



CERTIFICATE OF ACCREDITATION

The ANSI National Accreditation Board

Hereby attests that

Micro Precision Calibration Laboratory (Thailand) Co., Ltd.
413 Bondstreet Road, Bangpood Subdistrict,
Pakkred District, Nonthaburi 11120 Thailand

Fulfills the requirements of

ISO/IEC 17025:2017

and national standards

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

In the field of

CALIBRATION

This certificate is valid only when accompanied by a current scope of accreditation document.
The current scope of accreditation can be verified at www.anab.org.

R. Douglas Leonard Jr., VP, PILR SBU

Expiry Date: 31 October 2022

Certificate Number: AC-1969.20



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).

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

Micro Precision Calibration Laboratory (Thailand) Co., Ltd.

413 Bondstreet Road, Bangpood Subdistrict,
Pakkred District, Nonthaburi 11120 Thailand
Somsak Navayon +66-96-835 4295
Somsak.navayon@microprecision.com www.microprecision.com

CALIBRATION

Valid to: **October 31, 2022**

Certificate Number: **AC-1969.20**

Acoustics and Vibration

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Vibration ¹ (0.2 Hz to 10 kHz) Acceleration	(0 to 200) m/s ²	0.69 % of reading + 0.004 7 m/s ²	Vibration System
Velocity	(0 to 200) mm/s	0.69 % of reading + 0.004 7 mm/m	
Displacement	(0 to 200) μm	0.69 % of reading + 0.004 7 μm	
Accelerometers / Velocity Sensors / Displacement Sensors	Sensitivity: (0.04 to 1 000) pC/units (0.04 to 1 000) mV/units	0.83 % of sensitivity	
Sound Level Meter ¹	(74 to 114) dB (125 Hz to 4 kHz)	0.32 dB	Sound Calibrator, Sound Level Meter
Sound Calibrator ¹	(74 to 134) dB (100 Hz to 100 kHz)	0.12 dB	Multimeter w/Conditioning Amplifier and Microphone

Chemical Quantities

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Optical System Aerosol Particle Counter	Counting efficiency Particle sizes: (0.1, 0.2, 0.3, 0.5, 0.7, 1, 2, 3, 5, 10) μm	4.5 % (Counting efficiency)	Comparison to Master Particle Counter



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Chemical Quantities

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Conductivity – Measure ¹	84 μ S/cm 1 413 μ S/cm 12 880 μ S/cm	0.46 μ S/cm 7.8 μ S/cm 71 μ S/cm	Comparison to Standard Solutions
pH – Measure ¹	(4, 7, 10) pH	0.012 pH	Comparison to Standard Solutions

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
DC Voltage – Source ¹	(0 to 220) mV 220 mV to 2.2 V (2.2 to 11) V (11 to 22) V (22 to 220) V (220 to 1 100) V	8 μ V/V + 2 μ V 5 μ V/V + 3 μ V 4 μ V/V + 5 μ V 4 μ V/V + 8 μ V 5 μ V/V + 62 μ V 7 μ V/V + 470 μ V	Multi-Function Calibrator
DC Voltage – Source ¹ Fixed Points	1.018 V 10 V	1.9 μ V 4.2 μ V	DC Voltage Reference Standard
DC Voltage – Measure ¹	(0 to 100) mV 100 mV to 1V (1 to 10) V (10 to 100) V (100 to 1 000) V	11 μ V/V + 6 μ V 10 μ V/V + 2 μ V 10 μ V/V + 2 μ V 12 μ V/V + 2 μ V 12 μ V/V + 6 μ V	Multimeter
	100 mV 1 V 10 V 100 V 1 kV	0.71 μ V/V + 2.0 μ V 0.47 μ V/V + 1.7 μ V 0.4 μ V/V + 1.6 μ V 0.47 μ V/V + 1.7 μ V 0.71 μ V/V + 2.0 μ V	Direct transfer with Reference Divider and DC Reference Standard
DC High Voltage ¹ (Source & Measure)	(0 to 10) kV (10 to 35) kV	0.35 mV/V + 0.035 V 0.41 mV/V + 0.081 V	Comparison with High Voltage Meter and High Voltage Probe
DC Power – Source ^{1,2} 0.01 mW to 20.5 kW	33 mV to 1 020 V (0.33 to 330) mA 330 mA to 11 A (11 to 20.5) A	0.03 % of Watts output + 0.58·R 0.059 % of Watts output + 0.58·R 0.096 % of Watts output + 0.58·R	Multi-Product Calibrator w/Amplifier

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment	
DC Current – Source ¹	(0 to 220) μ A 220 μ A to 2.2 mA (2.2 to 22) mA (22 to 220) mA (220 mA to 2.2) A	40 μ A/A + 6 nA 35 μ A/A + 7 nA 35 μ A/A + 40 nA 47 μ A/A + 0.7 μ A 98 μ A/A + 12 μ A	Multi-Function Calibrator	
	(0 to 11) A	360 μ A/A + 480 μ A	Multi-Function Calibrator with Amplifier	
	(0 to 20.5) A	776 μ A/A + 600 μ A	Multi-Product Calibrator	
	(0 to 16.5) A (16.5 to 150) A (150 to 1 025) A	3.2 mA/A + 3.5 mA 3.2 mA/A + 29 mA 3.4 mA/A + 104 mA	Multi-Product Calibrator w/50-turns coil	
DC Current – Measure ¹	(0 to 100) nA 100 nA to 1 μ A (1 to 10) μ A (10 to 100) μ A 100 μ A to 1 mA (1 to 10) mA (10 to 100) mA 100 mA to 1 A	36 μ A/A + 50 pA 25 μ A/A + 50 pA 25 μ A/A + 121 pA 25 μ A/A + 1 nA 25 μ A/A + 7 nA 25 μ A/A + 68 nA 41 μ A/A + 0.7 μ A 128 μ A/A + 14 μ A	Multimeter	
	(0 to 20) (20 to 2 000) A	0.12 mA/A 0.25 mA/A	Current Shunt /Multimeter	
	Resistance – Source ¹	(0 to 11) Ω (11 to 33) Ω (33 to 110) Ω (110 to 330) Ω (0.33 to 1.1) k Ω (1.1 to 3.3) k Ω (3.3 to 11) k Ω (11 to 33) k Ω (33 to 110) k Ω (110 to 330) k Ω 330 k Ω to 1.1 M Ω (1.1 to 3.3) M Ω (3.3 to 11) M Ω (11 to 33) M Ω (33 to 110) M Ω (110 to 330) M Ω (330 to 1 100) M Ω	31 $\mu\Omega/\Omega$ + 8 m Ω 24 $\mu\Omega/\Omega$ + 12 m Ω 22 $\mu\Omega/\Omega$ + 12 m Ω 22 $\mu\Omega/\Omega$ + 16 m Ω 22 $\mu\Omega/\Omega$ + 16 m Ω 22 $\mu\Omega/\Omega$ + 160 m Ω 22 $\mu\Omega/\Omega$ + 76 m Ω 22 $\mu\Omega/\Omega$ + 0.78 Ω 22 $\mu\Omega/\Omega$ + 0.78 Ω 25 $\mu\Omega/\Omega$ + 7.8 Ω 25 $\mu\Omega/\Omega$ + 7.8 Ω 47 $\mu\Omega/\Omega$ + 120 Ω 100 $\mu\Omega/\Omega$ + 200 Ω 194 $\mu\Omega/\Omega$ + 2.0 k Ω 388 $\mu\Omega/\Omega$ + 2.3 k Ω 2.3 m Ω/Ω + 78 k Ω 12 m Ω/Ω + 390 k Ω	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 Fixed Points	0 Ω	40 μΩ	Multi-Function Calibrator		
	1 Ω	96 μΩ			
	1.9 Ω	185 μΩ			
	10 Ω	240 μΩ			
	19 Ω	460 μΩ			
	100 Ω	1.3 mΩ			
	190 Ω	2.4 mΩ			
	1 kΩ	11 mΩ			
	1.9 kΩ	21 mΩ			
	10 kΩ	110 mΩ			
	19 kΩ	210 mΩ			
	100 kΩ	1.3 Ω			
	190 kΩ	2.5 Ω			
	1 MΩ	22 Ω			
	1.9 MΩ	45 Ω			
	10 MΩ	440 Ω			
19 MΩ	1.1 kΩ				
100 MΩ	11 kΩ				
Resistance – Source ¹ Fixed Points	0.05 mΩ	30 μΩ/Ω	Standard Resistors		
	0.1 mΩ	29 μΩ/Ω			
	10 mΩ	12 μΩ/Ω			
	1 Ω	2.4 μΩ/Ω			
	100 Ω	18 μΩ/Ω			
	1 kΩ	18 μΩ/Ω			
Resistance – Source ¹	100 kΩ to 1 MΩ (1 to 100) MΩ	0.2 mΩ/Ω 0.8 mΩ/Ω	Standard Decade Resistors		
	100 MΩ to 10 GΩ (10 to 100) GΩ	3.1 mΩ/Ω 6 mΩ/Ω			
	Resistance – Measure ¹	(0 to 10) Ω		18 μΩ/Ω + 68 μΩ	Multimeter
		(10 to 100) Ω		15 μΩ/Ω + 0.7 mΩ	
100 Ω to 1 kΩ		13 μΩ/Ω + 0.7 mΩ			
(1 to 10) kΩ		13 μΩ/Ω + 7 mΩ			
(10 to 100) kΩ		13 μΩ/Ω + 68 mΩ			
100 kΩ to 1 MΩ		18 μΩ/Ω + 5 Ω			
(1 to 10) MΩ		61 μΩ/Ω + 135 Ω			
(10 to 100) MΩ		584 μΩ/Ω + 2 kΩ			
100 MΩ to 1 GΩ		5.8 mΩ/Ω + 14 kΩ			



