



CERTIFICATE OF ACCREDITATION

This is to attest that

CSA GROUP – CLEVELAND (CSA AMERICA TESTING & CERTIFICATION LLC)

8501 EAST PLEASANT VALLEY ROAD
INDEPENDENCE, OHIO 44131, U.S.A.

Calibration Laboratory CL-140

has met the requirements of AC204, *IAS Accreditation Criteria for Calibration Laboratories*, and has demonstrated compliance with ISO/IEC Standard 17025:2017, *General requirements for the competence of testing and calibration laboratories*. This organization is accredited to provide the services specified in the scope of accreditation.

Effective Date February 21, 2024

Expiration Date January 1, 2025



A handwritten signature in black ink, reading "Raj Nathan".

President

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CSA GROUP – CLEVELAND (CSA AMERICA TESTING & CERTIFICATION LLC)

www.csagroup.org

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Accredited to ISO/IEC 17025:2017

Effective Date February 21, 2024

CALIBRATION AND MEASUREMENT CAPABILITY (CMC)*

MEASURED QUANTITY or DEVICE TYPE CALIBRATED	RANGE	UNCERTAINTY ^{1,2} (±)	CALIBRATION METHOD OR PROCEDURE, STANDARD EQUIPMENT (OPTIONAL)
Dimensional			
Length – 1 Dimension	up to 1.9685 in 1.9686 in to 6.0000 in 6.0001 in to 8.0000 in	0.00094 in 0.0012 in 0.0014 in	Caliper ⁵
	8.0001 in to 24.0000 in	60 µin/in + 0.018 in	Steel Ruler ⁵
Micrometers	up to 25.000 mm	(0.57 + 0.00049L) µm	Gauge Blocks ^{5,9}
Calipers	up to 224.50 mm 224.5005 mm to 305.00 mm	5.7 µm 5.8 µm	Gauge Blocks ⁵
Mechanical			
Gas Flow Meters/ Measuring Equipment	0 SCFH to 2.12 SCFH	0.0027 SCFH	Fluke Molbox 1 + A700K-A and Fluke 5E3-VCR-V-Q ⁵
	2.12 SCFH to 21.2 SCFH	0.13 %	
	15.3 SCFH to 106 SCFH	0.13 %	Fluke Molbox 1 + A700K-A and Fluke 3E4-VCR-V-Q ⁵
	30.5 SCFH to 212 SCFH	0.088 %	Fluke Molbox 1 + A700K-A, Fluke 3E4-VCR-V-Q and Fluke 3E4-VCR-V-Q ⁵
	50.9 SCFH to 509 SCFH	0.13 %	Fluke Molbox 1 + A700K-A and Fluke 5E2-S ⁵
Water Flow Meters/ Measuring Equipment	0.5 gal/min to 7 gal/min	0.12 %	Micro Motion CMF025 ⁵
	4 gal/min to 21 gal/min	0.11 %	Micro Motion CMF050 ⁵
	21 gal/min to 140 gal/min	0.15 %	Micro Motion CMF200 ⁵
Pressure Gauges	-100.000 in H ₂ O to -0.001 in H ₂ O	0.11 %	Fluke 7252i ⁵
	-10.000 in H ₂ O to 10.000 in H ₂ O	0.001 in H ₂ O	

* If information in this CMC is presented in non-SI units, the conversion factors stated in NIST Special Publication 811 "Guide for the Use of the International System of Units (SI)" apply.

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Pressure Gauges (continued)	10.001 in H ₂ O to 100 in H ₂ O	0.057 %	Fluke 7252i ⁵
	-15.000 psi to -0.001 psi	0.015 psi	
	0.000 psi to 125 psi	0.011 psi	
	125.001 psi to 500 psi	0.022 %	
	50 psi to 15000 psi	0.11 %	Ametek T-150 ⁵
Force – Compression and Tension (Force Gauges, Load Cells, Hanging Scales, Surface Probes)	up to 5 lbf	0.043 % + 0.00043 lbf	Class 6 and Class 7 Weights ⁵
	5.5 lbf to 15 lbf	0.022 % + 0.0014 lbf	
	15.5 lbf to 30 lbf	0.015 % + 0.0024 lbf	
	5 lbf	0.067 lbf	Interface Force Measurement 9840 and 1500ASK-100 ⁵
	30.001 lbf to 65 lbf	0.013 % + 0.065 lbf	
	65.001 lbf to 100 lbf	0.020 % + 0.06 lbf	Interface Force Measurement 9840 and 1610AJH-500 ⁵
100.001 lbf to 250 lbf	0.006 % + 0.18 lbf		
250.001 lbf to 500 lbf	0.012 % + 0.17 lbf	Interface Force Measurement 9840 and 1610AJH-1K ⁵	
500.01 lbf to 750 lbf	0.032 % + 0.29 lbf		
750.001 lbf to 1000 lbf	0.038 % + 0.24 lbf	Interface Force Measurement 9840 and 1610AJH-10K ⁵	
1000.001 lbf to 2500 lbf	0.013 % + 3.1 lbf		
2500.1 lbf to 5000 lbf	0.025 % + 2.9 lbf		
5000.1 lbf to 7500 lbf	0.034 % + 2.4 lbf		
7500.1 lbf to 10000 lbf	0.04 % + 1.9 lbf		
Scales and Balances	up to 9 g	0.034 % + 240 µg	Class 5 Weights ⁵
	10 g to 19 g	0.0097 % + 4.7 mg	
	20 g to 35 g	0.011 % + 9.1 mg	
	36 g to 49 g	0.026 % + 3.7 mg	
	50 g to 79 g	0.0081 % + 0.024 g	
	80 g to 99 g	0.0088 % + 0.024 g	
	100 g to 120 g	0.0056 % + 0.051 g	
	121 g to 130 g	0.003 % + 0.054 g	
	131 g to 149 g	0.005 % + 0.051 g	
	150 g to 199 g	0.0032 % + 0.08 g	
	200 g to 210 g	0.0014 % + 0.11 g	
	211 g to 255 g	0.0077 % + 0.097 g	
	256 g to 665 g	0.021 % + 0.063 g	
	666 g to 999 g	0.013 % + 0.12 g	
	1000 g to 2299 g	0.010 % + 0.17 g	
	2300 g to 3100 g	0.0085 % + 0.21 g	
	3101 g to 3999 g	0.0064 % + 0.27 g	
	4000 g to 5099 g	0.0051 % + 0.34 g	
	5100 g to 6669 g	0.0055 % + 0.32 g	
	6670 g to 11375 g	0.0045 % + 0.39 g	
11376 g to 15000 g	0.0038 % + 0.45 g		
15001 g to 30190 g	0.0024 % + 0.81 g		

