



SCOPE OF ACCREDITATION TO ISO/IEC 17025:2017
& ANSI/NCSL Z540-1-1994 & ANSI/NCSL Z540.3-2006

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CALIBRATION

Valid To: May 31, 2024

Certificate Number: 1022.02

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory to perform the following calibrations^{1, 9}:

I. Chemical

Parameter/Equipment	Range	CMC ^{2, 5} (±)	Comments
pH – Measuring Equipment ³	4 pH 7 pH 10 pH	0.012 pH 0.015 pH 0.021 pH	Buffer solutions
Electrolytic Conductivity – Measuring Equipment ³	10 µS/cm 100 µS/cm 1000 µS/cm 10 000 µS/cm	0.35 µS/cm 1.4 µS/cm 12 µS/cm 110 µS/cm	Conductivity solutions

II. Dimensional

Parameter/Equipment	Range	CMC ^{2, 5, 6} (±)	Comments
Angle – Measure ³	Up to 60°	5.4 arc-sec	Gage blocks, sine bar & surface plate
Bore Gages	(0.2 to 4.0) in	150 µin	Master rings

Parameter/Equipment	Range	CMC ^{2, 5, 6} ($\pm$)	Comments
Angle – Measuring Equipment ³	Up to 360°	4.7 arc-sec	Angle encoder
Vial Sensitivity	Up to 45°	5.4 arc-sec	Gage blocks w/ sine bar
	Up to 60 °	7.4 arc-sec	Gage blocks w/ sine plate
	90°	1.7 arc-sec	Cylinder square
	For Level Base Length up to 15 in	0.22 arc-sec	Gage blocks, surface plate
Gage Blocks – English	Up to 0.05 in (0.05 to 8) in	2.8 μ in 2.7 μ in + 2.1 μ in/in	Gage blocks, comparator Comparator or SuperMic, gage blocks
Gage Blocks – Metric	Up to 1 mm (1 to 25) mm (25 to 100) mm (100 to 200) mm	0.067 μ m 0.03 μ m 0.033 μ m 0.12 μ m	Gage blocks, comparator Comparator or SuperMic, gage blocks
Length Standards & Thickness Gauges	Up to 38 in (38 to 72) in	45 μ in + 1.5 μ in/in 100 μ in	Gage blocks, height gage, dial indicator, gage blocks
Foils & Shims	Up to 2 in	16 μ in	ULM
Hand Tools ³ –			
Calipers			
Outside	Up to 72 in	31 μ in + 4.9 μ in/in	Gage blocks
Step & Depth	Up to 72 in	31 μ in + 4.9 μ in/in	
Inside	Up to 1 in	42 μ in	Master ring
Digital & Dial Indicators	Up to 72 in	31 μ in + 4.9 μ in/in	Gage blocks
Micrometers			
Spindle Linearity	Up to 72 in	16 μ + 5.2 μ in/in	Gage blocks
Anvil Flatness	Up to 50 μ in	5.5 μ in	Optical flat
Parallelism	Up to 50 μ in	5.5 μ in	
Height Gages	Up to 72 in	31 μ in + 4.9 μ in/in	Gage blocks

Parameter/Equipment	Range	CMC ^{2, 4, 5, 6} (±)	Comments
Linear Displacement ³ – Measuring Equipment, LVDT	Up to 24 in	3 μin + 14 μin/in	Gage blocks
Optical Comparators ³ – Linear (X & Y) Magnification Rotational Accuracy Squareness (X to Y)	Up to 30 in 10x to 100x (0 to 360) ° Up to 10 in	83 μin + 6.2 μin/in 0.014 % 0.56 arc-sec 280 μin	Glass scales Magnification checker, spheres Spheres Precision square
Plain Diameter – Internal (Plain Rings)	(0.125 to 2.0) in (2 to 11.55) in	34 μin 34 μin	Universal super mic (USM) w/master ring Gage blocks
Plain Diameter –External (Plug Gages)	(0.125 to 11.5) in	16 μin	USM, gage blocks
Plain Diameter – External (Pin Gages)	(0.003 to 1.0) in	19 μin	Laser micrometer, master pins
Steel Tapes ³	(1 to 100) ft	0.0035 in	Steel tape, Jeweler's Loupe
Thread Wires – English Metric	Up to 0.25 in Up to 6 mm	6.3 μin 0.15 μm + 1.7 μm/mm	USM, gage blocks
Surface Plate ³ – Flatness Local Area Flatness	Up to 16 ft Diagonal Up to 0.001 in	√D x 9.2 μin 30 μin	Electronic leveling system <i>D= Surface diagonal in inches</i> Repeat-o-meter

Parameter/Equipment	Range	CMC ² (±)	Comments
1D – Measure Length	Up to 10 in	170 µin + 46 µin/in	Optical comparator
Angle	Up to 360 °	7 arc-min	
Threaded Plug Gages – Simple Pitch Diameter, English	Up to 8 in (4 to 80) TPI	76 µin	Gage blocks, thread wires & USM
Metric	Up to 300 mm (0.2 to 10) mm Pitch	1.9 µm	
Sieves & Sieve Cloths	20 µm to 26.5 mm	4.2 µm	ASTM E11 with optical comparator
Adjustable Thread Rings	(0.04 to 3.125) in (4 to 30) mm	Class X Tolerance	Set using master plug gages Class X
Gage Amplifier & Probe(s) Single Probe	Up to 0.025 in	8.3 µin + 0.8 µin/in	Gage blocks
Dual Probe	Up to 0.002 in	8.3 µin + 1.1 µin/in	

III. Electrical – DC/Low Frequency

Parameter/Equipment	Range	CMC ^{2, 6, 7} (±)	Comments
DC Voltage – Generate ³	(0 to 220) mV (0.22 to 2.2) V (2.2 to 11) V (11 to 22) V (22 to 220) V (220 to 1100) V	0.68 µV + 7 µV/V 1 µV + 6.2 µV/V 3.4 µV + 6.2 µV/V 6.4 µV + 6.2 µV/V 79 µV + 7 µV/V 0.48 mV + 9 µV/V	Fluke 5700A w/wideband option
DC Voltage – Generate, Fixed Points	1 V 1.018 V 10 V	4.5 µV/V 4.2 µV/V 1.6 µV/V	Fluke 732A

