CERTIFICATE OF ACCREDITATION

The ANSI National Accreditation Board

Hereby attests that

American Calibration Inc.
204 Northwest Hwy
Fox River Grove, IL 60021

Fulfills the requirements of

ISO/IEC 17025:2017

and national standard

ANSI/NCSL Z540-1-1994 (R2002)

In the fields of

CALIBRATION and DIMENSIONAL MEASUREMENT

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.

Jason Stine, Vice President

Expiry Date: 06 August 2028
Certificate Number: ACT-1886

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)

American Calibration Inc.
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Fox River Grove, IL 60021
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CALIBRATION AND DIMENSIONAL MEASUREMENT

ISO/IEC 17025 Accreditation Granted: **06 August 2026**

Certificate Number: **ACT-1886** Certificate Expiry Date: **06 August 2028**

CALIBRATION

Acoustics and Vibration

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Accelerometer [1] Voltage Sensitivity – Frequency Response (100 mV/g) (Up to 800 g payload)	7 Hz to 10 Hz 7 Hz to 30 Hz (30 to 2000) Hz (2 to 10) kHz	7.44 % of reading 5 % of reading 6.09 % of reading 7.21 % of reading	Accelerometer Calibrator, Reference Accelerometer Utilizing Back-to-Back Method
Sound Level Meters [1]	1 kHz 94 dB 114 dB	 0.76 dB 0.76 dB	Comparison to Acoustic Calibrator

Chemical Quantities

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
pH Meters [1,7]	4 pH 7 pH 10 pH 12 pH	0.017 pH 0.023 pH 0.052 pH 0.045 pH	Comparison to Accredited pH Solutions

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Chemical Quantities

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Conductivity Meters [1,7]	10 µS/cm 100 µS/cm 1 000 µS/cm 1 400 µS/cm 10 000 µS/cm 100 mS/cm	0.65 µS/cm 2.9 µS/cm 20 µS/cm 28 µS/cm 0.19 mS/cm 1.8 mS/cm	Comparison to Accredited Conductivity Solutions
Refractometers [1,7]	(10 to 60) ºBx	0.94 °Bx	Comparison to Reference Sucrose Solutions
Viscosity [1,7]	500 cP	39 cP	Comparison to Reference Viscosity Solution
Carbon Dioxide (CO_2) Analyzers [1,7] CO_2 Concentration in Gas	0 % CO_2 5 % CO_2 20 % CO_2	0.26 % CO_2 0.17 % CO_2 0.59 % CO_2	Comparison to Vaisala GMP221 CO_2 Sensor

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
DC Current – Measure [1]	(0 to 10) µA (10 to 100) µA (0.1 to 1) mA (1 to 10) mA (10 to 100) mA (0.1 to 1) A (1 to 10) A (10 to 30) A	26 pA/µA + 0.42 nA 10 pA/µA + 0.41 nA 9.5 nA/mA + 4.3 nA 14 nA/mA + 42 nA 57 nA/mA + 1 µA 0.13 mA/A + 0.1 mA 0.24 mA/A + 0.41 mA 0.55 mA/A + 4.4 mA	Comparison to Fluke 8588A Reference Multimeter
DC Current – Source [1]	(0 to 220) µA (0.22 to 2.2) mA (2.2 to 22) mA (22 to 220) mA (0.22 to 2.2) A	55 pA/µA + 6 nA 38 nA/mA + 7 nA 41 nA/mA + 40 nA 57 nA/mA + 0.7 µA 0.1 mA/A + 12 µA	Comparison to Fluke 5730A Multiproduct Calibrator

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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
DC Current – Source [1,2]	(0 to 120) µA (0.12 to 1.2) mA (1.2 to 12) mA (12 to 120) mA (0.12 to 1.2) A (1.2 to 3.1) A (3.1 to 12) A (12 to 30.2) A	98 pA/µA + 5 nA 83 nA/mA + 12 nA 80 nA/mA + 63 nA 79 nA/mA + 0.63 µA 0.12 mA/A + 8 µA 0.23 mA/A + 12 µA 0.23 mA/A + 0.2 mA 0.8 mA/A + 0.39 mA	Comparison to Fluke 5560A Multiproduct Calibrator
DC Clamp-on Meters [1]	(12 to 1 000) A	24.5 mA/A + 0.5 A	Comparison to Fluke 5502A Multiproduct Calibrator, 50-turn Coil
AC Current – Measure [1]	Up to 1 A (3 to 5) Hz (5 to 10) Hz 10 Hz to 5 kHz (1 to 3) A (3 to 5) Hz (5 to 10) Hz 10 Hz to 5 kHz	 12 mA 40 mA 1.8 mA 40 mA 14 mA 8.5 mA	Comparison to Keysight 34401A 6.5 Digit Multimeter
AC Current – Measure [1]	(3 to 5) A (20 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz	 17.3 mA/A + 2.8 mA 9.3 mA/A + 3 mA 4.9 mA/A + 6.6 mA	Comparison to Fluke 289 Digital Multimeter
AC Current – Measure [1]	(5 to 10) A (20 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz	 17.3 mA/A + 6.3 mA 9.3 mA/A + 6.6 mA 4.9 mA/A + 12 mA	Comparison to Fluke 289 Digital Multimeter
Magnetic Inspection Unit [1] AC Current – Measure	(500 to 10 000) A	15 A/kA + 13 A	Comparison to Ammeter, Current Shunt
AC Current – Source [1]	(9 to 220) µA (10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	 0.28 nA/µA + 16 nA 0.19 nA/µA + 10 nA 0.11 nA/µA + 8 nA 0.35 nA/µA + 12 nA 1.2 nA/µA + 65 nA	Comparison to Fluke 5730A Multiproduct Calibrator

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Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current – Source [1]	(0.22 to 2.2) mA		Comparison to Fluke 5730A Multiproduct Calibrator
	(10 to 20) Hz	0.29 µA/mA + 40 nA	
	(20 to 40) Hz	0.19 µA/mA + 35 nA	
	40 Hz to 1 kHz	0.12 µA/mA + 35 nA	
	(1 to 5) kHz	0.25 µA/mA + 0.11 µA	
	(5 to 10) kHz	1.3 µA/mA + 0.65 µA	
	(2.2 to 22) mA		
	(10 to 20) Hz	0.29 µA/mA + 0.4 µA	
	(20 to 40) Hz	0.19 µA/mA + 0.35 µA	
	40 Hz to 1 kHz	0.12 µA/mA + 0.35 µA	
	(1 to 5) kHz	0.25 µA/mA + 0.55 µA	
	(5 to 10) kHz	1.3 µA/mA + 5 µA	
	(22 to 220) mA		
	(10 to 20) Hz	0.29 µA/mA + 4 µA	
	(20 to 40) Hz	0.16 µA/mA + 3.5 µA	
	40 Hz to 1 kHz	0.13 µA/mA + 2.5 µA	
	(1 to 5) kHz	0.24 µA/mA + 3.5 µA	
	(5 to 10) kHz	1.3 µA/mA + 10 µA	
	(0.22 to 2.2) A		
	(20 to 1 000) Hz	0.32 mA/A + 35 µA	
	(1 to 5) kHz	0.55 mA/A + 80 µA	
	(5 to 10) kHz	7.9 mA/A + 0.16 mA	
AC Current – Source [1,2]	Up to 120 µA		Comparison to Fluke 5560A Multiproduct Calibrator
	(3 to 45) Hz	0.2 nA/µA + 8 nA	
	45 Hz to 1 kHz	0.2 nA/µA + 8 nA	
	(1 to 5) kHz	0.2 nA/µA + 8 nA	
	(5 to 10) kHz	1.3 nA/µA + 31 nA	
	(10 to 30) kHz	4 nA/µA + 1 µA	
	(0.12 to 1.2) mA		
	(3 to 45) Hz	0.2 µA/mA + 0.1 µA	
	45 Hz to 1 kHz	0.2 µA/mA + 0.1 µA	
	(1 to 5) kHz	0.2 µA/mA + 0.1 µA	
	(5 to 10) kHz	1.3 µA/mA + 0.1 µA	
	(10 to 30) kHz	4 µA/mA + 4 µA	
	(1.2 to 12) mA		
	(3 to 45) Hz	0.2 µA/mA + 0.8 µA	
	45 Hz to 1 kHz	0.2 µA/mA + 0.8 µA	
	(1 to 5) kHz	0.2 µA/mA + 1 µA	
	(5 to 10) kHz	1.3 µA/mA + 1 µA	
	(10 to 30) kHz	4 µA/mA + 8 µA	

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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current – Source [1,2]	(12 to 120) mA (3 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (10 to 30) kHz (0.12 to 1.2) A (3 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (10 to 30) kHz (1.2 to 3.1) A (3 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (3.1 to 12) A (3 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (12 to 30.2) A (3 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz	 0.2 µA/mA + 8 µA 0.2 µA/mA + 4 µA 0.2 µA/mA + 7 µA 1.3 µA/mA + 8 µA 4 µA/mA + 78 µA 0.19 mA/A + 78 µA 0.19 mA/A + 39 µA 0.19 mA/A + 63 µA 1.9 mA/A + 0.24 mA 3.9 mA/A + 0.24 mA 0.3 mA/A + 0.38 mA 0.3 mA/A + 0.24 mA 0.3 mA/A + 0.24 mA 2 mA/A + 0.38 mA 0.3 mA/A + 0.78 mA 0.3 mA/A + 0.38 mA 0.3 mA/A + 0.62 mA 2 mA/A + 0.78 mA 0.8 mA/A + 7.8 mA 0.6 mA/A + 6.2 mA 4 mA/A + 6.2 mA	Comparison to Fluke 5560A Multiproduct Calibrator
AC Clamp-on Meters [1]	60 Hz (12 to 1 000) A	6.1 mA/A + 0.52 A	Comparison to Fluke 5502A Multiproduct Calibrator, 50-turn Coil
Resistance – Source [1] (Fixed Artifacts)	0.1 mΩ 1 mΩ 10 mΩ 100 mΩ	58 nΩ 0.58 µΩ 5.8 µΩ 58 µΩ	Comparison to Precision Resistance Standard