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Scales and Balances (continued)	67 lb to 70 lb 70.5 lb to 130 lb 130.5 lb to 165 lb 165.5 lb to 200 lb 200.5 lb to 330 lb 330.5 lb to 660 lb 660.5 lb to 1000 lb	0.0051 % + 0.0078 lb 0.0059 % + 0.0079 lb 0.0052 % + 0.0088 lb 0.0045 % + 0.01 lb 0.0014 % + 0.057 lb 0.0013 % + 0.057 lb 0.0012 % + 0.058 lb	Class 6 and Class 7 Weights ⁵
Torque (Wrenches, Screwdrivers, Sensors)	up to 200 lbf-in	0.068 % + 0.016 lbf-in	AKO Torque Specialties TSP-650 P and AKO Torque Specialties TSD011/020BT ⁵
	16.67 lbf-ft to 100 lbf-ft	0.068 % + 0.0082 lbf-ft	AKO Torque Specialties TSP-650 P and AKO Torque Specialties TSD111BT ⁵
	100.1 lbf-ft to 800 lbf-ft	0.068 % + 0.077 lbf-ft	AKO Torque Specialties TSP-650 P and AKO Torque Specialties TSD821 ⁵
Thermal			
Temperature Measuring Devices (Thermocouples, Thermometers, RTDs, Thermistors)	-5 °C to 0 °C 0 °C to 150 °C	0.0015 % + 0.016 °C 0.0077 % + 0.016 °C	Hart Scientific 2560 and Hart Scientific 5615-12 ⁵
	150.0001 °C to 600 °C 600.001 °C to 1000 °C	0.071 % + 0.11 °C 0.07 % + 0.12 °C	Hart Scientific 2560 and Fluke 5624-20 ⁵
Temperature and Humidity Measuring Devices (Probes and Monitors)	0 °C to 50 °C 50 °C to 70 °C	0.06 °C 0.08 °C	Thunder Scientific 2500 ⁵
	10 %RH to 95 %RH at 5 °C to 70 °C	0.5 %RH	
Electrical – DC/LF			
DC Voltage - Source ³	0 mV to 329.9999 mV	16 µV/V + 1 µV	Fluke 5522A ⁵
	0 V to 3.299999 V	9 µV/V + 2 µV	
	0 V to 32.99999 V	9 µV/V + 16 µV	
	30 V to 329.9999 V	14 µV/V + 0.21 mV	
	100 V to 1020.000 V	14 µV/V + 1.2 mV	
DC Current - Source ³	0 µA to 329.999 µA	120 µA/A + 0.02 µA	Fluke 5522A ⁵
	0 mA to 3.29999 mA	78 µA/A + 0.04 µA	
	0 mA to 32.9999 mA	78 µA/A + 0.19 µA	
	0 mA to 329.999 mA	78 µA/A + 2 µA	
	330 mA to 699.999 mA	160 µA/A + 34 µA	Fluke 5522A and Fluke 52120A ⁵
	700 mA to 1 A	78 µA/A + 77 µA	
	1.000001 A to 2 A	78 µA/A + 80 µA	
	2.00001 A to 2.99999 A	300 µA/A + 31 µA	Fluke 5522A ⁵

