CERTIFICATE OF ACCREDITATION

The ANSI National Accreditation Board

Hereby attests that

Transcat – Philadelphia
100 Dobbs Lane, Suite 108-110
Cherry Hill, NJ 08034

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 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-2489.03

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 – Philadelphia
100 Dobbs Lane, Suite 108-110
Cherry Hill, NJ 08034
Russell Greer russell.greer@transcat.com

CALIBRATION AND DIMENSIONAL MEASUREMENT

ISO/IEC 17025 Accreditation Granted: **07 September 2025**

Certificate Number: **AC-2489.03** Certificate Expiry Date: **07 September 2027**

CALIBRATION

Chemical Quantities

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
pH – Measuring Equipment [1]	4 pH 7 pH 10 pH	0.011 pH 0.011 pH 0.012 pH	Accredited Reference Material; Direct Measure
Conductivity Meters – Measuring Equipment	5 µS/cm 10 µS/cm 100 µS/cm 1000 µS/cm 10 000 µS/cm 100 000 µS/cm 150 000 µS/cm	0.35 µS/cm 0.35 µS/cm 0.84 µS/cm 3.5 µS/cm 38 µS/cm 310 µS/cm 610 µS/cm	Accredited Reference Material; Direct Measure

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
DC Voltage – Source [1]	(0 to 220) mV (0.22 to 2.2) V (2.2 to 11) V (11 to 22) V (22 to 220) V (220 to 1 100) V	7.5 µV/V + 0.4 µV 5 µV/V + 0.7 µV 3.5 µV/V + 2.5 µV 3.5 µV/V + 4 µV 5 µV/V + 40 µV 6.5 µV/V + 0.4 mV	Fluke 5730A Multiproduct Calibrator; Direct Measure
DC Voltage – Measure [1]	Up to 100 mV 100 mV to 1 V (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 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	Agilent 3458A Opt.002 8.5 Digit Multimeter; Direct Measure
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 + 92 mV 0.064 % of reading + 0.66 V 0.088 % of reading + 0.81 V 0.17 % of reading + 0.92 V	Vitrek 4700A High Voltage Meter; Vitrek HVL-35, HVL-70, HVL-100 High Voltage Probes; Direct Measure
AC Voltage – Source [1]	Up to 2.2 mV (10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz (2.2 to 22) mV (10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz	 0.024 % of reading + 4 µV 0.009 % of reading + 4 µV 0.008 % of reading + 4 µV 0.02 % of reading + 4 µV 0.05 % of reading + 5 µV 0.11 % of reading + 10 µV 0.14 % of reading + 20 µV 0.27 % of reading + 20 µV 0.024 % of reading + 4 µV 0.009 % of reading + 4 µV 0.008 % of reading + 4 µV 0.02 % of reading + 4 µV 0.05 % of reading + 5 µV 0.11 % of reading + 10 µV 0.14 % of reading + 20 µV 0.27 % of reading + 20 µV	Fluke 5730A Multiproduct Calibrator; Direct Measure

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]	(22 to 220) mV		Fluke 5730A Multiproduct Calibrator; Direct Measure
	(10 to 20) Hz	0.024 % of reading + 12 µV	
	(20 to 40) Hz	0.009 % of reading + 7 µV	
	40 Hz to 20 kHz	0.005 7 % of reading + 7 µV	
	(20 to 50) kHz	0.012 % of reading + 7 µV	
	(50 to 100) kHz	0.031 % of reading + 17 µV	
	(100 to 300) kHz	0.066 % of reading + 20 µV	
	(300 to 500) kHz	0.14 % of reading + 25 µV	
	500 kHz to 1 MHz	0.27 % of reading + 45 µV	
	(0.22 to 2.2) V		
	(10 to 20) Hz	0.024 % of reading + 40 µV	
	(20 to 40) Hz	0.009 % of reading + 15 µV	
	40 Hz to 20 kHz	0.004 2 % of reading + 8 µV	
	(20 to 50) kHz	0.006 7 % of reading + 10 µV	
	(50 to 100) kHz	0.008 5 % of reading + 30 µV	
	(100 to 300) kHz	0.034 % of reading + 80 µV	
	(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 + 50 µV	
	(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	0.034 % 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	0.024 % of reading + 4 mV	
	(20 to 40) Hz	0.009 % of reading + 1.5 mV	
	40 Hz to 20 kHz	0.005 2 % of reading + 0.6 mV	
	(20 to 50) kHz	0.008 % of reading + 1 mV	
	(50 to 100) kHz	0.015 % of reading + 2.5 mV	
	(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	
	(220 to 250) V		
	(15 to 50) Hz	0.03 % of reading + 16 mV	
	(250 to 1 100) V		
	50 Hz to 1 kHz	0.007 % of reading + 3.5 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]	(220 to 750) V		Fluke 5730A Multiproduct Calibrator, Fluke 5725A Amplifier; Direct Measure
	(30 to 50) kHz	0.06 % of reading + 11 mV	
	(50 to 100) kHz	0.06 % of reading + 11 mV	
	(220 to 1 100) V		
	40 Hz to 1 kHz	0.009 % of reading + 4 mV	
	(1 to 20) kHz	0.017 % of reading + 6 mV	
	(20 to 30) kHz	0.23 % of reading + 45 mV	
AC Voltage – Measure [1]	Up to 10 mV		Agilent 3458A Opt.002 8.5 Digit Multimeter; Direct Measure
	(1 to 40) Hz	0.04 % of reading + 3.5 µV	
	40 Hz to 1 kHz	0.03 % of reading + 1.2 µV	
	(1 to 20) kHz	0.04 % of reading + 1.2 µV	
	(20 to 50) kHz	0.15 % of reading + 1.2 µV	
	(50 to 100) kHz	0.59 % of reading + 1.2 µV	
	(100 to 300) kHz	4.6 % of reading + 2.3 µV	
	300 kHz to 1 MHz	1.5 % of reading + 5.8 µV	
	1 MHz to 4 MHz	8.1 % of reading + 8.1 µV	
	(10 to 100) mV		
	(1 to 40) Hz	0.013 % of reading + 4.6 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	

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]	(1 to 10) V		Agilent 3458A Opt.002 8.5 Digit Multimeter; Direct Measure
	(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	
	(10 to 100) V		
	(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 [1]	(1 to 10) kV		Vitrek 4700A High Voltage Meter; Vitrek HVL-35, HVL-70, HVL-100 High Voltage Probes; Direct Measure
	(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	1.5 % of reading + 0.81 V	
	(35 to 70) kV		
	(30 to 100) Hz	0.14 % of reading + 1 V	
	(100 to 450) Hz	0.7 % of reading + 1 V	
	(450 to 600) Hz	2.9 % of reading + 1 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 High Voltage – Measure [1]	(70 to 100) kV (30 to 100) Hz (100 to 450) Hz (450 to 600) Hz	 0.21 % of reading + 1.3 V 1.2 % of reading + 1.3 V 1.7 % of reading + 1.3 V	Vitrek 4700A High Voltage Meter; Vitrek HVL-35, HVL-70, HVL-100 High Voltage Probes; Direct Measure
Capacitance – Source [1] (Simulation)	10 Hz to 10 kHz 190 pF to 1.1 nF 10 Hz to 3 kHz (1.1 to 3.3) nF 10 Hz to 1 kHz (3.3 to 11) nF (11 to 110) nF 10 Hz to 1 kHz (110 to 330) nF (10 to 600) Hz 330 nF to 1.1 µF (10 to 300) Hz (1.1 to 3.3) µF (10 to 150) Hz (3.3 to 11) µF (10 to 120) Hz (11 to 33) µF (10 to 80) Hz (33 to 110) µF DC to 50 Hz (110 to 330) µF DC to 20 Hz 330 µF to 1.1 mF DC to 6 Hz (1.1 to 3.3) mF DC to 2 Hz (3.3 to 11) mF DC to 0.6 Hz (11 to 33) mF DC to 0.2 Hz (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 0.21 % of reading + 0.78 nF 0.21 % of reading + 2.3 nF 0.21 % 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 0.58 % of reading + 23 µF 0.85 % of reading + 78 µF	Fluke 5522A Multiproduct Calibrator; Direct Measure

