



CERTIFICATE OF ACCREDITATION

The ANSI National Accreditation Board

Hereby attests that

Transcat – Los Angeles
1503 E. Orangethorpe Ave., Unit A
Fullerton, CA 92831

Fulfills the requirements of

ISO/IEC 17025:2017

and national standards

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

In the 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: 27 March 2029

Certificate Number: AC-2489.08



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)

ANSI/NCSL Z540.3-2006 (R2013)

Transcat – Los Angeles

1503 E. Orangethorpe Ave., Unit A

Fullerton, CA 92831

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CALIBRATION AND DIMENSIONAL MEASUREMENT

ISO/IEC 17025 Accreditation Granted: **24 August 2026**

Certificate Number: **AC-2489.08** Certificate Expiry Date: **27 March 2029**

CALIBRATION

Acoustics and Vibration

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Sound Level Measuring Equipment – Measure and Generate	125 Hz to 2 kHz	0.46 dB	Comparison to GenRad 1986 Sound Level Calibrator
	(74 to 104) dB	0.36 dB	
	114 dB		
	4 kHz	0.73 dB	
	(74 to 104) dB	0.62 dB	
	114 dB		

Chemical Quantities

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
pH – Measuring Equipment ^{1,7}	4 pH	0.011 pH	Comparison to Accredited Buffer Solutions
	7 pH	0.011 pH	
	10 pH	0.012 pH	

Chemical Quantities

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Conductivity Meters ⁷	10 μ S/cm 100 μ S/cm 1 000 μ S/cm 10 000 μ S/cm 100 000 μ S/cm	0.5 μ S/cm 2.2 μ S/cm 3.7 μ S/cm 36 μ S/cm 440 μ S/cm	Comparison to Accredited Buffer Solutions

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Sine Wave Flatness ¹	Up to 3 V 10 Hz to 1 MHz (1 to 10) MHz (10 to 30) MHz (30 to 50) MHz (50 to 80) MHz (80 to 100) MHz	0.06 % of reading 0.1 % of reading 0.18 % of reading 0.41 % of reading 0.71 % of reading 0.84 % of reading	Comparison to Thermal Voltage Converters
DC Current – Measure/Source ¹	(0 to 100) μ A 100 μ A to 1 mA (1 to 10) mA (10 to 100) mA 100 mA to 1 A	33 μ A/A + 0.92 nA 29 μ A/A + 5.8 nA 29 μ A/A + 58 nA 46 μ A/A + 0.58 μ A 0.013 % of reading + 12 μ A	Comparison to Agilent 3458A 8.5 Digit Multimeter w/ Current Source
DC Current – Measure/Source ¹	(1 to 100) A	0.012 % of reading + 0.5 mA	Comparison to Ohms Labs CS-100 Precision Shunt w/ Agilent 3458A 8.5 Digit Multimeter
DC Current – Measure/Source ¹	(100 to 580) A	0.29 mA/A + 0.58 mA	Comparison to DC Current Shunts w/ DMM and Current Source
DC Current – Measure ¹	(580 to 1 000) A	0.29 mA/A + 0.5 mA	Comparison to DC Current Shunt w/ DMM
DC Current – Source ¹	(0.2 to 220) μ A (0.2 to 2.2) mA (2.2 to 22) mA (22 to 220) mA (0.22 to 2.2) A	40 μ A/A + 6 nA 35 μ A/A + 7 nA 35 μ A/A + 40 nA 45 μ A/A + 0.7 μ A 80 μ A/A + 12 μ A	Comparison to Fluke 5730A Multiproduct Calibrator

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
DC Current – Source ¹	(2.2 to 11) A	0.036 % of reading + 0.48 mA	Comparison to Fluke 5730A Multiproduct Calibrator, Fluke 5725A Amplifier
DC Clamp-on Ammeters (Non-Toroidal Type) Transformer Type Sensor ¹	(20 to 150) A (150 to 1 000) A	0.58 % of reading + 0.14 A 0.58 % of reading + 0.52 A	Comparison to Fluke 5520A/1100 Multiproduct Calibrator w/ Fluke 5500A/Coil
AC Current – Measure ¹	Up to 100 μ A (10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz 100 μ A to 1 mA (10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz (1 to 10) mA (10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz (10 to 100) mA (10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz 100 mA to 1 A (10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz	0.46 % of reading + 35 nA 0.17 % of reading + 35 nA 0.072 % of reading + 35 nA 0.072 % of reading + 35 nA 0.46 % of reading + 0.23 μ A 0.17 % of reading + 0.23 μ A 0.071 % of reading + 0.23 μ A 0.038 % of reading + 0.23 μ A 0.46 % of reading + 2.3 μ A 0.17 % of reading + 2.3 μ A 0.071 % of reading + 2.3 μ A 0.038 % of reading + 2.3 μ A 0.48 % of reading + 23 μ A 0.17 % of reading + 23 μ A 0.071 % of reading + 23 μ A 0.037 % of reading + 23 μ A 0.46 % of reading + 0.23 mA 0.19 % of reading + 0.23 mA 0.097 % of reading + 0.23 mA 0.12 % of reading + 0.23 mA	Comparison to Agilent 3458A 8.5 Digit Multimeter
AC Current – Measure ¹	Up to 10 A 50 Hz to 1 kHz 1 kHz 10 A to 100 A (50 to 100) Hz 100 Hz to 1 kHz 1 kHz	0.015 % of reading + 1.3 mA 0.12 % of reading + 1.3 mA 0.038 % of reading + 2.3 mA 0.14 % of reading + 2.3 mA 0.12 % of reading + 2.3 mA	Comparison to Ohms Labs CS-100 Precision Shunt w/ Agilent 3458A 8.5 Digit Multimeter

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current – Source ¹	Up to 220 μ A		Comparison to Fluke 5730A Multiproduct Calibrator
	(10 to 20) Hz	0.025 % of reading + 16 nA	
	(20 to 40) Hz	0.016 % of reading + 10 nA	
	40 Hz to 1 kHz	0.011 % of reading + 8 nA	
	(1 to 5) kHz	0.028 % of reading + 12 nA	
	(5 to 10) kHz	0.11 % of reading + 65 nA	
	(0.22 to 2.2) mA		
	(10 to 20) Hz	0.025 % of reading + 40 nA	
	(20 to 40) Hz	0.016 % of reading + 35 nA	
	40 Hz to 1 kHz	0.011 % of reading + 35 nA	
	(1 to 5) kHz	0.028 % of reading + 0.11 μ A	
	(5 to 10) kHz	0.11 % of reading + 0.65 μ A	
	(2.2 to 22) mA		
	(10 to 20) Hz	0.025 % of reading + 0.4 μ A	
	(20 to 40) Hz	0.016 % of reading + 0.35 μ A	
	40 Hz to 1 kHz	0.011 % of reading + 0.35 μ A	
	(1 to 5) kHz	0.02 % of reading + 0.55 μ A	
	(5 to 10) kHz	0.11 % of reading + 5 μ A	
AC Current – Source ¹	(22 to 220) mA		Comparison to Fluke 5730A Multiproduct Calibrator, Fluke 5725A Amplifier
	(10 to 20) Hz	0.025 % of reading + 4 μ A	
	(20 to 40) Hz	0.016 % of reading + 3.5 μ A	
	40 Hz to 1 kHz	0.011 % of reading + 2.5 μ A	
	(1 to 5) kHz	0.02 % of reading + 3.5 μ A	
	(5 to 10) kHz	0.11 % of reading + 10 μ A	
AC Current – Source ¹	(0.22 to 2.2) A		Comparison to Fluke 5522A Multiproduct Calibrator
	20 Hz to 1 kHz	0.025 % of reading + 35 μ A	
	(1 to 5) kHz	0.045 % of reading + 80 μ A	
	(5 to 10) kHz	0.7 % of reading + 0.16 mA	
AC Current – Source ¹	(2.2 to 11) A		Comparison to Fluke 5522A Multiproduct Calibrator
	40 Hz to 1 kHz	0.046 % of reading + 0.17 mA	
	(1 to 5) kHz	0.095 % of reading + 0.38 mA	
	(5 to 10) kHz	0.36 % of reading + 0.75 mA	
AC Current – Source ¹	(11 to 20.5) A		Comparison to Fluke 5522A Multiproduct Calibrator
	(45 to 100) Hz	0.092 % of reading + 3.9 mA	
	100 Hz to 1 kHz	0.12 % of reading + 3.9 mA	
	(1 to 5) kHz	2.3 % of reading + 3.9 mA	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current – Source ¹	(10 to 100) A (50 to 60) Hz 400 Hz 1 kHz	0.22 mA/A + 5 mA 0.26 mA/A + 5 mA 1.1 mA/A + 1.3 mA	Comparison to Ohms Labs CS-100 Precision Shunt w/ Agilent 3458A 8.5 Digit Multimeter and Current Source
AC Current – Source Extended Frequency Ranges ¹	29 μ A to 329.99 μ A (10 to 30) kHz 330 μ A to 3.299 mA (10 to 30) kHz 3.3 mA to 32.99 mA (10 to 30) kHz 33 mA to 329.99 mA (10 to 30) kHz	1.2 % of reading + 0.31 μ A 0.78 % of reading + 0.47 μ A 0.31 % of reading + 3.1 μ A 0.31 % of reading + 0.16 mA	Comparison to Fluke 5522A Multiproduct Calibrator
AC Clamp-on Ammeters (Toroidal Type) Transformer Type Sensor ¹	(20 to 150) A (45 to 65) Hz (65 to 440) Hz (150 to 1 000) A (45 to 65) Hz (65 to 440) Hz	0.34 % of reading + 35 mA 0.95 % of reading + 66 mA 0.38 % of reading + 0.17 A 1.2 % of reading + 0.29 A	Comparison to Fluke 5522A Multiproduct Calibrator w/ Fluke 5500A/Coil
AC Clamp-on Ammeters (Non-Toroidal Type) Hall Effect Sensor ¹	(20 to 150) A (45 to 65) Hz (65 to 440) Hz (150 to 1 000) A (45 to 65) Hz (65 to 440) Hz	0.66 % of reading + 0.26 A 1.2 % of reading + 0.29 A 0.68 % of reading + 1 A 1.4 % of reading + 1.1 A	Comparison to Fluke 5522A Multiproduct Calibrator w/ Fluke 5500A/Coil
DC Resistance – Measure/Source ¹ (Variable Artifact)	(0 to 10) Ω (10 to 100) Ω 100 Ω to 1 k Ω (1 to 10) k Ω (10 to 100) k Ω 100 k Ω to 1 M Ω (1 to 10) M Ω (10 to 100) M Ω 100 M Ω to 1 G Ω	18 $\mu\Omega/\Omega$ + 58 $\mu\Omega$ 15 $\mu\Omega/\Omega$ + 0.58 m Ω 13 $\mu\Omega/\Omega$ + 0.58 m Ω 12 $\mu\Omega/\Omega$ + 5.8 m Ω 13 $\mu\Omega/\Omega$ + 58 m Ω 21 $\mu\Omega/\Omega$ + 2.3 Ω 62 $\mu\Omega/\Omega$ + 120 Ω 0.059 % of reading + 1.2 k Ω 0.82 % of reading + 12 k Ω	Comparison to Agilent 3458A 8.5 Digit Multimeter w/ Decade Resistor
DC Resistance – Source ^{1,7} (Fixed Artifact)	1 m Ω	50 $\mu\Omega/\Omega$	Comparison to L&N 4223B Standard Resistor

