



CERTIFICATE OF ACCREDITATION

ANSI-ASQ National Accreditation Board

500 Montgomery Street, Suite 625, Alexandria, VA 22314, 877-344-3044

This is to certify that

Martin Calibration, Inc.

11965 12th Avenue South

Burnsville MN 55337

Including satellite locations located in: Mundelein, IL and Watertown, SD

has been assessed by ANAB

and meets the requirements of international standard

ISO/IEC 17025:2005

and national standard

ANSI/NCSL Z540-1-1994 (R2002)

while demonstrating technical competence in the fields of

CALIBRATION & TESTING

Refer to the accompanying Scope of Accreditation for information regarding the types of tests &/or calibrations to which this accreditation applies.

ACT-1265

Certificate Number


ANAB Approval

Certificate Valid: 08/17/2017-07/06/2018

Version No. 003 Issued: 08/17/2017



This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005. 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).



SCOPE OF ACCREDITATION TO ISO/IEC 17025:2005 AND ANSI/NC SL Z540-1-1994 (R2002)

Martin Calibration, Inc.

11965 12th Avenue South
Burnsville, MN 55337
952-882-1528

CEO: Keith Bennett kbennett@martincalibration.com
Quality Manager: Paul Barber pbarber@martincalibration.com

Satellite Locations at

1208 Allanson Road, Mundelein, IL 60060
847-566-3700

General Manager: Curtis Anderson canderson@martincalibration.com

18 8th Avenue, Watertown, SD 57201
605-884-5017

General Manager: Dave Verschelden dverschelden@martincalibration.com

CALIBRATION

Valid to: July 6, 2018

Certificate Number: ACT-1265

Acoustics and Vibration

Table with 4 columns: Parameter/Equipment, Range, Expanded Uncertainty of Measurement (+/-), Reference Standard, Method, and/or Equipment. Rows include Sound Level - Source and Accelerometers.



Chemical Quantities

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Conductivity Meters ¹	(25 to 2 060) μ S	0.25 % of reading	Conductivity Standards
Refractometers	10.00 Brix 40.00 Brix	0.19 Brix 0.15 Brix	Distilled Water Calibration Oils
pH Meters ¹	4, 7, 10 pH	0.017 pH	Buffer Solutions

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
DC Voltage - Source ¹ Fixed Point	10V	0.3 μ V/V	732B's with Fluke Maps
DC Voltage - Source ¹	0V Up to 1 mV (1 to 10) mV (10 to 100) mV (100 mV to 1) V (1 to 10) V (10 to 100) V (100 to 1 100) V	20 nV 100 nV 22 μ V/V + 25 nV 5.3 μ V/V 0.5 μ V/V 0.31 μ V/V 0.35 μ V/V 1 μ V/V	MI Potentiometer/ Divider & Fluke 5720A
DC Voltage - Measure ¹	0V Up to 1 mV (1 to 10) mV (10 to 100) mV (100 mV to 1) V (1 to 10) V (10 to 100) V (100 to 1 100) V	20 nV 100 nV 22 μ V/V + 25 nV 5.3 μ V/V 0.5 μ V/V 0.31 μ V/V 0.35 μ V/V 1 μ V/V	Nano Voltmeter Fluke 732B with MI Potentiometer/ Divider
DC Voltage - Measure ¹	(1.05 to 100) kV	0.1 % of reading	Hipotronics KVM100-A
DC Current – Source & Measure ¹	Up to 100 nA (0.1 to 1) μ A (1 to 10) μ A (10 to 100) μ A (0.1 to 1) mA (1 to 10) mA (10 to 100) mA (0.1 to 1) A	22 pA 30 μ A/A 6.8 μ A/A 6.2 μ A/A 4.1 μ A/A 4.2 μ A/A 3.9 μ A/A 17 μ A/A	Standard resistors and DMM and Multifunction Calibrator



Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
DC Current – Source & Measure ¹	(1 to 10) A (10 to 20) A (20 to 100) A	80 μ A/A + 80 μ A 80 μ A/A + 800 μ A 80 μ A/A + 40 mA	Fluke 52120A
DC Current - Source ¹	(100 to 150) A (150 to 1 025) A	5 mA/A + 20 mA 5.1 mA/A + 0.9 A	Fluke 5520A with 50-turn Coil
DC Power – Source	10 μ W to 336 W 336 W to 3.06 kW (3.06 to 20.9) kW	0.23 mW/W 0.22 mW/W 0.7 mW/W	Fluke 5520A
AC Power – Source (45 to 65) Hz	109 μ W to 2.97 mW 1.09 mW to 9.18 W 297 μ W to 10.9 mW 2.97 mW to 33.66 W (1.09 to 29.7) mW 10.9 mW to 91.8 W (2.97 to 108.9) mW 29.7 mW to 336.6 W	1.4 mW/W 1.2 mW/W 1.1 mW/W 0.8 mW/W 1.4 mW/W 1.2 mW/W 1 mW/W 0.8 mW/W	Fluke 5520A
AC Voltage – Source & Measure ¹	(0 to 2.2) mV (10 to 20) Hz (20 to 40) Hz (0.04 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (0.5 to 1) MHz (2.2 to 7) mV (10 to 20) Hz (20 to 40) Hz (0.04 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (0.5 to 1) MHz	0.035 % of reading + 1.3 μ V 0.037 % of reading + 1.3 μ V 0.04 % of reading + 1.3 μ V 0.025 % of reading + 2.0 μ V 0.027 % of reading + 2.5 μ V 0.033 % of reading + 4 μ V 0.036 % of reading + 8 μ V 0.02 % of reading + 8 μ V 0.023 % of reading + 1.3 μ V 0.024 % of reading + 1.3 μ V 0.022 % of reading + 1.3 μ V 0.014 % of reading + 2 μ V 0.009 % of reading + 2.5 μ V 0.029 % of reading + 4 μ V 0.055 % of reading + 8 μ V 0.056 % of reading + 8 μ V	Fluke 5790A w/ 5720A



AC Voltage – Source & Measure	(7 to 22) mV		
	(10 to 20) Hz		0.01 % of reading + 1.3 μV
	(20 to 40) Hz		0.011 % of reading + 1.3 μV
	(0.04 to 20) kHz		0.01 % of reading + 1.3 μV
	(20 to 50) kHz		70 μV/V + 2 μV
	(50 to 100) kHz		90 μV/V + 2.5 μV
	(100 to 300) kHz		0.022 % of reading + 4 μV
	(300 to 500) kHz		0.044 % of reading + 8 μV
	(0.5 to 1) MHz		0.041 % of reading + 8 μV
	(22 to 70) mV		
	(10 to 20) Hz		60 μV/V + 1.5 μV
	(20 to 40) Hz		47 μV/V + 1.5 μV
	(0.04 to 20) kHz		53 μV/V + 1.5 μV
	(20 to 50) kHz		90 μV/V + 2 μV
	(50 to 100) kHz		0.016 % of reading + 2.5 μV
	(100 to 300) kHz		0.027 % of reading + 4 μV
	(300 to 500) kHz		0.046 % of reading + 8 μV
	(0.5 to 1) MHz		0.041 % of reading + 8 μV
	(70 to 220) mV		
	(10 to 20) Hz		26 μV/V + 1.5 μV
	(20 to 40) Hz		19 μV/V + 1.5 μV
	(0.04 to 20) kHz		24 μV/V + 1.5 μV
	(20 to 50) kHz		41 μV/V + 2 μV
	(50 to 100) kHz		77 μV/V + 2.5 μV
	(100 to 300) kHz		0.012 % of reading + 4 μV
	(300 to 500) kHz		0.013 % of reading + 8 μV
	(0.5 to 1) MHz		0.02 % of reading + 8 μV
	(220 to 700) mV		
	(10 to 20) Hz		36 μV/V + 1.5 μV
	(20 to 40) Hz		11 μV/V + 1.5 μV
	(0.04 to 20) kHz		11 μV/V + 1.5 μV
	(20 to 50) kHz		23 μV/V + 2 μV
	(50 to 100) kHz		27 μV/V + 2.5 μV
(100 to 300) kHz		96 μV/V + 4 μV	
(300 to 500) kHz		0.01 % of reading + 8 μV	
(0.5 to 1) MHz		0.015 % of reading + 8 μV	
(0.7 to 2.2) V			
(10 to 20) Hz		0.01 % of reading	
(20 to 40) Hz		13 μV/V	
(0.04 to 20) kHz		11 μV/V	
(20 to 50) kHz		46 μV/V	
(50 to 100) kHz		12 μV/V	
(100 to 300) kHz		70 μV/V	
(300 to 500) kHz		90 μV/V	
(0.5 to 1) MHz		0.02 % of reading	
			Fluke 5790A w/ 5720A



Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Source & Measure	(2.2 to 70) V		Fluke 5790A w/ 5720A
	(10 to 20) Hz	33 μ V/V	
	(20 to 40) Hz	13 μ V/V	
	(0.04 to 20) kHz	12 μ V/V	
	(20 to 50) kHz	31 μ V/V	
	(50 to 100) kHz	16 μ V/V	
	(100 to 300) kHz	72 μ V/V	
	(70 to 220) V		
	(10 to 20) Hz	33 μ V/V	
	(20 to 40) Hz	18 μ V/V	
	(0.04 to 20) kHz	41 μ V/V	
	(20 to 50) kHz	16 μ V/V	
	(50 to 100) kHz	47 μ V/V	
	(220 to 1 000) V		
	(10 to 20) Hz	27 μ V/V	
(20 to 40) Hz	27 μ V/V		
(0.04 to 20) kHz	33 μ V/V		
(20 to 50) kHz	0.01 % of reading		
(50 to 100) kHz	82 μ V/V		
AC Voltage – Source & Measure Flatness relative to 1 kHz	(0 to 2.2) mV		Fluke 5790A w/ 5720A (Wideband)
	(10 to 30) Hz	0.1 % of reading + 1.3 μ V	
	(30 to 120) Hz	0.05 % of reading + 1.3 μ V	
	(0.12 to 1.2) kHz	0.05 % of reading + 1.3 μ V	
	(1.2 to 120) kHz	0.05 % of reading + 2.0 μ V	
	(120 to 500) kHz	0.07 % of reading + 1 μ V	
	(0.5 to 1.2) MHz	0.07 % of reading + 1 μ V	
	(1.2 to 2) MHz	0.07 % of reading + 1 μ V	
	(2 to 10) MHz	0.17 % of reading + 1 μ V	
	(10 to 20) MHz	0.32 % of reading + 1 μ V	
(20 to 30) MHz	0.7 % of reading + 2 μ V		



Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
<p>AC Voltage – Source & Measure Flatness relative to 1 kHz</p>	(2.2 to 7) mV		<p>Fluke 5790A w/ 5720A (Wideband)</p>
	(10 to 30) Hz	0.1 % of reading	
	(30 to 120) Hz	0.05 % of reading	
	(0.12 to 1.2) kHz	0.05 % of reading	
	(1.2 to 120) kHz	0.05 % of reading	
	(120 to 500) kHz	0.07 % of reading + 1 μV	
	(0.5 to 1.2) MHz	0.07 % of reading + 1 μV	
	(1.2 to 2) MHz	0.07 % of reading + 1 μV	
	(2 to 10) MHz	0.1 % of reading + 1 μV	
	(10 to 20) MHz	0.17 % of reading + 1 μV	
	(20 to 30) MHz	0.37 % of reading + 1 μV	
	(7 to 22) mV		
	(10 to 30) Hz	0.1 % of reading	
	(30 to 120) Hz	0.05 % of reading	
	(0.12 to 1.2) kHz	0.05 % of reading	
	(1.2 to 120) kHz	0.05 % of reading	
	(120 to 500) kHz	0.07 % of reading	
	(0.5 to 1.2) MHz	0.07 % of reading	
	(1.2 to 2) MHz	0.07 % of reading	
	(2 to 10) MHz	0.1 % of reading	
	(10 to 20) MHz	0.17 % of reading	
	(20 to 30) MHz	0.37 % of reading	
	(22 to 70) mV		
	(10 to 30) Hz	0.1 % of reading	
	(30 to 120) Hz	0.05 % of reading %	
	(0.12 to 1.2) kHz	0.05 % of reading	
	(1.2 to 120) kHz	0.05 % of reading	
(120 to 500) kHz	0.05 % of reading		
(0.5 to 1.2) MHz	0.05 % of reading		
(1.2 to 2) MHz	0.05 % of reading		
(2 to 10) MHz	0.1 % of reading		
(10 to 20) MHz	0.15 % of reading		
(20 to 30) MHz	0.35 % of reading		



<p>AC Voltage – Source & Measure Flatness relative to 1 kHz</p>	(70 to 220) mV		
	(10 to 30) Hz	0.1 % of reading	
	(30 to 120) Hz	0.04 % of reading	
	(0.12 to 1.2) kHz	0.04 % of reading	
	(1.2 to 120) kHz	0.04 % of reading	
	(120 to 500) kHz	0.04 % of reading	
	(0.5 to 1.2) MHz	0.05 % of reading	
	(1.2 to 2) MHz	0.05 % of reading	
	(2 to 10) MHz	0.1 % of reading	
	(10 to 20) MHz	0.15 % of reading	
	(20 to 30) MHz	0.35 % of reading	
	(220 to 700) mV		
	(10 to 30) Hz	0.1 % of reading	
	(30 to 120) Hz	0.03 % of reading	
	(0.12 to 1.2) kHz	0.03 % of reading	
	(1.2 to 120) kHz	0.03 % of reading	
	(120 to 500) kHz	0.03 % of reading	
	(0.5 to 1.2) MHz	0.05 % of reading	
	(1.2 to 2) MHz	0.05 % of reading	
	(2 to 10) MHz	0.1 % of reading	
	(10 to 20) MHz	0.15 % of reading	
	(20 to 30) MHz	0.35 % of reading	
	(0.7 to 2.2) V		
	(10 to 30) Hz	0.1 % of reading	
	(30 to 120) Hz	0.03 % of reading	
	(0.12 to 1.2) kHz	0.03 % of reading	
	(1.2 to 120) kHz	0.03 % of reading	
	(120 to 500) kHz	0.03 % of reading	
	(0.5 to 1.2) MHz	0.05 % of reading	
	(1.2 to 2) MHz	0.05 % of reading	
	(2 to 10) MHz	0.1 % of reading	
	(10 to 20) MHz	0.15 % of reading	
	(20 to 30) MHz	0.35 % of reading	
(2.2 to 7) V			
(10 to 30) Hz	0.1 % of reading		
(30 to 120) Hz	0.03 % of reading		
(0.12 to 1.2) kHz	0.03 % of reading		
(1.2 to 120) kHz	0.03 % of reading		
(120 to 500) kHz	0.03 % of reading		
(0.5 to 1.2) MHz	0.05 % of reading		
(1.2 to 2) MHz	0.05 % of reading		
(2 to 10) MHz	0.1 % of reading		
(10 to 20) MHz	0.15 % of reading		
(20 to 30) MHz	0.35 % of reading		
			Fluke 5790A w/ 5720A (Wideband)



Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current – Source and Measure ¹	Up to 10 mA (0.01 to 100) kHz	250 μA/A	Fluke 5720A and Fluke 5725A w/ A40B's
	(10 to 20) mA (0.01 to 100) kHz (20 to 200) mA (0.01 to 100) kHz	250 μA/A 250 μA/A 250 μA/A	
	(0.2 A to 20) A 0.01 to 1) kHz (1 to 10) kHz (10 to 30) kHz (30 to 100) kHz	250 μA/A 250 μA/A 300 μA/A 350 μA/A	
AC Current – Source and Measure ¹	(20 to 100) A	0.015 % of reading	Fluke 52120A
AC Current - Source ¹	(10 to 16.5) A (16.5 to 150) A (150 to 1 025) A	5.9 mA/A + 30 mA 5.7 mA/A + 25 mA 5.7 mA/A + 0.9 A	Fluke 5520A with 50-turn Coil
(45 to 65) Hz	(10 to 16.5) A (16.5 to 150) A (150 to 1 025) A	11 mA/A + 30 mA 10 mA/A + 0.25 A 13 mA/A + 0.9 A	
(65 to 440) Hz			
AC Current - Measure ¹	Up to 200 μA (1 to 10) Hz	0.62 mA/A	Fluke 8508A
	10 Hz to 10 kHz	0.54 mA/A	
	(10 to 30) kHz	0.94 mA/A	
	(30 to 100) kHz	8.4 mA/A	
	200 μA to 2 mA (1 to 10) Hz	0.6 mA/A	
	10 Hz to 10 kHz	0.54 mA/A	
	(10 to 30) kHz	0.94 mA/A	
	(30 to 100) kHz	4.2 mA/A	
	(2 to 20) mA (1 to 10) Hz	0.6 mA/A	
	10 Hz to 10 kHz	0.54 mA/A	
	(10 to 30) kHz	0.94 mA/A	
	(30 to 100) kHz	4.2 mA/A	
(20 to 200) mA (1 to 10) Hz	0.57 mA/A		
10 Hz to 10 kHz	0.49 mA/A		
(10 to 30) kHz	0.83 mA/A		



Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current - Measure ¹	200 mA to 2 A 10 Hz to 2 kHz (2 to 10) kHz (10 to 30) kHz (2 to 20) A	0.83 mA/A 0.93 mA/A 3.2 mA/A	Fluke 8508A
	10 Hz to 2 kHz (2 to 10) kHz	1 mA/A 2.7 mA/A	
Resistance - Source ¹	0.001 Ω	3.5 μΩ/Ω	Standard resistors
	0.01Ω	4.3 μΩ/Ω	
	0.1 Ω	1.5 μΩ/Ω	
	1Ω	0.85 μΩ/Ω	
	10Ω	0.66 μΩ/Ω	
	100 Ω	1.7μΩ/Ω	
	1 kΩ	1.2 μΩ/Ω	
	10 kΩ	2.4 μΩ/Ω	
	100 kΩ	0.57 μΩ/Ω	
	1 MΩ	1.3 μΩ/Ω Ω	
	10 MΩ	14 μΩ/Ω	
100 MΩ	130 μΩ/Ω		
Resistance - Source ¹	(0.01 to 10) MΩ (0.01 to 10) GΩ	10 μΩ/Ω 0.5 %	Decade resistors with bridge and DMM
	(10 to 100) GΩ	1.2 % of reading	Decade Resistor
Resistance - Measure ¹ Normal Mode	(10 to 100) μΩ	0.15 % of reading	Decade resistors with bridge and DMM
	(0.1 to 1) mΩ	15 μΩ/Ω	
	(1 to 10) mΩ	5.1 μΩ/Ω	
	(10 o 100) mΩ	1.8 μΩ/Ω	
	(0.1 to 1) Ω	0.92 μΩ/Ω	
	(1 to 10) Ω	0.74 μΩ/Ω	
	(10 to 100) Ω	1.7 μΩ/Ω	
	(0.1 to 1) kΩ	1.3 μΩ/Ω	
	(1 to 10) kΩ	2.4 μΩ/Ω	
	(10 o 100) kΩ	1.1 μΩ/Ω	
	(0.1 to 1) MΩ	8.2 μΩ/Ω	
(1 to 10) MΩ	21μΩ/Ω		
Resistance - Measure ¹ Normal Mode	(10 to 200) MΩ (0.2 to 2) GΩ (2 to 20) GΩ	72 μΩ/Ω + 1kΩ 0.18 mΩ/Ω + 100 kΩ 0.67 mΩ/Ω + 10 MΩ	Decade resistors with bridge and DMM



Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Resistance - Measure ¹ High Voltage Mode up to 200 V	(2 to 20) MΩ (20 to 200) MΩ 200 MΩ to 2 GΩ (2 to 20) GΩ	15 μΩ/Ω + 10 Ω 60 μΩ/Ω + 1 kΩ 0.15 mΩ/Ω + 100 kΩ 0.53 mΩ/Ω + 10 MΩ	Decade resistors with bridge and DMM
Capacitance - Measure ¹	1 pF @ 1 kHz 10 pF @ 1 kHz 100 pF @ 1kHz 1 nF 1kHz 1 μF @ 1 kHz	1.9 mF/F 1.1 mF/F 1.2 mF/F 1.2 mF/F 1.2 mF/F	QuadTech 1730
Capacitance - Source ¹ (fixed values) @ 100 Hz @ 1 kHz	1 pF 1 nF 10 nF 100 nF 1 μF	1.8 mF/F 0.23 mF/F 0.25 mF/F 0.21 mF/F 0.25 mF/F	Standard Capacitors
Capacitance - Source ¹ 10 Hz to 10 kHz 10 Hz to 3 kHz 10 Hz to 1 kHz 10 Hz to 1 kHz 10 Hz to 1 kHz (10 to 600) Hz 10 Hz to 300 Hz 10 Hz to 150 Hz 10 Hz to 120 Hz 10 Hz 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	0.19 nF to 1.1 nF (1.1 to 3.3) nF (3.3 to 11) nF (11 to 110) nF (110 to 330) nF 330 nF 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 330 μF to 1.1 mF (1.1 to 3.3) mF (3.3 to 11) mF (11 to 33) mF (33 to 110) mF	15 mF/F 8.4 mF/F 3.6 mF/F 3.6 mF/F 3.7 mF/F 3.6 mF/F 3.6 mF/F 3.6 mF/F 5.1 mF/F 5.6 mF/F 5.6 mF/F 8.7 mF/F 5.5 mF/F 5.5 mF/F 8.5 mF/F 12 mF/F	Fluke 5520A
Inductance - Measure ¹	100 μH @ 1 kHz 1 mH @ 1 kHz 10 mH @ 1 kHz 100 mH @ 1 kHz 1 H @ 1 kHz	1.2 mH/H	QuadTech 1730



Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Inductance - Source ¹	500 μ H @ 100 Hz	1.2 mH/H	Standard Inductors
	500 μ H @ 1 kHz	1 mH/H	
	2 mH @ 100 Hz	1.1 mH/H	
	2 mH @ 1 kHz	1 mH/H	
	20 mH @ 100 Hz	1.1 mH/H	
	20 mH @ 1 kHz	1 mH/H	
	1 H @ 100 Hz	1 mH/H	
	1 H @ 1 kHz	1 mH/H	
	10 H @ 100 Hz	1 mH/H	
	10 H @ 1 kHz	1 mH/H	
Oscilloscopes ¹			Fluke 9500B/3200/9530
Square Wave Signal 50 Ω at 1 kHz	40 μ V to 5 V	1 mV/V	
Square Wave Signal 1 M Ω at 1 kHz	40 μ V to 5 V	1 mV/V	
DC Voltage, 50 Ω	1 mV to 5 V	0.26 mV/V	
DC Voltage, 1 M Ω	1 mV to 200 V	0.25 mV/V	
Leveled Sine Wave Amplitude	5 mV to 5 V	15 mV/V	
Leveled Sine Wave Flatness (relative to 50 kHz)	0.1 Hz to 300 MHz	43 mV/V	
	(300 to 550) MHz	43 mV/V	
	550 MHz to 1.1 GHz	52 mV/V	
	(1.1 to 3.2) GHz	52 mV/V	
Time Marker 50 Ω Source and Period	9 nS to 55 S	0.25 μ S/S	
Rise/Fall Time - Source	150 pS	27 pS	
Pulse Width - Source	(1 to 100) nS	52 mS/S	



Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Electrical Simulation of Thermocouple Indicators ¹	Type B		Ectron 1140A
	(250 to 350) °C	1.1 °C	
	(350 to 445) °C	0.85 °C	
	(445 to 580) °C	0.67 °C	
	(580 to 750) °C	0.52 °C	
	(750 to 1000) °C	0.43 °C	
	(1000 to 1820) °C	0.33 °C	
	Type C		
	(0 to 250) °C	0.23 °C	
	(250 to 1000) °C	0.18 °C	
	(1000 to 1500) °C	0.21 °C	
	(1500 to 1800) °C	0.24 °C	
	(1800 to 2000) °C	0.27 °C	
	(2000 to 2250) °C	0.33 °C	
	(2250 to 2315) °C	0.37 °C	
	Type E		
	(-270 to -245) °C	1.38 °C	
	(-245 to -195) °C	0.21 °C	
	(-195 to -155) °C	0.12 °C	
	(-155 to -90) °C	0.09 °C	
	(-90 to 15) °C	0.08 °C	
	(15 to 890) °C	0.07 °C	
	(890 to 1000) °C	0.08 °C	
	Type J		
(-210 to -180) °C	0.14 °C		
(-180 to -120) °C	0.12 °C		
(-120 to -50) °C	0.09 °C		
(-50 to 990) °C	0.08 °C		
(990 to 1200) °C	0.08 °C		
Type K			
(-270 to -255) °C	2.5 °C		
(-255 to -195) °C	0.81 °C		
(-195 to -115) °C	0.14 °C		
(-115 to -55) °C	0.10 °C		
(-55 to 1000) °C	0.08 °C		
(1 000 to 1 372) °C	0.09 °C		



Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Electrical Simulation of Thermocouple Indicators ¹	Type N		Ectron 1140A
	(-270 to -260) °C	5.8 °C	
	(-260 to -200) °C	1.2 °C	
	(-200 to -140) °C	0.27 °C	
	(-140 to -70) °C	0.17 °C	
	(-70 to 25) °C	0.14 °C	
	(25 to 160) °C	0.12 °C	
	(160 to 1300) °C	0.1 °C	
	Type R		
	(-50 to -30) °C	0.75 °C	
	(-30 to 45) °C	0.63 °C	
	(45 to 160) °C	0.46 °C	
	(160 to 380) °C	0.35 °C	
	(380 to 775) °C	0.3 °C	
	(775 to 1768) °C	0.25 °C	
	Type S		
	(-50 to -30) °C	0.71 °C	
	(-30 to -45) °C	0.64 °C	
	(-45 to -105) °C	0.46 °C	
	(-105 to 310) °C	0.38 °C	
	(310 to 615) °C	0.33 °C	
(615 to 1768) °C	0.3 °C		
Type T			
(-270 to -255) °C	2.1 °C		
(-255 to -240) °C	0.56 °C		
(-240 to -210) °C	0.35 °C		
(-210 to -150) °C	0.21 °C		
(-150 to -40) °C	0.14 °C		
(-40 to 100) °C	0.09 °C		
(100 to 400) °C	0.08 °C		
Electrical Simulation of RTDs ¹	PT 395 100 Ω		Fluke 5520A
	(-200 to 0) °C	0.06 °C	
	(0 to 100) °C	0.08 °C	
	(100 to 300) °C	0.11 °C	
	(300 to 400) °C	0.12 °C	
	(400 to 630) °C	0.14 °C	
	(630 to 800) °C	0.27 °C	

Electrical Simulation of RTDs ¹	PT 3926 100 Ω		
	(-200 to 0) °C		0.06 °C
	(0 to 100) °C		0.08 °C
	(100 to 300) °C		0.11 °C
	(300 to 400) °C		0.12 °C
	(400 to 630) °C		0.14 °C
	PT 3916 100 Ω		
	(-200 to -190) °C		0.29 °C
	(-190 to -80) °C		0.05 °C
	(-80 to 0) °C		0.06 °C
	(0 to 100) °C		0.07 °C
	(100 to 260) °C		0.08 °C
	(260 to 300) °C		0.09 °C
	(300 to 400) °C		0.11 °C
	(400 to 600) °C		0.12 °C
	(600 to 630) °C		0.27 °C
	PT 385 200 Ω		
	(-200 to 100) °C		0.05 °C
	(100 to 260) °C		0.06 °C
	(260 to 300) °C		0.14 °C
	(300 to 400) °C		0.15 °C
	(400 to 600) °C		0.16 °C
	(600 to 630) °C		0.19 °C
	PT 385 500 Ω		
	(-200 to -80) °C		0.05 °C
	(-80 to 100) °C		0.06 °C
	(100 to 260) °C		0.07 °C
(260 to 400) °C		0.09 °C	
(400 to 600) °C		0.01 °C	
(600 to 630) °C		0.13 °C	
PT 395 100 Ω			
(-200 to 0) °C		0.06 °C	
(0 to 100) °C		0.08 °C	
(100 to 300) °C		0.11 °C	
(300 to 400) °C		0.12 °C	
(400 to 630) °C		0.14 °C	
(630 to 800) °C		0.27 °C	
PT 3926 100 Ω			
(-200 to 0) °C		0.06 °C	
(0 to 100) °C		0.08 °C	
(100 to 300) °C		0.11 °C	
(300 to 400) °C		0.12 °C	
(400 to 630) °C		0.14 °C	

Fluke 5520A



Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Electrical Simulation of RTDs ¹	PT 3916 100 Ω		Fluke 5520A
	(-200 to -190) °C	0.29 °C	
	(-190 to -80) °C	0.05 °C	
	(-80 to 0) °C	0.06 °C	
	(0 to 100) °C	0.07 °C	
	(100 to 260) °C	0.08 °C	
	(260 to 300) °C	0.09 °C	
	(300 to 400) °C	0.11 °C	
	(400 to 600) °C	0.12 °C	
	(600 to 630) °C	0.27 °C	
	PT 385 200 Ω		
	(-200 to 100) °C	0.05 °C	
	(100 to 260) °C	0.06 °C	
	(260 to 300) °C	0.14 °C	
	(300 to 400) °C	0.15 °C	
	(400 to 600) °C	0.16 °C	
	(600 to 630) °C	0.19 °C	
	PT 385 500 Ω		
	(-200 to -80) °C	0.05 °C	
	(-80 to 100) °C	0.06 °C	
	(100 to 260) °C	0.07 °C	
	(260 to 400) °C	0.09 °C	
	(400 to 600) °C	0.01 °C	
	(600 to 630) °C	0.13 °C	
	PT 385 1 000 Ω		
	(-200 to 0) °C	0.04 °C	
	(0 to 100) °C	0.05 °C	
	(100 to 260) °C	0.06 °C	
(260 to 300) °C	0.07 °C		
(300 to 600) °C	0.08 °C		
(600 to 630) °C	0.27 °C		
PtNi 120 Ω			
(-80 to 100) °C	0.09 °C		
(100 to 260) °C	0.16 °C		
Cu 427 10 Ω			
(-100 to 260) °C	0.35 °C		



Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
RF Power - Measure Absolute Level ¹ 100 kHz to 30 MHz 30 MHz to 2 GHz (2 to 18) GHz (18 to 26.5) GHz	(20 to 30) dBm	0.37 dB 0.37 dB 0.44 dB 0.5 dB	Agilent N5531S Measuring Receiver with N5532A Sensor Module
RF Power - Measure Absolute Level ¹ 100 kHz to 30 MHz 30 MHz to 2 GHz (1 to 18) GHz (18 to 26.5) GHz	(-20 to 20) dBm	0.2 dB 0.21 dB 0.31 dB 0.4 dB	Agilent N5531S Measuring Receiver with N5532A Sensor Module
RF Power - Measure Absolute Level ¹ 100 kHz to 30 MHz	(-30 to 20) dBm	3.1 % of reading	Agilent N5531S Measuring Receiver with 8482A Sensor
Relative Power - Measure ¹ 100 kHz to 26.5 GHz	(0 to -10) dB (-20 to -10) dB (-30 to -20) dB (-40 to -30) dB (-50 to -40) dB (-60 to -50) dB (-70 to -60) dB (-80 to -70) dB (-90 to -80) dB (-100 to -90) dB (-110 to -100) dB (-120 to -110) dB (-130 to -120) dB (-140 to -130) dB	0.02 dB 0.03 dB 0.03 dB 0.05 dB 0.06 dB 0.06 dB 0.07 dB 0.07 dB 0.08 dB 0.08 dB 0.09 dB 0.1 dB 0.1 dB 0.1 dB	Agilent N5531S Measuring Receiver with N5532A Sensor Module
RF Power - Source ¹	(-90 to -75) dBm 250 kHz to 2 GHz (2 to 20) GHz (20 to 32) GHz (-75 to -10) dBm 250 kHz to 2 GHz (2 to 20) GHz (20 to 32) GHz	0.73 dBm 1 dBm 1.2 dBm 0.72 dBm 1 dBm 1.2 dBm	Agilent N5183A



Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
RF Power - Source ¹	(-20 to -10) dBm 250 kHz to 2 GHz (2 to 20) GHz (20 to 32) GHz (-10 to 10) dBm 250 kHz to 2 GHz (2 to 20) GHz (20 to 32) GHz > 10 dBm 250 kHz to 2 GHz (2 to 20) GHz (20 to 32) GHz	1.4 dBm 1.3 dBm 1.3 dBm 0.61 dBm 0.91 dBm 0.93 dBm 0.63 dBm 0.92 dBm 1 dBm	Agilent N5183A
Phase Modulation - Source ¹ 100 kHz to 32 GHz	Rate: DC to 1 MHz DC to 4 MHz	0.59 % of reading + 0.01 rad	Agilent N5183A
Narrow Pulse Modulation ¹ – Source	500 MHz to 3.2 GHz > 3.2 GHz	1.1 dB 1.1 dB	Agilent N5183A
Amplitude Modulation ¹ - Source 100 kHz to 32 GHz	Rate: DC to 10 kHz Depths: 1% to 90 %	4.1 % of reading	Agilent N5183A
Amplitude Modulation - Measure ¹			Agilent N5531S Measuring Receiver with N5532A Sensor Modules
100 kHz to 10 MHz	Rate: 20 Hz to 10 kHz Depths: 5 % to 99 %	0.83 % of reading	
10 MHz to 3 GHz	Rate: 50 Hz to 100 kHz Depths: 20 % to 99 %	0.59 % of reading	
10 MHz to 3 GHz	Rate: 50 Hz to 100 kHz Depths: 5 % to 20 %	2.6 % of reading	
(3 to 26.5) GHz	Rate: 50 Hz to 100 kHz Depths: 20 % to 99 %	1.6 % of reading	
(3 to 26.5) GHz	Rate: 50 Hz to 100 kHz Depths: 5 % to 20 %	4.7 % of reading	
Pulse Generation - Source ¹ Repetition Frequency: 0.10 Hz to 10.0 MHz Period: 30 ns to 42 s	30 ns to 42 s	10 ns	Agilent N5183A



Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Phase Modulation-Measure ¹ 100 kHz to 6.6 GHz	Rate: 200 Hz 20 kHz Dev.: > 0.7 rad	1.1 % of reading	Agilent N5531S Measuring Receiver with N5532A Sensor Modules
100 kHz to 6.6 GHz	Rate: 200 Hz, 20 kHz Dev.: > 0.3 rad	3.1 % of reading	
(6.6 to 13.2) GHz	Rate: 200 Hz 20 kHz Dev.: > 2.0 rad	1.1 % of reading	
(6.6 to 13.2) GHz	Rate: 200 Hz 20 kHz Dev.: > 0.6 rad	3.1 % of reading	
(13.2 to 26.5) GHz	Rate: 200 Hz 20 kHz Dev.: > 2.0 rad	1.1 % of reading	
(13.2 to 26.5) GHz	Rate: 200 Hz 20 kHz Dev.: > 0.6 rad	3.1 % of reading	
Frequency Modulation ¹ - Source 100 kHz to 32 GHz	1 dB Rate: DC to 3 MHz 3 dB Rate: DC to 7 MHz	2 % of setting + 20 Hz	Agilent N5183A
Freq Modulation-Measure ¹ Freq. Dev. Mod Rate Ratio >0.2	Rate: 20 Hz to 10 kHz Dev.: 200 Hz to 40 kHz peak Freq. Dev. Mod Rate Ratio >0.2	1.6 % of reading	Agilent N5531S Measuring Receiver with N5532A Sensor Modules
250 kHz to 10 MHz	Rate: 20 Hz to 10 kHz Dev.: 200 Hz to 40 kHz peak Freq. Dev. Mod Rate Ratio >1.2	1.1 % of reading	



Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Freq Modulation-Measure ¹ Freq. Dev. Mod Rate Ratio >0.2			
10 MHz to 6.6 GHz	Rate: 50 Hz to 200kHz Dev.: 250 Hz to 400 kHz peak Freq. Dev. Mod Rate Ratio >0.2	1.6 % of reading	Agilent N5531S Measuring Receiver with N5532A Sensor Modules
10 MHz to 6.6 GHz	Rate: 50 Hz to 200kHz Dev.: 250 Hz to 400 kHz peak Freq. Dev. Mod Rate Ratio >0.45	1.1 % of reading	
(6.6 to 13.2) GHz	Rate: 50 Hz to 200kHz Dev.: 250 Hz to 400 kHz peak Freq. Dev. Mod Rate Ratio >0.2	2.6 % of reading	
(6.6 to 13.2) GHz	Rate: 50 Hz to 200kHz Dev.: 250 Hz to 400 kHz peak Freq. Dev. Mod Rate Ratio >8	1.1 % of reading	
(13.2 to 26.5) GHz	Rate: 50 Hz to 200kHz Dev.: 250 Hz to 400 kHz peak Freq. Dev. Mod Rate Ratio >0.2	3.9 % of reading	
(13.2 to 26.5) GHz	Rate: 50 Hz to 200kHz Dev.: 250 Hz to 400 kHz peak	1.1 % of reading	



Length – Dimensional metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Angle Blocks	(0.25 to 60) °	0.019 °	Gage Blocks, Gage Amplifier, Sine Bar
Angle Plates - Squareness ²	Up to 18 in	(96.3 + 2.75L) μin	Gage Amplifier with probe, Master Square(s)
Gage Blocks ²	(0.01 to 1) in (1 to 2) in 4 in	(1.4 + 1.3 L) μin (1 + 1.3 L) μin 9.4 μin	Gage Blocks Gage Block Comparator
	(5 to 12) in (12 to 20) in	(5 + 2 L) μin (2 + 2.8L) μin	Horizontal Measuring Machine
	100 mm (125 to 500) mm	0.17 μm (0.06 + 0.0006L) μm	Comparison to Primary Master Gage Blocks
Indicators ^{1,2}	(0.0001 to 6) in	(5+8L) μin	Horizontal Measuring Machine
Calipers ^{1,2}	Up to 60 in	(5+8L) μin	Gage Blocks
Micrometers OD ^{1,2}	Up to 12 in	(5+8L) μin	Gage Blocks, Optical Parallels
Height Measuring Devices ^{1,2}	Up to 36 in (36 to 48) in	(45 + 2L) μin (7 + 3L) μin	Gage Blocks
Grind Gages	Up to 100 mm	0.35 mm	Digital Indicator
Coating Thickness Gages ^{1,2}	Up to 0.02 in	58 μin + 0.6R	Coating Thickness Standards
Coating Thickness Gage Standards	Up to 0.10 in	21 μin	Horizontal Measuring Machine
External Diameter ^{1,2}	(0.0001 to 12) in	(3 + 3L) μin	Horizontal Measuring Machine
Internal Diameter ^{1,2}	(0.04 to 13) in	(3 + 3L) μin	Horizontal Measuring Machine
Thread Plugs ^{1,2} Pitch Diameter	Up to 8 in Pitch (0.2 to 5) mm	(87 + 1.9L) μin	Horizontal Measuring Machine
Major Diameter	Pitch 90 – 4 TPI Up to 4 in	(3.5 + 4.6L) μin	Thread Measuring Wires
Thread Rings	Up to 4 in	160 μin	Thread Setting Plug



Length – Dimensional metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Optical Comparators ^{1,2} Linear Accuracy	Up to 6 in 6 to 12 in	(43 + 11L) μin (30 + 7.5L) μin	Glass Scale
Magnification	(5 to 100) X	350 μin	Glass Scale (Sphere)
Surface Plates ^{1,2} Overall Flatness	Up to (168 by 168) in	(25 + 2.9L) μin	Laser System
Local Area Flatness	Up to (168 by 168) in	34 μin	Repeat-O-Meter
Roundness/Cylindricity	Up to 150 mm	0.02 μm	Rondcom41c
Surface Finish Analysis	Up to 500 μin	2.4 μin	Profilometer, Master Patch
Profilometers ¹	Up to 500 μin	3.1 μin	Master Patch
Optical Flats Parallelism Flatness	Up to 6 in	2.7 μin 3.5 μin	Gage Block Comparator, Master Flat
CMMs ^{1,2}	Linearity	(25 + 2.4L) μin	Laser Measuring System
	Volumetric Repeatability	66 μin 45 μin	Ball Bar CMM Sphere
VMMs ^{1,2}	Linearity	(32 + 4.1L) μin	Glass Scales
Graduated Scales ^{1,2} Glass, Steel, Tape	Up to 12 in (1 to 200) ft	(40 + 1L) μin (10+ 3L) μin	Laser Measuring System
Horizontal Measuring Systems ^{1,2}	Up to 8 in (8 to 60) in	(6 + 1.7L) μin (3 + 2.5L) μin	Gage Blocks
Bore Gages ² 2-point	(0.24 to 9) in	(4.3 + 3L) μin + 0.6R	Horizontal Measuring Machine
		(85.1 + 7L) μin + 0.6R	Cylindrical Rings
Protractors	(0 to 90) °	0.16 °	Sine Bar, Gage Blocks
Chamfer Gages ²	(0.179 to 2.749) in	280 μin + 0.6R	Chamfer Rings
Cylindrical Squares - Squareness	Up to 12 in	1.5 arc seconds	Gage Amplifier w/ probe, Master Square(s)
		Cylindricity	0.02 μm



Length – Dimensional metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Feeler/Thickness Gages ²	Up to 0.2 in	(4.3 + 3L) μin	Horizontal Measuring System
Gage Amplifier w/ Probe(s)	Up to 0.1 in	10 μin	Gage Blocks
Gage Balls/Spheres ² - Diameter	Up to 6 in	(4.3 + 3D) μin	Gage Blocks, Horizontal Measuring System
Roundness		0.02 μm	Roundness Machine
Indicator Calibrator ² - Linearity	Up to 6 in	60 μin + 0.6R	Horizontal Measuring System
Groove Micrometers ²	Up to 12 in	(44 + 2.6L) μin + 0.6R	Gage Blocks
Machinist Levels ² – Zero Check Linearity	Up to 24 in	350 μin (100 + 0.83L) μin	Master Level Gage Blocks
Microscopes, Stereo Reticle Linearity	Up to 2 in	870 μin	Stage Micrometer
Microscopes - Toolmakers ² Scale Linearity	Up to 4 in	(774 + 70L) μin + 0.6R	Stage Micrometer
Length Standards ²	(1 to 60) in	(3.4 + 3.5L) μin	Horizontal Measuring System
Micrometers - Inside ²	Up to 8 in 8 to 60 in	(6 + 1.7L) μin (3 + 2.5L) μin	Horizontal Measuring System
Pi Tapes ² – Length	Up to 12 in	(40 + 1L) μin (10+ 3L) μin	Laser System
Thickness	(12 to 200) in	240 μin	Micrometer
Parallels ² – Steel	Up to 18 in	(96.3 + 1.8L) μin	Electronic Amplifier with Probe
Granite		(48.6 + 0.7L) μin	Surface Plate
Pitch Micrometer Standard ² Length	(1 to 65) in	(3.4 + 3.5L) μin	Horizontal Measuring System
Angle	60 °	0.18 °	Vision System
Radius Gages	(0.015625 to 0.5) in	300 μin	Vision System



Length – Dimensional metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Sine Plates/Bars ² – Top Surface Flatness	Up to 0.1 in	(41 + 2.2L) μin	Electronic Amplifier with Probe
Overall Length	Up to 10 in	3.4 + 3.5L) μin	Horizontal Measuring System
Squares ² - Granite Steel	Up to 18 in	(14 + 4.5L) μin (96 + 2.8L) μin	Electronic Amplifier with Probe, Master Square
Straightness and Straight Edges ²	Up to 60 in	(208 + 2.3L) μin	Electronic Amplifier with Probe, Surface Plate
Tapered Plugs ² - Pitch Diameter Major Diameter Step Height	(0.0625 to 6) in	(137 + 3.3L) μin (123 + 6.7L) μin 280 μin	Horizontal Measuring System, Sine Block Thread Wires Height Gage
Roundness Machine - Roundness (Spindle Performance)	Up to 0.016 in	15 μin	Master Sphere
Tapered Rings - Pitch Diameter	(0.0625 to 6) in	160 μin	NPT Master Plug, Electronic Amplifier with Probe
Step Height		5 μin	Height Gage
Thickness Gages ² - Dial Digital	Up to 1 in	410 μin + 0.6R 44 μin+ 0.6R	Gage Blocks
Thread Micrometers ² (Screw Thread, Pitch Point)	Up to 12 in	(44 + 2.6L) μin + 0.6R	Gage Blocks Thread Setting Plug
Linearity Anvil Wear		690 μin	
Granite V Blocks - Side Parallelism V Parallelism Squareness	Up to 12 in	(51 + 0.47L) μin	Electronic Amplifier with Probe, Surface Plate