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 [1]	100 Hz to 1 kHz Up to 10 pF (10 to 100) pF 100 pF to 1 µF (1 to 100) µF 100 µF to 1 mF	0.5 % of reading + 50 fF 0.059 % of reading + 50 fF 0.027 % of reading + 50 fF 0.037 % of reading + 50 fF 0.24 % of reading	GR 1689-M Precision Impedance Meter; Direct Measure
DC Current – Source [1]	(0.2 to 220) µA (0.22 to 2.2) mA (2.2 to 22) mA (22 to 220) mA (0.22 to 2.2) A	40 µA/A + 6 nA 35 µA/A + 7 nA 35 µA/A + 40 nA 45 µA/A + 0.7 µA 80 µA/A + 12 µA	Fluke 5730A Multiproduct Calibrator; Direct Measure
DC Current – Source [1]	Up to 2 A (2.2 to 11) A (2 to 20) A	0.036 % of reading + 0.48 mA 0.012 % of reading + 0.16 mA 0.012 % of reading + 1.6 mA	Fluke 5730A Multiproduct Calibrator, Fluke 5725A Amplifier; Direct Measure
DC Current – Source [1]	(20 to 120) A	0.012 % of reading + 9.6 mA	Fluke 5730A Multiproduct Calibrator, Fluke 52120A Current Amplifier; Direct Measure
DC Clamp-on Ammeters (Non-Toroidal Type) Hall Effect Sensor [1]	(20 to 54.999 5) A (55 to 149.999 5) A (150 to 549.995) A (550 to 1 025) A	0.47 % of reading + 0.11 A 0.41 % of reading + 0.11 A 0.45 % of reading + 0.39 A 0.51 % of reading + 0.39 A	Fluke 5520A Multiproduct Calibrator, 50-turn Coil; Direct Measure
DC Clamp-on Ammeters (Non-Toroidal Type) Hall Effect Sensor [1]	(1 to 5) kA	0.58 % of reading	Fluke 5522A Multiproduct Calibrator, Fluke 52120A Amplifier, 3 kA Coil, 6 kA Coil; Direct Measure
DC Current – Source/Measure [1]	Up 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	Current Source, Characterized with Agilent 3458A Opt.002 8.5 Digit Multimeter; Direct Measure
DC Current – Source/Measure [1]	(10 to 100) A	0.15 mA/A + 3 mA	Ohms Labs CS-100 Current Shunt, Agilent 3458A Opt. 002 8.5 Digit Multimeter; Direct Measure

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 – Measure [1]	(1 to 3) A (3 to 10) A	0.096 % of reading + 0.47 mA 0.12 % of reading + 0.62 mA	Fluke 8846A 6.5 Digit Multimeter; Direct Measure
DC Current – Measure	(0.2 to 2) A (2 to 20) A (20 to 30) A	0.13 mA/A + 0.1 mA 0.23 mA/A + 0.4 mA 0.55 mA/A + 4.4 mA	Fluke 8588A 8.5 Digit Multimeter; Direct Measure
DC Current – Measure [1]	(100 to 1 500) A	0.37 % of reading + 0.17 A	Empro WT-1500-50 Current Shunt, Agilent 3458A Opt. 002 8.5 Digit Multimeter; Direct Measure
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	 0.025 % of reading + 16 nA 0.016 % of reading + 10 nA 0.011 % of reading + 8 nA 0.028 % of reading + 12 nA 0.11 % of reading + 65 nA	Fluke 5730A Multiproduct Calibrator; Direct Measure
AC Current – Source [1]	(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 (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	 0.25 % of reading + 40 nA 0.016 % of reading + 35 nA 0.011 % of reading + 35 nA 0.02 % of reading + 0.11 µA 0.11 % of reading + 0.65 µA 0.025 % of reading + 0.4 µA 0.016 % of reading + 0.35 µA 0.011 % of reading + 0.35 µA 0.020 % of reading + 0.55 µA 0.11 % of reading + 5 µA 0.025 % of reading + 0.4 µA 0.016 % of reading + 0.35 µA 0.011 % of reading + 0.35 µA 0.02 % of reading + 0.55 µA 0.11 % of reading + 5 µA	Fluke 5730A Multiproduct Calibrator; Direct Measure

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]	(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 (2.2 to 11) A (40 to 100) Hz (1 to 5) kHz (5 to 10) kHz	 0.025 % of reading + 4 µA 0.016 % of reading + 3.5 µA 0.011 % of reading + 2.5 µA 0.02 % of reading + 3.5 µA 0.11 % of reading + 10 µA 0.025 % of reading + 35 µA 0.045 % of reading + 80 µA 0.7 % of reading + 0.16 µA 0.046 % of reading + 0.17 mA 0.095 % of reading + 0.38 mA 0.36 % of reading + 0.75 mA	Fluke 5730A Multiproduct Calibrator, Fluke 5725A Amplifier; Direct Measure
AC Current – Source [1]	Up to 2 A (10 to 850) Hz 850 Hz to 6 kHz (6 to 10) kHz (2 to 20) A (10 to 850) Hz 850 Hz to 6 kHz (6 to 10) kHz	 0.009 % of reading + 40 µA 0.04 % of reading + 80 µA 1.6 % of reading + 62 mA 0.009 % of reading + 0.4 mA 0.04 % of reading + 0.8 mA 2.3 % of reading + 94 mA	Fluke 5730A Multiproduct Calibrator, Fluke 52120A Current Amplifier; Direct Measure
AC Current – Source [1]	(20 to 120) A (10 to 850) Hz 850 Hz to 6 kHz (6 to 10) kHz	 0.009 % of reading + 2.4 mA 0.04 % of reading + 4.8 mA 3.1 % of reading + 0.7 A	Fluke 5730A Multiproduct Calibrator, Fluke 52120A Current Amplifier; Direct Measure
AC Current – Source [1] Extended Frequency Ranges	(29 to 330) µA (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 + 0.31 µA 0.78 % of reading + 0.47 µA 0.031 % of reading + 3.1 µA 0.31 % of reading + 0.16 mA	Fluke 5522A Multiproduct Calibrator; Direct Measure

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 Clamp-on Ammeters (Toroidal Type) Transformer Type Sensor [1]	(20 to 150) A (45 to 65) Hz (65 to 440) Hz (150 to 1 025) A (45 to 65) Hz (65 to 440) Hz	 0.24 % of reading + 19 mA 0.62 % of reading + 21 mA 0.24 % of reading + 70 mA 0.61 % of reading + 78 mA	Fluke 5520A Multiproduct Calibrator, 5500A/COIL 50-turn Coil; Direct Measure
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	 0.5 % of reading + 0.19 A 0.9 % of reading + 0.19 A 0.52 % of reading + 0.7 A 0.9 % of reading + 0.7 A	Fluke 5520A Multiproduct Calibrator, Fluke 5500A/COIL 50-turn Coil; Direct Measure
AC Clamp-on Ammeters (Non-Toroidal Type) Hall Effect Sensor [1]	(10 to 300) Hz (1 to 6) kA (300 to 440) Hz (1 to 2) kA (2 to 6) kA	 0.6 % of reading 0.8 % of reading 0.66 % of reading	Fluke 5522A Multiproduct Calibrator, Fluke 52120A Amplifier, 3 kA Coil, 6 kA Coil; Direct Measure
AC Current – Measure [1]	Up to 100 µA (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 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	Agilent 3458A Opt.002 8.5 Digit Multimeter; Direct Measure