Parameter/Equipment	Range	CMC ^{2, 4, 6, 7} ($\pm$)	Comments
DC Voltage – Measure ³	(0 to 1) mV (1 to 10) mV	25 nV + 52 μ V/V 0.41 μ V + 53 μ V/V	Agilent 34420A
	(0 to 100) mV (0.1 to 1) V (1 to 10) V (10 to 100) V (100 to 1000) V	0.33 μ V + 17 μ V/V 0.52 μ V + 8 μ V/V 8.8 μ V + 8.1 μ V/V 35 μ V + 10 μ V/V 1.2 mV + 11 μ V/V	Agilent 3458A
DC High Voltage ³ – Generate	(1 to 10) kV (10 to 35) kV (35 to 40) kV	0.04 % 0.042 % 0.062 %	Vitretek 4700 w/HVP-35 w/HVL-100
Measure	(1 to 10) kV (10 to 35) kV (35 to 100) kV	0.04 % 0.042 % 0.063 %	Vitretek 4700 w/HVP-35 w/HVL-100
Generate & Measure	(1 to 2) kV (2 to 20) kV	0.95 V + 0.45 mV/V 5.7 V + 0.46 mV/V	Vitretek 4620A
DC Current – Generate ³	0.1 nA 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 (2.2 to 11) A	7.8 nA + 47 μ A/A 8 nA + 46 μ A/A 78 nA + 47 μ A/A 0.8 μ A + 62 μ A/A 23 μ A + 0.11 mA/A 0.38 mA + 0.28 mA/A	Fluke 5700A w/ 5725A
Clamp Meter	(11 to 20.5) A	9.1 mA + 0.78 mA/A	Fluke 5520A
	(10 to 666) A	0.05 %	Agilent 3458A w/ ram shunts
	(10 to 16.5) A (16.5 to 150) A (150 to 1025) A	50 mA + 6.5 mA/A 0.18 A + 3.4 mA/A 0.83 A + 3.3 mA/A	Fluke 5520A w/ 5500A/coil
DC Current – Measure ³	Up to 2 nA (2 to 20) nA (20 to 200) nA (0.2 to 2) μ A (2 to 20) μ A (20 to 200) μ A (0.2 to 2) mA	0.51 pA + 3 mA/A 7.1 pA + 2.1 mA/A 51 pA + 1.6 mA/A 0.51 nA + 1.6 mA/A 4.1 nA + 1.1 mA/A 41 nA + 1 mA/A 0.41 μ A + 0.99 mA/A	Keithley 487

Parameter/Equipment	Range	CMC ^{2, 4, 6, 7} ($\pm$)	Comments
DC Current – Measure ³ (cont)	(0 to 100) nA (0.1 to 1) μ A (1 to 10) μ A (10 to 100) μ A (0.1 to 1) mA (1 to 10) mA (10 to 100) mA (0.1 to 1) A	41 pA + 89 μ A/A 70 pA + 21 μ A/A 0.7 nA + 18 μ A/A 5.8 nA + 9.2 μ A/A 58 nA + 9.7 μ A/A 0.58 μ A + 8 μ A/A 5.8 μ A + 17 μ A/A 59 μ A + 81 μ A/A	Agilent 3458A
	(1 to 2) A (2 to 20) A	12 μ A + 0.18 mA/A 0.33 mA + 0.39 mA/A	8508A
	(10 to 666) A	0.05 %	Agilent 3458A w/ ram shunts
DC Resistance – Generate, Fixed Points ³	1 m Ω 10 m Ω 100 m Ω 1 Ω 10 Ω 100 Ω 1 k Ω 10 k Ω 100 k Ω	81 $\mu\Omega/\Omega$ 81 $\mu\Omega/\Omega$ 81 $\mu\Omega/\Omega$ 81 $\mu\Omega/\Omega$ 81 $\mu\Omega/\Omega$ 81 $\mu\Omega/\Omega$ 81 $\mu\Omega/\Omega$ 81 $\mu\Omega/\Omega$ 81 $\mu\Omega/\Omega$	Fluke 742A, L&N, & IET standard resistors
	0 Ω 1 Ω 1.9 Ω 10 Ω 19 Ω 100 Ω 190 Ω 1 k Ω 1.9 k Ω 10 k Ω 19 k Ω 100 k Ω 190 k Ω 1 M Ω 1.9 M Ω 10 M Ω 19 M Ω 100 M Ω	39 $\mu\Omega$ 86 $\mu\Omega$ 0.16 m Ω 0.26 m Ω 0.46 m Ω 1.6 m Ω 3 m Ω 12 m Ω 22 m Ω 0.11 Ω 0.21 Ω 1.2 Ω 2.4 Ω 18 Ω 35 Ω 0.36 k Ω 0.81 k Ω 39 k Ω	Fluke 5700A
	100 M Ω 1 G Ω 10 G Ω 100 G Ω 1 T Ω	8.1 k Ω 0.28 M Ω 16 M Ω 0.91 G Ω 12 G Ω	IET VRS-100-5- 100M-BP

Parameter/Range	Frequency	CMC ^{2, 6, 7} (±)	Comments
AC Voltage – Generate ³			
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 (0.5 to 1) MHz	3.9 µV + 0.47 mV/V 3.9 µV + 0.19 mV/V 3.9 µV + 93 µV/V 3.9 µV + 0.32 mV/V 6.2 µV + 0.74 mV/V 12 µV + 1 mV/V 23 µV + 1.4 mV/V 31 µV + 3.7 mV/V	Fluke 5700A/5725A w/wideband option
(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 (0.5 to 1) MHz	5.7 µV + 0.47 mV/V 5.1 µV + 0.19 mV/V 4.9 µV + 93 µV/V 5.4 µV + 0.32 mV/V 7.9 µV + 0.74 mV/V 14 µV + 1 mV/V 27 µV + 1.4 mV/V 40 µV + 3.7 mV/V	
(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 (0.5 to 1) MHz	23 µV + 0.47 mV/V 12 µV + 0.19 mV/V 9.7 µV + 85 µV/V 14 µV + 0.28 mV/V 39 µV + 0.7 mV/V 43 µV + 0.85 mV/V 63 µV + 1.4 mV/V 0.14 mV + 2.8 mV/V	
(0.22 to 2.2) 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 (0.5 to 1) MHz	0.18 mV + 0.47 mV/V 55 µV + 0.14 mV/V 38 µV + 66 µV/V 40 µV + 0.11 mV/V 0.11 mV + 0.22 mV/V 0.2 mV + 0.37 mV/V 0.65 mV + 0.88 mV/V 1.2 mV + 1.9 mV/V	
(2.2 to 22) 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 (0.5 to 1) MHz	1.8 mV + 0.47 mV/V 0.55 mV + 0.14 mV/V 0.21 mV + 66 µV/V 0.4 mV + 0.11 mV/V 0.79 mV + 0.22 mV/V 2.4 mV + 0.47 mV/V 6.3 mV + 1.1 mV/V 12 mV + 2.3 mV/V	