Mass

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Force ¹ Source and Measure	(0.035 to 16) ozf (1 to 10) lbf (10 to 50) lbf (50 to 500) lbf	(0.018 % of reading + 0.21μ) ozf (0.018 % of reading + 0.33μ) lbf (0.018 % of reading + 9.3m) lbf (0.036 % of reading + 5.3m) lbf	Dead Weight
	(350 to 100 000) lb	0.09 % of applied value	Load Cells, Class AA
	(30 000 to 400 000) lb	0.29 % of applied value	Load Cells, Class A (compression only)
Test Machine Crosshead Displacement ^{1,2}	Up to 1 in (1 to 36) in	0.0003 in 150 μin + (146L) μin	Indicator Indicator/Gage Blocks
Extensometers ¹	up to 2 in	220 μin	Extensometer Calibrator
Cable Tensiometers	Up to 600 lb (600 to 2 000) lb	1.2 % of applied value 1.3 % of applied value	Dead Weight Load Cells
Viscometers ¹	Up to 25 cP (25 to 1 500) cP (1 500 to 75 000) cP	0.33 % of reading 0.52 % of reading 0.55 % of reading	Viscosity Standards
Pressure ¹	(-14.7 to 300) psi (300 to 1 000) psi (1 000 to 10 000) psi	65 μpsi/psi + 6e ⁻⁴ inch H ₂ O 65 μpsi/psi 0.12 % of reading	Pressure Calibrator
Pressure	(1 to 500) psi (500 to 10,000) psi (300 to 16 000) psi	60 μpsi/psi 70 μpsi/psi 0.03 % of reading	Dead Weight Tester
Flow (Gas)	(5 to 50 000) SCCM (0.5 to 50) SLPM (50 to 500) SLPM	0.25 % of reading 0.22 % of reading 0.2 % of reading	Mesa Flow System Mesa Flow System Mesa Flow System
Torque Tools ¹	0.5 ozf-in to 1 000 lbf-ft	0.86 % of reading	Torque Tester
Torque Transducers ¹	0.5 ozf-in to 1 000 lbf-ft	0.08 % of reading	Dead Weight Torque Arms
Pipettes	up to 1 μL (1 to 5) μL (5 to 10) μL (10 to 200) μL (200 to 500) μL (500 to 1000) μL	0.042 μL 0.063 μL 0.096 μL 1.3 μL 2.1 μL 3.1 μL	Pipette Calibration System
Graduated Cylinders	(1 to 200) mL (100 to 1 000) mL (600 to 6 000) mL	1.9 μL 3.2 μL 26 μL	Balances



Mass

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Scales and Balances ¹	Up to 5 mg (5 to 500) mg 500 mg to 5 g (5 to 10) g (10 to 20) g (20 to 50) g (50 to 100) g (100 to 250) g 250 g to 1.1 kg (1.1 to 6.1) kg (6.1 to 33) kg	0.005 mg 0.006 mg 0.007 mg 0.012 mg 0.014 mg 0.024 mg 0.086 mg 0.092 mg 1.4 mg 9 mg 90 mg	OIML E2 Class 1 Weights
	(0.5 to 2 000) lb	0.01 % of reading	Class 6 Weights
Mass	1 mg to 5 g (5 to 50) g (50 to 100) g (100 to 250) g (250 to 500) g (500 to 1 kg (1 to 6) kg (6 to 25) kg	0.04 mg 0.04 mg 0.04 mg 0.12 mg 0.17 mg 0.9 mg 9 mg 90 mg	Class 1 Weights
Indirect Verification of Microindentation Hardness Testers ¹ (Knoop and Vickers)	Repeatability under forces (gf): 100 ≤ HK ≤ 500 HV = 100	2.1 % of Reading 1. 4.1 % of Reading	Indirect Verification to Test Blocks
Indirect Verification of Brinell Hardness Testers ¹	Repeatability at: 500kgf ≤ 100 HBW ≥ 64 HBW 1 500kgf ≤ 257 HBW ≥ 91 HBW 3 000kgf ≤ 587 HBW ≥ 186 HBW	0.025 mm 0.025 mm 0.025 mm 0.03 mm 0.025 mm 0.025 mm	Indirect Verification to Test Blocks



Mass

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Rockwell Hardness Testers ¹	HRA Low	1.6 HRA	Indirect Verification to Test Blocks
	HRA Middle	1.6 HRA	
	HRA High	1.2 HRA	
	HRBW Low	1.6 HRBW	
	HRBW Middle	2.1 HRBW	
	HRBW High	1.6 HRBW	
	HRC Low	1.6 HRC	
	HRC Middle	1.6 HRC	
	HRC High	1.2 HRC	
	HREW Low	1.6 HREW	
	HREW Middle	1.6 HREW	
	HREW High	1.6 HREW	
	HRMW Low	1.6 HRMW	
	HRMW Middle	1.6 HRMW	
	HRMW High	1.6 HRMW	
Rockwell Superficial Hardness Testers ¹	HR15N Low	1.7 HR15N	Indirect Verification to Test Blocks
	HR15N Middle	1.6 HR15N	
	HR15N High	1.3 HR15N	
	HR15TW Low	1.6 HR15TW	
	HR15TW Middle	1.6 HR15TW	
	HR15TW High	1.6 HR15TW	
	HR30N Low	1.6 HR30N	
	HR30N Middle	1.6 HR30N	
	HR30N High	1.4 HR30N	
	HR30TW Low	1.6 HR30TW	
	HR30TW Middle	1.6 HR30TW	
	HR30TW High	1.6 HR30TW	
	HR45N Low	1.6 HR45N	
	HR45N Middle	1.6 HR45N	
	HR45N High	1.6 HR45N	



Mass

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Durometers Spring Force Types A, B, E, O Types C, D, and DO Types OO, OOO, OOO-S	(1.3 to 8.05) N (4.445 to 44.5) N (0.294 to 1.932) N	0.023 N 0.06 N 0.002 N	Shore Durometer Calibrator Balance
Indenter Angle Indenter Length Indenter Radius	(20 to 40) ° (0.049 to 0.198) in (0.05 to 0.1) in	0.05 ° 220 μin 250 μin	VMM

Thermodynamic

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Temperature - Measure	(-200 to -20) °C (-20 to 120) °C (120 to 200) °C (200 to 300) °C (300 to 600) °C	0.0062 °C 0.0017 °C 0.023 °C 0.023 °C 0.024 °C	Fluke 5699 Fluke 1590
Temperature – Source	(-20 to 120) °C (120 to 425) °C (425 to 660) °C	0.0017 °C 0.038 °C 0.063 °C	SPRT Fluke 1590 With liquid baths and Metrology Well
Infrared Temperature	(50 to 100) °C (100 to 200) °C (200 to 250) °C (250 to 300) °C (300 to 400) °C (400 to 500) °C	0.8 °C 0.93 °C 0.96 °C 1 °C 1.1 °C 1.2 °C	Black Body Calibrator <i>Monitored with a PRT</i>
Infrared Temperature	(550 to 1 500) °C	0.46 % of reading	Comparison to Reference Infrared Thermometer
Humidity ¹ Source and Measure	(20 to 50) %RH (50 to 90) %RH	1.6 %RH 2.1 %RH	Humidity Indicator



Time and Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Frequency – Source ⁴	10 MHz	5×10^{-11} Hz	SRS FS Rubidium GPSDO

DIMENSIONAL MEASUREMENT

Dimensional

Specific Tests and / or Properties Measured	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
Dimensional Inspection Contact	(18 x 20 x 12) in	(163 + 4.8L) μ in	Coordinate Measuring Machine
Non-contact	(12 x 8 x 4) in	(44 + 1L) μ in	Vision System

Services performed at satellite laboratory

1208 Allanson Road, Mundelein, IL 60060

847-566-3700

General Manager: Curtis Anderson canderson@martincalibration.com

Chemical Quantities

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
pH Meters ¹	4, 7, 10 pH	0.017 pH	Buffer Solutions

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
DC Voltage - Source ¹ fixed point	10V	0.3 μ V/V	732B's with Fluke Maps



Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
DC Voltage - Source ¹	0V Up to 1 mV (1 to 10) mV (10 to 100) mV (100 mV to 1) V (1 to 10) V (10 to 100) V (100 to 1 100) V	20 nV 100 nV 22 μ V/V + 25 nV 5.3 μ V/V 0.5 μ V/V 0.31 μ V/V 0.35 μ V/V 1 μ V/V	MI Potentiometer/ Divider & Fluke 5720A
DC Voltage - Measure ¹	0V Up to 1 mV (1 to 10) mV (10 to 100) mV (100 mV to 1) V (1 to 10) V (10 to 100) V (100 to 1 100) V	20 nV 100 nV 22 μ V/V + 25 nV 5.3 μ V/V 0.5 μ V/V 0.31 μ V/V 0.35 μ V/V 1 μ V/V	Nano Voltmeter Fluke 732B with MI Potentiometer/ Divider
DC Voltage - Measure ¹	(1.05 to 100) kV	0.1 % of reading	Hipotronics KVM100-A
DC Current – Source & Measure ¹	Up to 100 nA (0.1 to 1) μ A (1 to 10) μ A (10 to 100) μ A (0.1 to 1) mA (1 to 10) mA (10 to 100) mA (0.1 to 1) A	22 pA 30 μ A/A 6.8 μ A/A 6.2 μ A/A 4.1 μ A/A 4.2 μ A/A 3.9 μ A/A 17 μ A/A	Standard resistors and DMM and Multifunction Calibrator
DC Current – Source & Measure ¹	(1 to 10) A (10 to 20) A (20 to 100) A	80 μ A/A + 80 μ A 80 μ A/A + 800 μ A 80 μ A/A + 40 mA	Fluke 52120A
DC Current - Source ¹	(100 to 150) A (150 to 1 025) A	5 mA/A + 20 mA 5.1 mA/A + 0.9 A	Fluke 5520A with 50-turn Coil
AC Voltage – Source & Measure ¹	(0 to 2.2) mV (10 to 20) Hz (20 to 40) Hz (0.04 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (0.5 to 1) MHz	0.035 % of reading + 1.3 μ V 0.037 % of reading + 1.3 μ V 0.04 % of reading + 1.3 μ V 0.025 % of reading + 2.0 μ V 0.027 % of reading + 2.5 μ V 0.033 % of reading + 4 μ V 0.036 % of reading + 8 μ V 0.02 % of reading + 8 μ V	Fluke 5790A w/ 5720A



Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Source & Measure ¹	(2.2 to 7) mV (10 to 20) Hz (20 to 40) Hz (0.04 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (0.5 to 1) MHz	0.023 % of reading + 1.3 μV 0.024 % of reading + 1.3 μV 0.022 % of reading + 1.3 μV 0.014 % of reading + 2 μV 0.009 % of reading + 2.5 μV 0.029 % of reading + 4 μV 0.055 % of reading + 8 μV 0.056 % of reading + 8μV	Fluke 5790A w/ 5720A
AC Current – Source and Measure ¹	Up to 10 mA (0.01 to 100) kHz	250 μA/A	Fluke 5720A and Fluke 5725A w/ A40B's
	(10 to 20) mA (0.01 to 100) kHz (20 to 200) mA (0.01 to 100) kHz	250 μA/A 250 μA/A	
	(0.2 A to 20) A 0.01 to 1) kHz (1 to 10) kHz (10 to 30) kHz (30 to 100) kHz	250 μA/A 250 μA/A 300 μA/A 350 μA/A	
AC Current – Source and Measure ¹	(20 to 100) A	0.015 % of reading	Fluke 52120A
AC Current - Source ¹ (45 to 65) Hz (65 to 440) Hz	(10 to 16.5) A (16.5 to 150) A (150 to 1 025) A	5.9 mA/A + 30 mA 5.7 mA/A + 25 mA 5.7 mA/A + 0.9 A	Fluke 5520A with 50-turn Coil
	(10 to 16.5) A (16.5 to 150) A (150 to 1 025) A	11 mA/A + 30 mA 10 mA/A + 0.25 A 13 mA/A + 0.9 A	
AC Current - Measure ¹	Up to 200 μA (1 to 10) Hz 10 Hz to 10 kHz (10 to 30) kHz (30 to 100) kHz	0.62 mA/A 0.54 mA/A 0.94 mA/A 8.4 mA/A	Fluke 8508A
	200 μA to 2 mA (1 to 10) Hz 10 Hz to 10 kHz (10 to 30) kHz (30 to 100) kHz	0.6 mA/A 0.54 mA/A 0.94 mA/A 4.2 mA/A	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current - Measure ¹	(2 to 20) mA		Fluke 8508A
	(1 to 10) Hz	0.6 mA/A	
	10 Hz to 10 kHz	0.54 mA/A	
	(10 to 30) kHz	0.94 mA/A	
	(30 to 100) kHz	4.2 mA/A	
	(20 to 200) mA		
	(1 to 10) Hz	0.57 mA/A	
	10 Hz to 10 kHz	0.49 mA/A	
	(10 to 30) kHz	0.83 mA/A	
	200 mA to 2 A		
	10 Hz to 2 kHz	0.83 mA/A	
	(2 to 10) kHz	0.93 mA/A	
	(10 to 30) kHz	3.2 mA/A	
	(2 to 20) A		
10 Hz to 2 kHz	1 mA/A		
(2 to 10) kHz	2.7 mA/A		
Resistance - Source ¹	0.001 Ω	3.5 μΩ/Ω	Standard resistors
	0.01Ω	4.3 μΩ/Ω	
	0.1 Ω	1.5 μΩ/Ω	
	1Ω	0.85 μΩ/Ω	
	10Ω	0.66 μΩ/Ω	
	100 Ω	1.7μΩ/Ω	
	1 kΩ	1.2 μΩ/Ω	
	10 kΩ	2.4 μΩ/Ω	
	100 kΩ	0.57 μΩ/Ω	
	1 MΩ	1.3 μΩ/Ω	
	10 MΩ	14 μΩ/Ω	
	100 MΩ	130 μΩ/Ω	
	1 GΩ	0.32 μΩ/Ω	
Resistance - Source ¹	(0.01 to 10) MΩ (0.01 to 10) GΩ	10 μΩ/Ω 0.5 %	Decade resistors with bridge and DMM
Resistance - Source ¹	(10 to 100) GΩ	1.2 % of reading	Decade Resistor
Resistance - Measure ¹ Normal Mode	(10 to 100) μΩ	0.15 % of reading	
	(0.1 to 1) mΩ	15 μΩ/Ω	
	(1 to 10) mΩ	5.1 μΩ/Ω	
	(10 to 100) mΩ	1.8 μΩ/Ω	
	(0.1 to 1) Ω	0.92 μΩ/Ω	
	(1 to 10) Ω	0.74 μΩ/Ω	
	(10 to 100) Ω	1.7 μΩ/Ω	



Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Resistance - Measure ¹ Normal Mode	(0.01 to 1) kΩ (1 to 10) kΩ (10 to 100) kΩ (0.1 to 1) MΩ (1 to 10) MΩ (10 to 200) MΩ (0.2 to 2) GΩ (2 to 20) GΩ	1.3 μΩ/Ω 2.4 μΩ/Ω 1.1 μΩ/Ω 8.2 μΩ/Ω 21 μΩ/Ω 72 μΩ/Ω + 1kΩ 0.18 mΩ/Ω + 100 kΩ 0.67 mΩ/Ω + 10 MΩ	Decade resistors with bridge and DMM
Resistance - Measure ¹ High Voltage Mode up to 200 V	(2 to 20) MΩ (20 to 200) MΩ 200 MΩ to 2 GΩ (2 to 20) GΩ	15 μΩ/Ω + 10 Ω 60 μΩ/Ω + 1 kΩ 0.15 mΩ/Ω + 100 kΩ 0.53 mΩ/Ω + 10 MΩ	Decade resistors with bridge and DMM
Capacitance - Measure ¹	1 pF @ 1 kHz 10 pF @ 1 kHz 100 pF @ 1kHz 1 nF 1kHz 1 μF @ 1 kHz	1.9 mF/F 1.1 mF/F 1.2 mF/F 1.2 mF/F 1.2 mF/F	QuadTech 1730
Capacitance - Source ¹ (fixed values) @ 100 Hz @ 1 kHz	1 pF 1 nF 10 nF 100 nF 1 μF	1.8 mF/F 0.23 mF/F 0.25 mF/F 0.21 mF/F 0.25 mF/F	Standard Capacitors
Capacitance - Source ¹ 10 Hz to 10 kHz 10 Hz to 3 kHz 10 Hz to 1 kHz 10 Hz to 1 kHz 10 Hz to 1 kHz (10 to 600) Hz 10 Hz to 300 Hz 10 Hz to 150 Hz 10 Hz to 120 Hz 10 Hz 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	0.19 nF to 1.1 nF (1.1 to 3.3) nF (3.3 to 11) nF (11 to 110) nF (110 to 330) nF 330 nF 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 330 μF to 1.1 mF (1.1 to 3.3) mF (3.3 to 11) mF (11 to 33) mF (33 to 110) mF	15 mF/F 8.4 mF/F 3.6 mF/F 3.6 mF/F 3.7 mF/F 3.6 mF/F 3.6 mF/F 3.6 mF/F 5.1 mF/F 5.6 mF/F 5.6 mF/F 8.7 mF/F 5.5 mF/F 5.5 mF/F 8.5 mF/F 12 mF/F	Fluke 5520A



Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Inductance - Measure ¹	100 μ H @ 1 kHz 1 mH @ 1 kHz 10 mH @ 1 kHz 100 mH @ 1 kHz 1 H @ 1 kHz	1.2 mH/H	QuadTech 1730
Inductance - Source ¹	500 μ H @ 100 Hz 500 μ H @ 1 kHz 2 mH @ 100 Hz 2 mH @ 1 kHz 20 mH @ 100 Hz 20 mH @ 1 kHz	1.2 mH/H 1 mH/H 1.1 mH/H 1 mH/H 1.1 mH/H 1 mH/H	Standard Inductors
Inductance - Source ¹	1 H @ 100 Hz 1 H @ 1 kHz 10 H @ 100 Hz 10 H @ 1 kHz	1 mH/H 1 mH/H 1 mH/H 1 mH/H	Standard Inductors
Oscilloscopes ¹			
Square Wave Signal 50 Ω at 1 kHz	40 μ V to 5 V	1 mV/V	Fluke 9500B/3200/9530
Square Wave Signal 1 M Ω at 1 kHz	40 μ V to 5 V	1 mV/V	
DC Voltage, 50 Ω	1 mV to 5 V	0.26 mV/V	
DC Voltage, 1 M Ω	1 mV to 200 V	0.25 mV/V	
Leveled Sine Wave Amplitude	5 mV to 5 V	15 mV/V	
Leveled Sine Wave Flatness (relative to 50 kHz)	0.1 Hz to 300 MHz (300 to 550) MHz 550 MHz to 1.1 GHz (1.1 to 3.2) GHz	43 mV/V 43 mV/V 52 mV/V 52 mV/V	
Time Marker 50 Ω Source and Period	9 nS to 55 S	0.25 μ S/S	
Rise/Fall Time - Source	150 pS	27 pS	
Pulse Width - Source	(1 to 100) nS	52 mS/S	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Electrical Simulation of Thermocouple Indicators ¹	Type B		Ectron 1140A
	(250 to 350) °C	1.1 °C	
	(350 to 445) °C	0.85 °C	
	(445 to 580) °C	0.67 °C	
	(580 to 750) °C	0.52 °C	
	(750 to 1000) °C	0.43 °C	
	(1000 to 1820) °C	0.33 °C	
	Type C		
	(0 to 250) °C	0.23 °C	
	(250 to 1000) °C	0.18 °C	
	(1000 to 1500) °C	0.21 °C	
	(1500 to 1800) °C	0.24 °C	
	(1800 to 2000) °C	0.27 °C	
	(2000 to 2250) °C	0.33 °C	
	(2250 to 2315) °C	0.37 °C	
	Type E		
	(-270 to -245) °C	1.38 °C	
	(-245 to -195) °C	0.21 °C	
	(-195 to -155) °C	0.12 °C	
	(-155 to -90) °C	0.09 °C	
	(-90 to 15) °C	0.08 °C	
	(15 to 890) °C	0.07 °C	
	(890 to 1000) °C	0.08 °C	
	Type J		
(-210 to -180) °C	0.14 °C		
(-180 to -120) °C	0.12 °C		
(-120 to -50) °C	0.09 °C		
(-50 to 990) °C	0.08 °C		
(990 to 1200) °C	0.08 °C		
Type K			
(-270 to -255) °C	2.5 °C		
(-255 to -195) °C	0.81 °C		
(-195 to -115) °C	0.14 °C		
(-115 to -55) °C	0.10 °C		
(-55 to 1000) °C	0.08 °C		
(1 000 to 1 372) °C	0.09 °C		



Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Electrical Simulation of Thermocouple Indicators ¹	Type N		Ectron 1140A
	(-270 to -260) °C	5.8 °C	
	(-260 to -200) °C	1.2 °C	
	(-200 to -140) °C	0.27 °C	
	(-140 to -70) °C	0.17 °C	
	(-70 to 25) °C	0.14 °C	
	(25 to 160) °C	0.12 °C	
	(160 to 1300) °C	0.1 °C	
	Type R		
	(-50 to -30) °C	0.75 °C	
	(-30 to 45) °C	0.63 °C	
	(45 to 160) °C	0.46 °C	
	(160 to 380) °C	0.35 °C	
	(380 to 775) °C	0.3 °C	
	(775 to 1768) °C	0.25 °C	
	Type S		
	(-50 to -30) °C	0.71 °C	
	(-30 to -45) °C	0.64 °C	
	(-45 to -105) °C	0.46 °C	
	(-105 to 310) °C	0.38 °C	
(310 to 615) °C	0.33 °C		
(615 to 1768) °C	0.3 °C		
Type T			
(-270 to -255) °C	2.1 °C		
(-255 to -240) °C	0.56 °C		
(-240 to -210) °C	0.35 °C		
(-210 to -150) °C	0.21 °C		
(-150 to -40) °C	0.14 °C		
(-40 to 100) °C	0.09 °C		
(100 to 400) °C	0.08 °C		
Electrical Simulation of RTDs ¹	PT 395 100 Ω		Fluke 5520A
	(-200 to 0) °C	0.06 °C	
	(0 to 100) °C	0.08 °C	
	(100 to 300) °C	0.11 °C	
	(300 to 400) °C	0.12 °C	
	(400 to 630) °C	0.14 °C	
	(630 to 800) °C	0.27 °C	

