



CERTIFICATE OF ACCREDITATION

ANSI National Accreditation Board
11617 Coldwater Road, Fort Wayne, IN 46845 USA

This is to certify that

Calibration Laboratory, LLC
3330 East 83rd Place
Merrillville, IN 46410
(and satellite location as listed on the scope)

has been assessed by ANAB and meets the requirements of international standard

ISO/IEC 17025:2017

and national standards

ANSI/NCSL Z540-1-1994 (R2002) and
ANSI/NCSL Z540.3-2006 (R2013)

while demonstrating technical competence in the field of

CALIBRATION AND DIMENSIONAL MEASUREMENT

Refer to the accompanying Scope of Accreditation for information regarding the types of activities to which this accreditation applies

L2216
Certificate Number


ANAB Approval

Certificate Valid Through: 02/15/2021
Version No. 004 Issued: 02/13/2019



This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017. 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).



ANSI National Accreditation Board

SCOPE OF ACCREDITATION TO ISO/IEC 17025:2017, ANSI/NCSL Z540-1-1994 (R2002), AND ANSI/NCSL Z540.3-2006 (R2013)

Calibration Laboratory, LLC

3330 East 83rd Place
Merrillville, IN 46410
Glenn Haag 708-596-5800

CALIBRATION AND DIMENSIONAL MEASUREMENT

Valid to: February 15, 2021

Certificate Number: L2216

Chemical Quantities

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
pH Meters (Fixed Points) ¹	4, 7 & 10 pH	0.05 pH	Buffer Solutions and RTD Probe

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Capacitance – Measure @ 1 kHz	(0.1 to 10) pF (10 to 100) pF 100 pF to 10 μ F (10 to 100) μ F (100 to 1 000) μ F	4.8 mF/F 0.6 mF/F 0.26 mF/F 0.6 mF/F 4.7 mF/F	GenRad 1689M LCR Meter



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Capacitance – Source ¹	0.1 nF	0.5 pF	Arco SS-32 Capacitors
	0.2 nF	0.5 pF	
	0.3 nF	0.5 pF	
	0.4 nF	0.5 pF	
	0.5 nF	0.5 pF	
	0.6 nF	0.6 pF	
	0.7 nF	0.7 pF	
	0.8 nF	0.8 pF	
	0.9 nF	0.9 pF	
	1 nF	1 pF	
	2 nF	2 pF	
	3 nF	3 pF	
	4 nF	4 pF	
	5 nF	5 pF	
	6 nF	6 pF	
	7 nF	7 pF	
	8 nF	8 pF	
	9 nF	9 pF	
	10 nF	10 pF	
	20 nF	20 pF	
	30 nF	30 pF	
	40 nF	40 pF	
	50 nF	50 pF	
	60 nF	60 pF	
	70 nF	70 pF	
	80 nF	80 pF	
	90 nF	90 pF	
	100 nF	100 pF	
	200 nF	200 pF	
	300 nF	300 pF	
400 nF	400 pF		
500 nF	500 pF		



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Capacitance – Source ¹	(0.19 to 3.3) nF (3.3 to 11) nF (11 to 110) nF (110 to 330) nF (0.33 to 1.1) μF (1.1 to 3.3) μF (3.3 to 11) μF (11 to 33) μF (33 to 110) μF (110 to 330) μF (0.33 to 1.1) mF (1.1 mF to 3.3) mF (3.3 to 11) mF (11 to 33) mF (33 to 110) mF	0.008 nF + 0.004 nF/nF 0.008 nF + 0.002 nF/nF 0.08 nF + 0.002 nF/nF 0.23 nF + 0.002 nF/nF 0.75 nF + 0.002 μF/μF 2.3 nF + 0.002 μF/μF 8 nF + 0.002 μF/μF 23 nF + 0.003 μF/μF 0.08 μF + 0.003 μF/μF 0.23 μF + 0.003 μF/μF 0.78 μF + 0.003 μF/μF 2.3 μF + 0.004 mF/mF 7.6 μF + 0.004 mF/mF 23 μF + 0.006 mF/mF 0.08 mF + 0.009 mF/mF	Fluke 5522A/SC1100 Multi Product Calibrator
AC Current - Source	(9 to 220) μA (10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (0.22 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 (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	20 nA + 0.3 nA/μA 12 nA + 0.2 nA/μA 10 nA + 0.12 nA/μA 15 nA + 0.35 nA/μA 80 nA + 1.3 nA/μA 50 nA + 0.3 nA/μA 40 nA + 0.2 nA/μA 40 nA + 0.12 nA/μA 130 nA + 0.24 nA/μA 800 nA + 1.3 nA/μA 0.5 μA + 0.3 nA/μA 0.4 μA + 0.2 nA/μA 0.4 μA + 0.12 nA/μA 0.7 μA + 0.24 nA/μA 6 μA + 1.3 nA/μA	Fluke 5730A Multi Product Calibrator



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current - Source	(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	4 μ A + 0.25 nA/ μ A 3.5 μ A + 0.16 nA/ μ A 2.5 μ A + 0.1 nA/ μ A 3.5 μ A + 0.2 nA/ μ A 10 μ A + 1.1 nA/ μ A	Fluke 5730A Multi Product Calibrator
	(0.22 to 2.2) A 20 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	35 μ A + 0.25 nA/ μ A 80 μ A + 0.45 nA/ μ A 160 μ A + 7 nA/ μ A	
	(2.2 to 11) A 40 Hz to 1kHz (1 to 5) kHz (5 to 10) kHz	0.17 mA + 0.46 mA/A 0.38 mA + 0.95 mA/A 0.75 mA + 3.6 mA/A	Fluke 5730A Multi Product Calibrator Fluke 5725A
AC Current - Source	(0.2 to 2) A 10 Hz to 850 Hz 850 Hz to 6 kHz 6 kHz to 10 kHz	36 μ A + 0.11 mA/A 72 μ A + 0.44 mA/A 62 mA \pm 16 mA/A	Fluke 5730A Multi Product Calibrator Fluke 52120A
	(2 to 20) A 10 Hz to 850 Hz 850 Hz to 6 kHz 6 kHz to 10 kHz	36 μ A + 0.11 mA/A 72 μ A + 0.44 mA/A 94 mA + 23 mA/A	
	(20 to 120) A 10 Hz to 850 Hz 850 Hz to 6 kHz 6 kHz to 10 kHz	36 μ A + 0.11 mA/A 72 μ A + 0.44 mA/A 700 mA + 31 mA/A	



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current – Source ¹	(30 to 330) μ A		Fluke 5522A/SC1100 Multi Product Calibrator
	(10 to 20) Hz	0.08 μ A + 1.6 nA/ μ A	
	(20 to 45) Hz	0.08 μ A + 1.2 nA/ μ A	
	45 Hz to 1 kHz	0.08 μ A + 1 nA/ μ A	
	(1 to 5) kHz	0.12 μ A + 2.3 nA/ μ A	
	(5 to 10) kHz	0.16 μ A + 6.2 nA/ μ A	
	(10 to 30) kHz	0.31 μ A + 12 nA/ μ A	
	(0.33 to 3.3) mA		
	(10 to 20) Hz	0.12 μ A + 1.6 μ A/mA	
	(20 to 45) Hz	0.12 μ A + 0.97 μ A/mA	
	45 Hz to 1 kHz	0.12 μ A + 0.78 μ A/mA	
	(1 to 5) kHz	0.16 μ A + 1.6 μ A/mA	
	(5 to 10) kHz	0.23 μ A + 3.9 μ A/mA	
	(10 to 30) kHz	0.47 μ A + 7.8 μ A/mA	
	(3.3 to 33) mA		
	(10 to 20) Hz	1.6 μ A + 1.4 μ A/mA	
	(20 to 45) Hz	1.6 μ A + 0.7 μ A/mA	
	45 Hz to 1 kHz	1.6 μ A + 0.31 μ A/mA	
	(1 to 5) kHz	1.6 μ A + 0.62 μ A/mA	
	(5 to 10) kHz	2.3 μ A + 1.6 μ A/mA	
	(10 to 30) kHz	3.1 μ A + 3.1 μ A/mA	
	(33 to 330) mA		
	(10 to 20) Hz	16 μ A + 1.4 μ A/mA	
	(20 to 45) Hz	16 μ A + 0.7 μ A/mA	
	45 Hz to 1 kHz	16 μ A + 0.31 μ A/mA	
	(1 to 5) kHz	39 μ A + 0.78 μ A/mA	
	(5 to 10) kHz	78 μ A + 1.6 μ A/mA	
10 kHz to 30 kHz	0.16 mA + 3.1 μ A/mA		
(0.33 to 1.1) A			
(10 to 45) Hz	0.14 mA + 1.2 μ A/mA		
45 Hz to 1 kHz	0.094 mA + 0.34 μ A/mA		
(1 to 5) kHz	0.98 mA + 4.1 μ A/mA		
(5 to 10) kHz	3.9 mA + 19 μ A/mA		



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current – Source ¹	(1.1 to 3) A (10 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (3 to 11) A (45 to 100) Hz 100 Hz to 1 kHz (1 to 5) kHz (11 to 20) A (45 to 100) Hz 100 Hz to 1 kHz (1 to 5) kHz	0.078 mA + 1.4 mA/A 0.078 mA + 0.47 mA/A 0.78 mA + 4.7 mA/A 3.9 mA + 19 mA/A 1.6 mA + 0.47 mA/A 1.6 mA + 0.78 mA/A 1.6 mA + 23 mA/A 3.9 mA + 0.93 mA/A 3.9 mA + 1.2 mA/A 3.9 mA + 23 mA/A	Fluke 5522A/SC1100 Multi Product Calibrator
AC Current Source – Current Clamps ¹	(45 to 65) Hz (10 to 16.5) A (16.5 to 150) A (150 to 1 025) A (65 to 440) Hz (10 to 16.5) A (16.5 to 150) A (150 to 1 025) A	0.021 A + 1.6 mA/A 0.28 A + 1.1 mA/A 0.12 A + 2.4 mA/A 0.036 A + 4.4 mA/A 0.22 A + 5.2 mA/A 0.094 A + 6.4 mA/A	Fluke 5522A/SC1100 Multi Product Calibrator Fluke 50-Turn Coil
AC Current Source – Current Clamps	(0.2 to 25) A (6 kHz to 10 kHz) (0.2 to 50) A (3 kHz to 6 kHz) (0.2 to 50) A (1 kHz to 3 kHz) (0.2 to 50) A 10 Hz to 1 kHz (50 to 75) A (3 kHz to 6 kHz) (50 to 300) A (1 kHz to 3 kHz) (50 to 500) A 10 Hz to 1 kHz (500 to 1 000) A 300 Hz to 1 kHz (500 to 3 000) A 10 Hz to 300 Hz	16 mA + 39 mA/A 16 mA + 12 mA/A 16 mA + 6.2 mA/A 11 mA + 5.4 mA/A 150 mA + 12 mA/A 160 mA + 6.2 mA/A 110 mA + 5.4 mA/A 660 mA + 5.4 mA/A 650 mA + 5.4 mA/A	Fluke 5730A Multi Product Calibrator Fluke 52120A Fluke 3KA 25-Turn Coil