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]	(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	Agilent 3458A Opt.002 8.5 Digit Multimeter; Direct Measure
AC Current – Measure	(0.2 to 2) A 1 Hz to 2 kHz (2 to 10) kHz (10 to 30) kHz (2 to 20) A 10 Hz to 2 kHz (2 to 10) kHz (20 to 30) A 10 Hz to 2 kHz (2 to 10) kHz	 0.3 mA/A + 0.1 mA 0.56 mA/A + 0.1 mA 0.8 mA/A + 0.1 mA 0.84 mA/A + 0.5 mA 0.86 mA/A + 0.5 mA 0.84 mA/A + 12 mA 1.2 mA/A + 12 mA	Fluke 8588A 8.5 Digit Multimeter; Direct Measure
AC Current – Measure [1]	(10 to 100) A 50/60 Hz 400 Hz 1 kHz	 0.023 % of reading + 5 mA 0.11 % of reading + 5 mA 0.2 % of reading + 5 mA	Ohms Labs CS-100 Current Shunt, Agilent 3458A Opt. 002 8.5 Digit Multimeter; Direct Measure
DC Resistance – Source [1] (Fixed Artifacts)	1 mΩ 10 mΩ 100 mΩ 1 Ω 100 Ω	59 µΩ/Ω 58 µΩ/Ω 58 µΩ/Ω 58 µΩ/Ω 1.3 µΩ/Ω	Standard Resistors; Direct Measure
DC Resistance – Source [1] (Variable Artifact)	(1 to 10) GΩ (10 to 100) GΩ 100 GΩ to 1 TΩ	0.59 % 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	IET HRRS-B-7-100k-5kV Decade Resistor; Direct Measure (V is the DUT Voltage)
DC Resistance – Source [1] (Simulation)	(1.1 to 3.3) MΩ (3.3 to 11) MΩ (11 to 33) MΩ (33 to 110) MΩ (110 to 330) MΩ	0.005 9 % of reading + 23 Ω 0.011 % of reading + 39 Ω 0.021 % of reading + 1.9 kΩ 0.041 % of reading + 2.3 kΩ 0.26 % of reading + 78 kΩ	Fluke 5522A Multiproduct Calibrator; Direct Measure
DC Resistance – Source/Measure [1] (Artifacts)	250 µΩ to 4 mΩ (4 to 40) mΩ (40 to 400) mΩ 400 mΩ to 4 Ω 4 Ω to 400 kΩ	85 µΩ/Ω 25 µΩ/Ω 20 µΩ/Ω 16 µΩ/Ω 5 µΩ/Ω	Fluke 1594A Bridge in Ratio Mode, Characterized Resistors; Direct Measure

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/Measure [1] (Variable Artifacts)	Up 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 + 0.12 kΩ 0.59 kΩ/MΩ + 1.2 kΩ 8.2 kΩ/MΩ + 12 kΩ	Agilent 3458A Opt. 002 8.5 Digit Multimeter, Decade Resistors; Direct Measure
DC Resistance – Measure	(0.2 to 2) GΩ	1.3 MΩ/GΩ + 1 MΩ	Fluke 8588A 8.5 Digit Multimeter; Direct Measure
High Voltage DC Resistance – Measure	(0.2 to 2) GΩ (2 to 20) GΩ	0.23 MΩ/GΩ + 0.1 MΩ 1.3 MΩ/GΩ + 10 MΩ	Fluke 8588A 8.5 Digit Multimeter; Direct Measure
DC Resistance – Source (Fixed Artifacts)	0 Ω 1 Ω 1.9 Ω 10 Ω 19 Ω 100 Ω 190 Ω 1 kΩ 1.9 kΩ 10 kΩ 19 kΩ 100 kΩ 190 kΩ 1 MΩ 1.9 MΩ 10 MΩ 19 MΩ 100 MΩ	40 μΩ 95 μΩ/Ω 95 μΩ/Ω 23 μΩ/Ω 23 μΩ/Ω 10 μΩ/Ω 10 μΩ/Ω 6.5 μΩ/Ω 6.5 μΩ/Ω 6.5 μΩ/Ω 6.5 μΩ/Ω 8.5 μΩ/Ω 8.5 μΩ/Ω 13 μΩ/Ω 18 μΩ/Ω 40 μΩ/Ω 47 μΩ/Ω 0.1 mΩ/Ω	Fluke 5730A Multiproduct Calibrator; Direct Measure
AC Resistance – Measure [1,10]	10 Ω to 100 kΩ (12 to 29) Hz (30 to 999) Hz 1 kHz 10 Ω to 100 kΩ 10 kHz 50 kHz	 0.11 % of reading 0.06 % of reading 0.03 % of reading 0.06 % of reading 0.21 % of reading	GenRad 1689M Precision Impedance Meter; Direct Measure

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 – Source [1] (Fixed Artifacts)	1 kHz 1 mH 10 mH 100 mH 1 H	 0.13 % of reading 0.13 % of reading 0.13 % of reading 0.13 % of reading	Standard Inductors; Direct Measure
Inductance – Measure [1]	100 Hz to 1 kHz (1 to 10) mH 10 mH to 10 H	 0.041 % of reading + 0.1 µH 0.035 % of reading + 1.4 µH	GenRad 1689M Precision Impedance Meter; Direct Measure
Electrical Simulation of Thermocouple Indicating Devices – Measure/Source [1]	Type B (250 to 350) °C (350 to 445) °C (445 to 580) °C (580 to 750) °C (750 to 1 000) °C (1 000 to 1 820) °C Type C (0 to 250) °C (250 to 1 000) °C (1 000 to 1 500) °C (1 500 to 1 800) °C (1 800 to 2 000) °C (2 000 to 2 250) °C (2 250 to 2 315) °C Type E (-270 to -245) °C (-245 to -195) °C (-195 to -155) °C (-155 to -90) °C (-90 to 0) °C (0 to 15) °C (15 to 890) °C (890 to 1 000) °C Type J (-210 to -180) °C (-180 to -120) °C (-120 to -50) °C (-50 to 990) °C (990 to 1 200) °C	 1.2 °C 0.9 °C 0.71 °C 0.55 °C 0.45 °C 0.35 °C 0.24 °C 0.19 °C 0.21 °C 0.24 °C 0.27 °C 0.33 °C 0.37 °C 1.6 °C 0.24 °C 0.12 °C 0.09 °C 0.08 °C 0.08 °C 0.06 °C 0.07 °C 0.13 °C 0.11 °C 0.09 °C 0.08 °C 0.08 °C	Ectron 1140A Thermocouple Calibrator/Simulator; Direct Measure

