



# CERTIFICATE OF ACCREDITATION

**The ANSI National Accreditation Board**

Hereby attests that

**Transcat - Portland**  
**14058 SW Milton Court**  
**Portland, OR 97224**

Fulfills the requirements of

**ISO/IEC 17025:2017**

and national standards

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

In the field of

**CALIBRATION**

This certificate is valid only when accompanied by a current scope of accreditation document.  
The current scope of accreditation can be verified at [www.anab.org](http://www.anab.org).

A handwritten signature in black ink, appearing to be 'J. Stine', is positioned above a horizontal line.

Jason Stine, Vice President

Expiry Date: 07 September 2025  
Certificate Number: AC-2489.01



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 (R2013)**

**Transcat - Portland**

14058 SW Milton Court

Portland, OR 97224

Michael Gettle 800-828-1470 ext. 7606

**CALIBRATION**

Valid to: **September 7, 2025**

Certificate Number: **AC-2489.01**

**Electrical – DC/Low Frequency**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Sine Wave Flatness <sup>1</sup>	Up to 3 V (10 to 100) Hz 100 Hz to 300 kHz 300 kHz to 10 MHz (10 to 20) MHz (20 to 30) MHz (30 to 50) MHz (50 to 70) MHz (70 to 80) MHz (80 to 100) MHz	0.07 % of reading 0.071 % of reading 0.13 % of reading 0.21 % of reading 0.22 % of reading 0.48 % of reading 0.75 % of reading 0.89 % of reading 1 % of reading	Thermal Voltage Converters
DC Current – Source/Measure <sup>1</sup>	Up to 100 µA (0.1 to 1) mA (1 to 10) mA (10 to 100) mA (0.1 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	Agilent 3458A Opt 02 8.5 Digit Multimeter, Current Source
DC Current – Source/Measure <sup>1</sup>	(1 to 10) A (10 to 100) A (100 to 300) A	0.013 % of reading 0.048 % of reading 0.062 % of reading	Guildline 9211 DC Current Shunt, Current Source
DC Clamp-on Ammeter (Non-Toroidal Type) Hall Effect Sensor <sup>1</sup>	(20 to 150) A (150 to 1 000) A	0.5 % of reading + 0.14 A 0.52 % of reading + 0.5 A	Fluke 5520A Multiproduct Calibrator, Wavetek Coil



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
DC Clamp-on Ammeter (Non-Toroidal Type) Hall Effect Sensor <sup>1</sup>	(1 000 to 5 000) A	0.58 % of reading	Fluke 52120A Transconductance Amplifier, Fluke 5520A Multiproduct Calibrator, 3 kA or 6 kA Coil
AC Current – Measure <sup>1</sup>	Up to 100 $\mu$ A (10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 1 kHz (0.1 to 1) mA (10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz (1 to 10) mA (10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz (10 to 100) mA (10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz (0.1 to 1) A (10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz	0.46 % of reading + 35 nA 0.17 % of reading + 35 nA 0.072 % of reading + 35 nA 0.072 % of reading + 35 nA 0.46 % of reading + 0.23 $\mu$ A 0.17 % of reading + 0.23 $\mu$ A 0.07 % of reading + 0.23 $\mu$ A 0.038 % of reading + 0.23 $\mu$ A 0.46 % of reading + 2.3 $\mu$ A 0.17 % of reading + 2.3 $\mu$ A 0.071 % of reading + 2.3 $\mu$ A 0.038 % of reading + 2.3 $\mu$ A 0.48 % of reading + 23 $\mu$ A 0.17 % of reading + 23 $\mu$ A 0.071 % of reading + 23 $\mu$ A 0.037 % of reading + 23 $\mu$ A 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 02 8.5 Digit Multimeter
AC Current – Measure <sup>1</sup>	(1 to 3) A 10 Hz to 5 kHz (3 to 10) A 10 Hz to 1 kHz	0.17 % of reading + 1.8 mA 0.18 % of reading + 6 mA	Fluke 8846A 6.5 Digit Multimeter
AC Current – Measure <sup>1</sup>	(10 to 100) A 10 Hz to 1 kHz	0.12 % of reading	Ohms Labs Current Shunt, Digital Multimeter



