



# CERTIFICATE OF ACCREDITATION

**The ANSI National Accreditation Board**

Hereby attests that

**Transcat - Ottawa**  
**4043 Carling Avenue, Suite 110**  
**Ottawa, ON K2K 2A4 Canada**

Fulfills the requirements of

**ISO/IEC 17025:2017**

and the national standards

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

In the 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 'Jason Stine', is positioned above a horizontal line.

Jason Stine, Vice President

Expiry Date: 07 September 2025  
Certificate Number: AC-2489.24



This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017.  
This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory  
quality management system (refer to joint ISO-ILAC-IAF Communiqué dated April 2017).

**SCOPE OF ACCREDITATION TO ISO/IEC 17025:2017**

**AND**

**ANSI/NCSL Z540-1-1994 (R2002)**

**ANSI/NCSL Z540.3-2006 (R2013)**

**Transcat - Ottawa**

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**CALIBRATION**

Valid to: **September 7, 2025**

Certificate Number: **AC-2489.24**

**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 5700A-EP Multiproduct Calibrator, Fluke 5725A Amplifier
	(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		



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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>	(0.22 to 2.2) A 20 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (2.2 to 11) A 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.027 % of reading + 35 µA 0.046 % of reading + 80 µA 0.7 % of reading + 0.16 mA 0.048 % of reading + 0.17 mA 0.096 % of reading + 0.38 mA 0.36 % of reading + 0.75 mA	Fluke 5700A-EP 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	0.095 % of reading + 3.9 mA 0.12 % of reading + 3.9 mA 2.3 % of reading + 3.9 mA	Multiproduct Calibrator
AC Current – Source <sup>1</sup> Extended Frequency Range	(29 to 330) µA (10 to 30) kHz (0.33 to 3.3) mA (10 to 30) kHz (3.3 to 33) mA (10 to 30) kHz (33 to 330) mA (10 to 30) kHz	1.2 % of reading + 0.31 µA 0.78 % of reading + 0.47 µA 0.31 % of reading + 3.1 µA 0.31 % of reading + 0.16 mA	Multiproduct Calibrator
AC Clamp-on Ammeters <sup>1</sup> (Toroidal Type) Transformer Type Sensor	(20.5 to 150) A (45 to 65) Hz (65 to 440) Hz (150 to 1 025) A (45 to 65) Hz (65 to 440) Hz	0.3 % of reading + 26 mA 0.83 % of reading + 47 mA 0.35 % of reading + 0.12 A 1.1 % of reading + 0.22 A	Multiproduct Calibrator, 50-turn Coil
AC Clamp-on Ammeters <sup>1</sup> (Non-Toroidal Type) Hall Effect Sensor	(20.5 to 150) A (45 to 65) Hz (65 to 440) Hz (150 to 1 025) A (45 to 65) Hz (65 to 440) Hz	0.57 % of reading + 0.25 A 1 % of reading + 0.25 A 0.6 % of reading + 0.9 A 1.3 % of reading + 0.92 A	Multiproduct Calibrator, 50-turn Coil

