



# CERTIFICATE OF ACCREDITATION

## The ANSI National Accreditation Board

Hereby attests that

**Transcat – Denver**  
**3251 Lewiston St., Suite 12**  
**Aurora, CO 80011**

Fulfills the requirements of

**ISO/IEC 17025:2017**

and the national standards

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

In the fields of

**CALIBRATION & 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](http://www.anab.org).

Jason Stine, Vice President

Expiry Date: 07 September 2027  
Certificate Number: AC-2489.10



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 – Denver

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## CALIBRATION AND DIMENSIONAL MEASUREMENT

ISO/IEC 17025 Accreditation Granted: 29 August 2025

Certificate Number: AC-2489.10

Certificate Expiry Date: 07 September 2027

### CALIBRATION

#### Acoustics and Vibration

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Acceleration	(0.5 to 1) Hz (1 to 5) Hz (5 to 10) Hz (10 to 99) Hz 100 Hz (101 to 920) Hz (921 to 5 000) Hz (5 001 to 10 000) Hz (10 to 15) kHz (15 to 20) kHz	1.1 % of reading 0.8 % of reading 0.8 % of reading 1.2 % of reading 0.75 % of reading 1 % of reading 1.4 % of reading 1.8 % of reading 2.2 % of reading 2.8 % of reading	Comparison to Master Accelerometer

#### Chemical Quantities

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
pH Meters	4 pH 7 pH 10 pH	0.012 pH 0.011 pH 0.012 pH	Comparison to Accredited pH Solutions

### Chemical Quantities

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Conductivity Meters	1 $\mu$ S	0.3 $\mu$ S	Comparison to Accredited Conductivity Solutions
	10 $\mu$ S	0.3 $\mu$ S	
	100 $\mu$ S	2.1 $\mu$ S	
	1 000 $\mu$ S	5 $\mu$ S	
	1 413 $\mu$ S	4 $\mu$ S	
	10 000 $\mu$ S	44 $\mu$ S	
	100 000 $\mu$ S	330 $\mu$ S	
	150 000 $\mu$ S	570 $\mu$ S	
	200 000 $\mu$ S	670 $\mu$ S	

### Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Sine Wave Flatness <sup>1</sup>	Up to 3 V		Comparison to Thermal Converters, HP 3458A 8.5 Digit Multimeter
	10 Hz to 1 MHz	0.06 % of reading	
	(1 to 10) MHz	0.1 % of reading	
	(10 to 30) MHz	0.18 % of reading	
	(30 to 50) MHz	0.41 % of reading	
	(50 to 80) MHz	0.71 % of reading	
DC Current – Source <sup>1</sup>	(80 to 100) MHz	0.84 % of reading	Comparison to Keithley 263 Calibrator/Source
	Up to 2 pA	0.8 % of reading + 10 fA	
	(2 to 20) pA	0.44 % of reading + 10 fA	
	(20 to 200) pA	0.3 % of reading + 30 fA	
	(0.2 to 2) nA	0.077 % of reading + 100 fA	
	(2 to 20) nA	0.076 % of reading + 1 pA	
DC Current – Source <sup>1</sup>	(20 to 200) nA	0.041 % of reading + 10 pA	Comparison to Fluke 5730A Multiproduct Calibrator
	(0.2 to 2) $\mu$ A	0.029 % of reading + 0.1 nA	
	(2 to 220) $\mu$ A	40 $\mu$ A/A + 6 nA	
	(0.22 to 2.2) mA	36 $\mu$ A/A + 7 nA	
	(2.2 to 22) mA	35 $\mu$ A/A + 40 nA	
DC Current – Source <sup>1</sup>	(22 to 220) mA	48 $\mu$ A/A + 0.7 $\mu$ A	Comparison to Fluke 5730A/5725A Multiproduct Calibrator with Amplifier
	(0.22 to 2.2) A	80 $\mu$ A/A + 12 $\mu$ A	
	(2.2 to 11) A	0.036 % of reading + 0.48 mA	

## Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
DC Current – Source <sup>1</sup>	(11 to 20.5) A	0.082 % of reading + 0.75 mA	Comparison to Fluke 5520A Multiproduct Calibrator
DC Current – Source <sup>1</sup>	(1 to 10) A (10 to 100) A (100 to 300) A	0.01 % of reading 0.06 % of reading 0.12 % of reading	Comparison to Guideline 9211 Multi-tap DC Current Shunt, Current Source
DC Clamp-on Ammeters (Non-Toroidal Type) Transformer Type Sensor <sup>1</sup>	(20 to 150) A (150 to 1 000) A	0.5 % of reading + 0.14 A 0.51 % of reading + 0.5 A	Comparison to Fluke 5520A Multiproduct Calibrator, 5500A/COIL 50-turn Coil
DC Current – Measure <sup>1</sup>	Up to 2 pA (2 to 20) pA (20 to 200) pA (0.2 to 2) nA (2 to 20) nA (20 to 200) nA	2.1 % of reading + 6.6 fA 1.9 % of reading + 7 fA 1.9 % of reading + 10 fA 0.3 % of reading + 0.5 pA 0.3 % of reading + 1 pA 0.3 % of reading + 10 pA	Comparison to Keithley 617 Programmable Electrometer
DC Current – Measure <sup>1</sup>	(0.2 to 1) $\mu$ A (1 to 10) $\mu$ A (10 to 100) $\mu$ A (0.1 to 1) mA (1 to 10) mA (10 to 100) mA (0.1 to 1) A	25 $\mu$ A/A + 46 pA 25 $\mu$ A/A + 0.12 nA 33 $\mu$ A/A + 0.92 nA 29 $\mu$ A/A + 5.8 nA 29 $\mu$ A/A + 58 nA 46 $\mu$ A/A + 0.58 $\mu$ A 0.013 % of reading + 12 $\mu$ A	Comparison to Agilent 3458A Opt 002 8.5 Digit Multimeter
DC Current – Measure <sup>1</sup>	(1 to 10) A (10 to 100) A (100 to 300) A	0.01 % of reading 0.06 % of reading 0.12 % of reading	Comparison to Guideline 9211 Multi-tap DC Current Shunt, Digital Multimeter
AC Current – Source <sup>1</sup>	Up to 220 $\mu$ A (10 to 20) Hz (20 to 40 Hz) 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.025 % of reading + 16 nA 0.016 % of reading + 10 nA 0.01 % of reading + 8 nA 0.028 % of reading + 12 nA 0.11 % of reading + 65 nA	Comparison to Fluke 5730A Multiproduct Calibrator

# Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current – Source <sup>1</sup>	(0.22 to 2.2) mA		Comparison to Fluke 5730A Multiproduct Calibrator
	(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	0.01 % of reading + 35 nA	
	(1 to 5) kHz	0.02 % of reading + 0.11 µA	
	(5 to 10) kHz	0.11 % of reading + 0.65 µA	
	(2.2 to 22) mA		
	(10 to 20) Hz	0.025 % of reading + 0.4 µA	
	(20 to 40 Hz)	0.016 % of reading + 0.35 µA	
	40 Hz to 1 kHz	0.01 % of reading + 0.35 µA	
	(1 to 5) kHz	0.02 % of reading + 0.55 µA	
	(5 to 10) kHz	0.11 % of reading + 5 µA	
AC Current – Source <sup>1</sup>	(22 to 220) mA		Comparison to Fluke 5730A Multiproduct Calibrator
	(10 to 20) Hz	0.025 % of reading + 4 µA	
	(20 to 40 Hz)	0.016 % of reading + 3.5 µA	
	40 Hz to 1 kHz	0.01 % of reading + 2.5 µA	
	(1 to 5) kHz	0.02 % of reading + 3.5 µA	
	(5 to 10) kHz	0.11 % of reading + 10 µA	
AC Current – Source <sup>1</sup>	(0.22 to 2.2) A		Comparison to Fluke 5730A Multiproduct Calibrator, Fluke 5725A Amplifier
	20 Hz to 1 kHz	0.024 % of reading + 35 µA	
	(1 to 5) kHz	0.045 % of reading + 80 µA	
	(5 to 10) kHz	0.7 % of reading + 0.16 mA	
AC Current – Source <sup>1</sup>	(2.2 to 3) A		Comparison to Fluke 5520A Multiproduct Calibrator
	(10 to 45) Hz	0.18 % of reading + 0.1 mA	
	45 Hz to 1 kHz	0.06 % of reading + 0.1 mA	
	(1 to 5) kHz	0.6 % of reading + 1 mA	
AC Current – Source <sup>1</sup>	(5 to 10) kHz	2.5 % of reading + 5 mA	
	(11 to 20.5) A		Comparison to Fluke 5520A Multiproduct Calibrator
	(45 to 100) Hz	0.12 % of reading + 5 mA	
	100 Hz to 1 kHz	0.15 % of reading + 5 mA	
	(1 to 5) kHz	3 % of reading + 5 mA	

## Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current – Source <sup>1</sup> Extended Frequency Ranges	(29 to 330) $\mu$ A (10 to 30) kHz (0.33 to 3.3) mA (10 to 30) kHz (3.3 to 33) mA (10 to 30) kHz (33 to 330) mA (10 to 30) kHz	1.2 % of reading + 0.4 $\mu$ A 0.78 % of reading + 0.6 $\mu$ A 0.31 % of reading + 4 $\mu$ A 0.31 % of reading + 0.2 mA	Comparison to Fluke 5520A Multiproduct Calibrator
AC Clamp-on Ammeters (Toroidal Type) Transformer Type Sensor <sup>1</sup>	(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	0.3 % of reading + 26 mA 0.83 % of reading + 47 mA 0.35 % of reading + 0.12 A 1.1 % of reading + 0.22 A	Comparison to Fluke 5520A Multiproduct Calibrator, Fluke 5500A/COIL 50-turn Coil
AC Clamp-on Ammeters (Non-Toroidal Type) Hall Effect Sensor <sup>1</sup>	(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	0.57 % of reading + 0.25 A 1 % of reading + 0.25 A 0.6 % of reading + 0.9 A 1.3 % of reading + 0.92 A	Comparison to Fluke 5520A Multiproduct Calibrator, Fluke 5500A/COIL 50-turn Coil
AC Current – Measure <sup>1</sup>	Up to 100 $\mu$ A (10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 1 kHz (0.1 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	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 $\mu$ A 0.17 % of reading + 0.23 $\mu$ A 0.07 % of reading + 0.23 $\mu$ A 0.038 % of reading + 0.23 $\mu$ A 0.46 % of reading + 2.3 $\mu$ A 0.17 % of reading + 2.3 $\mu$ A 0.071 % of reading + 2.3 $\mu$ A 0.038 % of reading + 2.3 $\mu$ A 0.48 % of reading + 23 $\mu$ A 0.17 % of reading + 23 $\mu$ A 0.071 % of reading + 23 $\mu$ A 0.037 % of reading + 23 $\mu$ A	Comparison to Agilent 3458A Opt 002 8.5 Digit Multimeter