Parameter/Range	Frequency	CMC ^{2, 4, 6, 7} ($\pm$)	Comments
AC Voltage – Generate ³ (cont)			
Amplitude Flatness Up to 1.1 mV (1.1 to 3) mV (3 to 11) mV (11 to 33) mV (33 to 110) mV (110 to 330) mV (0.33 to 1.1) V (1.1 to 3.5) V	30 Hz to 500 kHz	2.2 μ V + 6.2 mV/V 8.4 μ V + 5.4 mV/V 23 μ V + 5.4 mV/V 68 μ V + 4.7 mV/V 0.19 mV + 4.7 mV/V 0.51 mV + 3.9 mV/V 1.6 mV + 3.9 mV/V 3.8 mV + 3.1 mV/V	Fluke 5700A/5725A w/wideband option
Referenced to 1 kHz Up to 1.1 mV	(10 to 30) Hz 30 Hz to 120 kHz 120 kHz to 2 MHz (2 to 10) MHz (10 to 20) MHz (20 to 30) MHz	1.3 μ V + 2.3 mV/V 0.44 μ V + 0.76 mV/V 3.2 μ V + 1.6 mV/V 4 μ V + 3.1 mV/V 4.9 μ V + 4.7 mV/V 18 μ V + 12 mV/V	
(1.1 to 3) mV	(10 to 30) Hz 30 Hz to 120 kHz 120 kHz to 2 MHz (2 to 10) MHz (10 to 20) MHz (20 to 30) MHz	2.6 μ V + 2.3 mV/V 0.86 μ V + 0.77 mV/V 3.2 μ V + 0.77 mV/V 4.9 μ V + 2.3 mV/V 6.6 μ V + 3.9 mV/V 15 μ V + 12 mV/V	
≥ 3 mV	(10 to 30) Hz 30 Hz to 120 kHz 120 kHz to 2 MHz (2 to 10) MHz (10 to 20) MHz (20 to 30) MHz	0.23 % 0.078 % 3 μ V + 0.078 % 3 μ V + 0.16 % 3 μ V + 0.31 % 3 μ V + 0.78 %	
(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 (0.5 to 1) MHz	18 mV + 0.47 mV/V 5.5 mV + 0.14 mV/V 2.4 mV + 70 μ V/V 7.7 mV + 0.19 mV/V 18 mV + 0.47 mV/V 0.11 V + 1.2 mV/V 0.18 V + 4.2 mV/V 0.39 V + 10 mV/V	
(220 to 1100) V	(15 to 50) Hz** 50 Hz to 1 kHz (1 to 20) kHz (20 to 30) kHz	95 mV + 0.36 mV/V 19 mV + 70 μ V/V 36 mV + 0.13 mV/V 0.11 V + 0.46 mV/V	
(220 to 750) V	(30 to 50) kHz (50 to 100) kHz	0.11 V + 0.46 mV/V 0.43 V + 1.8 mV/V	

Parameter/Range	Frequency	CMC ^{2, 6, 7} ($\pm$)	Comments
AC Voltage – Measure ³			Agilent 3458A
(0.1 to 10) mV	(1 to 40) Hz	0.0061 mV + 0.0003 mV/mV	
	40 Hz to 1 kHz	0.0041 mV + 0.0002 mV/mV	
	(1 to 20) kHz	0.0042 mV + 0.0003 mV/mV	
	(20 to 50) kHz	0.0049 mV + 0.001 mV/mV	
	(50 to 100) kHz	0.009 mV + 0.005 mV/mV	
	(100 to 300) kHz	0.045 mV + 0.04 mV/mV	
(10 to 100) mV	(1 to 40) Hz	0.012 mV + 0.000 07 mV/mV	
	40 Hz to 1 kHz	0.0027 mV + 0.000 07 mV/mV	
	(1 to 20) kHz	0.011 mV + 0.000 14 mV/mV	
	(20 to 50) kHz	0.012 mV + 0.0003 mV/mV	
	(50 to 100) kHz	0.017 mV + 0.0008 mV/mV	
	(100 to 300) kHz	0.047 mV + 0.003 mV/mV	
	(0.3 to 1) MHz	0.12 mV + 0.01 mV/mV	
100 mV to 1 V	(1 to 40) Hz	0.000 12 V + 0.000 07 V/V	
	40 Hz to 1 kHz	0.0001 V + 0.000 07 V/V	
	(1 to 20) kHz	0.000 11 V + 0.000 14 V/V	
	(20 to 50) kHz	0.000 12 V + 0.0003 V/V	
	(50 to 100) kHz	0.000 17 V + 0.0008 V/V	
	(100 to 300) kHz	0.000 47 V + 0.003 V/V	
	(0.3 to 1) MHz	0.0012 V + 0.010 013 V/V	
(1 to 10) V	(1 to 40) Hz	0.0012 V + 0.000 07 V/V	
	40 Hz to 1 kHz	0.001 V + 0.000 07 V/V	
	(1 to 20) kHz	0.001 V + 0.000 14 V/V	
	(20 to 50) kHz	0.0012 V + 0.0003 V/V	
	(50 to 100) kHz	0.0017 V + 0.0008 V/V	
	(100 to 300) kHz	0.0047 V + 0.003 V/V	
	(0.3 to 1) MHz	0.012 V + 0.01 V/V	
(10 to 100) V	(1 to 40) Hz	0.013 V + 0.0002 V/V	
	40 Hz to 1 kHz	0.011 V + 0.0002 V/V	
	(1 to 20) kHz	0.011 V + 0.0002 V/V	
	(20 to 50) kHz	0.013 V + 0.000 35 V/V	
	(50 to 100) kHz	0.021 V + 0.0012 V/V	
	(100 to 300) kHz	0.057 V + 0.004 V/V	
	(0.3 to 1) MHz	0.17 V + 0.015 V/V	
(100 to 1000) V	(1 to 40) Hz	0.098 V + 0.0004 V/V	
	40 Hz to 1 kHz	0.084 V + 0.0004 V/V	
	(1 to 20) kHz	0.098 V + 0.0006 V/V	
	(20 to 50) kHz	0.14 V + 0.0012 V/V	
	(50 to 100) kHz	0.27 V + 0.003 V/V	