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DC Current - Source ³ (continued)	3 A to 9.99999 A 10 A to 20 A 20.001 A to 40 A 40.1 A to 100 A	78 μ A/A + 780 μ A 78 μ A/A + 880 μ A 78 μ A/A + 4.7 mA 78 μ A/A + 55 mA	Fluke 5522A and Fluke 52120A ⁵
	100.1 A to 149.999 A 150 A to 549.995 A 550 A to 1025 A	0.39 % + 0.12 A 0.39 % + 0.39 A 0.4 % + 0.39 A	Fluke 5522A and Fluke 5500A/COIL ⁵
DC Resistance - Source ³	20 m Ω 50 m Ω 100 m Ω 120 m Ω 150 m Ω 200 m Ω 400 m Ω 550 m Ω	580 $\mu\Omega$ 580 $\mu\Omega$ 580 $\mu\Omega$ 580 $\mu\Omega$ 580 $\mu\Omega$ 580 $\mu\Omega$ 580 $\mu\Omega$ 580 $\mu\Omega$	Keysight 3458A and Monitored Resistors ⁸
	250 m Ω 350 m Ω	630 $\mu\Omega$ 680 $\mu\Omega$	Fluke 5522A and Fluke 8846A ⁶
	10 m Ω 140 m Ω 180 m Ω 280 m Ω	570 $\mu\Omega$ 630 $\mu\Omega$ 700 $\mu\Omega$ 850 $\mu\Omega$	Fluke 5522A, Fluke 8846A and Voltech CT1000 ⁶
	0 Ω to 10.9999 Ω 11 Ω to 32.9999 Ω 33 Ω to 109.9999 Ω 110 Ω to 329.9999 Ω 330 Ω to 1.099999 k Ω 1.1 k Ω to 3.299999 k Ω 3.3 k Ω to 10.99999 k Ω 11 k Ω to 32.99999 k Ω 33 k Ω to 109.9999 k Ω 110 k Ω to 329.9999 k Ω 330 k Ω to 1.099999 M Ω 1.1 M Ω to 3.299999 M Ω 3.3 M Ω to 10.99999 M Ω 11 M Ω to 32.99999 M Ω 33 M Ω to 109.9999 M Ω 110 M Ω to 329.9999 M Ω	31 $\mu\Omega/\Omega$ + 0.001 Ω 23 $\mu\Omega/\Omega$ + 0.002 Ω 22 $\mu\Omega/\Omega$ + 0.001 Ω 22 $\mu\Omega/\Omega$ + 0.002 Ω 22 $\mu\Omega/\Omega$ + 0.002 Ω 22 $\mu\Omega/\Omega$ + 0.02 Ω 22 $\mu\Omega/\Omega$ + 0.02 Ω 22 $\mu\Omega/\Omega$ + 0.2 Ω 22 $\mu\Omega/\Omega$ + 0.2 Ω 25 $\mu\Omega/\Omega$ + 1.6 Ω 25 $\mu\Omega/\Omega$ + 1.6 Ω 47 $\mu\Omega/\Omega$ + 24 Ω 100 $\mu\Omega/\Omega$ + 59 Ω 190 $\mu\Omega/\Omega$ + 1.9 k Ω 390 $\mu\Omega/\Omega$ + 2.3 k Ω 0.23 % + 80 k Ω	Fluke 5522A ⁵
	330.00 M Ω to 999.9 M Ω 1.0000 G Ω to 9.999 G Ω 10.000 G Ω to 50.00 G Ω 50.01 G Ω to 100.00 G Ω	0.38 % + 15 k Ω 0.76 % + 23 k Ω 2.3 % + 2.5 M Ω 2.3 % + 7.2 M Ω	Fluke 5322A ⁵

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AC Voltage - Source ³ (Sine Wave)	1.0 mV to 32.999 mV (10 Hz to 45 Hz)	620 μ V/V + 5 μ V	Fluke 5522A ⁵
	(45 Hz to 10 kHz)	120 μ V/V + 7 μ V	
	(10 kHz to 20 kHz)	160 μ V/V + 5 μ V	
	(20 kHz to 50 kHz)	780 μ V/V + 6 μ V	
	(50 kHz to 100 kHz)	0.27 % + 11 μ V	
	(100 kHz to 500 kHz)	0.62 % + 39 μ V	
	33 mV to 329.999 mV (10 Hz to 45 Hz)	23 μ V/V + 6 μ V	
	(45 Hz to 10 kHz)	110 μ V/V + 7 μ V	
	(10 kHz to 20 kHz))	120 μ V/V + 6 μ V	
	(20 kHz to 50 kHz)	270 μ V/V + 6 μ V	
	(50 kHz to 100 kHz)	620 μ V/V + 25 μ V	
	(100 kHz to 500 kHz)	0.16 % + 54 μ V	
	0.33 V to 3.29999 V (10 Hz to 45 Hz)	230 μ V/V + 39 μ V	
	(45 Hz to 10 kHz)	120 μ V/V + 57 μ V	
	(10 kHz to 20 kHz)	150 μ V/V + 47 μ V	
(20 kHz to 50 kHz)	230 μ V/V + 40 μ V		
(50 kHz to 100 kHz)	540 μ V/V + 100 μ V		
(100 kHz to 500 kHz)	0.19 % + 0.47 mV		
3.3 V to 32.9999 V (10 Hz to 45 Hz)	230 μ V/V + 0.52 mV		
(45 Hz to 10 kHz)	120 μ V/V + 0.59 mV		
(10 kHz to 20 kHz)	190 μ V/V + 0.57 mV		
(20 kHz to 50 kHz)	270 μ V/V + 0.72 mV		
(50 kHz to 100 kHz)	700 μ V/V + 1.2 mV		
33 V to 329.999 V (45 Hz to 1 kHz)	150 μ V/V + 2.2 mV		
(1 kHz to 10 kHz)	160 μ V/V + 4.7 mV		
(10 kHz to 20 kHz)	190 μ V/V + 4.7 mV		
(20 kHz to 50 kHz)	230 μ V/V + 6.2 mV		
(50 kHz to 100 kHz)	0.16 % + 40 mV		
330 V to 1020 V (45 Hz to 1 kHz)	230 μ V/V + 7.9 mV		
(1 kHz to 5 kHz)	190 μ V/V + 7.8 mV		
(5 kHz to 10 kHz)	230 μ V/V + 7.8 mV		

