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: 07 September 2027
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
Mathew Bundy 657-217-368

CALIBRATION AND DIMENSIONAL MEASUREMENTS

ISO/IEC 17025 Accreditation Granted: **05 May 2025**

Certificate Number: **AC-2489.08** Certificate Expiry Date: **07 September 2027**

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 (74 to 104) dB 114 dB 4 kHz (74 to 104) dB 114 dB	 0.46 dB 0.36 dB 0.73 dB 0.62 dB	Comparison to GenRad 1986 Sound Level Calibrator

Chemical Quantities

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

Chemical Quantities

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Conductivity Meters [7]	10 µS/cm 100 µS/cm 1 000 µS/cm 10 000 µS/cm 100 000 µS/cm	0.5 µS/cm 2.2 µS/cm 3.7 µS/cm 36 µS/cm 440 µS/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) µA 100 µA to 1 mA (1 to 10) mA (10 to 100) mA 100 mA to 1 A	33 µA/A + 0.92 nA 29 µA/A + 5.8 nA 29 µA/A + 58 nA 46 µA/A + 0.58 µA 0.013 % of reading + 12 µA	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

1899 L Street NW, Suite 1100-A, Washington, DC 20036
414-501-5494
www.anab.org

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
DC Current – Source [1]	(0 to 220) µA 220 µA to 2.2 mA (2.2 to 22) mA (22 to 220) mA 0.22 A to 2.2 A (2.2 to 11) A	40 µA/A + 6 nA 36 µA/A + 7 nA 35 µA/A + 40 nA 48 µA/A + 0.7 µA 84 µA/A + 12 µA 0.036 % of reading + 0.48 mA	Comparison to Fluke 5700A-EP Multiproduct Calibrator, w/ Fluke 5725A Amplifier
DC Current – Source [1]	(11 to 20) A	0.096 % of reading + 0.58 mA	Comparison to Fluke 5522A Multiproduct Calibrator
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 µA (10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz 100 µA 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 µA 0.17 % of reading + 0.23 µA 0.071 % of reading + 0.23 µA 0.038 % of reading + 0.23 µA 0.46 % of reading + 2.3 µA 0.17 % of reading + 2.3 µA 0.071 % of reading + 2.3 µA 0.038 % of reading + 2.3 µA 0.48 % of reading + 23 µA 0.17 % of reading + 23 µA 0.071 % of reading + 23 µA 0.037 % of reading + 23 µA 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

1899 L Street NW, Suite 1100-A, Washington, DC 20036
414-501-5494
www.anab.org

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
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
AC Current – Source [1]	Up to 220 µA (10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (0.22 to 2.2) mA (10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (2.2 to 22) mA (10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (22 to 220) mA (10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (0.22 to 2.2) A 20 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	 0.031 % of reading + 16 nA 0.019 % of reading + 10 nA 0.015 % of reading + 8 nA 0.03 % of reading + 12 nA 0.11 % of reading + 65 nA 0.03 % of reading + 40 nA 0.018 % of reading + 35 nA 0.013 % of reading + 35 nA 0.021 % of reading + 0.11 µA 0.11 % of reading + 0.65 µA 0.039 % of reading + 0.4 µA 0.019 % of reading + 0.35 µA 0.014 % of reading + 0.35 µA 0.021 % of reading + 0.55 µA 0.11 % of reading + 5 µA 0.033 % of reading + 4 µA 0.018 % of reading + 3.5 µA 0.014 % of reading + 2.5 µA 0.021 % of reading + 3.5 µA 0.11 % of reading + 10 µA 0.027 % of reading + 35 µA 0.046 % of reading + 80 µA 0.7 % of reading + 0.16 mA	Comparison to Fluke 5700A-EP Multiproduct Calibrator
AC Current – Source [1]	(2.2 to 11) A 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	 0.048 % of reading + 0.17 mA 0.096 % of reading + 0.38 mA 0.36 % of reading + 0.75 mA	Comparison to Fluke 5700A-EP Multiproduct Calibrator w/ Fluke 5725A Amplifier

1899 L Street NW, Suite 1100-A, Washington, DC 20036
414-501-5494
www.anab.org

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current – Source [1]	(11 to 20.5) A (45 to 100) Hz 100 Hz to 1 kHz (1 to 5) kHz	0.092 % of reading + 3.9 mA 0.12 % of reading + 3.9 mA 2.3 % of reading + 3.9 mA	Comparison to Fluke 5522A Multiproduct Calibrator
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 µA to 329.99 µA (10 to 30) kHz 330 µA 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 µA 0.78 % of reading + 0.47 µA 0.31 % of reading + 3.1 µA 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 kΩ (1 to 10) kΩ (10 to 100) kΩ 100 kΩ to 1 MΩ (1 to 10) MΩ (10 to 100) MΩ 100 MΩ to 1 GΩ	18 µΩ/Ω + 58 µΩ 15 µΩ/Ω + 0.58 mΩ 13 µΩ/Ω + 0.58 mΩ 12 µΩ/Ω + 5.8 mΩ 13 µΩ/Ω + 58 mΩ 21 µΩ/Ω + 2.3 Ω 62 µΩ/Ω + 120 Ω 0.059 % of reading + 1.2 kΩ 0.82 % of reading + 12 kΩ	Comparison to Agilent 3458A 8.5 Digit Multimeter w/ Decade Resistor