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current – Source <sup>1</sup>	Up to 220 $\mu$ A		Fluke 5720A Multiproduct Calibrator
	(10 to 20) Hz	0.031 % of reading + 16 nA	
	(20 to 40) Hz	0.019 % of reading + 10 nA	
	40 Hz to 1 kHz	0.015 % of reading + 8 nA	
	(1 to 5) kHz	0.03 % of reading + 12 nA	
	(5 to 10) kHz	0.11 % of reading + 65 nA	
	(0.22 to 2.2) mA		
	(10 to 20) Hz	0.03 % of reading + 40 nA	
	(20 to 40) Hz	0.018 % of reading + 35 nA	
	40 Hz to 1 kHz	0.013 % of reading + 35 nA	
	(1 to 5) kHz	0.021 % of reading + 0.11 $\mu$ A	
	(5 to 10) kHz	0.11 % of reading + 0.65 $\mu$ A	
	(2.2 to 22) mA		
	(10 to 20) Hz	0.039 % of reading + 0.4 $\mu$ A	
	(20 to 40) Hz	0.019 % of reading + 0.35 $\mu$ A	
40 Hz to 1 kHz	0.014 % of reading + 0.35 $\mu$ A		
(1 to 5) kHz	0.021 % of reading + 0.55 $\mu$ A		
(5 to 10) kHz	0.11 % of reading + 5 $\mu$ A		
(22 to 220) mA			
(10 to 20) Hz	0.033 % of reading + 4 $\mu$ A		
(20 to 40) Hz	0.018 % of reading + 3.5 $\mu$ A		
40 Hz to 1 kHz	0.014 % of reading + 2.5 $\mu$ A		
(1 to 5) kHz	0.021 % of reading + 3.5 $\mu$ A		
(5 to 10) kHz	0.11 % of reading + 10 $\mu$ A		
(0.22 to 2.2) A			
20 Hz to 1 kHz	0.027 % of reading + 35 $\mu$ A		
(1 to 5) kHz	0.046 % of reading + 80 $\mu$ A		
(5 to 10) kHz	0.7 % of reading + 0.16 mA		
AC Current – Source <sup>1</sup>	(2.2 to 11) A 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.048 % of reading + 0.17 mA 0.096 % of reading + 0.38 mA 0.36 % of reading + 0.75 mA	Fluke 5720A Multiproduct Calibrator, Fluke 5725A Amplifier
AC Current – Source <sup>1</sup>	(11 to 20.5) A (45 to 100) Hz 100 Hz to 1 kHz (1 to 5) kHz	0.09 % of reading + 3.9 mA 0.12 % of reading + 3.9 mA 2.3 % of reading + 3.9 mA	Fluke 5520 A Multiproduct Calibrator
AC Current – Source <sup>1</sup>	(20 to 100) A 10 Hz to 1 kHz	0.12 % of reading	Ohms Labs Current Shunt, Current Source

**Electrical – DC/Low Frequency**

<b>Parameter/Equipment</b>	<b>Range</b>	<b>Expanded Uncertainty of Measurement (+/-)</b>	<b>Reference Standard, Method, and/or Equipment</b>
AC Current – Source <sup>1</sup>	Up to 10 A 50 Hz to 1 kHz 1 kHz (10 to 100) A (50 to 100) Hz (100 to 999) Hz	0.05 % of reading + 1.3 mA 0.12 % of reading + 1.3 mA 0.04 % of reading + 2.3 mA 0.42 % of reading + 2.3 mA	Ohms Labs CS-100 Precision Shunt w/ Agilent 3458A Opt 02 Multimeter and Source
AC Current – Source <sup>1</sup> Extended Frequency Ranges	(29 to 330) $\mu$ A (10 to 30) kHz (0.33 to 3.3) mA (10 to 30) kHz (3.3 to 33) mA (10 to 30) kHz (33 to 330) mA (10 to 30) kHz	1.2 % of reading + 3 $\mu$ A 0.78 % of reading + 0.5 $\mu$ A 0.31 % of reading + 3 $\mu$ A 0.31 % of reading + 0.16 mA	Fluke 5520A Multiproduct Calibrator
AC Clamp-on Ammeters (Toroidal Type) Transformer Type Sensor <sup>1</sup>	(20 to 150) A (45 to 65) Hz (65 to 440) Hz (150 to 1 000) A (45 to 65) Hz (65 to 440) Hz	0.34 % of reading + 35 mA 0.95 % of reading + 66 mA 0.38 % of reading + 0.17 A 1.2 % of reading + 0.29 A	Fluke 5520A Calibrator, Wavetek Coil
AC Clamp-on Ammeters (Non-Toroidal Type) Hall Effect Sensor <sup>1</sup>	(20 to 150) A (45 to 65) Hz (65 to 440) Hz (150 to 1 000) A (45 to 65) Hz (65 to 440) Hz	0.66 % of reading + 0.26 A 1.2 % of reading + 0.29 A 0.68 % of reading + 1 A 1.4 % of reading + 1.2 A	
AC Clamp-on Ammeters (Non-Toroidal Type) Hall Effect Sensor <sup>1</sup>	(1 000 to 6 000) A (10 to 300) Hz (300 to 440) Hz	0.77 % of reading 0.77 % of reading	Fluke 52120A Transconductance Amplifier, Fluke 5520A Multiproduct Calibrator, 3 kA or 6 kA Coil
DC Resistance – Source/Measure <sup>1</sup>	Up to 10 $\Omega$ (10 to 100) $\Omega$ (0.1 to 1) k $\Omega$ (1 to 10) k $\Omega$ (10 to 100) k $\Omega$ (0.1 to 1) M $\Omega$ (1 to 10) M $\Omega$ (10 to 100) M $\Omega$ (0.1 to 1) G $\Omega$	18 $\mu\Omega/\Omega$ + 58 $\mu\Omega$ 15 $\mu\Omega/\Omega$ + 0.58 m $\Omega$ 13 $\mu\Omega/\Omega$ + 0.58 m $\Omega$ 12 $\mu\Omega/\Omega$ + 5.8 m $\Omega$ 13 $\mu\Omega/\Omega$ + 58 m $\Omega$ 21 $\mu\Omega/\Omega$ + 2.3 $\Omega$ 62 $\mu\Omega/\Omega$ + 120 $\Omega$ 0.059 % of reading + 1.2 k $\Omega$ 0.82 % of reading + 12 k $\Omega$	Agilent 3458A Opt 02 8.5 Digit Multimeter, Decade Resistor