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Capacitance – Source ¹ 50 Hz to 1 kHz	(0.19 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	3.9 mF/F + 7.8 pF 1.9 mF/F + 7.8 pF 1.9 mF/F + 78 pF 1.9 mF/F + 233 pF 1.9 mF/F + 0.78 nF 1.9 mF/F + 2.3 nF 1.9 mF/F + 7.8 nF 3.1 mF/F + 23 nF 3.5 mF/F + 78 nF 3.5 mF/F + 233 nF 3.5 mF/F + 0.78 μF 3.5 mF/F + 2.3 μF 3.5 mF/F + 7.8 μF 5.8 mF/F + 23 μF 8.5 mF/F + 78 μF	Multi-Product Calibrator
Capacitance – Measure ¹ @ 1 kHz	1 pF to 1 mF	1 mF/F	RLC DigiBridge
AC Voltage – Source ¹	220 μV 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 (2.2 to 22) mV (10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz	240 μV/V + 4 μV 90 μV/V + 4 μV 80 μV/V + 4 μV 200 μV/V + 4 μV 500 μV/V + 5 μV 1.1 mV/V + 10 μV 1.4 mV/V + 20 μV 2.7 mV/V + 20 μV 240 μV/V + 4 μV 90 μV/V + 4 μV 80 μV/V + 4 μV 200 μV/V + 4 μV 500 μV/V + 5 μV 1.1 mV/V + 10 μV 1.4 mV/V + 20 μV 2.7 mV/V + 20 μV	Multi-Function 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 ¹	(22 to 220) mV		Multi-Function Calibrator
	(10 to 20) Hz	240 $\mu\text{V/V} + 12 \mu\text{V}$	
	(20 to 40) Hz	90 $\mu\text{V/V} + 8 \mu\text{V}$	
	40 Hz to 20 kHz	80 $\mu\text{V/V} + 8 \mu\text{V}$	
	(20 to 50) kHz	207 $\mu\text{V/V} + 10 \mu\text{V}$	
	(50 to 100) kHz	463 $\mu\text{V/V} + 22 \mu\text{V}$	
	(100 to 300) kHz	0.9 mV/V + 26 μV	
	(300 to 500) kHz	1.4 mV/V + 30 μV	
	500 kHz to 1 MHz	2.7 mV/V + 48 μV	
	220 mV to 2.2 V		
	(10 to 20) Hz	296 $\mu\text{V/V} + 53 \mu\text{V}$	
	(20 to 40) Hz	104 $\mu\text{V/V} + 23 \mu\text{V}$	
	40 Hz to 20 kHz	46 $\mu\text{V/V} + 9 \mu\text{V}$	
	(20 to 50) kHz	83 $\mu\text{V/V} + 12 \mu\text{V}$	
	(50 to 100) kHz	115 $\mu\text{V/V} + 33 \mu\text{V}$	
	(100 to 300) kHz	503 $\mu\text{V/V} + 95 \mu\text{V}$	
	(300 to 500) kHz	1 mV/V + 243 μV	
	500 kHz to 1 MHz	1.7 mV/V + 458 μV	
	(2.2 to 22) V		
	(10 to 20) Hz	296 $\mu\text{V/V} + 529 \mu\text{V}$	
	(20 to 40) Hz	104 $\mu\text{V/V} + 183 \mu\text{V}$	
	40 Hz to 20 kHz	46 $\mu\text{V/V} + 61 \mu\text{V}$	
	(20 to 50) kHz	83 $\mu\text{V/V} + 122 \mu\text{V}$	
	(50 to 100) kHz	106 $\mu\text{V/V} + 243 \mu\text{V}$	
	(100 to 300) kHz	390 $\mu\text{V/V} + 794 \mu\text{V}$	
	(300 to 500) kHz	1 mV/V + 2.3 mV	
	500 kHz to 1 MHz	1.5 mV/V + 3.6 mV	
(22 to 220) V			
(10 to 20) Hz	296 $\mu\text{V/V} + 5.3 \text{ mV}$		
(20 to 40) Hz	104 $\mu\text{V/V} + 1.8 \text{ mV}$		
40 Hz to 20 kHz	52 $\mu\text{V/V} + 0.7 \text{ mV}$		
(20 to 50) kHz	87 $\mu\text{V/V} + 1.1 \text{ mV}$		
(50 to 100) kHz	154 $\mu\text{V/V} + 3 \text{ mV}$		
(100 to 300) kHz	1 mV/V + 16 mV		
(300 to 500) kHz	4.5 mV/V + 40 mV		
500 kHz to 1 MHz	8 mV/V + 80 mV		
(220 to 1 100) V			
(15 to 50) Hz	346 $\mu\text{V/V} + 16 \text{ mV}$		
50 Hz to 1 kHz	70 $\mu\text{V/V} + 3.5 \text{ mV}$		



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Source ¹	(220 to 750) V (30 to 50) kHz (50 to 100) kHz (220 to 1 100) V 40 Hz to 1 kHz (1 to 20) kHz (20 to 30) kHz	0.6 mV/V + 11 mV 2.3 mV/V + 45 mV 92 μV/V + 4 mV 166 μV/V + 6 mV 0.6 mV/V + 11 mV	Multi-Function Calibrator with Amplifier
AC Voltage – Measure ¹	(0 to 10) mV (1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (10 to 100) mV (1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz 300 kHz to 1 MHz (1 to 2) MHz 100 mV to 10 V (1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz 300 kHz to 1 MHz (1 to 2) MHz (10 to 100) V (1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz 300 kHz to 1 MHz	353 μV/V + 7.7 μV 241 μV/V + 7 μV 353 μV/V + 7 μV 1.2 mV/V + 7 μV 5.8 mV/V + 7 μV 46 mV/V + 7.3 μV 88 μV/V + 4.6 μV 88 μV/V + 2.3 μV 165 μV/V + 2.3 μV 348 μV/V + 2.3 μV 924 μV/V + 2.3 μV 3.5 mV/V + 12 μV 12 mV/V + 12 μV 18 mV/V + 12 μV 88 μV/V + 463 μV 88 μV/V + 234 μV 165 μV/V + 234 μV 348 μV/V + 234 μV 924 μV/V + 234 μV 3.5 mV/V + 1.2 mV 12 mV/V + 1.2 mV 18 mV/V + 1.2 mV 234 μV/V + 4.6 mV 234 μV/V + 2.3 mV 234 μV/V + 2.3 mV 406 μV/V + 2.3 mV 1.4 mV/V + 2.3 mV 4.6 mV/V + 12 mV 18 mV/V + 12 mV	Multimeter