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AC Current - Source ³ (Sine Wave)	29.00 µA to 329.99 µA		Fluke 5522A ⁵
	(10 Hz to 20 Hz)	0.2 % + 0.1 µA	
	(20 Hz to 45 Hz)	0.12 % + 0.1 µA	
	(45 Hz to 1 kHz)	0.097 % + 0.1 µA	
	(1 kHz to 5 kHz)	0.2 % + 0.12 µA	
	(5 kHz to 10 kHz)	0.6 % + 0.2 µA	
	(10 kHz to 30 kHz)	1.2 % + 0.3 µA	
	0.33 mA to 3.29999 mA		
	(10 Hz to 20 Hz)	0.2 % + 0.12 µA	
	(20 Hz to 45 Hz)	0.097 % + 0.12 µA	
	(45 Hz to 1 kHz)	0.1 % + 0.12 µA	
	(1 kHz to 5 kHz)	0.2 % + 0.2 µA	
	(5 kHz to 10 kHz)	0.4 % + 0.2 µA	
	(10 kHz to 30 kHz)	0.8 % + 0.5 µA	
	3.3 mA to 32.9999 mA		
	(10 Hz to 20 Hz)	0.14 % + 2 µA	
	(20 Hz to 45 Hz)	0.07 % + 2 µA	
	(45 Hz to 1 kHz)	0.03 % + 2 µA	
	(1 kHz to 5 kHz)	0.06 % + 2 µA	
	(5 kHz to 10 kHz)	0.2 % + 2 µA	
	(10 kHz to 30 kHz)	0.3 % + 3 µA	
	33 mA to 329.999 mA		
	(10 Hz to 20 Hz)	0.14 % + 16 µA	
	(20 Hz to 45 Hz)	0.07 % + 16 µA	
(45 Hz to 1 kHz)	0.03 % + 16 µA		
(1 kHz to 5 kHz)	0.08 % + 39 µA		
(5 kHz to 10 kHz)	0.2 % + 78 µA		
(10 kHz to 30 kHz)	0.3 % + 160 µA		
0.33 A to 1.09999 A			
(10 Hz to 45 Hz)	0.14 % + 78 µA		
(45 Hz to 1 kHz)	0.04 % + 78 µA		
(1 kHz to 5 kHz)	0.5 % + 780 µA		
(5 kHz to 10 kHz)	1.9 % + 3.9 mA		
1.1 A to 2.99999 A			
(10 Hz to 45 Hz)	0.14 % + 78 µA		
(45 Hz to 1 kHz)	0.04 % + 78 µA		
(1 kHz to 5 kHz)	0.5 % + 780 µA		
(5 kHz to 10 kHz)	1.9 % + 3.9 mA		
3 A to 10.9999 A			
(45 Hz to 100 Hz)	0.05 % + 1.6 mA		
(100 Hz to 1 kHz)	0.08 % + 1.6 mA		
(1 kHz to 5 kHz)	2.3 % + 1.6 mA		

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AC Current - Source ³ (Sine Wave) (continued)	11 A to 20 A (10 Hz to 45 Hz) (45 Hz to 65 Hz) (65 Hz to 300 Hz) (300 Hz to 1 kHz) (1 kHz to 3 kHz) (3 kHz to 6 kHz) (6 kHz to 10 kHz)	260 μ A/A + 8.1 mA 160 μ A/A + 8.9 mA 260 μ A/A + 9.1 mA 780 μ A/A + 9.3 mA 0.23 % + 31 mA 0.78 % + 62 mA 2.3 % + 93 mA	Fluke 5522A and Fluke 52120A ⁵
	20.001 A to 32.999 A (10 Hz to 45 Hz) (45 Hz to 65 Hz) (65 Hz to 300 Hz) (300 Hz to 1 kHz) (1 kHz to 3 kHz) (3 kHz to 6 kHz)	260 μ A/A + 16 mA 160 μ A/A + 18 mA 260 μ A/A + 28 mA 780 μ A/A + 93 mA 0.23 % + 230 mA 0.78 % + 420 mA	
	33 A to 40 A (10 Hz to 45 Hz) (45 Hz to 65 Hz) (65 Hz to 300 Hz) (300 Hz to 1 kHz) (1 kHz to 3 kHz) (3 kHz to 6 kHz)	260 μ A/A + 17 mA 160 μ A/A + 19 mA 260 μ A/A + 28 mA 780 μ A/A + 93 mA 0.23 % + 230 mA 0.78 % + 420 mA	
	40.1 A to 120 A (10 Hz to 45 Hz) (45 Hz to 65 Hz) (65 Hz to 300 Hz) (300 Hz to 500 Hz)	260 μ A/A + 53 mA 160 μ A/A + 56 mA 260 μ A/A + 59 mA 780 μ A/A + 120 mA	
	120.1 A to 149.9 A (45 Hz to 65 Hz) (65 Hz to 100 Hz) (100 Hz to 440 Hz)	0.24 % + 26 mA 0.62 % + 24 mA 0.66 % + 46 mA	Fluke 5522A and Fluke 5500A/COIL ⁵
	150 A to 1025 A (45 Hz to 65 Hz) (65 Hz to 100 Hz)	0.24 % + 0.11 A 0.62 % + 0.11 A	
	150 A to 400 A (100 Hz to 440 Hz)	0.99 % + 0.21 A	
Duty Cycle - Source ³	30 % (signal at 500 Hz) 50 % (signal at 2 kHz)	0.014 % Duty 0.06 % Duty	Fluke 5522A ⁵
Phase - Source ³	-90° @ 1 kHz 90° @ 1 kHz	0.39° 0.39°	Fluke 5522A ⁵

