



CERTIFICATE OF ACCREDITATION

The ANSI National Accreditation Board

Hereby attests that

Techmaster Electronics Joint Stock Company
169/1/5 Luong Dinh Cua Street, An Khanh Ward, Thu Duc City
Ho Chi Minh City, Vietnam
(and satellite location as shown on scope)

Fulfills the requirements of

ISO/IEC 17025:2017

and national standards

ANSI/NCSL Z540-1-1994 (R2002)

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.

A handwritten signature in black ink, appearing to read 'R. Douglas Leonard Jr.', is positioned above a horizontal line.

R. Douglas Leonard Jr., VP, PILR SBU

Expiry Date: 29 October 2023

Certificate Number: AC-1868



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

AND

ANSI/NCSL Z540-1-1994 (R2002)

TECHMASTER ELECTRONICS J.S.C

169/1/5 Luong Dinh Cua Street, An Khanh Ward, Thu Duc City,
Ho Chi Minh City, Vietnam (Primary Laboratory).

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CALIBRATION

Valid to: **October 29, 2023**

Certificate Number: **AC-1868**

Acoustics and Vibration

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Sound Level Meters ¹	94 dB, 1 kHz 114 dB, 1 kHz	0.39 dB	Sound Calibrator
Vibration Meters ¹ Acceleration, Velocity	Up to 50 g Up to 1 000 Hz, (1 to 2) kHz	1.9 % of reading + 0.25g 2.6 % of reading + 0.25g	Vibration Calibration System

Chemical Quantities

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
pH meters ¹	4.00 pH 7.00 pH 10.00 pH	0.013 pH 0.013 pH 0.015 pH	Control Company Solutions
Conductivity meters ¹	1 µS/cm 10 µS/cm 84 µS/cm 1 413 µS/cm	0.83 µS/cm 0.93 µS/cm 1.4 µS/cm 9.2 µS/cm	

Chemical Quantities

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Refractometers	(0, 15, 40) °Brix (1 to 20) % Salinity	0.22 Brix 0.18 % Refraction	Analytical Balance, Volumetric Flask, Digital Thermometer
Viscosity Meters ¹	1 000 mPa.s (cP) (1 000 to 200 000 mPa.s (cP))	0.95 % of reading 2.1% of reading	Viscosity Reference Solutions
Gas Detectors ¹	H ₂ S 25 ppm Concentration CO 50 ppm Concentration 100 ppm Concentration CH ₄ 50% Concentration LEL O ₂ 12% Concentration in N ₂ 18% Concentration in N ₂ NH ₃ 50 ppm Concentration	2 parts in 10 ⁶ Concentration 2.6 parts in 10 ⁶ Concentration 3.4 parts in 10 ⁶ Concentration 3 % of reading 1.4 % of reading 2.7 % of reading 3 % of reading	Standard Gases
Total Volatile Organic Compounds (TVOC) ¹	Up to 100 ppm Concentration	0.8 parts in 10 ⁶ Concentration	Standard Gas
Turbidity Meter ¹	(0 to 500) NTU (500 to 1 000) NTU	0.1 NTU + 0.01 NTU / NTU 0.2 NTU + 0.001 NTU / NTU	Turbidity Calibration Standards Solution
Alcohol meter ¹	(10 to 100) % Vol / Vol	0.24 % Vol / Vol	Reference Alcohol meter

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
DC Voltage – Source ¹	Up to 220 mV 220 mV to 2.2 V (2.2 to 11) V (11 to 22) V (22 to 220) V 220 V to 1.1 kV	8.1 μV/V + 0.8 μV 7.1 μV/V + 1 μV 8.1 μV/V + 3.5 μV 7.1 μV/V + 6.5 μV 8.1 μV/V + 80 μV 11 μV/V + 0.5 μV	Multiproduct Calibrator
DC Voltage – Measure ¹	Up to 100 mV 100 mV to 1 V (1 to 10) V (10 to 100) V (100 to 1 000) V	11 μV/V + 1.2 μV 9.5 μV/V + 1.2 μV 9.5 μV + 2.6 μV 12 μV/V + 36 μV 118 μV/V + 12 μV/V	Precision Multimeter

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
DC Voltage – Measure ¹	(1 to 10) kV	0.062 kV	Digital High Voltage Meter
DC Voltage – Measure ¹	(10 to 40) kV	0.47 kV	High Voltage Probe
DC Current – Measure ¹	Up to 100 nA 100 nA to 1 μ A (1 to 100) μ A 100 μ A to 1 mA (1 to 10) mA (10 to 100) mA 100 mA to 1 A	35 μ A/A + 0.05 nA 24 μ A/A + 0.05 nA 24 μ A/A + 0.95 nA 24 μ A/A + 5.9 nA 24 μ A/A + 5.9 nA 41 μ A/A + 0.6 nA 0.13 μ A/A + 0.01 mA	Precision Multimeter
	(1 to 10) A (10 to 300) A (300 to 1 000) A (1 000 to 2 000) A	0.58 μ A/A 0.14 μ A/A 6.8 mA/A 4.1 A	Multimeter with Current Shunt, Clamp Meter
DC Current – Source ¹	Up to 220 μ A 220 μ A to 22 mA (22 to 220) mA 220 mA to 2.2 A (2.2 to 11) A	50 μ A/A + 8 nA 50 μ A/A + 8 nA 50 μ A/A + 80 nA 60 μ A/A + 0.8 μ A 80 μ A/A + 25 μ A	Multiproduct Calibrator
	330 μ A to 3.3 mA (3.3 to 33) mA (33 to 330) mA 330 mA to 2.2 A (2.2 to 20) A	0.15 mA/A + 0.06 μ A 0.11 mA/A + 0.46 μ A 0.1 μ A/A + 8.8 μ A 0.32 μ A/A + 0.12 mA 0.66 μ A/A + 0.81 mA	Multiproduct Calibrator
	(20 to 1 000) A	5.4 mA/A	Multiproduct Calibrator w Fluke Coil
AC Voltage – Source ¹	Up to 2.2 mV (10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz	0.55 mV/V + 4.5 μ V 0.21 mV/V + 4.5 μ V 0.11 mV/V + 4.5 μ V 0.37 mV/V + 4.5 μ V 0.85 mV/V + 7 μ V 1.1 mV/V + 13 μ V 1.7 mV/V + 25 μ V 3.4 mV/V + 25 μ V	Multiproduct Calibrator

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Source ¹	(2.2 to 22) mV		Multiproduct Calibrator
	(10 to 20) Hz	0.55 mV/V + 5 μV	
	(20 to 40) Hz	0.21 mV/V + 5 μV	
	40 Hz to 20 kHz	0.11 mV/V + 5 μV	
	(20 to 50) kHz	0.37 mV/V + 5 μV	
	(50 to 100) kHz	0.85 mV/V + 7 μV	
	(100 to 300) kHz	1.1 mV/V + 12 μV	
	(300 to 500) kHz	1.7 mV/V + 25 μV	
	500 kHz to 1 MHz	3.4 mV/V + 25 μV	
	(22 to 220) mV		
	(10 to 20) Hz	0.55 mV/V + 13 μV	
	(20 to 40) Hz	0.21 mV/V + 8 μV	
	40 Hz to 20 kHz	0.11 mV/V + 8 μV	
	(20 to 50) kHz	0.37 mV/V + 8 μV	
	(50 to 100) kHz	0.85 mV/V + 25 μV	
	(100 to 300) kHz	1.1 mV/V + 25 μV	
	(300 to 500) kHz	1.7 mV/V + 35 μV	
	500 kHz to 1 MHz	3.4 mV/V + 80 μV	
	220 mV to 2.2 V		
	(10 to 20) Hz	0.5 mV/V + 80 μV	
	(20 to 40) Hz	0.16 mV/V + 25 μV	
	40 Hz to 20 kHz	80 μV/V + 6 μV	
	(20 to 50) kHz	0.13 mV/V + 16 μV	
	(50 to 100) kHz	0.26 mV/V + 70 μV	
(100 to 300) kHz	0.44 mV/V + 0.13 mV		
(300 to 500) kHz	1.8 mV/V + 35 mV		
500 kHz to 1 MHz	2.6 mV/V + 8.5 mV		
(2.2 to 22) V			
(10 to 20) Hz	0.55 mV/V + 0.8 mV		
(20 to 40) Hz	0.16 mV/V + 0.25 mV		
40 Hz to 20 kHz	80 μV/V + 0.06 mV		
(20 to 50) kHz	0.13 mV/V + 0.16 mV		
(50 to 100) kHz	0.27 mV/V + 0.35 mV		
(100 to 300) kHz	0.5 mV/V + 1.5 mV		
(300 to 500) kHz	1.9 mV/V + 4.3 mV		
500 kHz to 1 MHz	3.1 mV/V + 8.5 mV		



ANSI National Accreditation Board

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Source ¹	(22 to 220) V (10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz 220 V to 1.1 kV (15 to 50) Hz 50 Hz to 1 kHz	0.5 mV/V + 8 mV 0.16 mV/V + 2.5 mV 80 μV/V + 0.8 mV 0.22 mV/V + 3.5 mV 0.5 mV/V + 8 mV 2 mV/V + 90 mV 0.4 mV/V + 16 mV 80 μV/V + 3.5 mV	Multiproduct Calibrator
AC Voltage – Measure ¹	Up to 10 mV (1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (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 1 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	0.36 mV/V + 3.5 μV 0.24 mV/V + 1.3 μV 0.35 mV/V + 1.3 μV 1.2 mV/V + 1.3 μV 5.9 mV/V + 1.3 μV 47 mV/V + 2.4 μV 0.008 mV/V + 2.4 μV 0.017 mV/V + 2.4 μV 0.035 mV/V + 2.4 μV 0.095 mV/V + 2.4 μV 0.35 mV/V + 12 μV 1.2 mV/V + 12 μV 1.8 mV/V + 12 μV 18 mV/V + 12 μV 0.08 mV/V + 48 μV 0.08 mV/V + 24 μV 0.17 mV/V + 24 μV 0.35 mV/V + 24 μV 0.95 mV/V + 24 μV 0.36 mV/V + 0.12 mV 12 mV/V + 0.12 mV 18 mV/V + 0.12 mV	Precision Multimeter

