



SCOPE OF ACCREDITATION TO ISO/IEC 17025:2017

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CALIBRATION

Valid To: May 31, 2024

Certificate Number: 1741.17

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory to perform the following calibrations^{1, 12}:

I. Chemical

Parameter/Equipment	Range	CMC ² (±)	Comments
pH Meters ³	4 pH 7 pH 10 pH	0.03 pH units 0.03 pH units 0.03 pH units	Standard pH solutions

II. Dimensional

Parameter/Equipment	Range	CMC ^{2, 7, 8} (±)	Comments
Protractors, Angle Indicators, Inclinometers ³	30°, 45°, 60°, 90°	0.03°	Angle block set
Calipers ³	Up to 12 in (12 to 48) in	(7.5 + 9.6L) μin + 0.6R (7.5 + 9.8L) μin + 0.6R	Gage blocks
Crimpers ³ – Functional Diameter Pull Force	(0.011 to 0.250) in Up to 50 lb	260 μin 0.05 %	Pin gages Class F weights

Parameter/Equipment	Range	CMC ^{2, 7, 11} ($\pm$)	Comments
Cylindrical Measure – Plain Rings	Up to 6 in	$(20 + 5L) \mu\text{in}$	P & W Labmaster™ w/ XX master rings
Pins, Plain Plugs, Discs, Spheres – External Diameter	Up to 8 in	$(6.3 + 2.5L) \mu\text{in}$	P & W Labmaster™ w/ gage blocks
Feeler Gages ³	Up to 0.2 in	80 μin	Micrometer
Gage Blocks	Up to 4 in	$(3.1 + 1.1L) \mu\text{in}$	Gage block comparator
Hand Tools ³ – Depth Gages, Snap Gages, Fixture Gages, Thickness Gages	Up to 12 in (12 to 48) in	$(6 + 9.7L) \mu\text{in} + 0.6R$ $(10 + 11L) \mu\text{in} + 0.6R$	Gage blocks
Height Gages ³	Up to 12 in (12 to 48) in	$(6 + 9.7L) \mu\text{in} + 0.6R$ $(10 + 11L) \mu\text{in} + 0.6R$	Gage blocks, surface plate
Length Measure -1D ³ Fixtures, Linear Encoders	Up to 8 in Up to 300 in	640 μin $(11 + 2.4L) \mu\text{in}$	Optical comparator Renishaw ML10 Gold
Micrometer Standards	Up to 20 in	$36 + 8.5L$	Mic Trac
Linear Indicators ³ – Lever Probes, LVDT's, Dial and Test	(0.0001 to 12) in	$(6 + 9.7L) \mu\text{in} + 0.6R$	Gage blocks
Micrometers ³	Up to 12 in (12 to 40) in	$(6 + 9.7L) \mu\text{in} + 0.6R$ $(10 + 11L) \mu\text{in} + 0.6R$	Gage blocks

Parameter/Equipment	Range	CMC ^{2, 7} ($\pm$)	Comments
Optical Comparator ³ – X-Y Linearity Magnification Angle	Up to 12 in 10x to 250x 0.25° to 30°	0.0012 in 0.014 in 0.11°	Glass master scales Glass master and gage blocks Angle block set
Pin Gages ³ – Class Z and ZZ	Up to 1 in	80 μ in	Micrometer
Radius Gages	Up to 2 in	640 μ in	Optical comparator
Surface Plates ³ – Grades AA, A, and B Repeatability/Local Flatness Flatness	0.002 in Up to 60 <i>DL</i> in (>60 to 120) <i>DL</i> in	40 μ in (31 + 0.2 <i>DL</i>) μ in (30 + 0.3 <i>DL</i>) μ in	Repeat-o-meter Federal level systems
Tape Measures ³	Up to 25 ft	(5 + 10 <i>L</i>) μ in + 0.6 <i>R</i>	Gage blocks
Steel Rules ³	Up to 72 in Up to 72 in	(11 + 2.4 <i>L</i>) μ in + 0.6 <i>R</i> (5 + 10 <i>L</i>) μ in + 0.6 <i>R</i>	Renishaw ML10 Gold Gage blocks
Thread Plugs – Major Diameter Pitch Diameter	Up to 7 in Up to 7 in	(6.3 + 2.5 <i>L</i>) μ in 72 μ in	P & W Labmaster™ universal w/ thread wires

