CERTIFICATE OF ACCREDITATION

ANSI National Accreditation Board

11617 Coldwater Road, Fort Wayne, IN 46845 USA

This is to certify that

Transcat-Phoenix

8240 S. Kyrene Road, Suite 107
Tempe, AZ 85284

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-2489.11
Certificate Number

ANAB Approval

Certificate Valid Through: 09/07/2021
Version No. 004 Issued: 09/04/2019

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 – Phoenix
8240 S. Kyrene Road, Suite 107
Tempe, AZ 85284
Ryan Verdin

CALIBRATION

Valid to: **September 7, 2021** Certificate Number: **AC-2489.11**

Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) [2]	Reference Standard, Method and/or Equipment
Sine Wave Flatness [1] (0.3 V to 1 V, 50 Ω)	10 Hz to 1 MHz	0.073 %	Agilent 11050A
	1 MHz to 10 MHz	0.14 %	
	10 MHz to 30 MHz	0.39 %	
	30 MHz to 50 MHz	0.79 %	
	50 MHz to 80 MHz	1.6 %	
	80 MHz to 100 MHz	2.4 %	
(1 V to 3 V, 50 Ω)	10 Hz to 1 MHz	0.071 %	Agilent 11049A
	1 MHz to 10 MHz	0.11 %	
	10 MHz to 30 MHz	0.21 %	
	30 MHz to 50 MHz	0.47 %	
	50 MHz to 80 MHz	0.96 %	
	80 MHz to 100 MHz	1.3 %	

Electrical - DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) [2]	Reference Standard, Method and/or Equipment
AC Current – Measuring Equipment [1]	0 µA to 220 µA		Fluke 5720A
	10 Hz to 20 Hz	0.032 % + 16 nA	
	20 Hz to 40 Hz	0.019 % + 10 nA	
	40 Hz to 1 kHz	0.014 % + 8 nA	
	1 kHz to 5 kHz	0.029 % + 12 nA	
	5 kHz to 10 kHz	0.11 % + 65 nA	
	0.22 mA to 2.2 mA		
	10 Hz to 20 Hz	0.032 % + 40 nA	
	20 Hz to 40 Hz	0.019 % + 35 nA	
	40 Hz to 1 kHz	0.014 % + 35 nA	
	1 kHz to 5 kHz	0.021 % + 110 nA	
	5 kHz to 10 kHz	0.11 % + 650 nA	
	2.2 mA to 22 mA		
	10 Hz to 20 Hz	0.032 % + 0.4 µA	
	20 Hz to 40 Hz	0.019 % + 0.35 µA	
	40 Hz to 1 kHz	0.015 % + 0.35 µA	
	1 kHz to 5 kHz	0.022 % + 0.55 µA	
	5 kHz to 10 kHz	0.11 % + 5 µA	
	22 mA to 220 mA		
	10 Hz to 20 Hz	0.032 % + 4 µA	
	20 Hz to 40 Hz	0.018 % + 3.5 µA	
	40 Hz to 1 kHz	0.013 % + 2.5 µA	

Electrical - DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) [2]	Reference Standard, Method and/or Equipment
AC Current – Measuring Equipment [1]	1 kHz to 5 kHz	0.021 % + 3.5 µA	Fluke 5720A
	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	0.045 % + 80 µA	
	5 kHz to 10 kHz	0.70 % + 160 µA	
	2.2 A to 11 A		Fluke 5720A with 5725A
	5 kHz to 10 kHz	0.36 % + 0.75 mA	
	2.2 A to 20 A		Fluke Y5020 with Agilent 3458A opt 2
	45 Hz to 100 Hz	0.021 % + 230 µA	
	100 Hz to 300 Hz	0.024 % + 230 µA	
	300 Hz to 1 kHz	0.033 % + 230 µA	
	1 kHz to 3 kHz	0.061 % + 230 µA	
	3 kHz to 4 kHz	0.075 % + 230 µA	
	4 kHz to 5 kHz	0.088 % + 230 µA	
Extended Frequency Ranges [1]	29 µA to 330 µA		Fluke 5520A
	10 kHz to 30 kHz	1.2 % + 0.31 µA	
	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 % + 3.1 µA	