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
DC Current – Source ¹	0 μ A to 330 μ A 0.3 mA to 3.3 mA 3.3 mA to 33 mA 33 mA to 330 mA 0.33 A to 1.1 A 1.1 A to 3 A 3 A to 11 A 11 A to 20 A	23 nA + 0.11 nA/ μ A 41 nA + 0.077 μ A/mA 0.24 μ A + 0.081 μ A/mA 2 μ A + 0.078 μ A/ μ A 31 μ A + 0.16 mA/A 32 μ A + 0.29 mA/A 0.39 mA + 0.39 mA/A 0.58 mA + 0.78 mA/A	Fluke 5522A/SC1100 Multi Product Calibrator
DC Current – Source	(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	6 nA + 40 μ A/A 7 nA + 35 μ A/A 40 nA + 35 μ A/A 0.7 μ A + 45 μ A/A 12 μ A + 80 μ A/A	Fluke 5730A Multi Product Calibrator
	(2.2 to 11) A	0.48 mA + 0.36 mA/A	Fluke 5730A Multi Product Calibrator Fluke 5725A Amplifier
DC Current – Source	(0 to 120) A	80 μ A + 0.12 mA/A	Fluke 52120A Amplifier
DC Current Source – Current Clamps ¹	(10 to 150) A (150 to 1 025) A	1.3 mA + 2 mA/A 0.13 A + 2 mA/A	Fluke 5522A/SC1100 Multi Product Calibrator Fluke 50-Turn Coil
DC Current Source – Current Clamps	(0 to 2 500) A	11 mA + 5.7 mA/A	Fluke 5730A Multi Product Calibrator Fluke 52120A Fluke 3KA 25-Turn Coil
DC Current – Measure	0.01 nA to 10 nA	5.9 pA + 14 700 μ A/A	Transmille 8081 Multimeter
	(0 to 200) μ A 200 μ A to 2 mA (2 to 20) mA (20 to 200) mA 200 mA to 2 A (2 to 20) A	17 pA + 30 μ A/A 4.2 nA + 12 μ A/A 41 nA + 0.014 μ A/mA 0.82 μ A + 0.049 μ A/mA 16 μ A + 200 μ A/A 0.41 mA + 0.4 mA/A	Fluke 8508A Multimeter
	(20 to 30) A	4.3 mA + 764 μ A/A	Transmille 8081 Multimeter



Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
DC Current – Measure	(30 to 3 000) A	0.81 A + 0.107 mA/A	Empro Shunt Fluke 8508A Multimeter
DC Current – Measure ¹	(30 to 3 000) A	0.81 A + 0.107 mA/A	Empro Shunt HP 34401A Multimeter
AC Current – Measure	0.1 nA to 100 μA (10 to 40) Hz 40 Hz to 1 kHz (1 to 10) kHz 20 to 30 A (10 to 40) Hz 40 Hz to 1 kHz	0.015 μA + 0.9 nA/μA 0.012 μA + 0.5 nA/μA 0.03 μA + 1.2 nA/μA 30 mA + 1.5 mA/A 150 mA + 5 mA/A	Transmille 8081 Multimeter
AC Current – Measure	(20 to 200) μA (1 to 10) Hz 10 Hz to 10 kHz (10 to 30) kHz (30 to 100) kHz (0.2 to 2) mA (1 to 10) Hz 10 Hz to 10 kHz (10 to 30) kHz (30 to 100) kHz (2 to 20) mA (1 to 10) Hz 10 Hz to 10 kHz (10 to 30) kHz (30 to 100) kHz (20 to 200) mA (1 to 10) Hz 10 Hz to 10 kHz (10 to 30) kHz 200 mA to 2 A 10 Hz to 2 kHz (2 to 10) kHz (10 to 30) kHz (2 to 20) A 10 Hz to 2 kHz (2 to 10) kHz	0.025 μA + 0.29 nA/μA 0.025 μA + 0.26 nA/μA 0.024 μA + 0.6 nA/μA 0.021 μA + 4 nA/μA 0.2 μA + 0.31 μA/mA 0.2 μA + 0.28 μA/mA 0.2 μA + 0.65 μA/mA 0.2 μA + 4 μA/mA 2 μA + 0.31 μA/mA 2 μA + 0.28 μA/mA 2 μA + 0.65 μA/mA 2 μA + 4 μA/mA 20 μA + 0.31 μA/mA 20 μA + 0.25 μA/mA 20 μA + 0.6 μA/mA 0.2 mA + 0.6 mA/A 0.2 mA + 0.7 mA/A 0.2 mA + 3 mA/A 2 mA + 0.8 mA/A 2 mA + 2.5 mA/A	Fluke 8508A Multimeter



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current – Measure ¹ @ 60 Hz	(30 to 3 000) A	0.81 A + 0.11 mA/A	Empro Shunt, HP 34401A Multimeter
	5A to 30 kA	7.7 A + 10 mA/A	AEMC 30K-24-2 Current Probe
Inductance – Measure @ 1 kHz	(10 to 100) μ H (0.1 to 1) mH (1 to 10) mH (10 to 100) mH (0.1 to 1) H 1 H to 10 H	0.2 μ H + 0.1 nH/ μ H 0.3 μ H + 0.5 μ H/mH 0.2 μ H + 0.8 μ H/mH 4 μ H + 0.8 μ H/mH 0.2 mH + 0.6 mH/H 0.2 mH + 0.8 mH/H	GenRad 1689M LCR Meter
Inductance – Source ¹	100 μ H 500 μ H 1 mH 10 mH 50 mH 100 mH 200 mH 1 H 2 H 10 H	0.12 μ H 0.61 μ H 1.2 μ H 12 μ H 61 μ H 120 μ H 250 μ H 1.2 mH 2.5 mH 12 mH	GenRad 1482 Series Inductors
Phase – Measure/Source (0.01 to 100) V ¹	(0 to 360) Deg 1 Hz to 1 kHz (1 to 10) kHz (10 to 100) kHz 100 kHz to 1 MHz	2.5 mDeg 3.3 mDeg 32 mDeg 320 mDeg	Keysight 53220A Phase Meter Fluke 5522A/SC1100 Multi Product Calibrator
DC Power – Source ¹	(0 to 336) W (336 to 3 060) W (3 060 to 20 910) W	0.04 % of output 0.053 % of output 0.12 % of output	Fluke 5522A/SC1100 Multi Product Calibrator



Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Power – Source ¹	(45 to 65) Hz (0.11 to 3) mW (3 to 11) mW (11 to 30) mW (30 to 110) mW (110 to 300) mW (300 to 730) mW (0.73 to 1.5) W (1.5 to 6.8) W (6.8 to 9.2) W (9.2 to 34) W (34 to 92) W (92 to 337) W (337 to 918) W (918 to 2 244) W (2 244 to 4 590) W (4 590 to 11 220) W	0.11 % of output 0.12 % of output 0.16 % of output 0.12 % of output 0.15 % of output 0.13 % of output 0.15 % of output 0.14 % of output 0.14 % of output 0.1 % of output 0.14 % of output 0.1 % of output 0.13% of output 0.11 % of output 0.14 % of output 0.12 % of output	Fluke 5522A/SC1100 Multi Product Calibrator
Resistance – Source	0 Ω 1 Ω 1.9 Ω 10 Ω 19 Ω 100 Ω 190 Ω 1 kΩ 1.9 kΩ 10 kΩ 19 kΩ 100 kΩ 190 kΩ 1 MΩ 1.9 MΩ 10 MΩ 19 MΩ 100 MΩ	40 μΩ 95 μΩ 0.18 mΩ 0.23 mΩ 0.44 mΩ 1 mΩ 1.9 mΩ 6.5 mΩ 12 mΩ 65 mΩ 120 mΩ 0.85 Ω 1.6 Ω 13 Ω 34 Ω 400 Ω 890 Ω 10 kΩ	Fluke 5730A Multi Product Calibrator



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Resistance – Source	1 Ω 10 Ω 100 Ω 1 kΩ 10 kΩ 100 kΩ 1 MΩ 10 MΩ	12 μΩ 58 μΩ 620 μΩ 6.3 mΩ 18 mΩ 400 mΩ 6.5 Ω 56 Ω	Transmille 3000RS Resistance Standard
Resistance – Source ¹	(0 to 11) Ω (11 to 33) Ω (33 to 110) Ω (110 to 330) Ω (330 to 1100) Ω (1.1 to 3.3) kΩ (3.3 to 11) kΩ (11 to 33) kΩ (33 to 110) kΩ (110 to 330) kΩ (0.33 to 1.1) MΩ (1.1 to 3.3) MΩ (3.3 to 11) MΩ (11 to 33) MΩ (33 to 110) MΩ (110 to 330) MΩ (330 to 1 100) MΩ	0.8 mΩ + 31 μΩ/Ω 1.2 mΩ + 23 μΩ/Ω 1.1 mΩ + 22 μΩ/Ω 1.7 mΩ + 22 μΩ/Ω 1.6 mΩ + 22 μΩ/Ω 16 mΩ + 22 μΩ/Ω 17 mΩ + 20 μΩ/Ω 170 mΩ + 20 μΩ/Ω 200 mΩ + 21 μΩ/Ω 1.6 Ω + 25 μΩ/Ω 1.7 Ω + 25 μΩ/Ω 18 Ω + 53 μΩ/Ω 40 Ω + 100 μΩ/Ω 1.9 kΩ + 190 μΩ/Ω 2.3 kΩ + 0.39 mΩ/Ω 150 kΩ + 1.7 mΩ/Ω 0.39 MΩ + 12 mΩ/Ω	Fluke 5522A/SC1100 Multi Product Calibrator
Resistance – Measure	(0.1 to 2) Ω (2 to 20) Ω (20 to 200) Ω (0.2 to 2) kΩ (2 to 20) kΩ (20 to 200) kΩ (0.2 to 2) MΩ (2 to 20) MΩ	4 μΩ + 10 μΩ/Ω 14 μΩ + 9 μΩ/Ω 50 μΩ + 7.5 μΩ/Ω 0.5 mΩ + 7.5 μΩ/Ω 5 mΩ + 8 μΩ/Ω 50 mΩ + 7.5 μΩ/Ω 1 Ω + 9 μΩ/Ω 100 Ω + 20 Ω/MΩ	Fluke 8508A Multimeter
	(2 to 20) MΩ (20 to 200) MΩ (0.2 to 2) GΩ (2 to 20) GΩ	20 Ω + 14 Ω/MΩ 1 kΩ + 65 Ω/MΩ 0.1 MΩ + 180 Ω/MΩ 10 MΩ + 1500 Ω/MΩ	Fluke 8508A Multimeter HV mode



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Resistance – Measure	24 GΩ to 2 TΩ	1.2 MΩ + 16 MΩ/GΩ	Transmille 8081 Multimeter
Electrical Simulation of RTD Indicating Devices ¹	Pt 385, 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 (630 to 800) °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 600) °C (600 to 630) °C Pt 385, 500 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 600) °C (600 to 630) °C Pt 385, 1000 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 600) °C (600 to 630) °C	0.042 °C 0.042 °C 0.056 °C 0.072 °C 0.079 °C 0.094 °C 0.18 °C 0.035 °C 0.035 °C 0.035 °C 0.042 °C 0.094 °C 0.1 °C 0.11 °C 0.13 °C 0.035 °C 0.042 °C 0.042 °C 0.049 °C 0.064 °C 0.064 °C 0.072 °C 0.087 °C 0.028 °C 0.028 °C 0.035 °C 0.042 °C 0.049 °C 0.056 °C 0.056 °C 0.18 °C	Fluke 5522A/SC1100 Multi Product Calibrator