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
DC Resistance – Source <sup>1</sup> (Fixed)	0.33 mΩ 1 mΩ 10 mΩ 100 mΩ	0.047 % of reading 0.037 % of reading 0.013 % of reading 0.012 % of reading	DC Current Shunts
DC Resistance – Source (Variable)	(10 to 100) MΩ (0.1 to 1) GΩ (1 to 10) GΩ (10 to 100) GΩ (100 to 900) GΩ 1 TΩ	0.036 % of reading 0.13 % of reading 0.25 % of reading 0.59 % of reading 0.77 % of reading 1.6 % of reading	Decade Resistor
DC Voltage – Source/Measure <sup>1</sup>	(0 to 100) mV (0.1 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 02 8.5 Digit Multimeter, Fluke 5700A-EP Multiproduct Calibrator
DC High Voltage – Measure <sup>1</sup>	(1 to 10) kV (10 to 20) kV (20 to 70) kV (70 to 100) kV	0.04 % of reading + 92 mV 0.09 % of reading + 2.4 V 0.09 % of reading + 2.4 V 0.17 % of reading + 2.5 V	Vitrek 4700 Digital HV Meter, Associated High Voltage Probes
DC Voltage – Source <sup>1</sup>	Up to 0.22 V (0.22 to 2.2) V (2.2 to 11) V (11 to 22) V (22 to 220) V (220 to 1 100) V	8.6 μV/V + 0.4 μV 5.1 μV/V + 0.7 μV 4 μV/V + 2.5 μV 3.9 μV/V + 4 μV 6.2 μV/V + 40 μV 7.6 μV/V + 0.4 mV	Fluke 5720A Multiproduct Calibrator, Fluke 5725A Amplifier
AC Voltage – Measure <sup>1</sup>	Up to 10 mV (1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz 300 kHz to 1 MHz (1 to 4) MHz	0.04 % of reading + 3.5 μV 0.03 % of reading + 1.2 μV 0.04 % of reading + 1.2 μV 0.15 % of reading + 1.2 μV 0.59 % of reading + 1.2 μV 4.6 % of reading + 2.3 μV 1.5 % of reading + 5.8 μV 8.1 % of reading + 8.1 μV	Agilent 3458A Opt 02 8.5 Digit Multimeter



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AC Voltage – Measure <sup>1</sup>	(10 to 100) mV		Agilent 3458A Opt 02 8.5 Digit Multimeter
	(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	
	(1 to 10) V		
	(1 to 40) Hz	0.009 5 % of reading + 0.46 mV	
	40 Hz to 1 kHz	0.023 % of reading + 0.23 mV	
(1 to 20) kHz	0.017 % of reading + 0.23 mV		
(20 to 50) kHz	0.036 % of reading + 0.23 mV		
(50 to 100) kHz	0.093 % of reading + 0.23 mV		
(100 to 300) kHz	0.35 % of reading + 1.2 mV		
300 kHz to 1 MHz	1.2 % of reading + 1.2 mV		
(1 to 2) MHz	1.8 % of reading + 1.2 mV		
(2 to 4) MHz	4.6 % of reading + 8.1 mV		
(4 to 8) MHz	4.6 % of reading + 9.2 mV		
(8 to 10) MHz	17 % of reading + 12 mV		



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Measure <sup>1</sup>	(10 to 100) V (1 to 40) Hz 40Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz 300 kHz to 1 MHz (100 to 700) V (1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.024 % of reading + 4.6 mV 0.024 % of reading + 2.3 mV 0.024 % of reading + 2.3 mV 0.041 % of reading + 2.3 mV 0.14 % of reading + 2.3 mV 0.46 % of reading + 12 mV 1.7 % of reading + 12 mV 0.048 % of reading + 46 mV 0.048 % of reading + 23 mV 0.071 % of reading + 23 mV 0.19 % of reading + 23 mV 0.35 % of reading + 23 mV	Agilent 3458A Opt 2 8.5 Digit Multimeter
AC High Voltage – Measure <sup>1</sup>	(0.7 to 10) kV (20 to 100) Hz (100 to 400) Hz	0.14 % of reading + 0.37 V 0.48 % of reading + 0.17 V	Vitrek 4700 Digital HV Meter
AC High Voltage – Measure <sup>1</sup>	(10 to 30) kV (30 to 70) Hz (70 to 200) Hz (200 to 450) Hz (30 to 50) kV (30 to 70) Hz (70 to 200) Hz (200 to 450) Hz (50 to 70) kV (30 to 70) Hz (70 to 200) Hz	0.11 % of reading + 2.4 V 0.7 % of reading + 2.4 V 1.4 % of reading + 2.4 V 0.13 % of reading + 2.5 V 0.7 % of reading + 2.5 V 2.9 % of reading + 2.5 V 0.16 % of reading + 2.6 V 1.2 % of reading + 2.6 V	Vitrek 4700 Digital HV Meter; Vitrek HVL-35, HVL-70, HVL-100 High Voltage Probes