Electrical - DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) [2]	Reference Standard, Method and/or Equipment
Extended Frequency Ranges [1]	33 mA to 330 mA 10 kHz to 30 kHz	0.31 % + 0.16 mA	Fluke 5520A
Clamp-on Ammeter Toroidal Type [1] Transformer Type	20 A to 150 A 45 Hz to 65 Hz 65 Hz to 440 Hz	0.35 % + 30 mA 0.94 % + 50 mA	Fluke 5520A with 5500A/Coil
	150 A to 1000 A 45 Hz to 65 Hz 65 Hz to 440 Hz	0.34 % + 0.13 A 1.2 % + 0.23 A	
Clamp-on Ammeter Non-Toroidal Type [1] Hall Effect Sensor	20 A to 150 A 45 Hz to 65 Hz 65 Hz to 440 Hz	0.68 % + 0.29 A 1.2 % + 0.29 A	Fluke 5520A with 5500A/Coil
	150 A to 1 000 A 45 Hz to 65 Hz 65 Hz to 440 Hz	0.66 % + 1 A 1.4 % + 1.1 A	
AC Current – Measure [1]	0 µA to 100 µA 10 Hz to 20 Hz 20 Hz to 45 Hz 45 Hz to 100 Hz 100 Hz to 5 kHz	0.46 % + 35 nA 0.18 % + 35 nA 0.072 % + 35 nA 0.072 % + 35 nA	Agilent 3458A opt 2
	100 µA to 1 mA 10 Hz to 20 Hz 20 Hz to 45 Hz	0.46 % + 0.23 µA 0.17 % + 0.23 µA	

Electrical - DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) [2]	Reference Standard, Method and/or Equipment
AC Current – Measure [1]	45 Hz to 100 Hz	0.071 % + 0.23 µA	Agilent 3458A opt 2
	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	0.07 % + 23 µA	
	100 Hz to 5 kHz	0.037 % + 23 µA	
	100 mA to 1 A		
	10 Hz to 20 Hz	0.46 % + 0.23 mA	
	20 Hz to 45 Hz	0.19 % + 0.23 mA	
	45 Hz to 100 Hz	0.097 % + 0.23 mA	
	100 Hz to 5 kHz	0.12 % + 0.23 mA	
	1 A to 20 A		Fluke Y5020 with Agilent 3458A opt 2
	50 Hz to 100 Hz	0.021 % + 230 µA	
	100 Hz to 300 Hz	0.024 % + 230 µA	
	300 Hz to 1 kHz	0.033 % + 230 µA	
	1 kHz to 3 kHz	0.061 % + 230 µA	

Electrical - DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) [2]	Reference Standard, Method and/or Equipment
AC Current – Measure [1]	3 kHz to 4 kHz	0.075 % + 230 µA	Fluke Y5020 with Agilent 3458A opt 2
	4 kHz to 5 kHz	0.088 % + 230 µA	
DC Resistance – Measuring Equipment and Measure [1]	0 Ω to 10 Ω	18 µΩ/Ω + 58 µΩ	Agilent 3458A with Decade Resistor
	10 Ω to 100 Ω	15 µΩ/Ω + 0.58 mΩ	
	100 Ω to 1 kΩ	13 µΩ/Ω + 0.58 mΩ	
	1 kΩ to 10 kΩ	12 µΩ/Ω + 5.8 mΩ	
	10 kΩ to 100 kΩ	13 µΩ/Ω + 58 mΩ	
	100 kΩ to 1 MΩ	21 µΩ/Ω + 2.3 Ω	
	1 MΩ to 10 MΩ	62 µΩ/Ω + 0.12 kΩ	
	10 MΩ to 100 MΩ	0.012 % + 0.28 kΩ	Extended Arm Bridge
	100 MΩ to 1 GΩ	0.012 % + 9.7 kΩ	
	1 GΩ to 10 GΩ	0.012 % + 0.42 MΩ	
	10 GΩ to 100 GΩ	0.012 % + 45 MΩ	
	100 GΩ to 300 GΩ	0.016 % + 45 MΩ	
	300 GΩ to 700 GΩ	0.016 % + 0.11 GΩ	
	700 GΩ to 1 TΩ	0.016 % + 0.49 GΩ	
DC Resistance – Measuring Equipment [1]	10 µΩ	0.4 %	Fixed Resistor
	100 µΩ	0.046 %	
	1 mΩ	0.046 %	
	10 mΩ	35 µΩ/Ω	
	100 mΩ	67 µΩ/Ω	
	1 Ω	96 µΩ/Ω	Fluke 5720A