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Electrical Simulation of RTD Indicating Devices ¹	Pt 3916, 100 Ω		Fluke 5522A/SC1100 Multi Product Calibrator
	(-200 to -190) °C	0.19 °C	
	(-190 to -80) °C	0.035 °C	
	(-80 to 0) °C	0.042 °C	
	(0 to 100) °C	0.049 °C	
	(100 to 260) °C	0.057 °C	
	(260 to 300) °C	0.064 °C	
	(300 to 400) °C	0.072 °C	
	(400 to 600) °C	0.079 °C	
	(600 to 630) °C	0.18 °C	
	Pt 3926, 100 Ω		
	(-200 to -80) °C	0.042 °C	
	(-80 to 0) °C	0.042 °C	
	(0 to 100) °C	0.057 °C	
	(100 to 300) °C	0.072 °C	
(300 to 400) °C	0.079 °C		
(400 to 630) °C	0.095 °C		
PtNi 385, 120 Ω			
(-80 to 0) °C	0.066 °C		
(0 to 100) °C	0.066 °C		
(100 to 260) °C	0.11 °C		
Cu 427, 10 Ω			
(-100 to 260) °C	0.23 °C		
DC Voltage – Source	(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 1 100) V	0.4 μV + 8.3 μV/V 0.7 μV + 5 μV/V 2.5 μV + 3.5 μV/V 4 μV + 3.5 μV/V 58 μV + 5.8 μV/V 0.4 mV + 6.5 μV/V	Fluke 5730A Multi Product Calibrator
	(0.01 to 1 400) V (1.4 to 10) kV (1 to 35) kV (10 to 100) kV	0.037 V + 0.3 mV/V 0.3 V + 0.3 V/kV 0.2 V + 0.8 V/kV 0.5 V/kV	HV Output Monitored with Vitrek 4700 High Voltage Meter HVL-35 Probe HVL-100 Probe
DC Voltage - Source ¹	(0 to 330) mV (0.3 to 3.3) V (3.3 to 33) V (33 to 330) V (330 to 1 000) V	2.1 μV + 13 μV/V 3.8 μV + 8 μV/V 35 μV + 8.9 μV/V 260 μV + 13.6 μV/V 1.1 mV + 14 μV/V	Fluke 5522A/SC1100 Multi Product Calibrator



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Source	(0.22 to 2.2) mV		Fluke 5730A Multi Product Calibrator
	(10 to 20) Hz	4 μ V + 0.24 mV/V	
	(20 to 40) Hz	4 μ V + 90 nV/mV	
	40 Hz to 20 kHz	4 μ V + 80 nV/mV	
	(20 to 50) kHz	4 μ V + 0.2 μ V/mV	
	(50 to 100) kHz	5 μ V + 0.5 μ V/mV	
	(100 to 300) kHz	10 μ V + 1.1 μ V/mV	
	(300 to 500) kHz	20 μ V + 1.4 μ V/mV	
	500 kHz to 1 MHz	20 μ V + 2.7 μ V/mV	
	(2.2 to 22) mV		
	(10 to 20) Hz	4 μ V + 0.24 μ V/mV	
	(20 to 40) Hz	4 μ V + 90 nV/mV	
	40 Hz to 20 kHz	4 μ V + 80 nV/mV	
	(20 to 50) kHz	4 μ V + 0.2 μ V/mV	
	(50 to 100) kHz	5 μ V + 0.5 μ V/mV	
	(100 to 300) kHz	10 μ V + 1.1 μ V/mV	
	(300 to 500) kHz	20 μ V + 1.4 μ V/mV	
	500 kHz to 1 MHz	20 μ V + 2.7 μ V/mV	
	(22 to 220) mV		
	(10 to 20) Hz	12 μ V + 0.24 μ V/mV	
	(20 to 40) Hz	7 μ V + 90 nV/mV	
	40 Hz to 20 kHz	7 μ V + 57 nV/mV	
	(20 to 50) kHz	7 μ V + 0.12 μ V/mV	
	(50 to 100) kHz	17 μ V + 0.31 μ V/mV	
	(100 to 300) kHz	20 μ V + 0.66 μ V/mV	
	(300 to 500) kHz	25 μ V + 1.4 μ V/mV	
	500 kHz to 1 MHz	45 μ V + 2.7 μ V/mV	
(0.22 to 2.2) V			
(10 to 20) Hz	40 μ V + 0.24 mV/V		
(20 to 40) Hz	15 μ V + 90 μ V/V		
40 Hz to 20 kHz	8 μ V + 42 μ V/V		
(20 to 50) kHz	10 μ V + 67 μ V/V		
(50 to 100) kHz	30 μ V + 85 μ V/V		
(100 to 300) kHz	80 μ V + 0.34 mV/V		
(300 to 500) kHz	0.2 mV + 1 mV/V		
500 kHz to 1 MHz	0.3 mV + 1.7 mV/V		



ANSI National Accreditation Board

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Source	(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	0.4 mV + 0.24 mV/V 0.15 mV + 90 μV/V 50 μV + 42 μV/V 0.1 mV + 67 μV/V 0.2 mV + 83 μV/V 0.6 mV + 0.25 mV/V 2 mV + 1 mV/V 3.2 mV + 1.5 mV/V	Fluke 5730A Multi Product Calibrator
	(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	4 mV + 0.24 mV/V 1.5 mV + 90 μV/V 0.6 mV + 52 μV/V 1 mV + 80 μV/V 2.5 mV + 0.15 mV/V 16 mV + 0.9 mV/V 40 mV + 3.6 mV/V 80 mV + 8 mV/V	
	(220 to 1100) V (15 to 50) Hz 50 Hz to 1 kHz	16 mV + 0.3 mV/V 3.5 mV + 70 μV/V	
	(220 to 750) V 30 kHz to 50 kHz 50 kHz to 100 kHz	11 mV + 0.6 mV/V 45 mV + 2.3 mV/V	Fluke 5730A Multi Product Calibrator Fluke 5725A
	(220 to 1100) V 40 to 1 kHz 1 kHz to 20 kHz 20 kHz to 30 kHz	4 mV + 90 μV/V 6 mV + 0.17 mV/V 11 mV + 0.6 mV/V	
AC Voltage - Source ¹	(1 to 33) mV (10 to 45) Hz 45 Hz to 10 kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 500) kHz	5 μV + 0.62 μV/mV 5 μV + 0.11 μV/mV 5 μV + 0.15 μV/mV 4.9 μV + 0.77 μV/mV 9.4 μV + 2.7 μV/mV 39 μV + 6.2 μV/mV	Fluke 5522A/SC1100 Multi Product Calibrator



ANSI National Accreditation Board

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage - Source ¹	(33 to 330) mV	6.3 μ V + 0.23 μ V/mV	Fluke 5522A/SC1100 Multi Product Calibrator
	(10 to 45) Hz	6.3 μ V + 0.11 μ V/mV	
	45 Hz to 10 kHz	6.3 μ V + 0.12 μ V/mV	
	(10 to 20) kHz	6.3 μ V + 0.27 μ V/mV	
	(20 to 50) kHz	25 μ V + 0.62 μ V/mV	
	(50 to 100) kHz	54 μ V + 1.6 μ V/mV	
	(100 to 500) kHz		
	(0.33 to 3.3) V	39 μ V + 233 μ V/V	
	(10 to 45) Hz	47 μ V + 120 μ V/V	
	45 Hz to 10 kHz	47 μ V + 147 μ V/V	
	(10 to 20) kHz	39 μ V + 233 μ V/V	
	(20 to 50) kHz	97 μ V + 543 μ V/V	
	(50 to 100) kHz	0.47 mV + 1.9 mV/V	
	(100 to 500) kHz		
	(3.3 to 33) V	0.5 mV + 0.23 mV/V	
	(10 to 45) Hz	0.47 mV + 0.12 mV/V	
	45 Hz to 10 kHz	0.47 mV + 0.19 mV/V	
	(10 to 20) kHz	0.47 mV + 0.27 mV/V	
	(20 to 50) kHz	1.2 mV + 0.7 mV/V	
	(50 to 100) kHz		
(33 to 330) V	1.6 mV + 0.15 mV/V		
45 Hz to 1 kHz	4.7 mV + 0.16 mV/V		
(1 to 10) kHz	4.7 mV + 0.19 mV/V		
(10 to 20) kHz	4.7 mV + 0.23 mV/V		
(20 to 50) kHz	39 mV + 1.6 mV/V		
(50 to 100) kHz			
(330 to 1 000) V	8.1 mV + 0.23 mV/V		
45 Hz to 1 kHz	8.1 mV + 0.19 mV/V		
(1 to 5) kHz	8.1 mV + 0.23 mV/V		
(5 to 10) kHz			
AC Voltage – Source @ 60 Hz	(0.01 to 1400) V (1.4 to 10) kV (10 to 25) kV	0.15 V + 1.2 mV/V 0.15 V + 1.2 mV/V 0.25 V + 0.8 mV/V	HV Output Monitored with Vitretek 4700 High Voltage Meter HVL-35 Probe



ANSI National Accreditation Board

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
DC Voltage – Measure	(0 to 200) mV (0.2 to 2) V (2 to 20) V (20 to 200) V (200 to 1 000) V	0.1 μ V + 4.5 μ V/V 0.4 μ V + 3 μ V/V 4 μ V + 3 μ V/V 0.04 mV + 4.5 μ V/V 0.53 mV + 4.5 μ V/V	Fluke 8508A Multimeter
	(0.01 to 1400) V (1.4 to 10) kV (1 to 35) kV (10 to 100) kV	0.035 V + 0.3 mV/V 0.039 V + 0.3 mV/V 0.075 V + 0.35 mV/V 0.35 V + 0.5 mV/V	Vitrek 4700 High Voltage Meter HVL-35 Probe HVL-100 Probe
DC Voltage – Measure ¹	(1 to 100) kV	7 V + 10 V/kV	Hipotronics KVM 100 High Voltage Meter
pH Calibrators	(-120 to 120) mV	0.11 μ V + 0.0045 μ V/mV	Fluke 8508A Multimeter
AC Voltage – Measure	Up to 2.2 mV (10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz	1.3 μ V + 1.7 μ V/mV 1.3 μ V + 0.73 μ V/mV 1.3 μ V + 0.41 μ V/mV 2 μ V + 0.81 μ V/mV 2.5 μ V + 1.2 μ V/mV 4 μ V + 2.3 μ V/mV 8 μ V + 2.4 μ V/mV 8 μ V + 3.5 μ V/mV	Fluke 5790A AC Voltage Measurement Standard
	(2.2 to 7) 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	1.3 μ V + 0.85 μ V/mV 1.3 μ V + 0.37 μ V/mV 1.3 μ V + 0.21 μ V/mV 2 μ V + 0.4 μ V/mV 2.5 μ V + 0.6 μ V/mV 4 μ V + 1.2 μ V/mV 8 μ V + 1.3 μ V/mV 8 μ V + 2.3 μ V/mV	