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 K		Ectron 1140A Thermocouple Calibrator/Simulator; Direct Measure
	(-270 to -255) °C	2.5 °C	
	(-255 to -195) °C	0.85 °C	
	(-195 to -115) °C	0.16 °C	
	(-115 to -55) °C	0.12 °C	
	(-55 to 1 000) °C	0.09 °C	
	(1 000 to 1 372) °C	0.1 °C	
	Type N		
	(-270 to -260) °C	5.4 °C	
	(-260 to -200) °C	1.5 °C	
	(-200 to -140) °C	0.29 °C	
	(-140 to -70) °C	0.18 °C	
	(-70 to 25) °C	0.14 °C	
	(-25 to 160) °C	0.12 °C	
	(160 to 1 300) °C	0.11 °C	
	Type R		
	(-50 to -30) °C	0.8 °C	
	(-30 to 45) °C	0.69 °C	
	(45 to 160) °C	0.49 °C	
	(160 to 380) °C	0.35 °C	
	(380 to 775) °C	0.3 °C	
	(775 to 1 768) °C	0.26 °C	
	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	0.31 °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	
DC Power – Source [1]			Fluke 5520A Multiproduct Calibrator; Direct Measure
(0.33 to 330) mA	(11 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 [1,2]			Fluke 5520A Multiproduct Calibrator; Direct Measure
PF = 1			
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	
Phase – Source [1]	Up to 180°		Fluke 5520A Multiproduct Calibrator; Direct Measure
	(10 to 65) Hz	0.092°	
	(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 20) kHz	7.8°	
Oscilloscopes [1,3]			Fluke 9500B/3200 3.2 GHz High-Performance Oscilloscope Calibrator; Direct Measure
Amplitude – DC			
into 50 Ω load	(-5 to 5) V	0.023 % of reading + 19 µV	
into 1 MΩ load	(-200 to 200) V	0.023 % of reading + 19 µV	
Amplitude – Square Wave			
Rate: 10 Hz to 10 kHz			
into 50 Ω load	40 µVp-p to 1 mVp-p	0.78 % of reading + 7.8 µV	
	1 mVp-p to 5 Vp-p	0.078 % of reading + 7.8 µV	
into 1 MΩ load	40 µVp-p to 1 mVp-p	0.78 % of reading + 7.8 µV	
Rate: 10 Hz to 100 kHz			
into 50 Ω load	1 mVp-p to 5 Vp-p	0.16 % of reading + 7.8 µV	
into 1 MΩ load	1 mVp-p to 200 Vp-p	0.78 % of reading + 7.8 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
Oscilloscopes [1,3]			
Time Markers			
100 mVp-p to 1 Vp-p			
into 50 Ω load			
Square Wave	9.009 1 ns to 83 µs	0.19 µs/s	
	83 µs to 55s	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 55s	2.3 µs/s	Fluke 9500B/3200 3.2 GHz High-Performance Oscilloscope Calibrator; Direct Measure
Triangle Wave	900.91 ns to 83 µs	0.19 µs/s	
	83 µs to 55s	2.3 µs/s	
Rise Time			
into 50 Ω load			
Rate: 10 Hz to 2 MHz	5 mVp-p to 3 Vp-p		
	500 ps (nominal)	290 ps	
	150 ps (nominal)	35 ps	
Rate: 10 Hz to 1 MHz	25 mVp-p to 2 Vp-p		
	70 ps (nominal)	24 ps	
	425 mVp-p to 575 mVp-p		
	25 ps (nominal)	6.7 ps	
Oscilloscopes [1,3]			
Leveled Sine Wave			
50 kHz Reference			Fluke 9500B/3200 3.2 GHz High-Performance Oscilloscope Calibrator, Fluke 9530 3.2 GHz Active Head, Fluke 9550 Active Head w/ 25 ps Capability, Fluke 9560 6 GHz Active Head, Tektronix 067-1330-000 Calibration Fixture; Direct Measure
into 50 Ω load	5 mVp-p to 5 Vp-p		
	50 kHz to 10 MHz	1.2 % of reading	
Input Impedance Measure	(10 to 40) Ω	0.39 % of reading	
	(40 to 90) Ω	0.083 % of reading	
	(90 to 150) Ω	0.39 % of reading	
	(50 to 800) kΩ	0.39 % of reading	
	(0.8 to 1.2) MΩ	0.083 % of reading	
	(1.2 to 12) MΩ	0.39 % of reading	
Input Capacitance Measure	(1 to 35) pF	1.6 % of reading + 0.19 pF	
	(35 to 95) pF	2.3 % of reading + 0.19 pF	

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
Bandwidth Flatness Measure [1] into VSWR (1.2:1) (wrt Reference Frequency)	5 mVp-p to 5 Vp-p 100 mHz 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	Fluke 9500B/3200 3.2 GHz High-Performance Oscilloscope Calibrator, Fluke 9530 3.2 GHz Active Head; Direct Measure
Total Harmonic Distortion – Measure	(-80 to 0) dB 20 Hz to 20 kHz (20 to 100) kHz	 1.1 dB 2 dB	Agilent 8903A Audio Analyzer; Direct Measure
Total Harmonic Distortion – Measure (0.3 to 100) % 0.1 %	 < 30 V 10 Hz to 1 MHz (1 to 3) MHz > 30 V 10 Hz to 300 kHz (300 to 500) kHz 500 kHz to 3 MHz < 30 V (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 3 % of reading 6 % of reading 12 % of reading 12 % of reading 6 % of reading 3 % of reading 6 % of reading 12 % of reading	HP 334A Distortion Analyzer; Direct Measure
Total Harmonic Distortion – Measure 0.1 %	 > 30 V (20 to 30) Hz 30 Hz to 300 kHz (300 to 500) kHz 500 kHz to 1.2 MHz	 12 % of reading 3 % of reading 6 % of reading 12 % of reading	HP 334A Distortion Analyzer; Direct Measure
Rise Time – Measure	≥ 350 ps	33 ps	Tektronix TDS874D Oscilloscope; Direct Measure

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
Rise Time – Measure	≥ 17.5 ps	12 ps	Agilent 83484A Dual Channel 50 GHz Electrical Module, Agilent 86100C Wideband Oscilloscope Mainframe; Direct Measure
Sine Wave Flatness	(0.1 to 3.9) V 20 Hz to 1 MHz (1 to 10) MHz (10 to 30) MHz (30 to 50) MHz (50 to 80) MHz (80 to 100) MHz	 0.067 % of reading 0.078 % of reading 0.11 % of reading 0.28 % of reading 0.49 % of reading 0.61 % of reading	Thermal Converters, HP 3458A 8.5 Digit Multimeter; Direct Measure

Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
RF Power – Power Meter Reference	50 MHz 1 mW Reference	0.43 % of reading	HP 478A Coaxial Thermistor Mount, HP 432A Power Meter; Direct Measure
S11/S22 Reflection Coefficients Magnitude – Measure [1,7] (Linear)	(10 to 700) MHz ≤ 0.25 lin (> 0.25 to 0.5) lin (> 0.5 to ≤ 0.7) lin (> 0.7 to ≤ 1) lin 700 MHz to 24 GHz ≤ 0.25 lin (> 0.25 to 0.5) lin (> 0.5 to ≤ 0.7) lin (> 0.7 to ≤ 1) lin	 0.012 0.013 0.014 0.016 0.006 2 0.006 6 0.076 0.097	R&S® ZVA50 Vector Network Analyzer, Calibration Kits; Direct Measure

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
S11/S22 Reflection Coefficients Magnitude – Measure [1,7] (Linear)	(24 to 33) GHz ≤ 0.25 lin (> 0.25 to 0.5) lin (> 0.5 to ≤ 0.7) lin (> 0.7 to ≤ 1) lin (33 to 50) GHz ≤ 0.25 lin (> 0.25 to 0.5) lin (> 0.5 to ≤ 0.7) lin (> 0.7 to ≤ 1) lin	 0.019 0.019 0.022 0.023 0.019 0.019 0.022 0.023	R&S® ZVA50 Vector Network Analyzer, Calibration Kits; Direct Measure
S11/S22 Reflection Coefficients Phase – Measure [1]	(10 to 700) MHz ≤ 0.25 lin (> 0.25 to 0.5) lin (> 0.5 to ≤ 0.7) lin (> 0.7 to ≤ 1) lin	 4° 2° 2° 1°	R&S® ZVA50 Vector Network Analyzer, Calibration Kits; Direct Measure
S11/S22 Reflection Coefficients Phase – Measure [1] (Linear)	700 MHz to 24 GHz ≤ 0.25 lin (> 0.25 to 0.5) lin (> 0.5 to ≤ 0.7) lin (> 0.7 to ≤ 1) lin (24 to 50) GHz ≤ 0.25 lin (> 0.25 to 0.5) lin (> 0.5 to ≤ 0.7) lin (> 0.7 to ≤ 1) lin	 4° 1° 1° 1° 11° 3° 2° 2°	R&S® ZVA50 Vector Network Analyzer, Calibration Kits; Direct Measure
S21/S12 Transmission Coefficients Magnitude – Measure [1] (dB)	(10 to 700) MHz (-90 to ≤ -80) dB (-80 to ≤ -70) dB (-70 to ≤ -60) dB (-60 to ≤ -50) dB (-50 to ≤ -40) dB (-40 to ≤ -30) dB (-30 to ≤ -20) dB (-20 to ≤ -10) dB (-10 to ≤ 0) dB	 0.56 dB 0.21 dB 0.13 dB 0.12 dB 0.12 dB 0.12 dB 0.12 dB 0.12 dB 0.12 dB	R&S® ZVA50 Vector Network Analyzer, Calibration Kits; Direct Measure