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Measure ¹	(1 to 10) V		Precision Multimeter
	(1 to 40) Hz	0.08 mV/V + 0.47 mV	
	40 Hz to 1 kHz	0.08 mV/V + 0.24 mV	
	(1 to 20) kHz	0.17 mV/V + 0.24 mV	
	(20 to 50) kHz	0.35 mV/V + 0.24 mV	
	(50 to 100) kHz	0.95 mV/V + 0.24 V	
	(100 to 300) kHz	3.6 mV/V + 1.2 mV	
	300 kHz to 1 MHz	12 mV/V + 1.2 mV	
	(1 to 2) MHz	18 mV/V + 1.2 mV	
	(10 to 100) V		
	(1 to 40) Hz	0.24 mV/V + 4.7 mV	
	40 Hz to 1 kHz	0.24 mV/V + 2.4 mV	
	(1 to 20) kHz	0.24 mV/V + 2.4 mV	
	(20 to 50) kHz	0.43 mV/V + 2.4 mV	
	(50 to 100) kHz	0.43 mV/V + 2.4 mV	
(100 to 300) kHz	4.7 mV/V + 12 mV		
300 kHz to 1 MHz	4.7 mV/V + 12 mV		
AC Voltage – Measure ¹	100 V to 1 kV		Digital High Voltage Meter, High Voltage Probe
	(1 to 40) Hz	0.47 mV/V + 47 mV	
	40 Hz to 1 kHz	0.47 mV/V + 47 mV	
	(1 to 20) kHz	0.71 mV/V + 24 mV	
	(20 to 50) kHz	1.5 mV/V + 24 mV	
	(50 to 100) kHz	3.6 mV/V + 2.4 mV	
AC Current – Source ¹	Up to 220 μA		Multiproduct Calibrator
	(10 to 20) Hz	0.9 mA/A	
	(20 to 40) Hz	0.5 mA/A	
	40 Hz to 1 kHz	0.3 mA/A	
	(1 to 5) kHz	0.8 mA/A	
	(5 to 10) kHz	2 mA/A	
	220 μA to 2.2 mA		
	(10 to 20) Hz	0.9 mA/A	
	(20 to 40) Hz	0.6 mA/A	
	40 Hz to 1 kHz	0.3 mA/A	
	(1 to 5) kHz	2.5 mA/A	
	(5 to 10) kHz	5.3 mA/A	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current – Source ¹	(2.2 to 22) mA		Multiproduct Calibrator
	(10 to 20) Hz	2.6 mA/A	
	(20 to 40) Hz	2 mA/A	
	40 Hz to 1 kHz	1.8 mA/A	
	(1 to 5) kHz	19 mA/A	
	(5 to 10) kHz	38 mA/A	
	(22 to 220) mA		
	(10 to 20) Hz	0.7 mA/A	
	(20 to 40) Hz	0.4 mA/A	
	40 Hz to 1 kHz	0.2 mA/A	
	(1 to 5) kHz	0.8 mA/A	
	(5 to 10) kHz	1.9 mA/A	
220 mA to 2.2 A	20 Hz to 1 kHz	0.8 μ A/A	
	(1 to 5) kHz	1.1 mA/A	
	(5 to 10) kHz	8.8 mA/A	
AC Current – Source ¹	(1 to 1 000) A 50Hz / 60Hz	5.4 mA/A	Multiproduct Calibrator with Coil
AC Current – Measure ¹	(5 to 100) μ A		Precision Multimeter
	(10 to 20) Hz	4.8 mA/A + 24 nA	
	(20 to 45) Hz	1.8 mA/A + 24 nA	
	(45 to 100) Hz	0.7 mA/A + 24 nA	
100 Hz to 5 kHz	0.7 mA/A + 24 nA		
AC Current – Measure ¹	100 μ A to 10 mA		Precision Multimeter
	(10 to 20) Hz	4.7 mA/A + 2.4 nA	
	(20 to 45) Hz	1.8 mA/A + 2.4 nA	
	(45 to 100) Hz	0.7 mA/A + 2.4 nA	
	100 Hz to 5 kHz	0.4 mA/A + 2.4 nA	
	(5 to 20) kHz	0.7 mA/A + 2.4 nA	
	(20 to 50) kHz	4.7 mA/A + 4.7 nA	
	(50 to 100) kHz	6.5 mA/A + 18 μ A	
	(10 to 100) mA		
	(10 to 20) Hz	4.7 mA/A + 24 μ A	
	(20 to 45) Hz	1.8 mA/A + 24 μ A	
	(45 to 100) Hz	0.7 mA/A + 24 μ A	
	100 Hz to 5 kHz	0.4 mA/A + 24 μ A	
	(5 to 20) kHz	0.7 mA/A + 24 μ A	
	(20 to 50) kHz	4.7 mA/A + 47 μ A	
	(50 to 100) kHz	6.5 mA/A + 0.18 mA	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current – Measure ¹	100 mA to 1 A (10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz (5 to 20) kHz (20 to 50) kHz	1.9 mA/A + 0.24 mA 0.9 mA/A + 0.24 mA 1.2 mA/A + 0.24 mA 3.5 mA/A + 0.24 mA 12 mA/A + 0.47 mA 47 mA/A + 0.47 mA	Precision Multimeter, Precision Shunt
AC Current – Measure ¹	(1 to 10) A (3 to 300) kHz (10 to 300) A (50 to 400) Hz	0.007 1 A + 0.01 mA 0.34 A	Clamp Meter w Flexible Probe
DC Power – Generate 33 mV to 1 020 V	0.33 mA to 330 mA 10 μW to 330 W 0.33 A to 3 A 10 mW to 3 kW 3 A to 20.5 100 mW to 21 kW	0.01 % of reading + 1.5 nW 0.11 W + 0.012 nW 1.1 W + 0.031 μW	Multiproduct Calibrator
AC Power – Generate PF = 1 (10 to 45) Hz 33 mV to 32.9999 V 3.3 mA to 2.999 99 A (45 to 65) Hz 33 mV to 1 000 V 3.3 mA to 20.5 A	110 μW to 99 W 110 μW to 20 kW	0.18 % of reading 0.14 % of reading	Multiproduct Calibrator
Oscilloscopes ¹ - DC Voltage Into 50 Ω Into 1 MΩ Square Wave in to 50 Ω 10 Hz to 10 kHz Into 1 MΩ 10 Hz to 10 kHz Level Sine Amplitude Reference @ 50 kHz	(0 to ± 6.6) V (0 to ± 130) V 1 mV to 6.6 Vp-p 1 mV to 130 Vp-p 5 mV to 5.5 V	0.2 % of reading + 36 μV 0.039 % of reading + 37 μV 0.2% of reading + 65 μV 0.19 % of reading + 39 μV 15 mV/V + 0.49 mV	Multiproduct Calibrator

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Oscilloscopes ¹ - Bandwidth (relative to 50 kHz) 5 mV to 5.5 V Time Markers Into 50 Ω Edge Transition Time (Rise time)	50 kHz to 100 MHz (100 to 300) MHz 300 to 600) MHz (600 to 1 100) MHz (1 to 50) ns 100 ns to 20 ms 50 ms to 5 s < 300 ps	14 mV/V + 0.12 mV 17 mV/V + 0.14 mV 32 mV/V + 0.15 mV 40 mV/V + 0.16 mV 0.001 1 % of reading + 0.048 ps 0.000 2 % of reading + 7 ps 0.4 % of reading 80 ps	Multiproduct Calibrator
LCR Meters ¹ Resistance (20 Hz to 13 MHz)	Up to 0.1 mΩ 0.1 mΩ to 1 Ω (1 to 10) Ω (10 to 100) Ω 100 Ω to 1 kΩ (1 to 10) kΩ (10 to 100) kΩ 100 kΩ to 1 MΩ (1 to 10) MΩ (10 to 100) MΩ	0.2 % of reading + 0.003 mΩ 0.1 % of reading + 2.4 mΩ 0.05 % of reading + 0.0026 Ω 0.02 % of reading + 0.01 Ω 0.02 % of reading + 0.092 Ω 0.02 % of reading + 0.92Ω 0.02 % of reading + 0.01 kΩ 0.03 % of reading + 0.093 kΩ 0.05 % of reading + 1.3 kΩ 0.5 % of reading + 0.63 MΩ	RLC Calibrator
LCR Meters ¹ Capacitance (20 Hz to 13 MHz)	Up to 10 pF (10 to 100) pF 100 pF to 1 nF (1 to 10) nF (10 to 100) nF 100 nF to 1 μF (1 to 10) μF (10 to 100) μF	1 % of reading + 0.14 pF 0.1 % of reading + 0.15 pF 0.05 % of reading + 0.28 pF 0.05 % of reading + 0.0014 nF 0.05 % of reading + 0.014 nF 0.05 % of reading + 0.14 nF 0.1 % of reading + 0.004 μF 0.1 % of reading + 0.058 μF	RLC Calibrator
LCR Meters ¹ Inductance (20 Hz to 13 MHz)	Up to 10 μH (10 to 100) μH 100 μH to 1 mH (1 to 10) mH (10 to 100) mH 10 mH to 1 H (1 to 10) H	0.3 % of reading + 0.006 μH 0.2 % of reading + 0.058 μH 0.1 % of reading + 0.63 μH 0.1 % of reading + 1.3 μH 0.1 % of reading + 13 μH 0.1 % of reading + 0.9 mH 0.1 % of reading + 1.5 mH	RLC Calibrator
HiPot Testers ¹ Impulse Tester	Up to 10 kV, 50 Hz Up to 40 kV, 50 Hz	0.001 2 kV + 0.012 kV	High Voltage Meter, High Voltage Probe w Multimeter, Current Calibrator Digital Oscilloscope
	Up to 100 mA, 50 Hz	0.015 mA + 0.000 62 mA/mA	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Insulation Testers ¹	Up to 10 kV Up to 100 GΩ	0.002 % of reading + 1.5 V 0.09 % of reading + 1.5 MΩ	High Voltage Voltmeter, Insulation Tester Calibrator
Resistance – Source ¹	Up to 11 Ω (11 to 33) Ω (33 to 110) Ω (110 to 330) Ω (0.33 to 1.1) kΩ (1.1 to 3.3) kΩ (3.3 to 11) kΩ (11 to 33) k (33 to 110) kΩ (110 to 330) kΩ 0.33 kΩ to 1.1 MΩ	0.1 mΩ/Ω + 8 mΩ 0.1 mΩ/Ω + 17 mΩ 1 mΩ/Ω + 17 mΩ 1 mΩ/Ω + 17 mΩ 0.1 mΩ/Ω + 0.07 Ω 0.1 mΩ/Ω + 0.08 Ω 0.1 mΩ/Ω + 0.71 Ω 0.1 mΩ/Ω + 0.70 Ω 0.1 mΩ/Ω + 7 Ω 0.1 mΩ/Ω + 7 Ω 0.2 mΩ/Ω + 64 Ω	Multiproduct Calibrator
Resistance – Source ¹	(1.1 to 3.3) MΩ (3.3 to 11) MΩ (11 to 33) MΩ (33 to 110) MΩ (110 to 330) MΩ	0.2 mΩ/Ω + 64 Ω 0.7 mΩ/Ω + 6.4 kΩ 1 mΩ/Ω + 6.1 kΩ 6 mΩ/Ω + 6.4 kΩ 6 mΩ/Ω + 19 kΩ	Multiproduct Calibrator
Resistance – Source ¹ Fixed Points	1.9 Ω 10 Ω 10 Ω 100 Ω 190 Ω 1 kΩ 1.9 kΩ 10 kΩ 19 kΩ	95 μΩ/Ω 28 μΩ/Ω 27 μΩ/Ω 17 μΩ/Ω 17 μΩ/Ω 20 μΩ/Ω 20 μΩ/Ω 18 μΩ/Ω 18 μΩ/Ω	Multiproduct Calibrator
Resistance – Source ¹ Fixed Points	100 kΩ 190 kΩ 1 MΩ 1.9 MΩ 10 MΩ 19 MΩ 100 MΩ	19 μΩ/Ω 19 μΩ/Ω 26 μΩ/Ω 26 μΩ/Ω 50 μΩ/Ω 50 μΩ/Ω 10 mΩ/Ω	Multiproduct Calibrator

