CERTIFICATE OF ACCREDITATION

ANSI National Accreditation Board

11617 Coldwater Road, Fort Wayne, IN 46845 USA

This is to certify that

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

has been assessed by ANAB and meets the requirements of international standard

ISO/IEC 17025:2017

and national standards

ANSI/NCSL Z540-1-1994 (R2002)

while demonstrating technical competence in the field of

CALIBRATION

Refer to the accompanying Scope of Accreditation for information regarding the types of activities to which this accreditation applies

AC-2489.03

Certificate Number

ANAB Approval

Certificate Valid Through: 09/07/2021

Version No. 003 Issued: 05/01/2019

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).

ANSI National Accreditation Board

SCOPE OF ACCREDITATION TO ISO/IEC 17025:2017 AND ANSI/NCSL Z540-1-1994 (R2002)

Transcat – Philadelphia
100 Dobbs Lane, Suite 108-110
Cherry Hill, NJ 08034
Derek Still
856-489-9453

CALIBRATION

Valid to: **September 7, 2021** Certificate Number: **AC-2489.03**

Chemical Quantities

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

Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) [2]	Reference Standard, Method and/or Equipment
Sine Wave Flatness	50 Ω, 1 V to 3 V		
	10 Hz to 1 MHz	0.17 %	Thermal Converter
	1 MHz to 10 MHz	0.2 %	w/3458A
	10 MHz to 30 MHz	0.13 %	

Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) [2]	Reference Standard, Method and/or Equipment
Sine Wave Flatness	30 MHz to 50 MHz	0.22 %	Thermal Converter w/3458A
	50 MHz to 80 MHz	0.4 %	
	80 MHz to 100 MHz	0.47 %	
AC Current – Measuring Equipment [1]	0 µA to 220 µA		Fluke 5700A-EP
	10 Hz to 20 Hz	0.03 % + 16 nA	
	20 Hz to 40 Hz	0.019 % + 10 nA	
	40 Hz to 1 kHz	0.015 % + 8 nA	
	1 kHz to 5 kHz	0.03 % + 12 nA	
	5 kHz to 10 kHz	0.11 % + 65 nA	
	0.22 mA to 2.2 mA		
	10 Hz to 20 Hz	0.03 % + 40 nA	
	20 Hz to 40 Hz	0.018 % + 35 nA	
	40 Hz to 1 kHz	0.013 % + 35 nA	
	1 kHz to 5 kHz	0.021 % + 0.11 µA	
	5 kHz to 10 kHz	0.11 % + 0.65 µA	
	2.2 mA to 22 mA		
	10 Hz to 20 Hz	0.039 % + 0.4 µA	
	20 Hz to 40 Hz	0.019 % + 0.35 µA	
	40 Hz to 1 kHz	0.014 % + 0.35 µA	
	1 kHz to 5 kHz	0.021 % + 0.55 µA	
	5 kHz to 10 kHz	0.11 % + 5 µA	

Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) [2]	Reference Standard, Method and/or Equipment
AC Current – Measuring Equipment [1]	22 mA to 220 mA		Fluke 5700A-EP
	10 Hz to 20 Hz	0.033 % + 4 µA	
	20 Hz to 40 Hz	0.018 % + 3.5 µA	
	40 Hz to 1 kHz	0.014 % + 2.5 µA	
	1 kHz to 5 kHz	0.021 % + 3.5 µA	
	5 kHz to 10 kHz	0.11 % + 10 µA	
	0.22 A to 2.2 A		
	20 Hz to 1 kHz	0.027 % + 35 µA	
	1 kHz to 5 kHz	0.046 % + 80 µA	
	5 kHz to 10 kHz	0.7 % + 160 µA	
	2.2 A to 11 A		Fluke 5700A-EP with 5725A
	40 Hz to 1 kHz	0.048 % + 170 µA	
	1 kHz to 5 kHz	0.096 % + 380 µA	
	5 kHz to 10 kHz	0.36 % + 750 µA	
	11 A to 20.5 A		Fluke 5522A
	45 Hz to 100Hz	0.092 % + 3.9 mA	
	100 Hz to 1 kHz	0.12 % + 3.9 mA	
	1 kHz to 5 kHz	2.3 % + 3.9 mA	
AC Current – Measuring Equipment [1]	20.5 A to 40 A		Parallel Fluke 5522A
	1 kHz to 5 kHz	3.3 % + 11 mA	

Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) [2]	Reference Standard, Method and/or Equipment
Extended Frequency Ranges [1]	29 µA to 330 µA 10 kHz to 30 kHz	1.2 % + 0.31 µA	Fluke 5522A
	330 µA to 3.3 mA 10 kHz to 30 kHz	0.78 % + 0.47 µA	
	3.3 mA to 33 mA 10 kHz to 30 kHz	0.31 % + 3 µA	
	29 mA to 330 mA 10 kHz to 30 kHz	0.31 % + 0.16 mA	
Clamp-on Ammeter Toroidal Type [1] Transformer Type	20 A to 150 A 45 Hz to 65 Hz	0.34 % + 35 mA	Fluke 5520A with 5500A/Coil
	65 Hz to 440 Hz	0.95 % + 66 mA	
	150 A to 1000 A 45 Hz to 65 Hz	0.38 % + 0.17 A	
	65 Hz to 440 Hz	1.2 % + 0.29 A	
Clamp-on Ammeter Non- Toroidal Type Hall Effect Sensor	20 A to 150 A 45 Hz to 65 Hz	0.66 % + 0.26 A	Fluke 5520A with 5500A/Coil
	65 Hz to 440 Hz	1.2 % + 0.29 A	
	150 A to 1000 A 45 Hz to 65 Hz	0.68 % + 1 A	
	65 Hz to 440 Hz	1.4 % + 1.1 A	

Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) [2]	Reference Standard, Method and/or Equipment
AC Current – Measure [1]	0 µA to 100 µA		Agilent 3458A opt 002
	10 Hz to 20 Hz	0.46 % + 35 nA	
	20 Hz to 45 Hz	0.17 % + 35 nA	
	45 Hz to 100 Hz	0.072 % + 35 nA	
	100 Hz to 5 kHz	0.072 % + 35 nA	
	100 µA to 1 mA		
	10 Hz to 20 Hz	0.46 % + 0.23 µA	
	20 Hz to 45 Hz	0.17 % + 0.23 µA	
	45 Hz to 100 Hz	0.071 % + 0.23 µA	
	100 Hz to 5 kHz	0.038 % + 0.23 µA	
	1 mA to 10 mA		
	10 Hz to 20 Hz	0.46 % + 2.3 µA	
	20 Hz to 45 Hz	0.17 % + 2.3 µA	
	45 Hz to 100 Hz	0.071 % + 2.3 µA	
	100 Hz to 5 kHz	0.038 % + 2.3 µA	
	10 mA to 100 mA		
	10 Hz to 20 Hz	0.46 % + 23 µA	
	20 Hz to 45 Hz	0.17 % + 23 µA	
	45 Hz to 100 Hz	0.071 % + 23 µA	
	100 Hz to 5 kHz	0.038 % + 23 µA	
	100 mA to 1 A		
	10 Hz to 20 Hz	0.46 % + 0.23 mA	

Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) [2]	Reference Standard, Method and/or Equipment
AC Current – Measure [1]	20 Hz to 45 Hz	0.19 % + 0.23 mA	Agilent 3458A opt 002
	45 Hz to 100 Hz	0.097 % + 0.23 mA	
	100 Hz to 5 kHz	0.12 % + 0.23 mA	
	1 A to 10 A 50 Hz to 999 Hz	0.05 % + 1.3 mA	Ohm-Labs CS-100 w/3458A
	1 kHz	0.12 % + 1.3 mA	
	10 A to 100 A 50 Hz to 100 Hz	0.038 % + 2.3 mA	
	100 Hz to 999 Hz	0.042 % + 2.3 mA	
	1 kHz	0.13 % + 2.3 mA	
AC Resistance – Measure [1]	10 Ω to 100 kΩ 12 Hz to 99.9 kHz	0.039 % + 0.01 Ω	GenRad 1689M
DC Resistance – Measuring Equipment and Measure [1]	250 μΩ to 4 mΩ	85 μΩ/Ω	Fluke 1594A bridge in ratio mode with characterized resistors
	4 mΩ to 40 mΩ	25 μΩ/Ω	
	40 mΩ to 400 mΩ	20 μΩ/Ω	
	400 mΩ to 4 Ω	16 μΩ/Ω	
	4 Ω to 400 kΩ	5 μΩ/Ω	
	0 Ω to 10 Ω	18 μΩ/Ω + 58 μΩ	Agilent 3458A with Decade Resistor
	10 Ω to 100 Ω	15 μΩ/Ω + 0.6 mΩ	
	100 Ω to 1 kΩ	12 μΩ/Ω + 0.58 mΩ	
	1 kΩ to 10 kΩ	12 μΩ/Ω + 5.8 mΩ	
	10 kΩ to 100 kΩ	12 μΩ/Ω + 58 mΩ	

Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) [2]	Reference Standard, Method and/or Equipment
DC Resistance – Measuring Equipment and Measure [1]	100 kΩ to 1 MΩ	19 μΩ/Ω + 2.3 Ω	Agilent 3458A with Decade Resistor
	1 MΩ to 10 MΩ	62 μΩ/Ω + 0.12 kΩ	
	10 MΩ to 100 MΩ	588 μΩ/Ω + 1.2 kΩ	
	100 MΩ to 1 GΩ	0.58 % + 10 kΩ	
DC Resistance – Measuring Equipment [1]	1 mΩ	59 μΩ/Ω	Fixed Resistor
	10 mΩ	58 μΩ/Ω	
	100 mΩ	58 μΩ/Ω	
	1 Ω	58 μΩ/Ω	
	100 Ω	1.3 μΩ/Ω	
	2 GΩ to 10 GΩ	0.58 %	IET HRRS-B-7-100k-5KV
	20 GΩ to 100 GΩ	1.2 %	
	200 GΩ to 1 TΩ	2.6 %	
DC Current – Measuring Equipment and Measure [1]	0 μA to 100 μA	26 μA/A + 0.9 nA	Agilent 3458A with Current Source
	100 μA to 1 mA	26 μA/A + 6 nA	
	1 mA to 10 mA	26 μA/A + 58 nA	
	10 mA to 100 mA	43 μA/A + 0.58 μA	
	100 mA to 1 A	128 μA/A + 12 μA	
	0 A to 100 A	0.012 % + 500 μA	CS-100 with 3458A
	100 A to 1 500 A	0.29 % + 0.025 μA	WT-1500-50 with 3458A
DC Current – Measuring Equipment [1]	0 μA to 220 μA	41 μA/A + 6 nA	Fluke 5700A-EP with 5725A
	0.22 mA to 2.2 mA	36 μA/A + 7 nA	
	2.2 mA to 22 mA	36 μA/A + 40 nA	

Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) [2]	Reference Standard, Method and/or Equipment
DC Current – Measuring Equipment [1]	22 mA to 220 mA	57 µA/A + 0.7 µA	Fluke 5700A-EP with 5725A
	0.22 A to 2.2 A	202 µA/A + 12 µA	
	2.2 A to 11 A	403 µA/A + 0.48 mA	
	11 A to 20 A	0.096 % + 580 µA	Fluke 5522A
Clamp-on Ammeter Non- Toroidal Type Hall Effect Sensor	20 A to 1 000 A	0.58 % + 0.52 A	Fluke 5522A with 5500A/Coil
DC Voltage – Measure [1]	0 mV to 100 mV	7.1 µV/V + 0.58 µV	Agilent 3458A
	100 mV to 1 V	5.0 µV/V + 0.58 µV	
	1 V to 10 V	5.1 µV/V + 0.58 µV	
	10 V to 100 V	7.6 µV/V + 35 µV	
	100 V to 500 V	11 µV/V + 0.12 mV	
	500 V to 800 V	16 µV/V + 0.12 mV	
	800 V to 1 kV	21 µV/V + 0.12 mV	
	1 kV to 10 kV	0.035 % + 0.035 V	Vitrek 4700
	10 kV to 35 kV	0.031 % + 0.081 V	Vitrek 4700 w/HVL-35
	35 kV to 70 kV	0.038 % + 0.23 V	Vitrek 4700 w/HVL-70
	70 kV to 100 kV	0.063 % + 0.35 V	Vitrek 4700 w/HVL-100
DC Voltage – Measuring Equipment [1]	0 to 220 mV	8.5 µV/V + 0.4 µV	Fluke 5700A-EP with 5725A
	220 mV to 2.2 V	5.1 µV/V + 0.7 µV	
	2.2 V to 11 V	4 µV/V + 2.5 µV	
	11 V to 22 V	3.9 µV/V + 4.0 µV	
	22 V to 220 V	6.2 µV/V + 40 µV	
	220 V to 1100 V	7.6 µV/V + 0.40 mV	

Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) [2]	Reference Standard, Method and/or Equipment
DC Voltage – Measuring Equipment and Measure [1]	0 V to 100 mV	7.1 µV/V + 0.5 µV	Agilent 3458A opt 2 with Fluke 5700A-EP
	100 mV to 1V	5 µV/V + 0.5 µV	
	1 V to 10 V	5.1 µV/V + 0.5 µV	
	10 V to 100 V	7.6 µV/V + 35 µV	
	100 V to 500 V	11 µV/V +120 µV	
	500 V to 800 V	17 µV/V + 120 µV	
	800 V to 1000 V	21 µV/V + 120 µV	
AC Voltage – Measure [1]	0 mV to 10 mV		Agilent 3458A
	1 Hz to 40 Hz	0.039 % + 3.5 µV	
	40 Hz to 1 kHz	0.028 % + 1.3 µV	
	1 kHz to 20 kHz	0.038 % + 1.3 µV	
	20 kHz to 50 kHz	0.15 % + 1.3 µV	
	50 kHz to 100 kHz	0.59 % + 1.3 µV	
	100 kHz to 300 kHz	4.6 % + 2.3 µV	
	10 mV to 100 mV		
	1 Hz to 40 Hz	0.013 % + 5 µV	
	40 Hz to 1 kHz	0.009 4 % + 2.3 µV	
	1 kHz to 20 kHz	0.017 % + 2.3 µV	
	20 kHz to 50 kHz	0.037 % + 2.3 µV	
	50 kHz to 100 kHz	0.093 % + 2.3 µV	
	100 kHz to 300 kHz	0.36 % + 12 µV	
	300 kHz to 1 MHz	1.2 % + 12 µV	

Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) [2]	Reference Standard, Method and/or Equipment
AC Voltage – Measure [1]	100 mV to 1 V		Agilent 3458A
	1 Hz to 40 Hz	0.009 8 % + 46 µV	
	40 Hz to 1 kHz	0.009 4 % + 23 µV	
	1 kHz to 20 kHz	0.017 % + 23 µV	
	20 kHz to 50 kHz	0.036 % + 23 µV	
	50 kHz to 100 kHz	0.093 % + 23 µV	
	100 kHz to 300 kHz	0.35 % + 0.12 mV	
	300 kHz to 1 MHz	1.2 % + 0.12 mV	
	1 V to 10 V		
	1 Hz to 40 Hz	0.009 4 % + 0.46 mV	
	40 Hz to 1 kHz	0.009 5 % + 0.23 mV	
	1 kHz to 20 kHz	0.017 % + 0.23 mV	
	20 kHz to 50 kHz	0.036 % + 0.23 mV	
	50 kHz to 100 kHz	0.093 % + 0.23 mV	
	100 kHz to 300 kHz	0.35 % + 1.2 mV	
	300 kHz to 1 MHz	1.2 % + 1.2 mV	
	10 V to 100 V		
	1 Hz to 40 Hz	0.024 % + 4.6 mV	
	40 Hz to 1 kHz	0.024 % + 2.3 mV	
	1 kHz to 20 kHz	0.024 % + 2.3 mV	
	20 kHz to 50 kHz	0.041 % + 2.3 mV	
	50 kHz to 100 kHz	0.14 % + 2.3 mV	

Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) [2]	Reference Standard, Method and/or Equipment
AC Voltage – Measure [1]	100 kHz to 300 kHz	0.46 % + 12 mV	Agilent 3458A
	300 kHz to 1 MHz	1.7 % + 12 mV	
	100 V to 700 V		
	1 Hz to 40 Hz	0.047 % + 46 mV	
	40 Hz to 1 kHz	0.047 % + 23 mV	
	1 kHz to 20 kHz	0.071 % + 23 mV	
	20 kHz to 50 kHz	0.14 % + 23 mV	
	50 kHz to 100 kHz	0.35 % + 23 mV	
	0.7 kV to 10 kV		Vitrek 4700 with associated probes
	60 Hz	0.14 % + 0.12 V	
	10 kV to 30 kV		
	60 Hz	0.064 % + 0.23 V	
	30 kV to 50 kV		
	60 Hz	0.091 % + 0.46 V	
	50 kV to 70 kV		
	60 Hz	0.14 % + 0.7 V	
AC Voltage – Measuring Equipment [1]	0 mV to 2.2 mV		Fluke 5700A-EP
	10 Hz to 20 Hz	0.16 % + 4 µV	
	20 Hz to 40 Hz	0.16 % + 4 µV	
	40 Hz to 20 kHz	0.1 % + 4 µV	
	20 kHz to 50 kHz	0.12 % + 4 µV	
	50 kHz to 100 kHz	0.17 % + 5 µV	

Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) [2]	Reference Standard, Method and/or Equipment
AC Voltage – Measuring Equipment [1]	100 kHz to 300 kHz	0.33 % + 10 µV	Fluke 5700A-EP
	300 kHz to 500 kHz	0.47 % + 20 µV	
	500 kHz to 1 MHz	0.58 % + 20 µV	
	2.2 mV to 22 mV		
	10 Hz to 20 Hz	0.044 % + 4 µV	
	20 Hz to 40 Hz	0.035 % + 4 µV	
	40 Hz to 20 kHz	0.015 % + 4 µV	
	20 kHz to 50 kHz	0.031 % + 4 µV	
	50 kHz to 100 kHz	0.059 % + 5 µV	
	100 kHz to 300 kHz	0.12 % + 10 µV	
	300 kHz to 500 kHz	0.16 % + 20 µV	
	500 kHz to 1 MHz	0.3 % + 20 µV	
	22 mV to 220 mV		
	10 Hz to 20 Hz	0.028 % + 12 µV	
	20 Hz to 40 Hz	0.017 % + 7 µV	
	40 Hz to 20 kHz	0.010 % + 7 µV	
	20 kHz to 50 kHz	0.021 % + 7 µV	
	50 kHz to 100 kHz	0.047 % + 17 µV	
	100 kHz to 300 kHz	0.092 % + 20 µV	
	300 kHz to 500 kHz	0.14 % + 25 µV	
	500 kHz to 1 MHz	0.28 % + 45 µV	

Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) [2]	Reference Standard, Method and/or Equipment
AC Voltage – Measuring Equipment [1]	220 mV to 2.2 V		Fluke 5700A-EP
	10 Hz to 20 Hz	0.028 % + 40 µV	
	20 Hz to 40 Hz	0.016 % + 15 µV	
	40 Hz to 20 kHz	0.006 % + 8 µV	
	20 kHz to 50 kHz	0.008 % + 10 µV	
	50 kHz to 100 kHz	0.012 % + 30 µV	
	100 kHz to 300 kHz	0.043 % + 80 µV	
	300 kHz to 500 kHz	0.1 % + 0.2 mV	
	500 kHz to 1 MHz	0.18 % + 0.3 mV	
	2.2 V to 22 V		
	10 Hz to 20 Hz	0.028 % + 0.4 mV	
	20 Hz to 40 Hz	0.016 % + 0.15 mV	
	40 Hz to 20 kHz	0.005 % + 0.05 mV	
	20 kHz to 50 kHz	0.008 % + 0.1 mV	
	50 kHz to 100 kHz	0.011 % + 0.2 mV	
	100 kHz to 300 kHz	0.03 % + 0.6 mV	
	300 kHz to 500 kHz	0.1 % + 2 mV	
	500 kHz to 1 MHz	0.17 % + 3.2 mV	
	22 V to 220 V		
	10 Hz to 20 Hz	0.028 % + 4 mV	
	20 Hz to 40 Hz	0.01 % + 1.5 mV	
	40 Hz to 20 kHz	0.006 % + 0.6 mV	
	20 kHz to 50 kHz	0.009 % + 1 mV	

Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) [2]	Reference Standard, Method and/or Equipment
AC Voltage – Measuring Equipment [1]	50 kHz to 100 kHz	0.016 % + 2.5 mV	Fluke 5700A-EP
	100 kHz to 300 kHz	0.09 % + 16 mV	
	300 kHz to 500 kHz	0.44 % + 40 mV	
	500 kHz to 1 MHz	0.8 % + 80 mV	
	220 V to 1100 V		Fluke 5720A-EP with 5725A
	50 Hz to 1 kHz	0.011 % + 4 mV	
	1 kHz to 20 kHz	0.017 % + 6 mV	
	20 kHz to 30 kHz	0.061 % + 11 mV	
	220 V to 750 V		
	30 kHz to 50 kHz	0.061 % + 11 mV	
	50 kHz to 100 kHz	0.23 % + 45 mV	
Capacitance – Measure [1] 0.1 kHz to 1 kHz	Up to 10 pF	0.5 % + 0.05 pF	GenRad 1689M
	10 pF to 100 pF	0.59 % + 0.05 pF	
	100 pF to 1 µF	0.024 % + 0.05 pF	
	1 µF to 100 µF	0.12 %	
	100 µF to 1000 µF	0.24 %	
Capacitance - Measuring Equipment [1]	0.19 nF to < 1.1 nF		5522A
	10 Hz to 10 kHz	0.39 % + 7.8 pF	
	1.1 nF to < 3.3 nF		
	10 Hz to 3 kHz	0.39 % + 7.8 pF	
	3.3 nF to < 11 nF		
	10 Hz to 1 kHz	0.21 % + 7.8 pF	

Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) [2]	Reference Standard, Method and/or Equipment
Capacitance - Measuring Equipment [1]	11 nF to < 110 nF 10 Hz to 1 kHz	0.21 % + 78 pF	5522A
	110 nF to < 330 nF 10 Hz to 1 kHz	0.21 % + 0.23 nF	
	0.33 µF to < 1.1 µF 10 Hz to 600 Hz	0.21 % + 0.78 nF	
	1.1 µF to < 3.3 µF 10 Hz to 300 Hz	0.21 % + 2.3 nF	
	3.3 µF to < 11 µF 10 Hz to 150 Hz	0.21 % + 7.8 nF	
	11 µF to < 33 µF 10 Hz to 120 Hz	0.32 % + 23 nF	
	33 µF to < 110 µF 10 Hz to 80 Hz	0.36 % + 78 nF	
	110 µF to < 330 µF DC to 50 Hz	0.36 % + 0.23 µF	
	0.33 mF to < 1.1 mF DC to 20 Hz	0.35 % + 0.78 µF	
	1.1 mF to < 3.3 mF DC to 6 Hz	0.35 % + 2.3 µF	
	3.3 mF to < 11 mF DC to 2 Hz	0.35 % + 7.8 µF	

Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) [2]	Reference Standard, Method and/or Equipment
Capacitance - Measuring Equipment [1]	11 mF to < 33 mF DC to 0.6 Hz	0.58 % + 23 µF	5522A
	33 mF to < 110 mF DC to 0.2 Hz	0.85 % + 78 µF	
Inductance – Measure [1] 0.1 kHz to 1 kHz	1 mH to 10 mH	0.041 % + 0.1 µH	GenRad 1689M
	10 mH to 10 H	0.035 % + 1.4 µH	
Inductance – Measuring Equipment [1] 1 kHz	1 mH	0.13 %	Fixed Inductor
	10 mH	0.13 %	
	100 mH	0.13 %	
	1 H	0.13 %	
Electrical Calibration of Thermocouple Devices [1] Type J	-210 °C to -180 °C	0.13 °C	Ectron 1140A
	-180 °C to -120 °C	0.11 °C	
	-120 °C to -50 °C	0.09 °C	
	-50 °C to 1 200 °C	0.08 °C	
Type K	-270 °C to -255 °C	2.2 °C	
	-255 °C to -195 °C	0.7 °C	
	-195 °C to -115 °C	0.13 °C	
Type K	-115 °C to -55 °C	0.1 °C	Ectron 1140A
	-55 °C to 1 000 °C	0.08 °C	
	1000 °C to 1 372 °C	0.09 °C	
Type T	-270 °C to -255 °C	1.8 °C	
	-255 °C to -240 °C	0.5 °C	

Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) [2]	Reference Standard, Method and/or Equipment
Electrical Calibration of Thermocouple Devices [1]	-240 °C to -210 °C	0.3 °C	
	-210 °C to -150 °C	0.18 °C	
Type T	-150 °C to -40 °C	0.13 °C	
	-40 °C to 100 °C	0.09 °C	
	100 °C to 400 °C	0.08 °C	
Type E	-270 °C to -245 °C	1.2 °C	
	-245 °C to -195 °C	0.18 °C	
	-195 °C to -155 °C	0.11 °C	
	-155 °C to 1 000 °C	0.09 °C	
Type R	-50 °C to -30 °C	0.65 °C	
	-30 °C to 45 °C	0.55 °C	
	45 °C to 160 °C	0.4 °C	
	160 °C to 775 °C	0.3 °C	
	775 °C to 1 768.1 °C	0.22 °C	
Type S	-50 °C to -30 °C	0.62 °C	
	-30 °C to 45 °C	0.56 °C	
	45 °C to 105 °C	0.4 °C	
Type S	105 °C to 310 °C	0.33 °C	Ectron 1140A
	310 °C to 1 768.1 °C	0.29 °C	
Type N	-270 °C to -260 °C	5 °C	
	-260 °C to -200 °C	1 °C	
	-200 °C to -140 °C	0.23 °C	

Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) [2]	Reference Standard, Method and/or Equipment
Electrical Calibration of Thermocouple Devices [1]			
Type N	-140 °C to -70 °C	0.16 °C	Ectron 1140A
	-70 °C to 25 °C	0.13 °C	
	25 °C to 1 300 °C	0.11 °C	
Type B	250 °C to 350 °C	0.95 °C	
	350 °C to 445 °C	0.74 °C	
	445 °C to 580 °C	0.58 °C	
	580 °C to 750 °C	0.45 °C	
	750 °C to 1 000 °C	0.37 °C	
	1 000 °C to 1 820 °C	0.29 °C	
Power Measuring Equipment[1]			
DC Power			
0.33 mA to 330 mA	11 µW to 1.1 mW	0.024 %	Fluke 5520A
	1.1 mW to 110 mW	0.027 %	
	0.11W to 110 W	0.024 %	
	110 W to 330 W	0.018 %	
0.33 A to 3 A	11 W to 110 mW	0.044 %	
	0.11 W to 990 W	0.053 %	
	1 W to 3 kW	0.009 6 %	
3 A to 20.5 A	0.099 W to 0.99 W	0.088 %	
	0.99 W to 6.8 kW	0.07 %	
	6.8 W to 20.5 kW	0.04 %	
AC Power [4] (PF=1)			
10 Hz to 65 Hz			
3.3 mA to 9.0 mA	0.11 mW to 3.0 mW	0.13%	Fluke 5520A
	3 mW to 9.0 W	0.077%	
9.0 mA to 33 mA	0.3 mW to 10 mW	0.089 %	
	10 mW to 33W	0.077%	

Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) [2]	Reference Standard, Method and/or Equipment
33 mA to 90 mA	1 mW to 30 mW 30 mW to 90 W	0.071 % 0.057 %	
90 mA to 330 mA	3 mW to 100 mW 100 mW to 300 W	0.089 % 0.078 %	
0.33 A to 0.9 A	11 mW to 300 mW 300 mW to 900 W	0.071 % 0.081 %	
0.9 A to 2.2 A	30 mW to 720 mW 720 mW to 2 kW	0.089 % 0.079 %	
2.2 A to 4.5 A	80 mW to 1.4 W 1.4 W to 4.5 kW	0.088 % 0.18 %	
4.5 A to 20.5 A	150 mW to 6.7 W 6.7 W to 20 kW	0.17 % 0.17 %	
Phase Meters – Measure Equipment [1]	0° to 180° 10 Hz to 65 Hz 65 Hz to 500 Hz 500 Hz to 1 kHz 1 kHz to 5 kHz 5 kHz to 10 kHz 10 kHz to 20 kHz	 0.11° 0.2° 0.4° 1.9° 3.9° 7.8°	Fluke 5520A
Oscilloscopes[1] Amplitude DC[1] into 50 Ω Load into 1 MΩ Load Amplitude Square Wave[1] into 50 Ω Load Rate: 10 Hz to 10 kHz into 1 MΩ Load Rate: 10 Hz to 1 kHz Rate: 1 kHz to 10 kHz	 (-6.6 to 6.6) V (-130 to 130) V 1 $mV_{(pk-pk)}$ to 6.6 $V_{(pk-pk)}$ 1 $mV_{(pk-pk)}$ to 6.6 $V_{(pk-pk)}$ 1 $mV_{(pk-pk)}$ to 6.6 $V_{(pk-pk)}$	 0.2 % + 31 µV 0.039 % + 31 µV 0.19 % + 31 µV 0.078 % + 31 µV 0.19 % + 31 µV	 Fluke 5520A/SC1100

Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) [2]	Reference Standard, Method and/or Equipment
Timing - Generate[1]			
50 Ω Load	5 s	0.3 %	
	2 s	0.12 %	
	1 s	0.062 %	
	500 ms	0.032 %	Fluke 5520A/SC1100
	200 ms	0.014 %	
	100 ms	0.007 6 %	
	50 ms	0.004 6 %	
	20 mS to 1 nS	0.000 22 %	
Rise Time – Generate[1,3]			
50 Ω Load			
5.0 $mV_{(pk-pk)}$ to 2.5 $V_{(pk-pk)}$			
Rate: 1 kHz to 2 MHz	250 ps (nominal)	50 ps	Fluke 5520A/SC1100
Rate: 2 MHz to 10 MHz	250 ps (nominal)	50 ps	
Rise Time – Measure[1]	≥ 700 ps	130 ps	HP 54615B
Leveled Sine Wave Generate[1]			
50 Ω Load			
5.0 $mV_{(pk-pk)}$ to 5.5 $V_{(pk-pk)}$	50 kHz	1.8 % + 230 µV	
	50 kHz to 100 MHz	2.8 % + 230 µV	
	100 MHz to 300 MHz	3.2 % + 230 µV	Fluke 5520A/SC1100
	300 MHz to 600 MHz	4 % + 230 µV	
5.0 $mV_{(pk-pk)}$ to 3.5 $V_{(pk-pk)}$	600 MHz to 1 GHz	5.5 % + 230 µV	
Bandwidth/Flatness Measure[1]			
50 Ω			
(50 kHz Reference)			
5.0 $mV_{(pk-pk)}$ to 5.5 $V_{(pk-pk)}$	50 kHz to 100 MHz	1.4 % + 78 µV	
	100 MHz to 300 MHz	1.8 % + 78 µV	
	300 MHz to 600 MHz	3.2 % + 78 µV	Fluke 5520A/SC1100
5.0 $mV_{(pk-pk)}$ to 3.5 $V_{(pk-pk)}$	600 MHz to 1.1 GHz	4 % + 78 µV	
Input Impedance Measure[1]			Fluke 5520A/SC1100
50 Ω	40 Ω to 60 Ω	0.082 %	
1 MΩ	500 kΩ to 1.5 MΩ	0.081 %	

Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) [2]	Reference Standard, Method and/or Equipment
Input Capacitance Measure[1]	5 pF to 50 pF	3.9 % + 0.39 pF	Fluke 5520A/SC1100
Wave Generator – Source[1] Amplitude (10 Hz to 10 kHz) Sine, Square, Triangle 50 Ω Load 1 MΩ Load	 1.8 $mV_{(pk-pk)}$ to 2.5 $V_{(pk-pk)}$ 1.8 $mV_{(pk-pk)}$ to 55 $V_{(pk-pk)}$	 2.3 % + 78 $\mu V_{(pk-pk)}$ 2.3 % + 78 $\mu V_{(pk-pk)}$	Fluke 5520A/SC1100
Wave Generator – Source[1] Frequency Sine, Square, Triangle	10 Hz to 10 kHz	0.001 9% + 0.012 Hz	Fluke 5520A/SC1100

Electrical - RF/Microwave

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) [2]	Reference Standard, Method and/or Equipment
Absolute RF Power [1]	20 dBm to -30 dBm 100 kHz to 1.3 GHz	2.5 %	Agilent 437B/8482A

Length – Dimensional Metrology

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) [5]	Reference Standard, Method and/or Equipment
Angle Measuring Devices Protractors, Inclinometers, Squares, Angle Gages	 0.1° to 60° 0° to 30° 30° to 90° 90°	 15 arc-sec 24 arc-sec 24 arc-sec + 9.5 arc-sec/degree 1.4 arc-sec	 Sine Bar, Gage Blocks, Gage Amp, Plate Angle Blocks w/plate

Length – Dimensional Metrology

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) [5]	Reference Standard, Method and/or Equipment
Micrometers and Calipers – Outside, Inside, Depth, Step [1]	0.01 in to 1 in 1 in to 9 in 4 in to 15 in 15 in to 40 in	(16 + 1*L*) µin (11 + 4*L*) µin (13 + 4.5 *L*) µin (15 + 4.6 *L*) µin	Comparison to Gage Blocks
Anvil Flatness [1]	0 in to 1 in Diameter	4.4 µin	Optical Flats
Anvil Parallelism [1]	0 in to 1 in Diameter	8.2 µin	Optical Parallel
Digital/Dial Indicators, LVDTs & Gage Amplifiers	0 in to 2 in 2 in to 6 in	(17 + 1.0 *L*) µin (18 + 2.2 *L*) µin	ULM
Length Single Axis Outside Dimension	(0 to 1) in	(6 + 1 *L*) µin	ULM
Length Single Axis Outside Dimension	(1 to 7) in (7 to 12) in (12 to 24) in	(4.3 + 3.5 *L*) µin (1 + 4 *L*) µin (24 + 5 *L*) µin	Gage Amp w/Gage blocks
Length Single Axis Inside Dimension	(0.04 to 1) in (1 to 2.5) in (2.5 to 10) in	11 µin 11 µin (18 + 3 *L*) µin	ULM
Height Gages [1]	(10 to 14) in 0 in to 4 in 4 in to 44 in	(38 + 3 *L*) µin 110 µin (94 + 3 *L*) µin	Gage Blocks w/Plate
Parallelism, Flatness, Straightness	0 in to 12 in 12 in to 24 in 24 in to 36 in 36 in to 48 in	45 µin 55 µin 67 µin 160 µin	Gage Amp w/plate
Squareness	(0 to 6) in (6 to 12) in	100 µin 100 µin	Gage Amp w/plate
Cylindrical Plug Gages Outside Diameter	(0 to 1) in (1 to 7) in	12 µin (9 + 3 *L*) µin	ULM

Length – Dimensional Metrology

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) [5]	Reference Standard, Method and/or Equipment
Cylindrical Ring Gages Inside Diameter	 (0.04 to 1) in (1.0 to 2.5) in	 11 µin 11 µin	ULM
Cylindrical Ring Gages Inside Diameter	(2.5 to 10) in (10 to 14) in	(18 + 3 *L*) µin (38 + 3 *L*) µin	ULM
Tapes and Rulers	0 in to 24 in 0 ft to 3 ft 3 ft to 12 ft 12 ft to 100 ft	(360 + 60 *L*) µin 0.003 5 in (0.003 4 + 25*L*) µin (0.007 2 + 12*L*) µin	Optical Comparator Glass Rule
Thread Wires	2 TPI to 120 TPI (0.008 to 0.5) in	12 µin	ULM
Thread Plug Gages Pitch Diameter Major Diameter	 (0 to 1) in (1 to 7) in (7 to 12) in (0 to 1) in (1 to 7) in	 79 µin 80 µin 83 µin 13 µin (10 + 3*L*) µin	ULM w/Thread Wires ULM
Thread Ring Gages Inner Diameter	 (0 to 1) in (1 to 7) in (7 to 12) in	 79 µin 80 µin 83 µin	Uncertainty of Master Ring
Linear Dimension X Axis	 0 in to 1 in 1 in to 3 in 3 in to 6 in	 210 µin 370 µin 480 µin	Optical Comparator
Y Axis	0 in to 2 in 2 in to 3 in 3 in to 5 in	360 µin 410 µin 560 µin	
Angle	0° to 180°	0.008°	
Radius	0 in to 1 in 1 in to 3 in 3 in to 6 in	260 µin 450 µin 590 µin	

Mass and Mass Related

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) [2]	Reference Standard, Method and/or Equipment
Gas Flow	1 sccm to 200 sccm	0.33 %	Fluke Molbloc
	0.2 slpm to 40 slpm	0.23 %	
	40 slpm to 80 slpm	0.32 %	
	80 slpm to 100 slpm	0.57 %	
	100 slpm to 300 slpm	0.6 %	Fluke Sonic Blox
	300 slpm to 1 200 slpm	0.81 %	
Compression/Tension	(0 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 0 lbf 0.005 8 lbf 0.009 3 lbf 0.061 lbf	Dead Weight
Mass – Metric	10 kg	3.4 mg	Echelon II
	5 kg	1.3 mg	
	3 kg	1.2 mg	
	2 kg	1.1 mg	
	1 kg	0.22 mg	
	500 g	91 µg	
	300 g	62 µg	
	200 g	41 µg	
	100 g	25 µg	
	50 g	12 µg	
	30 g	12 µg	
	20 g	9 µg	
	10 g	6.5 µg	
	5 g	4 µg	