**Electrical – DC/Low Frequency**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current – Measure <sup>1</sup>	Up to 100 $\mu$ A		Keysight 3458A 8.5 Digit Multimeter
	(10 to 20) Hz	0.46 % of reading + 35 nA	
	(20 to 45) Hz	0.17 % of reading + 35 nA	
	(45 to 100) Hz	0.072 % of reading + 35 nA	
	100 Hz to 5 kHz	0.072 % of reading + 35 nA	
	100 $\mu$ A to 1 mA		
	(10 to 20) Hz	0.46 % of reading + 0.23 $\mu$ A	
	(20 to 45) Hz	0.17 % of reading + 0.23 $\mu$ A	
	(45 to 100) Hz	0.071 % of reading + 0.23 $\mu$ A	
	100 Hz to 5 kHz	0.038 % of reading + 0.23 $\mu$ A	
	(1 to 10) mA		
	(10 to 20) Hz	0.46 % of reading + 2.3 $\mu$ A	
	(20 to 45) Hz	0.17 % of reading + 2.3 $\mu$ A	
	(45 to 100) Hz	0.071 % of reading + 2.3 $\mu$ A	
	100 Hz to 5 kHz	0.038 % of reading + 2.3 $\mu$ A	
	(10 to 100) mA		
(10 to 20) Hz	0.48 % of reading + 23 $\mu$ A		
(20 to 45) Hz	0.17 % of reading + 23 $\mu$ A		
(45 to 100) Hz	0.071 % of reading + 23 $\mu$ A		
100 Hz to 5 kHz	0.037 % of reading + 23 $\mu$ A		
100 mA to 1 A			
(10 to 20) Hz	0.46 % of reading + 0.23 mA		
(20 to 45) Hz	0.19 % of reading + 0.23 mA		
(45 to 100) Hz	0.097 % of reading + 0.23 mA		
100 Hz to 5 kHz	0.12 % of reading + 0.23 mA		
AC Current – Measure <sup>1</sup>	(1 to 2) A		Yokogawa WT310EH Digital Power Analyzer
	(10 to 45) Hz	0.12 % of reading + 4 mA	
	(45 to 66) Hz	0.12 % of reading + 1 mA	
	66 Hz to 1 kHz	0.12 % of reading + 4 mA	
	(2 to 5) A		
	(10 to 45) Hz	0.13 % of reading + 10 mA	
	(45 to 66) Hz	0.13 % of reading + 2.5 mA	
	66 Hz to 1 kHz	0.13 % of reading + 10 mA	
	(5 to 10) A		
	(10 to 45) Hz	0.13 % of reading + 20 mA	
	(45 to 66) Hz	0.13 % of reading + 5 mA	
	66 Hz to 1 kHz	0.13 % of reading + 20 mA	

**Electrical – DC/Low Frequency**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current – Measure <sup>1</sup>	(10 to 20) A (10 to 45) Hz (45 to 66) Hz 66 Hz to 1 kHz	0.16 % of reading + 40 mA 0.16 % of reading + 10 mA 0.18 % of reading + 40 mA	Yokogawa WT310EH Digital Power Analyzer
	(20 to 40) A (10 to 45) Hz (45 to 66) Hz 66 Hz to 1 kHz	0.2 % of reading + 80 mA 0.2 % of reading + 20 mA 0.23 % of reading + 80 mA	
DC Current – Source <sup>1</sup>	(0 to 220) $\mu$ A (0.22 to 2.2) mA (2.2 to 22) mA (22 to 220) mA (0.22 to 2.2) A (2.2 to 11) A	0.004 % of reading + 6 nA 0.003 6 % of reading + 7 nA 0.003 5 % of reading + 40 nA 0.004 8 % of reading + 0.7 $\mu$ A 0.002 % of reading + 12 $\mu$ A 0.004 % of reading + 0.48 mA	Fluke 5700A-EP Multiproduct Calibrator, Fluke 5725A Amplifier
DC Current – Source <sup>1</sup>	(11 to 20.5) A	0.093 % of reading + 0.58 mA	Multiproduct Calibrator
DC Clamp-on Ammeters <sup>1</sup> (Non-Toroidal Type)	(20 to 150) A (150 to 1 000) A	0.51 % of reading + 0.14 A 0.51 % of reading + 0.5 A	Multiproduct Calibrator, 50-turn Coil
DC Current – Measure <sup>1</sup>	(0 to 100) $\mu$ A (0.1 to 1) mA (1 to 10) mA (10 to 100) mA (0.1 to 1) A	0.003 3 % of reading + 0.92 nA 0.002 9 % of reading + 5.8 nA 0.002 9 % of reading + 58 nA 0.004 6 % of reading + 0.58 $\mu$ A 0.013 % of reading + 12 $\mu$ A	Keysight 3458A 8.5 Digit Multimeter
DC Current – Measure <sup>1</sup>	(1 to 50) A	0.03 % of reading	Yokogawa 2792A Standard Resistor Set, Keysight 3458A 8.5 Digit Multimeter
DC Current – Measure <sup>1</sup>	(50 to 100) A	0.3 % of reading	Empro HA-100-50 Current Shunt, Keysight 3458A 8.5 Digit Multimeter
DC Current – Measure <sup>1</sup>	(100 to 1 000) A	0.2 % of reading	Empro LAB-1000-50 Current Shunt, Keysight 3458A 8.5 Digit Multimeter



