L is the numerical value of the nominal length of the device measured in inches, D is the diameter of the device in inches; and R is the resolution of the unit under test.

⁷ Contact the laboratory for information on availability of service for specific gasses not listed, gasses that are not listed are not considered accredited services.

⁸ "Supermic" is a registered trade mark owned by Pratt & Whitney Measurement Systems, Inc., Connecticut U.S.A.





Accredited Laboratory

A2LA has accredited

ENERGY NORTHWEST STANDARDS LABORATORY

Richland, WA

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/NCSLI 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 26th day of February 2015.

A handwritten signature in black ink, reading "Peter Abney".

President & CEO
For the Accreditation Council
Certificate Number 2724.01
Valid to January 31, 2017

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