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AC Voltage – Source <sup>1</sup>	Up to 2.2 mV		Fluke 5720A Multiproduct Calibrator
	(10 to 20) Hz	0.16 % of reading + 4 μV	
	(20 to 40) Hz	0.1 % of reading + 4 μV	
	40 Hz to 20 kHz	0.078 % of reading + 4 μV	
	(20 to 50) kHz	0.13 % of reading + 4 μV	
	(50 to 100) kHz	0.17 % of reading + 5 μV	
	(100 to 300) kHz	0.33 % of reading + 10 μV	
	(300 to 500) kHz	0.47 % of reading + 20 μV	
	500 kHz to 1 MHz	0.58 % of reading + 20 μV	
	(2.2 to 22) mV		
	(10 to 20) Hz	0.042 % of reading + 4 μV	
	(20 to 40) Hz	0.03 % of reading + 4 μV	
	40 Hz to 20 kHz	0.014 % of reading + 4 μV	
	(20 to 50) kHz	0.03 % of reading + 4 μV	
	(50 to 100) kHz	0.058 % of reading + 5 μV	
	(100 to 300) kHz	0.12 % of reading + 10 μV	
	(300 to 500) kHz	0.16 % of reading + 20 μV	
	500 kHz to 1 MHz	0.27 % of reading + 20 μV	
	(22 to 220) mV		
	(10 to 20) Hz	0.028 % of reading + 12 μV	
	(20 to 40) Hz	0.011 % of reading + 7 μV	
	40 Hz to 20 kHz	0.0085 % of reading + 7 μV	
	(20 to 50) kHz	0.021 % of reading + 7 μV	
	(50 to 100) kHz	0.047 % of reading + 17 μV	
(100 to 300) kHz	0.091 % of reading + 20 μV		
(300 to 500) kHz	0.14 % of reading + 25 μV		
500 kHz to 1 MHz	0.28 % of reading + 45 μV		
(0.22 to 2.2) V			
(10 to 20) Hz	0.027 % of reading + 40 μV		
(20 to 40) Hz	0.01 % of reading + 15 μV		
40 Hz to 20 kHz	0.0048 % of reading + 8 μV		
(20 to 50) kHz	0.008 % of reading + 10 μV		
(50 to 100) kHz	0.012 % of reading + 30 μV		
(100 to 300) kHz	0.043 % of reading + 80 μV		
(300 to 500) kHz	0.1 % of reading + 0.2 mV		
500 kHz to 1 MHz	0.18 % of reading + 0.3 mV		



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Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Source <sup>1</sup>	(2.2 to 22) V (10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz (22 to 220) V (10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz	0.028 % of reading + 0.4 mV 0.01 % of reading + 0.15 mV 0.004 9 % of reading + 50 μV 0.008 3 % of reading + 0.1 mV 0.01 % of reading + 0.2 mV 0.03 % of reading + 0.6 mV 0.1 % of reading + 2 mV 0.17 % of reading + 3.2 mV 0.028 % of reading + 4 mV 0.01 % of reading + 1.5 mV 0.005 6 % of reading + 0.6 mV 0.009 3 % of reading + 1 mV 0.016 % of reading + 2.5 mV 0.09 % of reading + 16 mV 0.44 % of reading + 40 mV 0.8 % of reading + 80 mV	Fluke 5720A Multiproduct Calibrator
AC Voltage – Source <sup>1</sup>	(220 to 750) V (30 to 50) kHz (50 to 100) kHz (220 to 1 100) V 40 Hz to 1 kHz (1 to 20) kHz (20 to 30) kHz	0.061 % of reading + 11 mV 0.23 % of reading + 45 mV 0.011 % of reading + 4 mV 0.017 % of reading + 6 mV 0.061 % of reading + 11 mV	Fluke 5720A Multiproduct Calibrator, Fluke 5725A Amplifier
Capacitance – Source <sup>1</sup>	(0.19 to 3.3) nF (3.3 to 11) nF (11 to 110) nF (110 to 330) nF (0.33 to 1.1) μF (1.1 to 3.3) μF (3.3 to 11) μF (11 to 33) μF (33 to 110) μF (110 to 330) μF (0.33 to 1.1) mF (1.1 to 3.3) mF (3.3 to 11) mF (11 to 33) mF (33 to 110) mF	0.39 % of reading + 7.8 pF 0.21 % of reading + 7.8 pF 0.21 % of reading + 78 pF 0.21 % of reading + 0.23 nF 0.2 % of reading + 0.78 nF 0.2 % of reading + 2.3 nF 0.2 % of reading + 7.8 nF 0.31 % 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 0.86 % of reading + 78 μF	Fluke 5520A Multiproduct Calibrator