ANSI National Accreditation Board

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Measure	(7 to 22) mV		Fluke 5790A AC Voltage Measurement Standard
	(10 to 20) Hz	1.3 μ V + 0.29 μ V/mV	
	(20 to 40) Hz	1.3 μ V + 0.19 μ V/mV	
	40 Hz to 20 kHz	1.3 μ V + 0.11 μ V/mV	
	(20 to 50) kHz	2 μ V + 0.21 μ V/mV	
	(50 to 100) kHz	2.5 μ V + 0.31 μ V/mV	
	(100 to 300) kHz	4 μ V + 0.81 μ V/mV	
	(300 to 500) kHz	8 μ V + 0.89 μ V/mV	
	500 kHz to 1 MHz	8 μ V + 1.7 μ V/mV	
	(22 to 70) mV		
	(10 to 20) Hz	1.5 μ V + 0.24 μ V/mV	
	(20 to 40) Hz	1.5 μ V + 0.12 μ V/mV	
	40 Hz to 20 kHz	1.5 μ V + 0.07 μ V/mV	
	(20 to 50) kHz	2 μ V + 0.13 μ V/mV	
	(50 to 100) kHz	2.5 μ V + 0.26 μ V/mV	
	(100 to 300) kHz	4 μ V + 0.51 μ V/mV	
	(300 to 500) kHz	8 μ V + 0.67 μ V/mV	
	500 kHz to 1 MHz	8 μ V + 1.1 μ V/mV	
	(70 to 220) mV		
	(10 to 20) Hz	1.5 μ V + 0.21 μ V/mV	
	(20 to 40) Hz	1.5 μ V + 0.09 μ V/mV	
	40 Hz to 20 kHz	1.5 μ V + 0.04 μ V/mV	
	(20 to 50) kHz	2 μ V + 0.07 μ V/mV	
	(50 to 100) kHz	2.5 μ V + 0.16 μ V/mV	
	(100 to 300) kHz	4 μ V + 0.25 μ V/mV	
	(300 to 500) kHz	8 μ V + 0.38 μ V/mV	
	500 kHz to 1 MHz	8 μ V + 1 μ V/mV	
	(220 to 700) mV		
(10 to 20) Hz	1.6 μ V + 0.21 μ V/mV		
(20 to 40) Hz	1.7 μ V + 0.08 μ V/mV		
40 Hz to 20 kHz	2 μ V + 0.03 μ V/mV		
(20 to 50) kHz	2.3 μ V + 0.05 μ V/mV		
(50 to 100) kHz	2.7 μ V + 0.08 μ V/mV		
(100 to 300) kHz	4.1 μ V + 0.18 μ V/mV		
(300 to 500) kHz	8 μ V + 0.3 μ V/mV		
500 kHz to 1 MHz	8 μ V + 0.96 μ V/mV		



ANSI National Accreditation Board

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Measure	(0.7 to 2.2) V		Fluke 5790A AC Voltage Measurement Standard
	(10 to 20) Hz	0.02 μ V + 200 μ V/V	
	(20 to 40) Hz	0.07 μ V + 66 μ V/V	
	40 Hz to 20 kHz	0.2 μ V + 24 μ V/V	
	(20 to 50) kHz	0.1 μ V + 46 μ V/V	
	(50 to 100) kHz	0.07 μ V + 71 μ V/V	
	(100 to 300) kHz	0.03 μ V + 160 μ V / V	
	(300 to 500) kHz	0.02 μ V + 260 μ V/V	
	500 kHz to 1 MHz	0.01 μ V + 900 μ V/V	
	(2.2 to 7) V		
	(10 to 20) Hz	0.6 μ V + 200 μ V/V	
	(20 to 40) Hz	2 μ V + 70 μ V/V	
	40 Hz to 20 kHz	5 μ V + 20 μ V/V	
	(20 to 50) kHz	2 μ V + 50 μ V/V	
	(50 to 100) kHz	1 μ V + 80 μ V/V	
	(100 to 300) kHz	0.6 μ V + 200 μ V/V	
	(300 to 500) kHz	0.3 μ V + 400 μ V/V	
	500 kHz to 1 MHz	0.09 μ V + 1 mV/V	
	(7 to 22) V		
	(10 to 20) Hz	0.1 μ V + 0.2 mV/V	
	(20 to 40) Hz	0.1 μ V + 0.07 mV/V	
	40 Hz to 20 kHz	0.1 μ V + 0.03 mV/V	
	(20 to 50) kHz	0.6 μ V + 0.05 mV/V	
	(50 to 100) kHz	30 μ V + 0.08 mV/V	
	(100 to 300) kHz	0.1 μ V + 0.2 mV/V	
	(300 to 500) kHz	0.1 μ V + 0.4 mV/V	
	500 kHz to 1 MHz	0.02 μ V + 1 mV/V	
	(22 to 70) V		
	(10 to 20) Hz	2 μ V + 0.2 mV/V	
	(20 to 40) Hz	2 μ V + 0.07 mV/V	
	40 Hz to 20 kHz	10 μ V + 0.03 mV/V	
	(20 to 50) kHz	7 μ V + 0.06 mV / V	
	(50 to 100) kHz	4 μ V + 0.09 mV/V	
	(100 to 300) kHz	2 μ V + 0.2 mV/V	
	(300 to 500) kHz	1 μ V + 0.4 mV/V	
	500 kHz to 1 MHz	0.3 μ V + 1 mV/V	



Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Measure	(70 to 220) V		Fluke 5790A AC Voltage Measurement Standard
	(10 to 20) Hz	2 μ V + 0.2 mV/V	
	(20 to 40) Hz	6 μ V + 0.07 mV/V	
	40 Hz to 20 kHz	10 μ V + 0.03 mV/V	
	(20 to 50) kHz	6 μ V + 0.07 mV/V	
	(50 to 100) kHz	4 μ V + 0.1 mV/V	
	(100 to 300) kHz	2 μ V + 0.2 mV/V	
	(300 to 500) kHz	0.8 μ V + 0.5 mV/V	
	(220 to 700) V		
	(10 to 20) Hz	50 μ V + 0.2 mV/V	
	(20 to 40) Hz	100 μ V + 0.1 mV/V	
	40 Hz to 20 kHz	200 μ V + 0.04 mV/V	
(20 to 50) kHz	80 μ V + 0.1 mV/V		
(50 to 100) kHz	20 μ V + 0.5 mV/V		
(700 to 1 000) V			
(10 to 20) Hz	30 μ V + 0.2 mV/V		
(20 to 40) Hz	70 μ V + 0.1 mV/V		
40 Hz to 20 kHz	200 μ V + 0.04 mV/V		
(20 to 50) kHz	50 μ V + 0.1 mV/V		
(50 to 100) kHz	10 μ V + 0.5 mV/V		
AC Voltage – Measure ¹	50 to 600 Hz		Vitretek 4700 High Voltage Meter HVL-35 Probe HVL-100 Probe
	(0.01 to 1400) V	0.16 V + 1.2 V/kV	
	(1.4 to 10) kV	0.2 V + 1.2 V/kV	
	(1 to 35) kV	0.2 V + 0.8 V/kV	
50/60 Hz			
(10 to 70) kV	1.8 V/kV		
AC Voltage – Measure ¹	(60 to 400) Hz		Hipotronics KVM 100 High Voltage Meter
	(1 to 100) kV	7 V + 10 V/kV	



ANSI National Accreditation Board

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Electrical Simulation of Thermocouple Indicating Devices ¹	Type B		Fluke 5522A/SC1100 Multi Product Calibrator
	(600 to 800) °C	0.34 °C	
	(800 to 1 000) °C	0.26 °C	
	(1 000 to 1 550) °C	0.23 °C	
	(1 550 to 1 820) °C	0.26 °C	
	Type C		
	(0 to 150) °C	0.23 °C	
	(150 to 650) °C	0.2 °C	
	(650 to 1 000) °C	0.24 °C	
	(1 000 to 1 800) °C	0.39 °C	
	(1 800 to 2 316) °C	0.65 °C	
	Type E		
	(-250 to -100) °C	0.39 °C	
	(-100 to -25) °C	0.13 °C	
	(-25 to 350) °C	0.11 °C	
	(350 to 650) °C	0.13 °C	
	(650 to 1 000) °C	0.16 °C	
	Type J		
	(-210 to -100) °C	0.21 °C	
	(-100 to -30) °C	0.13 °C	
	(-30 to 150) °C	0.11 °C	
	(150 to 760) °C	0.13 °C	
	(760 to 1 200) °C	0.18 °C	
	Type K		
	(-200 to -100) °C	0.26 °C	
	(-100 to -25) °C	0.14 °C	
	(-25 to 120) °C	0.13 °C	
	(120 to 1 000) °C	0.2 °C	
(1 000 to 1 372) °C	0.31 °C		
Type N			
(-200 to -100) °C	0.31 °C		
(-100 to -25) °C	0.17 °C		
(-25 to 120) °C	0.15 °C		
(120 to 410) °C	0.14 °C		
(410 to 1 300) °C	0.21 °C		



ANSI National Accreditation Board

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Electrical Simulation of Thermocouple Indicating Devices ¹	Type R (0 to 250) °C	0.44 °C	Fluke 5522A/SC1100 Multi Product Calibrator
	(250 to 400) °C	0.27 °C	
	(400 to 1 000) °C	0.26 °C	
	(1 000 to 1 767) °C	0.31 °C	
	Type S (0 to 250) °C	0.37 °C	
	(250 to 1 000) °C	0.28 °C	
	(1 000 to 1 400) °C	0.29 °C	
	(1 400 to 1 767) °C	0.36 °C	
	Type T (-250 to -150) °C	0.49 °C	
	(-150 to 0) °C	0.19 °C	
(0 to 120) °C	0.13 °C		
(120 to 400) °C	0.11 °C		
Amplitude – DC Signal 50 Ω ¹	1 mV to 6.6 V	36 μV + 2.3 mV/V	Fluke 5522A/SC1100 Multi Product Calibrator
Amplitude – DC Signal 1 MΩ ¹	1 mV to 130 V	34 μV + 0.39 mV/V	
Amplitude – Square Wave 50 Ω ¹	1 mV _{pp} to 6.6 V _{pp} 10 Hz to 10kHz	31 μV + 3.9 mV/V	
Amplitude – Square Wave 1 MΩ ¹	1 mV _{pp} to 130 V _{pp} (0.01 to 1) kHz (1 to 10) kHz	34 μV + 0.79 mV/V 33 μV + 2.0 mV/V	
Leveled Sine Wave Amplitude (@ 50 kHz ref.) ¹	5 mV to 5.5 V 50 kHz to 100 MHz (100 to 300) MHz (300 to 600) MHz	260 μV + 27 mV/V 250 μV + 31 mV/V 260 μV + 47 mV/V	Fluke 5522A/SC1100 Multi Product Calibrator
	5 mV to 3.5 V (600 to 1 100) MHz	1.3 mV + 54 mV/V	
Leveled Sine Wave Flatness (@ 50 kHz ref.) ¹	5 mV to 5.5 V 50 kHz to 100 MHz (100 to 300) MHz (300 to 600) MHz	100 μV + 12 mV/V 100 μV + 16 mV/V 90 μV + 31 mV/V	
	4 mV to 3.5 V (600 to 1 100) MHz	100 μV + 39 mV/V	



ANSI National Accreditation Board

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Time Marker ¹	1 ns to 20 ms 50 ms 0.1 s 0.2 s 0.5 s 1 s 2 s 5 s	2.26 ps/μs 4.4 μs 9.8 μs 35 μs 210 μs 0.8 ms 3.1 ms 20 ms	Fluke 5522A/SC1100 Multi Product Calibrator
Rise Time ¹	(250 to 350) ps 1 kHz to 11 MHz	300 ps	
Total Harmonic Distortion ¹	10 Hz to 500 kHz (-95 to -50) dB (-50 to -20) dB (-20 to 0) dB	0.023 dB 0.088 dB 0.90 dB	Pico Technologies 4262 Digital Oscilloscope