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Power Factor - Source ³	0.3 0.4 0.6 0.8 1	0.0013 0.0012 0.0011 0.00081 0.000058	Fluke 5522A ⁵
Capacitance - Source ³	220 pF to 399.9 pF 0.4 nF to 1.0999 nF 1.1 nF to 3.2999 nF 3.3 nF to 10.9999 nF 11 nF to 32.9999 nF 33 nF to 109.999 nF 110 nF to 329.999 nF 0.33 μF to 1.09999 μF 1.1 μF to 3.29999 μF 3.3 μF to 10.9999 μF 11 μF to 32.9999 μF 33 μF to 109.999 μF 110 μF to 329.999 μF 0.33 mF to 1.09999 mF 1.1 mF to 3.29999 mF 3.3 mF to 10.9999 mF 11 mF to 32.9999 mF 33 mF to 110 mF	0.4 % + 8 pF 0.4 % + 0.01 nF 0.4 % + 0.01 nF 0.19 % + 0.04 nF 0.19 % + 0.09 nF 0.19 % + 0.43 nF 0.19 % + 0.41 nF 0.19 % + 4 nF 0.19 % + 4 nF 0.19 % + 43 nF 0.31 % + 36 nF 0.35 % + 360 nF 0.35 % + 350 nF 0.35 % + 4 μF 0.35 % + 4 μF 0.35 % + 36 μF 0.58 % + 31 μF 0.9 % + 82 μF	Fluke 5522A ⁵
DC Power - Source ³	33 mV to 1020 V (0.33 mA to 329.99 mA) (0.33 A to 2.9999 A) (3 A to 20.5 A)	% Watts output 0.018 0.018 0.05	Fluke 5522A ⁵
AC Power - Source ³ (45 Hz to 65 Hz)	33 mV to 329.999 mV (3.3 mA to 8.999 mA) (9 mA to 32.999 mA) (33 mA to 89.99 mA) (90 mA to 329.99 mA) 330 mV to 600 V (3.3 mA to 8.999 mA) (9 mA to 32.999 mA) (33 mA to 89.99 mA) (90 mA to 329.99 mA) 33 mV to 329.999 mV (0.33 A to 0.8999 A) (0.9 A to 2.1999 A) (2.2 A to 4.4999 A) (4.5 A to 20.5 A)	% Watts output 0.22 0.09 0.22 0.09 0.09 0.06 0.09 0.06 0.2 0.12 0.11 0.12	Fluke 5522A ⁵

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AC Power - Source ³ (45 Hz to 65 Hz) (continued)	330 mV to 1020 V (0.33 A to 0.8999 A) (0.9 A to 2.1999 A) (2.2 A to 4.4999 A) (4.5 A to 20.5 A)	% Watts output 0.09 0.07 0.09 0.08	Fluke 5522A ⁵
AC Energy - Source ³ (60 Hz) Watt-Hours	10 mWh 1 Wh 100 Wh 500 Wh 1 kWh 50 kWh	7.6 µWh 740 µWh 94 mWh 400 mWh 0.74 Wh 35 Wh	Fluke 5522A and Computer clock ⁷
Simulated Temperature - Source ³			Fluke 5522A ⁵
TC Type J	-210 °C to -100 °C -100 °C to -30 °C -30 °C to 150 °C 150 °C to 760 °C 760 °C to 1200 °C	0.21 °C 0.12 °C 0.11 °C 0.15 °C 0.18 °C	
TC Type K	-200 °C to -100 °C -100 °C to -25 °C -25 °C to 120 °C 120 °C to 1000 °C 1000 °C to 1372 °C	0.26 °C 0.14 °C 0.13 °C 0.20 °C 0.31 °C	
TC Type T	-250 °C to -150 °C -150 °C to 0 °C 0 °C to 120 °C 120 °C to 400 °C	0.49 °C 0.19 °C 0.12 °C 0.11 °C	
RTD Type Pt 385, 100 Ω	-200 °C to 0 °C 0.001 °C to 100 °C 100.001 °C to 300 °C 300.001 °C to 400 °C 400.001 °C to 630 °C	0.04 °C 0.05 °C 0.07 °C 0.08 °C 0.09 °C	
RTD Type Pt 3916, 100 Ω	-200 °C to -190.001 °C -190 °C to -80 °C -80.001 °C to 0 °C 0.001 °C to 260 °C 260.001 °C to 300 °C 300.001 °C to 400 °C 400.001 °C to 600 °C 600.001 °C to 630 °C	0.19 °C 0.03 °C 0.04 °C 0.05 °C 0.06 °C 0.07 °C 0.08 °C 0.18 °C	