Parameter/Range	Frequency	CMC ^{2, 4, 6, 7} (±)	Comments
AC High Voltage ³ – Generate (1 to 10) kV (10 to 20) kV Measure (1 to 10) kV (10 to 35) kV (35 to 70) kV Generate & Measure (1 to 2) kV (2 to 20) kV	60 Hz 50/60 Hz (20 to 100) Hz (100 to 400) Hz (20 to 100) Hz	0.16 % 0.12 % 0.16 % 0.12 % 0.12 % 3.1 V + 0.81 mV/V 9.3 V + 4.6 mV/V 28 V + 2.3 mV/V	Vitretek 4700 w/HVP-35 Vitretek 4700 w/HVP-35 w/HVL-100 Vitretek 4620A
AC Flatness – Measure, Fixed Points	10 Hz 100 Hz 10 kHz 30 kHz 100 kHz 300 kHz 1 MHz 2 MHz 10 MHz 20 MHz 30 MHz 50 MHz 100 MHz	0.096 % 0.096 % 0.096 % 0.096 % 0.096 % 0.096 % 0.096 % 0.099 % 0.14 % 0.23 % 0.32 % 0.67 % 1.8 %	EL-1100 thermal voltage converter
AC High Voltage – Measure ³ Up to 1.4 kV (1.4 to 35) kV (35 to 75) kV	Up to 600 Hz Up to 30 Hz (30 to 200) Hz (200 to 450) Hz (450 to 600) Hz Up to 30 Hz (30 to 70) Hz (70 to 200) Hz (200 to 450) Hz	0.12 % + 13 mV 0.59 % + 0.13 V 0.12 % + 0.13 V 0.71 % + 0.13 V 1.5 % + 0.13 V 0.35 % + 1.3 V 0.14 % + 1.3 V 1.2 % + 1.3 V 18 % + 1.3 V	Vitretek 4700 w/ HVL- 100 & HVP-35

Parameter/Range	Frequency	CMC ^{2, 6, 7} ($\pm$)	Comments
AC Current – Generate ³			
(0 to 220) μ A	(10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (10 to 30) kHz	66 nA + 0.5 mA/A 23 nA + 0.33 mA/A 17 nA + 0.12 mA/A 45 nA + 0.54 mA/A 93 nA + 1.4 mA/A 0.67 μ A + 12 mA/A	Fluke 5700A 5520A
(29 to 329.99) μ A	(10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (10 to 30) kHz	0.18 μ A + 0.62 mA/A 0.1 μ A + 0.33 mA/A 59 nA + 0.12 mA/A 0.51 μ A + 0.54 mA/A 1.1 μ A + 1.4 mA/A 3.2 μ A + 7.7 mA/A	Fluke 5700A 5520A
(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 (10 to 30) kHz	1.8 μ A + 0.62 mA/A 1 μ A + 0.33 mA/A 0.59 μ A + 0.12 mA/A 5.1 μ A + 0.54 mA/A 11 μ A + 1.4 mA/A 13 μ A + 3.1 mA/A	Fluke 5700A 5520A
(0.33 to 3.2999) mA	(10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (10 to 30) kHz	18 μ A + 0.62 mA/A 10 μ A + 0.33 mA/A 6.2 μ A + 0.14 mA/A 51 μ A + 0.54 mA/A 0.11 mA + 1.4 mA/A 0.26 mA + 3.1 mA/A	Fluke 5700A 5520A
(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 (10 to 30) kHz	0.16 mA + 0.58 mA/A 0.22 mA + 0.66 mA/A 1.9 mA + 7.8 mA/A	Fluke 5700A Fluke 5700 w/ 5725A
(3.3 to 32.999) mA	40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.92 mA + 0.36 mA/A 1.9 mA + 0.74 mA/A 6.7 mA + 2.8 mA/A	Fluke 5700 w/ 5725A
(22 to 220) mA	(45 to 100) Hz 100 Hz to 1 kHz (1 to 5) kHz	14 mA + 0.9 mA/A 17 mA + 1.2 mA/A 0.26 A + 23 mA/A	Fluke 5520A
(33 to 329.99) mA			
(0.22 to 2.2) A			
(2.2 to 11) A			
(11 to 20.5) A			
Toroidal			
(10 to 16.5) A (16.5 to 150) A (150 to 1025) A	(45 to 65) Hz	26 mA + 2.1 mA/A 50 mA + 1.9 mA/A 0.34 A + 1.9 mA/A	Fluke 5520A w/5500 coil
(10 to 16.5) A (16.5 to 150) A (150 to 1025) A	(65 to 440) Hz	60 mA + 6 mA/A 0.11 A + 5.3 mA/A 0.86 A + 5.3 mA/A	
Non-Toroidal			
(10 to 16.5) A (16.5 to 150) A (150 to 1025) A	(45 to 65) Hz	60 mA + 3.8 mA/A 0.23 A + 3.7 mA/A 1.2 A + 3.7 mA/A	