Length – Dimensional Metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-) ²	Reference Standard, Method, and/or Equipment
Caliper Masters	(0.5 to 4) in (4 to 40) in (40 to 60) in	(3.8 + 6.9L) μin (-2 + 8.4L) μin (200 + 0.4L) μin	P&W Labmaster Universal 1000A
Cylindrical Plug Gauges ¹²	(0.01 to 0.1) in (0.1 to 0.42) in (0.42 to 4) in (4 to 12) in	(6 - 2.8L) μin (5.6 + 1.2L) μin (4.8 + 3.1L) μin (-3.6 + 5.2L) μin	P&W Labmaster Universal 1000A
Cylindrical Ring Gauges ¹⁴	(0.01 to 0.22) in (0.22 to 1) in (1 to 14) in	(23 - 0.5L) μin (24 - 4L) μin (16 + 3.7L) μin	P&W Labmaster Universal 1000A
Depth Micrometer Master	(0.5 to 11.5) in	(28 + 1L) μin	Gauging Amplifier Gauge Blocks



ANSI National Accreditation Board

Length – Dimensional Metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-) ²	Reference Standard, Method, and/or Equipment
End Measuring Rods	(0.5 to 4) in (4 to 40) in (40 to 80) in	(3.8 + 7L) μin (-2.2 + 8L) μin (310 + 8L) μin	P&W Labmaster Universal 1000A
Feeler Gauges (Leaf-Style) ¹	(0 to 0.25) in	76 μin	Bench Micrometer
Gauge Balls (size only)	(0.0625 to 0.1) in (0.1 to 0.42) in (0.42 to 2) in	(10 - 0.9L) μin (10 + 2L) μin (9 + 5L) μin	P&W Labmaster Universal 1000A
Gauge Blocks ⁶	(0.005 to 4) in	(3.7 + 0.8L) μin	Mahr 130-B24 Comparator & Gauge Blocks
Gauge Blocks ⁶	(0.005 to 0.1) in (0.1 to 0.42) in (0.42 to 4) in (5 to 20) in	(6.1 - 3L) μin (6.2 + 0.07L) μin (3.8 + 7L) μin (-4 + 2.6L) μin	P&W Labmaster Universal 1000A
Micrometer Masters	(0 to 0.1) in (0.1 to 0.42) in (0.42 to 4) in (4 to 40) in	(6 - 4L) μin (5.6 + 0.8L) μin (4.8 + 3L) μin (-3.8 + 5L) μin	P&W Labmaster Universal 1000A
Optical Flats and Parallels Flatness UP to 4 in Diameter	(0 to 100) μin	5.6 μin	Optical Flat Monochromatic Light
	Parallelism (0 to 2) in thickness	4.5 μin	Mahr 130-B24 Comparator
Parallels	(0 to 36) in	66 μin	Gauging Amplifier Gauge Blocks
Pin Gauges – Class ZZ	(0.01 to 0.1) in (0.10 to 0.42) in (0.42 to 1) in	(6 - 2L) μin (5 + 3L) μin (6 + 3L) μin	P&W Labmaster Universal 1000A
Riser Blocks	(6 to 24) in	(19 + 7L) μin	Gauging Amplifier Gauge Blocks
Snap Gauges	(0.01 to 0.22) in (0.22 to 1) in (1 to 13) in	(23 - 1L) μin (24 - 4L) μin (16 + 3.7L) μin	P&W Labmaster Universal 1000A



Length – Dimensional Metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-) ²	Reference Standard, Method, and/or Equipment
Squares – Perpendicularity	(0 to 36) in	(65 + 3L) μin	Indi-Square Gauging Amplifier Gauge Blocks Tri-Square
Tapered Plugs	(0.0 to 0.1) in (0.1 to 0.42) in (0.42 to 2) in	(23 - 0.8L) μin (22 + 0.26L) μin (22 + 0.65L) μin	P&W Labmaster Universal 1000A Gauge Blocks Plug Gauges
Tapered Rings	(0.01 to 0.22) in (0.22 to 1) in (1 to 2) in	(24 - 0.14L) μin (25 - 1.7L) μin (17 + 6.3L) μin	P&W Labmaster Universal 1000A Gauge Blocks
Thickness (Film) Gauge Standards (Non-Ferrous)	(0 to 0.05) in	(6.1 - 3.5L) μin	P&W Labmaster Universal 1000A
Thread Measuring Wires ^{2,10}	Unified 60° (4 to 80) TPI Acme 29° (1 to 20) TPI	(13 - 50L) μin	P&W Labmaster Universal 1000A
Thread Micrometer Standards ²	1 in 2 in 3 in 4 in 5 in 6 in	8.8 μin 16 μin 24 μin 31 μin 40 μin 48 μin	P&W Labmaster Universal 1000A
Angle Blocks	(1 to 60) °	0.0022 °	Master Angle Blocks Sine Plate Gauging Amplifier
Angle Gauges (Leaf Style)	(0 to 90) °	3.7 min	STI Optical Comparator
Electronic Differential Levels	(0 to 1000) arc s	1.4 arc s	Brunson 470 Angle Generator
Functional Gauges & Fixtures	Linear (0 to 12) in	190 μin	STI Optical Comparator
	Angle (0 to 90) °	0.065 °	



Length – Dimensional Metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-) ²	Reference Standard, Method, and/or Equipment
Radius Gauges (Leaf Style)	(0 to 1) in	210 μin	STI Optical Comparator
Sine Bars & Plates	Angle (1 to 60) °	6.48 arc s	Gauge Blocks Angle Blocks Gauging Amplifier
Thread Pitch Gauges ¹⁰ (Leaf Style)	(4 to 84) TPI	160 μin	STI Optical Comparator
Tri-Blocks	Length (1 to 6) in	38 μin	Gauging Amplifier Gauge Blocks
	Flatness	22 μin	Gauging Amplifier
	Perpendicularity	59 μin	Indi-Square Gauging Amplifier
V-Blocks	Parallelism	22 μin	Gauging Amplifier Gauge Blocks
	Perpendicularity	59 μin	Gauging Amplifier Indi-Square
	V-Centrality	41 μin	Gauging Amplifier Master Plugs
Surface Plates ^{1,13}	Overall Flatness Up to (16 x 16) ft	(52 + 1D _L) μin	Optodyne LDDM per ASME B89.3.7
	Local Variation In Flatness	29 μin	Repeat-O-Meter per ASME B89.3.7
Pipe Thread Plugs ¹⁰	Simple Pitch Diameter (4 to 80 TPI)	(100 + 2L) μin	P&W Labmaster Universal 1000A Sine Plug
	Standoff (0 to 1) in (1 to 2) in	(28 + 10L) μin 28 μin	Gauging Amplifier Gauge Blocks



Length – Dimensional Metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-) ²	Reference Standard, Method, and/or Equipment
Thread Plugs – Setting ^{5,10}	Simple Pitch Diameter (4 to 80 TPI)	$(85 + 3L) \mu\text{in}$	P&W Labmaster Universal 1000A Thread Measuring Wires
	Major Diameter (0.06 to 4) in	$(17 + 8.2L) \mu\text{in}$	P&W Labmaster Universal 1000A
Thread Plugs – Setting ^{5,10}	Root Radius & Minor Diameter	210 μin	STI Optical Comparator
Thread Plugs – Working ^{5,10}	Simple Pitch Diameter (4 to 80 TPI)	$(160 + 2L) \mu\text{in}$	P&W Labmaster Universal 1000A Thread Measuring Wires
	Major Diameter (0.060 to 4) in	$(26 + 6L) \mu\text{in}$	P&W Labmaster Universal 1000A
	Root Radius & Minor Diameter	210 μin	STI Optical Comparator
Bench Micrometers ¹	Length (0 to 2) in	12 μin	Gauge Blocks
	Anvil Flatness (0 to 0.5) in Diameter	9.4 μin	Optical Flat Monochromatic Light
Bore Gauges (2 point) ¹	(0 to 1) in	$(48 + 0.6L) \mu\text{in}$	Indi-Check
Bore Gauges (2 point)	(0 to 4) in	$(8.4 + 7L) \mu\text{in}$	P&W Labmaster Universal 1000A
	(4 to 40) in	$(24 + 8L) \mu\text{in}$	
Bore Gauges (3 point) ¹	(0 to 8) in	$(72 + 3L) \mu\text{in}$	Ring Gauges
Calipers - Inside & Outside ^{1,3}	(0 to 20) in (21 to 40) in (41 to 60) in	$(280 + 10L) \mu\text{in}$ $(380 + 7L) \mu\text{in}$ $(960 + 3L) \mu\text{in}$	Gauge Blocks and Accessories
Chamfer Gauges ¹	(0 to 1) in	$(74 + 29L) \mu\text{in}$	Modified Ring Gauges
Gauging Amplifiers & LVDT Heads	(0 to 0.001) in	$(6.8 - 3L) \mu\text{in}$	P&W Labmaster Universal 1000A



Length – Dimensional Metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-) ²	Reference Standard, Method, and/or Equipment
Height Gauges ¹	(0 to 24) in (24 to 40) in	(290 + 2L) μin (250 + 4L) μin	Gauge Blocks Surface Plate
Height Masters	Length (0 to 24) in	(24 + 6L) μin	Gauging Amplifier Gauge Blocks
Height Masters	Block Parallelism (0 to 0.001) in	15 μin	Gauging Amplifier Gauge Blocks
Indicators ⁷	(0 to 0.01) in (0.1 to 0.42) in (0.42 to 4) in (4 to 8) in	(58 – 0.3L) μin (58 + 0.1L) μin (58 + 0.6L) μin (46 + 4L) μin	P&W Labmaster Universal 1000A
Indicators ^{1,7}	(0 to 1) in	(48 + 0.6L) μin	Indi-Check
Micrometer Heads	Length (0 to 0.1) in (0.1 to 0.42) in (0.42 to 2) in	(11 – 2L) μin (10 + 1.6L) μin (9 + 4.7L) μin	P&W Labmaster Universal 1000A
	Anvil Flatness (0 to 3) in Diameter	9.4 μin	
Micrometers - Depth	Length ¹ (0 to 12) in	(45 + 5L) μin	Gauge Blocks
	Base Flatness (0 to 3) in	9.4 μin	Optical Flat Monochromatic Light
Micrometers - Inside ¹	(0 to 4) in (5 to 20) in (21 to 40) in (41 to 60) in	(32 + 8L) μin (46 + 7L) μin (410 + 2L) μin (580 + 4L) μin	Gauge Blocks and Accessories
Micrometers - Outside ^{1,2}	(0 to 4) in (5 to 20) in (21 to 40) in (41 to 60) in	(32 + 8L) μin (46 + 7L) μin (250 + 7L) μin (580 + 4L) μin	Gauge Blocks
Micrometer Anvil (Flatness)	(0 to 3) in Diameter	9.4 μin	Optical Flat Monochromatic Light



Length – Dimensional Metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-) ²	Reference Standard, Method, and/or Equipment
Micrometers - Screw Thread ^{1,4}	(0 to 1) in	(160 + 10L) μin	Thread Setting Plugs
Micrometers - V-Anvil ¹	(0.0625 to 2) in	(53 + 7L) μin	Gauge Balls
Steel Rules and Tape Measures ¹¹	(0 to 12) in	890 μin	Optical Comparator
	(1 to 300) ft	(1 800 + 5L) μin	Optodyne LDDM
Thickness Gauges (Dial & Digital) ¹	(0 to 0.5) in	60 μin	Gauge Blocks
Optical Comparators & Vision Measuring Machines ¹	Magnification 10X, 20X, 31.25X, 50X and 62.5X	0.001 2 in	Magnification Checker Glass Scale
	Linear Length/ X/Y Axis Length (0 to 6) in	110 μin	Glass Scale
	Linear Length/ X/Y Axis Length (6 to 12) in	150 μin	Gauge Blocks
	Angle (0 to 90) °	0.021 °	Angle Blocks
Protractors & Inclometers	(0 to 90) °	2.9 min	Gauge Blocks Angle Blocks Gauging Amplifier Sine Plate
Levels	(0 to 1 000) arc s	2.9 arc s	Brunson 470 Angle Generator