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
S21/S12 Transmission Coefficients Magnitude – Measure [1] (dB)	700 MHz to 24 GHz (-80 to ≤ -70) dB (-70 to ≤ -60) dB (-60 to ≤ -50) dB (-50 to ≤ -40) dB (-40 to ≤ -30) dB (-30 to ≤ -20) dB (-20 to ≤ -10) dB (-10 to ≤ 0) dB (24 to 33) GHz (-80 to ≤ -70) dB (-70 to ≤ -60) dB (-60 to ≤ -50) dB (-50 to ≤ -40) dB (-40 to ≤ -30) dB (-30 to ≤ -20) dB (-20 to ≤ -10) dB (-10 to ≤ 0) dB (33 to 50) GHz (-80 to ≤ -70) dB (-70 to ≤ -60) dB (-60 to ≤ -50) dB (-50 to ≤ -40) dB (-40 to ≤ -30) dB (-30 to ≤ -20) dB (-20 to ≤ -10) dB (-10 to ≤ 0) dB	 0.55 dB 0.19 dB 0.08 dB 0.06 dB 0.05 dB 0.05 dB 0.05 dB 0.06 dB 0.56 dB 0.21 dB 0.11 dB 0.1 dB 0.1 dB 0.1 dB 0.1 dB 0.1 dB 0.56 dB 0.21 dB 0.11 dB 0.1 dB 0.1 dB 0.1 dB 0.1 dB 0.1 dB	R&S® ZVA50 Vector Network Analyzer, Calibration Kits; Direct Measure
S21/S12 Transmission Coefficients Phase – Measure [1] (dB)	(10 to 700) MHz (-90 to ≤ -40) dB (-40 to ≤ -30) dB (-30 to ≤ -20) dB (-20 to ≤ -10) dB (-10 to ≤ 0) dB 700 MHz to 24 GHz (-80 to ≤ -40) dB (-40 to ≤ -30) dB (-30 to ≤ -20) dB (-20 to ≤ -10) dB (-10 to ≤ 0) dB	 180° 52° 14° 4.5° 1° 180° 23° 7.2° 2.6° 0.6°	R&S® ZVA50 Vector Network Analyzer, Calibration Kits; Direct Measure

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
S21/S12 Transmission Coefficients Phase – Measure [1] (dB)	(24 to 33) GHz (-80 to ≤ -40) dB (-40 to ≤ -30) dB (-30 to ≤ -20) dB (-20 to ≤ -10) dB (-10 to ≤ 0) dB (33 to 50) GHz (-80 to ≤ -40) dB (-40 to ≤ -30) dB (-30 to ≤ -20) dB (-20 to ≤ -10) dB (-10 to ≤ 0) dB	 180° 52° 14° 4.5° 1° 180° 52° 14° 4.5° 1°	R&S® ZVA50 Vector Network Analyzer, Calibration Kits; Direct Measure
Absolute RF Power – Measure [8]	8 kHz to 18 GHz (-30 to 23) dBm	 0.18 dB	R&S® NRP18A Power Sensor, NRX Power Meter; Direct Measure
Absolute RF Power – Measure [8]	(-35 to 20) dBm DC to 100 MHz > 100 MHz to 2.4 GHz (> 2.4 to 12.4) GHz (> 12.4 to 18) GHz (>18 to 26.5) GHz (>26.5 to 40) GHz (>40 to 50) GHz	 0.08 dB 0.08 dB 0.09 dB 0.1 dB 0.11 dB 0.13 dB 0.17 dB	R&S® NRP18A R&S® NRP50T Power Sensors, NRX Power Meter; Direct Measure
Relative RF Power – Measure [8]	(-30 to 20) dBm DC to 50 GHz	 0.04 dB	R&S® NRP18T R&S® NRP50T Power Sensors, NRX Power Meter; Direct Measure
Amplitude Modulation – AM Depth Measure (Absolute) Rate: 10 Hz to 150 kHz	100 kHz to 50 GHz Up to 100 % Depth	0.5 % of reading	R&S® FSMR Measuring Receiver (B2, B4, B24); Direct Measure
Amplitude Modulation – AM Depth Measure (Flatness reference to 1 kHz) Rate: 10 Hz to 150 kHz	100 kHz to 50 GHz Up to 100 % Depth	0.3 % of reading	R&S® FSMR Measuring Receiver (B2, B4, B24); Direct Measure

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 – FM Deviation Measure Rate: 10 Hz to 5 MHz	100 kHz to 50 GHz Dev ≤ 5 MHz	1.2 % of reading	R&S® FSMR Measuring Receiver (B2, B4, B24); Direct Measure
Phase Modulation – Deviation Measure Rate: 10 Hz to 5 MHz	100 kHz to 50 GHz Dev ≤ 10 000 rad	1.2 % of reading	R&S® FSMR Measuring Receiver (B2, B4, B24); Direct Measure
Single-sideband Phase Noise – Source/Measure [8]	1 MHz to 50 GHz 10 mHz ≤ Offset < 1 MHz 1 MHz ≤ Offset ≤ 30 MHz Offset > 30 MHz	 1.8 dB 2.3 dB 3.5 dB	R&S® FSWP50 Phase Noise Analyzer (B1, B24, B320, K70); Direct Measure
Adjacent Channel Leakage Ratio (ACLR) [8] Signal Noise > 16 dB	DC to 50 GHz (-90 to -70) dB (-70 to 0) dB	 0.18 dB 0.14 dB	R&S® FSWP50 Phase Noise Analyzer; Direct Measure
Error Vector Magnitude (EVM) Rate: Up to 320 MHz	100 kHz to 6 GHz FSK/ASK/PSK/APSK/ MSK/16QAM/64QAM/ 128QAM/256QAM/ 1024QAM	2.3 % of reading	R&S® FSWP50 Phase Noise Analyzer; Direct Measure
Relative Tuned RF Power – Measure [1]	100 kHz to 22 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	 0.67 dB 0.22 dB 0.13 dB 0.12 dB 0.11 dB 0.11 dB 0.11 dB 0.11 dB 0.088 dB 0.086 dB 0.084 dB 0.083 dB	R&S® FSMR Measuring Receiver; Direct Measure

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
Relative Tuned RF Power – Measure [1]	(22 to 40) 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 (40 to 50) 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	 0.68 dB 0.23 dB 0.14 dB 0.13 dB 0.13 dB 0.12 dB 0.12 dB 0.12 dB 0.092 dB 0.09 dB 0.088 dB 0.086 dB 0.69 dB 0.26 dB 0.19 dB 0.18 dB 0.17 dB 0.17 dB 0.16 dB 0.16 dB 0.11 dB 0.11 dB 0.1 dB 0.1 dB	R&S® FSMR Measuring Receiver; Direct Measure
Absolute Tuned RF Power – Measure [1]	100 kHz to 22 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	 0.68 dB 0.25 dB 0.17 dB 0.16 dB 0.16 dB 0.16 dB 0.16 dB 0.16 dB 0.14 dB 0.14 dB 0.14 dB 0.14 dB	R&S® FSMR Measuring Receiver; R&S® NRP18T R&S® NRP50T Power Sensors, NRX Power Meter; Direct Measure