**Electrical – DC/Low Frequency**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current – Measure <sup>1</sup>	(0.1 to 1) A (10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz	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 Opt 002 8.5 Digit Multimeter
AC Current – Measure <sup>1</sup>	(1 to 20) A (50 to 100) Hz (100 to 300) Hz 300 Hz to 1 kHz (1 to 3) kHz (3 to 4) kHz (4 to 5) kHz	0.02 % of reading 0.03 % of reading 0.03 % of reading 0.06 % of reading 0.07 % of reading 0.09 % of reading	Comparison to Fluke Y5020 Precision AC Current Shunt, Precision Digital Multimeter
AC Current – Measure <sup>1</sup>	(20 to 100) A (50 to 60) Hz 400 Hz 1 kHz	0.022 % of reading + 5 mA 0.026 % of reading + 5 mA 0.11 % of reading + 1.3 mA	Comparison to AC Current Shunt, Agilent 3458A 8.5 Digit Multimeter
AC Resistance – Measure <sup>1</sup>	1 kHz 20 $\Omega$ to 100 k $\Omega$	0.039 % of reading + 10 m $\Omega$	Comparison to General Radio 1689 Precision LCR Meter
AC Resistance – Measure	50 Hz to 100 kHz (0.1 to 15) $\Omega$ 100 Hz to 100 kHz (15 to 420) $\Omega$ 100 Hz to 10 kHz (0.42 to 32) k $\Omega$ 100 Hz to 100 kHz (32 to 320) k $\Omega$ (0.32 to 10) M $\Omega$	0.12 % of reading 0.06 % of reading 0.06 % of reading 0.06 % of reading 0.12 % of reading	Comparison to Agilent 4284A Precision LCR Meter
AC Resistance – Measure	0.1 $\Omega$ 1 $\Omega$ 10 $\Omega$ 100 $\Omega$ 1 k $\Omega$ 10 k $\Omega$ 100 k $\Omega$	0.17 % of reading 0.12 % of reading 0.12 % of reading 0.05 % of reading 0.05 % of reading 0.13 % of reading 0.26 % of reading	Comparison to Impedance Standards
DC Resistance – Source <sup>1</sup> (Fixed Artifacts)	333 $\mu\Omega$ 1 m $\Omega$ 10 m $\Omega$ 100 m $\Omega$	0.12 % of reading 0.06 % of reading 0.01 % of reading 0.01 % of reading	Comparison to Guideline 9211 Precision Multi-tap DC Current Shunt

# Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
DC Resistance – Source <sup>1</sup> (Artifacts)	1 $\Omega$ 10 k $\Omega$	10 $\mu\Omega$ 54 m $\Omega$	Comparison to Fluke 742A Resistance Standard
DC High Resistance – Source <sup>1</sup> (Variable Artifact)	1 G $\Omega$ 10 G $\Omega$ 100 G $\Omega$ 1 T $\Omega$	0.2 % of reading 0.5 % of reading 0.55 % of reading 0.56 % of reading	Comparison to IET Labs HRRS-Q-8-100k-10 kV Precision Decade Resistor
DC Resistance – Source <sup>1</sup> (Fixed Artifacts)	0 $\Omega$ 1 $\Omega$ 1.9 $\Omega$ 10 $\Omega$ 19 $\Omega$ 100 $\Omega$ 190 $\Omega$ 1 k $\Omega$ 1.9 k $\Omega$ 10 k $\Omega$ 19 k $\Omega$ 100 k $\Omega$ 190 k $\Omega$ 1 M $\Omega$ 1.9 M $\Omega$ 10 M $\Omega$ 19 M $\Omega$ 100 M $\Omega$	40 $\mu\Omega$ 95 $\mu\Omega/\Omega$ 95 $\mu\Omega/\Omega$ 23 $\mu\Omega/\Omega$ 23 $\mu\Omega/\Omega$ 10 $\mu\Omega/\Omega$ 10 $\mu\Omega/\Omega$ 6.5 $\mu\Omega/\Omega$ 6.5 $\mu\Omega/\Omega$ 6.5 $\mu\Omega/\Omega$ 6.5 $\mu\Omega/\Omega$ 8.5 $\mu\Omega/\Omega$ 8.5 $\mu\Omega/\Omega$ 13 $\mu\Omega/\Omega$ 18 $\mu\Omega/\Omega$ 40 $\mu\Omega/\Omega$ 47 $\mu\Omega/\Omega$ 100 $\mu\Omega/\Omega$	Comparison to Fluke 5730A Multiproduct Calibrator
DC Resistance – Measure <sup>1</sup>	(0 to 10) $\Omega$ (10 to 100) $\Omega$ (0.1 to 1) k $\Omega$ (1 to 10) k $\Omega$ (10 to 100) k $\Omega$ (0.1 to 1) M $\Omega$ (1 to 10) M $\Omega$ (10 to 100) M $\Omega$ (0.1 to 1) G $\Omega$	18 $\mu\Omega/\Omega$ + 58 $\mu\Omega$ 15 $\mu\Omega/\Omega$ + 0.58 m $\Omega$ 13 $\mu\Omega/\Omega$ + 0.58 m $\Omega$ 12 $\mu\Omega/\Omega$ + 5.8 m $\Omega$ 13 $\mu\Omega/\Omega$ + 58 m $\Omega$ 21 $\mu\Omega/\Omega$ + 2.3 $\Omega$ 62 $\mu\Omega/\Omega$ + 0.12 k $\Omega$ 0.059 % of reading + 1.2 k $\Omega$ 0.82 % of reading + 12 k $\Omega$	Comparison to Agilent 3458A Opt 002 8.5 Digit Multimeter characterized with Standard Resistors.
DC High Resistance – Measure <sup>1</sup>	(1 to 2) G $\Omega$ (2 to 20) G $\Omega$ (20 to 200) G $\Omega$	1.7 % of reading + 0.1 M $\Omega$ 1.7 % of reading + 1 M $\Omega$ 1.8 % of reading + 10 M $\Omega$	Comparison to Keithley 617 Electrometer



## Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
DC Voltage – Source <sup>1</sup>	(0 to 220) mV (0.22 to 2.2) V (2.2 to 11) V (11 to 22) V (22 to 220) V	7.5 $\mu$ V/V + 0.4 $\mu$ V 5 $\mu$ V/V + 0.7 $\mu$ V 3.5 $\mu$ V/V + 2.5 $\mu$ V 3.5 $\mu$ V/V + 4 $\mu$ V 5 $\mu$ V/V + 40 $\mu$ V	Comparison to Fluke 5730A Multiproduct Calibrator
DC Voltage – Source <sup>1</sup>	(220 to 1 100) V	6.5 $\mu$ V/V + 0.4 mV	Comparison to Fluke 5730A Multiproduct Calibrator, Fluke 5725A Amplifier
DC High Voltage – Source <sup>1</sup>	(1.1 to 20) kV (20 to 36) kV	0.096 % of reading + 1.1 V 0.096 % of reading + 10 V	Comparison to High Voltage Source, Vitretek 4700 Digital HV Meter, Vitretek HVL-100 High Voltage Probe
DC Voltage – Measure <sup>1</sup>	(0 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 $\mu$ V/V + 0.58 $\mu$ V 5.3 $\mu$ V/V + 0.58 $\mu$ V 7.7 $\mu$ V/V + 35 $\mu$ V 15 $\mu$ V/V + 0.12 mV 18 $\mu$ V/V + 0.12 mV 21 $\mu$ V/V + 0.12 mV	Comparison to Agilent 3458A Opt 002 8.5 Digit Multimeter
DC High Voltage – Measure <sup>1</sup>	(1 to 5) kV (5 to 10) kV (10 to 20) kV (20 to 50) kV (50 to 70) kV (70 to 100) kV	0.04 % of reading + 0.26 V 0.04 % of reading + 1.7 V 0.065 % of reading + 1.1 V 0.066 % of reading + 10 V 0.067 % of reading + 28 V 0.069 % of reading + 81 V	Comparison to Vitretek 4700 Digital HV Meter, Associated High Voltage Probes
AC Voltage – Source <sup>1</sup>	Up to 2.2 mV (10 to 20) Hz (20 to 40) Hz (0.04 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (0.5 to 1) MHz	0.024 % of reading + 4 $\mu$ V 0.009 % of reading + 4 $\mu$ V 0.008 % of reading + 4 $\mu$ V 0.02 % of reading + 4 $\mu$ V 0.05 % of reading + 5 $\mu$ V 0.11 % of reading + 10 $\mu$ V 0.14 % of reading + 20 $\mu$ V 0.27 % of reading + 20 $\mu$ V	Comparison to Fluke 5730A Multiproduct Calibrator

**Electrical – DC/Low Frequency**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Source <sup>1</sup>	(2.2 to 22) mV		Comparison to Fluke 5730A Multiproduct Calibrator
	(10 to 20) Hz	0.024 % of reading + 4 $\mu$ V	
	(20 to 40) Hz	0.009 % of reading + 4 $\mu$ V	
	(0.04 to 20) kHz	0.008 % of reading + 4 $\mu$ V	
	(20 to 50) kHz	0.02 % of reading + 4 $\mu$ V	
	(50 to 100) kHz	0.05 % of reading + 5 $\mu$ V	
	(100 to 300) kHz	0.11 % of reading + 10 $\mu$ V	
	(300 to 500) kHz	0.14 % of reading + 20 $\mu$ V	
	(0.5 to 1) MHz	0.27 % of reading + 20 $\mu$ V	
	(22 to 220) mV		
	(10 to 20) Hz	0.024 % of reading + 12 $\mu$ V	
	(20 to 40) Hz	0.009 % of reading + 7 $\mu$ V	
	40 Hz to 20 kHz	0.005 7 % of reading + 7 $\mu$ V	
	(20 to 50) kHz	0.012 % of reading + 7 $\mu$ V	
	(50 to 100) kHz	0.031 % of reading + 17 $\mu$ V	
	(100 to 300) kHz	0.066 % of reading + 20 $\mu$ V	
	(300 to 500) kHz	0.14 % of reading + 25 $\mu$ V	
	500 kHz to 1 MHz	0.27 % of reading + 45 $\mu$ V	
	(0.22 to 2.2) V		
	(10 to 20) Hz	0.024 % of reading + 40 $\mu$ V	
	(20 to 40) Hz	0.009 % of reading + 15 $\mu$ V	
	40 Hz to 20 kHz	0.004 2 % of reading + 8 $\mu$ V	
	(20 to 50) kHz	0.006 7 % of reading + 10 $\mu$ V	
	(50 to 100) kHz	0.008 5 % of reading + 30 $\mu$ V	
	(100 to 300) kHz	0.034 % of reading + 80 $\mu$ V	
	(300 to 500) kHz	0.1 % of reading + 0.2 mV	
	500 kHz to 1 MHz	0.17 % of reading + 0.3 mV	
	(2.2 to 22) V		
	(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 + 0.05 mV	
	(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	0.026 % 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	

## Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Source <sup>1</sup>	(22 to 220) V (10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz	0.024 % of reading + 4 mV 0.009 % of reading + 1.5 mV 0.005 2 % of reading + 0.6 mV 0.008 % of reading + 1 mV 0.015 % of reading + 2.5 mV 0.09 % of reading + 16 mV 0.44 % of reading + 40 mV 0.8 % of reading + 80 mV	Comparison to Fluke 5730A Multiproduct Calibrator
AC Voltage – Source <sup>1</sup>	(220 to 750) V (30 to 50) kHz (50 to 100) kHz (220 to 1 100) V 40 Hz to 1 kHz (1 to 20) kHz (20 to 30) kHz	0.06 % of reading + 11 mV 0.23 % of reading + 45 mV 0.009 % of reading + 4 mV 0.017 % of reading + 6 mV 0.06 % of reading + 11 mV	Comparison to Fluke 5730A Multiproduct Calibrator, Fluke 5725A Amplifier
AC Voltage – Measure <sup>1</sup>	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 $\mu$ V 3.5 % of reading + 2.4 $\mu$ V 9.3 % of reading + 2.4 $\mu$ V 23 % of reading + 2.4 $\mu$ V 0.97 % of reading + 2 $\mu$ V 3.5 % of reading + 2 $\mu$ V 9.3 % of reading + 2 $\mu$ V 23 % of reading + 2 $\mu$ V 0.91 % of reading + 3 $\mu$ V 1.8 % of reading + 3 $\mu$ V 2.9 % of reading + 3 $\mu$ V 6.9 % of reading + 3 $\mu$ V 14 % of reading + 3 $\mu$ V	Comparison to Rohde & Schwarz URE3 RMS Voltmeter
AC Voltage – Measure <sup>1</sup>	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 $\mu$ V 0.03 % of reading + 1.2 $\mu$ V 0.04 % of reading + 1.2 $\mu$ V 0.15 % of reading + 1.2 $\mu$ V 0.59 % of reading + 1.2 $\mu$ V 4.6 % of reading + 2.3 $\mu$ V 1.5 % of reading + 5.8 $\mu$ V 8.1 % of reading + 8.1 $\mu$ V	Comparison to Agilent 3458A Opt 002 8.5 Digit Multimeter

**Electrical – DC/Low Frequency**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Measure <sup>1</sup>	(10 to 100) mV		Comparison to Agilent 3458A Opt 002 8.5 Digit Multimeter
	(1 to 40) Hz	0.013 % of reading + 4 $\mu$ V	
	40 Hz to 1 kHz	0.009 5 % of reading + 2 $\mu$ V	
	(1 to 20) kHz	0.017 % of reading + 2 $\mu$ V	
	(20 to 50) kHz	0.037 % of reading + 2 $\mu$ V	
	(50 to 100) kHz	0.093 % of reading + 2 $\mu$ V	
	(100 to 300) kHz	0.36 % of reading + 10 $\mu$ V	
	300 kHz to 1 MHz	1.2 % of reading + 10 $\mu$ V	
	(1 to 2) MHz	1.8 % of reading + 12 $\mu$ V	
	(2 to 4) MHz	4.7 % of reading + 81 $\mu$ V	
	(4 to 8) MHz	4.7 % of reading + 92 $\mu$ 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 $\mu$ V	
	40 Hz to 1 kHz	0.008 3 % of reading + 23 $\mu$ V	
	(1 to 20) kHz	0.017 % of reading + 23 $\mu$ V	
	(20 to 50) kHz	0.036 % of reading + 23 $\mu$ V	
	(50 to 100) kHz	0.093 % of reading + 23 $\mu$ 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 + 1.2 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 <sup>1</sup>	(10 to 100) V		Comparison to Agilent 3458A Opt 002 8.5 Digit Multimeter
	(1 to 40) Hz	0.024 % of reading + 4.6 mV	
	40Hz 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 High Voltage – Measure <sup>1</sup>	(0.7 to 5) kV		Comparison to Vitretek 4700 Digital HV Meter, Associated High Voltage Probes
	(10 to 200) Hz	0.14 % of reading + 0.34 V	
	(200 to 450) Hz	0.47 % of reading + 0.34 V	
	(5 to 10) kV		
	(10 to 200) Hz	0.16 % of reading + 1.9 V	
	(200 to 450) Hz	0.47 % of reading + 1.9 V	
	(10 to 20) kV		
	(30 to 70) Hz	0.16 % of reading + 1.4 V	
	(70 to 200) Hz	1.2 % of reading + 1.4 V	
	(200 to 450) Hz	2.9 % of reading + 1.8 V	
	(20 to 50) kV		
	(30 to 70) Hz	0.16 % of reading + 11 V	
	(70 to 200) Hz	1.2 % of reading + 11 V	
	(200 to 450) Hz	2.9 % of reading + 21 V	
Capacitance – Source <sup>1</sup> (Fixed Artifacts)	1 kHz		Comparison to Arco SS32 Capacitor Set
	(0.1 to 0.5) nF	0.59 pF	
	0.5 nF to 1.4 $\mu$ F	0.12 % of reading + 18 fF	

**Electrical – DC/Low Frequency**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Capacitance – Source <sup>1</sup> (Fixed Artifacts)	1 pF		Comparison to HP 16380A Series, HP 16830C Series Standard Air Capacitor Set
	1 kHz to 1 MHz	0.32 fF	
	(1 to 2) MHz	0.62 fF	
	(2 to 3) MHz	1.1 fF	
	(3 to 4) MHz	1.6 fF	
	(4 to 5) MHz	2.2 fF	
	(5 to 10) MHz	6.3 fF	
	(10 to 13) MHz	9.3 fF	
	10 pF		
	1 kHz to 5 MHz	2.5 fF	
	(5 to 10) MHz	3.7 fF	
	(10 to 13) MHz	4.5 fF	
	100 pF		
	1 kHz to 3 MHz	27 fF	
	(3 to 4) MHz	31 fF	
	(4 to 5) MHz	39 fF	
	(5 to 10) MHz	86 fF	
	(10 to 13) MHz	0.13 pF	
	1 000 pF		
	20 Hz to 1 MHz	0.27 pF	
	(1 to 2) MHz	0.43 pF	
	(2 to 3) MHz	0.74 pF	
	(3 to 4) MHz	1.1 pF	
	(4 to 5) MHz	1.6 pF	
	(5 to 10) MHz	4.8 pF	
	(10 to 13) MHz	7 pF	
	10 nF		
	120 Hz to 10 kHz	2.4 pF	
	(10 to 100) kHz	2.9 pF	
	100 nF		
	120 Hz to 10 kHz	25 pF	
	(10 to 100) kHz	30 pF	
	1 μF		
	120 Hz to 10 kHz	0.37 nF	
	(10 to 100) kHz	1.1 nF	
	10 μF		
	20 Hz to 1 kHz	3.4 nF	
	(1 to 10) kHz	6.1 nF	
	(10 to 100) kHz	34 nF	



**Electrical – DC/Low Frequency**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Dissipation Factor – Source <sup>4</sup> (Fixed Artifacts)	1 pF		Comparison to HP 16380A Series, HP 16830C Series Standard Air Capacitor Set
	1 kHz to 1 MHz	0.000 23	
	(1 to 2) MHz	0.000 15	
	(2 to 3) MHz	0.000 23	
	(3 to 4) MHz	0.000 35	
	(4 to 5) MHz	0.000 50	
	(5 to 10) MHz	0.001 4	
	(10 to 13) MHz	0.002 1	
	10 pF		
	1 kHz to 5 MHz	0.000 15	
	(5 to 10) MHz	0.000 2	
	(10 to 13) MHz	0.000 24	
	100 pF		
	1 kHz to 3 MHz	0.000 12	
	(3 to 4) MHz	0.000 13	
	(4 to 5) MHz	0.000 15	
	(5 to 10) MHz	0.000 4	
	(10 to 13) MHz	0.000 6	
	1 000 pF		
	20 Hz to 1 MHz	0.000 12	
	(1 to 2) MHz	0.000 15	
	(2 to 3) MHz	0.000 25	
	(3 to 4) MHz	0.000 38	
	(4 to 5) MHz	0.000 53	
	(5 to 10) MHz	0.001 5	
	(10 to 13) MHz	0.002 1	
	10 nF		
	120 Hz to 100 kHz	0.000 23	
	100 nF		
	120 Hz to 100 kHz	0.000 29	
	1 µF		
	120 Hz to 100 kHz	0.000 41	
	10 µF		
	20 Hz to 1 kHz	0.000 29	
	(1 to 10) kHz	0.000 7	
	(10 to 100) kHz	0.001 8	

**Electrical – DC/Low Frequency**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Capacitance – Source <sup>1</sup> (Simulated)	10 Hz to 10 kHz (0.19 to 1.1) nF	0.39 % of reading + 7.8 pF	Comparison to Fluke 5520A Multiproduct Calibrator
	10 Hz to 3 kHz (1.1 to 3.3) nF	0.39 % of reading + 7.8 pF	
	10 Hz to 1 kHz (3.3 to 11) nF	0.2 % of reading + 7.8 pF	
	(11 to 110) nF	0.2 % of reading + 78 pF	
	(110 to 330) nF	0.2 % of reading + 0.23 nF	
	(10 to 600) Hz (0.33 to 1.1) $\mu$ F	0.2 % of reading + 0.78 nF	
	(10 to 300) Hz (1.1 to 3.3) $\mu$ F	0.2 % of reading + 2.3 nF	
	(10 to 150) Hz (3.3 to 11) $\mu$ F	0.2 % of reading + 7.8 nF	
	(10 to 120) Hz (11 to 33) $\mu$ F	0.32 % of reading + 23 nF	
	(10 to 80) Hz (33 to 110) $\mu$ F	0.35 % of reading + 78 nF	
	DC to 50 Hz (110 to 330) $\mu$ F	0.37 % of reading + 0.23 $\mu$ F	
	DC to 20 Hz (0.33 to 1.1) mF	0.37 % of reading + 0.78 $\mu$ F	
	DC to 6 Hz (1.1 to 3.3) mF	0.35 % of reading + 2.3 $\mu$ F	
	DC to 2 Hz (3.3 to 11) mF	0.35 % of reading + 7.8 $\mu$ F	
	DC to 0.6 Hz (11 to 33) mF	0.58 % of reading + 23 $\mu$ F	
	DC to 0.2 Hz (33 to 110) mF	0.85 % of reading + 78 $\mu$ F	
Capacitance – Measure <sup>1</sup>	1 kHz Up to 10 pF	0.47 % of reading + 0.05 pF	Comparison to General Radio 1689 Precision LCR Meter
	(10 to 100) pF	0.058 % of reading + 0.05 pF	
	(0.1 to 1) $\mu$ F	0.024 % of reading + 0.05 pF	
	(1 to 100) $\mu$ F	0.04 % of reading	
	(0.1 to 1) mF	0.24 % of reading	