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
DC Resistance – Source ^{1,7} (Fixed Artifact)	10 mΩ	52 μΩ/Ω	Comparison to L&N 4222B Standard Resistor
DC Resistance – Source ^{1,7} (Fixed Artifact)	100 mΩ	0.15 mΩ/Ω	Comparison to L&N 4015B Standard Resistor
DC Resistance – Source ^{1,7} (Fixed Artifacts)	0 Ω 1 Ω 1.9 Ω 10 Ω 19 Ω 100 Ω 190 Ω 1 kΩ 1.9 kΩ 10 kΩ 19 kΩ 100 kΩ 190 kΩ 1 MΩ 1.9 MΩ 10 MΩ 19 MΩ 100 MΩ	40 μΩ 95 μΩ/Ω 95 μΩ/Ω 23 μΩ/Ω 23 μΩ/Ω 10 μΩ/Ω 10 μΩ/Ω 6.5 μΩ/Ω 6.5 μΩ/Ω 6.5 μΩ/Ω 6.5 μΩ/Ω 8.5 μΩ/Ω 8.5 μΩ/Ω 13 μΩ/Ω 18 μΩ/Ω 40 μΩ/Ω 47 μΩ/Ω 0.11 mΩ/Ω	Comparison to Fluke 5730A Multiproduct Calibrator
DC Resistance – Source ^{1,7} (Variable Artifact)	(100 to 1 000) kΩ (1 to 10) MΩ (10 to 100) MΩ (100 to 1 000) MΩ (1 to 10) GΩ (10 to 100) GΩ (100 to 1 000) GΩ	0.037 % of reading 0.037 % of reading + 1.2 μΩ/Ω/V 0.12 % of reading + 1.2 μΩ/Ω/V 0.24 % of reading + 1.2 μΩ/Ω/V 0.58 % of reading + 1.2 μΩ/Ω/V 1.2 % of reading + 2.3 μΩ/Ω/V 1.2 % of reading + 5.8 μΩ/Ω/V	Comparison to IET HRRS-B-3-1G-5KV Decade Resistor
DC Resistance – RTD Measure ¹	(0 to 25) Ω (25 to 400) Ω 400 to 1 kΩ (1 to 40) kΩ	42 μΩ 1.3 μΩ/Ω 4.1 μΩ/Ω 10 μΩ/Ω	Comparison to Hart 1590 Super Thermometer Readout

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
DC Voltage – Source ¹	(0 to 220) mV (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 μ V/V + 0.4 μ V 5 μ V/V + 0.7 μ V 3.5 μ V/V + 2.5 μ V 3.5 μ V/V + 4 μ V 5 μ V/V + 40 μ V 6.5 μ V/V + 0.4 mV	Comparison to Fluke 5730A Multiproduct Calibrator
DC Voltage – Measure ¹	Up to 100 mV (0.1 to 10) V (10 to 100) V (100 to 500) V (500 to 800) V (800 to 1 000) V	8.3 μ V/V + 0.58 μ V 5.3 μ V/V + 0.58 μ V 7.7 μ V/V + 35 μ V 15 μ V/V + 0.12 mV 18 μ V/V + 0.12 mV 21 μ V/V + 0.12 mV	Comparison to Agilent 3458A Opt. 002 8.5 Digit Multimeter
DC High Voltage – Measure ¹	(1 to 10) kV (10 to 35) kV (35 to 70) kV (70 to 100) kV	0.04 % of reading + 40 mV 0.064 % of reading + 66 mV 0.088 % of reading + 80 mV 0.17 % of reading + 0.92 V	Comparison to Vitretek 4700 DVM w/ Associated High Voltage Probes
AC Voltage – Measure ¹	Up to 1 mV 100 kHz to 1 MHz (1 to 3) MHz (3 to 10) MHz (10 to 20) MHz (1 to 3) mV 100 kHz to 1 MHz (1 to 3) MHz (3 to 10) MHz (10 to 20) MHz (3 to 100) mV 100 kHz to 1 MHz (1 to 3) MHz (3 to 10) MHz (10 to 20) MHz (20 to 30) MHz	1.8 % of reading + 2.4 μ V 3.5 % of reading + 2.4 μ V 9.3 % of reading + 2.4 μ V 23 % of reading + 2.4 μ V 0.97 % of reading + 2 μ V 3.5 % of reading + 2 μ V 9.3 % of reading + 2 μ V 23 % of reading + 2 μ V 0.91 % of reading + 3 μ V 1.8 % of reading + 3 μ V 2.9 % of reading + 3 μ V 7 % of reading + 3 μ V 14 % of reading + 3 μ V	Comparison to Rohde & Schwarz URE3 RMS Voltmeter
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 300 kHz to 1 MHz (1 to 4) MHz	0.04 % of reading + 3.5 μ V 0.03 % of reading + 1.2 μ V 0.04 % of reading + 1.2 μ V 0.15 % of reading + 1.2 μ V 0.59 % of reading + 1.2 μ V 4.6 % of reading + 2.3 μ V 1.5 % of reading + 5.8 μ V 8.1 % of reading + 8.1 μ V	Comparison to Agilent 3458A 8.5 Digit Multimeter