Parameter/Equipment	Range	CMC ² (±)	Comments
Thread Rings – Parallel Simple Pitch Diameter – Adjustable Rings ¹¹	Up to 8 in	X (Set Plug Tolerance)	ASME/ANSI B1.2- 1983 and ASME/ANSI B1.3- 2007

III. Electrical – DC/Low Frequency

Parameter/Range	Frequency	CMC ^{2, 4, 5, 8, 13} (±)	Comments
AC Voltage – Measure ³			
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	0.031 % + 0.03 % of rng 0.022 % + 0.01 % of rng 0.031 % + 0.01 % of rng 0.11 % + 0.01 % of rng 0.51 % + 0.01 % of rng 4.1 % + 0.02 % of rng	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	0.008 % + 0.004 % of rng 0.008 % + 0.002 % of rng 0.015 % + 0.002 % of rng 0.031 % + 0.002 % of rng 0.081 % + 0.002 % of rng 0.31 % + 0.01 % of rng	
(10 to 100) 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	0.021 % + 0.004 % of rng 0.021 % + 0.002 % of rng 0.021 % + 0.002 % of rng 0.036 % + 0.002 % of rng 0.13 % + 0.002 % of rng 0.41 % + 0.01 % of rng	
(100 to 600) V	(1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.041 % + 0.004 % of rng 0.041 % + 0.002 % of rng 0.061 % + 0.002 % of rng 0.13 % + 0.002 % of rng 0.31 % + 0.002 % of rng	
(1 to 10) kV	60 Hz	0.13 % + 0.1 V	Vitrek 4700
(10 to 50) kV	60 Hz	0.13 % + 0.4 V	Vitrek 4700 w/HVL-70

Parameter/Range	Frequency	CMC ^{2, 7, 11} ($\pm$)	Comments
AC Voltage – Generate ³			
(0.22 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	0.19 % + 4 μ V 0.12 % + 4 μ V 0.086 % + 4 μ V 0.15 % + 4 μ V 0.21 % + 5 μ V 0.37 % + 10 μ V 0.53 % + 20 μ V 0.69 % + 20 μ V	Fluke 5700A/5725A
(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	0.031 % + 4 μ V 0.014 % + 4 μ V 0.013 % + 4 μ V 0.03 % + 4 μ V 0.066 % + 5 μ V 0.14 % + 10 μ V 0.18 % + 20 μ V 0.35 % + 20 μ 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 500 kHz to 1 MHz	0.03 % + 12 μ V 0.011 % + 7 μ V 0.0073 % + 7 μ V 0.015 % + 7 μ V 0.038 % + 17 μ V 0.08 % + 20 μ V 0.17 % + 25 μ V 0.34 % + 45 μ V	
220 mV 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 500 kHz to 1 MHz	0.062 % + 40 μ V 0.024 % + 15 μ V 53 μ V/V + 8 μ V 83 μ V/V + 10 μ V 0.011 % + 30 μ V 0.041 % + 80 μ V 0.12 % + 200 μ V 0.21 % + 300 μ 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 500 kHz to 1 MHz	0.029 % + 400 μ V 0.12 % + 150 μ V 55 μ V/V + 50 μ V 86 μ V/V + 100 μ V 0.011 % + 200 μ V 0.032 % + 600 μ V 0.12 % + 2 mV 0.19 % + 3.2 mV	