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Source <sup>1</sup>	Up to 2.2 mV		Fluke 5700A-EP Multiproduct Calibrator
	(10 to 20) Hz	0.16 % of reading + 4 μV	
	(20 to 40) Hz	0.1 % of reading + 4 μV	
	40 Hz to 20 kHz	0.078 % of reading + 4 μV	
	(20 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	0.008 5 % 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	0.004 8 % 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	0.01 % of reading + 0.2 mV		
500 kHz to 1 MHz	0.18 % of reading + 0.3 mV		



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Electrical – DC/Low Frequency

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 0.005 % of reading + 50 μV 0.0083 % of reading + 0.1 mV 0.012 % of reading + 0.2 mV 0.03 % of reading + 0.6 mV 0.11 % of reading + 2 mV 0.17 % of reading + 3.2 mV 0.028 % of reading + 4 mV 0.01 % of reading + 1.5 mV 0.0057 % of reading + 0.6 mV 0.0093 % of reading + 1 mV 0.017 % of reading + 2.5 mV 0.091 % of reading + 16 mV 0.44 % of reading + 40 mV 0.8 % of reading + 80 mV	Fluke 5700A-EP Multiproduct Calibrator
AC Voltage – Source <sup>1</sup>	(220 to 1100) V 40 Hz to 1 kHz (1 to 20) kHz (20 to 30) kHz	0.011 % of reading + 4 mV 0.017 % of reading + 6 mV 0.061 % of reading + 11 mV	Fluke 5700A-EP Multiproduct Calibrator, Fluke 5725A Amplifier
AC Voltage – Source <sup>1</sup> Extended Frequency Ranges	220 V to 750 V (30 to 50) kHz (50 to 100) kHz	0.061 % of reading + 11 mV 0.23 % of reading + 45 mV	Fluke 5700A-EP 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	0.039 % of reading + 3.5 μV 0.029 % of reading + 1.2 μV 0.039 % of reading + 1.2 μV 0.15 % of reading + 1.2 μV 0.59 % of reading + 1.2 μV 4.7 % of reading + 2.3 μV 1.5 % of reading + 5.8 μV 8.1 % of reading + 8.1 μV	Keysight 3458A 8.5 Digit Multimeter



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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) mV		Keysight 3458A 8.5 Digit Multimeter
	(1 to 40) Hz	0.013 % of reading + 4.6 μV	
	40 Hz to 1 kHz	0.009 5 % of reading + 2.3 μV	
	(1 to 20) kHz	0.017 % of reading + 2.3 μV	
	(20 to 50) kHz	0.037 % 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	1.9 % 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	0.009 8 % of reading + 46 μV	
	40 Hz to 1 kHz	0.009 4 % 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	1.9 % of reading + 0.12 mV	
	(2 to 4) MHz	4.7 % of reading + 0.81 mV	
	(4 to 8) MHz	4.7 % 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	0.009 5 % 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	1.7 % of reading + 1.2 mV		
(1 to 2) MHz	1.8 % of reading + 1.2 mV		
(2 to 4) MHz	4.7 % of reading + 8.1 mV		
(4 to 8) MHz	4.7 % of reading + 9.3 mV		
(8 to 10) MHz	17 % of reading + 12 mV		