1899 L Street NW, Suite 1100-A, Washington, DC 20036
414-501-5494
www.anab.org

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
DC Resistance – Source [1,7] (Fixed Artifact)	1 mΩ	50 μΩ/Ω	Comparison to L&N 4223B Standard Resistor
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)	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	98 μΩ 96 μΩ 0.24 mΩ 0.48 mΩ 1.1 mΩ 2.1 mΩ 9.4 mΩ 18 mΩ 94 mΩ 0.18 Ω 1.2 Ω 2.3 Ω 22 Ω 44 Ω 0.42 kΩ 0.36 kΩ 11 kΩ	Comparison to Fluke 5700A-EP 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

1899 L Street NW, Suite 1100-A, Washington, DC 20036
414-501-5494
www.anab.org

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	8.8 µV/V + 0.4 µV 5.1 µV/V + 0.7 µV 4 µV/V + 2.5 µV 3.9 µV/V + 4 µV 6.2 µV/V + 40 µV 7.6 µV/V + 0.4 mV	Comparison to Fluke 5700A-EP 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 µV/V + 0.58 µV 5.3 µV/V + 0.58 µV 7.7 µV/V + 35 µV 15 µV/V + 0.12 mV 18 µV/V + 0.12 mV 21 µV/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 Vitrek 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 µV 3.5 % of reading + 2.4 µV 9.3 % of reading + 2.4 µV 23 % of reading + 2.4 µV 0.97 % of reading + 2 µV 3.5 % of reading + 2 µV 9.3 % of reading + 2 µV 23 % of reading + 2 µV 0.91 % of reading + 3 µV 1.8 % of reading + 3 µV 2.9 % of reading + 3 µV 7 % of reading + 3 µV 14 % of reading + 3 µV	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 µV 0.03 % of reading + 1.2 µV 0.04 % of reading + 1.2 µV 0.15 % of reading + 1.2 µV 0.59 % of reading + 1.2 µV 4.6 % of reading + 2.3 µV 1.5 % of reading + 5.8 µV 8.1 % of reading + 8.1 µV	Comparison to Agilent 3458A 8.5 Digit Multimeter

1899 L Street NW, Suite 1100-A, Washington, DC 20036
414-501-5494
www.anab.org

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 µV	
	40 Hz to 1 kHz	0.009 7 % of reading + 2.3 µV	
	(1 to 20) kHz	0.017 % of reading + 2.3 µV	
	(20 to 50) kHz	0.038 % of reading + 2.3 µV	
	(50 to 100) kHz	0.093 % of reading + 2.3 µV	
	(100 to 300) kHz	0.36 % of reading + 12 µV	
	300 kHz to 1 MHz	1.2 % of reading + 12 µV	
	(1 to 2) MHz	1.8 % of reading + 12 µV	
	(2 to 4) MHz	4.7 % of reading + 81 µV	
	(4 to 8) MHz	4.7 % of reading + 92 µV	
	(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 µV	
	40 Hz to 1 kHz	0.008 3 % of reading + 23 µV	
	(1 to 20) kHz	0.017 % of reading + 23 µV	
	(20 to 50) kHz	0.036 % of reading + 23 µV	
	(50 to 100) kHz	0.093 % of reading + 23 µV	
	(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	

1899 L Street NW, Suite 1100-A, Washington, DC 20036
414-501-5494
www.anab.org

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 Vitrek 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	

1899 L Street NW, Suite 1100-A, Washington, DC 20036
414-501-5494
www.anab.org

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 5700A-EP Multiproduct Calibrator
	(10 to 20) Hz	0.16 % of reading + 4 µV	
	(20 to 40) Hz	0.1 % of reading + 4 µV	
	40 Hz to 20 kHz	0.078 % of reading + 4 µV	
	(20 o 50) kHz	0.13 % of reading + 4 µV	
	(50 to 100) kHz	0.17 % of reading + 5 µV	
	(100 to 300) kHz	0.33 % of reading + 10 µV	
	(300 to 500) kHz	0.47 % of reading + 20 µV	
	500 kHz to 1 MHz	0.58 % of reading + 20 µV	
	(2.2 to 22) mV		
	(10 to 20) Hz	0.042 % of reading + 4 µV	
	(20 to 40) Hz	0.03 % of reading + 4 µV	
	40 Hz to 20 kHz	0.014 % of reading + 4 µV	
	(20 o 50) kHz	0.3 % of reading + 4 µV	
	(50 to 100) kHz	0.058 % of reading + 5 µV	
	(100 to 300) kHz	0.12 % of reading + 10 µV	
	(300 to 500) kHz	0.16 % of reading + 20 µV	
	500 kHz to 1 MHz	0.27 % of reading + 20 µV	
	(22 to 220) mV		
	(10 to 20) Hz	0.028 % of reading + 12 µV	
	(20 to 40) Hz	0.011 % of reading + 7 µV	
	40 Hz to 20 kHz	0.008 5 % of reading + 7 µV	
	(20 o 50) kHz	0.021 % of reading + 7 µV	
	(50 to 100) kHz	0.047 % of reading + 17 µV	
	(100 to 300) kHz	0.091 % of reading + 20 µV	
	(300 to 500) kHz	0.14 % of reading + 25 µV	
	500 kHz to 1 MHz	0.28 % of reading + 45 µV	
	220 mV to 2.2 V		
	(10 to 20) Hz	0.027 % of reading + 40 µV	
	(20 to 40) Hz	0.01 % of reading + 15 µV	
	40 Hz to 20 kHz	0.004 8 % of reading + 8 µV	
	(20 o 50) kHz	0.008 % of reading + 10 µV	
	(50 to 100) kHz	0.012 % of reading + 30 µV	
	(100 to 300) kHz	0.043 % of reading + 80 µV	
	(300 to 500) kHz	0.1 % of reading + 0.2 mV	
	500 kHz to 1 MHz	0.18 % of reading + 0.3 mV	