Electrical - DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) [2]	Reference Standard, Method and/or Equipment
DC Resistance – Measuring Equipment [1]	1.9 Ω	96 μΩ/Ω	Fluke 5720A
	10 Ω	24 μΩ/Ω	
	19 Ω	24 μΩ/Ω	
	100 Ω	11 μΩ/Ω	
	190 Ω	11 μΩ/Ω	
	1 kΩ	10 μΩ/Ω	
	1.9 kΩ	10 μΩ/Ω	
	10 kΩ	10 μΩ/Ω	
	19 kΩ	12 μΩ/Ω	
	100 kΩ	11 μΩ/Ω	
	190 kΩ	13 μΩ/Ω	
	1 MΩ	23 μΩ/Ω	
	1.9 MΩ	21 μΩ/Ω	
	10 MΩ	42 μΩ/Ω	
	19 MΩ	49 μΩ/Ω	
	100 MΩ	120 μΩ/Ω	
DC Current – Measuring Equipment and Measure [1]	0 μA to 100 μA	26 μA/A + 0.92 nA	Agilent 3458A with Current Source
	100 μA to 1 mA	26 μA/A + 5.8 nA	
	1 mA to 10 mA	26 μA/A + 58 nA	
	10 mA to 100 mA	41 μA/A + 0.58 μA	
	100 mA to 1 A	130 μA/A + 12 μA	
	1 A to 20 A	37 μA/A	Fluke Y5020 with Agilent 3458A opt 2

Electrical - DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) [2]	Reference Standard, Method and/or Equipment
DC Current – Measure	20 A to 100 A	0.046 %	L & N 4361 with Agilent 3458A opt 2
Clamp-on Ammeter Non-Toroidal Type [1] Hall Effect Sensor	20 A to 150 A	0.53 % + 0.17 A	Fluke 5520A with 5500A/Coil
	150 A to 1000 A	0.52 % + 0.58 A	
DC Voltage – Measuring Equipment [1]	0 mV to 220 mV	9.6 µV/V + 0.4 µV	Fluke 5720A
	220 mV to 2.2 V	5.6 µV/V + 0.7 µV	
	2.2 V to 11 V	4.1 µV/V + 2.5 µV	
	11 V to 22 V	4.1 µV/V + 4 µV	
	22 V to 220 V	5.9 µV/V + 40 µV	
	220 V to 1100 V	7.6 µV/V + 0.40 mV	Fluke 5720A w/5725A
DC Voltage – Measure	0 mV to 100 mV	8.3 µV/V + 0.35 µV	Agilent 3458A opt 2
	100 mV to 10 V	5.3 µV/V + 0.35 µV	
	10 V to 100 V	7.6 µV/V + 35 µV	
	100 V to 500 V	11 µV/V + 120 µ V	
	500 V to 700 V	14 µV/V + 120 µ V	
	700 V to 1000 V	21 µV/V + 120 µV	
	1 kV to 10 kV	0.042 % + 0.092 V	Vitrek 4700A
	10 kV to 35 kV	0.047 % + 2.4 V	Vitrek 4700A/HVL-35
	35 kV to 50 kV	0.056 % + 2.4 V	Vitrek 4700A/HVL-70
	50 kV to 70 kV	0.088 % + 2.4 V	Vitrek 4700A/HVL-70
	70 kV to 100 kV	0.17 % + 2.5 V	Vitrek 4700A/HVL-100