Parameter/Range	Frequency	CMC ^{2, 4, 5, 8, 13} ($\pm$)	Comments
AC Voltage – Generate ³ (cont)			
(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	0.029 % + 4 mV 0.012 % + 1.5 mV 66 μ V/V + 0.6 mV 0.011 % + 1 mV 0.019 % + 2.5 mV 0.11 % + 16 mV 0.53 % + 40 mV 0.97 % + 80 mV	Fluke 5700A/5725A
(220 to 1100) V	(15 to 50) Hz 50 Hz to 1 kHz	0.037 % + 16 mV 90 μ V/V + 3.5 mV	
(220 to 1100) V	40 Hz to 1 kHz (1 to 20) kHz (20 to 30) kHz	0.012 % + 4 mV 0.02 % + 6 mV 0.073 % + 11 mV	
(220 to 750) V	(30 to 50) kHz (50 to 100) kHz	0.073 % + 11 mV 0.28 % + 45 mV	
(330 to 1020) V	45 Hz to 10 kHz	0.036 % + 10 mV	
AC Current – Measure ³			
(0 to 100) μ A	(10 to 20) Hz (20 to 45) Hz 45 Hz to 1 kHz 100 Hz to 5 kHz	0.41 % + 0.03 % of rng 0.16 % + 0.03 % of rng 0.07 % + 0.03 % of rng 0.07 % + 0.03 % of rng	HP 3458A
(1 to 100) mA	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz (5 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.41 % + 0.02 % of rng 0.16 % + 0.02 % of rng 0.07 % + 0.02 % of rng 0.04 % + 0.02 % of rng 0.07 % + 0.02 % of rng 0.41 % + 0.04 % of rng 0.56 % + 0.15 % of rng	
100 mA to 1 A	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz (5 to 20) kHz (20 to 50) kHz	0.41 % + 0.02 % of rng 0.17 % + 0.02 % of rng 0.09 % + 0.02 % of rng 0.11 % + 0.02 % of rng 0.31 % + 0.02 % of rng 1.1 % + 0.04 % of rng	
(1 to 100) A	60 Hz	0.25 %	
			Empro shunt w/ DMM

Parameter/Range	Frequency	CMC ^{2, 4, 5, 8, 13} (±)	Comments
AC Current – Generate ³			
(0 to 220) µA	(10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.031 % + 16 nA 0.02 % + 10 nA 0.014 % + 8 nA 0.029 % + 12 nA 0.14 % + 65 nA	Fluke 5700A/5725A
220 µA to 2.2 mA	(10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.031 % + 40 nA 0.02 % + 35 nA 0.013 % + 35 nA 0.025 % + 110 nA 0.14 % + 650 nA	
(2.2 to 22) mA	(10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.033 % + 400 nA 0.02 % + 350 nA 0.013 % + 350 nA 0.025 % + 550 nA 0.14 % + 5 µA	
(22 to 220) mA	(10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.033 % + 4 µA 0.02 % + 3.5 µA 0.013 % + 2.5 µA 0.025 % + 3.5 µA 0.14 % + 10 µA	
220 mA to 2.2 A	20 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.03 % + 35 µA 0.055 % + 80 µA 0.85 % + 160 µA	
(2.2 to 11) A	40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.056 % + 170 µA 0.12 % + 380 µA 0.44 % + 750 µA	
(11 to 20.5) A	45 Hz to 1 kHz	0.19 % + 5 mA	Fluke 5522A

Parameter/Range	Frequency	CMC ^{2, 4, 8, 13} ($\pm$)	Comments
AC Clamp-On Meters ³ – Up to 150 A			
Toroidal	(45 to 65) Hz (65 to 440) Hz	0.49 % + 0.025 A 1 % + 0.027 A	Fluke 5522A w/ 5500 coil
Non-Toroidal	(45 to 65) Hz (65 to 440) Hz	0.76 % + 0.25 A 1.3 % + 0.25 A	
(150 to 1025) A			
Toroidal	(45 to 65) Hz (65 to 440) Hz	0.49 % + 0.09 A 1 % + 0.1 A	Fluke 5522A w/ 5500 coil
Non-Toroidal	(45 to 65) Hz (65 to 440) Hz	0.76 % + 0.9 A 1.3 % + 0.9 A	