1899 L Street NW, Suite 1100-A, Washington, DC 20036
414-501-5494
www.anab.org

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 5700A-EP Multiproduct Calibrator
	(10 to 20) Hz	0.028 % of reading + 0.4 mV	
	(20 to 40) Hz	0.01 % of reading + 0.15 mV	
	40 Hz to 20 kHz	0.004 9 % of reading + 50 µV	
	(20 o 50) kHz	0.008 3 % of reading + 0.1 mV	
	(50 to 100) kHz	0.011 % of reading + 0.2 mV	
	(100 to 300) kHz	0.03 % of reading + 0.6 mV	
	(300 to 500) kHz	0.1 % of reading + 2 mV	
	500 kHz to 1 MHz	0.17 % of reading + 3.2 mV	
	(22 to 220) V		
	(10 to 20) Hz	0.028 % of reading + 4 mV	
	(20 to 40) Hz	0.01 % of reading + 1.5 mV	
	40 Hz to 20 kHz	0.005 6 % of reading + 0.6 mV	
	(20 o 50) kHz	0.009 3 % of reading + 1 mV	
	(50 to 100) kHz	0.016 % of reading + 2.5 mV	
	(100 to 300) kHz	0.09 % of reading + 16 mV	
	(300 to 500) kHz	0.44 % of reading + 40 mV	
	500 kHz to 1 MHz	0.8 % of reading + 80 mV	
AC Voltage – Source [1]	(220 to 1 100) V		Comparison to Fluke 5700A-EP Calibrator w/ Fluke 5725A Amplifier
	40 Hz to 1 kHz	0.011 % of reading + 4 mV	
	(1 to 20) kHz	0.017 % of reading + 6 mV	
	(20 to 30) kHz	0.061 % of reading + 11 mV	
	(30 to 50) kHz	0.061 % of reading + 11 mV	
	(50 to 100) kHz	0.23 % of reading + 45 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 µF	0.02 % of reading + 0.05 pF	
	(25 to 100) µF	0.03 % of reading	
	(100 to 1 000) µF	0.24 % of reading	
Capacitance – Measure	0.1 pF		Comparison to Agilent E4980A LCR Mete
	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	

1899 L Street NW, Suite 1100-A, Washington, DC 20036
414-501-5494
www.anab.org

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Capacitance – Measure	10 pF		Comparison to Agilent E4980A LCR Meter
	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	
	100 nF		
	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	

1899 L Street NW, Suite 1100-A, Washington, DC 20036
414-501-5494
www.anab.org

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Capacitance – Measure	10 nF		Comparison to Agilent E4980A LCR Meter
	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	
	100 nF		
	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	

1899 L Street NW, Suite 1100-A, Washington, DC 20036
414-501-5494
www.anab.org

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Capacitance – Source [1] (Simulation)	190 pF to 1.1 nF (1.1 to 3.3) nF (3.3 to 11) nF (11 to 110) nF (110 to 330) nF 330 nF to 1.1 µF (1.1 to 3.3) µF (3.3 to 11) µF (11 to 33) µF (33 to 110) µF (110 to 330) µF 330 µF to 1.1 mF (1.1 to 3.3) mF (3.3 to 11) mF (11 to 33) mF (33 to 110) mF	0.39 % of reading + 7.8 pF 0.39 % of reading + 7.8 pF 0.21 % of reading + 7.8 pF 0.21 % of reading + 78 pF 0.21 % of reading + 0.23 nF 0.2 % of reading + 0.78 nF 0.2 % of reading + 2.3 nF 0.2 % of reading + 7.8 nF 0.32 % of reading + 23 nF 0.35 % of reading + 78 nF 0.35 % of reading + 0.23 µF 0.35 % of reading + 0.78 µF 0.35 % of reading + 2.3 µF 0.35 % of reading + 7.8 µF 0.59 % of reading + 23 µF 0.86 % of reading + 78 µF	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 µF 0.2 µF 0.5 µF 1 µF	 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 µH 0.026 % of reading + 1.4 µH	Comparison to GenRad 1689-9700 RLC Digibridge
Inductance – Measure	1 µH 10 kHz 100 kHz 1 MHz 2 MHz 10 µH 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	Comparison to Agilent E4980A LCR Meter