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MEASURED QUANTITY or DEVICE TYPE CALIBRATED	RANGE	UNCERTAINTY ^{1,2} (±)	CALIBRATION METHOD OR PROCEDURE, STANDARD EQUIPMENT (OPTIONAL)
Simulated Temperature - Source ³ (continued)			Fluke 5522A ⁵
RTD Type Pt 385, 200 Ω	-200 °C to 100 °C 100.001 °C to 260 °C	0.03 °C 0.04 °C	
RTD Type Cu 427, 10 Ω	-100 °C to 260 °C	0.23 °C	
DC Voltage - Measure ⁴	0 mV to 119.9999 mV 120 mV to 1.199999 V 1.2 V to 11.99999 V 12 V to 119.9999 V 120 V to 1000 V	0.0029 % + 2.7 μV 0.0019 % + 5.5 μV 0.0019 % + 39 μV 0.0029 % + 470 μV 0.0032 % + 7.8 mV	Fluke 8846A ⁵
	1 kV to 2 kV 2 kV to 3 kV 3 kV to 4 kV 4 kV to 5 kV 5 kV to 6 kV	0.93 % + 6.7 V 1 % + 4.3 V 1.1 % + 3.1 V 1.1 % + 1.2 V 1.1 % + 4 V	Fluke 8846A and Fluke 80k-6 ⁵
AC Voltage - Measure ⁴	0 mV to 119.9999 mV (5 Hz to 10 Hz) (10 Hz to 20 kHz) (20 kHz to 50 kHz) (50 kHz to 100 kHz) (100 kHz to 300 kHz)	0.27 % + 390 μV 0.05 % + 31 μV 0.09 % + 39 μV 0.47 % + 62 μV 3.1 % + 0.39 mV	Fluke 8846A ⁵
	120 mV to 1.199999 V (5 Hz to 10 Hz) (10 Hz to 20 kHz) (20 kHz to 50 kHz) (50 kHz to 100 kHz) (100 kHz to 300 kHz)	0.27 % + 1.4 mV 0.05 % + 0.23 mV 0.09 % + 0.39 mV 0.47 % + 0.62 mV 3.1 % + 3.9 mV	
	1.2 V to 11.99999 V (5 Hz to 10 Hz) (10 Hz to 20 kHz) (20 kHz to 50 kHz) (50 kHz to 100 kHz)	0.27 % + 2.7 mV 0.05 % + 2.3 mV 0.09 % + 3.9 mV 0.47 % + 6.2 mV	
	12 V to 119.9999 V (10 Hz to 20 kHz) (20 kHz to 50 kHz) (50 kHz to 100 kHz)	0.05 % + 23 mV 0.09 % + 39 mV 0.47 % + 62 mV	
	120 V to 1000 V (10 Hz to 20 kHz)	0.05 % + 0.17 V	

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AC Voltage - Measure ⁴ (continued)	1 kV to 2 kV (10 Hz to 500 Hz)	0.93 % + 7 V	Fluke 8846 and Fluke 80k-6 ⁵
	2 kV to 3 kV (10 Hz to 500 Hz)	1 % + 4.5 V	
	3 kV to 4 kV (10 Hz to 500 Hz)	1.1 % + 3.3 V	
	4 kV to 5 kV (10 Hz to 500 Hz)	1.1 % + 2.8 V	
DC Resistance - Measure ⁴	0 Ω to 11.99999 Ω	0.0078 % + 2.3 mΩ	Fluke 8846A ⁵
	12 Ω to 119.9999 Ω	0.0078 % + 3.1 mΩ	
	120 Ω to 1.199999 kΩ	0.0078 % + 7.8 mΩ	
	1.2 kΩ to 11.99999 kΩ	0.0078 % + 78 mΩ	
	12 kΩ to 119.9999 kΩ	0.0078 % + 0.78 Ω	
	120 kΩ to 1.199999 MΩ	0.0078 % + 7.9 Ω	
	1.2 MΩ to 11.99999 MΩ	0.031 % + 78 Ω	
	12 MΩ to 119.9999 MΩ	0.62 % + 7.8 kΩ	
DC Current - Measure ⁴	0 μA to 119.9999 μA	0.039 % + 19 nA	Fluke 8846A ⁵
	120 μA to 1.199999 mA	0.039 % + 39 nA	
	1.2 mA to 11.99999 mA	0.039 % + 1.6 μA	
	12 mA to 119.9999 mA	0.039 % + 3.9 μA	
	120 mA to 550.000 mA	0.039 % + 16 μA	
	550.001 mA to 1.199999 A	0.039 % + 0.16 mA	
	1.2 A to 3.59999 A	0.078 % + 0.47 mA	
3.6 A to 10 A	0.12 % + 0.62 mA		
AC Current - Measure ⁴	0 μA to 119.9999 μA (5 Hz to 10 Hz) (10 Hz to 5 kHz) (5 kHz to 10 kHz)	0.27 % + 180 nA 0.12 % + 47 nA 0.27 % + 0.54 μA	Fluke 8846A ⁵
	120 μA to 1.199999 mA (5 Hz to 10 Hz) (10 Hz to 5 kHz) (5 kHz to 10 kHz)	0.23 % + 0.39 μA 0.08 % + 0.31 μA 0.16 % + 1.9 μA	
	1.2 mA to 11.99999 mA (5 Hz to 10 Hz) (10 Hz to 5 kHz) (5 kHz to 10 kHz)	0.27 % + 17 μA 0.12 % + 4.7 μA 0.27 % + 54 μA	
	12 mA to 119.9999 mA (5 Hz to 10 Hz) (10 Hz to 5 kHz) (5 kHz to 10 kHz)	0.23 % + 160 μA 0.08 % + 31 μA 0.16 % + 0.19 mA	