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Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Force Gauges (Tension & Compression)	(0 to 5) lbf (5 to 50) lbf (50 to 600) lbf	0.000 2 lbf + 0.2 % of reading 0.008 lbf + 0.02 % of reading 0.042 lbf + 0.02 % of reading	NIST Class F Weights
Cable/Wire Tensiometers	(1 to 600) lbf	0.058 lbf + 0.01 % of reading	NIST Class F Weights
	(600 to 1 000) lbf	0.18 lbf + 0.3 % of reading	CDI 2000
Durometer Indenter	Angle Diameter Radius	0.065 ° 220 µin 250 µin	STI Optical Comparator
Durometer Force	Type A, B, E, O Type C, D, DO	0.054 N 0.098 N	Rex RDC-1 Durometer Calibrator
Durometer Calibrator Force	Type A, B, E, O Type C, D, & DO	0.017 N 0.26 N	ASTM Class 1 Weights
Hydraulic Pressure – Measure/Source	(20 to 6 000) psig	0.009 1 % of reading	Ruska 5100 Deadweight Tester
Low Pressure/Vacuum – Measure/Source	(0 to 2) inH ₂ O	0.000 81 inH ₂ O	Dwyer 1430 Microtector
	(-10 to +10) inH ₂ O	0.002 3 inH ₂ O	Meriam 34FBT2M Manometer
	(-20 to +20) inH ₂ O	0.003 1 inH ₂ O	
Pneumatic Pressure – Measure/Source	Absolute (0.2 to 1 015) psia	0.002 3 % of reading	Ruska 2465 Deadweight Tester
	Gauge (-14.4 to 1 000) psi	0.002 3 % of reading	
Pressure – Measure/Source ¹	(0 to 15) psi (-14.4 to 0) psi (-14.4 to 30) psi (0 to 100) psi (0 to 500) psi (0 to 1 000) psi (0 to 10 000) psi	0.008 9 psi 0.011 psi 0.023 psi 0.056 psi 0.25 psi 0.59 psi 8.3 psi	Fluke 700 Series Pressure Transducers



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Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Scales & Balances ¹	(0 to 610 x 0.000 1) g (0 to 5 000 x 0.001) g (0 to 35000 x 0.01) g (0 to 35 x 0.0001) kg	0.1 mg + 2 µg/g 0.8 mg + 3 µg/g 9 mg + 2 µg/g 0.11 g + 1 mg/kg	ASTM Class 1 Weights
	(0 to 10 x 0.001) lb (0 to 100 x 0.01) lb (0 to 600 x 0.1) lb	0.000 82 lb + 0.000 09 lb/lb 0.008 lb + 0.000 1 lb/lb 0.084 lb + 0.000 04 lb/lb	NIST Class F Weights
Torque – Measure	(20 to 200) ozf·in ¹ (4 to 50) lbf·in ¹ (30 to 400) lbf·in ¹ (80 to 1000) lbf·in ¹ (20 to 250) lbf·ft ¹ (100 to 1 000) lbf·ft	0.05 ozf·in + 0.2 % of reading 0.009 lbf·in + 0.2 % of reading 0.06 lbf·in + 0.2 % of reading 0.98 lbf·in + 0.18 % of reading 0.4 lbf·ft + 0.14 % of reading 0.01 lbf·ft + 0.61 % of reading	CDI 2000 Torque Tester
Torque – Source	(20 to 400) ozf·in (2.5 to 100) lbf·in (50 to 3 000) lbf·in (250 to 1 000) lbf·ft	0.002 ozf·in + 0.2 % of reading 0.009 lbf·in + 0.06 % of reading 0.19 lbf·in + 0.03 8 % of reading 0.1 lbf·ft + 0.04 % of reading	CDI Torque Arms & Wheels NIST Class F Weights

Thermodynamic

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Humidity – Measure ¹ (10 to 30) °C	(5 to 95) %RH	1.1 %RH + 0.14 % of reading	Rotronic HC2A Humidity Probe
Humidity – Source (15 to 35) °C	(5 to 95) %RH	0.56 %RH + 0.27 % of reading	Thunder Scientific 2500LT Chamber
Infrared – Source ¹ $\epsilon = 0.95, \lambda = (8 \text{ to } 14) \mu\text{m}$	(50 to 500) °C	0.47 °C + 0.14 % of reading	Fluke 9132 Blackbody
Temperature – Source	-196 °C ⁸	0.028 °C	Fluke 7196 LN2 Calibrator Fluke 5628 PRT
	0.0 °C ^{1,8}	0.058 °C	Kaye X0240 Ice Point
	0.01 °C ⁸	0.005 °C	Triple Point of Water Cell

Thermodynamic

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Temperature – Source	0 °C	0.028 °C	Fluidized Baths Thermometrics 1925-A Fluke 5628 PRT
	25 °C	0.025 °C	
	50 °C	0.03 °C	
	(-50 to 0) °C	0.056 °C	
	(0 to 100) °C	0.057 °C	
	(100 to 250) °C ⁸	0.06 % of reading	
Temperature – Source	(-15 to 350) °C ^{1,8}	0.26 °C + 0.15 % of reading	Hart 9009 Drywell
	(-95 to 140) °C ⁸	0.028 °C	Fluke 9190A Drywell Fluke 5628 PRT
	(-45 to 140) °C ⁸	0.097 °C - 0.006 % of reading	Fluke 9170 Drywell Fluke 5628 PRT
	(50 to 700) °C ⁸	0.158 °C + 0.042 % of reading	Fluke 9173 Drywell Fluke 5628 PRT
	(-10 to 70) °C	0.14 °C + 0.0004 % of reading	Thunder Scientific 2500LT Chamber
Temperature – Measure	(-200 to 660) °C	0.013 °C + 0.004 % of reading	Fluke 1586 Scanner Fluke 5628 PRT
	(0 to 100) °C	0.009 °C + 0.003 % of reading	Fluke 1586 Scanner Thermometrics 1925-A
Dew Point	(-25 to 69) °C	0.22 °C	Thunder Scientific 2500LT Chamber

Time and Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Frequency – Measure	10 Hz to 1.3 GHz	5.3 pHz/Hz + 100 μHz	Keysight 53220A Counter HP 58503A GPS Receiver
Frequency – Measure ¹	10 Hz to 1.3 GHz	59 pHz/Hz + 100 μHz	Keysight 53220A Counter Efratom FRK-LN Oscillator
Frequency – Source	10 MHz	5.3 pHz/Hz	HP 58503A GPS Receiver
Frequency – Source ¹	10 MHz	59 pHz/Hz	Efratom FRK-LN Oscillator



Time and Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Tachometers ¹	Contact Type (1 to 40 000) rpm	0.88 rpm	Quantum Dynamics N-11-ECS/3A Tachometer Keithly 53220A Counter
	Non-Contact Type (25 to 90 000) rpm	0.13 rpm + 2 μrpm/rpm	Fluke 5522A Multi Product Calibrator
	Strobotachometer (25 to 90 000) rpm	0.13 rpm + 5 μrpm/rpm	Keysight 53220A Counter Solar Cell
Stopwatches & Timers	Up to 19.99 s/day	0.058 s/day	Helmut Klein 4500 Timometer

DIMENSIONAL MEASUREMENT

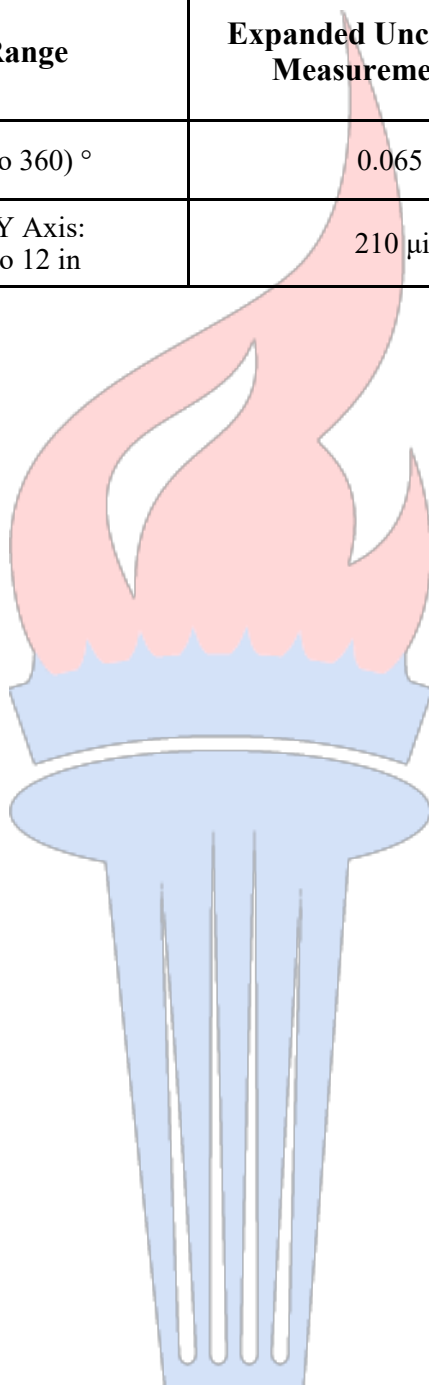
1D Measurement

Parameter ⁹	Range	Expanded Uncertainty of Measurement (+/-) ²	Reference Standard, Method and/or Equipment
Length Measures – External	(0 to 0.1) in	(6.1 – 0.009L) μin	P&W Labmaster Universal 1000A
	(0.10 to 0.42) in	(6.2 + 0.07L) μin	
Length Measures – Internal	(0.42 to 4) in	(3.8 + 7L) μin	
	(4 to 40) in	(-2.2 + 8L) μin	
Length Measures – Hand Tools	(40 to 80) in	(310 + 8L) μin	Digital Micrometer
	(0 to 1) in	(91 + 11.2L) μin	Digital Caliper
	(0 to 8) in	(1 400 + 5L) μin	



2D Measurement

Parameter ⁹	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
Angle	(0 to 360) °	0.065 °	STI Optical Comparator
2D Length	X/Y Axis: 0 to 12 in	210 μin	





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Services performed at satellite location

3695 N. 126th Street
 Brookfield, WI 53005
 Alex Cimaroli 708-596-5800

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Capacitance – Source ¹	0.1 nF	0.5 pF	Arco SS-32 Capacitors
	0.2 nF	0.5 pF	
	0.3 nF	0.5 pF	
	0.4 nF	0.5 pF	
	0.5 nF	0.5 pF	
	0.6 nF	0.6 pF	
	0.7 nF	0.7 pF	
	0.8 nF	0.8 pF	
	0.9 nF	0.9 pF	
	1 nF	1 pF	
	2 nF	2 pF	
	3 nF	3 pF	
	4 nF	4 pF	
	5 nF	5 pF	
	6 nF	6 pF	
	7 nF	7 pF	
	8 nF	8 pF	
	9 nF	9 pF	
	10 nF	10 pF	
	20 nF	20 pF	
	30 nF	30 pF	
	40 nF	40 pF	
	50 nF	50 pF	
	60 nF	60 pF	
	70 nF	70 pF	
	80 nF	80 pF	
	90 nF	90 pF	
	100 nF	100 pF	
200 nF	200 pF		
300 nF	300 pF		
400 nF	400 pF		
500 nF	500 pF		



Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Capacitance – Source ¹	(0.19 to 3.3) nF (3.3 to 11) nF (11 to 110) nF (110 to 330) nF (0.33 to 1.1) μF (1.1 to 3.3) μF (3.3 to 11) μF (11 to 33) μF (33 to 110) μF (110 to 330) μF (0.33 to 1.1) mF (1.1 mF to 3.3) mF (3.3 to 11) mF (11 to 33) mF (33 to 110) mF	0.008 nF + 0.004 nF/nF 0.008 nF + 0.002 nF/nF 0.08 nF + 0.002 nF/nF 0.23 nF + 0.002 nF/nF 0.75 nF + 0.002 μF/μF 2.3 nF + 0.002 μF/μF 8 nF + 0.002 μF/μF 23 nF + 0.003 μF/μF 0.08 μF + 0.003 μF/μF 0.23 μF + 0.003 μF/μF 0.78 μF + 0.003 μF/μF 2.3 μF + 0.004 mF/mF 7.6 μF + 0.004 mF/mF 23 μF + 0.006 mF/mF 0.08 mF + 0.009 mF/mF	Fluke 5522A/SC1100 Multi Product Calibrator
DC Current – Source ¹	0 μA to 330 μA 0.3 mA to 3.3 mA 3.3 mA to 33 mA 33 mA to 330 mA 0.33 A to 1.1 A 1.1 A to 3 A 3 A to 11 A 11 A to 20 A	23 nA + 0.11 nA/μA 41 nA + 0.077 μA/mA 0.24 μA + 0.081 μA/mA 2 μA + 0.078 μA/μA 31 μA + 0.16 mA/A 32 μA + 0.29 mA/A 0.39 mA + 0.39 mA/A 0.58 mA + 0.78 mA/A	Fluke 5522A/SC1100 Multi Product Calibrator
DC Current Source – Current Clamps ¹	(10 to 150) A (150 to 1 025) A	1.3 mA + 2 mA/A 0.13 A + 2 mA/A	Fluke 5522A/SC1100 Multi Product Calibrator Fluke 50-Turn Coil



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current – Source ¹	(30 to 330) μ A		Fluke 5522A/SC1100 Multi Product Calibrator
	(10 to 20) Hz	0.08 μ A + 1.6 nA/ μ A	
	(20 to 45) Hz	0.08 μ A + 1.2 nA/ μ A	
	45 Hz to 1 kHz	0.08 μ A + 1 nA/ μ A	
	(1 to 5) kHz	0.12 μ A + 2.3 nA/ μ A	
	(5 to 10) kHz	0.16 μ A + 6.2 nA/ μ A	
	(10 to 30) kHz	0.31 μ A + 12 nA/ μ A	
	(0.33 to 3.3) mA		
	(10 to 20) Hz	0.12 μ A + 1.6 μ A/mA	
	(20 to 45) Hz	0.12 μ A + 0.97 μ A/mA	
	45 Hz to 1 kHz	0.12 μ A + 0.78 μ A/mA	
	(1 to 5) kHz	0.16 μ A + 1.6 μ A/mA	
	(5 to 10) kHz	0.23 μ A + 3.9 μ A/mA	
	(10 to 30) kHz	0.47 μ A + 7.8 μ A/mA	
	(3.3 to 33) mA		
	(10 to 20) Hz	1.6 μ A + 1.4 μ A/mA	
	(20 to 45) Hz	1.6 μ A + 0.7 μ A/mA	
	45 Hz to 1 kHz	1.6 μ A + 0.31 μ A/mA	
	(1 to 5) kHz	1.6 μ A + 0.62 μ A/mA	
	(5 to 10) kHz	2.3 μ A + 1.6 μ A/mA	
	(10 to 30) kHz	3.1 μ A + 3.1 μ A/mA	
	(33 to 330) mA		
	(10 to 20) Hz	16 μ A + 1.4 μ A/mA	
	(20 to 45) Hz	16 μ A + 0.7 μ A/mA	
	45 Hz to 1 kHz	16 μ A + 0.31 μ A/mA	
	(1 to 5) kHz	39 μ A + 0.78 μ A/mA	
	(5 to 10) kHz	78 μ A + 1.6 μ A/mA	
	10 kHz to 30 kHz	0.16 mA + 3.1 μ A/mA	
	(0.33 to 1.1) A		
	(10 to 45) Hz	0.14 mA + 1.2 μ A/mA	
45 Hz to 1 kHz	0.094 mA + 0.34 μ A/mA		
(1 to 5) kHz	0.98 mA + 4.1 μ A/mA		
(5 to 10) kHz	3.9 mA + 19 μ A/mA		
(1.1 to 3) A			
(10 to 45) Hz	0.078 mA + 1.4 mA/A		
45 Hz to 1 kHz	0.078 mA + 0.47 mA/A		
(1 to 5) kHz	0.78 mA + 4.7 mA/A		
(5 to 10) kHz	3.9 mA + 19 mA/A		



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current – Source ¹	(3 to 11) A (45 to 100) Hz 100 Hz to 1 kHz (1 to 5) kHz (11 to 20) A (45 to 100) Hz 100 Hz to 1 kHz (1 to 5) kHz	1.6 mA + 0.47 mA/A 1.6 mA + 0.78 mA/A 1.6 mA + 23 mA/A 3.9 mA + 0.93 mA/A 3.9 mA + 1.2 mA/A 3.9 mA + 23 mA/A	Fluke 5522A/SC1100 Multi Product Calibrator
AC Current Source – Current Clamps ¹	(45 to 65) Hz (10 to 16.5) A (16.5 to 150) A (150 to 1 025) A (65 to 440) Hz (10 to 16.5) A (16.5 to 150) A (150 to 1 025) A	0.021 A + 1.6 mA/A 0.28 A + 1.1 mA/A 0.12 A + 2.4 mA/A 0.036 A + 4.4 mA/A 0.22 A + 5.2 mA/A 0.094 A + 6.4 mA/A	Fluke 5522A/SC1100 Multi Product Calibrator Fluke 50-Turn Coil
Inductance – Source ¹	100 μH 500 μH 1 mH 10 mH 50 mH 100 mH 200 mH 1 H 2 H 10 H	0.12 μH 0.61 μH 1.2 μH 12 μH 61 μH 120 μH 250 μH 1.2 mH 2.5 mH 12 mH	GenRad 1482 Series Inductors
DC Power – Source ¹	(0 to 336) W (336 to 3 060) W (3 060 to 20 910) W	0.04 % of output 0.053 % of output 0.12 % of output	Fluke 5522A/SC1100 Multi Product Calibrator

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Power – Source ¹	(45 to 65) Hz (0.11 to 3) mW (3 to 11) mW (11 to 30) mW (30 to 110) mW (110 to 300) mW (300 to 730) mW (0.73 to 1.5) W (1.5 to 6.8) W (6.8 to 9.2) W (9.2 to 34) W (34 to 92) W (92 to 337) W (337 to 918) W (918 to 2 244) W (2 244 to 4 590) W (4 590 to 11 220) W	0.11 % of output 0.12 % of output 0.16 % of output 0.12 % of output 0.15 % of output 0.13 % of output 0.15 % of output 0.14 % of output 0.14 % of output 0.1 % of output 0.14 % of output 0.1 % of output 0.13% of output 0.11 % of output 0.14 % of output 0.12 % of output	Fluke 5522A/SC1100 Multi Product Calibrator
Resistance – Source ¹	(0 to 11) Ω (11 to 33) Ω (33 to 110) Ω (110 to 330) Ω (330 to 1 100) Ω (1.1 to 3.3) kΩ (3.3 to 11) kΩ (11 to 33) kΩ (33 to 110) kΩ (110 to 330) kΩ (0.33 to 1.1) MΩ (1.1 to 3.3) MΩ (3.3 to 11) MΩ (11 to 33) MΩ (33 to 110) MΩ (110 to 330) MΩ (330 to 1 100) MΩ	0.8 mΩ + 31 μΩ/Ω 1.2 mΩ + 23 μΩ/Ω 1.1 mΩ + 22 μΩ/Ω 1.7 mΩ + 22 μΩ/Ω 1.6 mΩ + 22 μΩ/Ω 16 mΩ + 22 μΩ/Ω 17 mΩ + 20 μΩ/Ω 170 mΩ + 20 μΩ/Ω 200 mΩ + 21 μΩ/Ω 1.6 Ω + 25 μΩ/Ω 1.7 Ω + 25 μΩ/Ω 18 Ω + 53 μΩ/Ω 40 Ω + 100 μΩ/Ω 1.9 kΩ + 190 μΩ/Ω 2.3 kΩ + 0.39 mΩ/Ω 150 kΩ + 1.7 mΩ/Ω 0.39 MΩ + 12 mΩ/Ω	Fluke 5522A/SC1100 Multi Product Calibrator



ANSI National Accreditation Board

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Electrical Simulation of RTD Indicating Devices ¹	Pt 385, 100 Ω		Fluke 5522A/SC1100 Multi Product Calibrator
	(-200 to -80) °C	0.042 °C	
	(-80 to 0) °C	0.042 °C	
	(0 to 100) °C	0.056 °C	
	(100 to 300) °C	0.072 °C	
	(300 to 400) °C	0.079 °C	
	(400 to 630) °C	0.094 °C	
	(630 to 800) °C	0.18 °C	
	Pt 385, 200 Ω		
	(-200 to -80) °C	0.035 °C	
	(-80 to 0) °C	0.035 °C	
	(0 to 100) °C	0.035 °C	
	(100 to 260) °C	0.042 °C	
	(260 to 300) °C	0.094 °C	
	(300 to 400) °C	0.1 °C	
	(400 to 600) °C	0.11 °C	
	(600 to 630) °C	0.13 °C	
	Pt 385, 500 Ω		
	(-200 to -80) °C	0.035 °C	
	(-80 to 0) °C	0.042 °C	
	(0 to 100) °C	0.042 °C	
	(100 to 260) °C	0.049 °C	
	(260 to 300) °C	0.064 °C	
	(300 to 400) °C	0.064 °C	
	(400 to 600) °C	0.072 °C	
	(600 to 630) °C	0.087 °C	
	Pt 385, 1000 Ω		
	(-200 to -80) °C	0.028 °C	
(-80 to 0) °C	0.028 °C		
(0 to 100) °C	0.035 °C		
(100 to 260) °C	0.042 °C		
(260 to 300) °C	0.049 °C		
(300 to 400) °C	0.056 °C		
(400 to 600) °C	0.056 °C		
(600 to 630) °C	0.18 °C		