Parameter/Range	Frequency	CMC ^{2, 6, 7} ($\pm$)	Comments
Capacitance – Generate ³			
(0.19 to 0.3999) nF	10 Hz to 10 kHz	8.5 pF + 3.8 pF/nF	Fluke 5520A
0.4 to 1.0999) nF	10 Hz to 10 kHz	9.4 pF + 3.9 pF/nF	
(1.1 to 3.299) nF	10 Hz to 3 kHz	12 pF + 3.9 pF/nF	
(3.3 to 10.999) nF	(10 to 1000) Hz	15 pF + 2 pF/nF	
(11 to 32.9999) nF	(10 to 1000) Hz	0.1 nF + 1.9 pF/nF	
(33 to 109.999) nF	(10 to 1000) Hz	0.14 nF + 1.9 pF/nF	
(110 to 329.99) nF	(10 to 1000) Hz	0.45 nF + 1.9 pF/nF	
(0.33 to 1.0999) μ F	(10 to 600) Hz	1.4 nF + 1.9 nF/ μ F	
(1.1 to 3.2999) μ F	(10 to 300) Hz	4.4 nF + 1.9 nF/ μ F	
(3.3 to 10.999) μ F	(10 to 150) Hz	14 nF + 1.9 nF/ μ F	
(11 to 32.999) μ F	(10 to 120) Hz	58 nF + 3.1 nF/ μ F	
(33 to 109.99) μ F	(10 to 80) Hz	0.19 μ F + 3.5 nF/ μ F	
(110 to 329.99) μ F	Up to 50 Hz	0.62 μ F + 3.5 nF/ μ F	
(0.33 to 1.0999) mF	Up to 20 Hz	1.9 μ F + 3.5 μ F/mF	
(1.1 to 3.2999) mF	Up to 6 Hz	6.8 μ F + 3.4 μ F/mF	
(3.3 to 10.999) mF	Up to 2 Hz	38 μ F + 2.4 μ F/mF	
(11 to 32.999) mF	Up to 0.6 Hz	87 μ F + 5.8 μ F/mF	
(33 to 110) mF	Up to 0.2 Hz	0.36 mF + 8.5 μ F/mF	
(100 to 1000) pF	1 kHz	0.13 pF + 0.015 %	IET 1423A
(1 to 10) nF		0.31 pF + 0.016 %	
(10 to 100) nF		1.8 pF + 0.027 %	
100 nF to 1.1 μ F		26 pF + 0.045 %	
Distortion ³ – Measure			
(-101 to 0) dB	20 Hz to 20 kHz (20 to 100) kHz	1.2 dB 2.3 dB	Agilent U8903A
(-70 to +10) dB	100 kHz to 2.9 GHz (2.9 to 6.5) GHz (6.5 to 26.5) GHz	2.7 dB 3.8 dB 4.9 dB	Agilent 8593E
Oscilloscope ³ –			
DC Signal Into 50 Ω	(0 to 6.6) V	33 μ V + 2 mV/V	Fluke 5520A/SC1100
DC Signal Into 1 M Ω	(0 to 130) V	33 μ V + 0.39 mV/V	
Squarewave Into 50 Ω	1 mV to 6.6 V _{p-p} 10 Hz to 10 kHz	91 μ V + 4.3 mV/V	
Squarewave Into 1 M Ω	1 mV to 130 V _{p-p} 10 Hz to 1 kHz	0.2 mV + 0.8 mV/V	
	1 mV to 130 V _{p-p} (1 to 100) kHz	0.24 mV + 2 mV/V	

Parameter/Range	Frequency	CMC ^{2, 4, 6, 7} ($\pm$)	Comments
Oscilloscope ³ (cont) –			
Edge Into 50 Ω	(200 to 300) ps (1 to 2) MHz	82 ps	Fluke 5520A/SC1100
	(200 to 350) ps (2 to 10) MHz	82 ps	
Leveled Sine Wave Amplitude – 5 mV to 5.5 V _{p-p}	50 kHz Reference 50 kHz to 100 MHz (100 to 300) MHz (300 to 600) MHz	0.33 mV + 17 mV/V 0.4 mV + 31 mV/V 0.43 mV + 36 mV/V 0.53 mV + 56 mV/V	
4 mV to 3.5 V _{p-p}			
Time Marker Into 50 Ω Generate & Measure	(600 to 1100) MHz	0.58 mV + 67 mV/V	
	5 s to 50 ms 20 ms to 1 ns	0.000 63 % + $t \times 0.1\%$ 0.000 52 %	t = seconds
Bandwidth (-30 to +10) dBm	(1.1 to 4.2) GHz (4.2 to 18) GHz (18 to 26.5) GHz	3.6 % 3.7 % 4.3 %	E4418B power meter w/ 8482A 8481A E4413A
Voltage DC into 1 M Ω DC into 50 Ω Squarewave into 1 M Ω Squarewave into 50 Ω	1 mV to 200 V 1 mV to 5 V 40 μ V + 200 V _{p-p} 40 μ V to 5 V _{p-p}	28 μ V + 0.25 mV/V 29 μ V + 0.25 mV/V 12 μ V + 1 mV/V 12 μ V + 1 mV/V	Fluke 9500B
Risetime – Generate	500 ps 10 Hz to 2 MHz	62 ps	w/9510 active head
	70 ps 10 Hz to 1 MHz	17 ps	w/9560 active head
	15 ps 10 Hz to 1 MHz	8.4 ps	Tektronix, step gen. 067-1338-00
Risetime – Measure	(17 to 350) ps (0 to 50) GHz	11 ps	Tektronix 80E04
Time Marker	9 ns to 83 μ s 83 μ s to 55 s	0.000 047 % 0.000 35 %	Fluke 9500B
Bandwidth	50 kHz to 300 MHz (300 to 550) MHz (0.55 to 1.1) GHz (1.1 to 3.2) GHz	3.3 % 3.4 % 4 % 4.4 %	Fluke 9500B w/ active heads

Parameter/Equipment	Range	CMC ^{2, 7} (±)	Comments
Inductance – Generate, Fixed Point			
100 μ H	100 Hz 200 Hz 400 Hz 1 kHz 10 kHz	0.048 μ H 0.18 μ H 0.074 μ H 0.095 μ H 0.076 μ H	GenRad 1482-B
1 mH	100 Hz 200 Hz 400 Hz 1 kHz 10 kHz	0.65 μ H 0.71 μ H 0.49 μ H 0.6 μ H 0.47 μ H	GenRad 1482-E
10 mH	100 Hz 200 Hz 400 Hz 1 kHz 10 kHz	0.82 μ H 0.87 μ H 0.56 μ H 0.54 μ H 0.63 μ H	GenRad 1482-H
1 H	100 Hz 200 Hz 400 Hz 1 kHz	0.33 mH 0.72 mH 0.27 mH 0.31 mH	GenRad 1482-P
10 H	100 Hz 200 Hz 400 Hz 1 kHz	4 mH 3.5 mH 4.5 mH 62 mH	GenRad 1482-T
Inductance – Measure			
Up to 1 μ H (1 to 10) μ H (10 to 100) μ H (100 to 1000) μ H (1 to 10) mH (10 to 100) mH	120 Hz to 1 kHz	1.3 nH + 3.7 % 38 nH + 0.14 % 51 nH + 0.23 % 0.27 μ H + 0.4 % 4 μ H + 1.4 % 0.13 mH + 14 %	GenRad 1687