**Electrical – DC/Low Frequency**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Electrical Simulation of Thermocouple Indicating Devices – Measure/Source <sup>1</sup>	Type B		Ectron 1140A Thermocouple Calibrator/Simulator
	(250 to 350) °C	1.2 °C	
	(350 to 445) °C	0.9 °C	
	(445 to 580) °C	0.71 °C	
	(580 to 750) °C	0.55 °C	
	(750 to 1 000) °C	0.45 °C	
	(1 000 to 1 820) °C	0.35 °C	
	Type C		
	(0 to 250) °C	0.24 °C	
	(250 to 1 000) °C	0.19 °C	
	(1 000 to 1 500) °C	0.21 °C	
	(1 500 to 1 800) °C	0.24 °C	
	(1 800 to 2 000) °C	0.27 °C	
	(2 000 to 2 250) °C	0.33 °C	
	(2 250 to 2 315) °C	0.37 °C	
	Type E		
	(-270 to -245) °C	1.6 °C	
	(-245 to -195) °C	0.24 °C	
	(-195 to -155) °C	0.12 °C	
	(-155 to -90) °C	0.095 °C	
	(-90 to 0) °C	0.08 °C	
	(0 to 15) °C	0.076 °C	
	(15 to 890) °C	0.064 °C	
	(890 to 1 000) °C	0.074 °C	
Type J			
(-210 to -180) °C	0.15 °C		
(-180 to -120) °C	0.12 °C		
(-120 to -50) °C	0.093 °C		
(-50 to 990) °C	0.08 °C		
(990 to 1 200) °C	0.094 °C		
Type K			
(-270 to -255) °C	2.5 °C		
(-255 to -195) °C	0.85 °C		
(-195 to -115) °C	0.16 °C		
(-115 to -55) °C	0.12 °C		
(-55 to 1 000) °C	0.087 °C		
(1 000 to 1 372) °C	0.096 °C		



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Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Electrical Simulation of Thermocouple Indicating Devices – Measure/Source <sup>1</sup>	Type N		Ectron 1140A Thermocouple Calibrator/Simulator
	(-270 to -260) °C	5.4 °C	
	(-260 to -200) °C	1.5 °C	
	(-200 to -140) °C	0.29 °C	
	(-140 to -70) °C	0.18 °C	
	(-70 to 25) °C	0.14 °C	
	(-25 to 160) °C	0.12 °C	
	(160 to 1 300) °C	0.11 °C	
	Type R		
	(-50 to -30) °C	0.8 °C	
	(-30 to 45) °C	0.69 °C	
	(45 to 160) °C	0.49 °C	
	(160 to 380) °C	0.35 °C	
	(380 to 775) °C	0.3 °C	
	(775 to 1 768) °C	0.26 °C	
	Type S		
	(-50 to -30) °C	0.76 °C	
	(-30 to 45) °C	0.68 °C	
	(45 to 105) °C	0.49 °C	
	(105 to 310) °C	0.41 °C	
(310 to 615) °C	0.35 °C		
(615 to 1 768) °C	0.31 °C		
Type T			
(-270 to -255) °C	1.9 °C		
(-255 to -240) °C	0.6 °C		
(-240 to -210) °C	0.36 °C		
(-210 to -150) °C	0.22 °C		
(-150 to -40) °C	0.15 °C		
(-40 to 100) °C	0.095 °C		
(100 to 400) °C	0.08 °C		
Scope Voltage – Source <sup>1</sup> Amplitude DC into 50 Ω load into 1 MΩ load	(-6 to 6) V (-130 to 130) V	0.2 % of reading + 31 μV 0.04 % of reading + 31 μV	Fluke 5520A/1100 Multiproduct Calibrator

**Electrical – DC/Low Frequency**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Scope Voltage – Source <sup>1</sup> Square Wave into 50 Ω load	10 Hz to 100 kHz 1 mV p-p to 6.6 Vp-p	0.19 % of reading + 31 μV	Fluke 5520A/1100 Multiproduct Calibrator
into 1 MΩ load	10 Hz to 1 kHz 1 mV p-p to 6.6 Vp-p (1 kHz to 10) kHz	0.08 % of reading + 31 μV	
	1 mV p-p to 6.6 Vp-p	0.19 % of reading + 31 μV	
Scope – Time Markers <sup>1</sup> into 50 Ω load	1 ns to 20 ms 50 ms 0.1 s 0.2 s 0.5 s 1 s 2 s 5 s	0.000 2 % of reading 2.3 μs 7.6 μs 28 μs 0.16 ms 0.62 ms 2.4 ms 15 ms	Fluke 5520A/1100 Multiproduct Calibrator
Scope Rise Time – Source <sup>1,2</sup> into 50 Ω load Rate: 1 kHz to 2 MHz Rate: 2 MHz to 10 MHz	5 mVp-p to 2.5 Vp-p 250 ps (nominal) 250 ps (nominal)	50 ps 50 ps	Fluke 5520A/1100 Multiproduct Calibrator
Scope Levelled Sine Wave – Source <sup>1</sup> into 50 Ω load	5 mVp-p to 5 Vp-p 50 kHz 50 kHz to 100 MHz (100 to 300) MHz (300 to 600) MHz (600 to 1 100) MHz	1.8 % of reading + 0.23 mV 2.8 % of reading + 0.23 mV 3.2 % of reading + 0.23 mV 4 % of reading + 0.23 mV 4.9 % of reading + 0.23 mV	Fluke 5520A/1100 Multiproduct Calibrator
Scope Bandwidth/Flatness – Source <sup>1</sup> into 50 Ω load (50 kHz Reference)	5 mVp-p to 5.5 Vp-p 50 kHz to 100 MHz (100 to 300) MHz (300 to 600) MHz (600 to 1 100) MHz	1.4 % of reading + 78 μV 1.8 % of reading + 78 μV 3.2 % of reading + 78 μV 3.9 % of reading + 78 μV	Fluke 5520A/1100 Multiproduct Calibrator
Scope Input Impedance – Measure <sup>1</sup>	(40 to 60) Ω (0.5 to 1.5) MΩ	0.082 % of reading 0.081 % of reading	Fluke 5520A/1100 Multiproduct Calibrator
Scope Input Capacitance – Measure <sup>1</sup>	(5 to 50) pF	3.9 % of reading + 0.39 pF	Fluke 5520A/1100 Multiproduct Calibrator