1899 L Street NW, Suite 1100-A, Washington, DC 20036
414-501-5494
www.anab.org

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Inductance – Measure	100 µH		Comparison to Agilent E4980A LCR Meter
	1 kHz	0.40 % of reading	
	10 kHz	0.20 % of reading	
	100 kHz	0.12 % of reading	
	1 MHz	0.14 % of reading	
	2 MHz	0.72 % of reading	
	1 mH		
	100 Hz	0.55 % of reading	
	1 kHz	0.18 % of reading	
	10 kHz	0.12 % of reading	
	100 kHz	0.09 % of reading	
	1 MHz	0.23 % of reading	
	2 MHz	0.88 % of reading	
	10 mH		
	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	

1899 L Street NW, Suite 1100-A, Washington, DC 20036
414-501-5494
www.anab.org

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
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	
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	

1899 L Street NW, Suite 1100-A, Washington, DC 20036
414-501-5494
www.anab.org

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Resistance – Measure	1 kΩ		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	0.09 % of reading	
	1 MHz	0.14 % of reading	
	2 MHz	0.3 % of reading	
	10 kΩ		
	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 kΩ		
	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 µH	25 nH	Comparison to Standard Inductors characterized with GenRad 1689-9700 RLC Digibridge
	1 mH	0.25 µH	
	10 mH	2.5 µH	
	100 mH	25 µH	
	1 H	0.25 mH	
	10 H	2.5 mH	

1899 L Street NW, Suite 1100-A, Washington, DC 20036
414-501-5494
www.anab.org

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 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	0.09 °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	

1899 L Street NW, Suite 1100-A, Washington, DC 20036
414-501-5494
www.anab.org

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 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	0.09 °C	
	(100 to 400) °C	0.08 °C	
Scope Voltage – Source [1] DC Signal			Comparison to Fluke 9500B Oscilloscope Calibrator
into 50 Ω	(-5.0 to 5) V	0.023 % of reading + 19 µV	
into 1 MΩ	(-200 to 200) V	0.023 % of reading + 19 µV	

1899 L Street NW, Suite 1100-A, Washington, DC 20036
414-501-5494
www.anab.org

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Scope Voltage – Source [1]			
Square Wave			
10 Hz to 100 kHz			
into 50 Ω	40 µVp-p to 1 mVp-p	0.78 % of reading + 7.8 µV	Comparison to Fluke 9500B Oscilloscope Calibrator
	1 mVp-p to 5 Vp-p	0.08 % of reading + 7.8 µV	
10 Hz to 10 kHz			
into 1 MΩ	40 µVp-p to 1 mVp-p	0.78 % of reading + 7.8 µV	
10 Hz to 100 kHz			
into 1 MΩ	1 mVp-p to 200 Vp-p	0.08 % of reading + 7.8 µV	
Scope – Time Markers [1]			
100 mVp-p to 1 Vp-p			
(into 50 Ω)			
Square Wave	9.009 1 ns to 83 µs	0.19 µs/s	Comparison to Fluke 9500B Oscilloscope Calibrator
	83 µs to 55 s	2.3 µs/s	
Sine Wave	450.5 ps to 9.009 ns	0.19 µs/s	
Pulse	900.91 ns to 83 µs	0.19 µs/s	
	83 µs to 55 s	2.3 µs/s	
Triangle Wave	900.91 ns to 83 µs	0.19 µs/s	
	83 µs to 55 s	2.3 µs/s	
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		Comparison to Fluke 9500B Oscilloscope Calibrator with Fluke 9530 Active Head
	500 ps (Nominal)	290 ps	
	150 ps (Nominal)	35 ps	
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		Comparison to Fluke 9500B Oscilloscope Calibrator with Fluke 9530 Active Head
	25 ps (Nominal)	6.7 ps	
Scope Leveled Sine Wave – Source [1]			
(50 kHz Ref. Frequency)			
into 50 Ω	5 mVp-p to 5 Vp-p		Comparison to Fluke 9500B Oscilloscope Calibrator with Fluke 9530 Active Head
	50 kHz to 10 MHz	1.2 % of reading	