Parameter/Equipment	Range	CMC ^{2, 4, 8, 13} ($\pm$)	Comments
AC Power – Generate ³ (45 to 65) Hz; PF=1 (33 to 330) mV Range			
(3.3 to 8.99) mA	110 μ W to 3 mW	0.17 %	Fluke 5522A
(9 to 32.99) mA	(3 to 11) mW	0.12 %	
(33 to 89.99) mA	(1.1 to 30) mW	0.17 %	
(90 to 329.99) mA	(3 to 110) mW	0.12 %	
(0.33 to 0.8999) A	(11 to 300) mW	0.16 %	
(0.9 to 2.1999) A	(30 to 730) mW	0.14 %	
(2.2 to 4.4999) A	73 mW to 1.5 W	0.16 %	
(4.5 to 20.5) A	150 mW to 6.8 W	0.14 %	

Parameter/Equipment	Range	CMC ^{2, 4, 8, 13} ($\pm$)	Comments
AC Power – Generate ³ (cont) (45 to 65) Hz; PF=1 330 mV to 1020 V Range			
(3.3 to 8.99) mA	1.1 mW to 9 W	0.15 %	Fluke 5522A
(9 to 32.99) mA	3 mW to 33 W	0.1 %	
(33 to 89.99) mA	11 mW to 90 W	0.15 %	
(90 to 329.99) mA	30 mW to 330 W	0.1 %	
(0.33 to 0.8999) A	110 mW to 900 W	0.14 %	
(0.9 to 2.1999) A	300 mW to 2200 W	0.11 %	
(2.2 to 4.4999) A	730 mW to 4500 W	0.15 %	
(4.5 to 20.5) A	(1.5 to 20.9) kW	0.12 %	

Parameter/Equipment	Range	CMC ^{2, 4, 8, 13} ($\pm$)	Comments
DC Voltage – Measure ³	(0 to 100) mV 100 mV to 1 V (1 to 10) V (10 to 100) V (100 to 1000) V (1 to 10) kV (10 to 70) kV (Up to 100) kV	11 μ V/V + 0.3 μ V 10 μ V/V + 0.3 μ V 10 μ V/V + 0.5 μ V 12 μ V/V + 30 μ V 27 μ V/V + 100 μ V 0.05 % + 0.03 V 0.06 % + 0.2 V 0.6 %	HP 3458A Vitrek 4700 Vitrek 4700 w/ HVL-70 Spellman HV Divider
DC Voltage – Generate ³	(0 to 220) mV 220 mV to 2.2 V (2.2 to 11) V (11 to 22) V (22 to 220) V (220 to 1100) V Up to 40 KV	11 μ V/V + 0.4 μ V 6.7 μ V/V + 0.7 μ V 5 μ V/V + 2.5 μ V 5.1 μ V/V + 4 μ V 6.7 μ V/V + 40 μ V 8.5 μ V/V + 400 μ V 0.12 %	Fluke 5700A Power source w/ Vitrek 4700/HVL-70 probe