Electrical Simulation of RTDs ¹	PT 3926 100 Ω		
	(-200 to 0) °C		0.06 °C
	(0 to 100) °C		0.08 °C
	(100 to 300) °C		0.11 °C
	(300 to 400) °C		0.12 °C
	(400 to 630) °C		0.14 °C
	PT 3916 100 Ω		
	(-200 to -190) °C		0.29 °C
	(-190 to -80) °C		0.05 °C
	(-80 to 0) °C		0.06 °C
	(0 to 100) °C		0.07 °C
	(100 to 260) °C		0.08 °C
	(260 to 300) °C		0.09 °C
	(300 to 400) °C		0.11 °C
	(400 to 600) °C		0.12 °C
	(600 to 630) °C		0.27 °C
	PT 385 200 Ω		
	(-200 to 100) °C		0.05 °C
	(100 to 260) °C		0.06 °C
	(260 to 300) °C		0.14 °C
	(300 to 400) °C		0.15 °C
	(400 to 600) °C		0.16 °C
	(600 to 630) °C		0.19 °C
	PT 385 500 Ω		
	(-200 to -80) °C		0.05 °C
	(-80 to 100) °C		0.06 °C
	(100 to 260) °C		0.07 °C
	(260 to 400) °C		0.09 °C
(400 to 600) °C		0.01 °C	
(600 to 630) °C		0.13 °C	
PT 395 100 Ω			
(-200 to 0) °C		0.06 °C	
(0 to 100) °C		0.08 °C	
(100 to 300) °C		0.11 °C	
(300 to 400) °C		0.12 °C	
(400 to 630) °C		0.14 °C	
(630 to 800) °C		0.27 °C	
PT 3926 100 Ω			
(-200 to 0) °C		0.06 °C	
(0 to 100) °C		0.08 °C	
(100 to 300) °C		0.11 °C	
(300 to 400) °C		0.12 °C	
(400 to 630) °C		0.14 °C	

Fluke 5520A



Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Electrical Simulation of RTDs ¹	PT 3916 100 Ω		Fluke 5520A
	(-200 to -190) °C	0.29 °C	
	(-190 to -80) °C	0.05 °C	
	(-80 to 0) °C	0.06 °C	
	(0 to 100) °C	0.07 °C	
	(100 to 260) °C	0.08 °C	
	(260 to 300) °C	0.09 °C	
	(300 to 400) °C	0.11 °C	
	(400 to 600) °C	0.12 °C	
	(600 to 630) °C	0.27 °C	
	PT 385 200 Ω		
	(-200 to 100) °C	0.05 °C	
	(100 to 260) °C	0.06 °C	
	(260 to 300) °C	0.14 °C	
	(300 to 400) °C	0.15 °C	
	(400 to 600) °C	0.16 °C	
	(600 to 630) °C	0.19 °C	
	PT 385 500 Ω		
	(-200 to -80) °C	0.05 °C	
	(-80 to 100) °C	0.06 °C	
	(100 to 260) °C	0.07 °C	
	(260 to 400) °C	0.09 °C	
	(400 to 600) °C	0.01 °C	
	(600 to 630) °C	0.13 °C	
	PT 385 1 000 Ω		
	(-200 to 0) °C	0.04 °C	
	(0 to 100) °C	0.05 °C	
	(100 to 260) °C	0.06 °C	
(260 to 300) °C	0.07 °C		
(300 to 600) °C	0.08 °C		
(600 to 630) °C	0.27 °C		
PtNi 120 Ω			
(-80 to 100) °C	0.09 °C		
(100 to 260) °C	0.16 °C		
Cu 427 10 Ω			
(-100 to 260) °C	0.35 °C		



Length – Dimensional metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Gage Blocks ²	(0.01 to 1) in (1 to 2) in 4 in	(1.4 + 1.3 L) μin (1 + 1.3 L) μin 9.4 μin	Gage Blocks Gage Block Comparator
	(5 to 12) in (12 to 20) in	(5 + 2 L) μin (2 + 2.8L) μin	Horizontal Measuring Machine
	100 mm (125 to 500) mm	0.17 μm (0.06 + 0.0006L) μm	Comparison to Primary Master Gage Blocks
Indicators ^{1,2}	(0.0001 to 6) in	(5+8L) μin	Horizontal Measuring Machine
Calipers ^{1,2}	Up to 60 in	(5+8L) μin	Gage Blocks
Micrometers OD ^{1,2}	Up to 12 in	(5+8L) μin	Gage Blocks, Optical Parallels
Height Measuring Devices ^{1,2}	Up to 36 in (36 to 48) in	(45 + 2L) μin (7 + 3L) μin	Gage Blocks
Grind Gages	Up to 100 mm	0.35 mm	Digital Indicator
Coating Thickness Gages ^{1,2}	Up to 0.02 in	58 μin + 0.6R	Coating Thickness Standards
Coating Thickness Gage Standards	Up to 0.10 in	21 μin	Horizontal Measuring Machine
External Diameter ^{1,2}	(0.0001 to 12) in	(3 + 3L) μin	Horizontal Measuring Machine
Internal Diameter ^{1,2}	(0.04 to 13) in	(3 + 3L) μin	Horizontal Measuring Machine
Thread Plugs ^{1,2} Pitch Diameter	Up to 8 in Pitch (0.2 to 5) mm	(87 + 1.9L) μin	Horizontal Measuring Machine
Major Diameter	Pitch 90 – 4 TPI Up to 4 in	(3.5 + 4.6L) μin	Thread Measuring Wires
Thread Rings	Up to 4 in	160 μin	Thread Setting Plug
Optical Comparators ^{1,2} Linear Accuracy	Up to 6 in 6 to 12 in	(43 + 11L) μin (30 + 7.5L) μin	Glass Scale
Magnification	(5 to 100) X	350 μin	Glass Scale (Sphere)



Length – Dimensional metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Surface Plates ^{1,2} Overall Flatness	Up to (168 by 168) in	(25 + 2.9L) μin	Laser System
Local Area Flatness	Up to (168 by 168) in	34 μin	Repeat-O-Meter
Surface Finish Analysis	Up to 500 μin	2.4 μin	Profilometer, Master Patch
Profilometers ¹	Up to 500 μin	3.1 μin	Master Patch
Optical Flats Parallelism Flatness	Up to 6 in	2.7 μin 3.5 μin	Gage Block Comparator, Master Flat
CMMs ^{1,2}	Linearity	(25 + 2.4L) μin	Laser Measuring System
	Volumetric Repeatability	66 μin 45 μin	Ball Bar, CMM Sphere
VMMs ^{1,2}	Linearity	(32 + 4.1L) μin	Glass Scales
Graduated Scales ^{1,2} Glass, Steel, Tape	Up to 12 in (1 to 200) ft	(40 + 1L) μin (10+ 3L) μin	Laser Measuring System
Horizontal Measuring Systems ^{1,2}	Up to 8 in 8 to 60 in	(6 + 1.7L) μin (3 + 2.5L) μin	Gage Blocks
Protractors	(0 to 90) °	0.16 °	Sine Bar, Gage Blocks
Length Standards ²	(1 to 60) in	(3.4 + 3.5L) μin	Horizontal Measuring System
Micrometers - Inside ²	Up to 8 in 8 to 60 in	(6 + 1.7L) μin (3 + 2.5L) μin	Horizontal Measuring System

Mass

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Force ¹ Source and Measure	(0.035 to 16) ozf (1 to 10) lbf (10 to 50) lbf (50 to 500) lbf	(0.018 % of reading + 0.21μ) ozf (0.018 % of reading + 0.33μ) lbf (0.018 % of reading + 9.3m) lbf (0.036 % of reading + 5.3m) lbf	Dead Weight
	(350 to 100 000) lb	0.09 % of applied value	Load Cells, Class AA
	(30 000 to 400 000) lb	0.29 % of applied value	Load Cells, Class A (compression only)



Mass

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Pressure ¹	(-14.7 to 300) psi (300 to 1 000) psi (1 000 to 10 000) psi	65 μpsi/psi + 6e ⁻⁴ inch H ₂ O 65 μpsi/psi 0.12 % of reading	Pressure Calibrator
Torque Tools ¹	0.5 ozf-in to 1 000 lbf-ft	0.86 % of reading	Torque Tester
Scales and Balances ¹	Up to 5 mg (5 to 500) mg 500 mg to 5 g (5 to 10) g (10 to 20) g (20 to 50) g (50 to 100) g (100 to 250) g 250 g to 1.1 kg (1.1 to 6.1) kg (6.1 to 33) kg	0.005 mg 0.006 mg 0.007 mg 0.012 mg 0.014 mg 0.024 mg 0.086 mg 0.092 mg 1.4 mg 9 mg 90 mg	OIML E2 Class 1 Weights
Scales and Balances ¹	(0.5 to 2 000) lb	0.01 % of reading	Class 6 Weights
Indirect Verification of Microindentation Hardness Testers ¹ (Knoop and Vickers)	Repeatability under forces (gf): 100 ≤ HK ≤ 500 HV = 100	2.1 % of Reading 2. 4.1 % of Reading	Indirect Verification to Test Blocks
Indirect Verification of Brinell Hardness Testers ¹	Repeatability at: 500kgf ≤ 100 HBW ≥ 64 HBW 1 500kgf ≤ 257 HBW ≥ 91 HBW 3 000kgf ≤ 587 HBW ≥ 186 HBW	0.025 mm 0.025 mm 0.025 mm 0.03 mm 0.025 mm 0.025 mm	Indirect Verification to Test Blocks
Rockwell Hardness Testers ¹	HRA Low HRA Middle HRA High HRBW Low HRBW Middle HRBW High	1.6 HRA 1.6 HRA 1.2 HRA 1.6 HRBW 2.1 HRBW 1.6 HRBW	Indirect Verification to Test Blocks