**Electrical – DC/Low Frequency**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Capacitance – Measure <sup>1</sup>	1 MHz		Comparison to Agilent 4284A Precision LCR Meter
	(10 to 90) pF	0.12 % of reading	
	90 pF to 10 nF	0.06 % of reading	
	100 kHz		
	(12 to 90) pF	0.12 % of reading	
	90 pF to 100 nF	0.06 % of reading	
	(0.1 to 100) $\mu$ F	0.12 % of reading	
	10 kHz		
	(10 to 80) pF	0.12 % of reading	
	80 pF to 1 $\mu$ F	0.06 % of reading	
Inductance – Source <sup>1</sup> (Artifact)	400 Hz		Comparison to Standard Inductor
	10 nF to 10 $\mu$ F	0.06 % of reading	
	(100 to 120) Hz		
	10 nF to 100 $\mu$ F	0.06 % of reading	
	100 $\mu$ F to 12 mF	0.12 % of reading	
Inductance – Measure <sup>1</sup>	1 kHz		Comparison to Agilent 4284A Precision LCR Meter
	100 mH	0.14 mH	
	100 Hz to 1 kHz		
	(1 to 100) mH	0.04 % of reading + 0.1 $\mu$ H	
	(0.1 to 10) H	0.057 % of reading + 1.4 $\mu$ H	
	400 Hz		
	5 $\mu$ H to 5 mH	0.12 % of reading	
	5 mH to 10 H	0.06 % of reading	
	(100 to 120) Hz		
	(0.12 to 20) mH	0.12 % of reading	
	20 mH to 10 H	0.06 % of reading	
	1 kHz		
	1 $\mu$ H to 1 mH	0.12 % of reading	
	10 kHz		
	5 nH to 120 $\mu$ H	0.12 % of reading	
	120 $\mu$ H to 100 mH	0.06 % of reading	

## Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Oscilloscopes <sup>1</sup>			<p>Comparison to Fluke 9500B Oscilloscope Calibrator, Fluke 9530 3.2 GHz Active Head, Fluke 9560 Active Head w/ 70 ps Capability</p>
Amplitude – DC into 50 $\Omega$ load	(-5 to 5) V	0.023 % of reading + 19 $\mu$ V	
into 1 M $\Omega$ load	(-200 to 200) V	0.023 % of reading + 19 $\mu$ V	
Amplitude – Square Wave Rate: 10 Hz to 10 kHz			
into 50 $\Omega$ load	40 $\mu$ Vp-p to 1 mVp-p 1 mVp-p to 5 Vp-p	0.78 % of reading + 7.8 $\mu$ V 0.078 % of reading + 7.8 $\mu$ V	
into 1 M $\Omega$ load	40 $\mu$ Vp-p to 1 mVp-p	0.78 % of reading + 7.8 $\mu$ V	
Rate: 10 Hz to 100 kHz			
into 50 $\Omega$ load	1 mVp-p to 5 Vp-p	0.16 % of reading + 7.8 $\mu$ V	
into 1 M $\Omega$ load	1 mVp-p to 200 Vp-p	0.78 % of reading + 7.8 $\mu$ V	
Time Markers 100 mVp-p to 1 Vp-p into 50 $\Omega$ load			
Square Wave	9.009 1 ns to 83 $\mu$ s 83 $\mu$ s to 55s	0.19 $\mu$ s/s 2.3 $\mu$ s/s	
Sine Wave	450.5 ps to 9.009 ns	0.19 $\mu$ s/s	
Pulse	900.91 ns to 83 $\mu$ s 83 $\mu$ s to 55s	0.19 $\mu$ s/s 2.3 $\mu$ s/s	
Triangle Wave	900.91 ns to 83 $\mu$ s 83 $\mu$ s to 55s	0.19 $\mu$ s/s 2.3 $\mu$ s/s	

**Electrical – DC/Low Frequency**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Oscilloscopes <sup>1,2</sup> Rise Time into 50 $\Omega$ load Rate: 10 Hz to 2 MHz	5 mVp-p to 3 Vp-p 500 ps (nominal) 150 ps (nominal)	290 ps 34 ps	Comparison to Fluke 9500B Oscilloscope Calibrator, Fluke 9530 3.2 GHz Active Head, Fluke 9550 Active Head w/ 25 ps Capability, Fluke 9560 Active Head w/ 70 ps Capability, Tektronix 067-1330-000 Calibration Fixture
Rate: 10 Hz to 1 MHz	25 mVp-p to 2 Vp-p 70 ps (nominal) 425 mVp-p to 575 mVp-p 25 ps (nominal) 200 mVp-p 16 ps (nominal)	21 ps 5.7 ps 2.1 ps	
Leveled Sine Wave 50 kHz Reference into 50 $\Omega$ load	5 mVp-p to 5 Vp-p 50 kHz to 10 MHz	1.2 % of reading	
Input Impedance Measure	(10 to 40) $\Omega$ (40 to 90) $\Omega$ (90 to 150) $\Omega$ (50 to 800) k $\Omega$ (0.8 to 1.2) M $\Omega$ (1.2 to 12) M $\Omega$	0.39 % of reading 0.083 % of reading 0.39 % of reading 0.39 % of reading 0.083 % of reading 0.39 % of reading	
Input Capacitance Measure	(1 to 35) pF (35 to 95) pF	1.6 % of reading + 0.19 pF 2.3 % of reading + 0.19 pF	
Phase – Source <sup>1</sup>	Up to 180° (10 to 65) Hz (65 to 500) Hz 500 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (10 to 20) kHz	0.11° 0.2° 0.4° 1.9° 3.9° 7.8°	Comparison to Fluke 5520A Multiproduct Calibrator

**Electrical – DC/Low Frequency**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
DC Power – Source <sup>1</sup> (0.33 to 330) mA	11 $\mu$ W to 1.1 mW 1.1 mW to 0.11 W (0.11 to 110) W (110 to 330) W	0.024 % of reading 0.027 % of reading 0.024 % of reading 0.018 % of reading	Comparison to Fluke 5520A Multiproduct Calibrator
(0.33 to 3) A	11 $\mu$ W to 110 mW (0.11 to 990) W (0.99 to 3) kW	0.044 % of reading 0.053 % of reading 0.009 6 % of reading	
(3 to 20.5) A	99 mW to 0.99 W 0.99 W to 6.8 kW (6.8 to 20.5) kW	0.088 % of reading 0.07 % of reading 0.04 % of reading	
AC Power – Source <sup>1,3</sup> PF = 1			Comparison to Fluke 5520A Multiproduct Calibrator
(3.3 to 9) mA	(10 to 65) Hz (0.11 mW to 3) mW 3 mW to 9 W	0.13 % of reading 0.077 % of reading	
(9 to 33) mA	(10 to 65) W (0.3 to 10) mW 10 mW to 33 W	0.089 % of reading 0.077 % of reading	
(33 to 90) mA	(10 to 65) Hz (1 to 30) mW 30 mW to 90 W	0.071 % of reading 0.057 % of reading	
(90 to 330) mA	(10 to 65) Hz (3 to 100) mW 100 mW to 300 W	0.089 % of reading 0.078 % of reading	
(0.33 to 0.9) A	(10 to 65) Hz (11 to 300) mW (0.3 to 900) W	0.071 % of reading 0.081 % of reading	
(0.9 to 2.2) A	(10 to 65) Hz (30 to 720) mW 0.72 W to 2 kW	0.089 % of reading 0.079 % of reading	
(2.2 to 4.5) A	(10 to 65) Hz 80 mW to 1.4 W 1.4 W to 4.5 kW	0.088 % of reading 0.18 % of reading	
(4.5 to 20.5) A	(10 to 65) Hz 150 mW to 230 kW	0.17 % of reading	



**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 <sup>1</sup>	Type B		Comparison to Ectron 1140A Thermocouple Calibrator/Simulator
	(250 to 350) °C	1.2 °C	
	(350 to 445) °C	0.9 °C	
	(445 to 580) °C	0.71 °C	
	(580 to 750) °C	0.55 °C	
	(750 to 1 000) °C	0.45 °C	
	(1 000 to 1 820) °C	0.35 °C	
	Type C		
	(0 to 250) °C	0.24 °C	
	(250 to 1 000) °C	0.19 °C	
	(1 000 to 1 500) °C	0.21 °C	
	(1 500 to 1 800) °C	0.24 °C	
	(1 800 to 2 000) °C	0.27 °C	
	(2 000 to 2 250) °C	0.33 °C	
	(2 250 to 2 315) °C	0.37 °C	
	Type E		
	(-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	0.095 °C	
	(-90 to 0) °C	0.08 °C	
	(0 to 15) °C	0.076 °C	
	(15 to 890) °C	0.064 °C	
	(890 to 1 000) °C	0.074 °C	
	Type J		
	(-210 to -180) °C	0.15 °C	
	(-180 to -120) °C	0.12 °C	
	(-120 to -50) °C	0.093 °C	
	(-50 to 990) °C	0.08 °C	
	(990 to 1 200) °C	0.094 °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	0.087 °C	
	(1 000 to 1 372) °C	0.096 °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 <sup>1</sup>	Type N		Comparison to Ectron 1140A Thermocouple Calibrator/Simulator
	(-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	
	Type S		
	(-50 to -30) °C	0.76 °C	
	(-30 to 45) °C	0.68 °C	
	(45 to 105) °C	0.49 °C	
	(105 to 310) °C	0.41 °C	
	(310 to 615) °C	0.35 °C	
	(615 to 1 768) °C	0.31 °C	
	Type T		
	(-270 to -255) °C	1.9 °C	
	(-255 to -240) °C	0.6 °C	
	(-240 to -210) °C	0.36 °C	
	(-210 to -150) °C	0.22 °C	
	(-150 to -40) °C	0.15 °C	
	(-40 to 100) °C	0.095 °C	
	(100 to 400) °C	0.08 °C	
Bandwidth Flatness Measure <sup>1</sup> into VSWR (1.2:1) (wrt Reference Frequency)	5 mVp-p to 5 Vp-p 100 Hz to 300 MHz (300 to 550) MHz 5 mVp-p to 3 Vp-p 550 MHz to 1.1 GHz (1.1 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  3.1 % of reading	Comparison to Fluke 9500B/3200 Oscilloscope Calibrator, Fluke 9530 3.2 GHz Active Head