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Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Resistance – Source [1] (Fixed Artifacts)	500 kΩ 1 MΩ 5 MΩ 10 MΩ 25 MΩ 50 MΩ 100 MΩ 500 MΩ 1 GΩ 2 GΩ 50 GΩ 100 GΩ 200 GΩ	5.8 kΩ 12 kΩ 58 kΩ 0.12 MΩ 0.29 MΩ 0.58 MΩ 1.2 MΩ 5.8 MΩ 12 MΩ 25 MΩ 0.58 GΩ 1.2 GΩ 2.3 GΩ	Comparison to Resistance Test Box
Resistance – Source [1] (Fixed Artifacts)	1 Ω 1.9 Ω 10 Ω 19 Ω 100 Ω 190 Ω 1 kΩ 1.9 kΩ 10 kΩ 19 kΩ 100 kΩ 190 kΩ 1 MΩ 1.9 MΩ 10 MΩ 19 MΩ 100 MΩ	0.11 mΩ 0.11 mΩ 28 µΩ 29 µΩ 12 µΩ 12 µΩ 7.7 mΩ 7.9 mΩ 7.7 mΩ 7.9 mΩ 10 mΩ 10 mΩ 16 Ω 22 Ω 47 Ω 68 Ω 0.15 kΩ	Comparison to Fluke 5730A Multiproduct Calibrator
Resistance – Source [1,2] (Simulation)	(0 to 12) Ω (12 to 120) Ω (0.12 to 1.2) kΩ (1.2 to 12) kΩ (12 to 120) kΩ (0.12 to 1.2) MΩ (1.2 to 12) MΩ (12 to 120) MΩ (120 to 1 200) MΩ	21 µΩ/Ω + 0.8 mΩ 20 µΩ/Ω + 0.8 mΩ 20 mΩ/kΩ + 1.6 mΩ 20 mΩ/kΩ + 16 mΩ 20 mΩ/kΩ + 0.16 Ω 20 Ω/MΩ + 10 mΩ 28 Ω/MΩ + 30 mΩ 0.33 kΩ/MΩ + 2 kΩ 3.2 Ω/MΩ + 78 kΩ	Comparison to Fluke 5560A Multiproduct Calibrator

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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Resistance – Measure [1]	(0 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 100 MΩ to 1 GΩ	17 μΩ/Ω + 4 μΩ 11 μΩ/Ω + 14 μΩ 9.2 μΩ/Ω + 54 μΩ 9.2 μΩ/Ω + 0.49 mΩ 9.3 μΩ/Ω + 4.9 mΩ 9.5 μΩ/Ω + 49 mΩ 11 μΩ/Ω + 0.92 Ω 20 μΩ/Ω + 99 Ω 0.12 mΩ/Ω + 10 kΩ 1.3 mΩ/Ω + 1 MΩ	Comparison to Fluke 8588A Reference Multimeter
Electrical Simulation of RTD Indicating Devices – Source [1,2]	Pt 385, 100 Ω (-200 to -80) ºC (-80 to 0) °C (0 to 100) °C (100 to 300) °C (300 to 400) °C (400 to 630) °C (630 to 800) °C Pt 3926, 100 Ω (-200 to -80) ºC (-80 to 0) °C (0 to 100) °C (100 to 300) °C (200 to 400) °C (400 to 630) °C Pt 3916, 100 Ω (-200 to -190) ºC (-190 to -80) °C (-80 to 0) °C (0 to 100) °C (100 to 300) °C (300 to 400) °C (400 to 600) °C (600 to 630) °C	 0.013 ºC 0.02 ºC 0.02 ºC 0.024 ºC 0.026 ºC 0.033 ºC 0.038 ºC 0.013 ºC 0.015 ºC 0.017 ºC 0.022 ºC 0.026 ºC 0.032 ºC 0.01 ºC 0.013 ºC 0.015 ºC 0.017 ºC 0.022 ºC 0.026 ºC 0.031 ºC 0.033 ºC	Comparison to Fluke 7526A Precision Process Calibrator

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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Electrical Simulation of RTD Indicating Devices – Source [1,2]	Pt 385, 200 Ω (-200 to -80) ºC (-80 to 0) °C (0 to 100) °C (100 to 260) °C (260 to 300) °C (300 to 400) °C (400 to 630) °C Pt 385, 500 Ω (-200 to 0) ºC (0 to 100) °C (100 to 300) °C (300 to 400) °C (400 to 630) °C Pt 385, 1 000 Ω (-200 to 0) ºC (0 to 100) °C (100 to 300) °C (300 to 400) °C (400 to 630) °C Ni 120, 120 Ω (-80 to 260) ºC Cu 427, 10 Ω (-100 to 260) ºC	 0.053 ºC 0.056 ºC 0.06 ºC 0.06 ºC 0.069 ºC 0.071 ºC 0.088 ºC 0.025 ºC 0.028 ºC 0.034 °C 0.038 ºC 0.045 ºC 0.015 ºC 0.018 °C 0.024 ºC 0.026 ºC 0.033 ºC 0.009 ºC 0.11 ºC	Comparison to Fluke 7526A Precision Process Calibrator
Capacitance – Measure [1]	(1 to 5) nF (5 to 50) nF (50 to 500) nF 500 nF to 5 µF	0.1 nF 1 nF 10 nF 0.15 nF	Comparison to Fluke 87 Digital Multimeter
Capacitance – Measure [1] (1 kHz)	100 pF to 1µF	5.65 pF/nF + 1.2 nF	Comparison to B&K Precision 885 LCR/ESR Meter
Capacitance – Measure [1] (50, 60) Hz	Up to 2 nF (1.8 to 20) nF (18 to 200) nF (0.18 to 2) µF (1.8 to 20) µF (18 to 200) µF (0.18 to 2) mF (1.8 to 20) mF (18 to 200) mF	0.094 % of reading + 1.2 pF 0.075 % of reading + 1.8 pF 0.044 % of reading + 10 pF 0.02 % of reading + 60 pF 0.045 % of reading + 1.2 nF 0.049 % of reading + 2.6 nF 0.064 % of reading + 0.11 µF 0.074 % of reading + 1.1 µF 0.07 % of reading + 1.1 µF	Comparison to Fluke 8588A Reference Multimeter

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Capacitance – Source [1,2] (Simulation)	Up to 1.2 nF (1.2 to 12) nF (12 to 120) nF (0.12 to 1.2) µF (1.2 to 12) µF (12 to 120) µF (0.12 to 1.2) mF (1.2 to 12) mF (12 to 120) mF	0.09 % of reading + 2 pF 0.09 % of reading + 4 pF 0.1 % of reading + 24 pF 0.1 % of reading + 0.23 nF 0.1 % of reading + 2.3 nF 0.12 % of reading + 19.4 nF 0.2 % of reading + 0.19 µF 0.2 % of reading + 2.3 µF 0.39 % of reading + 23.3 µF	Comparison to Fluke 5560A Multiproduct Calibrator
Inductance – Source [1] (Variable Artifact)	(1 to 10) mH (10 to 100) mH 100 mH to 1 H (1 to 10) H	23 µH/mH 12 µH/mH 8.7 µH/mH 9 mH/H	Comparison to Decade Inductor
Inductance – Source [1,2] (Artifacts)	1 kHz Up to 120 µH (0.12 to 1.2) mH 110 Hz (1.2 to 12) mH 100 Hz (12 to 120) mH 10 Hz (0.12 to 1.2) H 3 Hz (1.2 to 12) H 2 Hz (12 to 120) H	 0.16 % of reading + 0.16 µH 0.09 % of reading + 0.78 µH 0.09 % of reading + 7.8 µH 0.09 % of reading + 78 µH 0.12 % of reading + 0.78 mH 0.16 % of reading + 7.8 mH 0.19 % of reading + 78 mH	Comparison to Fluke 5560A Multiproduct Calibrator
Inductance – Measure (1 kHz)	100 µH to 1 H	2.7 µH/mH + 1.2 mH	Comparison to B&K Precision 885 LCR/ESR Meter
DC Voltage – Source [1]	(0 to 220) mV (0.22 to 2.2) V (2.2 to 11) V (11 to 22) V (22 to 220) V (220 to 1 100) V	7.5 nV/mV + 0.4 µV 5.5 µV/V + 0.7 µV 3.6 µV/V + 2.5 µV 3.6 µV/V + 4 µV 5.6 µV/V + 40 µV 7.7 µV/V + 0.4 mV	Comparison to Fluke 5730A Multiproduct Calibrator
DC Voltage – Source [1,2]	(0 to 120) mV (0.12 to 1.2) V (1.2 to 12) V (12 to 120) V (120 to 1 020) V	9.5 nV/mV + 0.62 µV 6.5 µV/V + 0.78 µV 6.3 µV/V + 7.8 µV 8.8 µV/V + 78 µV 8.7 µV/V + 0.78 mV	Comparison to Fluke 5560A Multiproduct Calibrator

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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
DC Voltage – Measure [1]	(0 to 100) mV (0.1 to 1) V (1 to 10) V (10 to 100) V (100 to 1 000) V	8 µV/V + 0.21 µV 3 µV/V + 0.4 µV 3 µV/V + 0.7 µV 4.4 µV/V + 29 µV 4.7 µV/V + 0.48 mV	Comparison to Fluke 8588A Reference Multimeter
DC High Voltage – Measure [1]	100 V to 10 kV (10 to 35) kV (35 to 90) kV	0.036 % of reading + 40 mV 0.041 % of reading + 0.91 V 0.064 % of reading + 1 V	Comparison to Vitrek 4700 Precision High Voltage Meter
AC Voltage – Source [1]	(0.22 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 (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	 0.8 µV/mV + 4 µV 0.8 µV/mV + 4 µV 0.75 µV/mV + 4 µV 0.8 µV/mV + 4 µV 1 µV/mV + 5 µV 0.7 µV/mV + 10 µV 3.1 µV/mV + 20 µV 4.3 µV/mV + 20 µV 0.29 µV/mV + 4 µV 0.13 nV/mV + 4 µV 0.12 nV/mV + 4 µV 0.25 µV/mV + 4 µV 0.6 µV/mV + 5 µV 1.2 µV/mV + 10 µV 1.7 µV/mV + 20 µV 3.3 µV/mV + 20 µV 0.75 µV/mV + 7 µV 0.11 µV/mV + 7 µV 0.07 µV/mV + 7 µV 0.14 µV/mV + 7 µV 0.36 µV/mV + 17 µV 0.75 µV/mV + 20 µV 1.5 µV/mV + 25 µV 3.3 µV/mV + 45 µV	Comparison to Fluke 5730A Multiproduct Calibrator