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		Comparison to Agilent 3458A 8.5 Digit Multimeter
	(1 to 40) Hz	0.013 % of reading + 4.8 μ V	
	40 Hz to 1 kHz	0.009 7 % of reading + 2.3 μ V	
	(1 to 20) kHz	0.017 % of reading + 2.3 μ V	
	(20 to 50) kHz	0.038 % of reading + 2.3 μ V	
	(50 to 100) kHz	0.093 % of reading + 2.3 μ V	
	(100 to 300) kHz	0.36 % of reading + 12 μ V	
	300 kHz to 1 MHz	1.2 % of reading + 12 μ V	
	(1 to 2) MHz	1.8 % of reading + 12 μ V	
	(2 to 4) MHz	4.7 % of reading + 81 μ V	
	(4 to 8) MHz	4.7 % of reading + 92 μ V	
	(8 to 10) MHz	17 % of reading + 0.12 mV	
	(0.1 to 1) V		
	(1 to 40) Hz	0.008 8 % of reading + 46 μ V	
	40 Hz to 1 kHz	0.008 3 % of reading + 23 μ V	
	(1 to 20) kHz	0.017 % of reading + 23 μ V	
	(20 to 50) kHz	0.036 % of reading + 23 μ V	
	(50 to 100) kHz	0.093 % of reading + 23 μ V	
	(100 to 300) kHz	0.35 % of reading + 0.12 mV	
	300 kHz to 1 MHz	1.2 % of reading + 0.12 mV	
	(1 to 2) MHz	1.8 % of reading + 0.12 mV	
	(2 to 4) MHz	4.6 % of reading + 0.81 mV	
	(4 to 8) MHz	4.6 % of reading + 0.92 mV	
	(8 to 10) MHz	17 % of reading + 1.2 mV	
	(1 to 10) V		
	(1 to 40) Hz	0.009 5 % of reading + 0.46 mV	
	40 Hz to 1 kHz	0.023 % of reading + 0.23 mV	
	(1 to 20) kHz	0.017 % of reading + 0.23 mV	
	(20 to 50) kHz	0.036 % of reading + 0.23 mV	
	(50 to 100) kHz	0.093 % of reading + 0.23 mV	
	(100 to 300) kHz	0.35 % of reading + 1.2 mV	
	300 kHz to 1 MHz	1.2 % of reading + 1.2 mV	
	(1 to 2) MHz	1.8 % of reading + 2 mV	
	(2 to 4) MHz	4.6 % of reading + 8.1 mV	
	(4 to 8) MHz	4.6 % of reading + 9.2 mV	
	(8 to 10) MHz	17 % of reading + 12 mV	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Measure ¹	(10 to 100) V		Comparison to Agilent 3458A 8.5 Digit Multimeter
	(1 to 40) Hz	0.024 % of reading + 4.6 mV	
	40 Hz to 1 kHz	0.024 % of reading + 2.3 mV	
	(1 to 20) kHz	0.024 % of reading + 2.3 mV	
	(20 to 50) kHz	0.041 % of reading + 2.3 mV	
	(50 to 100) kHz	0.14 % of reading + 2.3 mV	
	(100 to 300) kHz	0.46 % of reading + 12 mV	
	300 kHz to 1 MHz	1.7 % of reading + 12 mV	
	(100 to 700) V		
	(1 to 40) Hz	0.048 % of reading + 46 mV	
	40 Hz to 1 kHz	0.048 % of reading + 23 mV	
	(1 to 20) kHz	0.071 % of reading + 23 mV	
	(20 to 50) kHz	0.19 % of reading + 23 mV	
	(50 to 100) kHz	0.35 % of reading + 23 mV	
AC Voltage – Measure ¹	(700 to 1 050) V		Comparison to Fluke 8508A 8.5 Digit Multimeter
	(1 to 10) Hz	0.034 % of reading + 62 mV	
	(10 to 40) Hz	0.03 % of reading + 19 mV	
	40 Hz to 10 kHz	0.03 % of reading + 19 mV	
	(10 to 30) kHz	0.11 % of reading + 39 mV	
	(30 to 100) kHz	0.16 % of reading + 0.19 V	
AC High Voltage – Measure/Source ¹	(1 to 10) kV		Comparison to Vitretek 4700 DVM w/ Associated High Voltage Probes
	(10 to 200) Hz	0.14 % of reading + 0.17 V	
	(200 to 450) Hz	0.46 % of reading + 0.17 V	
	(450 to 600) Hz	0.86 % of reading + 0.17 V	
	(10 to 35) kV		
	(30 to 200) Hz	0.11 % of reading + 0.81 V	
	(200 to 450) Hz	0.7 % of reading + 0.81 V	
	(450 to 600) Hz	1.45 % of reading + 0.81 V	
	(35 to 70) kV		
	(30 to 100) Hz	0.14 % of reading + 1.0 V	
	(100 to 450) Hz	0.7 % of reading + 1.0 V	
	(450 to 600) Hz	2.9 % of reading + 1.0 V	
	(70 to 100) kV		
	(30 to 100) Hz	0.21 % of reading + 1.3 V	
	(100 to 450) Hz	1.2 % of reading + 1.3 V	
	(450 to 600) Hz	17 % of reading + 1.3 V	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Source ¹	Up to 2.2 mV		Comparison to Fluke 5730A Multiproduct Calibrator
	(10 to 20) Hz	0.024 % of reading + 4 μ V	
	(20 to 40) Hz	0.009 % of reading + 4 μ V	
	40 Hz to 20 kHz	0.008 % of reading + 4 μ V	
	(20 to 50) kHz	0.02 % of reading + 4 μ V	
	(50 to 100) kHz	0.05 % of reading + 5 μ V	
	(100 to 300) kHz	0.11 % of reading + 10 μ V	
	(300 to 500) kHz	0.14 % of reading + 20 μ V	
	500 kHz to 1 MHz	0.27 % of reading + 20 μ V	
	(2.2 to 22) mV		
	(10 to 20) Hz	0.024 % of reading + 4 μ V	
	(20 to 40) Hz	0.009 % of reading + 4 μ V	
	40 Hz to 20 kHz	0.008 % of reading + 4 μ V	
	(20 to 50) kHz	0.02 % of reading + 4 μ V	
	(50 to 100) kHz	0.05 % of reading + 5 μ V	
	(100 to 300) kHz	0.11 % of reading + 10 μ V	
	(300 to 500) kHz	0.14 % of reading + 20 μ V	
	500 kHz to 1 MHz	0.27 % of reading + 20 μ V	
	(22 to 220) mV		
	(10 to 20) Hz	0.024 % of reading + 12 μ V	
	(20 to 40) Hz	0.009 % of reading + 7 μ V	
	40 Hz to 20 kHz	0.005 7 % of reading + 7 μ V	
	(20 to 50) kHz	0.012 % of reading + 7 μ V	
	(50 to 100) kHz	0.031 % of reading + 17 μ V	
	(100 to 300) kHz	0.066 % of reading + 20 μ V	
	(300 to 500) kHz	0.14 % of reading + 25 μ V	
	500 kHz to 1 MHz	0.27 % of reading + 45 μ V	
	220 mV to 2.2 V		
	(10 to 20) Hz	0.024 % of reading + 40 μ V	
	(20 to 40) Hz	0.009 % of reading + 15 μ V	
	40 Hz to 20 kHz	0.004 2 % of reading + 8 μ V	
	(20 to 50) kHz	0.006 7 % of reading + 10 μ V	
	(50 to 100) kHz	0.008 5 % of reading + 30 μ V	
	(100 to 300) kHz	0.034 % of reading + 80 μ V	
	(300 to 500) kHz	0.1 % of reading + 0.2 mV	
	500 kHz to 1 MHz	0.17 % of reading + 0.3 mV	

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) V		Comparison to Fluke 5730A Multiproduct Calibrator
	(10 to 20) Hz	0.024 % of reading + 0.4 mV	
	(20 to 40) Hz	0.009 % of reading + 0.15 mV	
	40 Hz to 20 kHz	0.004 2 % of reading + 50 μ V	
	(20 to 50) kHz	0.006 7 % of reading + 0.1 mV	
	(50 to 100) kHz	0.008 3 % of reading + 0.2 mV	
	(100 to 300) kHz	0.26 % of reading + 0.6 mV	
	(300 to 500) kHz	0.1 % of reading + 2 mV	
	500 kHz to 1 MHz	0.15 % of reading + 3.2 mV	
	(22 to 220) V		
	(10 to 20) Hz	0.024 % of reading + 4 mV	
	(20 to 40) Hz	0.009 % of reading + 1.5 mV	
	40 Hz to 20 kHz	0.005 2 % of reading + 0.6 mV	
	(20 to 50) kHz	0.008 % of reading + 1 mV	
	(50 to 100) kHz	0.015 % of reading + 2.5 mV	
AC Voltage – Source ¹	(100 to 300) kHz	0.09 % of reading + 16 mV	Comparison to Fluke 5730A Multiproduct Calibrator, Fluke 5725A Amplifier
	(300 to 500) kHz	0.44 % of reading + 40 mV	
	500 kHz to 1 MHz	0.8 % of reading + 80 mV	
	(220 to 250) V		
	(15 to 50) Hz	0.03 % of reading + 16 mV	
AC Voltage – Source ¹	(250 to 1 100) V		Comparison to GenRad 1689-9700 RLC DigiBridge
	50 Hz to 1 kHz	0.007 % of reading + 3.5 mV	
Capacitance – Measure ¹	(220 to 750) V		Comparison to GenRad 1689-9700 RLC DigiBridge
	(30 to 50) kHz	0.06 % of reading + 11 mV	
	(50 to 100) kHz	0.23 % of reading + 45 mV	
	(220 to 1 100) V		
	40 Hz to 1 kHz	0.009 % of reading + 4 mV	
	(1 to 20) kHz	0.017 % of reading + 6 mV	
Capacitance – Measure ¹	1 kHz		Comparison to GenRad 1689-9700 RLC DigiBridge
	Up to 10 pF	0.47 % of reading + 0.05 pF	
	(10 to 100) pF	0.06 % of reading + 0.05 pF	
	100 pF to 25 μ F	0.02 % of reading + 0.05 pF	
	(25 to 100) μ F	0.03 % of reading	
	(100 to 1 000) μ F	0.24 % of reading	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Capacitance – Measure ¹	0.1 pF		Comparison to Agilent E4980A LCR Meter
	100 kHz	1.4 % of reading	
	1 MHz	1.8 % of reading	
	1 pF		
	10 kHz	1.4 % of reading	
	100 kHz	0.37 % of reading	
	1 MHz	0.44 % of reading	
	2 MHz	1.1 % of reading	
	10 pF		
	1 kHz	1.4 % of reading	
	10 kHz	0.28 % of reading	
	100 kHz	0.28 % of reading	
	1 MHz	0.3 % of reading	
	2 MHz	0.75 % of reading	
	100 pF		
	100 Hz	2.1 % of reading	
	1 kHz	0.23 % of reading	
	10 kHz	0.18 % of reading	
	100 kHz	0.21 % of reading	
	1 MHz	0.23 % of reading	
	2 MHz	0.3 % of reading	
	1 nF		
	20 Hz	1.8 % of reading	
	100 Hz	0.3 % of reading	
	1 kHz	0.1 % of reading	
	10 kHz	0.1 % of reading	
	100 kHz	0.1 % of reading	
	1 MHz	0.14 % of reading	
	2 MHz	0.53 % of reading	
	10 nF		
	20 Hz	0.31 % of reading	
	100 Hz	0.12 % of reading	
	1 kHz	0.1 % of reading	
	10 kHz	0.1 % of reading	
	100 kHz	0.1 % of reading	
	1 MHz	0.25 % of reading	
	2 MHz	0.67 % of reading	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Capacitance – Measure ¹	100 nF		Comparison to Agilent E4980A LCR Meter
	20 Hz	0.16 % of reading	
	100 Hz	0.1 % of reading	
	1 kHz	0.1 % of reading	
	10 kHz	0.1 % of reading	
	100 kHz	0.18 % of reading	
	1 MHz	0.33 % of reading	
	2 MHz	0.97 % of reading	
	1 µF		
	20 Hz	0.15 % of reading	
	100 Hz	0.09 % of reading	
	1 kHz	0.09 % of reading	
	10 kHz	0.18 % of reading	
	100 kHz	0.25 % of reading	
	1 MHz	0.79 % of reading	
	10 µF		
	20 Hz	0.15 % of reading	
	100 Hz	0.09 % of reading	
	1 kHz	0.16 % of reading	
	10 kHz	0.28 % of reading	
	100 kHz	0.73 % of reading	
	100 µF		
	20 Hz	0.16 % of reading	
	100 Hz	0.17 % of reading	
	1 kHz	0.29 % of reading	
	10 kHz	0.8 % of reading	
Capacitance – Source ¹ (Simulation)	190 pF to 1.1 nF	0.39 % of reading + 7.8 pF	Comparison to Fluke 5520A/1100 Multiproduct Calibrator
	(1.1 to 3.3) nF	0.39 % of reading + 7.8 pF	
	(3.3 to 11) nF	0.21 % of reading + 7.8 pF	
	(11 to 110) nF	0.21 % of reading + 78 pF	
	(110 to 330) nF	0.21 % of reading + 0.23 nF	
	330 nF to 1.1 µF	0.2 % of reading + 0.78 nF	
	(1.1 to 3.3) µF	0.2 % of reading + 2.3 nF	
	(3.3 to 11) µF	0.2 % of reading + 7.8 nF	
	(11 to 33) µF	0.32 % of reading + 23 nF	
	(33 to 110) µF	0.35 % of reading + 78 nF	
	(110 to 330) µF	0.35 % of reading + 0.23 µF	
	330 µF to 1.1 mF	0.35 % of reading + 0.78 µF	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Capacitance – Source ¹ (Simulation)	(1.1 to 3.3) mF (3.3 to 11) mF (11 to 33) mF (33 to 110) mF	0.35 % of reading + 2.3 μ F 0.35 % of reading + 7.8 μ F 0.59 % of reading + 23 μ F 0.86 % of reading + 78 μ F	Comparison to Fluke 5520A/1100 Multiproduct Calibrator
Capacitance – Source ^{1,7} (Fixed Artifacts)	1 kHz 1 nF 2 nF 5 nF 10 nF 20 nF 50 nF 0.1 μ F 0.2 μ F 0.5 μ F 1 μ F	 0.32 pF 0.59 pF 1.4 pF 2.7 pF 5.4 pF 13 pF 38 pF 76 pF 0.19 nF 0.38 nF	Comparison to GenRad 1409 Series Standard Capacitors characterized with GenRad 1689-9700 RLC Digibridge
Inductance – Measure ¹	100 Hz to 1 kHz (1 to 10) mH 10 mH to 10 H	0.026 % of reading + 0.1 μ H 0.026 % of reading + 1.4 μ H	Comparison to GenRad 1689-9700 RLC Digibridge
Inductance – Measure ¹	1 μ H 10 kHz 100 kHz 1 MHz 2 MHz 10 μ H 10 kHz 100 kHz 1 MHz 2 MHz 00 μ H 1 kHz 10 kHz 100 kHz 1 MHz 2 MHz 1 mH 100 Hz 1 kHz 10 kHz 100 kHz 1 MHz 2 MHz	 1.6 % of reading 0.36 % of reading 0.27 % of reading 0.66 % of reading 0.37 % of reading 0.2 % of reading 0.2 % of reading 0.3 % of reading 0.40 % of reading 0.20 % of reading 0.12 % of reading 0.14 % of reading 0.72 % of reading 0.55 % of reading 0.18 % of reading 0.12 % of reading 0.09 % of reading 0.23 % of reading 0.88 % of reading	Comparison to Agilent E4980A LCR Meter