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Resistance – Measure ¹	(0 to 10) Ω (10 to 100) Ω 100 to 1 kΩ (1 to 10) kΩ (10 to 100) kΩ (0.1 to 1) MΩ (1 to 10) MΩ (10 to 100) MΩ (0.1 to 1) GΩ	16 μΩ/Ω + 81 μΩ 14 μΩ/Ω + 0.59 μΩ 12 μΩ/Ω + 0.61 μΩ 12 μΩ/Ω + 6.2 mΩ 12 μΩ/Ω + 61 mΩ 18 μΩ/Ω + 2.4 Ω 59 μΩ/Ω + 0.12 kΩ 0.59 mΩ/Ω + 1.2 kΩ 5.9 mΩ/Ω + 12 kΩ	Precision Multimeter
Capacitance ¹ 10 Hz to 10 kHz 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 Hz to 1 kHz (10 to 600) Hz (10 to 300) Hz	(220 to 399.9) pF (0.4 to 1.099 9) nF (1.1 to 3.299 9) nF (3.3 to 10.999 9) nF (11 to 32.999 9) nF (33 to 109.999) nF (110 to 329.999) nF (0.33 to 1.099 99) μF (1.1 to 3.299 99) μF	0.58 % of reading + 12 pF 0.57 % of reading + 12 pF 0.57 % of reading + 12 pF 0.22 % of reading + 27 pF 0.29 % of reading + 0.12 nF 0.29 % of reading + 0.13 nF 0.29 % of reading + 0.35 nF 0.28 % of reading + 1.5 nF 0.29 % of reading + 3.5 nF	Multiproduct Calibrator
Capacitance ¹ (10 to 150) Hz (10 to 120) Hz (10 to 80) Hz (0 to 50) Hz (0 to 20) Hz (0 to 6) Hz (0 to 2) Hz (0 to 0.6) Hz (0 to 0.2) Hz	(3.3 to 10.999 9) μF (11 to 32.999 9) μF (33 to 109.999) μF (110 to 329.999) μF (0.33 to 1.099 99) mF (1.1 to 3.299 99) mF (3.3 to 10.999 9) mF (11 to 32.999 9) mF (33 to 110) mF	0.29 % of reading + 1.3 nF 0.46 % of reading + 36 nF 0.53 % of reading + 0.12 μF 0.53 % of reading + 0.35 μF 0.5 % of reading + 1.5 μF 0.52 % of reading + 3.6 μF 0.51 % of reading + 13 μF 0.86 % of reading + 35 μF 1.3 % of reading + 0.13 mF	Multiproduct Calibrator
Temperature Indicator Thermocouple Simulation ¹	Type B (600 to 800) °C (800 to 1 000) °C (1 000 to 1 550) °C (1 550 to 1 820) °C Type C (0 to 150) °C (150 to 650) °C (650 to 1 000) °C (1 000 to 1 800) °C (1 800 to 2 316) °C	0.5 °C 0.41 °C 0.36 °C 0.4 °C 0.36 °C 0.32 °C 0.37 °C 0.59 °C 0.98 °C	Multiproduct Calibrator

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Temperature Indicator Thermocouple Simulation ¹	Type E (-250 to -100) °C (-100 to -25) °C (-25 to 350) °C (350 to 650) °C (650 to 1 000) °C Type J (-210 to -100) °C (-100 to -30) °C (-30 to 150) °C (150 to 760) °C (760 to 1 200) °C Type K (-200 to -100) °C (-100 to -25) °C (-25 to 120) °C (120 to 1 000) °C (1 000 to 1 372) °C Type R (0 to 250) °C (250 to 400) °C (400 to 1 000) °C (1 000 to 1 767) °C Type T (-250 to -150) °C (-150 to 0) °C (0 to 120) °C (120 to 400) °C	0.59 °C 0.22 °C 0.2 °C 0.23 °C 0.29 °C 0.33 °C 0.22 °C 0.2 °C 0.23 °C 0.29 °C 0.41 °C 0.26 °C 0.24 °C 0.3 °C 0.47 °C 0.66 °C 0.43 °C 0.38 °C 0.46 °C 0.73 °C 0.32 °C 0.24 °C 0.17 °C	Multiproduct Calibrator
Electrical Calibration of RTD Indicating Systems ¹	Pt 385, 100 Ω (-200 to 0) °C (0 to 100) °C (100 to 400) °C (400 to 630) °C (630 to 800) °C Pt 3926, 100 Ω (-200 to 0) °C (0 to 100) °C (100 to 400) °C (400 to 630) °C	0.05 °C 0.07 °C 0.1 °C 0.12 °C 0.23 °C 0.05 °C 0.07 °C 0.1 °C 0.12 °C	Multiproduct Calibrator

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		Multiproduct Calibrator	
	(-200 to 0) °C	0.05 °C		
	(0 to 100) °C	0.06 °C		
	(100 to 400) °C	0.09 °C		
	(400 to 630) °C			
	Pt 385, 1 kΩ	0.11 °C		
	(-200 to 0) °C	0.03 °C		
	(0 to 100) °C	0.05 °C		
	(100 to 400) °C	0.07 °C		
	(400 to 630) °C	0.23 °C		
Pt Ni 385, 100 Ω	(-80 to 100) °C	0.08 °C		
	(100 to 260) °C	0.14 °C		
	Cu 427, 10 Ω	(-100 to 260) °C		0.3 °C
Tesla Meter ¹ (Gauss Meter)	Up to 200 mT 200 mT to 1500 mT	5.1 % of reading + 0.35 mT 5.1 % of reading + 12 mT	Reference Magnetic Field Block	

Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
RF Power – Measure	0 dBm 50 MHz	0.027 dB	Power Meter, Thermistor Mount
RF Absolute Power - Measure	(-20 to 30) dBm		Measuring Receiver with Power Sensor
	100 kHz to 2.6 GHz	0.058 dB	
	50 MHz to 1.3 GHz	0.077 dB	
	(1.3 to 18) GHz	0.082 dB	
	(18 to 26.5) GHz	0.09 dB	Power Meter with Power Sensor
	(-70 to 20) dBm		
	10 MHz to 30 MHz	0.089 dB	
	30 MHz to 4 GHz	0.092 dB	
	(4 to 10) GHz	0.094 dB	
(10 to 15) GHz	0.094 dB		
(15 to 18) GHz	0.096dB		

Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Tuned RF Power – Measure 2.5 MHz to 26.5 MHz	(-22 to 10) dBm	0.15 dB	Measuring Receiver with Power Sensor
	(-42 to -22) dBm	0.15 dB	
	(-50 to -42) dBm	0.18 dB	
	(-60 to -50) dBm	0.19 dB	
	(-72 to -60) dBm	0.21 dB	
	(-80 to -72) dBm	0.23 dB	
	(-92 to -80) dBm	0.24 dB	
	(-102 to -92) dBm	0.26 dB	
	(-110 to -102) dBm	0.28 dB	
Distortion – Measure 250 kHz to 26.5 GHz	(0.01 to 100) % Distortion	0.065 % Distortion	Measuring Receiver
	Distortion – Measure Fundamental Frequency	(-99 to 0) dB 20 Hz to 20 kHz	1.2 dB
20 to 100 kHz		2.3 dB	
Amplitude Modulation – Measure	Depths: 5 % to 99 % 150 kHz to 10 MHz	0.86 % Depth + 1 digit	Measuring Receiver with Power Sensor
	Depths: 5 % to 20 % 10 MHz to 3 GHz	2.9 % Depth + 1 digit	
	Depths: 20 % to 99 % 10 MHz to 3 GHz	0.69 % Depth + 1 digit	
	Depths: 5 % to 20 % 3 GHz to 26.5 GHz	5.2 % Depth + 1 digit	
	Depths: 20 % to 99 % 3 GHz to 26.5 GHz	1.7 % Depth + 1 digit	
	Depths: 5 % to 20 % 26.5 GHz to 31.15 GHz	7.8 % Depth + 1 digit	
	Depths: 20 % to 99 % 26.5 GHz to 31.15 GHz	2.2 % Depth + 1 digit	
	Amplitude Modulation – Generate	Depths: 0 % to 95 % (11 to 13.5) MHz Rate: 20 Hz to 100 kHz	
Depths: 95 % to 99 % (11 to 13.5) MHz Rate: 20 Hz to 100 kHz		0.39 % Depth	

Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Frequency Modulation – Generate	10 kHz to 432 MHz Rate: DC to 100 kHz Dev.: ≤ 400 kHz peak	0.59 % Deviation	AM/FM Test Source
	10 kHz to 432 MHz Rate: 20 Hz to 200 kHz Dev.: ≤ 400 kHz peak	0.63% Deviation	
Frequency Modulation – Measure	250 kHz to 10 MHz Rate: 20 Hz to 10 kHz Dev.: ≤ 40 kHz peak	1.7 % of reading + 5.7 Hz 1.1 % of reading + 6.6 Hz	Measuring Receiver with Power Sensor
	10 MHz to 1.3 GHz Rate: 50 Hz to 100 kHz Dev.: ≤ 400 kHz peak	1.8 % of reading + 5.1 Hz 1.2 % of reading + 6.1 Hz	
	10 MHz to 1.3 GHz Rate: 20 Hz to 200 kHz Dev.: ≤ 400 kHz peak	2.9 % of reading + 4 Hz 1.2 % of reading + 6.4 Hz	
	(1.3 to 26.5) GHz Rate: 50 Hz to 100 kHz Dev.: ≤ 400 kHz peak	4.4 % of reading + 3.8Hz 1.2 % of reading + 7.6 Hz	

Length – Dimensional Metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Gage Blocks ¹	Up to 100 mm (100 to 500) mm	0.11 μm + 0.6L/1000 (L: mm) 0.2 μm + 0.6L/1000 (L: mm)	Universal Length Measuring System, Gage Block Set
Protractors	Up to 360 °	0.13 °	Angle Gauge Block Set, Granite Surface Plate
Calipers ¹	Up to 1 000 mm (Up to 39.37 inch)	0.017 mm + 0.51L	Gage Block Set
Micrometers ¹ External, Internal, Depth	Up to 25 mm Up to 1 000 mm	1.2 μm + 0.002 5 μm / mm	Optical Flat, Gage Block Set
Height Gages ¹	Up to 1 000 mm	0.005 mm	Gage Block Set
Steel Ruler ^{1,2}	Up to 5 000 mm	0.037L ml	Standard Steel Ruler, Scale Loupe, Granite Surface Plate

Length – Dimensional Metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Tape Ruler ^{1,2}	(0 to 1 000) mm (1 000 to 5 000) mm (5 000 to 10 000) mm (10 to 50 000) mm	0.039L mm	Tape and scale calibration unit
Laser Distance Meter	Up to 40 m	2.7 mm	Laser Distance Meter
Glass Scales ^{1,2}	Up to 300 mm	(0.7 + 0.001 6l) μm	Standard Glass Scale Microscope
Thickness Gages ¹	Up to 12 mm (Up to 0.4 inch)	0.002 mm	Gage Block Set
Feeler Gauge	Up to 1 mm (Up to 0.04 inch)	0.001 mm	Universal Length Measuring System
Digimatic, Dial Indicators ¹	Up to 25 mm (Up to 1 inch)	0.003 mm	Dial Gage Tester
Dial Test Indicators ¹	Up to 1 mm (Up to 0.04 in)	0.001 mm	Calibration Tester
Pin Gages, Plug Gages ¹	Up to 100 mm (Up to 4 inch)	0.002 mm	Universal Length Measuring System, Gauge Block Set
Calibration tester Resolution: 1 μm 0.2 μm	(0 to 100) mm (0 to 5) mm	0.38 μm 0.25 μm	Gauge Block Set
Thread Plug Gauge Pitch Diameter Major Diameter	Up to 100 mm Up to 100 mm	0.002 mm	Universal Length Measuring System, Thread Wire Set, Gauge Block Set, Master Ring
Thread Ring Gauge Pitch Diameter Minor Diameter	Up to 100 mm Up to 100 mm	0.002 mm	
Dial Bore Gages	Up to 50 mm (Up to 2 inch)	0.003 mm	Universal Length Measuring System
Ring Gauge	Up to 100 mm (Up to 4 inch)	0.82 μm	Universal Length Measuring System
Coordinate Measuring Machines (CMM) ^{1,2}	Axis X: 1 000 mm Axis Y: 1 000 mm Axis Z: 1 000 mm	(0.23 + 0.035l) μm	Gauge Block Set, Check Master
	Probe Performance	0.52 μm	Sphere