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Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Source [1]	(0.22 to 2.2) V		Comparison to Fluke 5730A Multiproduct Calibrator
	(10 to 20) Hz	0.12 mV/V + 15 µV	
	(20 to 40) Hz	0.11 mV/V + 15 µV	
	40 Hz to 20 kHz	61 µV/V + 8 µV	
	(20 to 50) kHz	88 µV/V + 10 µV	
	(50 to 100) kHz	0.14 mV /V + 30 µV	
	(100 to 300) kHz	0.55 mV/V + 80 µV	
	(300 to 500) kHz	2.5 mV/V + 0.2 mV	
	500 kHz to 1 MHz	3.2 mV/V + 0.3 mV	
	(2.2 to 22) V		
	(10 to 20) Hz	0.28 mV/V + 0.4 mV	
	(20 to 40) Hz	0.11 mV /V + 0.15 mV	
	40 Hz to 20 kHz	57 µV/V + 50 µV	
	(20 to 50) kHz	84 µV/V + 0.1 mV	
	(50 to 100) kHz	0.54 mV/V + 0.2 mV	
	(100 to 300) kHz	0.62 mV/V + 0.6 mV	
	(300 to 500) kHz	2.4 mV/V + 2 mV	
	500 kHz to 1 MHz	3.2 mV/V + 3.2 mV	
	(22 to 220) V		
	(10 to 20) Hz	0.28 mV/V + 4 mV	
	(20 to 40) Hz	0.11 mV/V = 1.5 mV	
	40 Hz to 20 kHz	82 µV/V + 0.6 mV	
	(20 to 50) kHz	0.3 mV/V + 1 mV	
	(50 to 100) kHz	0.19 mV/V + 2.5 mV	
	(220 to 1 100) V		
	(15 to 50) Hz	0.38 mV/V + 16 mV	
	50 Hz to 1 kHz	0.13 mV/V + 3.5 mV	
AC Voltage – Source [1,2]	(1 to 12) mV		Comparison to Fluke 5560A Multiproduct Calibrator
	(3 to 5) Hz	2 µV/mV + 6 µV	
	(5 to 10) Hz	0.7 µV/mV + 6 µV	
	10 Hz to 20 kHz	0.13 µV/mV + 5 µV	
	(20 to 50) kHz	0.3 µV/mV + 5 µV	
	(50 to 100) kHz	1.3 µV/mV + 12 µV	
	(100 to 300) kHz	6.3 µV/mV + 24 µV	
	(300 to 500) kHz	6.3 µV/mV + 24 µV	

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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Source [1,2]	(12 to 120) mV		Comparison to Fluke 5560A Multiproduct Calibrator
	(3 to 5) Hz	2 µV/V + 6 µV	
	(5 to 10) Hz	0.73 µV/mV + 6 µV	
	10 Hz to 20 kHz	0.12 µV/V + 5 µV	
	(20 to 50) kHz	0.27 µV/V + 7 µV	
	(50 to 100) kHz	0.64 µV/V + 16 µV	
	(100 to 300) kHz	1.6 µV/V + 24 µV	
	(300 to 500) kHz	1.6 µV/mV + 24 µV	
	(0.12 to 1.2) V		
	(3 to 5) Hz	2.1 mV/V + 59 µV	
	(5 to 10) Hz	0.71 mV/V + 55 µV	
	(10 to 40) Hz	0.12 mV/V + 47 µV	
	40.01 Hz to 20 kHz	0.12 mV/V + 6.2 µV	
	(20 to 50) kHz	0.24 mV/V + 11 µV	
	(50 to 100) kHz	0.55 mV/V + 31 µV	
	(100 to 300) kHz	1.6 mV/V + 63 µV	
	(300 to 500) kHz	1.5 mV/V + 63 µV	
	(1.2 to 12) V		
	(3 to 5) Hz	2 mV/V + 0.6 mV	
	(5 to 10) Hz	0.7 mV/V + 0.6 mV	
	(10 to 40) Hz	0.12 mV/V + 0.3 mV	
	40.01 Hz to 20 kHz	0.12 mV/V + 40 µV	
	(20 to 50) kHz	0.24 mV/V + 40 µV	
	(50 to 100) kHz	0.56 mV/V + 0.1 mV	
	(100 to 300) kHz	1.7 mV/V + 0.5 mV	
	(300 to 500) kHz	1.7 mV/V + 0.5 mV	
	(12 to 120) V		
	(3 to 5) Hz	2 mV/V + 5.9 mV	
	(5 to 10) Hz	0.7 mV/V + 5.9 mV	
	(10 to 40) Hz	0.12 mV/V + 2.8 mV	
	40.01 Hz to 20 kHz	0.12 mV/V + 0.4 mV	
	(20 to 50) kHz	0.24 mV/V + 0.4 mV	
	(50 to 100) kHz	0.57 mV/V + 1 mV	
	(120 to 300) V		
	(3 to 5) Hz	2 mV/V + 59 mV	
	(5 to 10) Hz	0.7 mV/V + 59 mV	
	10 Hz to 20 kHz	0.12 mV/V + 6.2 mV	
	(20 to 50) kHz	0.24 mV/V + 6.2 mV	
	(50 to 100) kHz	1.3 mV/V + 9.7 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 [1,2]	(300 to 1 020) V (3 to 5) Hz (5 to 10) Hz 10 Hz to 10 kHz	 2 mV/V + 59 mV 0.7 mV/V + 59 mV 0.12 mV/V + 63 mV	Comparison to Fluke 5560A Multiproduct Calibrator
AC Voltage – Measure [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 (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 (22 to 70) mV (10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz	 1.3 mV/V + 1 µV 0.6 mV/V + 1 µV 0.38 mV/V + 1 µV 0.66 mV/V + 1.6 µV 0.94 mV/V + 1.9 µV 1.8 mV/V + 3.1 µV 2 mV/V + 6.2 µV 4 mV/V + 6.2 µV 0.66 mV/V + 1 µV 0.31 mV/V + 1 µV 0.19 mV/V + 1 µV 0.33 mV/V + 1.6 µV 0.48 mV/V + 1.9 µV 0.97 mV/V + 3.1 µV 1.1 mV/V + 6.2 µV 2.8 mV/V + 6.2 µV 0.9 mV/V + 1 µV 0.38 mV/V + 1 µV 0.22 mV/V + 1 µV 0.21 mV/V + 1.6 µV 0.28 mV/V + 1.9 µV 0.73 mV/V + 3.1 µV 0.85 mV/V + 6.2 µV 2.1 mV/V + 6.2 µV 0.47 mV/V + 1.2 µV 0.45 mV/V + 1.2 µV 0.28 mV/V + 1.2 µV 0.18 mV/V + 1.6 µV 0.26 mV/V + 1.9 µV 0.56 mV/V + 3.1 µV 0.77 mV/V + 6.2 µV 1.1 mV/V + 6.2 µV	Comparison to Fluke 5790A AC Measurement Standard

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Electrical – DC/Low Frequency

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AC Voltage – Measure [1]	(70 to 220) mV		Comparison to Fluke 5790A AC Measurement Standard
	(10 to 20) Hz	0.96 mV/V + 1.2 µV	
	(20 to 40) Hz	0.59 mV/V + 1.2 µV	
	40 Hz to 20 kHz	0.26 mV/V + 1.2 µV	
	(20 to 50) kHz	0.31 mV/V + 1.6 µV	
	(50 to 100) kHz	0.44 mV/V + 1.9 µV	
	(100 to 300) kHz	0.59 mV/V + 3.1 µV	
	(300 to 500) kHz	1.1 mV/V + 6.2 µV	
	500 kHz to 1 MHz	1.9 mV/V + 6.2 µV	
	(220 to 700) mV		
	(10 to 20) Hz	2.4 mV/V + 1.2 µV	
	(20 to 40) Hz	2.2 mV/V + 1.2 µV	
	40 Hz to 20 kHz	1.1 mV/V + 1.2 µV	
	(20 to 50) kHz	1.5 mV/V + 1.6 µV	
	(50 to 100) kHz	0.82 mV/V + 1.9 µV	
	(100 to 300) kHz	2.4 mV/V + 3.1 µV	
	(300 to 500) kHz	1.2 mV/V + 6.2 µV	
	500 kHz to 1 MHz	1.9 mV/V + 6.2 µV	
	(0.7 to 2.2) V		
	(10 to 20) Hz	0.15 mV/V	
	(20 to 40) Hz	53 µV/V	
	40 Hz to 20 kHz	23 µV/V	
	(20 to 50) kHz	40 µV/V	
	(50 to 100) kHz	60 µV/V	
	(100 to 300) kHz	0.15 mV/V	
	(300 to 500) kHz	0.24 mV/V	
	500 kHz to 1 MHz	0.94 mV/V	
	(2.2 to 7) V		
	(10 to 20) Hz	60 µV/V	
	(20 to 40) Hz	55 µV/V	
	40 Hz to 20 kHz	26 µV/V	
	(20 to 50) kHz	42 µV/V	
	(50 to 100) kHz	69 µV/V	
	(100 to 300) kHz	0.17 mV/V	
	(300 to 500) kHz	0.36 mV/V	
	500 kHz to 1 MHz	1.2 mV/V	

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Electrical – DC/Low Frequency