**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 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 (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 0.042 % 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	Keysight 3458A 8.5 Digit Multimeter
AC High Voltage – Measure <sup>1</sup>	(0.7 to 10) kV (10 to 200) Hz (200 to 450) Hz (10 to 70) kV (30 to 70) Hz (70 to 200) Hz	0.14 % of reading + 0.12 V 0.46 % of reading + 0.12 V 0.14 % of reading + 0.7 V 1.2 % of reading + 0.7 V	Vitrek 4700 Digital High Voltage Meter w/ HVL-100 Probe
DC Voltage – Source <sup>1</sup>	(0 to 220) mV (0.22 to 2.2) V (2.2 to 11) V (11 to 22) V (22 to 220) V (220 to 1 100) V	0.000 9 % of reading + 0.44 μV 0.000 5 % of reading + 0.7 μV 0.000 4 % of reading + 2.5 μV 0.000 4 % of reading + 4 μV 0.000 6 % of reading + 40 μV 0.000 8 % of reading + 0.4 mV	Fluke 5700A-EP Multiproduct Calibrator
DC Voltage – 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	0.000 8 % of reading + 0.58 μV 0.000 5 % of reading + 0.58 μV 0.000 5 % of reading + 0.58 μV 0.000 8 % of reading + 35 μV 0.001 5 % of reading + 0.12 mV 0.001 8 % of reading + 0.12 mV 0.002 1 % of reading + 0.12 mV	Keysight 3458A 8.5 Digit Multimeter
DC High Voltage – Measure <sup>1</sup>	(1 to 10) kV (10 to 100) kV	0.038 % of reading + 35 mV 0.063 % of reading + 0.35 V	Vitrek 4700 Digital High Voltage Meter w/ HVL-100 Probe

**Electrical – DC/Low Frequency**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Capacitance – Source <sup>1</sup> (Simulation)	10 Hz to 10 kHz (0.22 to 1.1) nF	0.4 % of reading + 7.8 pF	Multiproduct Calibrator
	10 Hz to 3 kHz (1.1 to 3.3) nF	0.4 % of reading + 7.8 pF	
	10 Hz to 1 kHz (3.3 to 11) nF	0.21 % of reading + 7.8 pF	
	(11 to 33) nF	0.2 % of reading + 78 pF	
	(33 to 110) nF	0.21 % of reading + 78 pF	
	(110 to 330) nF	0.2 % of reading + 0.23 nF	
	(10 to 600) Hz (0.33 to 1.1) μF	0.21 % of reading + 0.78 nF	
	(10 to 300) Hz (1.1 to 3.3) μF	0.21 % of reading + 2.3 nF	
	(10 to 150) Hz (3.3 to 11) μF	0.2 % of reading + 7.8 nF	
	(10 to 120) Hz (11 to 33) μF	0.32 % of reading + 23 nF	
	(10 to 80) Hz (33 to 110) μF	0.37 % of reading + 78 nF	
	DC to 50 Hz (110 to 330) μF	0.38 % of reading + 0.23 μF	
	DC to 20 Hz (0.33 to 1.1) mF	0.35 % of reading + 0.78 μF	
	DC to 6 Hz (1.1 to 3.3) mF	0.35 % of reading + 2.3 μF	
	DC to 2 Hz (3.3 to 11) mF	0.35 % of reading + 7.8 μF	
	DC to 0.6 Hz (11 to 33) mF	0.58 % of reading + 23 μF	
	DC to 0.2 Hz (33 to 110) mF	0.85 % of reading + 78 μF	
	Capacitance – Source <sup>1</sup> (Fixed Artifacts)	1 kHz	
0.001 μF		0.065 % of reading	
0.01 μF		0.063 % of reading	
0.05 μF		0.063 % of reading	
0.1 μF		0.063 % of reading	
	1 μF	0.063 % of reading	