Length – Dimensional Metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Surface Roughness Tester	2.97 µm Ra 3.17 µm Ra 9.40 µm Ry	0.06 µm	Standard Roughness Specimen
Roundness Testing Machines	Roundness (10, 50) mm	0.021 µm	Master Roundness Standard
Master Ball ²	Up to 50 mm	(0.93 + 0.0026 <i>l</i>) µm	Universal Length Measuring System, Gauge Block Set
Contour Measuring Machine ²	X axis: up to 100 mm Z axis: up to 30 mm	(0.53 + 0.002 3 <i>l</i>) µm (1.4 + 0.008 4 <i>l</i>) µm	Gauge Block Set Pin Gauge Set, Master Ball
Measuring Microscopes / Profile Projectors	Up to 300 mm (Up to 12 inch)	0.004 mm	Standard Glass Scale.
Length Counter ²	0 to 30 km	0.38 <i>L</i> mm/m	Digimatic Caliper, Digital Tachometer
Levels	(0 to 30)°	0.015°	Sine Bar, Gauge Block Set, Surface Plate
Length Bar / Micrometer Standard Bar ²	Up to 1 000 mm	(0.23 <i>L</i> + 6.7) µm	Universal Length Measuring System, Gauge Block Set
Dimensional ² (length, hole)	Length: Up to 500 mm Hole: Up to 50 mm	1 µm + 1.7 <i>L</i> /10 ⁶ 0.18 µm + 1.2 <i>L</i> /10 ⁶	Coordinate Measuring Machine, Gauge Block Set
Surface Flatness – Local Area Flatness	Up to (1.8 X 3.6) m	41 µm	Repeat-o-Meter
Coating Thickness Meters ¹	Up to 3000 µm Up to 25 mm	2 µm 13 µm	Coating Thickness Standards
Sieves	Up to 5 mm	0.003 6 mm + 0.014 mm/mm	Profile Projector
	(5 to 125) mm	0.098 mm + 0.014 mm/mm	Digital Caliper
Needle Detector	(0.5 to 1.5) mm	0.017 mm	Ferrous and Non-Ferrous Dimensional Reference Standards

Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Torque Wrench ¹	Up to 1 000 N·m	1.2 % of reading + 0.085 N.m	Torque Wrench Tester

Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Torque Tools/Wrenches ¹	(1 to 10) lbf.in (2 to 25) lbf.in (5 to 50) lbf.in (10 to 100) lbf.in (5 to 50) lbf-ft (25 to 250) lbf-ft	0.7 % of reading + 0.008 lbf.in 0.7 % of reading + 0.02 lbf.in 0.7 % of reading + 0.04 lbf.in 0.7 % of reading + 0.07 lbf.in 0.7 % of reading + 0.04 lbf-ft 0.7 % of reading + 0.19 lbf-ft	Torque Testers with Transducers
Torque Testers/Transducers ¹	(20 to 200) lbf-ft	0.01 % of reading + 0.001 lbf-ft	Arm & Standard Weight Set
Mass, OIML E2	(1 to 500) g	0.01 mg + 0.002 mg / g	Standard Weight Set, Analytical Balance, Precision Balances
Mass, OIML F1	(1 to 500) g	0.36 mg + 0.005 mg / g	
Mass	(1 mg to 500 g), OIML F2 (1 to 20) kg, OIML F2 (1 to 20) kg, OIML M1	0.006 mg + 0.02 mg / g 0.2 g + 0.01 mg / g 0.5 g + 0.04 mg / g	
Balances / Scales ^{1,3} Class I	(1 to 20) mg (20 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 150) g (150 to 200) g	0.004 8 mg 0.01 mg 0.000 021 g 0.000 027 g 0.000 038 g 0.00 0075 g 0.000 14 g 0.000 29 g 0.000 44 g	OIML111-1 Standard Weight Set E1 and OIML R76-1 for calibration of balance, scale
Balances / Scales ^{1,3} Class I	(200 to 300) g (300 to 500) g	0.000 6 g 0.001 g	OIML111-1 Standard Weight Set E1 and OIML R76-1 for calibration of balance, scale
Balances / Scales ^{1,3} Class II	Up to 150 g (150 to 500) g (500 to 1 200) g (1 200 to 2 500) g (2 500 to 5 000) g (5 000 to 9 000) g	0.001 7 g 0.003 8 g 0.0013 g 0.02 g 0.036g 0.039 g	

Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Balances / Scales ^{1,3} Class III	(0 to 500) g	0.018 g	OIML111-1 Standard Weight Set E1 and OIML R76-1 for calibration of balance, scale
	(0.5 to 6) kg	0.17 g	
Balances / Scales ^{1,2,3} Class III	(6 to 35) kg	5.4 g	OIML111-1 Standard Weight Set E1 and OIML R76-1 for calibration of balance, scale
	(35 to 60) kg	0.013 kg	
	(60 to 100) kg	0.024 kg	
	(100 to 300) kg	0.048 kg	
	(300 to 1 000) kg	0.2 kg	
	(1 000 to 2 000) kg	0.46 kg	
	(2 000 to 5 000) kg	0.78 kg	
Compression & Tension Machines, Loadcell	Up to 500 kN Up to 20 kgf	0.05 kN + 0.01 kN/kN 0.03 kgf	Load cell & Indicator Standard Weight
Force Gages	Up to 5 kgf (5 to 20) kgf (20 to 100) kgf	0.006 5 kgf 0.001 7 kgf 0.025 kgf	Standard Weight Set
Pressure Gauge ¹ Differential, Absolute, and Vacuum	Up to -0.98 bar (0 to 70) bar (70 to 700) bar (700 to 1 000) bar	0.003 1 bar 0.041 bar 0.081 bar 0.38 bar	Digital Pressure Gauge
Air Velocity ¹	Up to 45 m/s	0.17 m/s + 0.004 4 m/s	Wind Tunnel and Standard Anemometer
Pneumatic Volume Flow Meters ¹	Up to 200 LPM	0.025 LPM + 0.011 LPM/LPM	Flow Calibrator Unit
Hardness Testers ¹	Up to 63.2 HRC Up to 84.4 HRB	0.56 HRC 1.5 HRB	ASTM E18 Indirect Verification using Standard Blocks
Hardness Testers ¹	Up to 1000 HV Up to 500 HMV	2.3 HV + 1.3 % HV 2.3 HMV + 1.3 % HMV	ASTM E92 Indirect Verification using Standard Blocks
Hardness Testers ¹	Up to 83.2 HRBS	1.5 HRBS	ASTM E18 Indirect Verification using Standard Blocks
Hardness Blocks	Up to 63.2 HRC Up to 84.4 HRB Up to 774 HV Up to 500 HMV Up to 83.2 HRBS	0.56 HRC 1.5 HRB 1.4 HV 1.5 HMV 1.5 HRBS	Hardness Tester w Hardness Blocks

Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Burette ¹	Up to 100 ml	0.5 µl/ml + 10 µl	Analytical Scale, Standard Weight Set, Temperature Calibrator
Pipettes & Micropipettes	Up to 100 ml	0.4 µl/ml + 6.6 µl	Analytical Scale, Standard Weight Set, Temperature Calibrator
Volumetric Flasks ¹	Up to 2 000 ml	450 µl	
Grain Moisture Tester ¹	(6 to 40) % Moisture Content	0.8 % Moisture Content	Temperature & Humidity Chamber, Analytical Balance
Wood Moisture Tester ¹	(up to 30) % Moisture Content	0.8 % Moisture Content	Standard Decade Resistance Temperature & Humidity Chamber Analytical Balance
Hydrometer ¹	Up to 1.18 g/ml	0.38 % of reading + 0.048 g/ml	Analytical Balance Standard Thermometer
Durometer – Shore A, B, C, D, D0, O Force Only	(0 to 100) duro	0.43 duro	Partial Direct Verification Rubber Hardness Tester Calibrator, Electronic Balance

Photometry and Radiometry

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Light Meters ¹	(100 to 20 000) lx	1.4 % of reading	Light System Calibration
UV-VIS Spectrophotometers ¹	(200 to 650) nm (0 to 2) Au	0.5 nm 0.007 9 Au	Standard UV-VIS Spectrophotometer
Gloss Meter ¹	92.4 GU / 20° 94.8 GU / 60° 99.5 GU / 85°	0.7 GU 0.6 GU 0.6 GU	Standards High Gloss
Light Box Day Light D65 Day Light D50 CWF A TL84/U35	6 500 K 5 000 K 4 150 K 2 856 K 4 100 K	230 K 180 K 150 K 100 K 140 K	Chroma Meter

Photometry and Radiometry

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
UV Meters Irradiance (200 to 400) nm	(Up to 100) mW/cm ²	3.3 % of reading	UV Calibration System
Color Meter, light source D65,A	Color Space CIE 1931: Tristimulus XYZ: X(13.77 to 94.28) Y(12.28 to 79.63) Z(2.22 to 65.37) Chromaticity Coordinate xy: x(0.1992 to 0.6309) y(0.2010 to 0.4792) UCS u'v': u'(0.1420 to 0.4376) v'(0.3608 to 0.5517) CIE L*u*v* L*(41.66 to 91.52) u*(-67.54 to 128.50) v*(-75.42 to 94.64) CEI L*a*b* L*(41.66 to 91.52) a*(-38.89 to 59.50) b*(-54.37 to 93.82)	0.34 0.002 5 0.002 6 0.48 0.43	Reference Color Standard, dimensionless quantity
Color Meter, light source D65,A	Color Space CIE 1964: Tristimulus:XYZ X(13.38 to 94.81) Y(12.45 to 77.41) Z(2.19 to 64.71) Chromaticity Coordinate x;y x(0.1961 to 0.5503) y(0.2210 to 0.4750) UCS u'v' u'(0.1430 to 0.4247) v'(0.3781 to 0.5508) CIE L*u*v* L*(41.92 to 90.51) u*(-66.67 to 116.48) v*(-67.28 to 89.12) CEI L*a*b* L*(41.92 to 90.51) a*(-38.00 to 53.78) b*(-52.50 to 95.55)	0.32 0.002 5 0.002 6 0.44 0.42	Reference Color Standard, dimensionless quantity