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AC Voltage – Measure [1]	(7 to 22) V		Comparison to Fluke 5790A AC Measurement Standard
	(10 to 20) Hz	0.29 mV/V	
	(20 to 40) Hz	65 µV/V	
	40 Hz to 20 kHz	45 µV/V	
	(20 to 50) kHz	44 µV/V	
	(50 to 100) kHz	68 µV/V	
	(100 to 300) kHz	0.17 mV/V	
	(300 to 500) kHz	0.36 mV/V	
	500 kHz to 1 MHz	1.2 mV/V	
	(22 to 70) V		
	(10 to 20) Hz	0.64 mV/V	
	(20 to 40) Hz	0.27 mV/V	
	40 Hz to 20 kHz	62 µV/V	
	(20 to 50) kHz	0.14 mV/V	
	(50 to 100) kHz	0.19 mV/V	
	(100 to 300) kHz	0.45 mV/V	
	(300 to 500) kHz	0.5 mV/V	
	500 kHz to 1 MHz	1.2 mV/V	
	(70 to 220) V		
	(10 to 20) Hz	3.3 mV/V	
	(20 to 40) Hz	0.2 mV/V	
	40 Hz to 20 kHz	0.15 mV/V	
	(20 to 50) kHz	0.23 mV/V	
	(50 to 100) kHz	0.39 mV/V	
	(100 to 300) kHz	0.31 mV/V	
	(300 to 500) kHz	0.56 mV/V	
	(220 to 700) V		
	(10 to 20) Hz	0.95 mV/V	
	(20 to 40) Hz	0.79 mV/V	
	40 Hz to 20 kHz	0.9 mV/V	
	(20 to 50) kHz	6.1 mV/V	
	(50 to 100) kHz	6.6 mV/V	
	(700 to 1 000) V		
	(10 to 20) Hz	0.32 mV/V	
	(20 to 40) Hz	1.1 mV/V	
	40 Hz to 20 kHz	1.3 mV/V	
	(20 to 50) kHz	1.5 mV/V	
	(50 to 100) kHz	6.6 mV/V	

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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] (relative to 1 kHz)	Up to 2.2 mV		Comparison to Fluke 5790A AC Measurement Standard with Wideband Option
	500 kHz to 1.2 MHz	0.08 % of reading + 1 µV	
	(1.2 to 2) MHz	0.08 % of reading + 1 µV	
	(2 to 10) MHz	0.16 % of reading + 1 µV	
	(10 to 20) MHz	0.27 % of reading + 1 µV	
	(20 to 30) MHz	0.62 % of reading + 1.6 µV	
	(2.2 to 7) mV		
	500 kHz to 1.2 MHz	0.11 % of reading + 1 µV	
	(1.2 to 2) MHz	0.14 % of reading + 1 µV	
	(2 to 10) MHz	0.16 % of reading + 1 µV	
	(10 to 20) MHz	0.18 % of reading + 1 µV	
	(20 to 30) MHz	0.62 % of reading + 1 µV	
	(7 to 22) mV		
	500 kHz to 1.2 MHz	0.22 % of reading	
	(1.2 to 2) MHz	0.18 % of reading	
	(2 to 10) MHz	0.24 % of reading	
	(10 to 20) MHz	0.52 % of reading	
	(20 to 30) MHz	0.74 % of reading	
	(22 to 70) mV		
	500 kHz to 1.2 MHz	0.22 % of reading	
	(1.2 to 2) MHz	0.23 % of reading	
	(2 to 10) MHz	0.39 % of reading	
	(10 to 20) MHz	0.7 % of reading	
	(20 to 30) MHz	0.7 % of reading	
	(70 to 220) mV		
	500 kHz to 1.2 MHz	0.32 % of reading	
	(1.2 to 2) MHz	0.34 % of reading	
	(2 to 10) MHz	0.49 % of reading	
	(10 to 20) MHz	0.62 % of reading	
	(20 to 30) MHz	0.84 % of reading	
	(220 to 700) mV		
	500 kHz to 1.2 MHz	0.31 % of reading	
	(1.2 to 2) MHz	0.28 % of reading	
	(2 to 10) MHz	0.43 % of reading	
	(10 to 20) MHz	0.47 % of reading	
	(20 to 30) MHz	0.65 % of reading	

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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] (relative to 1 kHz)	(0.7 to 2.2) V 500 kHz to 1.2 MHz (1.2 to 2) MHz (2 to 10) MHz (10 to 20) MHz (20 to 30) MHz (2.2 to 7) V 500 kHz to 1.2 MHz (1.2 to 2) MHz (2 to 10) MHz (10 to 20) MHz (20 to 30) MHz	 0.07 % of reading 0.13 % of reading 0.2 % of reading 0.25 % of reading 0.42 % of reading 0.05 % of reading 0.05 % of reading 0.11 % of reading 0.16 % of reading 0.36 % of reading	Comparison to Fluke 5790A AC Measurement Standard with Wideband Option
AC High Voltage – Measure [1]	60 Hz 10 V to 10 kV (10 to 35) kV (35 to 70) kV	 0.14 % of reading + 0.12 V 0.12 % of reading + 0.84 V 0.14 % of reading + 1.4 V	Comparison to Vitrek 4700 Precision High Voltage Meter
Phase – Measure [1]	Up to 360 ° 5 Hz to 2 kHz (2 to 5) kHz (5 to 10) kHz (10 to 50) kHz 50 kHz to 1 MHz	 0.026 ° 0.037 ° 0.051 ° 0.062 ° 0.24 °	Comparison to Clarke-Hess 6000A Precision Phase Meter
Phase – Source [1,2]	(0 to 360)° (3 to 65) Hz (1 to 360)° (65 to 500) Hz (2 to 360)° 500 Hz to 1 kHz (3 to 360)° (1 to 5) kHz (4 to 360)° (5 to 10) kHz (5 to 360)° (10 to 30) kHz	 0.1° 0.2° 0.4° 1.9° 3.9° 7.8°	Comparison to Fluke 5560A Multiproduct Calibrator

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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Electrical Simulation of Thermocouple Indicators – Source/Measure [1]	Type B		Comparison to Fluke 7526A Precision Process Calibrator
	(600 to 800) °C	0.36 °C	
	(800 to 1 550) °C	0.29 °C	
	(1 550 to 1 820) °C	0.22 °C	
	Type C		
	(0 to 1 000) °C	0.16 °C	
	(1 000 to 1 800) °C	0.23 °C	
	(1 800 to 2 000) °C	0.27 °C	
	(2 000 to 2 316) °C	0.36 °C	
	Type E		
	(-250 to -200) °C	0.26 °C	
	(-200 to -100) °C	0.12 °C	
	(-100 to 0) °C	0.09 °C	
	(0 to 600) °C	0.08 °C	
	(600 to 1 000) °C	0.1 °C	
	Type J		
	(-210 to -100) °C	0.14 °C	
	(-100 to 800) °C	0.09 °C	
	(800 to 1 200) °C	0.1 °C	
	Type K		
	(-250 to -200) °C	0.47 °C	
	(-200 to -100) °C	0.16 °C	
	(-100 to 800) °C	0.1 °C	
	(800 to 1 372) °C	0.13 °C	
	Type L		
	(-200 to 0) °C	0.1 °C	
	(0 to 900) °C	0.09 °C	
	Type N		
	(-250 to -200) °C	0.74 °C	
	(-200 to -100) °C	0.23 °C	
	(-100 to 0) °C	0.12 °C	
	(0 to 100) °C	0.11 °C	
	(100 to 800) °C	0.1 °C	
	(800 to 1 300) °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 Simulation of Thermocouple Indicators – Source/Measure [1]	Type R (-50 to -25) °C (-25 to 0) °C (0 to 100) °C (100 to 400) °C (400 to 600) °C (600 to 1 000) °C (1 000 to 1 600) °C (1 600 to 1 767) °C Type S (-50 to -25) °C (-25 to 0) °C (0 to 100) °C (100 to 400) °C (400 to 600) °C (600 to 1 000) °C (1 000 to 1 600) °C (1 600 to 1 767) °C Type T (-250 to -200) °C (-200 to -100) °C (-100 to 0) °C (0 to 200) °C (200 to 400) °C	 0.56 °C 0.46 °C 0.4 °C 0.29 °C 0.22 °C 0.21 °C 0.19 °C 0.23 °C 0.52 °C 0.44 °C 0.39 °C 0.3 °C 0.23 °C 0.22 °C 0.22 °C 0.27 °C 0.36 °C 0.16 °C 0.11 °C 0.09 °C 0.09 °C	Comparison to Fluke 7526A Precision Process Calibrator
Oscilloscopes [1] Amplitude 50 Ω Load 1 MΩ Load Bandwidth (relative to 50 kHz) 50 Ω load Risetime 50 Ω load	 1.8 mVp-p to 2.2 Vp-p 1.8 mVp-p to 105 Vp-p 50 kHz to 100 MHz (100 to 300) MHz Nominal: (250 to 350) ps	 2.3 mV/V + 0.81 mV 2.7 mV/V + 81 µV 5.2 % of reading + 0.38 V 5.9 % of reading + 0.37 V 100 ps	Comparison to Fluke 5500A w/SC300 Multiproduct Calibrator
Gauss Meters / Hall Effect Meters	(-5 to 5) Gs (-10 to 10) Gs (-20 to 20) Gs (-50 to 50) Gs (-100 to 100) Gs	0.1 Gs 0.2 Gs 0.4 Gs 1 Gs 2 Gs	Comparison to Helmholtz Coil, Power Supply

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Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
RF Absolute Power – Measure [1,3]	(-23 to +10) dBm 100 MHz ≤ f < 6 GHz 6 GHz ≤ f ≤ 18 GHz (> 10 to 20) dBm 100 MHz ≤ f < 500 MHz 500 MHz ≤ f < 1.2 GHz 1.2 GHz ≤ f < 6 GHz 6 GHz ≤ f ≤ 18 GHz (-30 to -10) dBm 100 kHz ≤ f < 10 MHz 10 MHz ≤ f < 1.2 GHz 1.2 GHz ≤ f ≤ 4.2 GHz (> -10 to +20) dBm 100 kHz ≤ f < 10 MHz 10 MHz ≤ f < 1.2 GHz 1.2 GHz ≤ f ≤ 4.2 GHz	 0.08 dB 0.16 dB 0.18 dB 0.17 dB 0.18 dB 0.19 dB 0.1 dB 0.18 dB 0.11 dB 0.17 dB 0.17 dB 0.17 dB	Comparison to Agilent E4418B RF Power Meter, Agilent 8481A Power Sensor
Distortion – Measure [1]	(-80 to 0) dB 20 Hz to 20 kHz (20 to 100) kHz	 1.2 dB 2.3 dB	Comparison to Agilent 8903B Audio Analyzer
Absolute Power – Source [1,3] into 50 Ω	(0.05 to 10) Vp-p Up to 100 kHz 100 kHz to 1 MHz (1 to 15) MHz	 60 mV 75 mV 92 mV	Comparison to Agilent 33120A Arbitrary Function Generator
Absolute Power – Measure [1]	(-120 to 20) dBm 10 MHz to 1.3 GHz	 1 dB	Comparison to Rigol DSA1030A-TG Spectrum Analyzer
Tuned RF Power – Measure [1] 2.5 MHz to 1.3 GHz	(-115 to 0) dBm (-127 to -115) dBm	2 dB 1.3 dB	Comparison to Agilent 8902A Modulation Analyzer, Agilent 11722A Power Sensor