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AC Current - Measure ⁴ (continued)	120 mA to 550.000 mA (5 Hz to 10 Hz) (10 Hz to 5 kHz) (5 kHz to 10 kHz)	0.23 % + 0.38 mA 0.08 % + 0.31 mA 0.16 % + 2.2 mA	Fluke 8846A ⁵
	550.001 mA to 1.199999 A (5 Hz to 10 Hz) (10 Hz to 5 kHz) (5 kHz to 10 kHz)	0.23 % + 1.7 mA 0.08 % + 0.31 mA 0.27 % + 5.4 mA	
	1.2 A to 3.59999 A (10 Hz to 5 kHz)	0.12 % + 1.4 mA	
	3.6 A to 10 A (10 Hz to 5 kHz)	0.12 % + 4.7 mA	
	10.0001 A to 11.9999 A (50 Hz to 60 Hz)	0.3 % + 2.1 mA	
	12 A to 60 A (50 Hz to 60 Hz)	0.28 % + 18 mA	Fluke 8846A and Voltech CT10005
Capacitance - Measure ⁴	0 nF to 1.199 nF 1.2 nF to 11.99 nF 12 nF to 119.9 nF 120 nF to 1.199 µF 1.2 µF to 11.99 µF 12 µF to 119.9 µF 120 µF to 1.199 mF 1.2 mF to 11.99 mF 12 mF to 119.9 mF	1.6 % + 19 pF 0.78 % + 39 pF 0.78 % + 0.39 nF 0.78 % + 3.9 nF 0.78 % + 39 nF 0.78 % + 0.39 µF 0.78 % + 3.9 µF 0.78 % + 39 µF 3.1 % + 0.16 mF	Fluke 8846A ⁵
Leakage (Touch) Current Network Box (output voltage to input voltage ratio)			Fluke 5522A and Keysight 3458A ⁵
IEC 60990:2016 Figure 3 (unweighted touch current)	0.250 V/V @ 20 Hz 0.251 V/V @ 50 Hz 0.252 V/V @ 60 Hz 0.255 V/V @ 100 Hz 0.269 V/V @ 200 Hz 0.349 V/V @ 500 Hz 0.511 V/V @ 1 kHz 0.740 V/V @ 2 kHz 0.937 V/V @ 5 kHz 0.983 V/V @ 10 kHz 0.996 V/V @ 20 kHz 0.999 V/V @ 50 kHz 1.00 V/V @ 100 kHz	7.7E-05 V/V 4.8E-05 V/V 4.8E-05 V/V 4.8E-05 V/V 5.1E-05 V/V 6.4E-05 V/V 9.0E-05 V/V 1.5E-04 V/V 1.8E-04 V/V 1.9E-04 V/V 2.2E-04 V/V 3.4E-04 V/V 8.4E-04 V/V	

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IEC 60990:2016 Figure 3 (unweighted touch current) (continued)	1.00 V/V @ 200 kHz	3.1E-03 V/V	Fluke 5522A and Keysight 3458A ⁵
	1.00 V/V @ 500 kHz	7.0E-03 V/V	
	1.00 V/V @ 1 MHz	9.4E-03 V/V	
IEC 60990:2016 Figure 4 (touch current weighted for perception or startle-reaction)	0.250 V/V @ 20 Hz	7.7E-05 V/V	
	0.251 V/V @ 50 Hz	4.8E-05 V/V	
	0.251 V/V @ 60 Hz	4.8E-05 V/V	
	0.252 V/V @ 100 Hz	4.8E-05 V/V	
	0.259 V/V @ 200 Hz	4.9E-05 V/V	
	0.282 V/V @ 500 Hz	5.3E-05 V/V	
	0.292 V/V @ 1 kHz	5.4E-05 V/V	
	0.246 V/V @ 2 kHz	5.4E-05 V/V	
	0.133 V/V @ 5 kHz	3.4E-05 V/V	
	0.0708 V/V @ 10 kHz	1.6E-05 V/V	
	0.0360 V/V @ 20 kHz	1.0E-05 V/V	
	0.0145 V/V @ 50 kHz	9.5E-06 V/V	
	0.00723 V/V @ 100 kHz	2.6E-05 V/V	
	0.00362 V/V @ 200 kHz	9.7E-05 V/V	
	0.00145 V/V @ 500 kHz	1.7E-05 V/V	
0.000723 V/V @ 1 MHz	1.0E-05 V/V		
IEC 60990:2016 Figure 5 (touch current weighted for letgo-immobilization)	0.250 V/V @ 20 Hz	7.7E-05 V/V	
	0.251 V/V @ 50 Hz	4.8E-05 V/V	
	0.251 V/V @ 60 Hz	4.8E-05 V/V	
	0.253 V/V @ 100 Hz	4.8E-05 V/V	
	0.261 V/V @ 200 Hz	4.9E-05 V/V	
	0.298 V/V @ 500 Hz	5.5E-05 V/V	
	0.348 V/V @ 1 kHz	6.4E-05 V/V	
	0.377 V/V @ 2 kHz	7.8E-05 V/V	
	0.280 V/V @ 5 kHz	6.0E-05 V/V	
	0.164 V/V @ 10 kHz	3.9E-05 V/V	
	0.0860 V/V @ 20 kHz	2.0E-05 V/V	
	0.0349 V/V @ 50 kHz	1.8E-05 V/V	
	0.0175 V/V @ 100 kHz	1.7E-05 V/V	
	0.00874 V/V @ 200 kHz	2.3E-04 V/V	
	0.00350 V/V @ 500 kHz	3.4E-05 V/V	
0.00175 V/V @ 1 MHz	2.0E-05 V/V		
IEC 60601-1 Figure 12 (touch current medical)	1.000 V/V @ 20 Hz	2.8E-04 V/V	
	0.999 V/V @ 50 Hz	1.7E-04 V/V	
	0.998 V/V @ 60 Hz	1.7E-04 V/V	
	0.996 V/V @ 100 Hz	1.7E-04 V/V	
	0.983 V/V @ 200 Hz	1.7E-04 V/V	
	0.905 V/V @ 500 Hz	1.6E-04 V/V	
	0.728 V/V @ 1 kHz	1.3E-04 V/V	
	0.469 V/V @ 2 kHz	9.5E-05 V/V	