**Electrical – DC/Low Frequency**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Bandwidth Flatness Measure <sup>1</sup> into VSWR (1.2:1)	5 mVp-p to 5 Vp-p 100 Hz to 300 MHz (300 to 550) MHz 5 mVp-p to 3 Vp-p 550 MHz to 1.1 GHz (1.1 to 2.5) GHz 5 mVp-p to 2 Vp-p (2.5 to 3) GHz 25 mVp-p to 2 Vp-p (3 to 6) GHz	1.6 % of reading 1.9 % of reading 2.3 % of reading 2.3 % of reading 2.3 % of reading 3.1 % of reading	Comparison to Fluke 9500B/1100 Oscilloscope Calibrator, Fluke 9560 6 GHz Active Head
AC Voltage – Source <sup>1</sup> Wide-Band Voltage (50 $\Omega$ )	30 Hz to 500 kHz (0.33 to 1.1) mV (1.1 to 3.3) mV (3.3 to 11) mV (11 to 33) mV (33 to 110) mV (110 to 330) mV (0.33 to 1.1) V (1.1 to 3.5) V	0.62 % of reading + 0.78 $\mu$ V 0.54 % of reading + 1.2 $\mu$ V 0.054 % of reading + 3.1 $\mu$ V 0.47 % of reading + 6.2 $\mu$ V 0.47 % of reading + 16 $\mu$ V 0.39 % of reading + 39 $\mu$ V 0.39 % of reading + 0.16 mV 0.31 % of reading + 0.19 mV	Comparison to Fluke 5730A Multiproduct Calibrator
AC Voltage – Source <sup>1</sup> Wide-Band Voltage (50 $\Omega$ ) 1 kHz Reference	(0.33 to 1.1) mV (10 to 30) Hz (30 to 119.99) Hz 120 Hz to 1.199 9 kHz (1.2 to 11.999) kHz (12 to 119.99) kHz 120 Hz to 1.199 9 MHz (1.2 to 2) MHz (2 to 11.9) MHz (12 to 20) MHz (20 to 30) MHz	0.23 % of reading 0.078 % of reading 0.078 % of reading 0.078 % of reading 0.078 % of reading 0.16 % of reading + 1.2 $\mu$ V 0.16 % of reading + 1.2 $\mu$ V 0.16 % of reading + 1.2 $\mu$ V 0.16 % of reading + 1.2 $\mu$ V 2.1 % of reading + 5.8 $\mu$ V	Comparison to Fluke 5730A Multiproduct Calibrator

**Electrical – DC/Low Frequency**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Source <sup>1</sup> Wide-Band Voltage (50 $\Omega$ ) 1 kHz Reference	(1.1 to 3.3) mV		Comparison to Fluke 5730A Multiproduct Calibrator
	(10 to 30) Hz	0.23 % of reading	
	(30 to 119.99) Hz	0.078 % of reading	
	120 Hz to 1.199 9 kHz	0.078 % of reading	
	(1.2 to 11.999) kHz	0.078 % of reading	
	(12 to 119.99) kHz	0.078 % of reading	
	120 Hz to 1.199 9 MHz	0.078 % of reading + 1.2 $\mu$ V	
	(1.2 to 2) MHz	0.078 % of reading + 1.2 $\mu$ V	
	(2 to 11.9) MHz	0.23 % of reading + 1.2 $\mu$ V	
	(12 to 20) MHz	0.39 % of reading + 1.2 $\mu$ V	
	(20 to 30) MHz	1.2 % of reading + 1.2 $\mu$ V	
	(3.3 to 11) mV		
	(10 to 30) Hz	0.23 % of reading	
	(30 to 119.99) Hz	0.078 % of reading	
	120 Hz to 1.199 9 kHz	0.078 % of reading	
	(1.2 to 11.999) kHz	0.078 % of reading	
	(12 to 119.99) kHz	0.078 % of reading	
	120 Hz to 1.199 9 MHz	0.078 % of reading + 1.2 $\mu$ V	
	(1.2 to 2) MHz	0.078 % of reading + 1.2 $\mu$ V	
	(2 to 11.9) MHz	0.16 % of reading + 1.2 $\mu$ V	
	(12 to 20) MHz	0.31 % of reading + 1.2 $\mu$ V	
	(20 to 30) MHz	0.78 % of reading + 1.2 $\mu$ V	
	(11 to 33) mV		
	(10 to 30) Hz	0.23 % of reading	
	(30 to 119.99) Hz	0.078 % of reading	
	120 Hz to 1.199 9 kHz	0.078 % of reading	
	(1.2 to 11.999) kHz	0.078 % of reading	
	(12 to 119.99) kHz	0.078 % of reading	
	120 Hz to 1.199 9 MHz	0.078 % of reading + 1.2 $\mu$ V	
	(11 to 16.5) mV		
	(1.2 to 2) MHz	0.16 % of reading + 1.2 $\mu$ V	
	(2 to 11.9) MHz	0.23 % of reading + 1.2 $\mu$ V	
	(12 to 20) MHz	0.39 % of reading + 1.2 $\mu$ V	
	(20 to 30) MHz	0.85 % of reading + 1.2 $\mu$ V	
	(16.5 to 33) mV		
	(1.2 to 2) MHz	0.078 % of reading + 1.2 $\mu$ V	
	(2 to 11.9) MHz	0.16 % of reading + 1.2 $\mu$ V	
	(12 to 20) MHz	0.31 % of reading + 1.2 $\mu$ V	
	(20 to 30) MHz	0.78 % of reading + 1.2 $\mu$ V	

**Electrical – DC/Low Frequency**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Source <sup>1</sup> Wide-Band Voltage (50 $\Omega$ ) 1 kHz Reference	(33 to 110) mV		Comparison to Fluke 5730A Multiproduct Calibrator
	(10 to 30) Hz	0.23 % of reading	
	(30 to 119.99) Hz	0.078 % of reading	
	120 Hz to 1.199 9 kHz	0.078 % of reading	
	(1.2 to 11.999) kHz	0.078 % of reading	
	(12 to 119.99) kHz	0.078 % of reading	
	120 Hz to 1.199 9 MHz	0.078 % of reading + 1.2 $\mu$ V	
	(33 to 55) mV		
	(1.2 to 2) MHz	0.16 % of reading + 1.2 $\mu$ V	
	(2 to 11.9) MHz	0.23 % of reading + 1.2 $\mu$ V	
	(12 to 20) MHz	0.39 % of reading + 1.2 $\mu$ V	
	(20 to 30) MHz	0.85 % of reading + 1.2 $\mu$ V	
	(55 to 110) mV		
	(1.2 to 2) MHz	0.078 % of reading + 1.2 $\mu$ V	
	(2 to 11.9) MHz	0.16 % of reading + 1.2 $\mu$ V	
	(12 to 20) MHz	0.31 % of reading + 1.2 $\mu$ V	
	(20 to 30) MHz	0.78 % of reading + 1.2 $\mu$ V	
	(110 to 330) V		
	(10 to 30) Hz	0.23 % of reading	
	(30 to 119.99) Hz	0.078 % of reading	
	120 Hz to 1.199 9 kHz	0.078 % of reading	
	(1.2 to 11.999) kHz	0.078 % of reading	
	(12 to 119.99) kHz	0.078 % of reading	
	120 Hz to 1.199 9 MHz	0.078 % of reading + 1.2 $\mu$ V	
	(110 to 165) mV		
	(1.2 to 2) MHz	0.16 % of reading + 1.2 $\mu$ V	
	(2 to 11.9) MHz	0.23 % of reading + 1.2 $\mu$ V	
	(12 to 20) MHz	0.39 % of reading + 1.2 $\mu$ V	
	(20 to 30) MHz	0.85 % of reading + 1.2 $\mu$ V	
	(165 to 330) mV		
	(1.2 to 2) MHz	0.078 % of reading + 1.2 $\mu$ V	
	(2 to 11.9) MHz	0.16 % of reading + 1.2 $\mu$ V	
	(12 to 20) MHz	0.31 % of reading + 1.2 $\mu$ V	
	(20 to 30) MHz	0.78 % of reading + 1.2 $\mu$ V	
	(0.33 to 1.1) V		
	(10 to 30) Hz	0.23 % of reading	
	(30 to 119.99) Hz	0.078 % of reading	
	120 Hz to 1.199 9 kHz	0.078 % of reading	
	(1.2 to 11.999) kHz	0.078 % of reading	
	(12 to 119.99) kHz	0.078 % of reading	
	120 Hz to 1.199 9 MHz	0.078 % of reading + 1.2 $\mu$ V	

# Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Source <sup>1</sup> Wide-Band Voltage (50 $\Omega$ ) 1 kHz Reference	(0.33 to 0.55) V		Comparison to Fluke 5730A Multiproduct Calibrator
	(1.2 to 2) MHz	0.16 % of reading + 1.2 $\mu$ V	
	(2 to 11.9) MHz	0.23 % of reading + 1.2 $\mu$ V	
	(12 to 20) MHz	0.39 % of reading + 1.2 $\mu$ V	
	(20 to 30) MHz	0.85 % of reading + 1.2 $\mu$ V	
	(0.55 to 1.1) V		
	(1.2 to 2) MHz	0.078 % of reading + 1.2 $\mu$ V	
	(2 to 11.9) MHz	0.16 % of reading + 1.2 $\mu$ V	
	(12 to 20) MHz	0.31 % of reading + 1.2 $\mu$ V	
	(20 to 30) MHz	0.78 % of reading + 1.2 $\mu$ V	
	(1.1 to 3.5) V		
	(10 to 30) Hz	0.23 % of reading	
	(30 to 119.99) Hz	0.078 % of reading	
	120 Hz to 1.199 9 kHz	0.078 % of reading	
	(1.2 to 11.999) kHz	0.078 % of reading	
	(12 to 119.99) kHz	0.078 % of reading	
	120 Hz to 1.199 9 MHz	0.078 % of reading + 1.2 $\mu$ V	
	(1.1 to 1.75) V		
	(1.2 to 2) MHz	0.16 % of reading + 1.2 $\mu$ V	
	(2 to 11.9) MHz	0.23 % of reading + 1.2 $\mu$ V	
	(12 to 20) MHz	0.39 % of reading + 1.2 $\mu$ V	
	(20 to 30) MHz	0.85 % of reading + 1.2 $\mu$ V	
	(1.75 to 3.5) V		
	(1.2 to 2) MHz	0.078 % of reading + 1.2 $\mu$ V	
	(2 to 11.9) MHz	0.16 % of reading + 1.2 $\mu$ V	
	(12 to 20) MHz	0.31 % of reading + 1.2 $\mu$ V	
	(20 to 30) MHz	0.78 % of reading + 1.2 $\mu$ V	