Electrical - DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) [2]	Reference Standard, Method and/or Equipment
AC High Voltage – Measure [1]	700 V to 5 kV		Vitrek 4700A with HVL Series Probe
	0.01 Hz to 10 Hz	0.15 % + 0.17 V	
	10 Hz to 30 Hz	0.13 % + 0.29 V	
	30 Hz to 200 Hz	0.11 % + 0.37 V	
	200 Hz to 450 Hz	0.48% + 0.17 V	
	450 Hz to 600 Hz	0.88% + 0.17 V	
	5 kV to 30 kV		Vitrek 4700A with HVL Series Probe
	0.01 Hz to 10 Hz	0.20 % + 2.4 V	
	10 Hz to 30 Hz	0.15 % + 2.4 V	
	30 Hz to 200 Hz	0.12% + 2.4 v	
	200 Hz to 450 Hz	0.71 % + 2.4 V	
	450 Hz to 600 Hz	1.4% + 2.4 V	
	30 kV to 50 kV		
	0.01 Hz to 10 Hz	0.25 % + 2.5 V	
	10 Hz to 30 Hz	0.19% + 2.5 V	
	30 Hz to 70 Hz	0.14% + 2.5 V	
	70 Hz to 200 Hz	0.70% + 2.5 V	
	200 Hz to 450 Hz	2.9% + 2.5 V	
	50 kV to 70 kV		
	0.01 Hz to 10 Hz	0.37% + 2.6 V	
	10 Hz to 30 Hz	0.27 % + 2.6 V	
	30 Hz to 70 Hz	0.18 % + 2.6 V	
	70 Hz to 200 Hz	1.2% + 2.6V	
	200 Hz to 450 Hz	1.7% + 2.6V	
AC Voltage – Measure [1]	0 mV to 10 mV		Agilent 3458A opt 2
	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	0.12 % + 1.3 µV	

Electrical - DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) [2]	Reference Standard, Method and/or Equipment
AC Voltage – Measure [1]	50 kHz to 100 kHz	0.59 % + 1.3 µV	Agilent 3458A opt 2
	100 kHz to 300 kHz	4.6 % + 2.3 µV	
	10 mV to 100 mV		
	1 Hz to 40 Hz	0.013 % + 4.6 µV	
	40 Hz to 1 kHz	0.0094 % + 2.3 µV	
	1 kHz to 20 kHz	0.017 % + 2.3 µV	
	20 kHz to 50 kHz	0.035 % + 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	
	1 MHz to 2 MHz	1.8 % + 12 µV	
	100 mV to 1 V		
	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 % + 120 µV	
	300 kHz to 1 MHz	1.2 % + 120 µV	
	1 MHz to 2 MHz	1.8% + 120 µV	
	1 V to 10 V		
	1 Hz to 40 Hz	0.009 5 % + 0.46 mV	

Electrical - DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) [2]	Reference Standard, Method and/or Equipment
AC Voltage – Measure [1]	40 Hz to 1 kHz	0.009 5 % + 0.23 mV	Agilent 3458A opt 2
	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	
	1 MHz to 2 MHz	1.7 % + 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	
	100 kHz to 300 kHz	0.47 % + 12 mV	
	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	

Electrical - DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) [2]	Reference Standard, Method and/or Equipment
AC Voltage – Measuring Equipment [1]	0 mV to 2.2 mV		Fluke 5720A
	10 Hz to 20 Hz	0.1 % + 4 µV	
	20 Hz to 40 Hz	0.077 % + 4 µV	
	40 Hz to 20 kHz	0.077 % + 4 µV	
	20 kHz to 50 kHz	0.077 % + 4 µV	
	50 kHz to 100 kHz	0.13 % + 5 µV	
	100 kHz to 300 kHz	0.24 % + 10 µV	
	300 kHz to 500 kHz	0.34 % + 20 µV	
	500 kHz to 1 MHz	0.52 % + 20 µV	
	2.2 mV to 22 mV		
	10 Hz to 20 Hz	0.041 % + 4 µV	
	20 Hz to 40 Hz	0.028 % + 4 µV	
	40 Hz to 20 kHz	0.015 % + 4 µV	
	20 kHz to 50 kHz	0.026 % + 4 µV	
	50 kHz to 100 kHz	0.056 % + 5 µV	
	100 kHz to 300 kHz	0.11 % + 10 µV	
	300 kHz to 500 kHz	0.15 % + 20 µV	
	500 kHz to 1 MHz	0.28 % + 20 µV	
	22 mV to 220 mV		
	10 Hz to 20 Hz	0.025 % + 12 µV	
	20 Hz to 40 Hz	0.009 6 % + 7 µV	
	40 Hz to 20 kHz	0.008 6 % + 7 µV	