Thermodynamic

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Relative Humidity ¹	Up to 97 %RH	2.1 %RH	Temperature and Humidity Chamber, Temp. & Humidity Meter
Temperature – Source/ Measure ¹	(-45 to 150) °C (150 to 1 200) °C (1 200 to 1 800) °C	0.06 °C 4.2 °C 6.5 °C	Temperature Block / Furnace Calibrator w Reference Thermometer Standard
Thermocouples (All Type)	(-45 to 150) °C (150 to 600) °C	0.17 °C 0.27 °C	Reference Thermometer, Temperature Bath
Thermocouples (All Type)	(600 to 1 800) °C	3.6 °C	Type B TC with Ice Bath and Thermocouple Readout
Infrared (IR) Thermometers ¹	(-15 to 120) °C (100 to 200) °C (200 to 350) °C (350 to 500) °C	0.61 °C 0.75 °C 1.3 °C 1.7 °C	Black Body Source (flat plate) $\lambda = 8$ to $14 \mu\text{m}$, $\epsilon = 0.95$
Temperature & Humidity Chambers ¹ Dry Oven, furnace, Autoclave, Incubator, Vacuum Oven	(-80 to 400) °C (150 to 1 200) °C (1 200 to 1 800) °C (10 to 97) %RH	0.065 °C 4.2 °C 3.2 °C 2.1 %RH	Temperature Data Logger, Humidity Data Logger,

Time and Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Stopwatches/Timers ¹	Up to 3 600 s	120 ms	Wave Form Generator, Frequency Counter
Frequency – Source ¹	1 μHz to 80 MHz 80 MHz to 26.5 GHz	5 pHz/Hz + floor needed 5 pHz/Hz	Wave Form Generator, Frequency Counter
Frequency – Measure ¹	100 μHz to 10 Hz 10 Hz to 3 GHz (3 to 12.4) GHz (12.4 to 26.5) GHz	5 pHz/Hz	Frequency Counter
Tachometers ¹	(1 to 100 000) rpm	0.01 % of reading	Signal Generator w Lamp

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Acoustics and Vibration

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Sound Level Meters ¹	94 dB, 1 kHz 114 dB, 1 kHz	0.39 dB	Sound Calibrator
Vibration Meters ¹ Acceleration, Velocity	(10 to 2 000) Hz, (0.1 to 100) m/s ²	1.9 % of reading + 0.25 g 2.6 % of reading + 0.25 g	Vibration Calibration System

Chemical Quantities

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
pH meters ¹	4.00 pH 7.00 pH 10.00 pH	0.013 pH 0.013 pH 0.015 pH	Control Company Solutions
Conductivity meters ¹	1 µS/cm 10 µS/cm 84 µS/cm 1 413 µS/cm	0.83 µS/cm 0.93 µS/cm 1.4 µS/cm 9.2 µS/cm	
Refractometers	(0, 15, 40) °Brix (1 to 20) % Salinity	0.22 °Brix 0.18 % Refraction	Analytical Balance, Volumetric Flask, Digital Thermometer
Viscosity Meters ¹	1 000 mPa.s (cP) (1 000 to 200 000 mPa.s (cP))	0.95 % of reading 2.1 % of reading	Viscosity Reference Solutions
Gas Detectors ¹	H ₂ S 25 ppm Concentration CO 50 ppm Concentration 100 ppm Concentration CH ₄ 50% Concentration LEL O ₂ 12% Concentration in N ₂ 18% Concentration in N ₂	2 parts in 10 ⁶ Concentration 2.6 parts in 10 ⁶ Concentration 3.4 parts in 10 ⁶ Concentration 3 % of reading 1.4 % of reading 2.7 % of reading	Standard Gases

Chemical Quantities

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Gas Detectors ¹	NH ₃ 50 ppm Concentration	3 % of reading	Standard Gases
Total Volatile Organic Compounds (TVOC) ¹	Up to 100 ppm Concentration	0.8 parts in 10 ⁶ Concentration	Standard Gas
Turbidity Meter ¹	(0 to 500) NTU (0 to 1 000) NTU	0.1 NTU + 0.01 NTU / NTU 0.2 NTU + 0.001 NTU / NTU	Turbidity Calibration Standards Solution
Alcohol meter ¹	(10 to 100) % Vol / Vol	0.24 % Vol / Vol	Reference Alcohol meter

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
DC Voltage – Source ¹	Up to 220 mV 220 mV to 2.2 V (2.2 to 11) V (11 to 22) V (22 to 220) V 220 V to 1.1 kV	8.1 μV/V + 0.8 μV 7.1 μV/V + 1 μV 8.1 μV/V + 3.5 μV 7.1 μV/V + 6.5 μV 8.1 μV/V + 80 μV 11 μV + 0.5 μV	Multiproduct Calibrator
DC Voltage – Measure ¹	Up to 100 mV 100 mV to 1 V (1 to 10) V (10 to 100) V (100 to 1 000) V	11 μV/V + 1.2 μV 9.5 μV/V + 1.2 μV 9.5 μV + 2.6 μV 12 μV/V + 36 μV 118 μV/V + 12 μV/V	Precision Multimeter
DC Voltage – Measure ¹	(1 to 10) kV	12 μV/V + 0.12 mV	Kikusui Digital High Voltage Meter
DC Voltage – Measure ¹	(10 to 40) kV	1 mV/V + 4 V	High Voltage Probe
DC Current – Measure ¹	Up to 100 nA 100 nA to 1 μA (1 to 100) μA 100 μA to 1 mA (1 to 10) mA (10 to 100) mA 100 mA to 1 A	35 μA/A + 0.05 nA 24 μA/A + 0.05 nA 24 μA/A + 0.95 nA 24 μA/A + 5.9 nA 24 μA/A + 5.9 nA 41 μA/A + 0.6 nA 0.13 μA/A + 0.01 mA	Precision Multimeter
DC Current – Measure ¹	(1 to 10) A (10 to 300) A (300 to 1 000) A	0.58 μA/A 0.14 μA/A 6.8 mA/A	Multimeter with Current Shunt
DC Current – Measure ¹	(1 000 to 2 000) A	4.1 A	Clamp Meter

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
DC Current – Source ¹	Up to 220 μ A 220 μ A to 22 mA (22 to 220) mA 220 mA to 2.2 A (2.2 to 11) A	50 μ A/A + 8 nA 50 μ A/A + 8 nA 50 μ A/A + 80 nA 60 μ A/A + 0.8 μ A 80 μ A/A + 25 μ A	Multiproduct Calibrator
	330 μ A to 3.3 mA (3.3 to 33) mA (33 to 330) mA 330 mA to 2.2 A (2.2 to 20) A	0.15 mA/A + 0.06 μ A 0.11 mA/A + 0.46 μ A 0.1 μ A/A + 8.8 μ A 0.32 μ A/A + 0.12 mA 0.66 μ A/A + 0.81 mA	Multiproduct Calibrator
	(20 to 1 000) A	5.4 mA/A	Multiproduct Calibrator w Fluke Coil
AC Voltage – Source ¹	Up to 2.2 mV (10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz	0.55 mV/V + 4.5 μ V 0.21 mV/V + 4.5 μ V 0.11 mV/V + 4.5 μ V 0.37 mV/V + 4.5 μ V 0.85 mV/V + 7 μ V 1.1 mV/V + 13 μ V 1.7 mV/V + 25 μ V 3.4 mV/V + 25 μ V	Multiproduct Calibrator
	(2.2 to 22) mV (10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz	0.55 mV/V + 5 μ V 0.21 mV/V + 5 μ V 0.11 mV/V + 5 μ V 0.37 mV/V + 5 μ V 0.85 mV/V + 7 μ V 1.1 mV/V + 12 μ V 1.7 mV/V + 25 μ V 3.4 mV/V + 25 μ V	
	(22 to 220) mV (10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz	0.55 mV/V + 13 μ V 0.21 mV/V + 8 μ V 0.11 mV/V + 8 μ V 0.37 mV/V + 8 μ V 0.85 mV/V + 25 μ V 1.1 mV/V + 25 μ V 1.7 mV/V + 35 μ V 3.4 mV/V + 80 μ V	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Source ¹	220 mV to 2.2 V (10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz (2.2 to 22) V (10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz (22 to 220) V (10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz 220 V to 1.1 kV (15 to 50) Hz 50 Hz to 1 kHz	0.5 mV/V + 80 μV 0.16 mV/V + 25 μV 80 μV/V + 6 μV 0.13 mV/V + 16 μV 0.26 mV/V + 70 μV 0.44 mV/V + 0.13 mV 1.8 mV/V + 35 mV 2.6 mV/V + 8.5 mV 0.55 mV/V + 0.8 mV 0.16 mV/V + 0.25 mV 80 μV/V + 0.06 mV 0.13 mV/V + 0.16 mV 0.27 mV/V + 0.35 mV 0.5 mV/V + 1.5 mV 1.9 mV/V + 4.3 mV 3.1 mV/V + 8.5 mV 0.5 mV/V + 8 mV 0.16 mV/V + 2.5 mV 80 μV/V + 0.8 mV 0.22 mV/V + 3.5 mV 0.5 mV/V + 8 mV 2 mV/V + 90 mV 0.4 mV/V + 16 mV 80 μV/V + 3.5 mV	Multiproduct Calibrator
AC Voltage – Measure ¹	Up to 10 mV (1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz	0.36 mV/V + 3.5 μV 0.24 mV/V + 1.3 μV 0.35 mV/V + 1.3 μV 1.2 mV/V + 1.3 μV 5.9 mV/V + 1.3 μV 47 mV/V + 2.4 μV	Precision Multimeter



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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	(10 to 100) mV		Precision Multimeter
	(1 to 40) Hz	0.008 mV/V + 2.4 μV	
	40 Hz to 1 kHz	0.017 mV/V + 2.4 μV	
	(1 to 20) kHz	0.035 mV/V + 2.4 μV	
	(20 to 50) kHz	0.095 mV/V + 2.4 μV	
	(50 to 100) kHz	0.354 mV/V + 12 μV	
	(100 to 300) kHz	1.2 mV/V + 12 μV	
	300 kHz to 1 MHz	1.8 mV/V + 12 μV	
	(1 to 2) MHz	18 mV/V + 12 μV	
	100 mV to 1 V		
	(1 to 40) Hz	0.08 mV/V + 48 μV	
	40 Hz to 1 kHz	0.08 mV/V + 24 μV	
	(1 to 20) kHz	0.17 mV/V + 24 μV	
	(20 to 50) kHz	0.35 mV/V + 24 μV	
	(50 to 100) kHz	0.95 mV/V + 24 μV	
	(100 to 300) kHz	0.36 mV/V + 0.12 mV	
	300 kHz to 1 MHz	12 mV/V + 0.12 mV	
	(1 to 2) MHz	18 mV/V + 0.12 mV	
	(1 to 10) V		
	(1 to 40) Hz	0.08 mV/V + 0.47 mV	
	40 Hz to 1 kHz	0.08 mV/V + 0.24 mV	
	(1 to 20) kHz	0.17 mV/V + 0.24 mV	
	(20 to 50) kHz	0.35 mV/V + 0.24 mV	
	(50 to 100) kHz	0.95 mV/V + 0.24 V	
	(100 to 300) kHz	3.6 mV/V + 1.2 mV	
	300 kHz to 1 MHz	12 mV/V + 1.2 mV	
	(1 to 2) MHz	18 mV/V + 1.2 mV	
	(10 to 100) V		
	(1 to 40) Hz	0.24 mV/V + 4.7 mV	
	40 Hz to 1 kHz	0.24 mV/V + 2.4 mV	
(1 to 20) kHz	0.24 mV/V + 2.4 mV		
(20 to 50) kHz	0.43 mV/V + 2.4 mV		
(50 to 100) kHz	0.43 mV/V + 2.4 mV		
(100 to 300) kHz	4.7 mV/V + 12 mV		
300 kHz to 1 MHz	4.7 mV/V + 12 mV		
100 V to 1 kV			
(1 to 40) Hz	0.47 mV/V + 47 mV		
40 Hz to 1 kHz	0.47 mV/V + 47 mV		
(1 to 20) kHz	0.71 mV/V + 24 mV		
(20 to 50) kHz	1.5 mV/V + 24 mV		
(50 to 100) kHz	3.6 mV/V + 2.4 mV		