Parameter/Equipment	Range	CMC ^{2, 4, 8, 13} ($\pm$)	Comments
DC Current – Measure ³	Up to 100 nA 100 nA to 1 μ A (1 to 10) μ A (10 to 100) μ A 100 μ A to 1 mA (1 to 10) mA (10 to 100) mA 100 mA to 1 A Up to 1000 A	35 μ A/A + 0.04 nA 25 μ A/A + 0.04 nA 25 μ A/A + 0.1 nA 25 μ A/A + 0.8 nA 25 μ A/A + 5 nA 25 μ A/A + 50 nA 40 μ A/A + 0.5 μ A 0.012 % + 10 μ A 0.13 %	HP 3458A Empro shunt w/ DMM
DC Current – Generate ³	(0.22 to 220) μ A 220 μ A to 2.2 mA (2.2 to 22) mA (22 to 220) mA 220 mA to 2.2 A (2.2 to 11) A (11 to 20.5) A	50 μ A/A + 6 nA 44 μ A/A + 7 nA 44 μ A/A + 40 nA 55 μ A/A + 0.7 μ A 0.011 % + 12 μ A 0.044 % + 480 μ A 0.12 % + 750 μ A	Fluke 5700A w/ 5725A Fluke 5522A
DC Clamp-On Meters ³ (Non-Toroidal)	(20.5 to 1000) A	0.65 % + 0.5 A	Fluke 5522A w/ 5500 coil
DC Power - Generate ³ 33 mV to 1020 V (0.33 to 329.99) mA (0.33 to 2.9999) A (3 to 20.5) A	(0.01 to 330) W (0.33 to 3.3) kW (3.3 to 20.5) kW	0.03 % 0.03 % 0.09 %	Fluke 5522A
Resistance – Measure ³	(0 to 10) Ω (10 to 100) Ω 100 Ω to 1 k Ω (1 to 10) k Ω (10 to 100) k Ω 100 k Ω to 1 M Ω (1 to 10) M Ω (10 to 100) M Ω 100 M Ω to 1 G Ω	18 $\mu\Omega/\Omega$ + 50 $\mu\Omega$ 15 $\mu\Omega/\Omega$ + 0.5 m Ω 13 $\mu\Omega/\Omega$ + 0.5 m Ω 13 $\mu\Omega/\Omega$ + 5 m Ω 13 $\mu\Omega/\Omega$ + 50 m Ω 18 $\mu\Omega/\Omega$ + 2 Ω 53 $\mu\Omega/\Omega$ + 100 Ω 0.062 % + 1 k Ω 0.51 % + 10 k Ω	HP 3458A

Parameter/Equipment	Range	CMC ^{2, 4, 8, 13} ($\pm$)	Comments
Capacitance – Generate ³ (220 to 399.9) pF (0.4 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 1.099 99) μ F (1.1 to 3.299 99) μ F (3.3 to 10.9999) μ F (11 to 32.9999) μ F (33 to 109.999) μ F (110 to 329.999) μ F (0.33 to 1.099 99) mF (1.1 to 3.299 99) mF (3.3 to 10.9999) mF (11 to 32.9999) mF (33 to 110) mF	(10 to 10 000) Hz (10 to 10 000) Hz (10 to 3000) Hz (10 to 1000) Hz (10 to 1000) Hz (10 to 1000) Hz (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	0.88 % + 10 pF 0.6 % + 0.01 nF 0.6 % + 0.01 nF 0.31 % + 0.1 nF 0.31 % + 0.1 nF 0.31 % + 0.3 nF 0.31 % + 1 nF 0.31 % + 3 nF 0.31 % + 10 nF 0.49 % + 30 nF 0.55 % + 100 nF 0.55 % + 300 nF 0.55 % + 1 μ F 0.55 % + 3 μ F 0.56 % + 10 μ F 0.91 % + 30 μ F 1.4 % + 100 μ F	Fluke 5522A
Capacitance – Generate ³ Fixed Points 10 pF 100 pF 1000 pF 10 μ F 90 μ F 100 μ F Decade Steps (100 to 1000) pF (1 to 10) nF (10 to 100) nF (100 to 500) nF (1 to 10) μ F	1000 Hz 100/1000 Hz	0.036 % 0.036 % 0.036 % 0.61 % 0.61 % 1.2 % 0.13 % 0.13 % 0.13 % 0.13 % 0.31 %	Genrad 1403 series Standard caps Arco SS-32 standard cap set Standard caps

Parameter/Equipment	Range	CMC ^{2, 4, 8, 13} (±)	Comments
Capacitance – Measure	10 pF 100 pF 1 nF to 10 µF (10 to 100) µF 100 µF to 1 mF	0.5 % 0.067 % 0.036 % 0.064 % 0.5 %	GenRad 1689 Digibridge
Inductance – Generate	100 µH 190 µH 1 mH 10 mH 100 mH 1 H 10 H	0.62 % 0.62 % 0.16 % 0.16 % 0.16 % 0.16 % 0.16 %	Standard inductors
Inductance – Measure	100 µH 1 mH to 10 H	0.2 % 0.072 %	GenRad 1689 Digibridge
Electrical Simulation of Thermocouples ³			
Type E	(-270 to 1000) °C	0.14 °C	Fluke 5700A w/ ice point reference
Type J	(-210 to 1200) °C	0.14 °C	
Type K	(-270 to 1372) °C	0.14 °C	
Type N	(-270 to 1300) °C	0.14 °C	
Type R	(-50 to 0) °C (0 to 1767) °C	0.18 °C 0.15 °C	
Type S	(-50 to 0) °C (0 to 1767) °C	0.18 °C 0.15 °C	
Type T	(-270 to 400) °C	0.14 °C	