Electrical - DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) [2]	Reference Standard, Method and/or Equipment
AC Voltage – Measuring Equipment [1]	20 kHz to 50 kHz	0.02 % + 7 µV	Fluke 5720A
	50 kHz to 100 kHz	0.046 % + 17 µV	
	100 kHz to 300 kHz	0.091 % + 20 µV	
	300 kHz to 500 kHz	0.14 % + 25 µV	
	500 kHz to 1 MHz	0.27 % + 45 µV	
	220 mV to 2.2 V		
	10 Hz to 20 Hz	0.024 % + 40 µV	
	20 Hz to 40 Hz	0.009 2 % + 15 µV	
	40 Hz to 20 kHz	0.004 8 % + 8 µV	
	20 kHz to 50 kHz	0.007 7 % + 10 µV	
	50 kHz to 100 kHz	0.011 % + 30 µV	
	100 kHz to 300 kHz	0.042 % + 80 µV	
	300 kHz to 500 kHz	0.1 % + 200 µV	
	500 kHz to 1 MHz	0.17 % + 300 µV	
	2.2 V to 22 V		
	10 Hz to 20 Hz	0.024 % + 0.4 mV	
	20 Hz to 40 Hz	0.009 2 % + 0.15 mV	
	40 Hz to 20 kHz	0.004 9 % + 0.05 mV	
	20 kHz to 50 kHz	0.007 8 % + 0.1 mV	
	50 kHz to 100 kHz	0.011 % + 0.2 mV	
	100 kHz to 300 kHz	0.028 % + 0.6 mV	
	300 kHz to 500 kHz	0.1 % + 2 mV	

Electrical - DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) [2]	Reference Standard, Method and/or Equipment
AC Voltage – Measuring Equipment [1]	500 kHz to 1 MHz	0.15 % + 3.2 mV	Fluke 5720A
	22 V to 220 V		
	10 Hz to 20 Hz	0.024 % + 4 mV	
	20 Hz to 40 Hz	0.009 3 % + 1.5 mV	
	40 Hz to 20 kHz	0.005 6 % + 0.6 mV	
	20 kHz to 50 kHz	0.008 3 % + 1 mV	
	50 kHz to 100 kHz	0.016 % + 2.5 mV	
	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 1 100 V		Fluke 5720A/5725A
	40 Hz to 1 kHz	0.011 % + 4 mV	
	1 kHz to 20 kHz	0.017 % + 6 mV	
	20 kHz to 30 kHz	0.06 % + 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 – Measuring Equipment [1]	0.19 nF to < 1.1 nF		Fluke 5520A
	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	

Electrical - DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) [2]	Reference Standard, Method and/or Equipment
Capacitance – Measuring Equipment [1]	3.3 nF to < 11 nF 10 Hz to 1 kHz	0.21 % + 7.8 pF	Fluke 5520A
	11 nF to < 110 nF 10 Hz to 1 kHz	0.21 % + 78 pF	
	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	