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Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Frequency Modulation – Measure [1]			Comparison to Agilent 8902A Modulation Analyzer
Freq: 250 kHz to 10 MHz	Deviation: ≤ 40 kHz Rate: 20 Hz to 10 kHz	0.41 kHz	
Freq: 10 MHz to 1.3 GHz	Deviation: ≤ 40 kHz Rate: 20 Hz to 100 kHz	1.5 kHz	
Freq: 10 MHz to 1.3 GHz	Deviation: ≤ 40 kHz Rate: 20 Hz to 200 kHz	5.9 kHz	
Amplitude Modulation – Measure [1]			Comparison to Agilent 8902A Modulation Analyzer
Freq: 150 kHz to 10 MHz	Depth: (5 to 99) % Rate: 50 Hz to 10 kHz	2.5 % Depth	
	Depth: (5 to 99) % Rate: 20 Hz to 10 kHz	3.7 % Depth	
Freq: 10 MHz to 1.3 GHz	Depth: (5 to 99) % Rate: 50 Hz to 50 kHz	1.5 % Depth	
	Depth: (5 to 99) % Rate: 20 Hz to 100 kHz	3.7 % Depth	
Attenuation – Source Coaxial, Fixed [1]			Comparison to Agilent 8491A Coaxial Fixed Attenuator with Type-N
3 dB	DC to 8 GHz SWR < 1.25:1	0.35 dB	
	(8 to 12.4) GHz SWR < 1.3:1	0.35 dB	

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Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Attenuation – Source Coaxial, Fixed [1]			
6 dB	DC to 8 GHz, SWR < 1.2:1	0.47 dB	Comparison to Agilent 8491A Coaxial Fixed Attenuator with Type-N
	(8 to 12.4) GHz, SWR < 1.3:1	0.47 dB	
10 dB	DC to 8 GHz, SWR < 1.2:1	0.7 dB	
	(8 to 12.4) GHz, SWR < 1.3:1	0.7 dB	
20 dB	DC to 8 GHz, SWR < 1.2:1	0.7 dB	
	(8 to 12.4) GHz, SWR < 1.3:1	0.7 dB	
Attenuation – Source Coaxial, Fixed [1]			
30 dB	DC to 8 GHz, SWR < 1.2:1	1.2 dB	Comparison to Agilent 8491A Coaxial Fixed Attenuator with Type-N
	(8 to 12.5) GHz, SWR < 1.3:1	1.2 dB	
60 dB	DC to 8 GHz, SWR < 1.2:1	2.3 dB	
	(8 to 12.5) GHz, SWR < 1.3:1	2.3 dB	
Thermal Noise Figure System – Measure [1] (0 to 30 dB)	10 MHz to 1.5 GHz SWR 1.7:1 ENR (14 to 16) dB	0.3 dB	Comparison to Agilent 8970A Noise Figure Meter, Agilent 346B Noise Source
Thermal Noise Figure System – Generate [1] ENR (14 to 16) dB	10 MHz to 18 GHz SWR 1.25:1	0.003 2 dB/GHz + 0.27 dB	Comparison to Agilent 346B Noise Source

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Length – Dimensional Metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Inside Micrometers [1,5] (0.001 in Resolution)	Up to 4 in (4 to 20) in (20 to 36) in (36 to 60) in	580 µin (560 + 2.1*L*) µin (500 + 4.6*L*) µin (400 + 6.7*L*) µin	Comparison to Gage Blocks
Feeler Gages	Up to 0.25 in Up to 6 mm	20 µin 0.51 µm	Comparison to Gages Blocks, Universal Length Measuring Machine
Surveillance Micrometer Masters [5]	(1 to 12) in (25 to 300) mm	(5.5 + 11*L*) µin (0.14 + 0.011*L*) µm	Comparison to Gages Blocks, Universal Length Measuring Machine
Taper Thread Plugs Pitch Diameter Major Diameter Length at Notch	 Up to 3 in Up to 3 in Up to 3 in	 130 µin 100 µin 250 µin	Comparisons to Thread Measuring Wires, Taper Block, Universal Length Measuring Machine Taper Block, Universal Length Measuring Machine Gage Blocks, Height Gage
Radius Gage	(0 to 0.5) in	260 µin	Comparison to Vision System
Rulers	Up to 24 in	0.005 8 in	Comparison to Vision System
Steel Tape [1]	Up to 10 m	250 µm	Comparison to Master Tape
Vision System X-Y Linearity Z Linearity	 Up to 18 in Up to 4 in	 100 µin 52 µin	Comparisons to Master Grid, Gage Blocks
Levels [1] Base Flatness Parallelism	Up to 12 in	100 µin	Comparison to Height Transfer Standard, Gage Blocks, Surface Plate

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Length – Dimensional Metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Metal / X-Ray Detector Standards [4,5]	(0.031 5 to 0.28) in	(5.5 + 11*L*) µin	Comparison to Universal Length Measuring Machine
Gage Blocks [5]	(0.01 to 5) in	(7 + 1.3*L*) µin	Comparison to Gage Block Comparator, Master Gage Blocks
Gage Blocks [5]	(5 to 12) in	(2.3 + 2.4*L*) µin	Comparison to P&W LMU 175 Labmaster® Universal, Master Gage Blocks
Laser Micrometer [1] (1 µin Resolution)	(0.01 to 2) in	23 µin	Comparison to XXX Pin Gages
Angle Blocks [4]	(1 to 45)°	0.2 ″/ ° + 14″	Comparison to Sine Block, Height Transfer Standard, Surface Plate
Bench / Super Micrometers / Universal Length Measuring Machine [5] Linearity Anvil Parallelism Force	 Up to 4 in 25 µin TIR 2 ozf 4 ozf 8 ozf 16 ozf 40 ozf	 (3 + 22*L*) µin 4 µin 0.019 ozf 0.021 ozf 0.027 ozf 0.74 ozf 0.78 ozf	 Comparisons to Gage Blocks Optical Flats w/ Monochromatic Light Digital Force Gage
Snap Gages [1]	(0.05 to 4) in	22 µin	Comparison to Gage Blocks
Pin Gages / Cylindrical Plug Gages	(0.01 to 2) in	46 µin	Comparison to Laser Micrometer
Pin Gages / Cylindrical Plug Gages [5]	Up to 2 in (1.9 to 18) in	(6.9 + 10*D*) µin (4.7 + 11*D*) µin	Comparison to Universal Length Measuring Machine
Cylindrical Rings [5]	(0.275 to 13.25) in	(41 + 11*D*) µin	Comparison to Master Rings, Universal Length Measuring Machine

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Length – Dimensional Metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Thread Wires [5]	Up to 0.144 34 in	(11 + 1.3*D*) µin	Comparison to Universal Length Measuring Machine
Measuring Rods [5]	(1 to 12) in (12 to 18) in (18 to 59) in	(5.5 + 11*L*) µin (1.7 + 12*L*) µin (91 + 13*L*) µin	Comparison to Gage Blocks, Universal Length Measuring Machine
Height Masters [5] Micrometer Linearity Step Height, Top/Bottom Step Parallelism	 Up to 1 in (1 to 24) in Up to 100 µin	 66 µin (43 + 2*L*) µin 84 µin	Comparison to Height Transfer Standard, Gage Blocks, Surface Plate
Thread Plugs [5] Pitch Diameter (5 to 100) TPI	Up to 8 in	(76 + 7.7*D*) µin	Comparison to Thread Wires, Universal Length Measuring Machine
Adjustable Thread Rings [1]	Up to 2 in	340 µin	Comparison to Master Thread Setting Plugs
Solid Thread Rings [5] (5.5 to 40) TPI (0.7 to 4.5) Pitch	(0.125 to 4) in	(23 + 6.8*L*) µin	Comparison to P&W LMU 175 Labmaster® Universal. Class XX Master Ring Gage
External Spline Gages [5] Measurement over Pins Circular Tooth Thickness Major Diameter	Up to 8 in Up to 8 in Up to 8 in	(180 + 30*D*) µin (120 + 20*L*) µin (30 + 16*D*) µin	Comparisons to Gear Wires, Universal Length Measuring Machine Vision System Universal Length Measuring Machine
Chamfer Gages / Countersink Gages [1]	Up to 3 in	540 µin	Comparison to Master Cylindrical Rings
Bore Gages [1] (0.000 1 in Resolution)	(0.25 to 6) in (1 to 8) in	190 µin 0.002 % of reading + 1 800 µin	Comparison to Master Cylindrical Rings, Bore Gage Calibrator