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Scope Waveform Generator – Source <sup>1</sup> Amplitude (Sine, Square, Triangle) into 50 Ω load into 1 MΩ load  Frequency (Sine, Square, Triangle)	10 Hz to 10 kHz 1.8 mVp-p to 2.5 Vp-p 1.8 mVp-p to 55 Vp-p  10 Hz to 10 kHz	2.3 % of reading + 78 μV 2.3 % of reading + 78 μV  0.001 9 % of reading + 12 mHz	Fluke 5520A/1100 Multiproduct Calibrator
LF Phase – Source <sup>1</sup>	(0 to 90)° (10 to 65) Hz (65 to 500) Hz 500 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (10 to 30) kHz	0.11° 0.2° 0.39° 1.9° 3.9° 7.8°	Fluke 5520A/1100 Calibrator
DC Power – Source <sup>1</sup> (0.33 to 330) mA  (0.33 to 3) A  (3 to 20.5) A	11 μW to 1.1 mW 1.1 mW to 0.11 W (0.11 to 110) W (110 to 330) W  11 μW to 110 mW (0.11 to 990) W (0.99 to 3) kW  99 mW to 0.99 W 0.99 W to 6.8 kW (6.8 to 20.5) kW	0.024 % of reading 0.027 % of reading 0.024 % of reading 0.018 % of reading  0.044 % of reading 0.053 % of reading 0.009 6 % of reading  0.088 % of reading 0.07 % of reading 0.04 % of reading	Fluke 5520A/1100 Calibrator

**Electrical – DC/Low Frequency**

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

**Electrical – RF/Microwave**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Total Harmonic Distortion – Measure	(-80 to 0) dB 20 Hz to 20 kHz (20 to 100) kHz	1.2 dB	Agilent 8903B Audio Analyzer
		2.3 dB	
Harmonic Distortion	9 kHz to 100 MHz	1.7 dB	Agilent 8592L Spectrum Analyzer
Rise Time – Measure <sup>1</sup>	≥700 ps	0.81 ns	Tektronix TDS3052 Digital Oscilloscope

**Length – Dimensional Metrology**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Angle Measuring Devices <sup>3</sup>	(0.017 to 5)°	1.7"	Sine Bar, Gage Blocks, Surface Plate  Granite Master Square
	(5 to 20)°	2.4"	
	(20 to 35)°	3.8"	
	(35 to 45)°	5.1"	
	(45 to 60)°	8.5"	
	(60 to 75)°	18"	
	(75 to 85)° 90°	55" 1.7"	
Bubble Levels <sup>3</sup>	(0 to 140)"	3"	Gage Blocks
Micrometers and Calipers– Outside, Inside, Depth <sup>1,3</sup>	(0.05 to 1) in	13 μin	Gage Blocks, Long Blocks
	(1 to 9) in	(10 + 4L) μin	
	(5 to 15) in	(11 + 4.6L) μin	
	(15 to 40) in	(14 + 46L) μin	
Anvil Flatness <sup>1</sup>	Up to 1 in Diameter	4.7 μin	Optical Flats
Anvil Parallelism <sup>1</sup>	Up to 1 in	6.1 μin	Optical Parallels
Dial Indicators <sup>1,3</sup>	Up to 0.1 in	4.5 μin	Gage Blocks, Surface Plate
	(0.1 to 6) in	(4 + 4L) in	
Height Gages, Digital Indicators <sup>3</sup>	(0.05 to 1) in	(10 + 3L) μin	Gage Blocks, Long Blocks, Surface Plate
	(1 to 9) in	(12 + 4L) μin	
	(4 to 15) in	(11 + 4.6L) μin	
	(15 to 24) in	(14 + 4.6L) μin	
Length – Single Axis <sup>3</sup> Outside Dimension	Up to 1 in	(6 + 1L) μin	Universal Length Measuring Machine
	(1 to 7) in	(4 + 4L) μin	
	(7 to 12) in	(4.5L) μin	
	Inside Dimension	(10 + 1L) μin	
	(0.04 to 1) in	(9 + 4L) μin	
	(1 to 2.5) in	(12 + 4L) μin	
	(2.5 to 10) in	(26 + 3L) μin	
	(10 to 14) in		
Linear Dimensions – Two Axis (X-Y)	12 in x 12 in	320 μin	Vision System
Master 1-2-3 Blocks, Caliper Masters, Parallels <sup>3</sup>	Up to 6 in (6 to 24) in	(10 + 3L) μin (12 + 4L) μin	Gage Blocks, Surface Plate, Gage Amplifier