Electrical - DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) [2]	Reference Standard, Method and/or Equipment
Capacitance – Measuring Equipment [1]	3.3 mF to < 11 mF DC to 2 Hz	0.35 % + 7.8 µF	Fluke 5520A
	11 mF to < 33 mF DC to 0.6 Hz	0.58 % + 23 µF	
	33 mF to < 110 mF DC to 0.2 Hz	0.85 % + 78 µF	
Electrical Calibration of Thermocouple Devices [1] Type E	-270 °C to -245 °C	2.1 °C	Ectron 1140A
	-245 °C to -195 °C	2 °C	
	-195 °C to -155 °C	1.1 °C	
	-155 °C to -90 °C	0.93 °C	
	-90 °C to 0 °C	0.08 °C	
	0 °C to 15 °C	0.08 °C	
	15 °C to 890 °C	0.07 °C	
	890 °C to 1 000 °C	0.08 °C	
Type J	-210 °C to -180 °C	0.13 °C	
	-180 °C to -120 °C	0.11 °C	
	-120 °C to -50 °C	0.09 °C	
	-50 °C to 990 °C	0.08 °C	
	990 °C to 1 200 °C	0.08 °C	
Type K	-270 °C to -255 °C	2.3 °C	
	-255 °C to -195 °C	0.73 °C	
	-195 °C to -115 °C	0.14 °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 K	-115 °C to -55 °C	0.1 °C	Ectron 1140A
	-55 °C to 1 000 °C	0.08 °C	
	1 000 °C to 1 372 °C	0.09 °C	
Type T	-270 °C to -250 °C	1.8 °C	Ectron 1140A
	-255 °C to -240 °C	0.52 °C	
	-240 °C to -210 °C	0.32 °C	
	-210 °C to -150 °C	0.19 °C	
	-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 R	-50 °C to -30 °C	0.68 °C	
	-30 °C to 45 °C	0.58 °C	
	45 °C to 160 °C	0.42 °C	
	160 °C to 380 °C	0.31 °C	
	380 °C to 775 °C	0.28 °C	
	775 °C to 1 768.1 °C	0.23 °C	
Type S	-50 °C to -30 °C	0.65 °C	
	-30 °C to 45 °C	0.59 °C	
	45 °C to 105 °C	0.42 °C	
	105 °C to 310°C	0.33 °C	
	310 °C to 615 °C	0.31 °C	
	615 °C to 1 768.1 °C	0.27 °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	-270 °C to -260 °C	5.1 °C	Ectron 1140A
	-260 °C to -200 °C	1.1 °C	
	-200 °C to -140 °C	0.25 °C	
	-140 °C to -70 °C	0.16 °C	
Power – Measuring Equipment 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 %	Fluke 5520A
	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) 3.3 mA to 9 mA	0.11 mW to 3 mW 10 Hz to 65 Hz	0.13 %	Fluke 5520A
	3 mW to 9 W 10 Hz to 65 Hz	0.077 %	
9 mA to 33 mA	0.3 mW to 10 mW 10 Hz to 65 Hz	0.089 %	
	10 mW to 33 W 10 Hz to 65 Hz	0.077 %	
33 mA to 90 mA	1 mW to 30 mW 10 Hz to 65 Hz	0.071 %	Fluke 5520A
	30 mW to 90 W 10 Hz to 65 Hz	0.057 %	

Electrical - DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) [2]	Reference Standard, Method and/or Equipment
AC Power [4] (PF = 1) 90 mA to 330 mA	3 mW to 100 mW 10 Hz to 65 Hz	0.089 %	Fluke 5520A
	100 mW to 300 W 10 Hz to 65 Hz	0.078 %	
0.33 A to 0.9 A	11 mW to 300 mW 10 Hz to 65 Hz	0.071 %	
	300 mW to 900 W 10 Hz to 65 Hz	0.081 %	
0.9 A to 2.2 A	30 mW to 720 mW 10 Hz to 65 Hz	0.089 %	
	720 mW to 2 kW 10 Hz to 65 Hz	0.079 %	
2.2 A to 4.5 A	80 mW to 1.4 W 10 Hz to 65 Hz	0.088 %	
	1.4 W to 4.5 kW 10 Hz to 65 Hz	0.18 %	
4.5 A to 20.5 A	150 mW to 6.7 W 10 Hz to 65 Hz	0.17 %	
	6.7 W to 20 kW 10 Hz to 65 Hz	0.17 %	
Phase Meters – Measure Equipment [1]	0° to 179.99° 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 30 kHz	0.11° 0.2° 0.4° 1.9° 3.9° 7.8°	Fluke 5520A