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Length – Dimensional Metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Calipers [1,5] (0.000 5 in Resolution) (0.001 in Resolution)	 (0.05 to 24) in (0.05 to 12) in (12 to 80) in	 470 µin 800 µin (600 + 19*L*) µin	Comparison to Gage Blocks, End Measuring Rod, Surface Plate
Outside Micrometers [1,5] 50 µin Resolution 100 µin Resolution 100 µin Resolution 0.001 in Resolution	 Up to 1 in Up to 1 in (1 to 12) in (12 to 20) in	 (35 + 8.8*L*) µin (66 + 19*L*) µin (770 + 26*L*) µin (1 600 + 106*L*) µin	Comparison to Gage Blocks, End Measuring Rods, Surface Plate
Depth Micrometers[1,5] (0.000 1 in Resolution) (0.001 in Resolution)	 Up to 12 in Up to 12 in	 (88 + 4*L*) µin (890 + 23*L*) µin	Comparison to Gage Blocks, Surface Plate
V-Anvil OD Micrometers [1,5] 100 µin Resolution 500 µin Resolution	 (0.4 to 1) in (1.25 to 4) in	 60 µin (330 + 54*L*) µin	Comparison to Cylindrical Plug Gages, Pin Gages
Ultrasonic Thickness Gage [1,5]	Up to 12 in	(760 + 13*L*) µin	Comparison to Gage Blocks
Dial / Digital Indicators [1] 10 µin resolution 20 µin resolution 50 µin resolution 100 µin resolution 500 µin resolution 0.001 in resolution	 (-0.015 to 0.015) in (-0.001 to 0.001) in Up to 2 in Up to 2 in Up to 2 in Up to 2 in	 7.3 µin 13 µin 61 µin 110 µin 300 µin 1 200 µin	Comparison to Gage Blocks, Indicator Calibrator, Surface Plate
Test Indicators [1]	50 µin to 0.01 in	61 µin	Comparison to Indicator Calibrator, Surface Plate
Height Gages [1,5]	Up to 12 in (12 to 36) in	(35 + 5*L*) µin (280 + 12*L*) µin	Comparison to Gage Blocks, Surface Plate, Measuring Rods
Linear Scales [1]	(1 to 142) in	7 µin/in + 0.009 5 µin	Comparison to Measuring Rods
Extensometers [1] 50 µin resolution	 Up to 2 in	 140 µin	Comparison to Micrometer Head
Extensometers [1] 10 µin resolution	 Up to 2 in	 61 µin	Comparison to Extensometer Calibrator

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Length – Dimensional Metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Optical Comparators [1] Magnification	10 X to 100 X	210 µin	Comparisons to Glass Scale
Linearity (10 µin Resolution)	Up to 18 in	0.001 5 % of reading + 59 µin	Glass Scale
Angularity	Up to 30°	2′10″	Angle Blocks
Coating Thickness Measuring Systems [1]	Up to 0.018 in	7.7 % of reading	Comparison to Ferrous Coated Thickness Standards
Protractors	Up to 180º	0.06º	Comparison to Height Transfer Standard, Sine Block, Surface Plate
Microscopes [1]	Up to 2 in	160 µin	Comparison to Glass Scale
Profilometers [1]	118 µin 123 µin	3.1 µin 3.1 µin	Comparison to Roughness Standard
Surface Roughness Specimen (Ra)	(10 to 500) µin	3.7 µin	Comparison to Surface Finish Analyzer
Roundness Measuring System [1] Radial Error	Up 5 in	5.5 µin	Comparison to Precision Ball
Coordinate Measuring Machines [5] Linear Accuracy	(0.5 to 24.5) in	(88 + 7*L*) µin	Step Gage, Ball Bars per ASME B89.4.1.
Volumetric Accuracy	(9 to 25) in	209 µin	
Squareness	(0.25 to 11.75) in	362 µin	
Coordinate Measuring Machines [5] Linear Accuracy	(0.5 to 39) in	(20 + 4*L*) µin	Gage Blocks per ISO 10360-2.
Surface Plates [1,5] Overall Flatness	Up to 68 in*DL*	(5 + 0.5*DL*) µin	In accordance with ASME B89.3.7 using Optodyne LDDM Laser Measurement System
Local Area Flatness	Up to 0.03 in	16 µin	Repeat Reading Gage

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Length – Dimensional Metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Optical Flats	Up to 100 µin	5 µin	Comparison to Optical Flat, Monochromatic Light
Inclinometers	Up to 45°	0.06°	Comparison to Sine Plate, Gage Blocks
Crosshead Displacement	(0.2 to 2) in	0.001 5 in/in + 1 800 µin	Dial Depth Indicator per ASTM E2309.
Laser Interferometer System Flatness	Up to 100 µin	5.5 µin	Comparison to Flatness Master
Mahr Dimensionair Gages [1]	(-0.001 5 to 0.001 5) in	59 µin	Comparison to Mahr AMR-12 Magnification Test Kit

Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Aqueous Volumetric Flow Rate [1] (Inline)	Up to 65 gpm Up to 150 gpm	0.2 % of reading + 0.6 gpm 0.2 % of reading + 0.3 gpm	Comparison to Coriolis Meter
Aqueous Volumetric Flow Rate [1] (Non-Intrusive)	(100 to 500) gpm (150 to 900) gpm	1.84 % of reading + 0.64 gpm 1.8 % of reading + 0.65 gpm	Comparison to Ultrasonic Transducers
Volumetric Gas Flow Meters, Rotameters	(2 to 20) sccm (10 to 100) sccm (100 to 1 000) sccm (0.5 to 5) slpm (5 to 50) slpm	1 % of reading + 0.6 sccm 1 % of reading + 0.9 sccm 0.81 % of reading + 5.5 sccm 0.14 % of reading + 0.3 slpm 1 % of reading + 0.4 slpm	Comparison to Thermal Volumetric Flow Sensors
Gas Flow Velocity	(50 to 6 000) ft/min	1.3 % of reading + 2 ft/min	Comparison to Master Anemometer, Open Jet Wind Tunnel
Metal Detectors – Magnetic Separation [1]	(0.5 to 6) lbf	0.37 lbf	Comparison to Digital Magnetic Pull Tester
Force Gauges [1]	Up to 21.5 lbf (10 to 110) lbf (50 to 1 050) lbf	0.035 % of reading + 0.000 93 lbf 0.043 % of reading + 0.007 3 lbf 0.051 % of reading + 0.073 lbf	Comparison to NIST Class F Weights, Weight Hanger

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Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Force Machines – Tension [1]	(5 to 50) lbf (76 to 500) lbf (290 to 3 000) lbf (480 to 5 000) lbf (261 to 10 000) lbf (3 000 to 30 000) lbf (3 000 to 60 000) lbf (3 000 to 120 000) lbf (10 000 to 300 000) lbf	0.025 lbf 0.25 lbf 0.61 lbf 2.2 lbf 4.2 lbf 6.5 lbf 12 lbf 0.03 % of reading + 16 lbf 0.02 % of reading + 8 lbf	Load Cell w/Indicator and ASTM E74 utilized in the calibration of this system.
Force Machines – Compression [1]	(5 to 50) lbf (48 to 500) lbf (88 to 3 000) lbf (450 to 5 000) lbf (1 000 to 10 000) lbf (3 000 to 30 000) lbf (6 000 to 60 000) lbf (60 000 to 120 000) lbf (19 000 to 300 000) lbf (52 000 to 800 000) lbf	0.03 lbf 0.25 lbf 0.61 lbf 2.3 lbf 7.5 lbf 6.4 lbf 17 lbf 0.03 % of reading + 16 lbf 0.02 % of reading + 6 lbf 0.03 % of reading + 10 lbf	Load Cell w/Indicator and ASTM E74 utilized in the calibration of this system.
Ductility Tester, Olsen Cup Tester [1]	(300 to 6 000) lbf (6 000 to 30 000) lbf	7.5 lbf 17 lbf	Master Load Cell w/ Indicator and ASTM E74 utilized in the calibration of this system.
Load Cell – Tension [1]	(5 to 50) lbf (76 to 500) lbf (290 to 3 000) lbf (480 to 5 000) lbf (261 to 10 000) lbf (3 000 to 30 000) lbf (3 000 to 60 000) lbf (3 000 to 120 000) lbf (10 000 to 300 000) lbf	0.025 lbf 0.25 lbf 0.61 lbf 2.2 lbf 4.2 lbf 6.5 lbf 12 lbf 0.03 % of reading + 16 lbf 0.02 % of reading + 6 lbf	Master Load Cell w/ Indicator and ASTM E74 utilized in the calibration of this system.
Load Cell – Compression [1]	(5 to 50) lbf (48 to 500) lbf (88 to 3 000) lbf (450 to 5 000) lbf (1 000 to 10 000) lbf (3 000 to 30 000) lbf (6 000 to 60 000) lbf	0.03 lbf 0.25 lbf 0.61 lbf 2.3 lbf 7.5 lbf 6.4 lbf 17 lbf	Master Load Cell w/ Indicator and ASTM E74 utilized in the calibration of this system.

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Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Load Cell – Compression [1]	(60 000 to 120 000) lbf (19 000 to 300 000) lbf (52 000 to 800 000) lbf	0.03 % of reading + 16 lbf 0.02 % of reading + 6 lbf 0.03 % of reading + 10 lbf	Master Load Cell w/ Indicator and ASTM E74 utilized in the calibration of this system.
Rockwell Hardness Testers [1]	HRA Low Middle High HRBW Low Middle High HRC Low Middle High HRE Low High HRF Low High HRGw Low High HRHw Low High HRLw Low High HRMw Low High HRRw Low High	 0.44 HRA 0.38 HRA 0.26 HRA 0.74 HRBW 0.69 HRBW 0.59 HRBW 0.41 HRC 0.36 HRC 0.36 HRC 0.62 HRE 0.55 HRE 0.69 HRF 0.62 HRF 1.1 HRGw 0.91 HRGw 0.87 HRHw 0.45 HRHw 0.9 HRLw 0.46 HRLw 0.69 HRMw 0.51 HRMw 0.58 HRRw 0.58 HRRw	Indirect verification per ASTM E18 using Hardness Blocks

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Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Superficial Rockwell Hardness Testers [1]	HR15N Low Middle High HR30N Low Middle High HR45N Low Middle High HR15TW Low Middle High HR30TW Low Middle High HR45TW Low Middle High HR15Yw Low High	 0.13 HR15N 0.16 HR15N 0.1 HR15N 0.67 HR30N 0.59 HR30N 0.51 HR30N 0.49 HR45N 0.57 HR45N 0.5 HR45N 0.69 HR15TW 0.62 HR15TW 0.4 HR15TW 0.52 HR30TW 0.45 HR30TW 0.44 HR30TW 0.49 HR45TW 0.46 HR45TW 0.62 HR45TW 0.83 HR15Yw 0.8 HR45Yw	Indirect verification per ASTM E18 using Hardness Blocks
Brinell Hardness Testers [1]	(500 to 3 000) kgf	6.7 kgf	Direct verification per ASTM E10, ASTM E74; Class A Proving Ring