ANSI National Accreditation Board

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Measure ¹	(100 to 1 000) V (1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz	463 μ V/V + 47 mV 463 μ V/V + 24 mV 694 μ V/V + 24 mV 1.4 mV/V + 24 mV 3.5 mV/V + 24 mV	Multimeter
AC Voltage – Measure ¹	(0 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 (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 (7 to 22) mV (10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz	1.7 mV/V + 1.3 μ V 740 μ V/V + 1.3 μ V 420 μ V/V + 1.3 μ V 810 μ V/V + 2 μ V 1.2 mV/V + 2.5 μ V 2.3 mV/V + 4 μ V 2.4 mV/V + 8 μ V 3.5 mV/V + 8 μ V 850 μ V/V + 1.3 μ V 370 μ V/V + 1.3 μ V 210 μ V/V + 1.3 μ V 400 μ V/V + 2 μ V 600 μ V/V + 2.5 μ V 1.2 mV/V + 4 μ V 1.3 mV/V + 8 μ V 2.3 mV/V + 8 μ V 290 μ V/V + 1.3 μ V 190 μ V/V + 1.3 μ V 110 μ V/V + 1.3 μ V 210 μ V/V + 2 μ V 310 μ V/V + 2.5 μ V 810 μ V/V + 4 μ V 890 μ V/V + 8 μ V 1.7 mV/V + 8 μ V	AC Measurement Standard



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Measure ¹	(22 to 70) mV		AC Measurement Standard
	(10 to 20) Hz	240 $\mu\text{V/V} + 1.5 \mu\text{V}$	
	(20 to 40) Hz	120 $\mu\text{V/V} + 1.5 \mu\text{V}$	
	40 Hz to 20 kHz	65 $\mu\text{V/V} + 1.5 \mu\text{V}$	
	(20 to 50) kHz	130 $\mu\text{V/V} + 2 \mu\text{V}$	
	(50 to 100) kHz	260 $\mu\text{V/V} + 2.5 \mu\text{V}$	
	(100 to 300) kHz	510 $\mu\text{V/V} + 4 \mu\text{V}$	
	(300 to 500) kHz	670 $\mu\text{V/V} + 8 \mu\text{V}$	
	500 kHz to 1 MHz	1.1 mV/V + 8 μV	
	(70 to 220) mV		
	(10 to 20) Hz	210 $\mu\text{V/V} + 1.5 \mu\text{V}$	
	(20 to 40) Hz	85 $\mu\text{V/V} + 1.5 \mu\text{V}$	
	40 Hz to 20 kHz	38 $\mu\text{V/V} + 1.5 \mu\text{V}$	
	(20 to 50) kHz	69 $\mu\text{V/V} + 2 \mu\text{V}$	
	(50 to 100) kHz	160 $\mu\text{V/V} + 2.5 \mu\text{V}$	
	(100 to 300) kHz	250 $\mu\text{V/V} + 4 \mu\text{V}$	
	(300 to 500) kHz	380 $\mu\text{V/V} + 8 \mu\text{V}$	
	500 kHz to 1 MHz	1 mV/V + 8 μV	
	(220 to 700) mV		
	(10 to 20) Hz	210 $\mu\text{V/V} + 1.5 \mu\text{V}$	
	(20 to 40) Hz	76 $\mu\text{V/V} + 1.5 \mu\text{V}$	
	40 Hz to 20 kHz	33 $\mu\text{V/V} + 1.5 \mu\text{V}$	
	(20 to 50) kHz	51 $\mu\text{V/V} + 2 \mu\text{V}$	
	(50 to 100) kHz	79 $\mu\text{V/V} + 2.5 \mu\text{V}$	
	(100 to 300) kHz	180 $\mu\text{V/V} + 4 \mu\text{V}$	
	(300 to 500) kHz	300 $\mu\text{V/V} + 8 \mu\text{V}$	
	500 kHz to 1 MHz	960 $\mu\text{V/V} + 8 \mu\text{V}$	
700 mV to 2.2 V			
(10 to 20) Hz	200 $\mu\text{V/V} + 0.058 \mu\text{V}$		
(20 to 40) Hz	66 $\mu\text{V/V} + 0.058 \mu\text{V}$		
40 Hz to 20 kHz	24 $\mu\text{V/V} + 0.058 \mu\text{V}$		
(20 to 50) kHz	46 $\mu\text{V/V} + 0.058 \mu\text{V}$		
(50 to 100) kHz	71 $\mu\text{V/V} + 0.058 \mu\text{V}$		
(100 to 300) kHz	160 $\mu\text{V/V} + 0.058 \mu\text{V}$		
(300 to 500) kHz	260 $\mu\text{V/V} + 0.058 \mu\text{V}$		
500 kHz to 1 MHz	900 $\mu\text{V/V} + 0.058 \mu\text{V}$		

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Measure ¹	(2.2 to 7) V		AC Measurement Standard
	(10 to 20) Hz	200 $\mu\text{V/V} + 0.058 \mu\text{V}$	
	(20 to 40) Hz	67 $\mu\text{V/V} + 0.058 \mu\text{V}$	
	40 Hz to 20 kHz	24 $\mu\text{V/V} + 0.058 \mu\text{V}$	
	(20 to 50) kHz	48 $\mu\text{V/V} + 0.058 \mu\text{V}$	
	(50 to 100) kHz	81 $\mu\text{V/V} + 0.058 \mu\text{V}$	
	(100 to 300) kHz	190 $\mu\text{V/V} + 0.058 \mu\text{V}$	
	(300 to 500) kHz	400 $\mu\text{V/V} + 0.058 \mu\text{V}$	
	500 kHz to 1 MHz	1.2 $\text{mV/V} + 0.058 \mu\text{V}$	
	(7 to 22) V		
	(10 to 20) Hz	200 $\mu\text{V/V} + 0.58 \mu\text{V}$	
	(20 to 40) Hz	67 $\mu\text{V/V} + 0.58 \mu\text{V}$	
	40 Hz to 20 kHz	27 $\mu\text{V/V} + 0.58 \mu\text{V}$	
	(20 to 50) kHz	48 $\mu\text{V/V} + 0.58 \mu\text{V}$	
	(50 to 100) kHz	81 $\mu\text{V/V} + 0.58 \mu\text{V}$	
	(100 to 300) kHz	190 $\mu\text{V/V} + 0.58 \mu\text{V}$	
	(300 to 500) kHz	400 $\mu\text{V/V} + 0.58 \mu\text{V}$	
	500 kHz to 1 MHz	1.2 $\text{mV/V} + 0.58 \mu\text{V}$	
	(22 to 70) V		
	(10 to 20) Hz	200 $\mu\text{V/V} + 0.58 \mu\text{V}$	
	(20 to 40) Hz	68 $\mu\text{V/V} + 0.58 \mu\text{V}$	
	40 Hz to 20 kHz	32 $\mu\text{V/V} + 0.58 \mu\text{V}$	
	(20 to 50) kHz	57 $\mu\text{V/V} + 0.58 \mu\text{V}$	
	(50 to 100) kHz	94 $\mu\text{V/V} + 0.58 \mu\text{V}$	
	(100 to 300) kHz	200 $\mu\text{V/V} + 0.58 \mu\text{V}$	
	(300 to 500) kHz	410 $\mu\text{V/V} + 0.58 \mu\text{V}$	
	500 kHz to 1 MHz	1.2 $\text{mV/V} + 0.58 \mu\text{V}$	
	(70 to 220) V		
(10 to 20) Hz	200 $\mu\text{V/V} + 5.8 \mu\text{V}$		
(20 to 40) Hz	68 $\mu\text{V/V} + 5.8 \mu\text{V}$		
40 Hz to 20 kHz	31 $\mu\text{V/V} + 5.8 \mu\text{V}$		
(20 to 50) kHz	69 $\mu\text{V/V} + 5.8 \mu\text{V}$		
(50 to 100) kHz	98 $\mu\text{V/V} + 5.8 \mu\text{V}$		
(100 to 300) kHz	210 $\mu\text{V/V} + 5.8 \mu\text{V}$		
(300 to 500) kHz	500 $\mu\text{V/V} + 5.8 \mu\text{V}$		