Electrical - DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) [2]	Reference Standard, Method and/or Equipment
Oscilloscopes[1]			Fluke 5520A/SC1100
Amplitude DC[1]			
into 50 Ω Load	(-6.6 to 6.6) V	0.20% + 31 µV	
into 1 MΩ Load	(-130 to 130) V	0.039% + 31 µV	
Amplitude Square Wave[1]			
into 50 Ω Load			
Rate: 10 Hz to 10 kHz	1 $mV_{(pk-pk)}$ to 6.6 $V_{(pk-pk)}$	0.19% + 31 µV	
into 1 MΩ Load			
Rate: 10 Hz to 1 kHz	1 $mV_{(pk-pk)}$ to 6.6 $V_{(pk-pk)}$	0.078% + 31 µV	
Rate: 1 kHz to 10 kHz	1 $mV_{(pk-pk)}$ to 6.6 $V_{(pk-pk)}$	0.19% + 31 µV	
Timing - Generate[1]	5 s	0.30 %	Fluke 5520A/SC1100
	2 s	0.12 %	
	1 s	0.062 %	
50 Ω Load	500 ms	0.032 %	
	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 [1,4]			Fluke 5520A/SC1100
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	
Rate: 2 MHz to 10 MHz	250 ps (nominal)	50 ps	

Electrical - DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) [2]	Reference Standard, Method and/or Equipment
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	Fluke 5520A/SC1100
	100 MHz to 300 MHz	3.2 % + 230 µV	
	300 MHz to 600 MHz	4.0 % + 230 µV	
5.0 $mV_{(pk-pk)}$ to 3.5 $V_{(pk-pk)}$	600 MHz to1 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	Fluke 5520A/SC1100
	100 MHz to 300 MHz	1.8 % + 78 µV	
	300 MHz to 600 MHz	3.2 % + 78 µV	
5.0 $mV_{(pk-pk)}$ to 3.5 $V_{(pk-pk)}$	600 MHz to 1.1 GHz	4.0 % + 78 µV	
Input Impedance Measure[1]			
50 Ω	40 Ω to 60 Ω	0.082 %	Fluke 5520A/SC1100
1 MΩ	500 kΩ to 1.5 MΩ	0.081 %	
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			Fluke 5520A/SC1100
50 Ω Load	1.8 $mV_{(pk-pk)}$ to 2.5 $V_{(pk-pk)}$	2.3 % + 78 $µV_{(pk-pk)}$	
1 MΩ Load	1.8 $mV_{(pk-pk)}$ to 55 $V_{(pk-pk)}$	2.3 % + 78 $µV_{(pk-pk)}$	

Electrical - DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) [2]	Reference Standard, Method and/or Equipment
Wave Generator – Source[1] Frequency Sine, Square, Triangle	10 Hz to 10 kHz	0.001 9% + 0.012 Hz	Fluke 5520A/SC1100

Length – Dimensional Metrology

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) [5]	Reference Standard, Method and/or Equipment
Micrometers – Outside, Inside, Depth [1]	0.05 in to 0.4 in	27 µin	Comparison to Gage Blocks
	0.4 to 40 in	(10 + 19*L*) µin	
Calipers – Outside, Inside, Depth [1]	0.05 in to 0.4 in	60 µin	Comparison to Gage Blocks
	0.4 to 40 in	(60 + 19*L*) µin	
Anvil Flatness [1]	0 in to 1 in	4.7 µin	Optical Flats
Dial Indicators [1]	0.01 in to 0.4 in	7 µin	Gage Blocks with Surface Plate
	0.45 in to 3 in	(17 + 5.3*L*) µin	
Height Measuring Equipment	0.01 in to 8 in	(17 + 3.4*L*) µin	Gage Blocks with Surface Plate
	8 in to 40 in	(15 + 4.3*L*) µin	
Height Measure	0.01 in to 6 in	(24 + 2.6*L*) µin	Gage Blocks with Surface Plate
	6 in to 12 in	(14 + 4.4*L*) µin	
Pin Gage – Outer Diameter Non-contact	0.004 in to 1 in	32 µin	Laser Micrometer