Parameter/Equipment	Range	CMC ^{2, 4, 8, 13} ($\pm$)	Comments
Electrical Simulation of RTDs ³			
Pt 385, 100 Ω	(-200 to 0) °C (0 to 100) °C (100 to 300) °C (300 to 400) °C (400 to 630) °C (630 to 800) °C	0.08 °C 0.10 °C 0.11 °C 0.13 °C 0.15 °C 0.28 °C	Fluke 5522A
Oscilloscopes ³ –			
Square Wave Signal:			
50 Ω Load @ 1 kHz	1 mV to 6.6 V _{pk - pk}	0.31 % + 40 μ V	Fluke 5522A w/ SC1100
1 M Ω Load @ 1 kHz	1 mV to 130 V _{pk - pk}	0.14 % + 40 μ V	
DC Volt Amplitude:			
50 Ω Load	(0 to 6.6) V	0.3 % + 40 μ V	
1 M Ω Load	(0 to 130) V	0.06 % + 40 μ V	
Level Sine Wave:			
Frequency	(0 to 1100) MHz	3.3 μ Hz/Hz	
Amplitude	50 kHz Reference 50 kHz to 100 MHz (100 to 300) MHz (300 to 600) MHz (300 to 1100) MHz	2.4 % + 300 μ V 4.2 % + 300 μ V 4.8 % + 300 μ V 7.2 % + 300 μ V 8.4 % + 300 μ V	
Flatness (Bandwidth)	0 kHz to 100 MHz (100 to 300) MHz (300 to 600) MHz (300 to 1100) MHz	1.8 % + 100 μ V 2.4 % + 100 μ V 4.8 % + 100 μ V 6 % + 100 μ V	
Time Markers:			
Into a 50 Ω load	5 s to 50 ms 20 ms to 2 ns	(30 + 1000t) μ s/s 3.5 μ s/s	t = time in seconds
Rise Time:			
1 kHz to 2 MHz (2 to 10) MHz	(200 to 300) ps (200 to 350) ps	130 ps 130 ps	

IV. Electrical – RF/Microwave

Parameter/Frequency	Range	CMC ^{2, 8} (±)	Comments
Power Meters – Range Calibration	3 µW to 100 mW	0.3 %	HP 11683A, 8477A range calibrators
RF Power – Measure			
10 MHz to 18 GHz	(-70 to -20) dBm 100 pW to 10 µW	2.0 %	HP437B/8484A/ 11708A
100 kHz to 4.2 GHz	(-20 to 30) dBm 1 µW to 100 mW	2.5 %	HP437B/8482A
10 MHz to 18 GHz	(-20 to 30) dBm 1 µW to 100 mW	1.8 %	HP437B /8481A
Relative Power – Measure ³ –			
10 MHz 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 (-110 to -120) dB	0.24 dB 0.24 dB 0.24 dB 0.24 dB 0.24 dB 0.24 dB 0.24 dB 0.24 dB 0.24 dB 0.24 dB 0.24 dB 0.24 dB	Agilent 8902A w/ 11722A
Amplitude Modulation ³ –			
Carrier: (0.15 to 10) MHz Depth: Up to 5 % Depth: (5 to 99) %	(20 to 50) Hz 50 Hz to 100 kHz	3.7 % 2.5 %	Agilent 8902A w/ 11722A
Carrier: 10 MHz to 1.3 GHz Depth: Up to 5 % Depth: (5 to 99) %	(20 to 50) Hz 50 Hz to 100 kHz	3.7 % 2.5 %	