Mass

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Rockwell Hardness Testers ¹	HRC Low	1.6 HRC	Indirect Verification to Test Blocks
	HRC Middle	1.6 HRC	
	HRC High	1.2 HRC	
	HREW Low	1.6 HREW	
	HREW Middle	1.6 HREW	
	HREW High	1.6 HREW	
	HRMW Low	1.6 HRMW	
	HRMW Middle	1.6 HRMW	
	HRMW High	1.6 HRMW	
Rockwell Superficial Hardness Testers ¹	HR15N Low	1.7 HR15N	Indirect Verification to Test Blocks
	HR15N Middle	1.6 HR15N	
	HR15N High	1.3 HR15N	
	HR15TW Low	1.6 HR15TW	
	HR15TW Middle	1.6 HR15TW	
	HR15TW High	1.6 HR15TW	
	HR30N Low	1.6 HR30N	
	HR30N Middle	1.6 HR30N	
	HR30N High	1.4 HR30N	
	HR30TW Low	1.6 HR30TW	
	HR30TW Middle	1.6 HR30TW	
	HR30TW High	1.6 HR30TW	
	HR45N Low	1.6 HR45N	
	HR45N Middle	1.6 HR45N	
	HR45N High	1.6 HR45N	
Durometers Spring Force Types A, B, E, O Types C, D, and DO Types OO, OOO, OOO-S	(1.3 to 8.05) N	0.023 N	Shore Durometer Calibrator Balance
	(4.445 to 44.5) N	0.06 N	
	(0.294 to 1.932) N	0.002 N	
Indenter Angle Indenter Length Indenter Radius	(20 to 40) °	0.05 °	VMM
	(0.049 to 0.198) in	220 μin	
	(0.05 to 0.1) in	250 μin	



Thermodynamic

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Temperature - Measure	(-200 to -20) °C	0.0062 °C	Fluke 5699 Fluke 1590
	(-20 to 120) °C	0.0017 °C	
	(120 to 200) °C	0.023 °C	
	(200 to 300) °C	0.023 °C	
	(300 to 600) °C	0.024 °C	
Temperature – Source	(-20 to 120) °C	0.0017 °C	SPRT Fluke 1590 With liquid baths and Metrology Well
	(120 to 425) °C	0.038 °C	
	(425 to 660) °C	0.063 °C	
Infrared Temperature	(50 to 100) °C	0.8 °C	Black Body Calibrator <i>Monitored with a PRT</i>
	(100 to 200) °C	0.93 °C	
	(200 to 250) °C	0.96 °C	
	(250 to 300) °C	1 °C	
	(300 to 400) °C	1.1 °C	
(400 to 500) °C	1.2 °C		
Infrared Temperature	(550 to 1 500) °C	0.46 % of reading	Comparison to Reference Infrared Thermometer
Humidity ¹ Source and Measure	(20 to 50) %RH	1.6 %RH	Humidity Indicator
	(50 to 90) %RH	2.1 %RH	

Services performed at satellite laboratory

18 8th Avenue, Watertown, SD 57201

605-884-5017

General Manager: Dave Verschelden

dverschelden@martincalibration.com

Chemical Quantities

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Conductivity Meters ¹	(25 to 2 060) µS	0.25 % of reading	Conductivity Standards
Refractometers	10.00 Brix	0.19 Brix	Distilled Water Calibration Oils
	40.00 Brix	0.15 Brix	
pH Meters ¹	4, 7, 10 pH	0.017 pH	Buffer Solutions



Length – Dimensional metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Angle Blocks ²	(0.25 to 60) °	0.019 °	Gage Blocks, Gage Amplifier, Sine Bar
Angle Plates - Squareness ²	Up to 18 in	(96.3 + 2.75L) μin	Gage Amplifier with probe, Master Square(s)
Gage Blocks ²	(0.01 to 1) in (1 to 2) in 4 in	(1.4 + 1.3 L) μin (1 + 1.3 L) μin 9.4 μin	Gage Blocks Gage Block Comparator
	(5 to 12) in (12 to 20) in	(5 + 2 L) μin (2 + 2.8L) μin	Horizontal Measuring Machine
	100 mm (125 to 500) mm	0.17 μm (0.06 + 0.0006L) μm	Comparison to Primary Master Gage Blocks
Indicators ^{1,2}	(0.0001 to 6) in	(5+8L) μin	Horizontal Measuring Machine
Calipers ^{1,2}	Up to 60 in	(5+8L) μin	Gage Blocks
Micrometers OD ^{1,2}	Up to 12 in	(5+8L) μin	Gage Blocks, Optical Parallels
Height Measuring Devices ^{1,2}	Up to 36 in (36 to 48) in	(45 + 2L) μin (7 + 3L) μin	Gage Blocks
Coating Thickness Gages ^{1,2}	Up to 0.02 in	58 μin + 0.6R	Coating Thickness Standards
Coating Thickness Gage Standards	Up to 0.10 in	21 μin	Horizontal Measuring Machine
External Diameter ^{1,2}	(0.0001 to 12) in	(3 + 3L) μin	Horizontal Measuring Machine
Internal Diameter ¹	(0.04 to 13) in	(3 + 3L) μin	Horizontal Measuring Machine
Thread Plugs ^{1,2} Pitch Diameter	Up to 8 in Pitch (0.2 to 5) mm	(87 + 1.9L) μin	Horizontal Measuring Machine
Major Diameter	Pitch 90 – 4 TPI Up to 4 in	(3.5 + 4.6L) μin	Thread Measuring Wires
Thread Rings	Up to 4 in	160 μin	Thread Setting Plug

Length – Dimensional metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Optical Comparators ^{1,2} Linear Accuracy	Up to 6 in 6 to 12 in	(43 + 11L) μin (30 + 7.5L) μin	Glass Scale
Magnification	(5 to 100) X	350 μin	Glass Scale (Sphere)
Surface Plates ^{1,2} Overall Flatness	Up to (168 by 168) in	(25 + 2.9L) μin	Laser System
Local Area Flatness	Up to (168 by 168) in	34 μin	Repeat-O-Meter
Profilometers ¹	Up to 500 μin	3.1 μin	Master Patch
VMMs ^{1,2}	Linearity	(32 + 4.1L) μin	Glass Scales
Graduated Scales ^{1,2} Glass, Steel, Tape	Up to 12 in (1 to 200) ft	(40 + 1L) μin (10+ 3L) μin	Laser Measuring System
Horizontal Measuring Systems ¹	Up to 8 in 8 to 60 in	(6 + 1.7L) μin (3 + 2.5L) μin	Gage Blocks
Bore Gages ² 2-point	(0.24 to 9) in	(4.3 + 3L) μin + 0.6R	Horizontal Measuring Machine
3-point		(85.1 + 7L) μin + 0.6R	Cylindrical Rings
Protractors	(0 to 90) °	0.16 °	Sine Bar, Gage Blocks
Chamfer Gages ²	(0.179 to 2.749) in	280 μin + 0.6R	Chamfer Rings
Feeler/Thickness Gages ²	Up to 0.2 in	(4.3 + 3L) μin	Horizontal Measuring System
Gage Amplifier w/ Probe(s)	Up to 0.1 in	10 μin	Gage Blocks
Indicator Calibrator ² - Linearity	Up to 6 in	60 μin + 0.6R	Horizontal Measuring System
Groove Micrometers ²	Up to 12 in	(44 + 2.6L) μin+ 0.6R	Gage Blocks
Microscopes, Stereo Reticle Linearity	Up to 2 in	870 μin	Stage Micrometer
Microscopes - Toolmakers ² Scale Linearity	Up to 4 in	(774 + 70L) μin + 0.6R	Stage Micrometer
Micrometers - Inside ²	Up to 8 in 8 to 60 in	(6 + 1.7L) μin (3 + 2.5L) μin	Horizontal Measuring System



Length – Dimensional metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Length Standards ²	(1 to 60) in	(3.4 + 3.5L) μin	Horizontal Measuring System
Parallels ² – Steel	Up to 18 in	(96.3 + 1.8L) μin	Electronic Amplifier with Probe
Granite		(48.6 + 0.7L) μin	Surface Plate
Pitch Micrometer Standards ² Length	(1 to 65) in	(3.4 + 3.5L) μin	Horizontal Measuring System
Angle	60 °	0.18 °	Vision System
Radius Gages	(0.015625 to 0.5) in	300 μin	Vision System
Sine Plates/Bars ² – Top Surface Flatness	Up to 0.1 in	(41 + 2.2L) μin	Electronic Amplifier with Probe
Overall Length	Up to 10 in	3.4 + 3.5L) μin	Horizontal Measuring System
Squares - Granite Steel	Up to 18 in	(14 + 4.5L) μin (96 + 2.8L) μin	Electronic Amplifier with Probe, Master Square
Straightness and Straight Edges ²	Up to 60 in	(208 + 2.3L) μin	Electronic Amplifier with Probe, Surface Plate
Tapered Plugs ² - Pitch Diameter Major Diameter Step Height	(0.0625 to 6) in	(137 + 3.3L) μin (123 + 6.7L) μin 280 μin	Horizontal Measuring System, Sine Block Thread Wires Height Gage
Tapered Rings - Pitch Diameter	(0.0625 to 6) in	160 μin	NPT Master Plug, Electronic Amplifier with Probe
Step Height		5 μin	Height Gage
Thickness Gages ² - Dial Digital	Up to 1 in	410 μin + 0.6R 44 μin+ 0.6R	Gage Blocks



Length – Dimensional metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Thread Micrometers ² (Screw Thread, Pitch Point) Linearity Anvil Wear	Up to 12 in	(44 + 2.6L) μin + 0.6R 690 μin	Gage Blocks Thread Setting Plug
Granite V Blocks ² - Side Parallelism V Parallelism Squareness	Up to 12 in	(51 + 0.47L) μin	Electronic Amplifier with Probe, Surface Plate

Mass

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Force ¹ Source and Measure	(0.035 to 16) ozf (1 to 10) lbf (10 to 50) lbf (50 to 500) lbf	(0.018 % of reading + 0.21μ) ozf (0.018 % of reading + 0.33μ) lbf (0.018 % of reading + 9.3m) lbf (0.036 % of reading + 5.3m) lbf	Dead Weight
	(350 to 100 000) lb	0.09 % of applied value	Load Cells, Class AA
	(30 000 to 400 000) lb	0.29 % of applied value	Load Cells, Class A (compression only)
Pressure ¹	(-14.7 to 300) psi (300 to 1 000) psi (1 000 to 10 000) psi	65 μpsi/psi + 6e ⁻⁴ inch H ₂ O 65 μpsi/psi 0.12 % of reading	Pressure Calibrator
Torque Tools ¹	0.5 ozf-in to 1 000 lbf-ft	0.86 % of reading	Torque Tester
Scales and Balances ¹	Up to 5 mg (5 to 500) mg 500 mg to 5 g (5 to 10) g (10 to 20) g (20 to 50) g (50 to 100) g (100 to 250) g 250 g to 1.1 kg (1.1 to 6.1) kg (6.1 to 33) kg	0.005 mg 0.006 mg 0.007 mg 0.012 mg 0.014 mg 0.024 mg 0.086 mg 0.092 mg 1.4 mg 9 mg 90 mg	OIML E2 Class 1 Weights
Scales and Balances ¹	(0.5 to 2 000) lb	0.01 % of reading	Class 6 Weights



Thermodynamic

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Humidity ¹ Source and Measure	(20 to 50) %RH (50 to 90) %RH	1.6 %RH 2.1 %RH	Humidity Indicator

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:

1. 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.
2. The use of (R) signifies the Resolution of the unit under test, The use of (L) represents Length in inches, The use of (D) represents Diameter in inches.
3. Uncertainties listed for Electromagnetic - DC/Low Frequency and RF/Microwave does not include possible contributions from a "best available" unit under test
4. Derivatives of 10MHz will have different uncertainties due to resolution, noise, and gating errors.
5. This scope is formatted as part of a single document including Certificate of Accreditation No. ACT-1265.



Vice President