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Inductance – Measure ¹	10 mH		Comparison to Agilent E4980A LCR Meter
	20 Hz	0.85 % of reading	
	100 Hz	0.22 % of reading	
	1 kHz	0.09 % of reading	
	10 kHz	0.09 % of reading	
	100 kHz	0.10 % of reading	
	1 MHz	0.35 % of reading	
	2 MHz	1.3 % of reading	
	100 mH		
	20 Hz	0.28 % of reading	
	100 Hz	0.10 % of reading	
	1 kHz	0.09 % of reading	
	10 kHz	0.09 % of reading	
	100 kHz	0.21 % of reading	
	1 MHz	0.88 % of reading	
	1 H		
	20 Hz	0.16 % of reading	
	100 Hz	0.09 % of reading	
	1 kHz	0.09 % of reading	
	10 kHz	0.10 % of reading	
	100 kHz	0.31 % of reading	
Inductance – Measure	10 H		Comparison to Agilent E4980AL LCR Meter
	20 Hz	0.15 % of reading	
	100 Hz	0.10 % of reading	
	1 kHz	0.11 % of reading	
	10 kHz	0.21 % of reading	
	100 kHz	0.69 % of reading	
	100 H		
	20 Hz	0.15 % of reading	
	100 Hz	0.10 % of reading	
	1 kHz	0.15 % of reading	
	10 kHz	0.62 % of reading	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Resistance – Measure	0.1 Ω		Comparison to Agilent E4980A LCR Meter
	1 kHz	1.8 % of reading	
	10 kHz	1.6 % of reading	
	100 kHz	1.0 % of reading	
	1 MHz	1.5 % of reading	
	1 Ω		
	20 Hz	0.67 % of reading	
	100 Hz	0.43 % of reading	
	1 kHz	0.33 % of reading	
	10 kHz	0.32 % of reading	
	100 kHz	0.31 % of reading	
	1 MHz	0.38 % of reading	
	2 MHz	0.92 % of reading	
	10 Ω		
	20 Hz	0.29 % of reading	
	100 Hz	0.20 % of reading	
	1 kHz	0.17 % of reading	
	10 kHz	0.19 % of reading	
	100 kHz	0.19 % of reading	
	1 MHz	0.27 % of reading	
	2 MHz	0.67 % of reading	
	100 Ω		
	20 Hz	0.16 % of reading	
	100 Hz	0.09 % of reading	
	1 kHz	0.09 % of reading	
	10 kHz	0.12 % of reading	
	100 kHz	0.12 % of reading	
	1 MHz	0.2 % of reading	
	2 MHz	0.53 % of reading	
	1 k Ω		
	20 Hz	0.15 % of reading	
	100 Hz	0.09 % of reading	
	1 kHz	0.09 % of reading	
	10 kHz	0.09 % of reading	
	100 kHz	0.09 % of reading	
	1 MHz	0.14 % of reading	
	2 MHz	0.3 % of reading	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Resistance – Measure ¹	10 k Ω		Comparison to Agilent E4980A LCR Meter
	20 Hz	0.15 % of reading	
	100 Hz	0.09 % of reading	
	1 kHz	0.09 % of reading	
	10 kHz	0.09 % of reading	
	100 kHz	0.1 % of reading	
	1 MHz	0.29 % of reading	
	2 MHz	0.87 % of reading	
	100 k Ω		
	20 Hz	0.17 % of reading	
	100 Hz	0.1 % of reading	
	1 kHz	0.1 % of reading	
	10 kHz	0.17 % of reading	
	100 kHz	0.28 % of reading	
	1 MHz	0.38 % of reading	
	2 MHz	1.3 % of reading	
Inductance – Source ^{1,7} (Fixed Artifacts)	100 μ H	25 nH	Comparison to Standard Inductors characterized with GenRad 1689-9700 RLC Digibridge
	1 mH	0.25 μ H	
	10 mH	2.5 μ H	
	100 mH	25 μ H	
	1 H	0.25 mH	
	10 H	2.5 mH	
Electrical Simulation of Thermocouple Indicating Devices – Measure/Source ¹	Type B		Comparison to Ectron 1140A Thermocouple Calibrator/Simulator
	(250 to 350) $^{\circ}$ C	1.2 $^{\circ}$ C	
	(350 to 445) $^{\circ}$ C	0.9 $^{\circ}$ C	
	(445 to 580) $^{\circ}$ C	0.71 $^{\circ}$ C	
	(580 to 750) $^{\circ}$ C	0.55 $^{\circ}$ C	
	(750 to 1 000) $^{\circ}$ C	0.45 $^{\circ}$ C	
	(1 000 to 1 820) $^{\circ}$ C	0.35 $^{\circ}$ C	
	Type C		
	(0 to 250) $^{\circ}$ C	0.24 $^{\circ}$ C	
	(250 to 1 000) $^{\circ}$ C	0.19 $^{\circ}$ C	
	(1 000 to 1 500) $^{\circ}$ C	0.21 $^{\circ}$ C	
	(1 500 to 1 800) $^{\circ}$ C	0.24 $^{\circ}$ C	
	(1 800 to 2 000) $^{\circ}$ C	0.27 $^{\circ}$ C	
	(2 000 to 2 250) $^{\circ}$ C	0.33 $^{\circ}$ C	
	(2 250 to 2 315) $^{\circ}$ C	0.37 $^{\circ}$ C	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Electrical Simulation of Thermocouple Indicating Devices – Measure/Source ¹	Type E		Comparison to Ectron 1140A Thermocouple Calibrator/Simulator
	(-270 to -245) °C	1.6 °C	
	(-245 to -195) °C	0.24 °C	
	(-195 to -155) °C	0.12 °C	
	(-155 to -90) °C	0.09 °C	
	(-90 to 0) °C	0.08 °C	
	(0 to 15) °C	0.08 °C	
	(15 to 890) °C	0.06 °C	
	(890 to 1 000) °C	0.07 °C	
	Type J		
	(-210 to -180) °C	0.15 °C	
	(-180 to -120) °C	0.12 °C	
	(-120 to -50) °C	0.09 °C	
	(-50 to 990) °C	0.08 °C	
	(990 to 1 200) °C	0.09 °C	
	Type K		
	(-270 to -255) °C	2.5 °C	
	(-255 to -195) °C	0.85 °C	
	(-195 to -115) °C	0.16 °C	
	(-115 to -55) °C	0.12 °C	
	(-55 to 1 000) °C	0.09 °C	
	(1 000 to 1 372) °C	0.1 °C	
	Type N		
	(-270 to -260) °C	5.4 °C	
	(-260 to -200) °C	1.5 °C	
	(-200 to -140) °C	0.29 °C	
	(-140 to -70) °C	0.18 °C	
	(-70 to 25) °C	0.14 °C	
	(25 to 160) °C	0.12 °C	
	(160 to 1 300) °C	0.11 °C	
	Type R		
	(-50 to -30) °C	0.8 °C	
	(-30 to 45) °C	0.69 °C	
	(45 to 160) °C	0.49 °C	
	(160 to 380) °C	0.35 °C	
	(380 to 775) °C	0.3 °C	
	(775 to 1 768) °C	0.26 °C	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Electrical Simulation of Thermocouple Indicating Devices – Measure/Source ¹	Type S (-50 to -30) °C (-30 to 45) °C (45 to 105) °C (105 to 310) °C (310 to 615) °C (615 to 1 768) °C Type T (-270 to -255) °C (-255 to -240) °C (-240 to -210) °C (-210 to -150) °C (-150 to -40) °C (-40 to 100) °C (100 to 400) °C	0.76 °C 0.68 °C 0.49 °C 0.41 °C 0.35 °C 0.31 °C 1.9 °C 0.6 °C 0.36 °C 0.22 °C 0.15 °C 0.09 °C 0.08 °C	Comparison to Ectron 1140A Thermocouple Calibrator/Simulator
Scope Voltage – Source ¹ DC Signal into 50 Ω into 1 MΩ	(-5.0 to 5) V (-200 to 200) V	0.023 % of reading + 19 μV 0.023 % of reading + 19 μV	Comparison to Fluke 9500B Oscilloscope Calibrator
Scope Voltage – Source ¹ Square Wave 10 Hz to 100 kHz into 50 Ω 10 Hz to 10 kHz into 1 MΩ 10 Hz to 100 kHz into 1 MΩ	40 μVp-p to 1 mVp-p 1 mVp-p to 5 Vp-p 40 μVp-p to 1 mVp-p 1 mVp-p to 200 Vp-p	0.78 % of reading + 7.8 μV 0.08 % of reading + 7.8 μV 0.78 % of reading + 7.8 μV 0.08 % of reading + 7.8 μV	Comparison to Fluke 9500B Oscilloscope Calibrator
Scope – Time Markers ¹ 100 mVp-p to 1 Vp-p (into 50 Ω) Square Wave Sine Wave Pulse Triangle Wave	9.009 1 ns to 83 μs 83 μs to 55 s 450.5 ps to 9.009 ns 900.91 ns to 83 μs 83 μs to 55 s 900.91 ns to 83 μs 83 μs to 55 s	0.19 μs/s 2.3 μs/s 0.19 μs/s 0.19 μs/s 2.3 μs/s 0.19 μs/s 2.3 μs/s	Comparison to Fluke 9500B Oscilloscope Calibrator