**Electrical – DC/Low Frequency**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Resistance – Source <sup>1</sup> (Simulation)	1 Ω	98 μΩ	Fluke 5700A-EP Multiproduct Calibrator
	1.9 Ω	0.18 mΩ	
	10 Ω	0.24 mΩ	
	19 Ω	0.48 mΩ	
	100 Ω	1.1 mΩ	
	190 Ω	2.1 mΩ	
	1 kΩ	9.4 mΩ	
	1.9 kΩ	18 mΩ	
	10 kΩ	94 mΩ	
	19 kΩ	0.18 Ω	
	100 kΩ	1.2 Ω	
	190 kΩ	2.3 Ω	
	1 MΩ	22 Ω	
	1.9 MΩ	44 Ω	
	10 MΩ	0.43 kΩ	
19 MΩ	0.93 kΩ		
100 MΩ	10.8 kΩ		
Resistance – Source <sup>1</sup> (Fixed Artifacts)	100 μΩ	0.1 μΩ	Standard Resistors
	500 μΩ	1.3 μΩ	
	1 mΩ	0.13 μΩ	
	10 mΩ	1.2 μΩ	
	100 mΩ	10 μΩ	
Resistance – Source <sup>1</sup> (Variable Artifact)	(10 to 100) MΩ	0.08 % of reading	IET HRRS-B-100K-5KV Standard Decade Resistor
	(0.1 to 1) GΩ	0.24 % of reading	
	(1 to 10) GΩ	0.41 % of reading	
	(10 to 100) GΩ	0.84 % of reading	
	(0.1 to 1) TΩ	2.5 % of reading	
Resistance – Source/Measure <sup>1</sup>	(0 to 10) Ω	0.001 8 % of reading + 58 μΩ	Keysight 3458A 8.5 Digit Multimeter, Standard Decade Resistors
	(10 to 100) Ω	0.001 5 % of reading + 0.58 mΩ	
	(0.1 to 1) kΩ	0.001 2 % of reading + 0.58 mΩ	
	(1 to 10) kΩ	0.001 2 % of reading + 5.8 mΩ	
	(10 to 100) kΩ	0.001 2 % of reading + 58 mΩ	
	(0.1 to 1) MΩ	0.002 % of reading + 2.3 Ω	
	(1 to 10) MΩ	0.006 % of reading + 0.12 kΩ	
	(10 to 100) MΩ	0.059 % of reading + 1.2 kΩ	
(0.1 to 1) GΩ	0.58 % of reading + 12 kΩ		