ANSI National Accreditation Board

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Measure ¹	(220 to 700) V (10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (700 to 1 000) V (10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz	200 μ V/V + 5.8 μ V 99 μ V/V + 5.8 μ V 41 μ V/V + 5.8 μ V 130 μ V/V + 5.8 μ V 500 μ V/V + 5.8 μ V 200 μ V/V + 5.8 μ V 99 μ V/V + 5.8 μ V 38 μ V/V + 5.8 μ V 130 μ V/V + 5.8 μ V 500 μ V/V + 5.8 μ V	AC Measurement Standard
AC High Voltage – Source ¹	(0 to 10) kV (50 to 60) Hz	1.4 mV/V + 0.13 V	Comparison with High Voltage Meter and High Voltage Probe
AC High Voltage – Measure ¹	(0 to 10) kV (50 to 60) Hz (10 to 30) kV (50 to 60) Hz	1.4 mV/V + 0.13 V 1.2 mV/V + 0.24 V	Comparison with High Voltage Meter and High Voltage Probe
AC Resistance Measure ¹	1 Ω to 1 M Ω 12 Hz to 100 kHz	0.91 m Ω / Ω	RLC Digibridge
AC Power – Source ^{1,2} 0.1 mW to 20.5 kW (45 to 65) Hz PF = 1	(33 to 330) mV (3.3 to 9) mA (9 to 33) mA (33 to 90) mA (90 to 330) mA (0.33 to 0.9) A (0.9 to 3) A (3 to 11) A (11 to 20.5) A 330 mV to 1 020 V (3.3 to 9) mA (9 to 33) mA (33 to 90) mA (90 to 330) mA (0.33 to 0.9) A (0.9 to 3) A (3 to 11) A (11 to 20.5) A	0.11 % of Watts output + 0.58·R 0.081 % of Watts output + 0.58·R 0.11 % of Watts output + 0.58·R 0.081 % of Watts output + 0.58·R 0.1 % of Watts output + 0.58·R 0.088 % of Watts output + 0.58·R 0.1 % of Watts output + 0.58·R 0.13 % of Watts output + 0.58·R 0.096 % of Watts output + 0.58·R 0.066 % of Watts output + 0.58·R 0.096 % of Watts output + 0.58·R 0.066 % of Watts output + 0.58·R 0.066 % of Watts output + 0.58·R 0.088 % of Watts output + 0.58·R 0.073 % of Watts output + 0.58·R 0.096 % of Watts output + 0.58·R 0.15 % of Watts output + 0.58·R	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 Power – Source ^{1,2} 0.1 mW to 20.5 kW (45 to 65) Hz (PF = 0 to 0.999)	(33 to 330) mV (3.3 to 9) mA (9 to 33) mA (33 to 90) mA (90 to 330) mA (0.33 to 0.9) A (0.9 to 3) A (3 to 11) A (11 to 20.5) A 330 mV to 1 020 V (3.3 to 9) mA (9 to 33) mA (33 to 90) mA (90 to 330) mA (0.33 to 0.9) A (0.9 to 3) A (3 to 11) A (11 to 20.5) A	0.21 % of Watts output + 0.58·R 0.19 % of Watts output + 0.58·R 0.21 % of Watts output + 0.58·R 0.19 % of Watts output + 0.58·R 0.2 % of Watts output + 0.58·R 0.19 % of Watts output + 0.58·R 0.2 % of Watts output + 0.58·R 0.21 % of Watts output + 0.58·R 0.2 % of Watts output + 0.58·R 0.19 % of Watts output + 0.58·R 0.2 % of Watts output + 0.58·R 0.19 % of Watts output + 0.58·R 0.19 % of Watts output + 0.58·R 0.19 % of Watts output + 0.58·R 0.2 % of Watts output + 0.58·R 0.23 % of Watts output + 0.58·R	Multi-Product Calibrator
AC Current – Source ¹	(0 to 220) μA (10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (0.22 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	250 μA/A + 16 nA 160 μA/A + 10 nA 120 μA/A + 8 nA 280 μA/A + 12 nA 1.1 mA/A + 65 nA 250 μA/A + 40 nA 160 μA/A + 35 nA 120 μA/A + 35 nA 200 μA/A + 110 nA 1.1 mA/A + 650 nA 250 μA/A + 400 nA 160 μA/A + 350 nA 120 μA/A + 350 nA 200 μA/A + 550 nA 1.1 mA/A + 5 μA	Multi-Function 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 ¹	(22 to 220) mA (10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (0.22 to 2.2) A 20 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	250 μ A/A + 4 μ A 160 μ A/A + 4 μ A 120 μ A/A + 3 μ A 200 μ A/A + 4 μ A 1.1 mA/A + 10 μ A 260 μ A/A + 35 μ A 450 μ A/A + 80 μ A 7 mA/A + 160 μ A	Multi-Function Calibrator
AC Current – Source ¹	(0 to 20.5) A 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	460 μ A/A + 170 μ A 950 μ A/A + 380 μ A 3.6 mA/A + 750 μ A	Multi-Function Calibrator w/Amplifier, Multi-Product Calibrator
AC Current – Source ¹	(0 to 16.5) A (45 to 65) Hz (65 to 440) Hz (16.5 to 150) A (45 to 65) Hz (65 to 440) Hz (150 to 1 025) A (45 to 65) Hz (65 to 440) Hz	3.3 mA/A + 3.5 mA 9.1 mA/A + 3.5 mA 3.3 mA/A + 29 mA 9.1 mA/A + 31 mA 3.4 mA/A + 104 mA 9.2 mA/A + 116 mA	Multi-Product Calibrator w/50-turn coil
AC Current – Measure ¹	(0 to 100) μ A (10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz 100 μ A to 1 mA (10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz (5 to 20) kHz (20 to 50) kHz (50 to 100) kHz	4.6 mA/A + 0.035 μ A 1.7 mA/A + 0.035 μ A 0.7 mA/A + 0.035 μ A 0.7 mA/A + 0.035 μ A 4.6 mA/A + 0.23 μ A 1.7 mA/A + 0.23 μ A 0.7 mA/A + 0.23 μ A 0.4 mA/A + 0.23 μ A 0.7 mA/A + 0.23 μ A 4.6 mA/A + 0.46 μ A 6.4 mA/A + 1.7 μ A	Multimeter

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment		
AC Current – Measure ¹	(1 to 10) mA		Multimeter		
	(10 to 20) Hz	4.6 mA/A + 2.3 μA			
	(20 to 45) Hz	1.7 mA/A + 2.3 μA			
	(45 to 100) Hz	0.7 mA/A + 2.3 μA			
	100 Hz to 5 kHz	0.4 mA/A + 2.3 μA			
	(5 to 20) kHz	0.7 mA/A + 2.3 μA			
	(20 to 50) kHz	4.6 mA/A + 4.6 μA			
	(50 to 100) kHz	6.4 mA/A + 17 μA			
	(10 to 100) mA				
	(10 to 20) Hz	4.6 mA/A + 23 μA			
	(20 to 45) Hz	1.7 mA/A + 23 μA			
	(45 to 100) Hz	0.7 mA/A + 23 μA			
	100 Hz to 5 kHz	0.4 mA/A + 23 μA			
	(5 to 20) kHz	0.7 mA/A + 23 μA			
	(20 to 50) kHz	4.6 mA/A + 46 μA			
(50 to 100) kHz	6.4 mA/A + 0.17 mA				
100 mA to 1 A					
(10 to 20) Hz	4.6 mA/A + 0.23 mA				
(20 to 45) Hz	1.8 mA/A + 0.23 mA				
(45 to 100) Hz	0.9 mA/A + 0.23 mA				
100 Hz to 5 kHz	1.2 mA/A + 0.23 mA				
(5 to 20) kHz	3.5 mA/A + 0.23 mA				
(20 to 50) kHz	12 mA/A + 0.46 mA				
AC Current – Measure ¹	(0 to 10) A		Current Shunt with Multimeter, AC Measurement Standard		
	5 Hz to 100 kHz	0.20 mA/A + 0.58 μA			
	(10 to 20) A				
	45 Hz to 5 kHz	0.16 mA/A			
AC Current – Measure ¹	(20 to 1 000) A		Current Shunt with Multimeter, AC Measurement Standard		
	(45 to 400) Hz	0.31 mA/A			
	Electrical Calibration of Thermocouple Indicators ¹	Type B			Multi-Product Calibrator
		(600 to 800) °C		0.36 °C	
		(800 to 1 000) °C		0.29 °C	
(1 000 to 1 550) °C		0.26 °C			
(1 550 to 1 820) °C		0.28 °C			
Type C					
(0 to 150) °C	0.26 °C				
(150 to 650) °C	0.23 °C				
(650 to 1 000) °C	0.27 °C				
(1 000 to 1 800) °C	0.4 °C				
(1 800 to 2 316) °C	0.66 °C				