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Measure ¹	(1 to 30) kV (50 to 60) Hz	0.38 kV	Digital High Voltage Meter High Voltage Probe
AC Current – Source ¹	Up to 220 μ A (10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz 220 μ A 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 (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 220 mA to 2.2 A 20 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.9 mA/A 0.5 mA/A 0.3 mA/A 0.8 mA/A 2 mA/A 0.9 mA/A 0.6 mA/A 0.3 mA/A 2.5 mA/A 5.3 mA/A 2.6 mA/A 2 mA/A 1.8 mA/A 19 mA/A 38 mA/A 0.7 mA/A 0.4 mA/A 0.2 mA/A 0.8 mA/A 1.9 mA/A 0.8 μ A/A 1.1 mA/A 8.8 mA/A	Multiproduct Calibrator
AC Current – Source ¹	(1 to 1000) A 50Hz / 60Hz	5.4 mA/A	Multiproduct Calibrator with Coil
AC Current – Measure ¹	(5 to 100) μ A (10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz	4.8 mA/A + 24 nA 1.8 mA/A + 24 nA 0.7 mA/A + 24 nA 0.7 mA/A + 24 nA	Precision Multimeter

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current – Measure ¹	100 μ A to 10 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 (10 to 100) mA (10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz (5 to 20) kHz (20 to 50) kHz (50 to 100) kHz	4.7 mA/A + 2.4 nA 1.8 mA/A + 2.4 nA 0.7 mA/A + 2.4 nA 0.4 mA/A + 2.4 nA 0.7 mA/A + 2.4 nA 4.7 mA/A + 4.7 nA 6.5 mA/A + 18 μ A 4.7 mA/A + 24 μ A 1.8 mA/A + 24 μ A 0.7 mA/A + 24 μ A 0.4 mA/A + 24 μ A 0.7 mA/A + 24 μ A 4.7 mA/A + 47 μ A 6.5 mA/A + 0.18 mA	Precision Multimeter
AC Current – Measure ¹	100 mA to 1 A (10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz (5 to 20) kHz (20 to 50) kHz	4.7 mA/A + 0.24 mA 1.9 mA/A + 0.24 mA 0.9 mA/A + 0.24 mA 1.2 mA/A + 0.24 mA 3.5 mA/A + 0.24 mA 12 mA/A + 0.47 mA 47 mA/A + 0.47 mA	Precision Multimeter, Precision Shunt
AC Current – Measure ¹	(1 to 10) A (3 to 300) kHz (10 to 300) A (50 to 400) Hz	0.007 1 A + 0.01 mA 0.34 A	Clamp Meter w Flexible Probe
DC Power – Generate 33 mV to 1 020 V	0.33 mA to 330 mA 10 μ W to 330 W 0.33 A to 3 A 10 mW to 3 kW 3 A to 20.5 100 mW to 21 kW	0.01 % of reading + 1.5 nW 0.11 W + 0.012 nW 1.1 5W + 0.031 μ W	Multiproduct Calibrator

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Power – Generate PF = 1 (10 to 45) Hz 33 mV to 32.9999 V 3.3 mA to 2.999 99 A	110 μ W to 99 W	0.18 % of reading	Multiproduct Calibrator
(45 to 65) Hz 33 mV to 1 000 V 3.3 mA to 20.5 A	110 μ W to 20 kW	0.14 % of reading	
Oscilloscopes ¹ - DC Voltage Into 50 Ω Into 1 M Ω	(0 to \pm 6.6) V (0 to \pm 130) V	0.2 % of reading + 36 μ V 0.039 % of reading + 37 μ V	Multiproduct Calibrator
Square Wave In to 50 Ω 10 Hz to 10 kHz	1 mV to 6.6 Vp-p	0.2 % of reading + 65 μ V	
In to 1 M Ω 10 Hz to 10 kHz	1 mV to 130 Vp-p	0.19 % of reading + 39 μ V	
Level Sine Amplitude Reference @ 50 kHz	5 mV to 5.5 V	15 mV/V + 0.49 mV	
Edge Transition Time (Rise time)	< 300 ps	80 ps	
Bandwidth (relative to 50 kHz) 5 mV to 5.5 V	50 kHz to 100 MHz 100 to 300) MHz (300 to 600) MHz (600 to 1 100) MHz	14 mV/V + 0.12 mV 17 mV/V + 0.14 mV 32 mV/V + 0.15 mV 40 mV/V + 0.16 mV	
Time Markers Into 50 Ω	(1 to 50) ns 100 ns to 20 ms 50 ms to 5 s	0.001 1 % of reading + 0.048 ps 0.000 2 % of reading + 7 ps 0.4% of reading	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
LCR Meters ¹ Resistance (20 Hz to 1 MHz)	Up to 0.1 mΩ 0.1 mΩ to 1 Ω (1 to 10) Ω (10 Ω to 100) Ω 100 Ω to 1 kΩ (1 to 10) kΩ (10 to 100) kΩ 100 kΩ to 1 MΩ (1 to 10) MΩ (10 to 100) MΩ	0.2 % of reading + 0.003 mΩ 0.1 % of reading + 2.4 mΩ 0.05 % of Reading + 0.0026 Ω 0.02 % of Reading + 0.01 Ω 0.02 % of Reading + 0.092 Ω 0.02 % of Reading + 0.92Ω 0.02 % of Reading + 0.01 kΩ 0.03 % of Reading + 0.093 kΩ 0.05 % of Reading + 1.3 kΩ 0.5 % of Reading + 0.63 MΩ	RLC Calibrator
LCR Meters ¹ Capacitance (20 Hz to 1 MHz)	Up to 10 pF (10 to 100) pF 100 pF to 1 nF (1 to 10) nF (10 to 100) nF 100 nF to 1 μF (1 to 10) μF (10 to 100) μF	1 % of Reading + 0.14 pF 0.1 % of Reading+ 0.15 pF 0.05 % of Reading + 0.28 pF 0.05 % of Reading + 0.0014 nF 0.05 % of Reading + 0.014 nF 0.05 % of Reading + 0.14 nF' 0.1 % of Reading + 0.004 μF 0.1 % of Reading + 0.058 μF	RLC Calibrator
LCR Meters ¹ Inductance (20 Hz to 1 MHz)	Up to 10 μH (10 to 100) μH 100 μH to 1 mH (1 to 10) mH (10 to 100) mH 10 mH to 1 H (1 to 10) H	0.3 % of Reading + 0.006 μH 0.2 % of Reading + 0.058 μH 0.1 % of Reading + 0.63 μH 0.1 % of Reading + 1.3 μH 0.1 % of Reading + 13 μH 0.1 % of Reading + 0.9 mH 0.1 % of Reading + 1.5 mH	RLC Calibrator
HiPot Testers ¹ Impulse Tester	Up to 10 kV, 50 Hz Up to 40 kV, 50 Hz	0.001 2 kV+0.012 kV	High Voltage Meter, High Voltage Probe
HiPot Testers ¹ Impulse Tester	Up to 100 mA, 50 Hz	0.015 mA+0.000 6 2mA/ mA	Current Calibrator Digital Oscilloscope
Insulation Testers ¹	Up to 10 kV Up to 100 GΩ	0.002 % of reading + 1.5 V 0.09 % of reading + 1.5 MΩ	High Voltage Voltmeter, Insulation Tester Calibrator

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Resistance – Source ¹	Up to 11 Ω (11 to 33) Ω (33 to 110) Ω (110 to 330) Ω (0.33 to 1.1) kΩ (1.1 to 3.3) kΩ (3.3 to 11) kΩ (11 to 33) k (33 to 110) kΩ (110 to 330) kΩ 0.33 kΩ to 1.1 MΩ (1.1 to 3.3) MΩ (3.3 to 11) MΩ (11 to 33) MΩ (33 to 110) MΩ (110 to 330) MΩ	0.1 mΩ/Ω + 8 mΩ 0.1 mΩ/Ω + 17 mΩ 1 mΩ/Ω + 17 mΩ 1 mΩ/Ω + 17 mΩ 0.1 mΩ/Ω + 0.07 Ω 0.1 mΩ/Ω + 0.08 Ω 0.1 mΩ/Ω + 0.71 Ω 0.1 mΩ/Ω + 0.70 Ω 0.1 mΩ/Ω + 7 Ω 0.1 mΩ/Ω + 7 Ω 0.2 mΩ/Ω + 64 Ω 0.2 mΩ/Ω + 64 Ω 0.7 mΩ/Ω + 6.4 kΩ 1 mΩ/Ω + 6.1 kΩ 6 mΩ/Ω + 6.4 kΩ 6 mΩ/Ω + 19 kΩ	Multiproduct Calibrator
Resistance – Source ¹ Fixed Points	1.9 Ω 10 Ω 10 Ω 100 Ω 190 Ω 1 kΩ 1.9 kΩ 10 kΩ 19 kΩ 100 kΩ 190 kΩ 1 MΩ 1.9 MΩ 10 MΩ 19 MΩ 100 MΩ	95 μΩ/Ω 28 μΩ/Ω 27 μΩ/Ω 17 μΩ/Ω 17 μΩ/Ω 20 μΩ/Ω 20 μΩ/Ω 18 μΩ/Ω 18 μΩ/Ω 19 μΩ/Ω 19 μΩ/Ω 26 μΩ/Ω 26 μΩ/Ω 50 μΩ/Ω 50 μΩ/Ω 10 mΩ/Ω	Multiproduct Calibrator
Resistance – Measure ¹	(0 to 10) Ω (10 to 100) Ω 100 to 1 kΩ (1 to 10) kΩ (10 to 100) kΩ (0.1 to 1) MΩ (1 to 10) MΩ (10 to 100) MΩ (0.1 to 2) GΩ	16 μΩ/Ω + 81 μΩ 14 μΩ/Ω + 0.59 μΩ 12 μΩ/Ω + 0.61 μΩ 12 μΩ/Ω + 6.2 mΩ 12 μΩ/Ω + 61 mΩ 18 μΩ/Ω + 2.4 Ω 59 μΩ/Ω + 0.12 kΩ 0.59 mΩ/Ω + 1.2 kΩ 5.9 mΩ/Ω + 12 kΩ	Precision Multimeter