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
Absolute Tuned RF Power – Measure [1]	(22 to 40) 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 (40 to 50) 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	 0.69 dB 0.26 dB 0.19 dB 0.18 dB 0.18 dB 0.18 dB 0.18 dB 0.18 dB 0.16 dB 0.16 dB 0.16 dB 0.16 dB 0.71 dB 0.31 dB 0.25 dB 0.25 dB 0.24 dB 0.24 dB 0.23 dB 0.23 dB 0.2 dB 0.2 dB 0.2 dB 0.2 dB	R&S® FSMR Measuring Receiver; R&S® NRP18T R&S® NRP50T Power Sensors, NRX Power Meter; Direct Measure
Absolute Tuned RF Power – Measure	2.5 MHz to 26.5 GHz (-127 to -120) dB (-120 to -110) dB (-110 to -100) dB (-100 to -90) dB (-90 to -80) dB (-80 to -70) dB (-70 to -60) dB (-60 to -50) dB (-50 to -40) dB (-40 to -30) dB (-30 to -20) dB (-20 to -10) dB (-10 to -0) dB	 0.26 dB 0.26 dB 0.26 dB 0.26 dB 0.26 dB 0.25 dB 0.25 dB 0.25 dB 0.25 dB 0.14 dB 0.14 dB 0.14 dB 0.14 dB	HP 8902A Opt. 050 Measuring Receiver; HP 11722A, HP 11792A, HP 11793A Power Sensors; Direct Measure

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
Relative Tuned RF Power – Measure	2.5 MHz to 26.5 GHz (-127 to -120) dB (-120 to -110) dB (-110 to -100) dB (-100 to -90) dB (-90 to -80) dB (-80 to -70) dB (-70 to -60) dB (-60 to -50) dB (-50 to -40) dB (-40 to -30) dB (-30 to -20) dB (-20 to -10) dB (-10 to -0) dB	 0.23 dB 0.23 dB 0.23 dB 0.23 dB 0.22 dB 0.084 dB 0.081 dB 0.074 dB 0.071 dB 0.068 dB 0.064 dB 0.06 dB 0.056 dB	HP 8902A Opt. 050 Measuring Receiver; HP 11722A, HP 11792A, HP 11793A Power Sensors; Direct Measure

Length – Dimensional Metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Angle Measuring Devices, Protractors, Inclinometers, Squares, Angle Gages [4]	Up to 5° (5 to 20)° (20 to 35)° (35 to 45)° (45 to 60)° (60 to 75)° (75 to 85)° 90°	3.2″ 6.1″ 11″ 15″ 25″ 54″ 166″ 1.1″	Direct Measure; 5 in Sine Bar, Gage Blocks, Surface Plate Master Square, Surface Plate;
Bore Gages [1]	(0.18 to 0.75) in (0.75 to 1.25) in	60 µin 65 µin	Characterized Rings; Comparison Method

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
Calipers, Micrometers [1,4] Travel (Outside, Inside, Depth, Step)	Up to 1 in (1 to 9) in (4 to 15) in (15 to 40) in	(16 + 1*L*) µin (11 + 4*L*) µin (13 + 4.5*L*) µin (15 + 4.6*L*) µin	Direct Measure; B89.1 Grade 00 Gage Blocks B89.1 Grade 0 Gage Blocks
Anvil Flatness	Up to 1 in diameter	4.4 µin	Optical Flats
Anvil Parallelism	Up to 1 in diameter	8.2 µin	Optical Parallels
Dial/Digital Indicators	Up to 1 in (1 to 6) in	17 µin (12 + 4*L*) µin	B89.1 Grade 00 Gage Blocks; Direct Measure
Length – Single Axis [4] Outside Dimension	Up to 1 in (1 to 7) in (7 to 12) in	(6 + 1*L*) µin (4.3 + 3.5*L*) µin (1 + 4*L*) µin	Universal Length Measuring Machine; Direct Measure
Length – Single Axis [4] Inside Dimension	(0.04 to 0.125) in (0.125 to 0.25) in (0.25 to 1) in (1 to 2.5) in (2.5 to 10) in	17 µin 17 µin 11 µin (14 + 2*L*) µin (18 + 3*L*) µin	Universal Length Measuring Machine; Direct Measure
Height Gages [1,4]	(0 to 48) in	(27 + 3.4*L*) µin	Gage Blocks, Surface Plate; Direct Measure
Parallelism, Flatness, Straightness	Up to 36 in	45 µin	Gage Amplifier, Surface Plate; Direct Measure
Squareness	Up to 18 in	9.4 µin/in	Gage Amplifier, Granite Master Square; Direct Measure
Cylindrical Plug Gages [4] Outside Diameter	Up to 1 in (1 to 7) in	12 µin (9 + 3*L*) µin	Universal Length Measuring Machine; Direct Measure
Pin Gages (Outside Diameter)	0.01 to 1 in	31 µin	Non-contact Method using Laser Micrometer

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
Cylindrical Ring Gages [4] Inside Diameter	Up to 2.5 in (2.5 to 10) in (10 to 14) in	11 µin (18 + 3*L*) µin (38 + 3*L*) µin	Universal Length Measuring Machine; Direct Measure
Thread Plug Gages [4] Pitch Diameter Major Diameter	Up to 1 in (1 to 4) in (4 to 10) in Up to 4 in (4 to 10) in	80 µin (78 + 1.9*L*) µin (79 + 2.3*L*) µin (32 + 2.5*L*) µin (35 + 2.8*L*) µin	Direct Measure; Universal Length Measuring Machine, Thread Wires Universal Length Measuring Machine
Thread Ring Gages [4] Inner Pitch Diameter	Up to 1 in (1 to 4) in (4 to 7) in	79 µin 80 µin 83 µin	Comparison to Master Thread Setting Plug and using the Measurement Uncertainty from that Master.
Thread Wires (2 to 120) TPI	(0.008 to 0.5) in	12 µin	Universal Length Measuring Machine; Direct Measure
Measuring Tapes, Rulers [1,4]	Up to 40 in	(600 + 8*L*) µin	Comparison to Glass Rule
Measuring Tapes, Rulers [4]	Up to 1 ft (1 to 3) ft (3 to 1 000) ft	(710 + 2*L*) µin (660 + 5*L*) µin 19*L* µin	Single Axis Vision System; Direct Measure
Optical Comparators [1,4] X, Y Length Magnification Perpendicularity of X-Y axis	Up to 12 in 10X to 50X Up to 6 in	(90 + 5*L*) µin 200 µin 58 µin/in	Direct Measure; Calibration Grids Magnification Checker Precision Square
Length Measuring Equipment [4] Linear Displacement	Up to 48 in	(140 + 0.5*L*) µin	Laser Interferometer; Comparison Method