Parameter/Equipment	Range	CMC ² (±)	Comments
Electrical Calibration of RTDs – Measure ³			
Pt 385, 100 Ω	(-200 to 80) °C (-80 to 100) °C (100 to 300) °C (300 to 400) °C (400 to 600) °C (600 to 800) °C	0.019 °C 0.023 °C 0.027 °C 0.031 °C 0.038 °C 0.048 °C	Fluke 7526A
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	0.018 °C 0.018 °C 0.02 °C 0.024 °C 0.029 °C 0.038 °C	
Pt 3916, 100 Ω	(-200 to -190) °C (-190 to -80) °C (-80 to 0) °C (0 to 100) °C (100 to 300) °C (300 to 400) °C (400 to 600) °C (600 to 630) °C	0.017 °C 0.018 °C 0.019 °C 0.019 °C 0.025 °C 0.03 °C 0.036 °C 0.043 °C	
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 630) °C	0.054 °C 0.057 °C 0.061 °C 0.061 °C 0.071 °C 0.073 °C 0.09 °C	
Pt 385, 500 Ω	(-200 to 0) °C (0 to 100) °C (100 to 300) °C (300 to 400) °C (400 to 630) °C	0.029 °C 0.029 °C 0.036 °C 0.041 °C 0.049 °C	
Pt 385, 1000 Ω	(-200 to 0) °C (0 to 100) °C (100 to 300) °C (300 to 400) °C (400 to 630) °C	0.02 °C 0.02 °C 0.027 °C 0.03 °C 0.038 °C	
Ni 120, 120 Ω	(-80 to 260) °C	0.0097 °C	
Cu 427, 10 Ω	(-100 to 260) °C	0.11 °C	
YSI 400	(15 to 50) °C	0.0071 °C	
SPRT*	(-200 to 660) °C	0.06 °C	
			* Probe accuracy not included

Parameter/Equipment	Range	CMC ² (±)	Comments
Electrical Calibration of RTDs – Generate ³			
PT 385, 100 Ω	(-200 to 800) °C	0.052 °C	Fluke 7526A
PT 3926, 100 Ω	(-200 to 630) °C	0.052 °C	
PT 3916, 100 Ω	(-200 to 630) °C	0.052 °C	
PT 385, 200 Ω	(-200 to 400) °C (400 to 630) °C	0.4 °C 0.5 °C	
PT 385, 500 Ω	(-200 to 630) °C	0.17 °C	
PT 385, 1000 Ω	(-200 to 630) °C	0.091 °C	
Ni 120, 120 Ω	(-80 to 260) °C	0.021 °C	
Cu 427, 10 Ω	(-100 to 260) °C	0.38 °C	
YSI 400	(15 to 50) °C	0.009 °C	
Thermocouple – Indicating Systems & Measure ³			
Type B	600 to 800) °C (800 to 1550) °C (1550 to 1820) °C	0.35 °C 0.28 °C 0.23 °C	Fluke 7526A
Type C	(0 to 1000) °C (1000 to 1800) °C (1800 to 2000) °C (2000 to 2316) °C	0.16 °C 0.23 °C 0.27 °C 0.36 °C	
Type E	(-250 to -200) °C (-200 to -100) °C (-100 to 0) °C (0 to 600) °C (600 to 1000) °C	0.25 °C 0.12 °C 0.091 °C 0.082 °C 0.1 °C	
Type J	(-210 to -100) °C (-100 to 800) °C (800 to 1200) °C	0.14 °C 0.091 °C 0.11 °C	
Type K	(-250 to -200) °C (-200 to -100) °C (-100 to 500) °C (500 to 800) °C (800 to 1372) °C	0.46 °C 0.16 °C 0.1 °C 0.1 °C 0.14 °C	

Parameter/Equipment	Range	CMC ² (±)	Comments
Thermocouple – Indicating Systems & Measure ³ (cont)			
Type L	(-200 to -100) °C (-100 to 900) °C	0.1 °C 0.092 °C	Fluke 7526A
Type N	(-250 to -200) °C (-200 to -100) °C (-100 to 0) °C (0 to 100) °C (100 to 800) °C (800 to 1300) °C	0.73 °C 0.23 °C 0.12 °C 0.11 °C 0.1 °C 0.13 °C	
Type R	(-50 to -25) °C (-25 to 0) °C (0 to 100) °C (100 to 400) °C (400 to 600) °C (600 to 1000) °C (1000 to 1600) °C (1600 to 1767) °C	0.55 °C 0.45 °C 0.39 °C 0.28 °C 0.22 °C 0.21 °C 0.2 °C 0.24 °C	
Type S	(-50 to -25) °C (-25 to 0) °C (0 to 100) °C (100 to 400) °C (400 to 600) °C (600 to 1000) °C (1000 to 1600) °C (1600 to 1767) °C	0.51 °C 0.43 °C 0.38 °C 0.29 °C 0.23 °C 0.22 °C 0.22 °C 0.27 °C	
Type T	(-250 to -200) °C (-200 to -100) °C (-100 to 0) °C (0 to 200) °C (200 to 400) °C	0.35 °C 0.16 °C 0.14 °C 0.12 °C 0.12 °C	
Type U	(-200 to 0) °C (0 to 200) °C (200 to 600) °C	0.23 °C 0.1 °C 0.1 °C	

IV. Electrical – RF/Microwave

Parameter/Range	Frequency	CMC ^{2, 4, 6} (±)	Comments
Power Meter ³ –			
Power Reference @ 1 mW	50 MHz	0.44 %	432B, 478A-H76, 3458A
Power Accuracy	3 µW to 100 mW	0.29 %	Range calibrator

Parameter/Range	Frequency	CMC ^{2, 6, 7} ($\pm$)	Comments
Amplitude Modulation – Measure ³			
Depth			
(5 to 99) %	150 kHz to 10 MHz Rate: 50 Hz to 10 kHz	0.14 % depth + 0.024 % depth/% depth	Agilent 8902A
Up to 99 %	150 kHz to 10 MHz Rate: 10 Hz to 10 kHz	0.11 % depth + 0.023 % depth/% depth	
(5 to 99) %	(10 to 1300) MHz Rate: 50 Hz to 50 kHz	0.15 % depth + 0.01 % depth/% depth	
Up to 99 %	(10 to 1300) MHz Rate: 10 Hz to 100 kHz	0.11 % depth + 0.023 % depth/% depth	
(5 to 99) %	(1.3 to 26.5) GHz Rate: 50 Hz to 50 kHz	1.2 % depth + 0.004 % depth/% depth	
Up to 99 %	(1.3 to 26.5) GHz Rate: 10 Hz to 100 kHz	1.2 % depth + 0.015 % depth/% depth	
Frequency Modulation – Measure ³			
Deviation			
Up to 40 kHz	250 kHz to 10 MHz 20 Hz to 10 kHz Rate	3.5 Hz + 16 Hz/kHz	Agilent 8902A
Up to 400 kHz	(10 to 1300) MHz 50 Hz to 100 kHz Rate	3.5 Hz + 7.8 Hz/kHz	
Up to 400 kHz	(10 to 1300) MHz 20 Hz to 200 kHz Rate	6.8 Hz + 39 Hz/kHz	
Up to 400 kHz	(1.3 to 26.5) GHz 50 Hz to 100 kHz Rate	6.8 Hz + 7.8 Hz/kHz	
Up to 400 kHz	(1.3 to 26.5) GHz 20 Hz to 200 kHz Rate	6.8 Hz + 39 Hz/kHz	
Phase Modulation – Measure ³			
150 kHz to 10 MHz (10 to 1300) MHz (1.3 to 26.5) GHz	200 Hz to 10 kHz 200 Hz to 20 kHz 200 Hz to 20 kHz	36 mrad + 37 mrad/rad 36 mrad + 37 mrad/rad 36 mrad + 37 mrad/rad	Agilent 8902A