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Capacitance ¹			Multiproduct Calibrator
10 Hz to 10 kHz	(220 to 399.9) pF	0.58 % of reading + 12 pF	
10 Hz to 10 kHz	(0.4 to 1.099 9) nF	0.57 % of reading + 12 pF	
10 Hz to 3 kHz	(1.1 to 3.299 9) nF	0.57 % of reading + 12 pF	
10 Hz to 1 kHz	(3.3 to 10.999 9) nF	0.22 % of reading + 27 pF	
10 Hz to 1 kHz	(11 to 32.999 9) nF	0.29 % of reading + 0.12 nF	
10 Hz to 1 kHz	(33 to 109.999) nF	0.29 % of reading + 0.13 nF	
10 Hz to 1 kHz	(110 to 329.999) nF	0.29 % of reading + 0.35 nF	
(10 to 600) Hz	(0.33 to 1.099 99) μF	0.28 % of reading + 1.5 nF	
(10 to 300) Hz	(1.1 to 3.299 99) μF	0.29 % of reading + 3.5 nF	
(10 to 150) Hz	(3.3 to 10.999 9) μF	0.29 % of reading + 1.3 nF	
(10 to 120) Hz	(11 to 32.999 9) μF	0.46 % of reading + 36 nF	
(10 to 80) Hz	(33 to 109.999) μF	0.53 % of reading + 0.12 μF	
(0 to 50) Hz	(110 to 329.999) μF	0.53 % of reading + 0.35 μF	
(0 to 20) Hz	(0.33 to 1.099 99) mF	0.5 % of reading + 1.5 μF	
(0 to 6) Hz	(1.1 to 3.299 99) mF	0.52 % of reading + 3.6 μF	
(0 to 2) Hz	(3.3 to 10.999 9) mF	0.51 % of reading + 13 μF	
(0 to 0.6) Hz	(11 to 32.999 9) mF	0.86 % of reading + 35 μF	
(0 to 0.2) Hz	(33 to 110) mF	1.3 % of reading + 0.13 mF	
Temperature Indicator Thermocouple Simulation ¹	Type B		Multiproduct Calibrator
	(600 to 800) °C	0.5 °C	
	(800 to 1 000) °C	0.41 °C	
	(1 000 to 1 550) °C	0.36 °C	
	(1 550 to 1 820) °C	0.4 °C	
	Type C		
	(0 to 150) °C	0.36 °C	
	(150 to 650) °C	0.32 °C	
	(650 to 1 000) °C	0.37 °C	
	(1000 to 1 800) °C	0.59 °C	
	(1 800 to 2 316) °C	0.98 °C	
	Type E		
	(-250 to -100) °C	0.59 °C	
	(-100 to -25) °C	0.22 °C	
(-25 to 350) °C	0.2 °C		
(350 to 650) °C	0.23 °C		
(650 to 1 000) °C	0.29 °C		

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Temperature Indicator Thermocouple Simulation ¹	Type J (-210 to -100) °C (-100 to -30) °C (-30 to 150) °C (150 to 760) °C (760 to 1 200) °C Type K (-200 to -100) °C (-100 to -25) °C (-25 to 120) °C (120 to 1 000) °C (1 000 to 1 372) °C Type R (0 to 250) °C (250 to 400) °C (400 to 1 000) °C (1 000 to 1 767) °C Type T (-250 to -150) °C (-150 to 0) °C (0 to 120) °C (120 to 400) °C	0.33 °C 0.22 °C 0.2 °C 0.23 °C 0.29 °C 0.41 °C 0.26 °C 0.24 °C 0.3 °C 0.47 °C 0.66 °C 0.43 °C 0.38 °C 0.46 °C 0.73 °C 0.32 °C 0.24 °C 0.17 °C	Multiproduct Calibrator
Electrical Calibration of RTD Indicating Systems ¹	Pt 385, 100 Ω (-200 to 0) °C (0 to 100) °C (100 to 400) °C (400 to 630) °C (630 to 800) °C Pt 3926, 100 Ω (-200 to 0) °C (0 to 100) °C (100 to 400) °C (400 to 630) °C Pt 385, 500 Ω (-200 to 0) °C (0 to 100) °C (100 to 400) °C (400 to 630) °C	0.05 °C 0.07 °C 0.1 °C 0.12 °C 0.23 °C 0.05 °C 0.07 °C 0.1 °C 0.12 °C 0.05 °C 0.06 °C 0.09 °C 0.11 °C	Multiproduct Calibrator

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, 1 k Ω		Multiproduct Calibrator
	(-200 to 0) °C	0.03 °C	
	(0 to 100) °C	0.05 °C	
	(100 to 400) °C	0.07 °C	
	(400 to 630) °C	0.23 °C	
	Pt Ni 385, 100 Ω		
(-80 to 100) °C	0.08 °C		
(100 to 260) °C	0.14 °C		
Cu 427, 10 Ω			
(-100 to 260) °C	0.3 °C		
Tesla Meter ¹ (Gauss Meter)	Up to 200 mT 200 mT to 1500 mT	5.1 % of reading + 0.35mT 5.1 % of reading + 12 mT	Reference Magnetic Field Block

Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
RF Power – Measure	0 dBm 50 MHz	0.027 dB	Power Meter, Coaxial Thermistor Mount
RF Absolute Power - Measure	(-20 to 30) dBm		Measuring Receiver with Power Sensor
	100 kHz to 2.6 GHz	0.058 dB	
	50 MHz to 1.3 GHz	0.077 dB	
	(1.3 to 18) GHz	0.082 dB	
(18 to 26.5) GHz	0.09 dB		
RF Absolute Power - Measure	(-70 to 20) dBm		Power Meter with Power Sensor
	(10 to 30) MHz	0.089 dB	
	30 MHz to 4 GHz	0.092 dB	
	(4 to 10) GHz	0.094 dB	
	(10 to 15) GHz	0.094 dB	
(15 to 18) GHz	0.096 dB		

Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Tuned RF Power – Measure 2.5 MHz to 26.5 MHz	(-22 to 10) dBm	0.15 dB	Measuring Receiver with Power Sensor
	(-42 to -22) dBm	0.15 dB	
	(-50 to -42) dBm	0.18 dB	
	(-60 to -50) dBm	0.19 dB	
	(-72 to -60) dBm	0.21 dB	
	(-80 to -72) dBm	0.23 dB	
	(-92 to -80) dBm	0.24 dB	
	(-102 to -92) dBm	0.26 dB	
	(-110 to -102) dBm	0.28 dB	
Distortion – Measure kHz to 26.5 GHz	(0.01 to 100) % Distortion	0.065 % Distortion	Measuring Receiver
	Distortion – Measure Fundamental Frequency 20 Hz to 20 kHz 20 to 100 kHz	(-99 to 0) dB	1.2 dB
(-99 to 0) dB		2.3 dB	
Amplitude Modulation – Measure	Depths: (5 to 99) % 150 kHz to 10 MHz	0.86 % Depth + 1 digit	Measuring Receiver with Power Sensor
	Depths: (5 to 20) % 10 MHz to 3 GHz	2.9 % Depth + 1 digit	
	Depths: (20 to 99) % 10 MHz to 3 GHz	0.69 % Depth + 1 digit	
	Depths: (5 to 20) % (3 to 26.5) GHz	5.2 % Depth + 1 digit	
	Depths: (20 to 99) % (3 to 26.5) GHz	1.7 % Depth + 1 digit	
	Depths: (5 to 20) % (26.5 to 31.15) GHz	7.8 % Depth + 1 digit	
	Depths: (20 to 99) % (26.5 to 31.15) GHz	2.2 % Depth + 1 digit	
Amplitude Modulation – Generate	10 kHz to 432 MHz Rate: DC to 100 kHz Dev.: ≤ 400 kHz peak	0.59 % Deviation	AM/FM Test Source
	10 kHz to 432 MHz Rate: 20 Hz to 200 kHz Dev.: ≤ 400 kHz peak	0.63 % Deviation	

Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Frequency Modulation – Generate	10 kHz to 432 MHz Rate: DC to 100 kHz Dev.: ≤ 400 kHz peak	0.59 % Deviation	AM/FM Test Source
	10 kHz to 432 MHz Rate: 20 Hz to 200 kHz Dev.: ≤ 400 kHz peak	0.63 % Deviation	
Frequency Modulation – Measure	250 kHz to 10 MHz Rate: 20 Hz to 10 kHz Dev.: ≤ 40 kHz peak	1.7 % of reading + 5.7 Hz 1.1 % of reading + 6.6 Hz	Measuring Receiver with Power Sensor
	10 MHz to 1.3 GHz Rate: 50 Hz to 100 kHz Dev.: ≤ 400 kHz peak	1.8 % of reading + 5.1 Hz 1.2 % of reading + 6.1 Hz	
	10 MHz to 1.3 GHz Rate: 20 Hz to 200 kHz Dev.: ≤ 400 kHz peak	2.9 % of reading + 4 Hz 1.2 % of reading + 6.4 Hz	
	(1.3 to 26.5) GHz Rate: 50 Hz to 100 kHz Dev.: ≤ 400 kHz peak	4.4 % of reading + 3.8Hz 1.2 % of reading + 7.6 Hz	
Frequency Modulation – Measure	(1.3 to 26.5) GHz Rate: 50 Hz to 100 kHz Dev.: ≤ 400 kHz peak	0.79 % Deviation + 1 digit	Measuring Receiver with Power Sensor

Length – Dimensional Metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Protractors	Up to 360°	0.13°	Angle Gauge Block Set, Granite Surface Plate
Calipers ^{1,2}	Up to 1 000 mm Up to 39.37 inch	0.017 mm + 0.51L	Gage Block Set
Micrometers ¹ External, Internal, Depth	Up to 25 mm Up to 1 000 mm	1.2 μm + 0.002 5 μm / mm	Optical Flat, Gage Block Set
Height Gages ¹	Up to 1 000 mm (Up to 24 inch)	0.005 mm	Gage Block Set
Steel Ruler ^{1,2}	Up to 5 000 mm	0.037L mm	Standard Steel Ruler & Scale Loupe

Length – Dimensional Metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Tape Ruler ^{1,2}	(0 to 1 000) mm (1 000 to 5 000) mm (5 000 to 10 000) mm (10 to 50 000) mm	0.039L mm	Tape and scale calibration unit
Laser Distance Meter	Up to 40 m	2.7 mm	Laser Distance Meter
Thickness Gages ¹	Up to 12 mm (Up to 0.4 inch)	0.002 mm	Gage Block Set
Feeler Gauge	Up to 1 mm (Up to 0.04 inch)	0.002 mm	Micrometer
Digimatic, Dial Indicators ¹	Up to 25 mm (Up to 1 inch)	0.003 mm	Dial Gage Tester
Dial Test Indicators ¹	Up to 1 mm (Up to 0.04 in)	0.001 mm	Calibration Tester
Pin Gages, Plug Gages ¹	Up to 100 mm (Up to 4 inch)	0.001 9 mm	Micrometer
Calibration tester Resolution: 1 μm 0.2 μm	(0 to 100) mm (0 to 5) mm	0.38 μm 0.25 μm	Gauge Block Set
Dial Bore Gages	Up to 50 mm (Up to 2 inch)	0.003 mm	Universal Length Measuring System
Ring Gauge	Up to 100 mm (Up to 4 inch)	0.82 μm	Universal Length Measuring System
Coordinate Measuring Machines (CMM) ^{1,2}	Axis X: 1000 mm Axis Y: 1000 mm Axis Z: 1000 mm	(0.23 + 0.035L) μm	Gauge Block Set, Caliper Checker
	Probe Performance	0.52 μm	Sphere
Surface Roughness Tester	2.97 μm Ra 3.17 μm Ra 9.40 μm Ry	0.06 μm	Standard Roughness Specimen
Roundness Testing Machines	Roundness (10, 100) mm	0.021 μm	Master Roundness Standard
Contour Measuring Machine ²	X axis: up to 100 mm Z axis: up to 30 mm	(0.53 + 0.002 3L) μm (1.4 + 0.008 4L) μm	Gauge Block Set Pin Gauge Set Master Ball
Measuring Microscopes / Profile Projectors	Up to 300 mm (Up to 12 inch)	0.004 mm	Standard Glass Scale.