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
Gas Flow Devices	(2 to 200) sccm (0.2 to 40) slpm (40 to 80) slpm (80 to 100) slpm	0.33 % of reading 0.23 % of reading 0.32 % of reading 0.57 % of reading	Comparison to Fluke molbloc Laminar Flow Element Gas Flow Calibration System
Gas Flow Devices	(100 to 300) slpm (300 to 1 200) slpm	0.6 % of reading 0.81 % of reading	Comparison to Fluke molbloc Sonic Nozzle Gas Flow Calibration System
Force Gages (Tension and Compression)	Up to 5 lbf (5 to 10) lbf (10 to 20) lbf (20 to 30) lbf (30 to 100) lbf	0.001 1 lbf 0.002 lbf 0.005 8 lbf 0.009 3 lbf 0.061 lbf	Characterized NIST Class F Weights; Direct Measure
Force Gages (Tension and Compression)	Up to 5 lbf (5 to 10) lbf (10 to 20) lbf (20 to 30) lbf (30 to 100) lbf	0.001 2 lbf 0.002 3 lbf 0.006 2 lbf 0.009 9 lbf 0.063 lbf	NIST Class F Weights; Direct Measure
Mass Determination (SI)	1 mg 2 mg 3 mg 5 mg 10 mg 20 mg 30 mg 50 mg 100 mg 200 mg 300 mg 500 mg 1 g 2 g 3 g 5 g	1.9 µg 1.9 µg 1.9 µg 1.9 µg 1.9 µg 1.9 µg 1.9 µg 1.9 µg 1.9 µg 1.9 µg 1.9 µg 1.9 µg 4.2 µg 4.4 µg 6 µg 5.2 µg	Double 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)	10 g 20 g 30 g 50 g 100 g 200 g 300 g 500 g 1 kg 2 kg 3 kg 5 kg 10 kg 20 kg 25 kg	7.6 µg 11.1 µg 13.6 µg 16.5 µg 33 µg 70 µg 74 µg 0.16 mg 0.33 mg 0.73 mg 1 mg 1.6 mg 3.6 mg 7.2 mg 9.9 mg	Double Substitution Method; Reference Weights, Electronic Balances
Mass Determination (SI)	1 mg 2 mg 3 mg 5 mg 10 mg 20 mg 30 mg 50 mg 100 mg 200 mg 300 mg 500 mg 1 g 2 g 3 g 5 g 10 g 20 g 30 g 50 g 100 g 200 g 300 g 500 g	4.5 µg 4.5 µg 4.5 µg 4.5 µg 4.5 µg 4.5 µg 4.5 µg 4.5 µg 4.5 µg 4.5 µg 4.5 µg 4.5 µg 11.8 µg 12 µg 13.4 µg 12.4 µg 18.5 µg 27 µg 29 µg 43 µg 62 µg 0.18 mg 0.25 mg 0.42 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)	1 kg 2 kg 3 kg 5 kg 10 kg 20 kg 25 kg	0.9 mg 1.9 mg 2.9 mg 4.4 mg 6.9 mg 19 mg 25 mg	Single Substitution Method; Reference Weights, Electronic Balances
Mass Determination (Avoirdupois)	0.0312 5 oz 0.062 5 oz 0.125 oz 0.25 oz 0.5 oz 1 oz 2 oz 4 oz 8 oz 1 lb 2 lb 5 lb 7.5 lb 10 lb 15 lb 20 lb 25 lb 50 lb	7.7 µg 14 µg 15 µg 18 µg 26 µg 34 µg 45 µg 65 µg 0.18 mg 0.26 mg 0.5 mg 1.9 mg 2.9 mg 3.1 mg 4.5 mg 5.4 mg 6.8 mg 19 mg	Single Substitution Method; Reference Weights, Electronic Balances
Rockwell Hardness Testers [1]	HRC Scale (23 to 27) HRC (43 to 47) HRC (63 to 67) HRC HRBw Scale (48 to 52) HRBw (68 to 72) HRBw (93 to 97) HRBw	 0.87 HRC 0.66 HRC 0.49 HRC 1.24 HRBw 1.2 HRBw 1.21 HRBw	Indirect verification per ASTM E18 using Hardness Test Blocks.

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
Durometers Spring Force Types A, B, E, O Type D, C, DO Indicator Geometry Length Angle Radius	 Up to 100 Duro Up to 100 Duro Up to 1 in Up to 180° Up to 1 in	 0.31 Duro 0.16 Duro 210 µin 0.008° 260 µin	Direct Verification per ASTM D2240 using Duro Calibrator Optical Comparator
Torque Wrenches, Torque Drivers, Torque Indicators [1]	(3 to 80) ozf·in 15 ozf·in to 600 lbf·ft 5 lbf·in to 800 lbf·ft	1.7 % of reading 0.5 % of reading 1 % of reading	Torque Calibrators; Direct Measure
Torque Angle [1]	45° 90° 135° 180° 360°	0.35° 0.35° 0.35° 0.35° 0.35°	Comparison to Torque Angle Fixture
Torque Calibration Equipment	5 ozf·in to 2.5 lbf·in (2.5 to 50) lbf·in	0.09 % of reading 0.05 % of reading	Torque Wheel, Master Weights; Direct Measure
Torque Calibration Equipment	50 lbf·in to 250 lbf·ft	0.06 % of reading	Torque Butterfly, Master Weights; Direct Measure
Balances and Scales [1,5] (SI)	Up to 500 mg 500 mg to 2 g (2 to 5) g (5 to 10) g (10 to 20) g (20 to 50) g (50 to 100) g (100 to 200) g (200 to 500) g 500 g to 1 kg (1 to 2) kg (2 to 5) kg (5 to 10) kg (10 to 20) kg (20 to 30) kg (30 to 40) kg (40 to 50) kg	2.5 µg 6.2 µg 6.7 µg 11 µg 16 µg 27 µg 58 µg 0.11 mg 0.27 mg 0.54 mg 1.8 mg 3 mg 6.6 mg 14 mg 20 mg 27 mg 25 mg	Characterized ASTM E617 Class 1 weights and internal calibration procedure utilized for the calibration of the weighing 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
Balances and Scales [1,5] (SI)	(50 to 60) kg (60 to 70) kg (70 to 80) kg (80 to 100) kg	26 mg 28 mg 29 mg 30 mg	Characterized ASTM E617 Class 1 weights and internal calibration procedure utilized for the calibration of the weighing system.
Balances and Scales [1,5] (SI)	Up to 5 g (5 to 10) g (10 to 20) g (20 to 30) g (30 to 50) g (50 to 100) g (100 to 200) g (200 to 300) g (300 to 500) g (500 to 1 000) g (1 to 2) kg (2 to 3) kg (3 to 5) kg (5 to 6) kg (6 to 7) kg (7 to 8) kg (8 to 9) kg (9 to 10) kg	32 µg 44 µg 59 µg 88 µg 0.15 mg 0.29 mg 0.58 mg 0.89 mg 1.5 mg 3 mg 6.2 mg 9 mg 15 mg 18 mg 21 mg 24 mg 27 mg 30 mg	Characterized ASTM E617 Class 2 weights and internal calibration procedure utilized for the calibration of the weighing system.
Balances and Scales [1,5] (SI)	Up to 250 g (250 to 500) g 500 g to 750 kg	0.023 % of reading 0.017 % of reading 0.012 % of reading	NIST Class F weights and internal calibration procedure utilized for the calibration of the weighing system.
Balances and Scales [1,5] (Avoirdupois)	Up to 0.5 lb (0.5 to 1) lb (1 to 1 700) lb	0.023 % of reading 0.017 % of reading 0.012 % of reading	NIST Class F weights and internal calibration procedure utilized for the calibration of the weighing system.
Volumetric Devices	1 mL to 5 L	0.07 % of reading + 12 µL	Gravimetric method utilizing 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
Pneumatic Absolute Pressure	Up to 30 psia (30 to 300) psia (300 to 1 000) psia	0.002 6 psi 0.008 8 % of reading 0.01 % of reading	Comparison to Fluke RPM4 Reference Pressure Monitor with Pressure Source
Pneumatic Gauge Pressure	(-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 PPC4 Pressure Controller/Calibrator
Pneumatic Gauge Pressure	(-15 to 30) psig (30 to 300) psig (300 to 1000) psig	0.002 2 psi 0.007 5 % of reading 0.01 % of reading	Comparison to Fluke RPM4 Reference Pressure Monitor with Pressure Source.
Hydraulic Pressure [1]	(200 to 1 000) psi (1 000 to 10 000) psi	0.063 psi 0.006 % of reading + 0.002 6 psi	Comparison to Deadweight Tester, Fluke RPM4 Reference Pressure Monitor
Hydraulic Pressure [1]	(200 to 1 000) psig (1 000 to 10 000) psig	0.06 psig 0.006 % of reading	Ametek T-150 Deadweight Tester; Direct Measure