1899 L Street NW, Suite 1100-A, Washington, DC 20036
414-501-5494
www.anab.org

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
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) kΩ 800 kΩ to 1.2 MΩ (1.2 to 12) MΩ	0.39 % of reading 0.08 % of reading 0.39 % of reading 0.39 % of reading 0.08 % of reading 0.39 % of reading	Comparison to Fluke 9500B Oscilloscope Calibrator
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
AC Voltage Harmonics – Source [1,3]			Comparison to Fluke 6105A Electrical Power Quality Calibrator
Carrier Range: 45 V	Up to 13.5 V		
	(16 to 850) Hz	67 µV/V + 2 mV	
	850 Hz to 6.5 kHz	0.52 mV + 2 mV	
Carrier Range: 90 V	Up to 27 V		
	(16 to 850) Hz	69 µV/V + 2 mV	
	850 Hz to 6.5 kHz	0.52 mV + 2 mV	
Carrier Range: 180 V	Up to 54 V		
	(16 to 850) Hz	69 µV/V + 6 mV	
	850 Hz to 6.5 kHz	0.52 mV + 6 mV	
Carrier Range: Up to 360 V	Up to 108 V		
	(16 to 850) Hz	69 µV/V + 13 mV	
	850 Hz to 6.5 kHz	0.52 mV/V + 13 mV	
Carrier Range: 650 V	Up to 195 V		
	(16 to 850) Hz	70 µV/V + 22 mV	
	850 Hz to 6.5 kHz	0.52 mV/V + 22 mV	
Carrier Range: 1 008 V	Up to 302 V		
	(16 to 850) Hz	70 µV/V + 33 mV	
	850 Hz to 6.5 kHz	0.52 mV/V + 33 mV	

1899 L Street NW, Suite 1100-A, Washington, DC 20036
414-501-5494
www.anab.org

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current Harmonics – Source [1,3]			Comparison to Fluke 6105A Electrical Power Quality Calibrator
Carrier Range: 0.25 A	Up to 75 mA		
	(16 to 850) Hz	61 µA/A + 21 µA	
	850 Hz to 6.5 kHz	0.46 mA/A + 22 µA	
Carrier Range: 0.5 A	Up to 0.15 A		
	(16 to 850) Hz	70 µA/A + 21 µA	
	850 Hz to 6.5 kHz	0.46 mA/A + 23 µA	
Carrier Range: 1 A	Up to 0.3 A		
	(16 to 850) Hz	70 µA/A + 29 µA	
	850 Hz to 6.5 kHz	0.46 mA/A + 29 µA	
Carrier Range: 2 A	Up to 0.6 A		
	(16 to 850) Hz	70 µA/A + 0.1 mA	
	850 Hz to 6.5 kHz	0.46 mA/A + 0.1 mA	
Carrier Range: 5 A	Up to 1.5 A		
	(16 to 850) Hz	70 µA/A + 0.1 mA	
	850 Hz to 6.5 kHz	0.46 mA/A + 0.1 mA	
Carrier Range: 10 A	Up to 3 A		
	(16 to 850) Hz	74 µA/A + 0.29 mA	
	850 Hz to 6.5 kHz	0.46 mA/A + 0.29 mA	
Carrier Range: 20 A	Up to 6 A		
	(16 to 850) Hz	75 µA/A + 0.45 mA	
	850 Hz to 6.5 kHz	0.46 mA/A + 0.45 mA	
LF Phase – Source [1]	(0 to 90)°		Comparison to Fluke 5520A/1100 Multiproduct Calibrator
	(10 to 65) Hz	0.09°	
	(65 to 500) Hz	0.2°	
	500 Hz to 1 kHz	0.39°	
	(1 to 5) kHz	1.9°	
	(5 to 10) kHz	3.9°	
	(10 to 30) kHz	7.8°	
DC Power – Source [1]			Comparison to Fluke 5520A/1100 Multiproduct Calibrator
(0.33 to 330) mA	11 µW to 330 W	0.018 % of reading	
(0.33 to 3) A	11 W to 3 kW	0.017 % of reading	
(3 to 20.5) A	99 mW to 20.9 kW	0.054 % of reading	

1899 L Street NW, Suite 1100-A, Washington, DC 20036
414-501-5494
www.anab.org

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Power – Source [1,5] PF = 1			Comparison to Fluke 5520A/11 Multiproduct Calibrator
3.3 mA to 3 A	(10 to 45) Hz 0.11 mW to 99 W	0.18 % of reading	
3.3 mA to 20.5 A	(45 to 65) Hz 0.11 mW to 20.9 kW	0.14 % of reading	
33 mA to 3 A	(65 to 500) Hz 11 mW to 3.06 kW	0.16 % of reading	
33 mA to 20.5 A	500 Hz to 1 kHz 11 mW to 20.9 kW	0.17 % of reading	
(3 to 20.5) A	(65 to 500) Hz 9.9 W to 20.9 kW	0.16 % of reading	
AC Power – Source [1,5] PF = 1			Comparison to Fluke 6105A Electrical Power Quality Calibrator
(0.5 to 20) A	(65 to 850) Hz 23 W to 13 kW	0.024 % of reading	

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
	1 dB	0.3 dB	
	2 dB	0.3 dB	
	3 dB	0.4 dB	
	4 dB	0.4 dB	
	5 dB	0.5 dB	
	6 dB	0.5 dB	
	7 dB	0.6 dB	
	8 dB	0.6 dB	
	9 dB	0.6 dB	
	10 dB	0.6 dB	
	11 dB	0.7 dB	