Parameter/Frequency	Range	CMC ^{2, 8} (±)	Comments
Frequency Modulation ³ – Carrier: 250 kHz to 10 MHz Dev: Up to 40 kHz Carrier: 10 MHz to 1.3 GHz Dev: Up to 100 kHz Dev: (100 to 400) kHz	20 Hz to 10 kHz (20 to 50) Hz 50 Hz to 100 kHz (100 to 200) kHz	2.4 % 6 % 1.3 % 6 %	Agilent 8902A w/ 11722A
Phase Modulation ³ – Carrier: 150 kHz to 10 MHz Carrier: 10 MHz to 1.3 GHz	(200 to 10) kHz (200 to 20) kHz	3.6 % 3.6 %	Agilent 8902A w/ 11722A

V. Mechanical

Parameter/Equipment	Range	CMC ^{2, 7, 8, 11} (±)	Comments
Accelerometers ³ Sensitivity Magnitude	7 Hz to 10 kHz	4.1 %	PCB 9110D
Force ³ – Measuring Equipment Compression & Tension Compression Only	Up 500 lbf (100 to 1500) lbf (1500 to 15 000) lbf (4000 to 40 000) lbf (5000 to 50 000) lbf	0.04 % 0.36 % 0.36 % 0.36 % 140 lbf	Class F weights Load cells w/indicator
Speed Measure ³ – Non-Contact Contact	Up to 10 000 rpm (10 001 to 90 000) rpm Up to 3500 rpm	0.07 % + 0.1 rpm 0.07 % + 1 rpm 0.07 % + 0.1 rpm	Tachometer

Parameter/Equipment	Range	CMC ^{2, 7, 8, 11} ($\pm$)	Comments
Speed ³ – Measuring Equipment	Up to 200 000 rpm	0.002 %	HP 3325A
Scales & Balances ³	(1 to 500) mg Up to 5 g Up to 10 g Up to 30 g Up to 50 g Up to 100 g Up to 200 g Up to 300 g Up to 500 g Up to 1000 g (> 1 to 35) kg (5 to 10) g (10 to 500) g 501 g to 20 kg (> 20 to 500) kg Up to 1000 lb	0.013 mg + 0.6R 0.043 mg + 0.6R 0.062 mg + 0.6R 0.096 mg + 0.6R 0.17 mg + 0.6R 0.31 mg + 0.6R 0.63 mg + 0.6R 0.92 mg + 0.6R 1.5 mg + 0.6R 3.1 mg + 0.6R 3.1 mg per 1000 g + 0.6R 0.04 % + 0.6R 0.025 % + 0.6R 0.017 % + 0.6R 0.017 % per 20 kg + 0.6R 0.017 % + 0.6R	ASTM Class 1 weights (applied load) Class F weights (applied load)
Torque – Measure (Wrenches) ³	20 ozf·in to 600 lbf·ft	0.65 %	CDI Suretest
Torque – Measuring Equipment ³	Up to 250 lbf·ft	0.1 %	Class F weights and torque arms
Pressure ³ – Measuring Equipment			
Hydraulic	(10 to 10 000) psig	0.08 %	Ametek DM-TQ-100-2-ALC
Pneumatic	(-15 to 100) psig (0 to 1000) psig (0 to 10 000) psig (30 to 300) psig (300 to 3000) psig	0.05 psi 0.44 psi 4.5 psi 0.06 % + 0.02 psi 0.06 %	Fluke 750 series Crystal Engineering IS33-300/3000
Atmospheric Pressure (Vacuum) – Measuring Equipment ³	(0.01 to 28) in·Hg	0.088 in·Hg	Crystal Engineering XP2i

Parameter/Equipment	Range	CMC ^{2, 7, 8, 11} ($\pm$)	Comments
Indirect Verification of Rockwell Hardness Testers ^{3,10}	HRC: Low Medium High HRBW: Low Medium High HR15TW: Low Medium High HR30TW: Low Medium High HR45TW: Low Medium High	0.39 HRC 0.34 HRC 0.32 HRC 0.37 HRBW 0.27 HRBW 0.41 HRBW 0.35 HR15TW 0.40 HR15TW 0.37 HR15TW 0.32 HR30TW 0.33 HR30TW 0.34 HR30TW 0.37 HR45TW 0.37 HR45TW 0.37 HR45TW	Indirect verification Per ASTM E18