Length – Dimensional Metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Length Counter ²	(0 to 30) km	0.38L mm/m	Digimatic Caliper Digital Tachometer
Levels	(0 to 30) °	0.015 °	Angle Reference Standards
Dimensional ² (length, hole)	Length: Up to 500 mm Hole: Up to 50 mm	1 μm + 1.7*L/10 ⁶ 0.18 μm + 1.2*L/10 ⁶	Coordinate Measuring Machine, Gauge Block Set
Surface Flatness – Local Area Flatness	Up to (1.8 X 3.6) m	41 μm	Repeat-o-Meter
Coating Thickness Meters ¹	Up to 3 000 μm Up to 25 mm	2 μm 13 μm	Coating Thickness Standards
Sieves	Up to 5 mm (5 to 125) mm	0.003 6 mm + 0.014 mm/mm 0.098 mm + 0.014 mm/mm	Profile Projector Digital Caliper
Needle Detector	(0.5 to 1.5) mm	0.017 mm	Ferrous and Non-Ferrous Dimensional Reference Standards

Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Torque Wrench ¹	(100 to 1 000) N·m	1.2 % of reading + 0.085 N·m	Torque Wrench Tester
Torque Tools ¹	(1 to 10) lbf.in (2 to 25) lbf.in (5 to 50) lbf.in (10 to 100) lbf.in (5 to 50) lbf.ft (25 to 250) lbf.ft	0.7 % of reading + 0.008 lbf.in 0.7 % of reading + 0.02 lbf.in 0.7 % of reading + 0.04 lbf.in 0.7 % of reading + 0.07 lbf.in 0.7 % of reading + 0.04 lbf.ft 0.7 % of reading + 0.19 lbf.ft	Torque Testers with Transducers
Torque Transducers ¹	(20 to 200) lbf.ft	0.01 % of reading + 0.001 lbf.ft	Arm & Standard Weight Set
Mass OIML E2	(1 to 500) g	0.01 mg + 0.002 mg / g	OIML111-1 Standard Weight Set E1 and OIML R76-1 for calibration of balance, scale
Mass OIML F1	(1 to 500) g	0.36 mg + 0.005 mg / g	
Mass OIML F2	1 mg to 500 g (1 to 20) kg	0.006 mg + 0.02 mg / g 0.2 g + 0.01 mg / g	OIML111-1 Standard Weight Set E1 and

Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Mass OIML M1	(1 to 20) kg	0.5 g + 0.04 mg / g	OIML R76-1 for calibration of balance, scale
Balances / Scales ^{1,3} Class I	(1 to 20) mg (20 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 150) g (150 to 200) g (200 to 300) g (300 to 500) g	0.004 8 mg 0.01 mg 0.000 021 g 0.000 027 g 0.000 038 g 0.00 0075 g 0.000 14 g 0.000 29 g 0.000 44 g 0.000 6 g 0.001 g	OIML111-1 Standard Weight Set E1 and OIML R76-1 for calibration of balance, scale
Balances / Scales ^{1,3} Class II	Up to 150 g (150 to 500) g (500 to 1 200) g (1 200 to 2 500) g (2 500 to 5 000) g (5 000 to 9 000) g	0.001 7 g 0.003 8 g 0.0013 g 0.02 g 0.036g 0.039 g	OIML111-1 Standard Weight Set E1 and OIML R76-1 for calibration of balance, scale
Balances / Scales ^{1,3} Class III	(0 to 500) g (0.5 to 6) kg (6 to 35) kg (35 to 60) kg (60 to 100) kg (100 to 300) kg (300 to 1 000) kg (1 000 to 2 000) kg (2 000 to 5 000) kg	0.018 g 0.17 g 5.4 g 0.013 kg 0.024 kg 0.048 kg 0.2 kg 0.46 kg 0.78 kg	OIML111-1 Standard Weight Set E1 and OIML R76-1 for calibration of balance, scale
Balances / Scales ^{1,2} Class IIII	(1 to 200) kg	0.6 R	
Compression & Tension Machines, Loadcell	Up to 500 kN Up to 20 kgf	0.05 kN + 0.01 kN/kN 0.03 kgf	Load cell & Indicator Standard Weight
Force Gages	Up to 5 kgf (5 to 20) kgf (20 to 100) kgf	0.006 5 kgf 0.001 7 kgf 0.025 kgf	Standard Weight Set
Pressure Gauge ¹	Up to -0.98 bar (0 to 70) bar (70 to 700) bar (700 to 1 000) bar	0.003 1 bar 0.041 bar 0.081 bar 0.38 bar	Digital Pressure Gauge

Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Air Velocity ¹	Up to 45 m/s	0.17 m/s + 0.004 4 m/s	Wind Tunnel and Standard Anemometer
Pneumatic Volume Flow Meters ¹	Up to 200 LPM	0.025 LPM + 0.011 LPM/LPM	Primary Air Flow Calibrator/ Mass Flow Meter
Hardness Testers ¹	Up to 63.2 HRC Up to 84.4 HRB	0.56 HRC 1.5 HRB	ASTM E18 Indirect Verification using Standard Block
Hardness Testers ¹	Up to 1 000 HV Up to 500 HMV	2.3 HV + 1.3% HV 2.3 HMV + 1.3% HMV	ASTM 92 Indirect Verification using Standard Block
Hardness Testers ¹	Up to 83.2 HRBS	1.5 HRBS	ASTM E18 Indirect Verification using Standard Block
Hardness Blocks	Up to 63.2 HRC Up to 84.4 HRB Up to 774 HV Up to 500 HMV Up to 83.2 HRBS	0.56 HRC 1.5 HRB 1.4HV 1.5HMV 1.5 HRBS	Hardness Tester w Hardness Blocks
Burette ¹	(1 to 100) ml	0.5 µl/ml + 10 µl	Analytical Scale, Standard Weight Set, Temperature Calibrator
Pipettes & Micropipettes	(1 to 100) ml	0.4 µl/ml + 6.6 µl	
Volumetric Flasks ¹	(10 to 2 000) ml	450 µl	
Grain Moisture Tester ¹	(6 to 40) %Moisture Content	0.8 %Moisture Content	Temperature & Humidity Chamber, Analytical Balance
Wood Moisture Tester ¹	Up to 30 %Moisture Content	0.8 %Moisture Content	Standard Decade Resistance Temperature & Humidity Chamber Analytical Balance
Hydrometer ¹	(0.65 to 1.5) g/ml	0.003 g/ml	Analytical Balance Standard Thermometer
Durometer – Shore A, B, C, D, D0, O Force Only	(0 to 100) duro	0.43 duro	Partial Direct Verification Rubber Hardness Tester Calibrator, Electronic Balance

Photometry and Radiometry

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
UV-VIS Spectrophotometers ¹	(200 to 650) nm (0 to 2) Au	0.5 nm 0.007 9 Au	Standard UV-VIS Spectrophotometer
Gloss Meter ¹	92.4 GU / 20° 94.8 GU / 60° 99.5 GU / 85°	0.7 GU 0.6 GU 0.6 GU	Standards High Gloss
Light Box ¹ Day Light D65 Day Light D50 CWF A TL84/U35	6 500 K 5 000 K 4 150 K 2 856 K 4 100 K	230 K 180 K 150 K 100 K 140 K	Chroma Meter
UV Meters Irradiance (200 to 400) nm	(0.01 to 100) mW/cm ²	3.3 % of reading	UV Calibration System
Color Meter, light source D65,A	Color Space CIE 1931: Tristimulus XYZ: X(13.77 to 94.28) Y(12.28 to 79.63) Z(2.22 to 65.37) Chromaticity Coordinate xy: x(0.1992 to 0.6309) y(0.2010 to 0.4792) UCS u'v': u'(0.1420 to 0.4376) v'(0.3608 to 0.5517) CIE L*u*v* L*(41.66 to 91.52) u*(-67.54 to 128.50) v*(-75.42 to 94.64) CEI L*a*b* L*(41.66 to 91.52) a*(-38.89 to 59.50) b*(-54.37 to 93.82)	0.34 0.002 5 0.002 6 0.48 0.43	Reference Color Standard, dimensionless quantity

Photometry and Radiometry

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Color Meter, light source D65,A	Color Space CIE 1964: Tristimulus:XYZ X(13.38 to 94.81) Y(12.45 to 77.41) Z(2.19 to 64.71)	0.32	Reference Color Standard, dimensionless quantity
	Chromaticity Coordinate x;y x(0.1961 to 0.5503) y(0.2210 to 0.4750)	0.002 5	
	UCS u'v' u'(0.1430 to 0.4247) v'(0.3781 to 0.5508)	0.002 6	
	CIE L*u*v* L*(41.92 to 90.51) u*(-66.67 to 116.48) v*(-67.28 to 89.12)	0.44	
	CEI L*a*b* L*(41.92 to 90.51) a*(-38.00 to 53.78) b*(-52.50 to 95.55)	0.42	

Thermodynamic

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Relative Humidity ¹	Up to 97 %RH	2.1 %RH	Temperature and Humidity Chamber, Temp. & Humidity Meter
Temperature – Source ¹	(-45 to 150) °C (150 to 1 200) °C (1 200 to 1 800) °C	0.06 °C 4.2 °C 6.5 °C	Temperature Block / Furnace Calibrator w Reference Thermometer Standard
Temperature – Measure ¹	(-80 to 400) °C (150 to 1 200) °C (1 200 to 1 800) °C	0.065 °C 4.2 °C 6.5 °C	Reference Thermometer, Temperature Bath
Thermocouples (All Type)	(-45 to 150) °C (150 to 600) °C	0.17 °C 0.27 °C	Reference Thermometer, Temperature Bath
Thermocouples (All Type)	(600 to 1 800) °C	3.6 °C	Type B TC with Ice Bath and Thermocouple Readout

Thermodynamic

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Infrared (IR) Thermometers ¹	(-15 to 120) °C (100 to 200) °C (200 to 350) °C (350 to 500) °C	0.61 °C 0.75 °C 1.3 °C 1.7 °C	Black Body Source (flat plate) $\lambda = 8$ to $14 \mu\text{m}$, $\epsilon = 0.95$
Temperature & Humidity Chambers ¹ Dry Oven, Furnace, Autoclave, Incubator, Vacuum Oven	(-80 to 400) °C (150 to 1 200) °C (1 200 to 1 800) °C (10 to 97) %RH	0.065 °C 4.2 °C 3.2 °C 2.1 %RH	Temperature Data Logger, Humidity Data Logger


Time and Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Stopwatches/Timers ¹	Up to 3 600 s	120 ms	Wave Form Generator, Frequency Counter
Frequency – Source ¹	1 μHz to 80 MHz 80 MHz to 26.5 GHz	5 pHz/Hz + floor needed 5 pHz/Hz	Wave Form Generator, Frequency Counter
Frequency – Measure ¹	100 μHz to 10 Hz 10 Hz to 3 GHz (3 to 12.4) GHz (12.4 to 26.5) GHz	5 pHz/Hz	Frequency Counter
Tachometers ¹	(1 to 100 000) rpm	0.01 % of reading	Signal Generator w 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. L = length in meters, l = length in millimeters, R = resolution of unit under test.
3. The CMC for scales and balances are highly dependent upon the resolution of the unit under test. The uncertainty 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.
4. This scope is formatted as part of a single document including Certificate of Accreditation No. AC-1868.



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