Photometry and Radiometry

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Illuminance at 2 856 k	(30 to 10 764) lx (10 764 to 21 258) lx (21 258 to 32 300) lx	1.1 % of reading 1.7 % of reading 2.1 % of reading	Comparison to Standard Lamp

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
Humidity – Measuring Equipment	(-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 70) %RH (70 to 95) %RH	 0.5 %RH 0.65 %RH 0.5 %RH 0.5 %RH 0.7 %RH 0.85 %RH	Humidity Generator; Direct Measure
Humidity – Measure [1]	(15 to 25) °C (0 to 90) %RH (90 to 100) %RH (-20 to 15) °C (0 to 75) %RH (75 to 90) %RH (90 to 100) %RH (25 to 40) °C (0 to 50) %RH (50 to 75) %RH (75 to 100) %RH	 1.3 %RH 2 %RH 1.9 %RH 2.1 %RH 2.2 %RH 1.7 %RH 2 %RH 2.3 %RH	Comparison to Vaisala M170/HMP76B/77B Temp/Humidity Indicator/Probe
Temperature – Source (Thermocouple Probes, Digital Thermometers, etc.)	(-195 to 0) °C (0 to 155) °C (155 to 300) °C (300 to 660) °C	0.012 °C 0.017 °C 0.046 °C 0.074 °C	Comparison to SPRT, Hart Black Stack, Metrology Wells
Temperature – Source (Thermocouple Probes, Digital Thermometers, etc.)	(600 to 1 000) °C (1 000 to 1 200) °C	0.84 °C 2.2 °C	Comparison to Hart 5650 Type S Thermocouple Probe, Digital Multimeter
Temperature – Measure [1] (Room Measurements, Heat Sources, etc.)	(-195 to 0) °C (0 to 155) °C (155 to 420) °C (420 to 660) °C	0.01 °C 0.013 °C 0.017 °C 0.024 °C	Comparison to SPRT, Hart Black Stack
Temperature – Measure [1] (Heat Sources)	(600 to 1 000) °C (1 000 to 1450) °C	0.47 °C 2.1 °C	Comparison to Hart 5650 Type S Thermocouple Probe, Digital Multimeter

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
SPRT/PRT/RTD Calibration [6]	-195 °C	3.4 mK	$NBPLN_2$, SPRT, Super Thermometer; Comparison Method
SPRT/PRT/RTD Calibration	-78 °C -38 °C 0 °C	3.2 mK 2.9 mK 2.9 mK	Precision Bath, SPRT, Super Thermometer; Comparison Method
SPRT/PRT/RTD Calibration	0.01 °C	1.5 mK	Triple Point of Water Cell; Direct Comparison Method
SPRT/PRT/RTD Calibration	100 °C 156 °C 231 °C 300 °C 420 °C	3.6 mK 4.6 mK 6 mK 5.8 mK 8.4 mK	Precision Bath, SPRT, Super Thermometer; Comparison Method
SPRT/PRT/RTD Calibration	(-100 to 0) °C (0 to 420) °C	8.9 mK 0.003 % of reading + 5.9 mK	Precision Bath, SPRT, Super Thermometer; Comparison Method
Infrared Temperature Measuring Equipment	(-15 to 0) °C (0 to 50) °C (50 to 100) °C (100 to 120) °C (120 to 200) °C (200 to 350) °C (350 to 500) °C	0.8 °C 0.65 °C 0.7 °C 0.76 °C 0.95 °C 1.6 °C 2.1 °C	Blackbody Sources (flat plate) ε = (0.1 to 1), λ = (8 to 14) µm; Direct Measure

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 Fluke 910R GPS Frequency Standard
Frequency – Measure [1]	(1 to 10) kHz 10 kHz to 10 MHz (10 to 225) MHz	19 pHz/Hz + 4.5 µHz 19 pHz/Hz + 18 µHz 19 pHz/Hz + 0.64 mHz	Comparison to Agilent 53132A Universal Counter, Fluke 910R GPS Frequency Standard

Time and Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Frequency – Measure [1]	225 MHz to 50 GHz	6 pHz/Hz + 0.6 mHz	Comparison to R&S® FSWP50 Phase Noise Analyzer
Frequency – Source [1]	1 Hz to 50 MHz	58 nHz/Hz	Agilent 33250A Function/Arbitrary Function Generator, Fluke 910R GPS Frequency Standard; Direct Measure
Period – Measure [1]	(1 to 100) s	45 µs	Comparison to Agilent 53132A Universal Counter, Fluke 910R GPS Frequency Standard
Period – Source [1]	(1 to 100) s	58 ns/s	Agilent 33250A Function/Arbitrary Function Generator, Fluke 910R GPS Frequency Standard; Direct Measure
Stopwatches, Timers [1]	Up to 599 s/mon	58 ms/day	Vibrograf 4500 Timometer; Time Base Method
AC Duty Cycle – Source [1,10] 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 (91 to 99) % Duty Cycle 10 µs to 100 s	0.62 % of period + 78 ns 0.039 % of period + 78 ns 0.016 % of period + 78 ns 0.039 % of period + 78 ns 0.62 % of period + 78 ns	Fluke 5522A Multiproduct Calibrator; Direct Measure

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
Dimensional Measurement – 1D	X-Axis Up to 1 in (1 to 3) in (3 to 6) in Y-Axis Up to 2 in (2 to 3) in (3 to 6) in	 243 µin 333 µin 452 µin 390 µin 475 µin 579 µin	Optical Comparator utilized as Reference for Length Measurement Inspection; Customer Drawings, Specifications

2 Dimensional

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Angle – Measure	Up to 180°	0.01°	Optical Comparator utilized as Reference for Angle Measurement Inspection; Customer Drawings, Specifications
Dimensional Measurement – 2D	Up to 1 in (1 to 6) in	454 µin 652 µin	Optical Comparator utilized as Reference for Radius Measurement Inspection; Customer Drawings, Specifications

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 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.
3. The stated uncertainty for rise time is the laboratory's ability to source a fast rise pulse that is approximately 500 ps, 125 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.
4. L = length in inches; DL = diagonal length in inches; ″ = arc-second.

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

5. 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.
6. $NBPLN_2$ = Boiling Point of Liquid Nitrogen.
7. The Uncertainty for this measurand is a Unitless measure.
8. Mismatch due to the effects of the device-under-test (DUT) and instruments is not included in the Scope CMC but will be included in the Measurement Uncertainty (MU) on the calibration certificate.
9. Accuracies are based on non-constant voltage setting at (1 to 1.26) V, Slow Speed, and a Quality Factor of < 0.05 and a lab temperature of 23 °C +/-7 °C. Measurements taken at resistances below 10 Ω and other voltages, frequencies and speeds require recalculation using the IET accuracy tool and will result in greater uncertainties.
10. The CMC presented here for AC Duty Cycle: The source is defined relative to the period of the sourced signal. The reported percent duty cycle measurement uncertainty will be determined and applied at the time of calibration.
11. Unless otherwise specified in the far-right column above, the laboratory utilizes internally written calibration procedures in the process of calibrating the parameters listed in this document.
12. The legal entity for this location is Transcat, Inc.

Jason Stine, Vice President

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