ANSI National Accreditation Board

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment	
Electrical Simulation of RTD Indicating Devices ¹	Pt 3916, 100 Ω			
	(-200 to -190) °C	0.19 °C		
	(-190 to -80) °C	0.035 °C		
	(-80 to 0) °C	0.042 °C		
	(0 to 100) °C	0.049 °C		
	(100 to 260) °C	0.057 °C		
	(260 to 300) °C	0.064 °C		
	(300 to 400) °C	0.072 °C		
	(400 to 600) °C	0.079 °C		
	(600 to 630) °C	0.18 °C		
	Pt 3926, 100 Ω			
	(-200 to -80) °C	0.042 °C		
	(-80 to 0) °C	0.042 °C		
	(0 to 100) °C	0.057 °C		
	(100 to 300) °C	0.072 °C		
(300 to 400) °C	0.079 °C			
(400 to 630) °C	0.095 °C			
PtNi 385, 120 Ω				
(-80 to 0) °C	0.066 °C			
(0 to 100) °C	0.066 °C			
(100 to 260) °C	0.11 °C			
Cu 427, 10 Ω				
(-100 to 260) °C	0.23 °C			
DC Voltage - Source ¹	(0 to 330) mV	2.1 μV + 13 μV/V	Fluke 5522A/SC1100 Multi Product Calibrator	
	(0.3 to 3.3) V	3.8 μV + 8 μV/V		
	(3.3 to 33) V	35 μV + 8.9 μV/V		
	(33 to 330) V	260 μV + 13.6 μV/V		
	(330 to 1 000) V	1.1 mV + 14 μV/V		



ANSI National Accreditation Board

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage - Source ¹	(1 to 33) mV		Fluke 5522A/SC1100 Multi Product Calibrator
	(10 to 45) Hz	5 μV + 0.62 μV/mV	
	45 Hz to 10 kHz	5 μV + 0.11 μV/mV	
	(10 to 20) kHz	5 μV + 0.15 μV/mV	
	(20 to 50) kHz	4.9 μV + 0.77 μV/mV	
	(50 to 100) kHz	9.4 μV + 2.7 μV/mV	
	(100 to 500) kHz	39 μV + 6.2 μV/mV	
	(33 to 330) mV		
	(10 to 45) Hz	6.3 μV + 0.23 μV/mV	
	45 Hz to 10 kHz	6.3 μV + 0.11 μV/mV	
	(10 to 20) kHz	6.3 μV + 0.12 μV/mV	
	(20 to 50) kHz	6.3 μV + 0.27 μV/mV	
	(50 to 100) kHz	25 μV + 0.62 μV/mV	
	(100 to 500) kHz	54 μV + 1.6 μV/mV	
	(0.33 to 3.3) V		
	(10 to 45) Hz	39 μV + 233 μV/V	
	45 Hz to 10 kHz	47 μV + 120 μV/V	
	(10 to 20) kHz	47 μV + 147 μV/V	
	(20 to 50) kHz	39 μV + 233 μV/V	
	(50 to 100) kHz	97 μV + 543 μV/V	
	(100 to 500) kHz	0.47 mV + 1.9 mV/V	
	(3.3 to 33) V		
	(10 to 45) Hz	0.5 mV + 0.23 mV/V	
	45 Hz to 10 kHz	0.47 mV + 0.12 mV/V	
	(10 to 20) kHz	0.47 mV + 0.19 mV/V	
	(20 to 50) kHz	0.47 mV + 0.27 mV/V	
	(50 to 100) kHz	1.2 mV + 0.7 mV/V	
	(33 to 330) V		
45 Hz to 1 kHz	1.6 mV + 0.15 mV/V		
(1 to 10) kHz	4.7 mV + 0.16 mV/V		
(10 to 20) kHz	4.7 mV + 0.19 mV/V		
(20 to 50) kHz	4.7 mV + 0.23 mV/V		
(50 to 100) kHz	39 mV + 1.6 mV/V		
(330 to 1 000) V			
45 Hz to 1 kHz	8.1 mV + 0.23 mV/V		
(1 to 5) kHz	8.1 mV + 0.19 mV/V		
(5 to 10) kHz	8.1 mV + 0.23 mV/V		



ANSI National Accreditation Board

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
DC Voltage – Measure ¹	(1 to 100) kV	0.007 kV + 10 V/kV	Hipotronics KVM 100 High Voltage Meter
AC Voltage – Measure ¹	(60 to 400) Hz (1 to 100) kV	7 V + 10 V/kV	
Electrical Simulation of Thermocouple Indicating Devices ¹	Type B (600 to 800) °C	0.34 °C	Fluke 5522A/SC1100 Multi Product Calibrator
	(800 to 1 000) °C	0.26 °C	
	(1 000 to 1 550) °C	0.23 °C	
	(1 550 to 1 820) °C	0.26 °C	
	Type C (0 to 150) °C	0.23 °C	
	(150 to 650) °C	0.2 °C	
	(650 to 1 000) °C	0.24 °C	
	(1 000 to 1 800) °C	0.39 °C	
	(1 800 to 2 316) °C	0.65 °C	
	Type E (-250 to -100) °C	0.39 °C	
	(-100 to -25) °C	0.13 °C	
	(-25 to 350) °C	0.11 °C	
	(350 to 650) °C	0.13 °C	
	(650 to 1 000) °C	0.16 °C	
	Type J (-210 to -100) °C	0.21 °C	
	(-100 to -30) °C	0.13 °C	
	(-30 to 150) °C	0.11 °C	
	(150 to 760) °C	0.13 °C	
	(760 to 1 200) °C	0.18 °C	
	Type K (-200 to -100) °C	0.26 °C	
	(-100 to -25) °C	0.14 °C	
	(-25 to 120) °C	0.13 °C	
	(120 to 1 000) °C	0.2 °C	
	(1 000 to 1 372) °C	0.31 °C	
Type N (-200 to -100) °C	0.31 °C		
(-100 to -25) °C	0.17 °C		
(-25 to 120) °C	0.15 °C		
(120 to 410) °C	0.14 °C		
(410 to 1 300) °C	0.21 °C		



ANSI National Accreditation Board

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Electrical Simulation of Thermocouple Indicating Devices ¹	Type R (0 to 250) °C	0.44 °C	Fluke 5522A/SC1100 Multi Product Calibrator
	(250 to 400) °C	0.27 °C	
	(400 to 1 000) °C	0.26 °C	
	(1 000 to 1767) °C	0.31 °C	
	Type S (0 to 250) °C	0.37 °C	
	(250 to 1 000) °C	0.28 °C	
	(1 000 to 1 400) °C	0.29 °C	
	(1 400 to 1 767) °C	0.36 °C	
	Type T (-250 to -150) °C	0.49 °C	
	(-150 to 0) °C	0.19 °C	
(0 to 120) °C	0.13 °C		
(120 to 400) °C	0.11 °C		
Amplitude – DC Signal 50 Ω ¹	1 mV to 6.6 V	36 μV + 2.3 mV/V	Fluke 5522A/SC1100 Multi Product Calibrator
Amplitude – DC Signal 1 MΩ ¹	1 mV to 130 V	34 μV + 0.39 mV/V	
Amplitude – Square Wave 50 Ω ¹	1 mV _{pp} to 6.6 V _{pp} 10 Hz to 10kHz	31 μV + 3.9 mV/V	
Amplitude – Square Wave 1 MΩ ¹	1 mV _{pp} to 130 V _{pp} (0.01 to 1) kHz (1 to 10) kHz	34 μV + 0.79 mV/V 33 μV + 2.0 mV/V	
Leveled Sine Wave Amplitude (@ 50 kHz ref.) ¹	5 mV to 5.5 V 50 kHz to 100 MHz (100 to 300) MHz (300 to 600) MHz	260 μV + 27 mV/V 250 μV + 31 mV/V 260 μV + 47 mV/V	
	5 mV to 3.5 V (600 to 1 100) MHz	1.3 mV + 54 mV/V	
Leveled Sine Wave Flatness (@ 50 kHz ref.) ¹	5 mV to 5.5 V 50 kHz to 100 MHz (100 to 300) MHz (300 to 600) MHz	100 μV + 12 mV/V 100 μV + 16 mV/V 90 μV + 31 mV/V	
	4 mV to 3.5 V (600 to 1 100) MHz	100 μV + 39 mV/V	



Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Time Marker ¹	1 ns to 20 ms 50 ms 0.1 s 0.2 s 0.5 s 1 s 2 s 5 s	2.26 ps/μs 4.4 μs 9.8 μs 35 μs 210 μs 0.8 ms 3.1 ms 20 ms	Fluke 5522A/SC1100 Multi Product Calibrator
Rise Time ¹	(250 to 350) ps 1 kHz to 11 MHz	300 ps	

Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Pressure – Measure/Source ¹	(0 to 15) psi (-14.4 to 0) psi (-14.4 to 30) psi (0 to 100) psi (0 to 500) psi (0 to 1 000) psi (0 to 10 000) psi	0.0089 psi 0.011 psi 0.023 psi 0.056 psi 0.25 psi 0.59 psi 8.3 psi	Fluke 700 Series Pressure Transducers

Thermodynamic

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Humidity – Measure ¹ (10 to 30) °C	(5 to 95) %RH	1.1 %RH + 0.14 % of reading	Rotronic HC2A Humidity Probe
Infrared – Source ¹ ε = 0.95, λ = (8 to 14) μm	(50 to 500) °C	0.47 °C + 0.14 % of reading	Fluke 9132 Blackbody
Temperature Source ^{1,8}	(-15° to 350) °C	0.26 °C + 0.15 % of reading	Hart 9009 Drywell



Thermodynamic

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Temperature Source ^{1,8}	0.0 °C	0.058 °C	Kaye X0240 Ice Point

Time and Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Frequency – Measure ¹	10 Hz to 1.3 GHz	5.3 pHz/Hz + 100 µHz	Keysight 53220A Counter Efratom FRK-LN Oscillator
Frequency Source ¹	10 MHz	59 pHz/Hz + 100 µHz	Efratom FRK-LN Oscillator
Tachometers ¹ (Non-Contact Type)	(25 to 90 000) rpm	0.13 rpm + 2 µrpm/rpm	Fluke 5522A Multi Product Calibrator
Stopwatches & Timers	(2 to 86 400) s/day	0.058 s/day	Helmut Klein 4500 Timometer

Calibration and Measurement Capability (CMC) is expressed in terms of the measurement parameter, measurement range, expanded uncertainty of measurement and reference standard, method, and/or equipment. The expanded uncertainty of measurement is expressed as the standard uncertainty of the measurement multiplied by a coverage factor of 2 ($k=2$), corresponding to a confidence level of approximately 95%.

Notes:

- On-site calibration service is available for this parameter, since on-site conditions are typically more variable than those in the laboratory, larger measurement uncertainties are expected on-site than what is reported on the accredited scope.
- L = length in inches, DL = Diagonal Length
- Measurements include the following measurement functions: Outside, Inside, Step and Depth Extension Rods
- Inch thread setting plugs only with 60° Included Angle
- Includes 60° Metric, Unified and 55° Whitworth pitch gauges
- Uncertainty is for Steel Blocks. Carbide and Ceramic blocks may have a different uncertainty due to deformation coefficients and different coefficients of thermal expansion
- Includes dial, digital and test indicators
- Includes Liquid-in-Glass Thermometers, RTDs, Thermocouples, Bi-metallic Thermometers, etc. Liquid-in-Glass Thermometers are only calibrated in fluidized baths to ensure correct immersion depth and stem effect corrections
- Metric equivalencies for this type of equipment are available and converted by 1 in equals 25.4 mm exactly
- TPI indicates Threads per inch
- Verification performed in 12 ft. increments before repositioning
- Includes Master Setting Discs and Progressive Diameter Plugs
- This instrument/parameter has been characterized to lower the uncertainty
- The stated uncertainty is associated with a primary calibration which utilizes a comparison datum set with gauge blocks rather than a master ring.
- This scope is formatted as part of a single document including Certificate of Accreditation No. L2216.


 Vice President