**Electrical – RF/Microwave**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Amplitude Modulation – AM Depth Measure <sup>1</sup> Rate: 50 Hz to 10 kHz Rate: 20 Hz to 10 kHz Rate: 50 Hz to 50 kHz	(5 to 99) % Depth 150 kHz to 10 MHz (> 0 to 99) % Depth 150 kHz to 10 MHz (5 to 99) % Depth 10 MHz to 1.3 GHz (1.3 to 26.5) GHz	2.4 % Depth 3.5 % Depth 1.4 % Depth 1.9 % Depth	Comparison to HP 8902A Measuring Receiver
Amplitude Modulation – AM Depth Measure <sup>1</sup> Rate: 20 Hz to 100 kHz	(> 0 to 99) % Depth 10 MHz to 1.3 GHz (1.3 to 26.5) GHz	3.5 % Depth 3.5 % Depth	Comparison to HP 8902A Measuring Receiver
Frequency Modulation – Measure <sup>1</sup> Rate: 50 Hz to 10 kHz Rate: 50 Hz to 100 kHz Rate: 20 Hz to 200 kHz	≤ 40 kHz peak 250 kHz to 10 MHz ≤ 400 kHz peak 10 MHz to 26.5 GHz ≤ 400 kHz peak 10 MHz to 26.5 GHz	2.4 % Deviation 1.4 % Deviation 5.8 % Deviation	Comparison to HP 8902A Measuring Receiver
Phase Modulation – Measure <sup>1</sup> Rate: 200 Hz to 10 kHz Rate: 200 Hz to 20 kHz	< 40 rad Deviation 150 kHz to 10 MHz < 40 rad Deviation 10 MHz to 26.5 GHz	4.9 % Deviation 3.8 % Deviation	Comparison to HP 8902A Measuring Receiver
Harmonic Distortion <sup>1</sup>	(-80 to 0) dBc 30 Hz to 6.5 GHz (6.5 to 22) GHz (22 to 26.5) GHz	1.7 dB 2.6 dB 3.4 dB	Comparison to Agilent 8563E Spectrum Analyzer
Total Harmonic Distortion – Measure <sup>1</sup>	(-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
AM Total Harmonic Distortion – Measure <sup>1</sup>	(-80 to 0) dB 20 Hz to 100 kHz	2.7 dB	Comparison to Agilent 8903B Audio Analyzer

**Electrical – RF/Microwave**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Total Harmonic Distortion – Measure <sup>1</sup> Input Voltage Range 5 Hz to 1.2 MHz < 30 V	(0.3 to 100) % THD 10 Hz to 1 MHz (1 to 3) MHz 0.1 % THD (10 to 20) Hz (20 to 30) Hz 30 Hz to 300 kHz (300 to 500) kHz 500 kHz to 1.2 MHz	3 % of reading 6 % of reading 12 % of reading 6 % of reading 3 % of reading 6 % of reading 12 % of reading	Comparison to Agilent 334A Distortion Analyzer
Total Harmonic Distortion – Measure <sup>1</sup> Input Voltage Range 5 Hz to 1.2 MHz > 30 V	(0.3 to 100) % THD 10 Hz to 300 kHz (300 to 500) kHz 500 kHz to 3 MHz 0.1 % THD (20 Hz to 30) Hz 30 Hz to 300 kHz (300 to 500) kHz 500 kHz to 1.2 MHz	3 % of reading 6 % of reading 12 % of reading 12 % of reading 3 % of reading 6 % of reading 12 % of reading	Comparison to Agilent 334A Distortion Analyzer
Absolute RF Power – Measure <sup>1</sup>	100 kHz to 2.6 GHz (-20 to -10) dBm (-10 to 0) dBm (0 to 10) dBm (10 to 20) dBm (20 to 30) dBm (2.6 to 12.2) GHz (-20 to -10) dBm (-10 to 0) dBm (0 to 10) dBm (10 to 20) dBm (20 to 30) dBm	0.11 dB 0.1 dB 0.11 dB 0.11 dB 0.23 dB 0.14 dB 0.13 dB 0.13 dB 0.14 dB 0.25 dB	Comparison to Agilent 8902A Measuring Receiver, Agilent 11722A Power Sensor, Agilent 11792A Microwave Converter, Agilent 11793A Microwave Converter

**Electrical – RF/Microwave**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Absolute RF Power – Measure <sup>1</sup>	(12.2 to 17.75) GHz		Comparison to Agilent 8902A Measuring Receiver, Agilent 11722A Power Sensor, Agilent 11792A Microwave Converter, Agilent 11793A Microwave Converter
	(-20 to -10) dBm	0.15 dB	
	(-10 to 0) dBm	0.14 dB	
	(0 to 10) dBm	0.14 dB	
	(10 to 20) dBm	0.15 dB	
	(20 to 30) dBm	0.25 dB	
	(17.75 to 26.5) GHz		
	(-20 to -10) dBm	0.18 dB	
	(-10 to 0) dBm	0.18 dB	
	(0 to 5) dBm	0.18 dB	
Tuned RF Absolute Power – Measure <sup>1</sup>	2.5 MHz to 26.5 GHz		Comparison to Agilent 8902A Opt 50 Measuring Receiver, Agilent 11722A Power Sensor, Agilent 11792A Microwave Converter, Agilent 11793A Microwave Converter
	(-127 to -120) dB	0.26 dB	
	(-120 to -110) dB	0.26 dB	
	(-110 to -100) dB	0.26 dB	
	(-100 to -90) dB	0.26 dB	
	(-90 to -80) dB	0.26 dB	
	(-80 to -70) dB	0.25 dB	
	(-70 to -60) dB	0.25 dB	
	(-60 to -50) dB	0.25 dB	
	(-50 to -40) dB	0.25 dB	
	(-40 to -30) dB	0.14 dB	
	(-30 to -20) dB	0.14 dB	
	(-20 to -10) dB	0.14 dB	
	(-10 to 0) dB	0.14 dB	
Tuned RF Relative Power – Measure <sup>1</sup>	2.5 MHz to 26 GHz		Comparison to Agilent 8902A Opt 50 Measuring Receiver, Agilent 11722A Power Sensor, Agilent 11792A Microwave Converter, Agilent 11793A Microwave Converter
	(-127 to -120) dB	0.23 dB	
	(-120 to -110) dB	0.23 dB	
	(-110 to -100) dB	0.23 dB	
	(-100 to -90) dB	0.23 dB	
	(-90 to -80) dB	0.22 dB	
	(-80 to -70) dB	0.084 dB	
	(-70 to -60) dB	0.081 dB	
	(-60 to -50) dB	0.074 dB	
	(-50 to -40) dB	0.071 dB	
	(-40 to -30) dB	0.068 dB	
	(-30 to -20) dB	0.064 dB	
	(-20 to -10) dB	0.06 dB	
	(-10 to 0) dB	0.056 dB	

**Electrical – RF/Microwave**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Reflection (VSWR) <sup>1,4</sup> 10 MHz to 18 GHz	(Rho) 0.022 to 0.1 0.1 to 0.2 0.2 to 0.3 0.3 to 0.4	0.022 0.027 0.033 0.042	Comparison to VSWR Bridge
RF Power – Measure <sup>1</sup>	10 MHz to 18 GHz (-30 to -20) dBm (-20 to 10) dBm (10 to 20) dBm	0.26 dB 0.1 dB 0.17 dB	Comparison to EPM Power Meter, HP 8481A Power Sensor
RF Power – Measure <sup>1</sup>	100 kHz to 4.2 GHz (-30 to -20) dBm (-20 to 10) dBm (10 to 20) dBm	0.26 dB 0.1 dB 0.17 dB	Comparison to EPM Power Meter, HP 8482A Power Sensor
RF Power – Measure <sup>1</sup>	50 MHz to 18 GHz (-30 to -20) dBm (-20 to 10) dBm (10 to 20) dBm (18 to 26.5) GHz (-30 to -20) dBm (-20 to 10) dBm (10 to 20) dBm	0.26 dB 0.1 dB 0.17 dB 0.3 dB 0.18 dB 0.22 dB	Comparison to EPM Power Meter, HP 8485A Power Sensor
RF Power – Measure <sup>1</sup>	9 kHz to 6 GHz (-60 to -50) dBm (-50 to -40) dBm (-40 to -10) dBm (-10 to 0) dBm (0 to 20) dBm	3.3 dB 0.29 dB 0.17 dB 0.15 dB 0.13 dB	Comparison to EPM Power Meter, HP E9304A Power Sensor
Amplitude Modulation – Measure <sup>1</sup> Rate: 50 Hz to 10 kHz Rate: 50 Hz to 100 kHz Rate: 20 Hz to 100 kHz	(5 to 99) % Depth 100 kHz to 10 MHz (20 to 99) % Depth 10 MHz to 3 GHz (5 to 20) % Depth 10 MHz to 3 GHz (3 to 26.5) GHz (20 to 99) % Depth (3 to 26.5) GHz	1 % Depth 0.9 % Depth 3 % Depth 5.2 % Depth 1.9 % Depth	Comparison to Agilent E4440A PSA Spectrum Analyzer

**Electrical – RF/Microwave**

<b>Parameter/Equipment</b>	<b>Range</b>	<b>Expanded Uncertainty of Measurement (+/-)</b>	<b>Reference Standard, Method, and/or Equipment</b>
Amplitude Modulation Distortion – Measure <sup>1</sup> Rate: 20 Hz to 1 kHz	> 1% Depth 10 kHz to 10 MHz 10 MHz to 26.5 GHz	15 % of reading 16 % of reading	Comparison to Agilent E4440A PSA Spectrum Analyzer
Frequency Modulation – Measure <sup>1</sup> Rate: 20 Hz to 10 kHz	Deviation Rate > 0.2 250 kHz to 10 MHz Deviation Rate > 1.2 250 kHz to 10 MHz	1.8 % Deviation 1.3 % Deviation	Comparison to Agilent E4440A PSA Spectrum Analyzer
Frequency Modulation – Measure <sup>1</sup> Rate: 50 Hz to 200 kHz	Deviation Rate > 0.2 10 MHz to 6.6 GHz Deviation Rate > 0.45 10 MHz to 6.6 GHz Deviation Rate > 0.2 (6.6 to 13.2) GHz Deviation Rate > 0.8 (6.6 to 13.2) GHz Deviation Rate > 0.2 (13.2 to 26.5) GHz Deviation Rate > 16 (13.2 to 26.5) GHz	1.8 % Deviation 1.3 % Deviation 3 % Deviation 1.3 % Deviation 4.8 % Deviation 1.3 % Deviation	Comparison to Agilent E4440A PSA Spectrum Analyzer
Frequency Modulation Distortion – Measure <sup>1</sup> Rate: 20 Hz to 1 kHz	Deviation > 500 Hz 1 MHz to 6.6 GHz Deviation > 2.3 kHz (6.6 to 13.2) GHz Deviation > 2.7 kHz (13.2 to 26.5) GHz	14 % of reading 14 % of reading 14 % of reading	Comparison to Agilent E4440A PSA Spectrum Analyzer