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Electrical Calibration of Thermocouple Indicators ¹	Type E		Multi-Product Calibrator
	(-250 to -100) °C	0.4 °C	
	(-100 to -25) °C	0.17 °C	
	(-25 to 350) °C	0.16 °C	
	(350 to 650) °C	0.17 °C	
	(650 to 1 000) °C	0.2 °C	
	Type J		
	(-210 to -100) °C	0.24 °C	
	(-100 to -30) °C	0.17 °C	
	(-30 to 150) °C	0.16 °C	
	(150 to 760) °C	0.18 °C	
	(760 to 1 200) °C	0.21 °C	
	Type K		
	(-200 to -100) °C	0.28 °C	
	(-100 to -25) °C	0.18 °C	
	(-25 to 120) °C	0.17 °C	
	(120 to 1 000) °C	0.23 °C	
	(1 000 to 1 372) °C	0.33 °C	
	Type L		
	(-200 to -100) °C	0.31 °C	
	(-100 to 800) °C	0.23 °C	
	(800 to 900) °C	0.18 °C	
	Type N		
	(-200 to -100) °C	0.33 °C	
(-100 to -25) °C	0.21 °C		
(-25 to 120) °C	0.19 °C		
(120 to 410) °C	0.18 °C		
(410 to 1 300) °C	0.24 °C		
Type R			
(0 to 250) °C	0.46 °C		
(250 to 400) °C	0.29 °C		
(400 to 1 000) °C	0.28 °C		
(1 000 to 1 767) °C	0.33 °C		
Type S			
(0 to 250) °C	0.38 °C		
(250 to 1 000) °C	0.3 °C		
(1 000 to 1 400) °C	0.31 °C		
(1 400 to 1 767) °C	0.37 °C		

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Electrical Calibration of Thermocouple Indicators ¹	Type T		Multi-Product Calibrator
	(-250 to -150) °C	0.5 °C	
	(-150 to 0) °C	0.22 °C	
	(0 to 120) °C	0.17 °C	
	(120 to 400) °C	0.16 °C	
	Type U		
(-200 to 0) °C	0.45 °C		
(0 to 600) °C	0.24 °C		
Electrical Calibration of RTD Indicating Systems ¹	Pt 385, 100 Ω		Multi-Product Calibrator
	(-200 to -80) °C	0.039 °C	
	(-80 to 0) °C	0.039 °C	
	(0 to 100) °C	0.054 °C	
	(100 to 300) °C	0.07 °C	
	(300 to 400) °C	0.078 °C	
	(400 to 630) °C	0.093 °C	
	(630 to 800) °C	0.18 °C	
	Pt 3926, 100 Ω		
	(-200 to -80) °C	0.039 °C	
	(-80 to 0) °C	0.039 °C	
	(0 to 100) °C	0.054 °C	
	(100 to 300) °C	0.07 °C	
	(300 to 400) °C	0.078 °C	
	(400 to 630) °C	0.093 °C	
	Pt 3916, 100 Ω		
	(-200 to -190) °C	0.19 °C	
	(-190 to -80) °C	0.031 °C	
	(-80 to 0) °C	0.039 °C	
	(0 to 100) °C	0.047 °C	
	(100 to 260) °C	0.054 °C	
	(260 to 300) °C	0.062 °C	
	(300 to 400) °C	0.07 °C	
	(400 to 600) °C	0.078 °C	
	(600 to 630) °C	0.18 °C	
	Pt 385, 200 Ω		
	(-200 to -80) °C	0.031 °C	
	(-80 to 0) °C	0.031 °C	
	(0 to 100) °C	0.031 °C	
	(100 to 260) °C	0.039 °C	
(260 to 300) °C	0.093 °C		
(300 to 400) °C	0.1 °C		
(400 to 600) °C	0.11 °C		
(600 to 630) °C	0.12 °C		



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Electrical Calibration of RTD Indicating Systems ¹	Pt 385, 500 Ω		Multi-Product Calibrator
	(-200 to -80) °C	0.031 °C	
	(-80 to 0) °C	0.039 °C	
	(0 to 100) °C	0.039 °C	
	(100 to 260) °C	0.047 °C	
	(260 to 300) °C	0.062 °C	
	(300 to 400) °C	0.062 °C	
	(400 to 600) °C	0.07 °C	
	(600 to 630) °C	0.085 °C	
	Pt 385, 1 kΩ		
	(-200 to -80) °C	0.023 °C	
	(-80 to 0) °C	0.023 °C	
	(0 to 100) °C	0.031 °C	
	(100 to 260) °C	0.039 °C	
	(260 to 300) °C	0.047 °C	
(300 to 400) °C	0.054 °C		
(400 to 600) °C	0.054 °C		
(600 to 630) °C	0.18 °C		
PtNi 385, 120 Ω (Ni120)			
(-80 to 0) °C	0.062 °C		
(0 to 100) °C	0.062 °C		
(100 to 260) °C	0.11 °C		
Cu 427, 10 Ω			
(-100 to 260) °C	0.23 °C		
Inductance – Measure ¹ @ 1 kHz	100 μH to 10 H	1.2 mH/H	RLC Digibridge
Inductance – Source ¹ Fixed Points @ 1 kHz	100 μH	0.042 μH	Standard Inductors
	1 mH	0.42 μH	
	10 mH	4.2 μH	
	100 mH	20 μH	
	1 H	0.2 mH	
Oscilloscopes ¹ Rise/ Fall Time, (10 to 90) %	(0 to 1.25) s	1.3 ps	Oscilloscope Calibrator and Active Head
Oscilloscope ¹ Square Wave Amplitude, < 10 kHz into 50 Ω or 1 MΩ Load Impedance	(0 to 1) mVpp	10 mV/V + 10 μV	Oscilloscope Calibrator and Active Head
	(1 to 21) mVpp	1.5 mV/V + 20 μV	
	(21 to 556) mVpp	1.5 mV/V + 1.2 μV	
	556 mVpp to 210 Vpp	1.3 mV/V + 1.2 μV	
Oscilloscope ¹ Horizontal Deflection (Time)	150 ps to 50 s	0.39 ppm of reading	Oscilloscope Calibrator and Active Head



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Oscilloscopes ¹ Vertical Deflection (Amplitude)	(0 to 50) Vpp 50 Vpp to 100 Vpp 100 Vpp to 200 Vpp	250 μ V/V + 25 μ V 250 μ V/V + 26 μ V 250 μ V/V + 63 μ V	Oscilloscope Calibrator and Active Head
Oscilloscopes ¹ – Bandwidth	100 mHz to 50 GHz	2.1 % of reading	Oscilloscope Calibrator w/Active Head, Power Sensor
Phase – Measure ¹ 10 mV to 320 V	(0 to 360) ° 10 Hz to 100 kHz 100 kHz to 10 MHz	0.029° 0.064°	Precision Phasemeter

Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
RF Absolute Power – Measure ¹	(-70 to 44) dBm (100 to 300) kHz 300 kHz to 1 MHz 1 MHz to 2 GHz (2 to 6) GHz (6 to 12.4) GHz (12.4 to 18) GHz (18 to 26.5) GHz (26.5 to 40) GHz (40 to 50) GHz	0.11 dB 0.064 dB 0.054 dB 0.055 dB 0.057 dB 0.063 dB 0.07 dB 0.08 dB 0.086 dB	Measuring Receiver, Power Meter with Power Sensor
RF Tuned Power – Measure ¹	(-120 to 30) dB 100 kHz to 2.6 GHz (2.6 to 18) GHz (18 to 26.5) GHz	0.17 dB 0.18 dB 0.2 dB	Measuring Receiver with Power Sensor
RF Power – Source ¹	(-130 to 16) dBm 10 kHz to 2.56 GHz (-110 to 10) dBm 20 MHz to 2 GHz (2 to 20) GHz (20 to 40) GHz (40 to 50) GHz	0.4 dB 0.26 dB 0.32 dB 0.4 dB 0.83 dB	Signal Generators
Distortion – Measure ¹ 20 Hz to 20 kHz 20 Hz to 50 kHz (50 to 100) kHz	80 kHz BW: -80 dB 500 kHz BW: -70 dB 500 kHz BW: -65 dB	1.6 dB 1.6 dB 1.6 dB	Audio Analyzer

Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Harmonic Distortion ¹ (Source and Measure) 1 kHz to 26.5 GHz	(-100 to 0.01) dB	1.2 dB	Spectrum Analyzer
Phase Noise ¹ (Source and Measure) 1 MHz to 26.5 GHz Offset carrier ≤ 100 kHz	(-70 to -120) dBc/Hz	1.2 dB/Hz	Signal Generator, PSA Series Spectrum Analyzer
Amplitude Modulation – Measure ¹ AM Depth Accuracy 100 kHz to 10 MHz (Rate: 50 Hz to 10 kHz)	Depth: (5 to 99) %	0.91 % Depth	PSA Series Spectrum Analyzer
10 MHz to 3 GHz (Rate: 50 Hz to 100 kHz)	Depth: (20 to 99) % Depth: (5 to 20) %	0.61 % Depth 3 % Depth	
(3 to 26.5) GHz (Rate: 50 Hz to 100 kHz)	Depth: (20 to 99) % Depth: (5 to 20) %	1.8 % Depth 5.5 % Depth	
Flatness 10 MHz to 3 GHz (Rate: 90 Hz to 10 kHz)	Depth: (5 to 99) %	0.37 % Depth	
(3 to 26.5) GHz (Rate: 90 Hz to 10 kHz)	Depth: (5 to 99) %	0.49 % Depth	
FM Rejection (50 Hz to 3 kHz BW)	Depths: < 50% Deviations: < 5 kHz	0.17 % Depth	
10 MHz to 26.5 GHz (Rate: 400 Hz or 1 kHz)	Depths: < 50% Deviations: < 50 kHz	0.44 % Depth	
Residual AM 250 kHz to 26.5 GHz	(50 Hz to 3 kHz BW)	0.012 % (rms)	

Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Frequency Modulation – Measure ¹ FM Deviation Accuracy 250 kHz to 26.5 GHz (Rate: 20 Hz to 200 kHz) AM Rejection (50 Hz to 3 kHz BW) 150 kHz to 6.6 GHz (6.6 to 13.2) GHz (13.2 to 26.5) GHz Residual FM 100 kHz to 6.6 GHz (6.6 to 13.2) GHz (13.2 to 26.5) GHz	Deviations: 200 Hz to 400 kHz AM Depths: ≤ 50% (Rate: 400 Hz or 1 kHz) (50 Hz to 3 kHz BW)	1.3 % of reading 13 Hz 25 Hz 49 Hz 1.9 Hz 3.7 Hz 7.4 Hz	PSA Series Spectrum Analyzer
Phase Modulation – Measure ¹ PM Deviation Accuracy 100 kHz to 6.6 GHz (6.6 to 13.2) GHz (13.2 to 26.5) GHz AM Rejection (50 Hz to 3 kHz BW) 100 kHz to 26.5 GHz Residual PM 100 kHz to 6.6 GHz (6.6 to 13.2) GHz (13.2 to 26.5) GHz	Deviations: > 0.7 rad Deviations: > 0.3 rad Deviations: > 0.7 rad Deviations: > 0.3 rad Deviations: > 0.7 rad Deviations: > 0.3 rad AM Depths: ≤ 50% (Rate: 1 kHz) (50 Hz to 3 kHz BW)	1.3 % of reading 3.7 % of reading 1.3 % of reading 3.7 % of reading 1.3 % of reading 3.7 % of reading 0.000 58 rad 0.002 1 rad 0.004 1 rad 0.008 1 rad	PSA Series Spectrum Analyzer

Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Digital Modulation – Measure ¹ For 2/3/4/5G			
Composite Rho ³	450 MHz to 26.5 GHz $\rho = (0.9 \text{ to } 1.0)$	0.001	PSA Series Spectrum Analyzer, Signal Generator
Error Vector Magnitude (rms)	450 MHz to 26.5 GHz EVM = (0 to 25) %	0.3 % of reading	
Peak Code Domain Error	(-80 to 0) dB 450 MHz to 26.5 GHz	1.2 dB	
Phase error	450 MHz to 26.5 GHz (1 to 15) °	0.71 °	
Frequency Error	3 Hz to 26.5GHz	2.1 x 10 ⁻⁷ Hz/Hz	
I/Q Origin Offset	(-80 to 0) dB 450 MHz to 26.5 GHz	1.2 dB	
Channel Power	450 MHz to 26.5 GHz Power > -70 dBm	0.62 dB	
Amplitude Modulation – Source ¹	(11 to 13.5) MHz Rate: 20 Hz to 100 kHz Depth: 0% to 95% Depth: 95% to 99%	0.13 % Depth 0.24 % Depth	
	100 kHz to 26.5 GHz Rate: 1 kHz to 100 kHz Depth: (5 to 80) %	3.5 % of reading + 1.2 % Depth	Signal Generator
Frequency Modulation – Source ¹	(11 to 432) MHz Rate: 20 Hz to 100 kHz Deviations: ≤ 400 kHz	0.29 % Modulation	AM/FM Test Source
	100 kHz to 26.5 GHz Rate: 10 Hz to 10 MHz Deviations: ≤ 20 MHz	1.7 % Modulation + 23 Hz	Signal Generator
Phase Modulation – Source ¹	100 kHz to 26.5 GHz Rate: 10 Hz to 10 MHz Deviations: ≤ 40 rad	1.7 % of reading + 0.003 5 rad	Signal Generator

Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Reflection S11 / S22 - Measure ¹	Magnitude (0 to 110) dB (30 to 300) kHz 300 kHz to 1.3 GHz (1.3 to 3) GHz (3 to 40) GHz Phase (-180 to 180) ° 30 kHz to 3 GHz (3 to 40) GHz	0.025 dB 0.026 dB 0.033 dB 0.094 dB 0.073 ° 0.25 °	Vector Network Analyzer, Calibration Kit
Transmission S12 / S21 - Measure ¹	Magnitude (0 to 110) dB (30 to 300) kHz 300 kHz to 1.3 GHz (1.3 to 3) GHz (3 to 40) GHz Phase (-180 to 180) ° 30 kHz to 3 GHz (3 to 40) GHz	0.029 dB 0.028 dB 0.039 dB 0.089 dB 0.073 ° 0.25 °	Vector Network Analyzer, Calibration Kit
RF Power Sensors ¹ – Calibration Factors	Referenced at 1 mW 100 kHz to 10MHz 10 MHz to 1.2 GHz (1.2 to 6) GHz (6 to 14) GHz (14 to 18) GHz (18 to 26.5) GHz (26.5 to 33) GHz (33 to 40) GHz (40 to 45) GHz (45 to 50) GHz	1.4 % of reading 1.3 % of reading 1.4 % of reading 1.6 % of reading 2.1 % of reading 2.6 % of reading 2.9 % of reading 3 % of reading 4 % of reading 4.7 % of reading	Coaxial Thermistor, Power Sensors, Power Meter

Length – Dimensional Metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Calipers ^{1,2}	(0 to 1 500) mm	$(5.8 + 0.01 \cdot L) \mu\text{m}$	Gauge Blocks
Height Gages ^{1,2}	(0 to 1 500) mm	$(0.72 + 0.002 \cdot 2 \cdot L) \mu\text{m}$	Gage Blocks, Surface Plate,
Micrometers ^{1,2} External, Internal, Depth, Bore and Micrometer Head	(0 to 25) mm (25 to 1 050) mm	$(0.19 + 0.009 \cdot L) \mu\text{m}$ $(0.37 + 0.013 \cdot L) \mu\text{m}$	Gage Blocks, Master Ring, Universal Length Measuring Machine

Length – Dimensional Metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Indicators ^{1,2} Dial Gauge, Dial Test Indicator, LVDTs	(0 to 1) mm (1 to 100) mm (0 to 100) mm	0.39 μm (0.68 + 0.009·L) μm (0.069 + 0.003 4·L) μm	Universal Length Measuring Machine, Indicator Tester, Gage Block, Comparator Stand
Plain Plug Gages / Pin Gages / Thread Wires ^{1,2} (Cylindrical and Taper)	(0.001 to 300) mm	(0.4 + 0.001 6·L) μm	Universal Length Measuring Machine, High- Accuracy Micrometer, Gage Block
Plain Ring Gages ² (Cylindrical and Taper)	(1 to 300) mm	(0.35 + 0.002·L) μm	Universal Length Measuring Machine, Master Ring, Gage Block
Thread Plug Gages ² (Cylindrical and Taper) Simple Pitch Diameter Major Diameter	(0.001 to 150) mm (0.001 to 150) mm	(1.5 + 0.007·L) μm (0.41 + 0.001 4·L) μm	Universal Length Measuring Machine, High-Accuracy Micrometer, Gage Block, Thread Measuring Wires
Thread Ring Gages ² (Cylindrical and Taper) Simple Pitch Diameter Major Diameter	(1 to 150) mm (1 to 150) mm	(1.3 + 0.005·L) μm (0.39 + 0.002 6·L) μm	Universal Length Measuring Machine, Gage Block, Master Ring Gage, Thread Calibration Standards
Setting Rod, Micrometer Standard, Length Standards ²	(0.1 to 500) mm	(0.49 + 0.002 5·L) μm	Gage block, Universal Measuring Machine
Snap Gages ² (External / Internal)	(0.001 to 500) mm	(0.32 + 0.002 8·L) μm	Universal Measuring Machine, Gage Blocks, Master Ring
Thickness Gage / Feeler Gage ²	(0.001 to 25) mm	(0.4 + 0.000 6·L) μm	Universal Measuring Machine, Gage Blocks
Coating Thickness Gage ^{1,2}	(0 to 300) μm (300 to 5 000) μm	0.36 μm 0.10 % of reading + 0.58·R	Standard Calibration Foil
Gage Block – Length ²	(0.1 to 100) mm	(0.068 + 0.001 1·L) μm	Gage Block, Gage Block Comparator
Gage Block – Length ²	(0.1 to 100) mm (100 to 500) mm	(0.35 + 0.003 5·L) μm (0.28 + 0.009 8·L) μm	Gage Block, Universal Length Measuring Machine