Mass and Mass Related

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) [2]	Reference Standard, Method and/or Equipment
Mass – Metric	3 g	3.5 µg	Echelon II
	2 g	2.9 µg	
	1 g	2.9 µg	
	500 mg	1.7 µg	
	300 mg	1.7 µg	
	200 mg	1.7 µg	
	100 mg	1.7 µg	
	50 mg	1.7 µg	
	30 mg	1.7 µg	
	20 mg	1.7 µg	
	10 mg	1.7 µg	
	5 mg	1.7 µg	
	3 mg	1.7 µg	
	2 mg	1.7 µg	
	1 mg	1.7 µg	
	25 kg	0.1 g	Echelon III
	20 kg	0.1 g	
	10 kg	9.7 mg	
	5 kg	4.4 mg	
	3 kg	2.9 mg	
	2 kg	2.4 mg	
	1 kg	0.84 mg	

Mass and Mass Related

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) [2]	Reference Standard, Method and/or Equipment
Mass – Metric	500 g	0.42 mg	Echelon III
	300 g	0.25 mg	
	200 g	0.17 mg	
	100 g	88 µg	
	50 g	43 µg	
	30 g	29 µg	
	20 g	25 µg	
	10 g	17 µg	
	5 g	11 µg	
	3 g	12 µg	
	2 g	11 µg	
	1 g	11 µg	
	500 mg	4 µg	
	300 mg	4 µg	
	200 mg	4 µg	
	100 mg	4 µg	
	50 mg	4 µg	
	30 mg	4 µg	
	20 mg	4 µg	
	10 mg	4 µg	
	5 mg	4 µg	
	3 mg	4 µg	

Mass and Mass Related

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) [2]	Reference Standard, Method and/or Equipment
Mass – Metric	2 mg	4 µg	Echelon III
	1 mg	4 µg	
Mass – Avoirdupois	50 lb	0.1 g	Echelon III
	25 lb	0.1 g	
	20 lb	10 mg	
	15 lb	10 mg	
	10 lb	5.1 mg	
	7.5 lb	5.1 mg	
	5 lb	3 mg	
	2 lb	1 mg	
	1 lb	0.52 mg	
	8 oz	0.3 mg	
	4 oz	0.11 mg	
	2 oz	55 µg	
	1 oz	33 µg	
	0.5 oz	20 µg	
	0.25 oz	20 µg	
	0.125 oz	12 µg	
	0.062 5 oz	12 µg	
	0.0312 5 oz	12 µg	

Mass and Mass Related

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) [2]	Reference Standard, Method and/or Equipment
Rockwell Hardness [1]	HRC Scale		ASTM E18
	High	0.43 HRC	
	Middle	0.59 HRC	
	Low	0.78 HRC	
	HRBw Scale		
	High	1 HRBw	
	Middle	1 HRBw	
	Low	1.1 HRBw	
Durometer (Spring Force)	Type A, B, E, 0	0.31 duro	Duro Calibrator
	Type D, C, DO	0.16 duro	
Torque - Wrenches, Drivers, Indicators [1]	(3 to 80) ozf·in	1.7 %	Torque Calibrators
	15 ozf·in to 600 lbf·ft	0.5 %	
	5 lbf·in to 800 lbf·ft	1 %	
Torque – Hydraulic [1] (1 000 to 10 000) psi	270 Nm to 2 700 Nm (200 lbf·ft to 2 000 lbf·ft)	1.3%	Torque Calibration System
	2 700 Nm to 40 00 Nm (2 000 lbf·ft to 20 000 lbf·ft)	1.3%	
Torque – Multipliers [1]	270 Nm to 2 700 Nm (200 lbf·ft to 2 000 lbf·ft)	1.5%	Torque Calibration System
	2 700 Nm to 4 000 Nm (2 000 lbf·ft to 20 000 lbf·ft)	1.5%	
Torque Angle [1]	45°	0.35°	Torque Angle Fixture
	90°	0.35°	
	135°	0.35°	
	180°	0.35°	
	360°	0.35°	
Torque – Measuring Equipment	5 ozf·in to 2.5 lbf·in	0.09 %	Torque Wheel w/Weights
	2.5 lbf·in to 50 lbf·in	0.05 %	
	50 lbf·in to 250 lbf·ft	0.06 %	Torque Butterfly w/Weights

Mass and Mass Related

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) [2]	Reference Standard, Method and/or Equipment
Balances & Scales – Metric [1]	25 kg	62 mg	Characterized ASTM Class 1 Weights
	10 kg	7.4 mg	
	5 kg	3.7 mg	
	3 kg	2.1 mg	
	2 kg	1.5 mg	
	1 kg	0.72 mg	
	500 g	0.38 mg	
	300 g	0.21 mg	
	200 g	0.14 mg	
	100 g	0.08 mg	
	50 g	0.042 mg	
	30 g	0.024 mg	
	20 g	0.02 mg	
	10 g	0.014 mg	
	5 g	0.008 3 mg	
	3 g	0.007 8 mg	
	2 g	0.007 7 mg	
	1 g	0.007 7 mg	
	500 mg	0.002 4 mg	
	300 mg	0.002 4 mg	
	200 mg	0.002 4 mg	
	100 mg	0.002 4 mg	

Mass and Mass Related

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) [2]	Reference Standard, Method and/or Equipment
Balances & Scales – Metric [1]	50 mg	0.0024 mg	Characterized ASTM Class 1 Weights
	30 mg	0.002 4 mg	
	20 mg	0.002 4 mg	
	10 mg	0.002 4 mg	
	5 mg	0.002 4 mg	
	3 mg	0.002 4 mg	
	2 mg	0.002 4 mg	
	1 mg	0.002 4 mg	
Balances & Scales – Avoirdupois [1]	50 lb	59 mg	Characterized ASTM Class 4 Weights
	25 lb	58 mg	
	20 lb	58 mg	
	15 lb	51 mg	
	10 lb	2.3 mg	
	7.5 lb	2.3 mg	
	5 lb	1.9 mg	
	2 lb	0.84 mg	
	1 lb	0.61 mg	
	0.5 lb	0.16 mg	
Volume	1 mL to 5 000 mL	0.2 % + 0.02 mL	Gravimetric
Absolute Pressure – Source Pneumatic – In Lab	0 psia to 30 psia	0.002 6 psia	Fluke RPM4
	30 psia to 300 psia	0.008 8 % psia	
	300 psia to 1 000 psia	0.01 %	