1899 L Street NW, Suite 1100-A, Washington, DC 20036
414-501-5494
www.anab.org

Electrical – RF/Microwave

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

1899 L Street NW, Suite 1100-A, Washington, DC 20036
414-501-5494
www.anab.org

Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
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 (40 to 50) GHz (-70 to -30) dBm	3.8 % of reading 5.5 % of reading	Comparison to Agilent 8487D RF Power Sensor w/ RF Power Meter
RF Absolute Power – Measure [1]	(18 to 40) GHz (-30 to 20) dBm (40 to 50) GHz (-30 to 20) dBm	4.4 % of reading 5.5 % of reading	Comparison to Agilent 8487D RF Power Sensor w/ RF Power Meter
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 (2 to 20) GHz (20 to 40) GHz (40 to 50) GHz (-10 to 0) dBm 250 kHz to 2 GHz (2 to 20) GHz (20 to 40) GHz (40 to 50) GHz (0 to 10 dBm) 250 kHz to 2 GHz (2 to 20) GHz (20 to 40) GHz (40 to 50) GHz (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	 0.8 dB 1.1 dB 1.2 dB 1.8 dB 0.7 dB 0.9 dB 1.1 dB 1.1 dB 0.7 dB 0.9 dB 1.1 dB 1.5 dB 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

1899 L Street NW, Suite 1100-A, Washington, DC 20036
414-501-5494
www.anab.org

Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
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] (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] (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)
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)

1899 L Street NW, Suite 1100-A, Washington, DC 20036
414-501-5494
www.anab.org

Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
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 (26.5 to 50) GHz	20 Hz to 1 kHz > 1 % > 3 % 20 Hz to 1 kHz > 1 % > 3 % 20 Hz to 1 kHz > 1 % > 3 % > 5 %	 0.85 % of reading 0.42 % of reading 1 % of reading 0.5 % of reading 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

1899 L Street NW, Suite 1100-A, Washington, DC 20036
414-501-5494
www.anab.org

Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Frequency Modulation Deviation – Measure [1]			Comparison to Agilent E4448A Spectrum Analyzer
Rate: 250 kHz to 10 MHz	20 Hz to 10 kHz		
	Dev/Rate > 0.2	1.5 % Deviation	
	Dev/Rate > 1.2	1 % Deviation	
10 MHz to 6.6 GHz	50 Hz to 200 kHz		
	Dev/Rate > 0.2	1.5 % Deviation	
	Dev/Rate > 0.45	1 % Deviation	
(6.6 to 13.2) GHz	50 Hz to 200 kHz		
	Dev/Rate > 0.2	2.5 % Deviation	
	Dev/Rate > 8	1 % Deviation	
(13.2 to 31.15) GHz	50 Hz to 200 kHz		
	Dev/Rate > 0.2	3.8 % Deviation	
	Dev/Rate > 16	1 % Deviation	
(31.5 to 50) GHz	50 Hz to 200 kHz		
	Dev/Rate > 0.2	8.5 % Deviation	
	Dev/Rate > 32	1 % Deviation	
Frequency Modulation Distortion – Measure [1]			Comparison to Agilent E4448A Spectrum Analyzer
1 MHz to 6.6 GHz	20 Hz to 1 kHz		
	Dev 500 Hz to 2 kHz	0.3 % of reading	
	Dev ≥ 2 kHz	0.11 % of reading	
Frequency Modulation Distortion – Measure [1]			Comparison to Agilent E4448A Spectrum Analyzer
(6.6 to 13.2) GHz	20 Hz to 1 kHz		
	Dev > 2.3 kHz	0.3 % of reading	
	Dev ≥ 4.5 kHz	0.11 % of reading	
(13.2 to 31.15) GHz	20 Hz to 1 kHz		
	Dev > 2.7 kHz	0.31 % of reading	
	Dev ≥ 6 kHz	0.12 % of reading	
(31.5 to 50) GHz	20 Hz to 1 kHz		
	Dev > 4 kHz	0.32 % of reading	
	Dev ≥ 12 kHz	0.14 % of reading	
Frequency Modulation – Deviation Source [1]			Comparison to Agilent E8257D Analog Signal Generator
250 kHz to 50 GHz	DC to 10 MHz		
	Dev ≤ 128 MHz	3.9 % Deviation	

1899 L Street NW, Suite 1100-A, Washington, DC 20036
414-501-5494
www.anab.org

Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Phase Modulation Deviation – Measure [1]			
Rate: 100 kHz to 6.6 GHz	> 0.7 rad	1.1 % Deviation	Comparison to Agilent E4448A Spectrum Analyzer
	> 0.3 rad	3.2 % Deviation	
(6.6 to 13.2) GHz	> 2 rad	1.1 % Deviation	
	> 0.6 rad	3.2 % Deviation	
(13.2 to 26.5) GHz	> 4.0 rad	1.1 % Deviation	
	> 1.2 rad	3.2 % Deviation	
(26.5 to 31.15) GHz	> 4 rad	1.1 % Deviation	
	> 1.3 rad	3.2 % Deviation	
(31.15 to 50) GHz	> 8 rad	1.1 % Deviation	
	> 2.4 rad	3.2 % Deviation	
Phase Modulation Distortion – Measure [1]			
1 MHz to 6.6 GHz	(20 to 500) Hz		Comparison to Agilent E4448A Spectrum Analyzer
	> 0.8 rad	0.31 % of reading	
	≥ 2.5 rad	0.13 % of reading	
	500 Hz to 1 kHz		
	> 0.4 rad	0.31 % of reading	
	≥ 1.0 rad	0.13 % of reading	
(6.6 to 13.2) GHz	(20 to 500) Hz		
	> 1.8 rad	0.31 % of reading	
	≥ 5.5 rad	0.13 % of reading	
	500 Hz to 1 kHz		
	≥ 0.8 rad	0.31 % of reading	
	≥ 2.5 rad	0.13 % of reading	
Phase Modulation Distortion – Measure [1]			
(13.2 to 31.15) GHz	(20 to 500) Hz		Comparison to Agilent E4448A Spectrum Analyzer
	> 3.5 rad	0.31 % of reading	
	≥ 10 rad	0.13% of reading	
(31.15 to 50) GHz	(20 to 500) Hz		
	> 7.5 rad	0.31 % of reading	
	≥ 19 rad	0.13 % of reading	
	500 Hz to 1 kHz		
	> 3 rad	0.31 % of reading	
	≥ 8 rad	0.13 % of reading	