Parameter/Equipment	Range	CMC ^{2, 4, 6, 7} (±)	Comments
Absolute Power – Measure ³			E4418B power meter w/:
(-30 to +20) dBm	100 kHz to 4.2 GHz (4.2 to 18) GHz (18 to 26.5) GHz	3.6 % 3.7 % 4.3 %	8482A 8481A E4413A
(-70 to -30) dBm	10 MHz to 18 GHz	4.1 %	8484A
Attenuation – Measure ³			Agilent 8902A
(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 (-110 to -120) dB (-120 to -127) dB	2.5 MHz to 1.3 GHz	0.066 dB 0.06 dB 0.074 dB 0.087 dB 0.1 dB 0.096 dB 0.11 dB 0.12 dB 0.13 dB 0.15 dB 0.15 dB 0.2 dB 0.25 dB	
(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 (-110 to -120) dB (-120 to -127) dB	(1.3 to 18) GHz	0.25 dB 0.25 dB 0.25 dB 0.26 dB 0.26 dB 0.26 dB 0.27 dB 0.27 dB 0.28 dB 0.29 dB 0.29 dB 0.37 dB 0.38 dB	
(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 (-110 to -120) dB (-120 to -127) dB	(18 to 26.5) GHz	0.39 dB 0.39 dB 0.39 dB 0.39 dB 0.4 dB 0.39 dB 0.4 dB 0.4 dB 0.4 dB 0.4 dB 0.41 dB 0.41 dB 0.47 dB 0.47 dB	

Parameter/Equipment	Range	CMC ^{2, 6, 7} ($\pm$)	Comments
Transmission S_{12}/S_{21} – Measure			
Log Magnitude (0 to 60) dB	45 MHz to 2 GHz (2 to 8) GHz (8 to 20) GHz (20 to 26.5) GHz (26.5 to 40) GHz	0.049 dB 0.071 dB 0.075 dB 0.19 dB 0.22 dB	E8364C VNA, 8722ES VNA, & cal/ver kits
Log Phase (0 to 180)°	45 MHz to 2 GHz (2 to 8) GHz (8 to 20) GHz (20 to 26.5) GHz (26.5 to 40) GHz	1.5° 3.3° 3.3° 4.6° 5°	
Reflection S_{11}/S_{22} – Measure			
Lin Magnitude (1 to ∞)	45 MHz to 2 GHz (2 to 8) GHz (8 to 20) GHz (20 to 26.5) GHz (26.5 to 40) GHz	0.017 lin 0.023 lin 0.023 lin 0.03 lin 0.032 lin	E8364C VNA, 8722ES VNA, & cal/ver kits
Lin Phase (0 to 180)°	45 MHz to 2 GHz (2 to 8) GHz (8 to 20) GHz (20 to 26.5) GHz (26.5 to 40) GHz	1.8° 3.8° 3.8° 5.1° 5.5°	

V. Fluid Quantities

Parameter/Equipment	Range	CMC ^{2, 4, 5, 6} ($\pm$)	Comments
Hydrometers ³	(0.7 to 1.2) sp. gr. (1.2 to 2.0) sp. gr.	0.0012 sp. gr. 0.0024 sp. gr.	ASTM E126; by comparison using reference hydrometer
Gas Flow – Measure ³	(1 to 10) sccm (10 to 100) sccm (100 to 1000) sccm (1 to 10) slm (10 to 30) slm (30 to 100) slm	0.41 % 0.41 % 0.41 % 0.41 % 0.41 % 0.5 %	DHI molbloc system

Parameter/Equipment	Range	CMC ^{2, 4, 5, 6} ($\pm$)	Comments
Volume Glassware – Measure	Up to 500 μ L (0.5 to 5) mL (5 to 10) mL (10 to 30) mL (30 to 50) mL (50 to 100) mL (100 to 200) mL (200 to 300) mL (300 to 400) mL (400 to 600) mL 600 mL to 5 L (5 to 20) L (20 to 30) L	0.06 μ L 0.072 μ L 0.09 μ L 0.12 μ L 0.17 μ L 0.35 μ L 0.68 μ L 1 μ L 1.1 μ L 18 μ L 0.15 mL 0.16 mL 0.18 mL	Gravimetric method using Class 1 weights & MT AT400 electronic balance Jennings TB600 electronic balance Veritas KL32001 electronic balance
Viscosity ³ – Ford, Dip & Other Viscosity Cups	Cup Nos. 1 through 5	3.3 %	ASTM D1200, D4212, ISO-2431

VI. Mechanical

Parameter/Equipment	Range	CMC ^{2, 4, 5, 6} ($\pm$)	Comments
Mass – Measure	Up to 50 g (50 to 100) g (100 to 200) g (200 to 400) g (400 to 600) g (4 to 32) kg	0.61 mg 0.62 mg 0.63 mg 0.67 mg 78 mg 0.65 g	MT AT400 Jennings TB600 Mark KL32001
Balances ³ Unit Under Test R: (0.0001 to 10) g (0.1 to 10) g (1 to 10) g (1 to 10) g	Up to 200 g (200 to 1000) g (1 to 5) kg (5 to 9) kg	0.82R 1.0R 1.0R 1.3R	Class 1, F1 & 6 weights
Scales	Up to 1500 lbf	0.82R	Class F & 6 weights