Mass and Mass Related

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) [2]	Reference Standard, Method and/or Equipment
Gage Pressure – Source Pneumatic – Field [1]	-15 psig to 3 psig	0.015 %	Cosa Instruments T3500/3
	3 psig to 500 psig	0.006 5 %	
Pneumatic – In Lab	-60 inH_2O to -22 inH_2O	0.009 % + 150 μinH_2O	Fluke PPC4
	-22 inH_2O to 22 inH_2O	0.002 inH_2O	
	22 inH_2O to 60 inH_2O	0.009 % + 150 μinH_2O	
	60 inH_2O to 72 inH_2O	0.006 5 inH_2O	
	72 inH_2O to 804 inH_2O	0.009 % + 150 μinH_2O	
	-15 psig to 30 psig	0.002 1 psig	Fluke RPM4
	30 psig to 1000 psig	0.006 6 % + 0.000 1 psig	
Hydraulic – Field [1]	50 psig to 15 000 psig	0.011 %	Ametek T-150
	50 psia to 15 000 psia	0.011 % + 0.002 6 psi	Ametek T-150 with RPM 4

Photometry and Radiometry

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) [2]	Reference Standard, Method and/or Equipment
Illuminance	5.4 lx to 10 764 lx	1.1 %	Standard Lamp
	10 764 lx to 21 258 lx	1.7 %	
	21 258 lx to 32 300 lx	2.1 %	

Thermodynamic

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) [2]	Reference Standard, Method and/or Equipment
Relative Humidity			
Generate			Humidity Generator
(-10 °C to 15 °C)	(10 to 75) %RH (75 to 95) %RH	0.5 % RH 0.65 % RH	
(15 °C to 35 °C)	(10 to 95) %RH	0.5 % RH	
(35 °C to 70 °C)	(10 to 50) %RH (50 to 75) %RH (75 to 95) %RH	0.5 % RH 0.7 % RH 0.85 % RH	
Measure [1]			
(10 °C to 30 °C)	10 % RH to 90 % RH	1.3 % RH	Vaisala HMI41/HMP46
Temperature Measuring Equipment	-100 °C to 0 °C 0 °C to 150 °C 150 °C to 420 °C 420 °C to 600 °C	0.012 °C 0.023 °C + 0.001 % 0.039 °C + 0.001 % 0.072 °C + 0.001 %	SPRT, Metrology Wells
Infrared Temperature – Measuring Equipment Ɛ = (0.1 to 1.0) λ = (8 to 14) µm	-15 °C to 0 °C 0 °C to 50 °C 50 °C to 100 °C 100 °C to 120 °C 120 °C to 200 °C 200 °C to 350 °C 350 °C to 500 °C	0.8 °C 0.65 °C 0.7 °C 0.76 °C 0.95 °C 1.6 °C 2.1 °C	Black Body Sources
Temperature Measure [1]	-195 °C to 0 °C	0.012 °C	Hart Black Stack with SPRT
	0 °C to 420 °C	0.02 °C + 0.001 %	
	420 °C to 600 °C	0.028 °C + 0.001 %	
Temperature Measure	600 °C to 1 000 °C	0.94 °C	Type-S TC
	1 000 °C to 1450 °C	2.9 °C	

Thermodynamic

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) [2]	Reference Standard, Method and/or Equipment
SPRT/PRT/RTD Calibration by Comparison	-195 °C	3.4 mK	SPRT with $NBPLN_2$
	-78 °C -38 °C 0 °C	3.2 mK 2.9 mK 2.9 mK	SPRT with Precision Bath
	0.01 °C	1.5 mK	TPW Cell
	100 °C 156 °C 231 °C 300 °C 420 °C 500 °C	3.6 mK 4.6 mK 6 mK 5.8 mK 8.4 mK 14 mK	SPRT with Precision Bath
	-100 °C to 500 °C	2.9 mK to 21 mK	SPRT with Precision Bath
Thermocouple - Measuring Equipment	600 °C to 1 000 °C	0.94 °C	Type-S TC with Furnace
	1 000 °C to 1 200 °C	2.9 °C	

Time and Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) [2]	Reference Standard, Method and/or Equipment
Frequency – Source and Measure In-Lab	10 MHz	5.8×10^{-10} Hz/Hz	Rubidium Oscillator
Field [1]	10 MHz	2.1×10^{-7} Hz/Hz	Agilent 53132A
Total Harmonic Distortion	0 dB to -80 dB 20 Hz to 20 kHz 20 kHz to 100 kHz	 1.1 dB 2 dB	Agilent 8903B
Total Harmonic Distortion 5 Hz to 600 kHz Fundamental Input Voltage Range < 30 V 100 % to 0.3 %	10 Hz to 1 MHz	3 %	HP 334A
	1 MHz to 3 MHz	6 %	
Total Harmonic Distortion	10 Hz to 20 Hz	12 %	

Time and Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) [2]	Reference Standard, Method and/or Equipment
5 Hz to 600 kHz Fundamental Input Voltage Range < 30 V 0.1 %	20 Hz to 30 Hz	6 %	
	30 Hz to 300 kHz	3 %	
	300 kHz to 500 kHz	6 %	
	500 kHz to 1.2 MHz	12 %	
Input Voltage Range > 30 V 100 % to 0.3 %	10 Hz to 300 kHz	3 %	
	300 kHz to 500 kHz	6 %	
	500 kHz to 3 MHz	12 %	
Input Voltage Range > 30 V 0.1 %	20 Hz to 30 Hz	12 %	HP 334A
	30 Hz to 300 kHz	3 %	
	300 kHz to 500 kHz	6 %	
	500 kHz to 1.2 MHz	12 %	
Time – Measure	Up to 599 sec/month	0.058 sec/day	Vibrograf 4500

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. Values listed with percent (%) are percent of reading or generated value unless otherwise noted.
3. The stated uncertainty is the laboratory's ability to source a fast rise pulse that is approximately 250 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. 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 laboratory for more information regarding uncertainties at frequency and power factor combinations other than the ones shown.
5. L = Length in inches.
6. This scope is formatted as part of a single document including Certificate of Accreditation No. AC-2489.03.

Vice President