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Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Brinell Hardness Testers [1] Verification	HBW2.5/62.5		Indirect verification per ASTM E10 using Hardness Standards
	Low	2.8 HBW2.5/62.5	
	High	6.1 HBW2.5/62.5	
	HBW2.5/187.5		
	Low	2.3 HBW2.5/187.5	
	High	16 HBW2.5/187.5	
	HBW5/750		
	Low	4.9 HBW5/750	
	High	16 HBW5/750	
	HBW10/500		
	Low	0.63 HBW10/500	
	High	2.1 HBW10/500	
	HBW10/1500		
	Low	1.2 HBW10/1 500	
	High	3.2 HBW10/1 500	
	HBW10/3000		
	Low	3.3 HBW10/3 000	
	High	13 HBW10/3 000	
Indenter Error	Up to 0.1 mm	57 µm	Stage Micrometer
Brinell Scope [1]	(0 to 7) mm	6.7 µm	Comparison to Stage Micrometer
Vickers Hardness Tester – Force [1]	10 gf	1.1 gf	Direct verification per ASTM E92 / ISO 6507-2 using Force Gage
	25 gf	1.1 gf	
	50 gf	1.1 gf	
	100 gf	1.1 gf	
	200 gf	1.1 gf	
	300 gf	2.3 gf	
	500 gf	3.4 gf	
	1 kgf	6.6 gf	
	2 kgf	13 gf	
	5 kgf	33 gf	
	10 kgf	66 gf	
	20 kgf	0.13 kgf	
	30 kgf	0.2 kgf	
	50 kgf	0.33 kgf	

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Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Knoop Hardness Tester – Force [1]	10 gf 25 gf 50 gf 100 gf 200 gf 300 gf 500 gf 1 kgf 3 kgf 10 kgf 15 kgf 30 kgf 45 kgf 60 kgf 100 kgf 150 kgf	1.1 gf 1.1 gf 1.1 gf 1.1 gf 1.1 gf 2.3 gf 3.4 gf 6.1 gf 11 gf 11 gf 11 gf 11 gf 11 gf 33 gf 33 gf 33 gf	Direct verification per ASTM E92 / ISO 6507-2 using Force Gage
Rockwell Hardness Tester – Force [1]	3 kgf 10 kgf 15 kgf 30 kgf 45 kgf 60 kgf 100 kgf 150 kgf	8 gf 24 gf 0.21 kgf 0.22 kgf 0.23 kgf 0.25 kgf 0.31 kgf 0.41 kgf	Direct Verification per ASTM E18 using Load Cell w/ Indicator
Rockwell Hardness Testers – Indenter Depth [1]	(0.1 to 200) µm	0.3 µm	Comparison to LVDT Probe w/ Indicator
Rockwell Hardness Testers – Hysteresis [1] B, E, F, G, H and K Scale All Other Scales	 100 Rockwell Units 130 Rockwell Units	 0.31 HR 0.15 HR	Direct Verification using Blunt Indenter and Flat Anvil

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Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Vickers Hardness Tester [1]	< 240 HV 0.01 > 600 HV 0.01 < 240 HV 0.025 > 600 HV 0.025 < 240 HV 0.05 > 600 HV 0.05 < 240 HV 0.1 > 600 HV 0.1 < 240 HV 0.2 > 600 HV 0.2 < 240 HV 0.3 > 600 HV 0.3 < 240 HV 0.5 > 600 HV 0.5 < 240 HV 1 > 600 HV 1 < 240 HV 5 (240 to 600) HV 5 > 600 HV 5 < 240 HV 10 (240 to 600) HV 10 > 600 HV 10 < 240 HV 30 (240 to 600) HV 30 > 600 HV 30	12 HV 0.01 44 HV 0.01 11 HV 0.025 33 HV 0.025 11 HV 0.05 30 HV 0.05 11 HV 0.1 28 HV 0.1 9 HV 0.2 22 HV 0.2 9 HV 0.3 21 HV 0.3 8 HV 0.5 20 HV 0.5 7 HV 1 17 HV 1 6 HV 5 13 HV 5 22 HV 5 5 HV 10 10 HV 10 17 HV 10 7 HV 30 11 HV 30 18 HV 30	Indirect verification per ASTM E92 / ISO 6507-2 using Hardness Blocks
Knoop Hardness Tester [1]	< 250 HK 0.01 > 650 HK 0.01 < 250 HK 0.025 > 650 HK 0.025 < 250 HK 0.05 > 650 HK 0.05 < 250 HK 0.1 > 650 HK 0.1 < 250 HK 0.2 > 650 HK 0.2 < 250 HK 0.3 > 650 HK 0.3 < 250 HK 0.5 > 650 HK 0.5 < 250 HK 1 > 650 HK 1	9 HK 0.01 35 HK 0.01 9 HK 0.025 24 HK 0.025 9 HK 0.05 22 HK 0.05 9 HK 0.1 21 HK 0.1 7 HK 0.2 17 HK 0.2 7 HK 0.3 21 HK 0.3 7 HK 0.5 18 HK 0.5 8 HK 1 18 HK 1	Indirect verification per ASTM E92 / ISO 6507-2 using Hardness Blocks

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Leeb Hardness Testers [1]	776 HLD	12 HLD	Indirect Verification per ASTM A956/A959M using Hardness Blocks
Durometers Spring Force Only Types A, B, O Types D, C, DO	 (10 to 90) Duro (10 to 90) Duro	 0.7 Duro 0.6 Duro	Partial Direct Verification per ASTM D2240-02B using Durometer Calibrator.
Duro Calibrator Types A, B, O Types D, C, DO	 (1.3 to 8.05) N (4.445 to 44.45) N	 0.033 N 0.046 % of reading + 0.03 N	Comparison to Digital Force Gage
Pneumatic Pressure Gages [1]	(-0.25 to 0.25) in H_2O (-30 to 30) in H_2O (20 to 200) in H_2O	0.07 % of reading + 0.004 1 inH_2O 0.002 9 inH_2O 0.72 in H_2O	Comparison to Setra & Meriam Calibrator
Pneumatic Pressure Gages	(> 0 to 36) psig (> 0 to 145) psig (> 0 to 500) psig	0.008 5 % of reading + 0.007 2 psi 0.006 5 % of reading + 0.01 psi 0.008 7 % of reading + 0.019 psi	Comparison to Fluke 6270A Pressure Controller with Associated Module
Pneumatic/Hydraulic Pressure Gages [1]	(10 to 2000) psig (100 to 10 000) psig	0.18 % of reading + 0.27 psi 0.075 % of reading + 0.52 psi	Comparison to Deadweight Testers
Pneumatic/Hydraulic Pressure Gages [1]	(0 to 30) psig (0 to 300) psig (0 to 300) psia (0 to 500) psig (0 to 1 000) psig (1 000 to 10 000) psig (5 000 to 50 000) psig (10 000 to 100 000) psig	0.1 % of reading 0.1 % of reading 0.1 % of reading 0.3 psi 0.03 % of reading + 0.54 psi 0.05 % of reading + 17 psi 0.05 % of reading + 58 psi 0.04 % of reading + 380 psi	Comparison to High Accuracy Pressure Gage, Pressure Calibrator
Absolute Pneumatic Pressure Gages	(> 0 to 17.4) psia	0.001 5 % of reading + 0.007 7 psi	Comparison to Fluke 6270A Pressure Controller with Associated Module
Vacuum Gage	(-14.7 to < 0) psi	0.034 % of reading + 0.008 7 psi	Comparison to Fluke 6270A Pressure Controller with Associated Module
Vacuum Gage [1]	(-660 to < 0) mmHg	0.1 % of reading	Comparison to Pressure Calibrator

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Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Conventional Mass NIST Class F (SI)	(1 to 40) g (40 to 100) g (100 to 220) g (0.22 to 3.1) kg 500 g 1 kg 5 kg 10 kg 20 kg	0.000 6 % of reading + 20 µg 0.000 4 % of reading + 0.11 mg 0.000 5 % of reading + 0.17 mg 0.000 13 % of reading + 36 mg 27 mg 27 mg 36 mg 39 mg 0.49 g	Comparison to ASTM E617 Class 1 Weights, Balance
Conventional Mass NIST Class F (Avoirdupois)	0.5 lb 1 lb 2 lb 5 lb 10 lb 20 lb 25 lb 50 lb	26 mg 27 mg 27 mg 14 mg 21 mg 31 mg 37 mg 1.6 g	Comparison to ASTM E617 Class 1 Weights, Balance
Scales and Balances [1,6] (SI)	Up to 100 g (100 to 220) g (220 to 320) g (320 to 520) g	0.000 12 % of reading + 29 µg 0.000 12 % of reading + 53 µg 0.000 05 % of reading + 0.21 mg 0.000 06 % of reading + 0.16 mg	ASTM E617 Class 0 weights and NIST Handbook 44 utilized for the calibration of the weighing system.
Scales and Balances [1,6] (SI)	Up to 40 g (40 to 100) g (100 to 220) g (220 to 2 100) g (2 100 to 4 200) g (4 200 to 14 200) g (14 200 to 32 000) g	0.000 4 % of reading + 14 µg 0.000 4 % of reading + 16 µg 0.000 5 % of reading + 3.2 µg 0.000 7 % of reading + 3.6 mg 0.000 7 % of reading + 3.1 mg 0.000 3 % of reading + 2.7 mg 0.000 3 % of reading + 30 mg	ASTM E617 Class 1 weights and NIST Handbook 44 utilized for the calibration of the weighing system.
Scales and Balances [1,6] (Avoirdupois)	Up to 10 lb (10 to 50) lb (50 to 250) lb (250 to 500) lb (500 to 1 000) lb	0.008 % of reading + 0.002 lb 0.15 % of reading + 0.001 lb 0008 % of reading + 0.01 lb 0.006 % of reading + 0.05 lb 0.016 % of reading + 0.18 lb	ASTM E617 Class 3 weights, NIST Class F Weights, and NIST Handbook 44 utilized for the calibration of the weighing system.
Pipettes	(10 to 100) µL (100 to 1 000) µL (1 000 to 10 000) µL	0.37 µL 0.036 % of reading + 0.33 µL 0.005 7 % of reading + 0.61 µL	Gravimetric Method using Analytical Balance