Mass and Mass Related

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) [2]	Reference Standard, Method and/or Equipment
Force Measuring Equipment – Tension and Compression	1 lbf to 50 lbf	0.013 %	Dead Weight
	50 lbf to 250 lbf	0.004 4 % + 0.006 5 lbf	
	1 gf to 4 kgf	0.013 %	
Torque – Measure [1]	20 ozf·in to 600 lbf·ft	1 %	Torque Calibrator
Balances – Metric [1]	2 kg	1.3 mg	Class S Weights
	1 kg	700 µg	
	500 g	310 µg	
	200 g	180 µg	
Balances – Metric [1]	100 g	83 µg	Class 1 Weights
	50 g	46 µg	
	20 g	29 µg	
	10 g	16 µg	
	5 g	12 µg	
	2 g	7.7 µg	
	1 g	7.7 µg	
	Up to 500 mg	5.8 µg	
Balances – Avoirdupois [1]	1 lb to 400 lb	0.012 %	NIST Class F Weights
Absolute Pressure – Source (Pneumatic)	0 psia to 25 psia	0.001 9 psia	Ruska 7250xi
	25 psia to 500 psia	0.006 5 % + 0.001 psia	
Gage Pressure – Source (Pneumatic) [1]	-15 psig to 25 psig	0.0017 psig	Ruska 7250xi
	25 psig to 500 psig	0.006 5 %	
Gage Pressure – Source (Hydraulic) [1]	0 psig to 1 500 psig	0.36 psi	Fluke RPM4-E-DWT
	1 500 psig to 15 000 psig	0.023 %	

Mass and Mass Related

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) [2]	Reference Standard, Method and/or Equipment
Volume – Pipette [1]	(0.1 to 10) µL	0.026 µL	Gravimetric Method
	(>10 to 20) µL	0.031 µL	
	(>20 to 30) µL	0.051 µL	
	(>30 to 50) µL	0.099 µL	
	(>50 to 100) µL	0.15 µL	
	(>100 to 200) µL	0.19 µL	
	(>200 to 500) µL	0.22 µL	
	(>500 to 1 000) µL	0.25 µL	
	(>1 000 to 1 500) µL	0.35 µL	
	(>1 500 to 2 000) µL	0.46 µL	
	(>2 000 to 2 500) µL	0.52 µL	
	(>2 500 to 3 000) µL	0.63 µL	
	(>3 000 to 5 000) µL	0.99 µL	
	(>5 000 to 10 000) µL	2 µL	
Flow - Gas	(0.001 to 10) slpm (>10 to 680) slpm	0.23% 0.15%	Bell Prover
Flow - Liquid	(0.001 to 60) gpm (0.004 to 230) lpm (0.4 to 23 000) pph	0.1%	Liquid Ballistic Prover

Thermodynamic

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
Temperature – Measuring Equipment [1]	0 °C to 100 °C	0.038 °C	Hart 5628 w/Dry Block

Thermodynamic

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
Temperature – Measure [1]	-195 °C to 0 °C	0.012 °C	Hart 5628
	0 °C to 420 °C	0.026 °C	
	420 °C to 600 °C	0.036 °C	
Infrared Temperature – Measuring Equipment	-15 °C to 0 °C	0.79 °C	Fluke Black Body
	0 °C to 50 °C	0.54 °C	
	50 °C to 100 °C	0.67 °C	
Infrared Temperature – Measuring Equipment	100 °C to 120 °C	0.75 °C	Fluke Black Body
	120 °C to 200 °C	0.97 °C	
	200 °C to 350 °C	1.7 °C	
	350 °C to 500 °C	2.2 °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	SRS FS725
Field [1]	10 MHz	3.8×10^{-9} Hz/Hz	Agilent 8648C
Total Harmonic Distortion	0.01 % to 100 %		Agilent 339A
	20 Hz to 20 kHz	13 %	
	20 kHz to 50 kHz	21 %	
	50 kHz to 100 kHz	37 %	
	100 kHz to 500 MHz	37 %	Tektronix 2795
Rise Time – Measure	≥ 800 ps	0.13 % + 0.17 ns	Tektronix TDS 510A

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 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 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.
4. 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.
5. L = Length in inches
6. This scope is formatted as part of a single document including Certificate of Accreditation No. AC-2489.11.

Vice President