Parameter/Equipment	Range	CMC ^{2, 4, 5, 6, (±)}	Comments
Scales – Substitution Testing	(1500 to 3000) lbf (3000 to 4500) lbf	1.1R 1.4R	Test Loads, EURAMET CG-18
Force, Compression & Tension – Measuring Equipment ³	Up to 500 lbf	0.028 %	Morehouse force machine
Force – Compression & Tension ³ (Incl. Wheel Load Scales & Dynamometers)	(10 to 1000) lbf (1000 to 2000) lbf (2000 to 10 000) lbf (10 000 to 50 000) lbf	0.0084 % 0.039 % 0.027 % 0.024 %	Standard cells
Torque – Measuring Equipment	2 ozf·in to 150 lbf·in 150 lbf·in to 250 lbf·ft (250 to 1000) lbf·ft	0.036 % 0.033 % 0.034 %	Torque arms & Class F weights
Torque – Measure Tools	(10 to 100) ozf·in (10 to 100) lbf·in (30 to 100) lbf·ft (50 to 800) lbf·ft	0.59 % 0.13 % 0.13 % 0.13 %	CDI Transducer AKO digital torque tester
Pressure – Measure & Generate			
Hydraulic	(100 to 15 000) psig	0.018 %	Ametek T-1 DWT
Pneumatic	(0 to 2) inH ₂ O (-14.3 to +15) psig (0 to 15) psia (-14.3 to 100) psig (14.3 to 758) psig (758 to 1500) psig	0.000 32 inH ₂ O 0.0035 psi 0.0019 psi 0.014 psi 0.088 psi 0.012 %	Dwyer 1430 hook gage Mensor CPR6000

Parameter/Equipment	Range	CMC ² (±)	Comments
Indirect Verification of Rockwell Hardness Testers ³	HRA: High Middle Low HRBW: High Middle Low HRC: High Middle Low HREW: High Middle Low HRRW: High Middle HR15N: High Middle Low HR15T: High Middle Low HR30N: High Middle Low HR30TW: High Middle Low HR45N: High Middle Low	0.37 HRA 0.37 HRA 0.27 HRA 0.64 HRBW 0.34 HRBW 0.46 HRBW 0.44 HRC 0.34 HRC 0.33 HRC 0.69 HREW 0.31 HREW 0.62 HREW 0.24 HRRW 0.51 HRRW 0.51 HR15N 0.54 HR15N 0.47 HR15N 0.44 HR15T 0.4 HR15T 0.41 HR15T 0.47 HR30N 0.57 HR30N 0.57 HR30N 0.71 HR30TW 0.7 HR30TW 0.71 HR30TW 0.59 HR45N 0.4 HR45N 0.27 HR45N	ASTM E18 w/ traceable blocks

VII. Thermodynamics

Parameter/Equipment	Range	CMC ^{2, 5, 6} ($\pm$)	Comments
Temperature ³ – Measure	(-197 to 660) °C	0.028 °C + 0.000 03 °C/°C	Fluke 5609 & 1502A
Temperature ³ – Measuring Equipment	-78 °C (-40 to 140) °C (140 to 660) °C	0.065 °C 0.04 °C 0.071 °C	Fluke 5609 & 1502A dry wells, dry ice bath
Infrared Temperature – Measuring Equipment	(-15 to 12) °C (-12 to -9) °C (-9 to -6) °C (-6 to -2) °C (-2 to 0) °C (0 to 120) °C (35 to 500) °C	1.2 °C 1.1 °C 1 °C 0.94 °C 0.82 °C 0.87 °C + 0.01 °C/°C 0.62 °C + 0.017 °C/°C	Fluke 4180 Fluke 4181
Relative Humidity ³ – Measuring Equipment	(20 to 80) % RH (80 to 95) % RH	1.4 % RH 2.1 % RH	Kaymont 2000
Relative Humidity ³ – Measure	(20 to 90) % RH (90 to 95) % RH	1.4 % RH 2.1 % RH	Vaisala MI70, HMP77, HMP76

VIII. Time & Frequency

Parameter/Equipment	Range	CMC ^{2, 4, 5, 6} ($\pm$)	Comments
Frequency – Measuring Equipment ³	1 μ Hz to 21 MHz 21 MHz to 26.5 GHz	0.58 μ Hz + 28 pHz/Hz 0.14 mHz + 6.7 pHz/Hz	Rubidium oscillator, signal generators
Frequency ³ – Measure	1 mHz to 3 GHz (3 to 26.5) GHz	58 pHz + 59 pHz/Hz 0.18 Hz + 59 pHz/Hz	Rubidium oscillator & counters
Frequency – Measure	10 MHz	67 μ Hz	Rubidium oscillator

Parameter/Equipment	Range	CMC ^{2, 4, 5, 6} ($\pm$)	Comments
Stopwatches & Timers	Up to 86 400 s (0 to 19.99) sec/day	32 ms 0.037 sec/day	Rubidium oscillator, counter & generator Timometer
Tachometers – Optical	(1 to 100 000) rpm	0.000 044 rpm + 0.000 038 rpm/rpm	Function generator & LED
Stroboscopes	10 mHz to 2 kHz (1 to 100 000) FPM	12 nHz + 1.2 μ Hz/Hz 0.000 006 6 FPM + 0.000 12 %	Frequency counter, pickup
Speed – Measuring Equipment	35 mph 65 mph	0.021 % 0.021 %	Tuning forks

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

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. 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 In the statement of CMC, R is the numerical value of the resolution of the device in its respective units; and percentages are percentage of reading unless otherwise indicated.

⁵ The type of instrument or material being calibrated is defined by the parameter. This indicates the laboratory is capable of calibrating instruments that measure or generate the values in the ranges indicated for the listed measurement parameter.

⁶ CMC components that can be reasonably attributed to the Unit Under Test have not been utilized in the calculation of the CMC value for this measurement parameter.

⁷ 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.

⁸ 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.

⁹ This scope meets A2LA's *P112 Flexible Scope Policy*.



Accredited Laboratory

A2LA has accredited

TRESCAL, INC.

Cleveland, OH

for technical competence in the field of

Calibration

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017 *General requirements for the competence of testing and calibration laboratories*. This laboratory also meets the requirements of ANSI/NCSL Z540-1-1994, ANSI/NCSL Z540.3-2006, 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 April 2017).



Presented this 27th day of December 2022.

A blue ink signature of Mr. Trace McInturff, Vice President of Accreditation Services.

Mr. Trace McInturff, Vice President, Accreditation Services
For the Accreditation Council
Certificate Number 1022.02
Valid to May 31, 2024
Revised May 25, 2023

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