1899 L Street NW, Suite 1100-A, Washington, DC 20036
414-501-5494
www.anab.org

Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
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 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
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

1899 L Street NW, Suite 1100-A, Washington, DC 20036
414-501-5494
www.anab.org

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 (5 to 15) in (15 to 40) in	(13 + 1*L*) µin (9 + 4*L*) µin (11 + 4*L*) µin (16 + 4*L*) µin	Comparisons to Grade 0 Gage Blocks Long Gage Blocks
Anvil Flatness	Up to 1 in*D*	3.9 µin	Optical Flats
Anvil Parallelism	Up to 1 in*D*	6.3 µin	Optical Parallels
Calipers [1,2] Outside, Inside, Depth, Step	(0.05 to 1) in (1 to 9) in (5 to 15) in (15 to 40) in	(13 + 1*L*) µin (9 + 4*L*) µin (11 + 4*L*) µin (16 + 4*L*) µin	Comparisons to Grade 0 Gage Blocks Long Gage Blocks
Linear Displacement [2]	Up to 12 ft	(1 + 2.1*L*) µin	Comparison to Laser Interferometer
Dial Indicators [1, 2]	Up to 1 in (1 to 6) in	(10 + 2*L*) µin (5 + 6*L*) in	Comparison to Gage Blocks
Length – Single Axis [2] Outside Dimension	Up to 1 in (1 to 7) in (7 to 12) in	(6.1 + 1*L*) µin (4.5 + 3.5*L*) µin (2 + 4*L*) µin	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 + 1*L*) µin (10 + 3*L*) µin (15 + 3*L*) µin (26 + 3*L*) µin	

1899 L Street NW, Suite 1100-A, Washington, DC 20036
414-501-5494
www.anab.org

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 4) in (4 to 24) in	13 µin (10 + 3*L*) µin (10 + 4.5*L*) µin	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 + 1*L*) µin (9 + 4*L*) µin (11 + 4*L*) µin (16 + 4*L*) µin	Comparison to Gage Blocks, Surface Plate
Rulers [2]	Up to 12 in (12 to 26) in	(130 + 10*L*) µin (80 + 15*L*) µin	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 + 3*L*) µin (390 + 9*L*) µin (20*L*) µin	Comparison to Accu-Gage Single Axis Vision System
Plug Gages [2] Outside Diameter	Up to 1 in (1 to 7) in	12 µin (10 + 3*L*) µin	Direct Measure using Universal Length Measuring Machine
Pin Gages [2] Outside Diameter	(0.003 to 1) in	30 µin	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 µin 8 µin (11 + 5*L*) µin	Comparison to Characterized Master Pin Gages
Threaded Plugs [2] Pitch Diameter – 60° Thread Major Diameter Step Height	Up to 1 in (1 to 4) in (4 to 7) in Up to 1 in (1 to 7) in Up to 1 in	79 µin 80 µin 83 µin 13 µin (10 + 3*L*) µin 32 µin	Comparisons to Universal Length Measuring Machine, Thread Wires Universal Length Measuring Machine 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

1899 L Street NW, Suite 1100-A, Washington, DC 20036
414-501-5494
www.anab.org

Length – Dimensional Metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
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 + 1*L*) µin (10 + 3*L*) µin (15 + 3*L*) µin (26 + 3*L*) 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 in*D* Up to 36 in*D*	 Up to 250 µin Up to 0.05 in	 4.5 µin 36 µin	 Comparisons using Optical Flat 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

1899 L Street NW, Suite 1100-A, Washington, DC 20036
414-501-5494
www.anab.org

Mass and Mass Related

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

1899 L Street NW, Suite 1100-A, Washington, DC 20036
414-501-5494
www.anab.org

Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Mass Determination (SI)	500 g 300 g 200 g 100 g 50 g 30 g 20 g 10 g 5 g 3 g 2 g 1 g 500 mg 300 mg 200 mg 100 mg 50 mg 30 mg 20 mg 10 mg 5 mg 3 mg 2 mg 1 mg	0.38 mg 0.23 mg 0.16 mg 93 µg 38 µg 26 µg 24 µg 17 µg 11 µg 11 µg 12 µg 11 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 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