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Rise Time – Measure ¹	≥ 350 ps	28 ps	Comparison to Rigol MSO8104 Digital Oscilloscope
Scope Rise Time – Source ^{1,4} (into 50 Ω) 10 Hz to 2 MHz	5 mVp-p to 3 Vp-p 500 ps (Nominal) 150 ps (Nominal)	290 ps 35 ps	Comparison to Fluke 9500B Oscilloscope Calibrator with Fluke 9530 Active Head
10 Hz to 1 MHz	25 mVp-p to 2 Vp-p 70 ps (Nominal)	24 ps	
Scope Rise Time – Source ^{1,4} (into 50 Ω) 10 Hz to 1 MHz	425 mVp-p to 2 Vp-p 25 ps (Nominal)	6.7 ps	Comparison to Fluke 9500B Oscilloscope Calibrator with Fluke 9530 Active Head
Scope Levelled Sine Wave – Source ¹ (50 kHz Ref. Frequency) into 50 Ω	5 mVp-p to 5 Vp-p 50 kHz to 10 MHz	1.2 % of reading	Comparison to Fluke 9500B Oscilloscope Calibrator with Fluke 9530 Active Head
Scope Bandwidth/Flatness – Source ¹ into VSWR (1.2:1) (wrt Reference Frequency)	5 mVp-p to 5 Vp-p 0.1 Hz to 300 MHz (300 to 550) MHz 5 mVp-p to 3 Vp-p 550 MHz to 2.5 GHz 5 mVp-p to 2 Vp-p (2.5 to 3.2) GHz	1.6 % of reading 1.9 % of reading 2.7 % of reading 3.1 % of reading	Comparison to Fluke 9500B Oscilloscope Calibrator with Fluke 9530 Active Head
Scope Input Impedance – Measure ¹	(10 to 40) Ω (40 to 90) Ω (90 to 150) Ω (50 to 800) k Ω 800 k Ω to 1.2 M Ω (1.2 to 12) M Ω	0.39 % of reading 0.08 % of reading 0.39 % of reading 0.39 % of reading 0.08 % of reading 0.39 % of reading	
Scope Input Capacitance – Measure ¹	(1 to 35) pF (35 to 95) pF	1.6 % of reading + 0.19 pF 2.3 % of reading + 0.19 pF	Comparison to Fluke 9500B/3200 Oscilloscope Calibrator

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
LF Phase – Source ¹	(0 to 90)° (10 to 65) Hz (65 to 500) Hz 500 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (10 to 30) kHz	0.09° 0.2° 0.39° 1.9° 3.9° 7.8°	Comparison to Fluke 5520A/1100 Multiproduct Calibrator
DC Power – Source ¹ (0.33 to 330) mA (0.33 to 3) A (3 to 20.5) A	11 µW to 330 W 11 W to 3 kW 99 mW to 20.9 kW	0.018 % of reading 0.017 % of reading 0.054 % of reading	Comparison to Fluke 5520A/1100 Multiproduct Calibrator
AC Power – Source ^{1,5} PF = 1 3.3 mA to 3 A 3.3 mA to 20.5 A 33 mA to 3 A 33 mA to 20.5 A (3 to 20.5) A	(10 to 45) Hz 0.11 mW to 99 W (45 to 65) Hz 0.11 mW to 20.9 kW (65 to 500) Hz 11 mW to 3.06 kW 500 Hz to 1 kHz 11 mW to 20.9 kW (65 to 500) Hz 9.9 W to 20.9 kW	0.18 % of reading 0.14 % of reading 0.16 % of reading 0.17 % of reading 0.16 % of reading	Comparison to Fluke 5520A/11 Multiproduct Calibrator

Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Attenuation – Source ¹	DC to 12.4 GHz 1 dB 2 dB 3 dB 4 dB 5 dB 6 dB 7 dB	0.3 dB 0.3 dB 0.4 dB 0.4 dB 0.5 dB 0.5 dB 0.6 dB	Comparison to Agilent 8496H Programmable Attenuator w/ Type -N

Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Attenuation – Source ¹	DC to 12.4 GHz		Comparison to Agilent 8496H Programmable Attenuator w/ Type -N
	8 dB	0.6 dB	
	9 dB	0.6 dB	
	10 dB	0.6 dB	
	11 dB	0.7 dB	
Attenuation – Source ¹	(12.4 to 18) GHz		Comparison to Agilent 8496H Programmable Attenuator w/ Type -N
	1 dB	0.7 dB	
	2 dB	0.7 dB	
	3 dB	0.7 dB	
	4 dB	0.7 dB	
	5 dB	0.8 dB	
	6 dB	0.8 dB	
	7 dB	0.8 dB	
	8 dB	0.8 dB	
	9 dB	0.9 dB	
	10 dB	0.9 dB	
	11 dB	0.5 dB	
	DC to 12.4 GHz		
	10 dB	0.5 dB	
	20 dB	0.7 dB	
	30 dB	0.9 dB	
	40 dB	1.2 dB	
	50 dB	1.5 dB	
	60 dB	1.8 dB	
	70 dB	2.1 dB	
	80 dB	2.4 dB	
	90 dB	2.7 dB	
	100 dB	3 dB	
	110 dB	3.3 dB	
	(12.4 to 18) GHz		
	10 dB	0.6 dB	
	20 dB	0.8 dB	
	30 dB	1.2 dB	
	40 dB	1.6 dB	
	50 dB	2 dB	
	60 dB	2.4 dB	
	70 dB	2.8 dB	
	80 dB	3.2 dB	
	90 dB	3.6 dB	
	100 dB	4 dB	
	110 dB	4.4 dB	

Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
RF Absolute Power – Measure ¹	10 Hz to 20 kHz (-10 to 30) dBm	0.13 % of reading	Comparison to Fluke 8846A 6.5 Digit Multimeter
RF Absolute Power – Measure ¹	9 kHz to 18 GHz (-60 to 20) dBm	2.6 % of reading	Comparison to Agilent E9304A-H18 RF Power Sensor w/ RF Power Meter
RF Absolute Power – Measure ¹	(18 to 40) GHz (-70 to -30) dBm	3.8 % of reading	Comparison to Agilent 8487D RF Power Sensor w/ RF Power Meter
	(40 to 50) GHz (-70 to -30) dBm	5.5 % of reading	
RF Absolute Power – Measure ¹	(18 to 40) GHz (-30 to 20) dBm	4.4 % of reading	Comparison to Agilent 8487D RF Power Sensor w/ RF Power Meter
	(40 to 50) GHz (-30 to 20) dBm	5.5 % of reading	
RF Absolute Power – Measure ¹	30 MHz to 50 GHz (20 to 30) dBm	4.8 % of reading	Comparison to Agilent E5532A-550 RF Power Sensor Module w/ RF Power Meter
RF Absolute Power – Source ¹	(-70 to -10) dBm		
	250 kHz to 2 GHz	0.8 dB	
	(2 to 20) GHz	1.1 dB	
	(20 to 40) GHz	1.2 dB	
	(40 to 50) GHz	1.8 dB	
	(-10 to 0) dBm		
	250 kHz to 2 GHz	0.7 dB	
	(2 to 20) GHz	0.9 dB	
	(20 to 40) GHz	1.1 dB	
	(40 to 50) GHz	1.1 dB	
	(0 to 10 dBm)		
	250 kHz to 2 GHz	0.7 dB	
	(2 to 20) GHz	0.9 dB	
	(20 to 40) GHz	1.1 dB	
	(40 to 50) GHz	1.5 dB	

Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
RF Absolute Power – Source ¹	(10 to 14 dBm) 250 kHz to 2 GHz (2 to 20) GHz (20 to 40) GHz (14 to 19 dBm) 250 kHz to 2 GHz (2 to 20) GHz (20 to 40) GHz	0.7 dB 0.9 dB 1.2 dB 0.9 dB 0.9 dB 1.2 dB	Comparison to Agilent E8257D Analog Signal Generator
RF Relative Power – Measure ¹ (Tuned RF Level)	100 kHz to 50 GHz (-10 to 0) dB (-20 to -10) dB (-30 to -20) dB (-40 to -30) dB (-50 to -40) dB (-60 to -50) dB (-70 to -60) dB (-80 to -70) dB (-90 to -80) dB 100 kHz to 45 GHz (-100 to -90) dB (-110 to -100) dB 100 kHz to 31.15 GHz (-120 to -110) dB (-130 to -120) dB	0.02 dB 0.02 dB 0.03 dB 0.04 dB 0.04 dB 0.09 dB 0.10 dB 0.14 dB 0.15 dB 0.16 dB 0.29 dB 0.29 dB 0.29 dB	Comparison to Agilent E4448A Spectrum Analyzer
S11/S22 Reflection Magnitude – Measure ^{1,10} (Linear)	9 kHz to 10 MHz (0 to 0.5) lin (0.5 to 1) lin 10 MHz to 9 GHz (0 to 0.5) lin (0.5 to 1) lin	0.009 0.019 0.012 0.022	Comparison to Agilent E5071C Network Analyzer (Corrected with Agilent 85032F Calibration Kit)
S11/S22 Reflection Magnitude – Measure ^{1,10} (Linear)	50 MHz to 2 GHz (0 to 0.5) lin (0.5 to 1) lin (2 to 40) GHz (0 to 0.5) lin (0.5 to 1) lin	0.015 0.023 0.028 0.04	Comparison to Agilent E5235A Network Analyzer (Corrected with Agilent 85056K Calibration Kit)

Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
S12/S21 Transmission Magnitude – Measure ¹ (dB)	9 kHz to 10 MHz (-30 to 0) dB (-60 to -30) dB 10 MHz to 9 GHz (-30 to 0) dB (-60 to -30) dB	0.09 dB 0.45 dB 0.09 dB 0.26 dB	Comparison to Agilent E5071C Network Analyzer (Corrected with Agilent 85032F Calibration Kit)
S12/S21 Transmission Magnitude – Measure ¹ (dB)	(10 to 500) MHz (-30 to 0) dB (-60 to -30) dB 500 MHz to 2 GHz (-30 to 0) dB (-60 to -30) dB (2 to 50) GHz (-30 to 0) dB (-60 to -30) dB	0.07 dB 1.6 dB 0.05 dB 0.18 dB 0.14 dB 0.55 dB	Comparison to Agilent E5235A Network Analyzer (Corrected with Agilent 85056K Calibration Kit)
Amplitude Modulation – AM Depth Measure ¹ Rate: 100 kHz to 20 MHz 10 MHz to 3 GHz (3 to 26.5) GHz (26.5 to 31.15) GHz	50 Hz to 10 kHz (5 to 99) % Depth 50 Hz to 100 kHz (5 to 20) % Depth (20 to 99) % Depth 50 Hz to 100 kHz (5 to 20) % Depth (20 to 99) % Depth 50 Hz to 100 kHz (5 to 20) % Depth (20 to 99) % Depth	0.9 % Depth 0.8 % Depth 2.6 % Depth 1.6 % Depth 4.5 % Depth 2.1 % Depth 6.8 % Depth	Comparison to Agilent E4448A Spectrum Analyzer
Amplitude Modulation – AM Depth Measure ¹ Rate: (31.15 to 50) GHz	50 Hz to 100 kHz (5 to 20) % Depth (20 to 99) % Depth	6 % Depth 26 % Depth	Comparison to Agilent E4448A Spectrum Analyzer
Amplitude Modulation Distortion – Measure ¹ 100 kHz to 10 kHz 10 MHz to 26.5 GHz	20 Hz to 1 kHz > 1 % > 3 % 20 Hz to 1 kHz > 1 % > 3 %	0.85 % of reading 0.42 % of reading 1 % of reading 0.5 % of reading	Comparison to Agilent E4448A Spectrum Analyzer

Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Amplitude Modulation Distortion – Measure ¹ (26.5 to 50) GHz	20 Hz to 1 kHz > 1 % > 3 % > 5 %	6.2 % of reading 2 % of reading 1.5 % of reading	Comparison to Agilent E4448A Spectrum Analyzer
Amplitude Modulation – AM Depth – Source ¹ 250 kHz to 50 GHz	Up to 90 % Depth	6.6 % Depth	Comparison to Agilent E8257D Analog Signal Generator
Frequency Modulation Deviation – Measure ¹ Rate: 250 kHz to 10 MHz	20 Hz to 10 kHz Dev/Rate > 0.2 Dev/Rate > 1.2	1.5 % Deviation 1 % Deviation	Comparison to Agilent E4448A Spectrum Analyzer
10 MHz to 6.6 GHz	50 Hz to 200 kHz Dev/Rate > 0.2 Dev/Rate > 0.45	1.5 % Deviation 1 % Deviation	
(6.6 to 13.2) GHz	50 Hz to 200 kHz Dev/Rate > 0.2 Dev/Rate > 8	2.5 % Deviation 1 % Deviation	
(13.2 to 31.15) GHz	50 Hz to 200 kHz Dev/Rate > 0.2 Dev/Rate > 16	3.8 % Deviation 1 % Deviation	
(31.5 to 50) GHz	50 Hz to 200 kHz Dev/Rate > 0.2 Dev/Rate > 32	8.5 % Deviation 1 % Deviation	
Frequency Modulation Distortion – Measure ¹ 1 MHz to 6.6 GHz	20 Hz to 1 kHz Dev 500 Hz to 2 kHz Dev ≥ 2 kHz	0.3 % of reading 0.11 % of reading	Comparison to Agilent E4448A Spectrum Analyzer
(6.6 to 13.2) GHz	20 Hz to 1 kHz Dev > 2.3 kHz Dev ≥ 4.5 kHz	0.3 % of reading 0.11 % of reading	

Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Frequency Modulation Distortion – Measure ¹ (13.2 to 31.15) GHz (31.5 to 50) GHz	20 Hz to 1 kHz Dev > 2.7 kHz Dev ≥ 6 kHz 20 Hz to 1 kHz Dev > 4 kHz Dev ≥ 12 kHz	0.31 % of reading 0.12 % of reading 0.32 % of reading 0.14 % of reading	Comparison to Agilent E4448A Spectrum Analyzer
Frequency Modulation – Deviation Source ¹ 250 kHz to 50 GHz	DC to 10 MHz Dev ≤ 128 MHz	3.9 % Deviation	Comparison to Agilent E8257D Analog Signal Generator
Phase Modulation Deviation – Measure ¹ Rate: 100 kHz to 6.6 GHz (6.6 to 13.2) GHz (13.2 to 26.5) GHz (26.5 to 31.15) GHz (31.15 to 50) GHz	> 0.7 rad > 0.3 rad > 2 rad > 0.6 rad > 4.0 rad > 1.2 rad > 4 rad > 1.3 rad > 8 rad > 2.4 rad	1.1 % Deviation 3.2 % Deviation 1.1 % Deviation 3.2 % Deviation 1.1 % Deviation 3.2 % Deviation 1.1 % Deviation 3.2 % Deviation 1.1 % Deviation 3.2 % Deviation	Comparison to Agilent E4448A Spectrum Analyzer
Phase Modulation Distortion – Measure ¹ 1 MHz to 6.6 GHz (6.6 to 13.2) GHz	(20 to 500) Hz > 0.8 rad ≥ 2.5 rad 500 Hz to 1 kHz > 0.4 rad ≥ 1.0 rad (20 to 500) Hz > 1.8 rad ≥ 5.5 rad 500 Hz to 1 kHz ≥ 0.8 rad ≥ 2.5 rad	0.31 % of reading 0.13 % of reading 0.31 % of reading 0.13 % of reading 0.31 % of reading 0.13 % of reading 0.31 % of reading 0.13 % of reading	Comparison to Agilent E4448A Spectrum Analyzer

Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Phase Modulation Distortion – Measure ¹ (13.2 to 31.15) GHz (31.15 to 50) GHz	(20 to 500) Hz > 3.5 rad ≥ 10 rad (20 to 500) Hz > 7.5 rad ≥ 19 rad 500 Hz to 1 kHz > 3 rad ≥ 8 rad	0.31 % of reading 0.13% of reading 0.31 % of reading 0.13 % of reading 0.31 % of reading 0.13 % of reading	Comparison to Agilent E4448A Spectrum Analyzer
Phase Modulation Distortion – Source ¹	(250 to 500) MHz (0 to 10) rad 500 MHz to 1 GHz (0 to 20) rad (1 to 2) GHz (0 to 40) rad (2 to 3.2) GHz (0 to 80) rad (3.2 to 10) GHz (0 to 160) rad (10 to 20) GHz (0 to 320) rad (20 to 40) GHz (0 to 640) rad (40 to 50) GHz (0 to 1 280) rad	5.8 % of reading 5.8 % of reading 5.8 % of reading 5.8 % of reading 5.8 % of reading 5.8 % of reading 5.8 % of reading	Comparison to Agilent E8257D Analog Signal Generator
Single Sideband Phase Noise – Measure ¹ CW Frequency: 3 Hz to 3 GHz (3 to 6.6) GHz (6.6 to 22) GHz (22 to 26.8) GHz (26.8 to 31.15) GHz (31.15 to 50) GHz	Markers: 100 Hz to 1 MHz 100 Hz to 1 MHz 100 Hz to 1 MHz 100 Hz to 1 MHz 100 Hz to 1 MHz 100 Hz to 1 MHz	0.6 dB 1 dB 1.6 dB 1.7 dB 1.1 dB 1.4 dB	Comparison to Agilent E4448A Spectrum Analyzer
Total Harmonic Distortion – Measure ¹	(-100 to 0) dB 10 Hz to 100 kHz 20 Hz to 20 kHz (20 to 100) kHz	8.4 % of reading 1.1 dB 2 dB	Comparison to Agilent U8903A Audio Analyzer

Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Total Harmonic Distortion – Measure ¹ Rate: 5 Hz to 600 kHz Level: (0.3 to 100) %	10 Hz to 1 MHz (1 to 3) MHz	3 % of reading 6 % of reading	Comparison to Agilent 334A Distortion Analyzer

Length – Dimensional Metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Angle Measuring Devices ² (Protractors, Inclinometers, Squares, Angle Gages)	5° (5 to 20)° (20 to 35)° (35 to 45)° (45 to 60)° (60 to 75)° (75 to 85)°	1.4" 2.1" 3.5" 4.9" 8.3" 18" 54"	Comparison to 10 in Sine Bar, Gage Blocks, Surface Plate
Angle Measuring Devices ² (Protractors, Inclinometers, Squares, Angle Gages)	≥ 90°	1.9"	Comparison to Master Square, Surface Plate
Micrometers ^{1,2} Outside, Inside, Depth	(0.05 to 1) in (1 to 9) in	(13 + 1L) μin (9 + 4L) μin	Comparisons to Grade 0 Gage Blocks
	(5 to 15) in (15 to 40) in	(11 + 4L) μin (16 + 4L) μin	Long Gage Blocks
Anvil Flatness	Up to 1 inD	3.9 μin	Optical Flats
Anvil Parallelism	Up to 1 inD	6.3 μin	Optical Parallels
Calipers ^{1,2} Outside, Inside, Depth, Step	(0.05 to 1) in (1 to 9) in	(13 + 1L) μin (9 + 4L) μin	Comparisons to Grade 0 Gage Blocks
	(5 to 15) in (15 to 40) in	(11 + 4L) μin (16 + 4L) μin	Long Gage Blocks
Linear Displacement ²	Up to 12 ft	(1 + 2.1L) μin	Comparison to Laser Interferometer
Dial Indicators ^{1,2}	Up to 1 in (1 to 6) in	(10 + 2L) μin (5 + 6L) in	Comparison to Gage Blocks