Length – Dimensional Metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Surface Plates ^{1,2} Overall Flatness	(150 to 3 600) mm <i>D</i>	$(0.5 + 0.001\ 3 \cdot D) \mu\text{m}$	Differential level, Planekator
Local Area Flatness (Variation)	(0 to 0.13) mm <i>V</i>	0.6 μm	Repeat-o-meter
Universal Length Measuring Machine (ULM) ^{1,2}	(0 to 100) mm (100 to 500) mm	$(0.056 + 0.002\ 8 \cdot L) \mu\text{m}$ $(0.033 + 0.003\ 1 \cdot L) \mu\text{m}$	Gage Blocks
Line Scale Calibrator ^{1,2}	(0 to 1 000) mm (1 000 to 6 000) mm	$(1.5 + 0.008 \cdot L) \mu\text{m}$ $(0.009\ 5 \cdot L) \mu\text{m}$	Standard Scale, Precision Ruler, Gage Blocks
Standard Scale ²	(0 to 300) mm (300 to 1 000) mm	$(1 + 0.001\ 8 \cdot L) \mu\text{m}$ $(2.9 + 0.001\ 8 \cdot L) \mu\text{m}$	Standard Scale, Smart Scope, Line Scale Calibrator
Ruler & Tape Measures ^{1,2} (Comparison Method)	(0 to 1 000) mm (1 000 to 50 000) mm	11 μm $(0.011 \cdot L) \mu\text{m}$	Standard Scale, Precision Ruler, Line Scale Calibrator
Ruler & Tape Measures ² (Direct Measurement)	(0 to 1 000) mm (1 000 to 50 000) mm	$(15 + 0.009 \cdot L) \mu\text{m}$ $(0.024 \cdot L) \mu\text{m}$	Line Scale Calibrator
Precision Level	(0 to 1) mm/m (1 to 2) mm/m	0.85 % of reading + 3.5 $\mu\text{m}/\text{m}$ 1.8 % of reading	Level System
Master Level / Electronic Inclinometer / Angle Meter	(0 to 5) mm/m (0° to 90°) (4 Quadrant)	1.1 $\mu\text{m}/\text{m}$ 0.000 82°	Sine Bar, Gage Block, Surface Plate
Roughness Tester ¹	(0 to 3.1) μm (<i>Ra</i>) (0 to 12.5) μm (<i>Rz</i>) (0 to 95) μm (<i>Rsm</i>)	0.032 μm 0.17 μm 0.93 μm	Roughness Standard
Sine Bar & Sine Plate ²	(0 to 300) mm	$(0.35 + 0.0017 \cdot L) \mu\text{m}$	Universal length Measuring Machine, LVDT w/amplifier, Granite Surface Plate Granite Square, Angle Gage Block, Gauge Block, Optical Flat, Precision Height Gauge
Optical Comparators and Vision Systems/Measuring Microscope ^{1,2} X, Y, Z Axis	(0 to 1 000) mm	$(1.2 + 0.008 \cdot L) \mu\text{m}$	Standard Scales, Gage Blocks

Length – Dimensional Metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Check Master / Caliper Checker / Height Master / Riser Block ²			
Block Pitch Accuracy	(0 to 1 000) mm	$(0.55 + 0.001\ 1 \cdot L)\ \mu\text{m}$	Gage Blocks, Surface Plate, Electric Comparator, Linear Gage, Precision Height Gage
Parallelism of Block	(0 to 1 000) mm	0.6 μm	
Micrometer Head Accuracy	(0 to 25) mm	$(0.26 + 0.006\ 9 \cdot L)\ \mu\text{m}$	
Calibration Tester / Dial Gage Tester / Indicator Calibrator ²	(0 to 25) mm	$(0.26 + 0.006\ 9 \cdot L)\ \mu\text{m}$	Linear Gage, Optical Flat
Inspection Fixtures / Gages ²			
Angle Block	(0 to 100) mm	$(0.35 + 0.000\ 35 \cdot L)\ \mu\text{m}$	Universal Length Measuring Machine, Precision Height Gage, Electric Comparator, Linear Length Gage, Gage Block, Surface Plate, Smart Scope, Sine Bar, Differential Level, Granite Square, CMM
Straight Edges	(100 to 500) mm	$(0.28 + 0.000\ 98 \cdot L)\ \mu\text{m}$	
Parallel Bars	(500 to 1 000) mm	$(0.55 + 0.001\ 1 \cdot L)\ \mu\text{m}$	
Machine Squares			
Precision Squares			
Thickness Pads			
Radius Gauge			
Chamfer Gauge			
Taper Gauge			
Attribute Gages – GO / NOGO			
Dedicated Fixture Gages			

Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Rockwell Hardness Testers ¹	HRC Low Middle High	0.45 HRC	Indirect verification using hardness test blocks
	HRBS Low Middle High	0.45 HRBS	



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Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Rockwell Hardness Testers ¹	HRBW Low Middle High	0.45 HRBW	Indirect verification using hardness test blocks
Scales & Balances ^{1,4} (Platform & Spring)	(0 to 5) mg (5 to 10) mg (10 to 20) mg (20 to 50) mg (50 to 100) mg (100 to 200) mg (200 to 500) mg 500 mg to 1 g (1 to 2) g (2 to 5) g (5 to 10) g (10 to 20) g (20 to 50) g (50 to 100) g (100 to 200) g (200 to 500) g 500 g to 1 kg (1 to 50) kg (50 to 1 000) kg	0.008 8 mg 0.01 mg 0.01 mg 0.011 mg 0.012 mg 0.014 mg 0.016 mg 0.084 mg 0.085 mg 0.089 mg 0.1 mg 0.14 mg 0.26 mg 0.49 mg 1.3 mg 2.6 mg 9.8 mg 0.000 7 % of reading 0.002 6 % of reading	Standard Weights
Mass (Weights)	(1 to 5) mg 10 mg 20 mg 50 mg 100 mg 200 mg 500 mg 1 g 2 g 5 g 10 g 20 g 50 g 100 g 100 g to 20 kg	0.003 2 mg 0.004 2 mg 0.005 2 mg 0.006 2 mg 0.008 2 mg 0.011 mg 0.013 mg 0.016 mg 0.021 mg 0.027 mg 0.034 mg 0.048 mg 0.078 mg 0.17 mg 0.000 3% of reading	Standard Weight and Electronic Balance
Torque Tools ¹	(0 to 1 500) N·m	0.67 % of reading + 0.058 mN·m	Torque Testers



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Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Torque Testers ^{1,2}	(0 to 10) N·m (10 to 50) N·m (50 to 200) N·m (200 to 500) N·m (500 to 1 500) N·m	0.16 % of reading + 0.58·R 0.048 % of reading 0.028 % of reading 0.031 % of reading 0.014 % of reading	Torque Calibration Wheel with Standard Weight
Force and Load Cell ^{1,2} (Compression and Tension)	(0 to 10) N (10 to 20) N (20 to 50) N (50 to 1 500) N	0.010 % of reading + 0.58·R 0.007 4 % of reading 0.006 4 % of reading 0.006 2 % of reading	Standard weights
	(0 to 50) kN (50 to 500) kN	0.029 % of reading + 0.58·R 0.028 % of reading	Load cell
Hardness Durometers			
Spring Force	(0 to 50) N	0.008 N	Electronic Balance, Load Cell Gage Blocks
Extension at zero	(0 to 5) mm	0.005 mm	
Indenter Shape	(0 to 15) mm (0 to 90) °	0.004 mm 8 arc min	
Pressure Gage ¹ (Absolute & Differential)	(-100 to 125) kPa	0.003 4 % of reading but not less than 0.000 42 kPa	Piston gages
	(25 to 500) kPa	0.003 9 % of reading but not less than 0.001 9 kPa	
	(150 to 5 000) kPa	0.004 4 % of reading but not less than 0.022 kPa	
	(0.04 to 17) MPa	0.006 8 % of reading but not less than 0.15 kPa	
	(0.2 to 84) MPa	0.009 8 % of reading but not less than 0.56 kPa	
Pressure Gage ^{1,2} (Absolute & Differential)	(-100 to 0) kPa (0 to 345) kPa	0.023 % of reading + 0.58·R 0.018 % of reading + 0.58·R	Pressure Calibrator / Pressure Module
	345 kPa to 2.07 MPa (2.07 to 69) MPa	0.038 % of reading 0.057 % of reading	
	(69 to 250) MPa	0.04 % of reading	
Vacuum Gauges ¹ (Absolute Pressure)	(0.000 1 to 1) torr (1 to 10) torr	0.61 % of reading 0.47 % of reading	MKS PVS-6 System
	(10 to 1 000) torr	0.41 % of reading	

Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Pressure Balances (Dead Weight Tester) Hydraulic	(0.04 to 17) MPa	The effective area of the piston-cylinder assembly (A_p): $1.2 \times 10^{-4} \times A_p$ The pressure measured with a pressure balance (P): $1.2 \times 10^{-4} \times P$	Piston gage
	(0.2 to 84) MPa	The effective area of the piston-cylinder assembly (A_p): $8.4 \times 10^{-5} \times A_p$ The pressure measured with a pressure balance (P): $8.9 \times 10^{-4} \times P$	
Pressure Balances (Dead Weight Tester) Pneumatic:	(5 to 125) kPa	The effective area of the piston-cylinder assembly (A_p): $6.0 \times 10^{-5} \times A_p$ The pressure measured with a pressure balance (P): $6.6 \times 10^{-5} \times P$	Piston gage
	(25 to 500) kPa	The effective area of the piston-cylinder assembly (A_p): $6.3 \times 10^{-5} \times A_p$ The pressure measured with a pressure balance (P): $6.8 \times 10^{-5} \times P$	
	(150 to 5 000) kPa	The effective area of the piston-cylinder assembly (A_p): $6.6 \times 10^{-5} \times A_p$ The pressure measured with a pressure balance (P): $7.1 \times 10^{-5} \times P$	
Air Flow ^{1,2}	(0 to 33.33) mL/min (50 to 500) mL/min (0.5 to 5) L/min (1 to 30) L/min (0 to 50) L/min (0 to 100) L/min (0 to 500) L/min	0.64 % of reading + 0.58·R 0.54 % of reading 0.54 % of reading 0.53 % of reading 0.43 % of reading + 0.11 L/min 0.43 % of reading + 0.21 L/min 0.43 % of reading + 1.1 L/min	Air Flow Calibrator

Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Air Velocity	(0.2 to 35) m/s	1.3 % of reading	Wind Tunnel, Air Velocity Transducer, Pressure Module
Pipettes & Micropipettes Burette	(0 to 20) μ L (20 to 50) μ L (50 to 100) μ L (100 to 200) μ L 200 μ L to 10 mL (10 to 20) mL (20 to 2 000) mL	0.020 μ L 0.043 % of reading 0.026 % of reading 0.019 % of reading 0.015 % of reading 0.014 % of reading 0.012 % of reading	Analytical Scale Standard Weights
Volumetric Flask	(0 to 10) mL (10 to 20) mL (20 to 2 000) mL	0.001 5 mL 0.014% of reading 0.012% of reading	Analytical Scale Standard Weights

Photometry and Radiometry

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Optical Power (Source & Measure) ¹	(450 to 1 800) nm (-110 to 10) dBm	0.11 dB	Optical Test System
Optical Power Stability – Source ¹	(450 to 1 800) nm (-110 to 10) dBm	0.003 7 dB	Optical Test System
Optical Power Linearity – Measure ¹	(450 to 1 800) nm (-110 to 10) dBm	0.018 dB	Optical Test System
Optical Attenuation – Measure ¹ Optical Fixed Attenuators of Fiber Coils	(450 to 1 800) nm (-110 to 10) dBm	0.11 dB	Optical Test System
Optical Attenuation – Measure ¹ Optical Step Attenuators	(450 to 1 800) nm (-110 to 10) dBm	0.11 dB	Optical Test System
Optical Wavelength – (Source & Measure) ¹	(600 to 1 800) nm	0.25 ppm of reading	Optical Test System w/ Wavelength Meter
Fiber Optics Wavelength Measuring Equipment ¹	(1 510 to 1 540) nm	0.13 pm	NIST Wavelength SRM 2517A



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Photometry and Radiometry

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Laser Optical Power – (Source & Measure) ¹	20 pW to 10 W (190 to 11 000) nm (10 to 100) W (250 to 10 600) nm	1.7 % of output power 2.6 % of output power	Thermopile Sensor, Silicon Detector w/ Optical Power Meter
Luminous Intensity measuring equipment	(0.01 to 100 000) lux	2.2 % of reading	Comparison to Standard Light Meter
UV Irradiance, Calibration of UV Light Meters	(0.1 to 100) mW/cm ² @ Wavelength 365 nm	2 % of reading	Optical Power Meter w/ Power Detectors

Thermodynamic

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Humidity Measuring Equipment ¹	(10 to 40) %RH (40 to 95) %RH	0.66 %RH 1.1 %RH	Relative humidity sensor & chamber
Temperature Measure & Measuring Equipment ¹	(-80 to -40) °C (-40 to 0) °C (0 to 200) °C (200 to 300) °C (300 to 400) °C (400 to 500) °C (500 to 600) °C (600 to 1 100) °C	0.037 °C 0.029 °C 0.032 °C 0.041 °C 0.044 °C 0.048 °C 0.057 °C 1.6 °C	SPRT, Thermocouple, Temperature Calibrator
Radiation (Infrared) Thermometers ¹	(-30 to 0) °C (0 to 10) °C (10 to 50) °C (50 to 100) °C (100 to 160) °C	1 °C 1.4 °C 1.8 °C 2.4 °C 3.2 °C	Blackbody Calibrator (flat plate) $\epsilon = 0.95, \lambda = (8 \text{ to } 14) \mu\text{m}$
	100 °C (100 to 200) °C (200 to 230) °C	0.53 °C 0.90 °C 0.92 °C	Blackbody Calibrator (cavity) $\epsilon = 0.995, \lambda = (8 \text{ to } 14) \mu\text{m}$
	(230 to 300) °C (300 to 400) °C (400 to 500) °C (500 to 600) °C (600 to 800) °C (800 to 1 000) °C	0.95 °C 1.0 °C 1.6 °C 1.7 °C 1.7 °C 1.8 °C	Blackbody Calibrator (cavity) $\epsilon = 0.995, \lambda = (0.7 \text{ to } 1.8) \mu\text{m}$

Thermodynamic

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Temperature Chambers System Calibration & Profiling ¹	(-40 to 0) °C (0 to 100) °C (100 to 200) °C (200 to 300) °C	0.32 °C 0.33 °C 0.38 °C 0.43 °C	Datalogger w/RTD sensors and Datalogger w/Thermocouple sensors

Time and Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Frequency – Measure ¹	0.1 Hz to 5 GHz 500 MHz to 26.5 GHz	1.9 x 10 ⁻¹¹ Hz/Hz 6.9 x 10 ⁻¹² Hz/Hz	GPS Receiver and Counter
Frequency Measuring Equipment ¹	(1, 10) MHz	5 x 10 ⁻¹² Hz/Hz	GPS Receiver
	0.01 Hz to 50 GHz	6.2 x 10 ⁻¹² Hz/Hz	GPS Receiver and Signal Generator
Tachometer ^{1,2}	(0 to 100 000) rpm	0.000 23 % of reading + 0.58·R	Signal generator with lamp

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. D = diagonal length, V = variation, L = length in millimeters, P = applied pressure, t = time in seconds, R = Resolution or Readability of the Unit Under Calibration.
3. Unitless linear measure.
4. The CMC for scales and balances is highly dependent upon the resolution of the unit under test. The uncertainties presented here does not include the resolution of the unit under test. The resolution will be included in the reported measurement uncertainty at the time of calibration.
5. This scope is formatted as part of a single document including Certificate of Accreditation No. AC-1969.20.



R. Douglas Leonard Jr., VP, PILR SBU