**Electrical – RF/Microwave**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Phase Modulation – Measure <sup>1</sup>	> 0.7 rad 100 kHz to 6.6 GHz > 0.3 rad 100 kHz to 6.6 GHz > 2 rad (6.6 to 13.2) GHz > 0.6 rad (6.6 to 13.2) GHz > 4 rad (13.2 to 26.5) GHz > 1.2 rad (13.2 to 26.5) GHz	1.3 % of reading 3.5 % of reading 1.3 % of reading 3.5 % of reading 1.3 % of reading 3.5 % of reading	Comparison to Agilent E4440A PSA Spectrum Analyzer
Phase Modulation Distortion – Measure <sup>1</sup> Rate: (20 to 500) Hz	> 0.8 rad 1 MHz to 6.6 GHz > 1.8 rad (6.6 to 13.2) GHz > 3.5 rad (13.2 to 26.5) GHz	16 % of reading 17 % of reading 15 % of reading	Comparison to Agilent E4440A PSA Spectrum Analyzer
Phase Modulation Distortion – Measure <sup>1</sup> Rate: 500 Hz to 1 kHz	> 0.4 rad 1 MHz to 6.6 GHz > 0.8 rad (6.6 to 13.2) GHz > 1.2 rad (13.2 to 26.5) GHz	15 % of reading 14 % of reading 14 % of reading	Comparison to Agilent E4440A PSA Spectrum Analyzer
Tuned Relative RF Power – Measure <sup>1</sup>	100 kHz to 3.05 GHz (-120 to -110) dBm (-110 to -100) dBm (-100 to -90) dBm (-90 to -80) dBm (-80 to -70) dBm (-70 to -60) dBm (-60 to -50) dBm (-50 to -40) dBm (-40 to -30) dBm (-30 to -20) dBm (-20 to -10) dBm (-10 to 0) dBm	0.17 dB 0.1 dB 0.09 dB 0.086 dB 0.081 dB 0.068 dB 0.063 dB 0.046 dB 0.041 dB 0.035 dB 0.03 dB 0.024 dB	Comparison to Agilent E4440A PSA Spectrum Analyzer



**Electrical – RF/Microwave**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Tuned Relative RF Power – Measure <sup>1</sup>	(3.05 to 6.6) GHz (-120 to -110) dBm (-110 to -100) dBm (-100 to -90) dBm (-90 to -80) dBm (-80 to -70) dBm (-70 to -60) dBm (-60 to -50) dBm (-50 to -40) dBm (-40 to -30) dBm (-30 to -20) dBm (-20 to -10) dBm (-10 to 0) dBm	0.29 dB 0.1 dB 0.09 dB 0.086 dB 0.081 dB 0.068 dB 0.063 dB 0.046 dB 0.041 dB 0.035 dB 0.03 dB 0.024 dB	Comparison to Agilent E4440A PSA Spectrum Analyzer
RF Power – Power Meter Reference	50 MHz 1 mW Reference	0.43 % of reading	Comparison to HP 478A Thermistor, Agilent 3458A 8.5 Digit Multimeter, HP 432A Analog Power Meter
Tuned Relative RF Power – Measure <sup>1</sup>	(6.6 to 13.2) GHz (-110 to -100) dBm (-100 to -90) dBm (-90 to -80) dBm (-80 to -70) dBm (-70 to -60) dBm (-60 to -50) dBm (-50 to -40) dBm (-40 to -30) dBm (-30 to -20) dBm (-20 to -10) dBm (-10 to 0) dBm	0.25 dB 0.091 dB 0.086 dB 0.082 dB 0.077 dB 0.063 dB 0.058 dB 0.041 dB 0.035 dB 0.029 dB 0.023 dB	Comparison to Agilent E4440A PSA Spectrum Analyzer

**Electrical – RF/Microwave**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Tuned Relative RF Power – Measure <sup>1</sup>	(13.2 to 18) GHz		Comparison to Agilent E4440A PSA Spectrum Analyzer
	(-110 to -100) dBm	0.61 dB	
	(-100 to -90) dBm	0.19 dB	
	(-90 to -80) dBm	0.086 dB	
	(-80 to -70) dBm	0.083 dB	
	(-70 to -60) dBm	0.077 dB	
	(-60 to -50) dBm	0.073 dB	
	(-50 to -40) dBm	0.062 dB	
	(-40 to -30) dBm	0.055 dB	
	(-30 to -20) dBm	0.036 dB	
	(-20 to -10) dBm	0.029 dB	
	(-10 to 0) dBm	0.024 dB	
	(18 to 26.5) GHz		
	(-100 to -90) dBm	0.45 dB	
	(-90 to -80) dBm	0.12 dB	
	(-80 to -70) dBm	0.082 dB	
	(-70 to -60) dBm	0.077 dB	
	(-60 to -50) dBm	0.072 dB	
	(-50 to -40) dBm	0.069 dB	
	(-40 to -30) dBm	0.054 dB	
	(-30 to -20) dBm	0.05 dB	
	(-20 to -10) dBm	0.029 dB	
	(-10 to 0) dBm	0.023 dB	
	100 kHz to 3.05 GHz		
	(-120 to -110) dBm	0.21 dB	
	(-110 to -100) dBm	0.15 dB	
	(-100 to -90) dBm	0.15 dB	
	(-90 to -80) dBm	0.15 dB	
	(-80 to -70) dBm	0.14 dB	
	(-70 to -60) dBm	0.14 dB	
	(-60 to -50) dBm	0.14 dB	
	(-50 to -40) dBm	0.13 dB	
	(-40 to -30) dBm	0.13 dB	
	(-30 to -20) dBm	0.13 dB	
	(-20 to -10) dBm	0.12 dB	
	(-10 to 0) dBm	0.12 dB	

**Electrical – RF/Microwave**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Tuned Absolute RF Power – Measure <sup>1</sup>	(3.05 to 6.6) GHz		Comparison to Agilent E4440A PSA Spectrum Analyzer
	(-120 to -110) dBm	0.32 dB	
	(-110 to -100) dBm	0.18 dB	
	(-100 to -90) dBm	0.18 dB	
	(-90 to -80) dBm	0.18 dB	
	(-80 to -70) dBm	0.17 dB	
	(-70 to -60) dBm	0.17 dB	
	(-60 to -50) dBm	0.17 dB	
	(-50 to -40) dBm	0.16 dB	
	(-40 to -30) dBm	0.16 dB	
	(-30 to -20) dBm	0.16 dB	
	(-20 to -10) dBm	0.16 dB	
	(-10 to 0) dBm	0.16 dB	
	(6.6 to 13.2) GHz		
	(-110 to -100) dBm	0.29 dB	
	(-100 to -90) dBm	0.18 dB	
	(-90 to -80) dBm	0.18 dB	
	(-80 to -70) dBm	0.17 dB	
	(-70 to -60) dBm	0.17 dB	
	(-60 to -50) dBm	0.17 dB	
	(-50 to -40) dBm	0.17 dB	
	(-40 to -30) dBm	0.16 dB	
	(-30 to -20) dBm	0.16 dB	
	(-20 to -10) dBm	0.16 dB	
	(-10 to 0) dBm	0.16 dB	
	(13.2 to 18) GHz		
	(-110 to -100) dBm	0.63 dB	
	(-100 to -90) dBm	0.24 dB	
	(-90 to -80) dBm	0.18 dB	
	(-80 to -70) dBm	0.18 dB	
	(-70 to -60) dBm	0.17 dB	
	(-60 to -50) dBm	0.17 dB	
	(-50 to -40) dBm	0.17 dB	
	(-40 to -30) dBm	0.16 dB	
	(-30 to -20) dBm	0.16 dB	
	(-20 to -10) dBm	0.16 dB	
	(-10 to 0) dBm	0.16 dB	

### Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Tuned Absolute RF Power – Measure <sup>1</sup>	(18 to 26.5) GHz (-100 to -90) dBm (-90 to -80) dBm (-80 to -70) dBm (-70 to -60) dBm (-60 to -50) dBm (-50 to -40) dBm (-40 to -30) dBm (-30 to -20) dBm (-20 to -10) dBm (-10 to 0) dBm	0.51 dB 0.28 dB 0.26 dB 0.26 dB 0.26 dB 0.26 dB 0.26 dB 0.26 dB 0.25 dB 0.25 dB	Comparison to Agilent E4440A PSA Spectrum Analyzer

### Length – Dimensional Metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Angle Measuring Devices <sup>5</sup>	Up to 85°	1.5"	Comparison to Master Angle Blocks
Angle Measuring Devices <sup>5</sup>	90°	1.9"	Comparison to Master Square
Micrometers, Calipers <sup>1,5</sup> (Outside, Inside, and Depth)	(0.05 to 48) in	(8 + 8L) μin	Comparison to Gage Blocks
Anvil Flatness <sup>1</sup>	Up to 1 in	4.5 μin	Comparison to Optical Flats
Indicators <sup>1,5</sup> (Dial and Digital)	Up to 0.05 in	28 μin	Comparison to Dial Indicator Calibrator
Indicators <sup>1,5</sup> (Dial and Digital)	(0.05 to 5) in	(44 + 4L) μin	Comparison to Horizontal Comparator
Length – Single Axis <sup>5</sup> Outside Measurement	Up to 5 in	(6 + 8L) μin	Comparison to Horizontal Comparator
Inside Dimension	Up to 5 in	(22 + 3L) μin	
Height Measuring Equipment <sup>1,5</sup>	(0.4 to 8) in (8 to 48) in	(29 + 6L) μin (12 + 8L) μin	Comparison to Gage Blocks
Cylindrical Plug Gages <sup>5</sup> Outside Diameter	Up to 5 in	(6 + 8L) μin	Comparison to Horizontal Comparator
Cylindrical Pin Gages Outside Diameter	(0.004 to 1) in	36 μin	Direct measure using Laser Micrometer

### Length – Dimensional Metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Cylindrical Ring Gages <sup>5</sup> Inside Diameter	Up to 5 in	$(22 + 3L) \mu\text{in}$	Comparison to Horizontal Comparator
Rulers, Tape Measures <sup>5</sup>	Up to 16 in	$(120 + 10L) \mu\text{in}$	Comparison to Vision System
Thread Plug Gages <sup>5</sup> Pitch Diameter, 60°	Up to 1 in (1 to 3) in (3 to 5) in	79 $\mu\text{in}$ 84 $\mu\text{in}$ 94 $\mu\text{in}$	Comparison to Universal Length Measuring System, Master Thread Wires
Major Diameter	Up to 5 in	$(6 + 8L) \mu\text{in}$	Horizontal Comparator
Thread Ring Gages Pitch Diameter	Up to 1 in (1 to 3) in (3 to 5) in	79 $\mu\text{in}$ 84 $\mu\text{in}$ 94 $\mu\text{in}$	Tactile Fit using Master Thread Plug
Wire Crimpers/Dies Crimp Height	Up to 0.8 in	180 $\mu\text{in}$	Comparison to Height Micrometer
Die Diameter	(0.011 to 0.5) in	0.001 2 in	Class Z Pin Gage Set

### Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Force Measuring Equipment	(1 to 200) lbf	0.06 % of reading	Comparison to Deadweights
Torque Measuring Devices <sup>1</sup> (Wrenches, Electronic, etc.)	(0.5 to 15) ozf·in (15 to 200) ozf·in (4 to 80) lbf·in (80 to 1 000) lbf·in (20 to 2 000) lbf·ft (1 000 to 5 000) lbf·ft	0.83 % of reading 0.4 % of reading 0.43 % of reading 0.4 % of reading 0.4 % of reading 1 % of reading	Comparison to Torque Calibration System
Torque Calibration System (Analyzers, Transducers, etc.)	(0.5 to 16) ozf·in (1 to 40) lbf·in (40 to 260) lbf·in (260 to 3 000) lbf·in	0.83 % of reading 0.08 % of reading 0.07 % of reading 0.07 % of reading	Comparison to Torque Wheels, Torque Arms, NIST Class F Weights

## Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Torque Multipliers	(150 to 2 700) N·m (110 to 2 000) lbf·ft (2 700 to 4 000) N·m (2 000 to 3 000) lbf·ft (4 000 to 27 000) N·m (3 000 to 20 000) lbf·ft	1.1 % of reading 1.1 % of reading 1.3 % of reading 1.3 % of reading 1.4 % of reading 1.4 % of reading	Comparison to Torque Calibration System
Torque Angle	45° 90° 135° 180° 360°	0.49° 0.49° 0.49° 0.49° 0.49°	Comparison to Torque Angle Fixture
Hydraulic Torque Devices	(150 to 2 700) N·m (110 to 2 000) lbf·ft (2 700 to 4 000) N·m (2 000 to 3 000) lbf·ft (4 000 to 27 000) N·m (3 000 to 20 000) lbf·ft	1.1 % of reading 1.1 % of reading 1.3 % of reading 1.3 % of reading 1.3 % of reading 1.3 % of reading	Comparison to Torque Calibration System
Scales & Balances <sup>1,6</sup> (SI)	(5 to 500) mg (0.5 to 5) g (5 to 10) g (10 to 30) g 30 g to 9 kg (9 to 15) kg	12 µg 40 µg 58 µg 89 µg 0.000 32 % of reading 0.000 34 % of reading	ASTM E617 Class 1 weights and internal calibration procedure utilized for the calibration of the weighing system.
Scales & Balances <sup>1,6</sup> (SI)	Up to 100 mg (100 to 500) mg (0.5 to 5) g (5 to 10) g (10 to 20) g (20 to 30) g (30 to 100) g 100 g to 20 kg	16 µg 29 µg 58 µg 82 µg 0.12 mg 0.18 mg 0.35 mg 0.005 9 % of reading	ASTM E617 Class 2 weights and internal calibration procedure utilized for the calibration of the weighing system.
Scales & Balances <sup>1,6</sup> (Avoirdupois)	Up to 0.02 lb (0.02 to 1) lb (1 to 5) lb (5 to 977) lb	2.3 mg 0.041 % of reading 0.038 % of reading 0.036 % of reading	NIST Class F weights and internal calibration procedure utilized for the calibration of the weighing system.
Pressure Devices (Absolute Pressure)	Up to 25 psia (25 to 500) psia	0.001 9 psi 0.006 8 % of reading	Ruska 7250xi Pressure Controller/Calibrator



## Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Pneumatic Pressure Devices (Gauge Pressure)	(-60 to -22) inH <sub>2</sub> O (-22 to 22) inH <sub>2</sub> O (22 to 60) inH <sub>2</sub> O (60 to 72) inH <sub>2</sub> O (72 to 804) inH <sub>2</sub> O	0.009 % of reading + 0.000 15 inH <sub>2</sub> O 0.002 2 inH <sub>2</sub> O 0.009 % of reading + 0.000 15 inH <sub>2</sub> O 0.006 7 inH <sub>2</sub> O 0.009 % of reading + 0.000 15 inH <sub>2</sub> O	Comparison to DHI PPC4 Pressure Controller
Pneumatic Pressure Devices (Gauge Pressure)	(-14.7 to 25) psi (25 to 500) psig	0.001 6 psi 0.007 6 % of reading	Comparison to Ruska 7250xi Pressure Controller/Calibrator
Pneumatic Pressure Devices (Gauge Pressure)	(10 to 3 000) psig (3 000 to 30 000) psig	0.38 psi 0.01 % of reading	Comparison to Fluke RPM 4 Reference Pressure Monitor
Hydraulic Pressure Devices (Gauge Pressure)	(5 to 15 000) psig	0.02 % of reading	Comparison to Fluke P3125-PSI Oil Deadweight Tester

## Thermodynamic

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Relative Humidity – Measure <sup>1</sup>	(10 to 30) °C (10 to 90) %RH	1.3 %RH	Comparison to Temperature/Humidity Indicator/Probe
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 Two-pressure Humidity Generator

### Thermodynamic

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Temperature – Source <sup>1</sup> (Thermocouple Probes, RTD's, Thermistors)	(-25 to 140) °C (140 to 660) °C	0.06 °C 0.03 °C	Comparison to AccuMac AM1760 Secondary SPRT, Hart 1575 Super Thermometer, Hart Drywell
Temperature – Measure <sup>1</sup>	(-195 to 0) °C (0 to 420) °C (420 to 660) °C	0.001 % of reading + 0.011 °C 0.001 % of reading + 0.025 °C 0.001 % of reading + 0.037 °C	Direct measure using AccuMac AM1760 Secondary SPRT, Hart Black Stack
Temperature – Measure <sup>1</sup>	(-195 to 0) °C (0 to 420) °C (420 to 660) °C	0.001 % of reading + 0.01 °C 0.001 % of reading + 0.02 °C 0.001 % of reading + 0.031 °C	Direct measure using AccuMac AM1760 Secondary SPRT, Hart 1575 Super Thermometer
Infrared Temperature – Measuring Equipment <sup>1</sup>	(-15 to 0) °C (0 °C to 50) °C (50 °C to 100) °C (100 °C to 120) °C (120 °C to 200) °C (200 °C to 350) °C (350 °C to 500) °C	0.8 °C 0.65 °C 0.7 °C 0.76 °C 0.95 °C 1.6 °C 2.1 °C	Comparison to Blackbody Source (flat plate) $\epsilon = (0.9 \text{ to } 1)$ , $\lambda = (8 \text{ to } 14) \mu\text{m}$

### Time and Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Frequency – Reference <sup>1</sup>	10 MHz	3.8 pHz/Hz	Comparison to Fluke 910R GPS Frequency Standard
Stopwatches, Timers <sup>1</sup>	Up to 599 s/mon	58 ms/d	Comparison to Vibrograf TM-4500 Timometer

## Time and Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Duty Cycle – Source <sup>1</sup> Square Wave: < 3.3 Vp-p Freq: 0.1 Hz to 100 kHz	(1 to 10) % Duty Cycle 10 $\mu$ s to 100 s (10 to 49) % Duty Cycle 10 $\mu$ s to 100 s 50 % Duty Cycle 10 $\mu$ s to 100 s (51 to 90) % Duty Cycle 10 $\mu$ s to 100 s (90 to 99) % Duty Cycle 10 $\mu$ s to 100 s	0.62 % of reading + 78 ns 0.039 % of reading + 78 ns 0.001 6 % of reading + 78 ns 0.039 % of reading + 78 ns 0.62 % of reading + 78 ns	Comparison to Fluke 5522A Multiproduct Calibrator
Rotational Speed – Measure <sup>1,5</sup>	(10 to 999.9) rpm (1 000 to 99 999) rpm	0.058 % of reading + 0.12 rpm 0.082 % of reading + 1.2 rpm	Reflective Measure utilizing the Extech 461995 Photo Tachometer.
Rise Time – Source <sup>1,2</sup>	$\geq 14$ ps	2.4 ps	Comparison to Pulser
Rise Time – Source <sup>1,2</sup>	25 Vp-p 350 ps	64 ps	Comparison to Rise Time Pulse Generator
Rise Time – Measure	$\geq 17$ ps	3.9 ps	Comparison to Sampling System

## DIMENSIONAL MEASUREMENT

### 2 Dimensional

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Dimensional Measurement – 2D <sup>5</sup>	X-Y Axis: Up to 16 in	(120 + 10L) $\mu$ in	Vision System utilized as the Reference Standard for Dimensional Measurement.
Angles <sup>5</sup>	Up to 2 in Up to 360° (2 to 16) in Up to 360°	0.072° (0.062 + 0.000 5L)°	Vision System utilized as the Reference Standard for Dimensional Measurement.

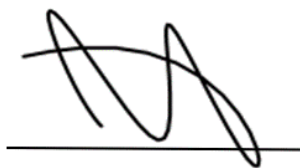
### 3 Dimensional

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Dimensional Measurement – 3D <sup>5</sup>	X: Up to 24 in Y: Up to 24 in Z: Up to 24 in	$(90 + 8.8L) \mu\text{in}$	Zeiss CONTURA G2 Coordinate Measuring Machine utilized for Dimensional Measurement.
Dimensional Measurement – 3D	X: Up to 30 in Y: Up to 30 in Z: Up to 24 in	300 $\mu\text{in}$	Zeiss CONTURA G2 Coordinate Measuring Machine utilized for Dimensional Measurement.
Dimensional Measurement – 3D	X: Up to 39 in Y: Up to 36 in Z: Up to 24 in	390 $\mu\text{in}$	Zeiss CONTURA G2 Coordinate Measuring Machine utilized for Dimensional Measurement.
Dimensional Measurement – 3D	X: Up to 39 in Y: Up to 48 in Z: Up to 24 in	430 $\mu\text{in}$	Zeiss CONTURA G2 Coordinate Measuring Machine utilized for Dimensional Measurement.
Dimensional Measurement – 3D	X: Up to 39 in Y: Up to 54 in Z: Up to 24 in	450 $\mu\text{in}$	Zeiss CONTURA G2 Coordinate Measuring Machine utilized for Dimensional Measurement.
Dimensional Measurement – 3D	X: Up to 39 in Y: Up to 62 in Z: Up to 24 in	490 $\mu\text{in}$	Zeiss CONTURA G2 Coordinate Measuring Machine utilized for Dimensional Measurement.
Angle Measurements – 3D <sup>5</sup>	X: Up to 1 in Y: Up to 1 in Z: Up to 1 in Up to 360°	12"	Zeiss CONTURA G2 Coordinate Measuring Machine utilized for Dimensional Measurement.
Angle Measurements – 3D <sup>5</sup>	X: Up to 3 in Y: Up to 3 in Z: Up to 3 in Up to 360°	4.5"	Zeiss CONTURA G2 Coordinate Measuring Machine utilized for Dimensional Measurement.
Angle Measurements – 3D <sup>5</sup>	X: Up to 12 in Y: Up to 12 in Z: Up to 12 in Up to 360°	1.9"	Zeiss CONTURA G2 Coordinate Measuring Machine utilized for Dimensional Measurement.
Angle Measurements – 3D <sup>5</sup>	X: Up to 39 in Y: Up to 62 in Z: Up to 24 in Up to 360°	1.6"	Zeiss CONTURA G2 Coordinate Measuring Machine utilized for Dimensional Measurement.

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 stated uncertainty is the laboratory's ability to source a fast rise pulse that is approximately 500 ps, 150 ps, 70 ps, and 25 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 DUT. The known source rise time is mathematically removed from the total measured rise time measured on the DUT.
3. 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.
4. This parameter is a unitless measurement.
5. " = arc-minute; L = length in inches; rpm = revolutions per minute.
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. Unless otherwise specified in the far-right column under the field of Calibration, the calibration procedure utilized by the laboratory was developed internally.
8. The legal entity for this site is Transcat, Inc.



Jason Stine, Vice President