Length – Dimensional Metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Length – Single Axis ² Outside Dimension	Up to 1 in (1 to 7) in (7 to 12) in	$(6.1 + 1L) \mu\text{in}$ $(4.5 + 3.5L) \mu\text{in}$ $(2 + 4L) \mu\text{in}$	Direct Measure using Universal Length Measuring Machine
Inside Dimension	(0.04 to 1) in (1 to 2.5) in (2.5 to 10) in (10 to 14) in	$(9 + 1L) \mu\text{in}$ $(10 + 3L) \mu\text{in}$ $(15 + 3L) \mu\text{in}$ $(26 + 3L) \mu\text{in}$	
Length – Single Axis ² Outside Dimension	Up to 1 in (1 to 4) in (4 to 24) in	$13 \mu\text{in}$ $(10 + 3L) \mu\text{in}$ $(10 + 4.5L) \mu\text{in}$	Comparison to 24 in Laser Length Measuring Machine
Height Measuring Equipment ²	(0.05 to 1) in (1 to 9) in (5 to 15) in (15 to 40) in	$(13 + 1L) \mu\text{in}$ $(9 + 4L) \mu\text{in}$ $(11 + 4L) \mu\text{in}$ $(16 + 4L) \mu\text{in}$	Comparison to Gage Blocks, Surface Plate
Rulers ²	Up to 12 in (12 to 26) in	$(130 + 10L) \mu\text{in}$ $(80 + 15L) \mu\text{in}$	Comparison to OGP Flash-500 Vision System
Measuring Tapes, Rulers ²	Up to 1 ft (1 to 3) ft (3 to 1 000) ft	$(460 + 3L) \mu\text{in}$ $(390 + 9L) \mu\text{in}$ $(20L) \mu\text{in}$	Comparison to Accu-Gage Single Axis Vision System
Plug Gages ² Outside Diameter	Up to 1 in (1 to 7) in	$12 \mu\text{in}$ $(10 + 3L) \mu\text{in}$	Direct Measure using Universal Length Measuring Machine
Pin Gages ² Outside Diameter	(0.003 to 1) in	$30 \mu\text{in}$	Direct Measure using Laser Micrometer
Laser Micrometers ^{1,2}	Up to 0.1 in (0.1 to 0.4 in) (0.4 to 1) in	$13 \mu\text{in}$ $8 \mu\text{in}$ $(11 + 5L) \mu\text{in}$	Comparison to Characterized Master Pin Gages
Thread Wires ² (2 to 120) TPI	(0.008 to 0.5) in	$(10.1 + 4L) \mu\text{in}$	Direct Measure using Universal Length Measuring Machine
Thread Wire Constants	-	$(16.4 + 4.7L) \mu\text{in}$	

Length – Dimensional Metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Threaded Plugs ² Pitch Diameter – 60° Thread	Up to 1 in (1 to 4) in (4 to 7) in	79 µin 80 µin 83 µin	Comparisons to Universal Length Measuring Machine, Thread Wires
Major Diameter	Up to 1 in (1 to 7) in	13 µin (10 + 3L) µin	Universal Length Measuring Machine
Step Height	Up to 1 in	32 µin	Gage Probe, Amplifier, Gage Blocks
Threaded Rings Inner Pitch Diameter	Up to 1 in (1 to 4) in (4 to 7) in	79 µin 80 µin 83 µin	Comparison Measurement using Master Plug Uncertainty
Plain Ring Gages ² Inside Diameter	(0.04 to 1) in (1 to 2.5) in (2.5 to 10) (10 to 14) in	(9 + 1L) µin (10 + 3L) µin (15 + 3L) µin (26 + 3L) µin	Direct Measure using Universal Length Measuring Machine
Squareness	Up to 4.5 in	2.4 µin/in	Comparison to Gage Amplifier with Probe, Grade AA Surface Plate, Cylindrical Square
Parallelism Physical Size Up to 36 in	Up to 0.05 in	41 µin	Comparison to Gage Amplifier with Probe, Grade AA Surface Plate
Straightness Physical Size Up to 36 in	Up to 0.05 in	52 µin	Comparison to Gage Amplifier with Probe, Grade AA Surface Plate
Flatness ² Physical Size Up to 3 inD	Up to 250 µin	4.5 µin	Comparisons using Optical Flat
Up to 36 inD	Up to 0.05 in	36 µin	Gage Amplifier with Probe, Grade AA Surface Plate

Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Force Measuring Equipment ¹	(0.03 to 600) lbf	0.017 % of reading	Comparison to NIST Class F Weights
Force Measuring Equipment – Tension ¹	Up to 500 lbf (500 to 10 000) lbf (10 000 to 25 000) lbf (25 000 to 100 000) lbf	0.024 % of reading + 0.11 lbf 0.024 % of reading + 0.51 lbf 0.024 % of reading + 4.8 lbf 0.024 % of reading + 6.4 lbf	Comparison to Load Cells
Force Measuring Equipment – Compression ¹	Up to 500 lbf (500 to 2 000) lbf (2 000 to 10 000) lbf (10 000 to 25 000) lbf (25 000 to 100 000) lbf	0.024 % of reading + 0.04 lbf 0.025 % of reading + 0.14 lbf 0.023 % of reading + 0.51 lbf 0.024 % of reading + 4.5 lbf 0.023 % of reading + 6.4 lbf	Comparison to Load Cells
Mass Determination (SI)	25 kg 20 kg 10 kg 5 kg 3 kg 2 kg 1 kg 500 g 300 g 200 g 100 g 50 g 30 g 20 g 10 g 5 g 3 g 2 g 1 g	7.9 mg 6.9 mg 6.5 mg 2.8 mg 2 mg 1.5 mg 0.56 mg 0.27 mg 0.12 mg 54 µg 56 µg 39 µg 11 µg 9.3 µg 7.2 µg 8.2 µg 4.5 µg 4.4 µg 4.7 µg 4.2 µg	Double Substitution Method; Reference Weights, Electronic Balances

Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Mass Determination (SI)	500 mg	2.3 µg	Double Substitution Method; Reference Weights, Electronic Balances
	300 mg	2.3 µg	
	200 mg	2.3 µg	
	100 mg	2.3 µg	
	50 mg	2.3 µg	
	30 mg	2.3 µg	
	20 mg	2.3 µg	
	10 mg	2.3 µg	
	5 mg	2.3 µg	
	3 mg	2.3 µg	
	2 mg	2.3 µg	
	1 mg	2.3 µg	
Mass Determination (SI)	50 kg	31 mg	Single Substitution Method; Reference Weights, Electronic Balances
	30 kg	24 mg	
	25 kg	21 mg	
	20 kg	17 mg	
	10 kg	5.2 mg	
	5 kg	4.7 mg	
	3 kg	3.1 mg	
	2 kg	1.6 mg	
	1 kg	0.8 mg	
	500 g	0.38 mg	
	300 g	0.23 mg	
	200 g	0.16 mg	
	100 g	93 µg	
	50 g	38 µg	
	30 g	26 µg	
	20 g	24 µg	
	10 g	17 µg	
	5 g	11 µg	
	3 g	11 µg	
	2 g	12 µg	
	1 g	11 µg	

Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Mass Determination (SI)	500 mg 300 mg 200 mg 100 mg 50 mg 30 mg 20 mg 10 mg 5 mg 3 mg 2 mg 1 mg	4.4 µg 4.4 µg 4.4 µg 4.4 µg 4.4 µg 4.4 µg 4.4 µg 4.4 µg 4.4 µg 4.4 µg 4.4 µg 4.4 µg	Single Substitution Method; Reference Weights, Electronic Balances
Mass Determination (Avoirdupois)	50 lb 30 lb 20 lb 10 lb 5 lb 3 lb 2 lb 1 lb 8 oz 4 oz 2 oz 1 oz 0.5 oz	17 mg 5.3 mg 5.7 mg 3.3 mg 1.7 mg 1.7 mg 0.5 mg 0.25 mg 0.17 mg 95 µg 42 µg 29 µg 23 µg	Single Substitution Method; Reference Weights, Electronic Balances
Torque Tools ¹	15 ozf·in to 2 000 lbf·ft	1 % of reading	Comparison to CDI Torque Measuring System
Torque Transducers, Torque Analyzers ⁸	(5 to 100) ozf·in (5 to 100) lbf·in (100 to 1 000) lbf·in (50 to 600) lbf·ft	0.06 % of reading 0.033 % of reading 0.015 % of reading 0.05 % of reading	Comparison to Torque Wheels, Torque Arms, Master Weights
Torque Angle ¹	(0 to 360)°	0.35°	Comparison to Torque Angle Generator
Balances ^{1,6} Metric (SI)	(1 to 500) mg 500 mg to 5 g (5 to 20) g (20 to 30) g 30 g to 5 kg (5 to 50) kg	6.3 µg 0.022 mg 0.033 mg 0.51 mg 0.000 19 % of reading 0.000 2 % of reading	ASTM E617 Class 1 (characterized) weights and internal calibration procedure utilized for the calibration of the weighing system.

Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Balances ^{1,6} Metric (SI)	(1 to 500) mg 500 mg to 5 g (5 to 20) g (20 to 30) g 30 g to 50 kg	12 µg 40 µg 60 µg 90 µg 0.000 32 % of reading	ASTM E617 Class 1 (non-characterized) weights and internal calibration procedure utilized for the calibration of the weighing system.
Balance/Scales ^{1,6} Avoirdupois	(0.5 to 16) oz (16 to 24) oz (24 to 29) oz (29 to 31) oz 1 lb (2 to 1 000) lb	0.024 % of reading 0.017 % of reading 0.014 % of reading 0.012 % of reading 0.018 % of reading 0.012 % of reading	NIST Class F weights (non-characterized) and internal calibration procedure utilized for the calibration of the weighing system.
Absolute Pneumatic Pressure Devices ¹	Up to 8 psia (8 to 17) psia (17 to 41.3) psia (41.3 to 1 015) psia	0.000 8 psi 0.01 % of reading 0.003 psi 0.008 % of reading	Comparison to Mensor CPC6050 Pressure Controller
Pneumatic Gauge Pressure Devices ¹	(0 to 41.3) psig (41.3 to 1 000) psig	0.003 psi 0.008 % of reading	Comparison to Mensor CPC6050 Pressure Controller
Pneumatic Gauge Pressure Devices ¹	(-60 to -22) inH ₂ O (-22 to 22) inH ₂ O (22 to 60) inH ₂ O (60 to 72) inH ₂ O (72 to 804) inH ₂ O	0.009 % of reading + 0.000 15 inH ₂ O 0.002 2 inH ₂ O 0.009 % of reading + 0.000 15 inH ₂ O 0.006 7 inH ₂ O 0.009 % of reading + 0.000 15 inH ₂ O	Comparison to Fluke/DHI PPC4-ui Pressure Measurement System
Pneumatic Gauge Pressure Devices ¹	Up to 6 000 psig	0.72 psi	Comparison to Mensor 2101 Digital Pressure Indicator
Pneumatic Gauge Pressure Devices ¹	Up to 10 000 psig	1.2 psi	Comparison to Mensor CPR2550 Digital Pressure Indicator
Hydraulic Gauge Pressure Devices ¹	(5 to 1 500) psig (1 500 to 15 000) psig	0.008 % of reading 0.008 % of reading	Comparison to Ametek T-150 Dead Weight Tester
Hydraulic Gauge Pressure Devices ¹	(1 000 to 25 000) psig	15 psi	Comparison to Heise 901B Digital Pressure Indicator

Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Hydraulic Gauge Pressure Devices ¹	(500 to 40 000) psig	0.006 3 % of reading	Comparison to Fluke/Ruska 2450 Hydraulic Deadweight Tester

Thermodynamic

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Relative Humidity – Measure ¹	(10 to 30) °C (20 to 90) % RH	1.3 % RH	Comparison to Vaisala HMI41/HMP46 Thermohygrometer
Relative Humidity – Source	(-10 to 15) °C (10 to 75) % RH (75 to 95) %RH (15 to 35) °C (10 to 95) %RH (35 to 70) °C (10 to 50) %RH (50 to 75) %RH (75 to 95) %RH	0.5 %RH 0.65 %RH 0.5 %RH 0.5 %RH 0.7 %RH 0.85 %RH	Comparison to Thunder Scientific 2500 Two-Pressure Humidity Generator
Temperature – Measure ¹	(-195 to 660) °C	0.003 % of reading + 0.009 °C	Comparison to Hart 5628 PRT w/ Black Stack Thermometer Indicator
Temperature – Measure ¹	(600 to 1 000) °C (1 000 to 1 200) °C	0.93 °C 1.2 °C	Comparison to Accu-Mac AM1210 Type S Reference Thermocouple w/ Hart 2565 Thermocouple Module and Black Stack
Temperature – Source ¹ (Thermocouple Probes, RTD's, Liquid-in-Glass)	(-80 to 0) °C (0 to 100) °C (100 to 200) °C (200 to 300) °C	0.003 % of reading + 0.014 °C 0.003 % of reading + 0.017 °C 0.003 % of reading + 0.025 °C 0.003 % of reading + 0.035 °C	Comparison to Hart 5628 PRT w/ Black Stack and Fluke 7381, 7321, and 6331 Baths

Thermodynamic

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Temperature – Source ¹ (Thermocouple Probes, RTD's)	(300 to 425) °C (425 to 660) °C	0.003 % of reading + 0.043 °C 0.003 % of reading + 0.06 °C	Comparison to Hart 5628 PRT w/ Black Stack and Fluke 9173 Dry Well
Temperature – Source ¹ (Thermocouple Probes)	(660 to 1 200) °C	3.1 °C	Comparison to Accu-Mac AM1210 Type S Reference Thermocouple w/ Hart 2565 Thermocouple Module, Black Stack and Furnace

Time and Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Frequency – Reference ¹	10 MHz	3.7 pHz/Hz	Comparison to GPS, Rubidium Frequency Oscillator
Frequency – Measure ¹	1 Hz to 10 kHz 10 kHz to 225 MHz	1.4 nHz/Hz + 4.5 µHz 1.4 nHz/Hz	Comparison to Function Generator, Rubidium Frequency Oscillator
Frequency – Source ¹ (Sine, Square, Triangle)	1 Hz to 80 MHz	58 nHz/Hz	Comparison to Function Generator, Rubidium Frequency Oscillator
Period – Measure ¹	(1 to 100) s	45 µs	Comparison to Function Generator, Rubidium Frequency Oscillator
Period – Source ¹	(1 to 100) s	58 µs/s	Function Generator, Rubidium Frequency Oscillator

Time and Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Duty Cycle – Source ¹ Square Wave: < 3.3 Vp-p Freq: 0.1 Hz to 100 kHz	(1 to 10) % Duty Cycle 10 μ s to 100 s (10 to 49) % Duty Cycle 10 μ s to 100 s 50 % Duty Cycle 10 μ s to 100 s (51 to 90) % Duty Cycle 10 μ s to 100 s (90 to 99) % Duty Cycle 10 μ s to 100 s	0.039 % of reading + 78 ns 0.62 % of reading + 78 ns 0.001 6 % of reading + 78 ns 0.62 % of reading + 78 ns 0.039 % of reading + 78 ns	Comparison to Fluke 5522A Multiproduct Calibrator
Rotational Speed – Measure ^{1,2}	(2 to 999) rpm (999 to 8 300) rpm (8 300 to 25 000) rpm (25 000 to 100 000) rpm	0.06 % of reading + 0.12 rpm 1.2 rpm 2.3 rpm 0.007 % of reading + 1.2 rpm	Comparison to Non-contact Laser Tachometer
Non-contact Tachometers ^{1,2}	(0.01 to 1 000) rpm (1 000 to 10 000) rpm (10 000 to 100 000) rpm (100 000 to 200 000) rpm	0.000 2 % of reading 0.000 4 % of reading 0.003 % of reading 0.006 % of reading	Comparison to Function Generator, Rubidium Frequency Oscillator, LED
Time Interval – Measure ¹	Up to 24 hr	1 s/d + 0.2 s	Comparison to Stopwatch
Stopwatches/Timers ¹	Up to 19.99 s/d	59 ms/d	Direct Measure using Vibrograf 4500 Timometer

DIMENSIONAL MEASUREMENT

1 Dimensional

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Fixtures, Gauging, Dies, Molds ² Single Axis Length Outside Dimensions	Up to 1 in (1 to 7) in (7 to 12) in	(6.1 + 1L) μ in (4.5 + 3.5L) μ in (2 + 4L) μ in	Universal Length Measuring Machine utilized as the Reference for 1D

1 Dimensional

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Fixtures, Gauging, Dies, Molds ² Single Axis Length Inside Dimensions	(0.04 to 1) in (1 to 2.5) in (2.5 to 10) in (10 to 14) in	$(9 + 1L) \mu\text{in}$ $(10 + 3L) \mu\text{in}$ $(15 + 3L) \mu\text{in}$ $(26 + 3L) \mu\text{in}$	Universal Length Measuring Machine utilized as the Reference for 1D Geometric Measurements.

2 Dimensional

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Angle Measurements	Up to 12 in (0 to 360)°	0.015°	OGP Flash-500 Vision System utilized for 2D Angle Measurements.
Length Measurements ² (X-Y Axis)	Up to 19 in x 17 in Up to 12 in (12 to 26) in	$(130 + 10L) \mu\text{in}$ $(80 + 15L) \mu\text{in}$	OGP Flash-500 Vision System utilized for 2D Dimensional Measurements.

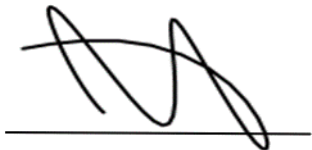
3 Dimensional

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Fixtures, Gauging, Dies, Molds ² Volumetric Measurement	X-axis Up to 27 in Y-axis Up to 39 in Z-axis Up to 27 in	$(160 + 3.8L) \mu\text{in}$	Global Advantage 7.10.7 Coordinate Measuring Machine utilized for 3D Measurements.

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. 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.
3. L = length in inches; D = diameter in inches; " = arc-second; rpm = revolutions per minute.
4. As frequency & amplitude deviate from the listed values, uncertainty may be higher than stated. If needed, contact the laboratory for more information regarding uncertainties at frequency and range combinations other than the ones shown.
5. The stated uncertainty is the laboratory's ability to source a fast rise pulse that is approximately 500 ps, 150 ps, or 70 ps. In the typical application of measuring rise time of an oscilloscope, this value is one of the contributing factors, but other factors are derived from the UUT. The known source rise time is mathematically removed from the total observed UUT rise time.
6. The uncertainties shown are for the most favorable conditions. There is an increase in uncertainty that corresponds to the laboratory's AC voltage and current uncertainties at different frequencies other than the ones shown. Power factors (PF) other than the one shown contribute to the power uncertainty. PF is related to the cosine of phase. Therefore, uncertainties track the laboratory's phase uncertainty closely at PF near one but are magnified heavily as PF approaches zero. The lab may also report reactive power, apparent power, and power factor under this accreditation. If needed, contact the laboratory for more information regarding uncertainties at frequency and power factor combinations other than the ones shown.
7. 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.
8. The values listed in the Range column are approximate. The certified values and corresponding Measurement Uncertainty (MU) will be reported at the time of calibration.
9. The resolution of the device under test (DUT) will be added to the Measurement Uncertainty (MU) at the time of calibration, which is stated as $0.6R$ (where R = resolution).
10. The unit of measure for this parameter is unitless, thus the Scope Uncertainty is unitless.
11. Unless otherwise specified in the far-right column above, the laboratory utilizes internally written calibration procedures in the process of calibrating the parameters listed in this document.
12. The Legal Entity for this facility is Transcat, Inc.



Jason Stine, Vice President