1899 L Street NW, Suite 1100-A, Washington, DC 20036
414-501-5494
www.anab.org

Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
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.
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]	(0 to 14.7) psia (14.7 to 139.7) psia (139.7 to 2 514.7) psia	0.002 5 psi 0.001 % of reading + 0.007 5 psi 0.007 % of reading	Comparison to Fluke/Ruska 7250xi Pressure Controller/Calibrator
Pneumatic Gauge Pressure Devices [1]	(-14.7 to 0) psig (0 to 125) psig (125 to 2 500) psig	0.001 3 psi 0.001 4 % of reading + 0.007 psi 0.007 % of reading	Comparison to Fluke/Ruska 7250xi Pressure Controller/Calibrator
Pneumatic Gauge Pressure Devices [1]	(-60 to -22) inH_2O (-22 to 22) inH_2O (22 to 60) inH_2O (60 to 72) inH_2O (72 to 804) inH_2O	0.009 % of reading + 0.000 15 inH_2O 0.002 2 inH_2O 0.009 % of reading + 0.000 15 inH_2O 0.006 7 inH_2O 0.009 % of reading + 0.000 15 inH_2O	Comparison to Fluke/DHI PPC4-ui Pressure Measurement System

1899 L Street NW, Suite 1100-A, Washington, DC 20036
414-501-5494
www.anab.org

Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
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
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

1899 L Street NW, Suite 1100-A, Washington, DC 20036
414-501-5494
www.anab.org

Thermodynamic

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
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 (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 ºC 0.003 % of reading + 0.017 ºC 0.003 % of reading + 0.025 ºC 0.003 % of reading + 0.035 ºC	Comparison to Hart 5628 PRT w/ Black Stack and Fluke 7381, 7321, and 6331 Baths
Temperature – Source (Thermocouple Probes, RTD's)	(300 to 425) ºC (425 to 660) °C	0.003 % of reading + 0.043 ºC 0.003 % of reading + 0.06 ºC	Comparison to Hart 5628 PRT w/ Black Stack and Fluke 9173 Dry Well
Temperature – Source (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	10 MHz	3.7 pHz/Hz	Comparison to GPS, Rubidium Frequency Oscillator
Frequency – Measure	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

1899 L Street NW, Suite 1100-A, Washington, DC 20036
414-501-5494
www.anab.org

Time and Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Frequency – Source (Sine, Square, Triangle)	1 Hz to 80 MHz	58 nHz/Hz	Comparison to Function Generator, Rubidium Frequency Oscillator
Period – Measure	(1 to 100) s	45 µs	Comparison to Function Generator, Rubidium Frequency Oscillator
Period – Source	(1 to 100) s	58 µs/s	Function Generator, Rubidium Frequency Oscillator
AC Duty Cycle – Source [1] Square Wave: < 3.3 Vp-p Freq: 0.1 Hz to 100 kHz	(1 to 10) % Duty Cycle 10 µs to 100 s (10 to 49) % Duty Cycle 10 µs to 100 s 50 % Duty Cycle 10 µs to 100 s (51 to 90) % Duty Cycle 10 µs to 100 s (90 to 99) % Duty Cycle 10 µs 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	Up to 19.99 s/d	59 ms/d	Direct Measure using Vibrograf 4500 Timometer

1899 L Street NW, Suite 1100-A, Washington, DC 20036
414-501-5494
www.anab.org

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	(6.1 + 1*L*) µin	Universal Length Measuring Machine utilized as the Reference for 1D Geometric Measurements.
	(1 to 7) in	(4.5 + 3.5*L*) µin	
	(7 to 12) in	(2 + 4*L*) µin	
Inside Dimensions	(0.04 to 1) in	(9 + 1*L*) µin	
	(1 to 2.5) in	(10 + 3*L*) µin	
	(2.5 to 10) in	(15 + 3*L*) µin	
	(10 to 14) in	(26 + 3*L*) µin	

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		OGP Flash-500 Vision System utilized for 2D Dimensional Measurements.
	Up to 12 in	(130 + 10*L*) µin	
	(12 to 26) in	(80 + 15*L*) µin	

3 Dimensional

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Fixtures, Gauging, Dies, Molds			
Volumetric Measurement (X, Y, Z Axes)	1 in x 1 in x 1 in	250 µin	Global Advantage 7.10.7 Coordinate Measuring Machine utilized for 3D Measurements.
	3 in x 3 in x 3 in	260 µin	
	6 in x 6 in 6 in	260 µin	
	12 in x 12 in x 12 in	270 µin	

1899 L Street NW, Suite 1100-A, Washington, DC 20036
414-501-5494
www.anab.org

3 Dimensional

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Fixtures, Gauging, Dies, Molds Volumetric Measurement (X, Y, Z Axes)	18 in x 18 in x 18 in 24 in x 24 in x 24 in 27 in x 39 in x 27 in	300 µin 320 µin 360 µin	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 coo responding 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. 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.
11. The Legal Entity for this facility is Transcat, Inc.

Jason Stine, Vice President

1899 L Street NW, Suite 1100-A, Washington, DC 20036
414-501-5494
www.anab.org