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Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Moisture Analyzers [1,6] Weighing System Temperature	Up to 220 g 160 °C	0.000 4 % of reading + 0.14 mg 2.5 °C	ASTM E617 Class 1 weights and NIST Handbook 44 utilized for the calibration of the weighing system. Reference Thermometer
Torque Watch [1]	(0.5 to 2.5) ozf·in (2 to 10) ozf·in (6 to 43) ozf·in (30 to 215) ozf·in	0.3 % of reading + 0.08 ozf·in 0.2 % of reading + 0.07 ozf·in 0.2 % of reading + 0.3 ozf·in 0.2 % of reading + 3 ozf·in	Comparison to Torque Watch Calibrator
Torque Devices [1]	(2.5 to 25) lbf·in (25 to 250) lbf·in (100 to 1 000) lbf·in (25 to 250) lbf·ft (80 to 800) lbf·ft (100 to 1 000) lbf·ft (500 to 5 000) lbf·ft	0.54 % of reading + 0.05 lbf·in 0.64 % of reading + 0.02 lbf·in 0.76 % of reading + 0.24 lbf·in 1.2 % of reading + 0.05 lbf·in 2 lbf·ft 1.1 % of reading + 0.84 lbf·in 1.1 % of reading + 9.1 lbf·in	Comparison to Torque Wrench Calibration System
Torque Analyzers, Torque Transducers [1]	(2.5 to 25) lbf·in (25 to 250) lbf·in (100 to 1 000) lbf·in (300 to 3 000) lbf·in (100 to 1 200) lbf·ft	0.4 % of reading 0.004 % of reading + 0.13 lbf·in 0.06 % of reading + 0.066 lbf·in 0.04 % of reading + 0.11 lbf·in 0.024 % of reading + 0.07 lbf·ft	Comparison to NIST Class F Weights, Torque Wheel, Torque Arm
Torque Watch Calibrators [1] Masses Dial	 0.5 oz 2 oz 8.5 oz 42.5 oz 13.25° 76.75°	 0.000 004 oz 0.000 012 oz 0.001 3 oz 0.001 4 oz 0.58° 0.58°	Comparison to ASTM E617 Class 1 Weights, Balance Masses
Hydrometers [1,5]	(0.9 to 1) SG (1.2 to 1.4) SG	0.001 7 SG 0.002 9 SG	Comparison to Reference Hydrometer per ASTM E126-19

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Photometry and Radiometry

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Gloss Meters [1,5]	93.5 GU, 20° 95.4 GU, 60° 99.6 GU, 85°	1.2 GU 0.65 GU 0.58 GU	Per ASTM D523-08 using Gloss Standards
Spectrophotometers Total Hemispherical Diffuse Reflectance [2] (8°:t)	(360 to 390) nm (400 to 830) nm	0.37 % of reading 0.27 % of reading	Comparison to Ultra-White Ceramic Reflectance Standard, ΔE CIELAB values reported.
Xenon arc Weathering Instruments [1] Illuminance (380 to 780) nm	Up to 240 000 lux	4.8 % of reading	Comparison to Atlas XenoCal BST Measure and Calibration Sensor
Xenon arc Weathering Instruments [1] Irradiance (300 to 800) nm	Up to 1 300 W/m^2	8.2 % of reading	Comparison to Atlas XenoCal 300-800 Measure and Calibration Sensor

Thermodynamic

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Thermometers [1]	(-196 to 0) ºC (0 to 420) ºC (420 to 660) °C	0.008 % of reading + 0.031 °C 0.001 % of reading + 0.031 °C 0.005 % of reading + 0.01 °C	Comparison to SPRT
Humidity Indicators [1] (at 23 ± 5 °C)	11 % RH 33 % RH 75 % RH 98 % RH	1.7 % RH 1.5 % RH 1.9 % RH 2.8 % RH	Comparison to Vaisala HMK15 Humidity Calibrator, Accredited Salts
Thermohygrometer Humidity Temperature	(10 to 95) % RH (10 to 60) ºC	0.16 % of reading + 0.67 % RH 0.12 ºC	Comparison to Thunder Scientific 1200 Two-Pressure Humidity Generator
Radiation (Infrared) Thermometers [1]	35 °C 100 °C 200 °C 350 °C 500 °C	0.47 °C 0.66 °C 0.95 °C 1.7 °C 2.1 °C	Comparison to Fluke 4181 Black Body Source (flat plate) Ɛ = 0.95, λ = (8 to 14) µm

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Thermodynamic

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Radiation (Infrared) Thermometers [1]	100 °C 250 °C 400 °C 550 °C 700 °C 850 °C 982 °C	2.3 °C 2.6 °C 3.4 °C 4 °C 4.8 °C 5.6 °C 6.5 °C	Comparison to Omega BB-4A Black Body Source (cavity) Ɛ = 0.99, λ = (8 to 14) µm
Ovens, Incubators, Stirred Water Baths, Fridges [1]	(0 to 100) °C (0 to 600) °C (-190 to 0) °C (0 to 1 300) °C	0.16 % of reading + 2.8 °C 0.5 % of reading + 2.8 °C 0.07 % of reading + 2.7 °C 0.65 % of reading + 2.8 °C	Comparison to Process Calibrator, Type K Thermocouple Probe
Ovens, Incubators, Stirred Water Baths, Fridges [1]	(-50 to 0) °C (0 to 500) °C	0.8 % of reading + 0.5 °C 0.6 % of reading + 0.5 °C	Comparison to Process Calibrator, Pt 100 RTD Probe
Thermocouples and Thermometers [1]	(-15 to 110) °C (50 to 350) °C (350 to 600) °C	0.41 °C 0.77 °C 0.1 % of reading + 0.25 °C	Comparison to Dry Block Calibrator
Xenon Arc Weathering Instruments [1] Surface Temperature	(20 to 120) °C	0.084 % of reading + 1.2 °C	Comparison to Atlas XenoCal BST Measure and Calibration Sensor

Time and Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Stopwatches, Timers [1]	Up to 48 h	40 ms	Comparison to Function Generator, Frequency Counter
Stopwatches, Timers [1]	Up to 1 d	53 ms/d	Comparison to Timometer
Frequency – Source [1]	10 mHz to 120 Hz 120 Hz to 1.2 kHz (1.2 to 12) kHz (12 to 120) kHz 120 kHz to 1.2 MHz (1.2 to 2) MHz	13 mHz 0.13 Hz 1.3 Hz 13 Hz 0.13 kHz 1.3 kHz	Comparison to Fluke 5502A Multiproduct Calibrator

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Time and Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Frequency – Source [1] Sine and Square Triangle and Ramp	 100 µHz to 15 MHz 100 µHz to 100 kHz	 0.002 5 % of reading 0.002 5 % of reading	Comparison to Agilent 33120A Arbitrary Function Generator
Frequency – Source [1]	(2 to 8.4) GHz	12 Hz	Comparison to Anritsu MG3691A RF/Microwave Signal Generator
Frequency – Measure [1] into 50 Ω load into 1 MΩ load into 50 Ω load	 (10 to 525) MHz 10 Hz to 80 MHz (10 to 100) MHz (0.1 to 1) GHz (1 to 10) GHz (10 to 20) GHz	 10.7 mHz/Hz + 1.8 Hz 19.3 nHz/Hz + 1.2 Hz 1.2 Hz/MHz + 1 Hz 0.12 kHz/GHz + 1 Hz 1.2 kHz/GHz + 1 Hz 8 kHz/GHz + 1 Hz	Comparison to HP 5350B Frequency Counter
Frequency – Measure [1]	10 Hz to 10 MHz	0.013 % of reading + 5 mHz	Comparison to Keysight 3458A 8.5 Digit Multimeter
Frequency – Time Based Aging [1]	10 MHz	1 pHz/Hz	Comparison to Fluke 910R GPS Controlled Atomic Clock
Rotational Viscometers [1,5]	(2 to 2 000) rpm	1.5 rpm	Comparison to Optical Tachometer
Crosshead Speed [1]	(0.2 to 2) in/min	0.07 % of reading + 0.005 3 in/min	Stopwatch, Depth Indicator per ASTM E2658.
Non-contact Tachometer [1,5]	(60 to 100 000) rpm	0.025 % of reading	Comparison to Function Generator, LED Light Source
Contact Tachometers [1,5]	(10 to 10 000) rpm	0.67 % of reading + 2.5 rpm	Comparison to Tachometer Standard

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DIMENSIONAL MEASUREMENT

1 Dimensional

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Dimensional Measurement – 1D [5]	Up to 12 in (12 to 18) in	(5.5 + 11*L*) µin (2.7 + 12*L*) µin	Direct Measure using Universal Length Measuring Machine
Dimensional Measurement – 1D [5]	Up to 24 in	(260 + 4*D*) µin	Direct Measure using Vision System
Flatness Measurement [5] Up to 4 in*D*	Up to 100 µin	10 µin	Direct Measure using ZyGo Verifier QPZ Laser Interferometer

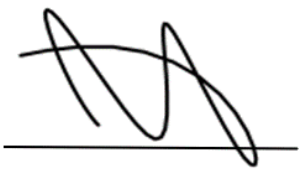
3 Dimensional

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Dimensional Measurement – 3D [5]	X = Up to 18 in Y = Up to 20 in Z = Up to 16 in	(320 + 6*L*) µin (320 + 6*L*) µin (320 + 9*L*) µin	Direct Measure using Coordinate Measuring Machine

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

Notes:

1. On-site calibration service is available for this parameter, since on-site conditions are typically more variable than those in the laboratory, larger measurement uncertainties are expected on-site than what is reported on the accredited scope.
2. The uncertainty does not include gage R&R study, and the unit under test resolution. Larger measurement uncertainties are expected.
3. Mismatch uncertainty is not considered in the CMC as it is DUT dependent. Higher uncertainties will be reported based on DUT VSWR.
4. This calibration is only applicable to the dimensional properties. The metallurgical properties/composition of the test spheres are not tested.
5. *L* = length in inches; *D* = diameter in inches; ″ = arc-second; *DL* = diagonal length; GU = gloss unit; rpm = revolutions per minute; SG = specific gravity.
6. The CMC for scales and balances is highly dependent upon the resolution of the unit under test. The CMC 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.
7. The values in the Range column are Nominal values. The actual certified values will be used at the time of calibration, along with the associated measurement Uncertainty.
8. Unless otherwise specified in the far-right hand column, the calibration procedure/method was written internally.



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