**Length – Dimensional Metrology**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Optical Comparators <sup>1,3</sup> X-Y Length	Up to 2 in (2 to 12) in	(42 + 36L) μin (75 + 27L) μin	Linear Glass Scale
Squareness	(0.001 to 10) in	(90 + 1L) μin	Glass Scale
Magnification	(10 to 50) X	(120 + 10L) μin	Magnification Checker
Parallelism, Straightness	Up to 12 in	20 μin	Gage Amplifier, Surface Plate
Cylindrical Plug Gages <sup>3</sup> Outside Diameter	Up to 1 in (1 to 7) in	12 μin (10 + 3.5L) μin	Universal Length Measuring Machine
Cylindrical Ring Gages <sup>3</sup> Inside Diameter	(0.4 to 1) in (1 to 2.5) in (2.5 to 10) in (10 to 14) in	(10 + 1L) μin (9 + 4L) μin (12 + 4L) μin (26 + 3L) μin	Universal Length Measuring Machine
Steel Rules	Up to 12 in	320 μin	Vision System
Surface Plates <sup>1,3</sup> Overall Flatness	Up to 168.4 inDL	1.7 √DL + 5.5 μin	In accordance with Fed Spec GGG-P-463 utilizing Electronic Levels
Local Area Flatness (Repeat Readings)	Up to 0.001 in	32 μin	Supramess Indicator
Thread Plug Gages <sup>3</sup> Pitch Diameter	Up to 1 in (1 to 4) in (4 to 7) in	79 μin 80 μin 84 μin	Thread Wires, Universal Length Measuring Machine
Major Diameter	Up to 1 in (1 to 7) in	13 μin (10 + 3.5L) μin	
Threaded Ring Pitch Diameter	Up to 1 in (1 to 4) in (4 to 7) in	79 μin 80 μin 84 μin	Comparison to Master Setting Plugs
Thread Wires	(2 to 120) TPI (0.008 33 to 0.5) in	12 μin	Universal Length Measuring Machine



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Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Durometers Spring Force Type A, B, E, O Type D, C, DO	Up to 100 Duro Up to 100 Duro	0.79 Duro 0.8 Duro	Durometer Calibrator
Indenter Length	Up to 1 in	320 µin	Vision System
Force Measuring Equipment	(10 to 100) gf	0.04 % of reading	ASTM E617 Class 2 Weights
Force Measuring Equipment	(0.2 to 500) lbf	0.025 % of reading + 0.001 lbf	NIST Class F Weights
Force Measuring Equipment	(500 to 1 000) lbf	0.58 lbf	Comparison to Master Load Cells
Mass – Measure	1 g to 1 kg (1 to 5.1) kg	18 mg 0.18 g	Mettler PR5003 DR Electronic Balance
Balances and Scales <sup>1,4</sup> (Metric)	Up to 500 mg (0.5 to 10) g 10 g to 3 kg (3 to 8) kg (8 to 13) kg (13 to 19) kg (19 to 27) kg (27 to 38) kg (38 to 40) kg	6 µg 22 µg 6 mg 8 mg 13 mg 16 mg 76 mg 77 mg 78 mg	SET 1: ASTM E617 Class 1 weights and internal calibration procedure utilized for the calibration of the weighing system.
Balances and Scales <sup>1,4</sup> (Metric)	Up to 500 mg (0.5 to 5) g (5 to 10) g (10 to 20) g 50 g to 3 kg (3 to 5) kg (5 to 10) kg (10 to 14) kg (14 to 19) kg (19 to 23) kg (23 to 26) kg (26 to 29) kg (29 to 33) kg (33 to 35) kg (35 to 40) kg	20 µg 40 µg 60 µg 90 µg 10 mg 15 mg 20 mg 34 mg 37 mg 76 mg 77 mg 78 mg 82 mg 83 mg 84 mg	SET 2: ASTM E617 Class 1 weights and internal calibration procedure utilized for the calibration of the weighing system.

**Mass and Mass Related**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Balances and Scales <sup>1,4</sup> Avoirdupois	Up to 1 lb (1 to 1 600) lb	0.024 % of reading 0.012 % of reading	NIST Class F weights and internal calibration procedure utilized for the calibration of the weighing system.
Metric	Up to 500 g 500 g to 726 kg	0.024 % of reading 0.012 % of reading	
Torque Devices <sup>1</sup>	(3 to 15) ozf·in (15 to 200) ozf·in (1 to 12.5) lbf·ft (12.5 to 600) lbf·ft (600 to 2 000) lbf·ft	1.7 % of reading + 0.006 ozf·in 0.44 % of reading + 0.3 ozf·in 0.44 % of reading 0.34 % of reading 1.3 % of reading	Torque Calibrator
Torque Calibration Equipment	(2.5 to 15) ozf·in (15 to 80) ozf·in	0.055 % of reading 0.06 % of reading	Torque Wheels, Weights
Torque Calibration Equipment	(0.42 to 50) lbf·ft (50 to 2 000) lbf·ft	0.06 % of reading 0.06 % of reading	Torque Arm, Weights
Absolute Pressure – Source	(0 to 30) psia (30 to 1 000) psia	0.002 4 psi 0.006 6 % of reading + 0.000 1 psi	Fluke/DHI RPM 4 Pressure Controller/Calibrator
Pressure – Source <sup>1</sup>	(0.14 to 25) psig	0.017 % of reading + 0.000 041 psi	Ametek RK-1000 WC Deadweight Tester
Pressure – Source	(-15 to 30) psig (30 to 1 000) psig	0.002 1 psi 0.006 6 % of reading + 0.000 1 psi	Fluke/DHI RPM 4 Pressure Controller/Calibrator
Pressure – Source <sup>1</sup> (Hydraulic)	(5 to 15 000) psig	0.018 % of reading	Fluke RPM4-E-DWT Deadweight Tester