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IEC 60601-1 Figure 12 (touch current medical) (continued)	0.208 V/V @ 5 kHz 0.1055 V/V @ 10 kHz 0.0530 V/V @ 20 kHz 0.02122 V/V @ 50 kHz 0.01061 V/V @ 100 kHz 0.00531 V/V @ 200 kHz 0.002122 V/V @ 500 kHz 0.001061 V/V @ 1 MHz	4.7E-05 V/V 2.2E-05 V/V 1.4E-05 V/V 1.2E-05 V/V 3.7E-05 V/V 1.4E-04 V/V 2.4E-05 V/V 1.3E-05 V/V	Fluke 5522A and Keysight 3458A ⁵
Time and Frequency			
Time (Timing functions in electrical equipment, computers, stopwatches)	28 h	1.1 s	U.S. Naval Observatory Clock ⁵
	10 s/day	58 ms/day	Greiner Timometer 4500 ⁵
Time (Timing functions in electrical equipment, computers)	1.000 s to 100.000 s 100.001 s to 500.000 s 500.001 s to 1000.000 s 1000.001 s to 2000.000 s 2000.001 s to 3000.000 s 3000.001 s to 4000.000 s	2.8 ms 370 ns/s + 2.8 ms 880 ns/s + 2.6 ms 1.4 µs/s + 2.1 ms 1.6 µs/s + 1.6 ms 1.9 µs/s + 0.78 ms	Fluke 5522A and Keysight 53220A ⁵
Frequency - Source ³	0.5 Hz to 2.99 Hz 3 Hz to 19.99999 Hz 20 Hz to 199.9999 Hz 200 Hz to 1.999999 kHz 2 kHz to 19.99999 kHz 20 kHz to 199.9 kHz 200 kHz to 999.9999 kHz 1 MHz to 2 MHz	1.9 µHz/Hz + 5.8 mHz 1.9 µHz/Hz + 6 µHz 1.9 µHz/Hz + 85 µHz 1.9 µHz/Hz + 870 µHz 1.9 µHz/Hz + 3.1 mHz 1.9 µHz/Hz + 31 mHz 1.9 µHz/Hz + 4.3 mHz 1.9 µHz/Hz + 99 mHz	Fluke 5522A ⁵
Frequency - Measure ⁴	5 Hz to 10 Hz 10 Hz to 40 Hz 40 Hz to 1 MHz	0.039 % 0.023 % 0.0078 %	Fluke 8846A ⁵
Chemical/Gas			
Gaseous fuel heating value (Calorimeter, Gas Chromatograph)	800 BTU/SCF to 1600 BTU/SCF	1.2 BTU/SCF	Compressed Gas Calibration Gases: Reference material (EPA Protocol Grade) ⁵
	1600 BTU/SCF to 3200 BTU/SCF	1.9 BTU/SCF	
2000 BTU/SCF to 3800 BTU/SCF	2.3 BTU/SCF		
	900 BTU/SCF to 1100 BTU/SCF	0.38 BTU/SCF	Compressed Gas Calibration Gases: Reference material (EPA Protocol Grade) ⁵
Flue Gas Analysis			Compressed Gas Calibration Gases: Reference material (EPA Protocol Grade) ⁵
CO	1 ppm to 5000 ppm	0.67 %	
CO ₂	0.1 % to 25 %	0.67 %	
NO _x	1 ppm to 500 ppm	0.67 %	

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¹The uncertainty covered by the Calibration and Measurement Capability (CMC) is expressed as the expanded uncertainty having a coverage probability of approximately 95 %. It is the smallest measurement uncertainty that a laboratory can achieve within its scope of accreditation when performing calibrations of a best existing device. The measurement uncertainty reported on a calibration certificate may be greater than that provided in the CMC due to the behavior of the calibration item and other factors that may contribute to the uncertainty of a specific calibration.

²When uncertainty is stated in relative terms (such as percent, a multiplier expressed as a decimal fraction or in scientific notation), it is in relation to instrument reading or instrument output, as appropriate, unless otherwise indicated.

³Capability is suitable for the calibration of measuring devices in the stated ranges.

⁴Capability is suitable for the calibration of devices intended to generate the indicated quantity in the stated ranges.

⁵Lab Procedures using Direct Comparison.

⁶Lab Procedures using Ohm's law.

⁷Lab Procedures using Indirect Comparison.

⁸Lab Procedures using comparison to monitored resistor artifacts.

⁹In the statement of CMC, L is the length in millimeters.

ppm = parts per million

SCFM = standard cubic feet per minute

SCFH = standard cubic feet per hour

gal = US gallon

BTU/SCF = British Thermal Unit per Standard Cubic Foot