VI. Thermodynamics

Parameter/Equipment	Range	CMC ^{2, 11} ($\pm$)	Comments
Temperature – Measuring Instruments ³	(-25 to 125) °C (50 to 500) °C (50 to 420) °C (420 to 660) °C (-25 to 125) °C	0.10 °C 0.25 °C 0.65 °C 0.89 °C 0.33 °C	Temperature sources monitored w/ Instrulab 4201C/840 Fluke 9144A Fluke 7103 bath
Temperature – Measure ³	(-196 to 300) °C (300 to 500) °C	0.043 °C 0.11 °C	Instrulab 4201C/840

Parameter/Equipment	Range	CMC ^{2, 11} (±)	Comments
Plate Temperature – Infrared Devices ³	35 °C (35 to 100) °C (100 to 200) °C (200 to 350) °C (350 to 500) °C	0.84 °C 1.0 °C 1.2 °C 1.7 °C 2.3 °C	Fluke 4181 infrared calibrator Spectral band (8 to 14) μm Emissivity 0.95
Relative Humidity – Measure ³	(10 to 90) % RH	1.0 % RH	Rotronic HC2-SH
Relative Humidity – Measuring Equipment ³	(30 to 80) % RH	1.0 % RH	Rotronic HC2-SH w/ controlled environmental

VII. Time & Frequency

Parameter/Equipment	Range	CMC ^{2, 11} (±)	Comments
Frequency – Measuring Equipment	0.001 Hz to 20 MHz 10 MHz to 2.1 GHz Up to 50 GHz	1.5 μHz/Hz 1.5 μHz/Hz 0.06 μHz/Hz	Agilent 83650B
Frequency – Measure	Up to 1300 MHz Up to 26.5 GHz	1.2 μHz/Hz 1.5 μHz/Hz	Stanford 620A frequency counter HP 5351B frequency counter
Timers and Stopwatches ³	(60 to 3600) s	0.05 s	Electronic counter

¹ This laboratory offers commercial calibration and field calibration services, 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. 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 Based on using the standard at the temperature the Fluke 5700A, Fluke 5522A was calibrated ($t_{cal} \pm 5$ °C) and assuming the instrument is zeroed at least every seven days or when the ambient temperature changes more than 5 °C. For resistance, a zero calibration is performed at least every 12 hours within ± 1 °C of use. CMC is based upon one-year floor specifications and is read as output plus range. CMC is expressed as either a specific value that covers the full range or as a combination of the percent or portion of the reading plus a fixed floor specification (for measure parameters).
- ⁵ Based on using the standard at the temperature the HP 3458A was calibrated ($t_{cal} \pm 5$ °C) and an auto-calibration (ACAL) was performed within the previous 24 hours (± 1 °C of ambient temperature). CMC is based upon one-year floor specifications and is read as output plus range. CMC is expressed as either a specific value that covers the full range or as a combination of the percent or portion of the reading plus a fixed floor specification (for measure parameters).
- ⁶ The standards used don't include the individual load cells calibrated using ASTM standards & methods.
- ⁷ In the statement of CMC, L is the numerical value of the nominal length of the device measured in microinches; R is the resolution of the device. DL is the diagonal length of the device in inches.
- ⁸ In the statement of CMC a percentage refers to percent of reading unless otherwise noted.
- ⁹ 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.
- ¹⁰ Contributions from the “best existing device” are not included in the CMC claim.
- ¹¹ 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.
- ¹² This scope meets A2LA's *P112 Flexible Scope Policy*.
- ¹³ 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.



Accredited Laboratory

A2LA has accredited

CROSS TECHNOLOGIES, INC dba CROSS (FORMERLY J.A. KING)

Huntsville, AL

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 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 23rd day of February 2022.

A blue ink signature of the Vice President of Accreditation Services.

Vice President, Accreditation Services
For the Accreditation Council
Certificate Number 1741.17
Valid to May 31, 2024

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