**Thermodynamic**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Relative Humidity – Source	(-10 to 15) °C		Thunder Scientific 2500 Two-Pressure Humidity Generator
	(10 to 75) %RH	0.5 %RH	
	(75 to 95) %RH	0.65 %RH	
	(15 to 35) °C		
	(10 to 95) %RH	0.5 %RH	
	(35 to 70) °C		
	(50 to 70) %RH	0.7 %RH	
	(70 to 95) %RH	0.85 %RH	

### Thermodynamic

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Relative Humidity – Measure <sup>1</sup>	(10 to 30) °C (10 to 90) %RH (90 to 99) %RH	1.3 %RH 2.3 %RH	Vaisala HMI41/HMP46 Temperature/Humidity Indicator w/ Probe
Temperature – Measure <sup>1</sup>	(-196 to 0) °C (0 to 420) °C (420 to 660) °C	0.011 °C 0.026 °C 0.035 °C	AccuMac AM1760 Secondary SPRT, Black Stack Indicator
Temperature – Measure <sup>1</sup>	(660 to 1 000) °C (1 000 to 1 200) °C	0.93 °C 1.2 °C	AccuMac AM1210 Type S Thermocouple Reference Standard, Black Stack Indicator
Temperature – Source	(-20 to 120) °C	0.028 °C	Comparison to RTD Probe, Temperature Indicator; Liquid Bath
Temperature – Source	(120 to 600) °C	0.13 °C	Comparison to RTD Probe, Temperature Indicator; Dry-block Calibrator
Infrared Measuring Devices	(-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	0.98 °C 0.67 °C 0.71 °C 0.77 °C 0.94 °C 1.7 °C 2.1 °C	Hart Black Body (flat plate) $\epsilon = (0.1 \text{ to } 1)$ , $\lambda = (8 \text{ to } 14) \mu\text{m}$

### Time and Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Frequency – Source/Measure <sup>5</sup>	10 MHz	6.4 nHz/Hz	SRS FS725 Rubidium Frequency Standard
Frequency – Source/Measure <sup>1</sup>	30 Hz to 225 MHz	2.1 $\mu$ Hz/Hz	HP 53131A (10) Frequency Counter, SRS FS725 Rubidium Frequency Standard
Time – Measure <sup>1</sup>	Up to 599 s/month	58 ms/d	Vibrograf 4500 Timometer

**Time and Frequency**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Duty Cycle – Source <sup>1</sup> Square Wave: < 3.3 Vp-p Freq: 0.1 Hz to 100 kHz	(1 to 10) % Duty Cycle 10 μs to 100 s	0.62 % of reading + 78 ns	Fluke 5522A Multiproduct Calibrator
	(10 to 49) % Duty Cycle 10 μs to 100 s	0.039 % of reading + 78 ns	
	50 % Duty Cycle 10 μs to 100 s	0.001 6 % of reading + 78 ns	
	(51 to 90) % Duty Cycle 10 μs to 100 s	0.039 % of reading + 78 ns	
	(90 to 99) % Duty Cycle 10 μs to 100 s	0.62 % of reading + 78 ns	

Calibration and Measurement Capability (CMC) is expressed in terms of the measurement parameter, measurement range, expanded uncertainty of measurement and reference standard, method, and/or equipment. The expanded uncertainty of measurement is expressed as the standard uncertainty of the measurement multiplied by a coverage factor of 2 ( $k=2$ ), corresponding to a confidence level of approximately 95%.

Notes:

1. On-site calibration service is available for this parameter, since on-site conditions are typically more variable than those in the laboratory, larger measurement uncertainties are expected on-site than what is reported on the accredited scope.
2. The stated uncertainty is the laboratory’s ability to source a fast rise pulse that is approximately 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.
3.  $L$  = length in inches;  $DL$  = diagonal length in inches; " = arc-second.
4. 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.
5. As frequency & amplitude deviate from the listed values, uncertainty may be higher than stated. If needed, contact laboratory for more information regarding uncertainties at frequency and range combinations other than the ones shown.
6. The uncertainties shown are for the most favorable conditions. There is an increase in uncertainty that corresponds to the laboratory’s AC voltage and current uncertainties at different frequencies other than the ones shown. Power factors (PF) other than the one shown contribute to the power uncertainty. PF is related to the cosine of phase. Therefore, uncertainties track the laboratory’s phase uncertainty closely at PF near one but are magnified heavily as PF approaches zero. The lab may also report reactive power, apparent power, and power factor under this accreditation. If needed, contact the laboratory for more information regarding uncertainties at frequency and power factor combinations other than the ones shown.
7. The legal entity for this location is Transcat, Inc.
8. This scope is formatted as part of a single document including Certificate of Accreditation No. AC-2489.01.



Jason Stine, Vice President