**Electrical – DC/Low Frequency**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Phase – Source <sup>1</sup>	(0.01 to 179.99) ° (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 °	Multiproduct 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 to 110) mW 110 mW to 110 W (110 to 330) W (11 to 110) mW (110 to 990) mW 990 mW to 3 kW (99 to 990) mW 0.99 W to 6.8 kW 6.8 W 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 0.01 % of reading 0.088 % of reading 0.07 % of reading 0.04 % of reading	Multiproduct Calibrator
AC Power – Source <sup>1,3</sup> PF = 1 (10 to 65) Hz	(3.3 to 9) mA 110 μW to 3 mW 3 mW to 9 W (9 to 33) mA 300 μW to 10 mW 10 mW to 33 W (33 to 90) mA (1 to 30) mW 30 mW to 90 W (90 to 330) mA (3 to 100) mW 100 mW to 300 W (0.33 to 0.9) A (11 to 300) mW 300 mW to 900 W (0.9 to 2.2) A 30 mW to 0.72 W 0.72 W to 2 kW (2.2 to 4.5) A 80 mW to 1.4 W 1.4 W to 4.5 kW (4.5 to 20.5) A (0.15 to 6.7) W 6.7 W to 20 kW	0.13 % of reading 0.077 % of reading 0.089 % of reading 0.077 % of reading 0.071 % of reading 0.057 % of reading 0.089 % of reading 0.078 % of reading 0.071 % of reading 0.081 % of reading 0.089 % of reading 0.079 % of reading 0.09 % of reading 0.18 % of reading 0.17 % of reading 0.17 % of reading	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 °C	
	(350 to 445) °C	0.77 °C	
	(445 to 580) °C	0.61 °C	
	(580 to 750) °C	0.47 °C	
	(750 to 1 000) °C	0.39 °C	
	(1 000 to 1 820) °C	0.31 °C	
	Type C		
	(0 to 250) °C	0.21 °C	
	(250 to 1 000) °C	0.17 °C	
	(1 000 to 1 500) °C	0.19 °C	
	(1 500 to 1 800) °C	0.22 °C	
	(1 800 to 2 000) °C	0.24 °C	
	(2 000 to 2 250) °C	0.3 °C	
	(2 250 to 2 315) °C	0.33 °C	
	Type E		
	(-270 to -245) °C	2.1 °C	
	(-245 to -195) °C	0.2 °C	
	(-195 to -155) °C	0.11 °C	
	(-155 to -90) °C	0.09 °C	
	(-90 to 0) °C	0.08 °C	
	(0 to 15) °C	0.08 °C	
	(15 to 890) °C	0.07 °C	
	(890 to 1 000) °C	0.08 °C	
Type J			
(-210 to -180) °C	0.13 °C		
(-180 to -120) °C	0.11 °C		
(-120 to -50) °C	0.09 °C		
(-50 to 990) °C	0.08 °C		
(990 to 1 200) °C	0.08 °C		
Type K			
(-270 to -255) °C	2.3 °C		
(-255 to -195) °C	0.73 °C		
(-195 to -115) °C	0.14 °C		
(-115 to -55) °C	0.1 °C		
(-55 to 1 000) °C	0.08 °C		
(1 000 to 1 372) °C	0.09 °C		

**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 N		Ectron 1140A Thermocouple Calibrator/Simulator
	(-270 to -260) °C	5.1 °C	
	(-260 to -200) °C	1.1 °C	
	(-200 to -140) °C	0.25 °C	
	(-140 to -70) °C	0.16 °C	
	(-70 to 25) °C	0.13 °C	
	(-25 to 160) °C	0.11 °C	
	(160 to 1 300) °C	0.1 °C	
	Type R		
	(-50 to -30) °C	0.68 °C	
	(-30 to 45) °C	0.58 °C	
	(45 to 160) °C	0.42 °C	
	(160 to 380) °C	0.31 °C	
	(380 to 775) °C	0.28 °C	
	(775 to 1 768) °C	0.23 °C	
	Type S		
	(-50 to -30) °C	0.65 °C	
	(-30 to 45) °C	0.59 °C	
	(45 to 105) °C	0.42 °C	
	(105 to 310) °C	0.35 °C	
(310 to 615) °C	0.31 °C		
(615 to 1 768) °C	0.27 °C		
Type T			
(-270 to -255) °C	1.8 °C		
(-255 to -240) °C	0.52 °C		
(-240 to -210) °C	0.32 °C		
(-210 to -150) °C	0.19 °C		
(-150 to -40) °C	0.13 °C		
(-40 to 100) °C	0.09 °C		
(100 to 400) °C	0.08 °C		
Oscilloscopes <sup>1,4</sup> Amplitude – DC into 50 Ω load into 1 MΩ load	(-6 to 6) V (-130 to 130) V	0.22 % of reading + 31 μV 0.12 % of reading + 31 μV	Multiproduct Calibrator with 1.1 GHz Scope Option



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment	
Oscilloscopes <sup>1,4</sup> Amplitude – Square Wave into 50 Ω load	10 Hz to 100 kHz 1 mV p-p to 6.6 V p-p	0.22 % of reading + 31 μV	Multiproduct Calibrator with 1.1 GHz Scope Option	
	into 1 MΩ load	10 Hz to 1 kHz 1 mV p-p to 6.6 V p-p		0.14 % of reading + 31 μV
		(1 kHz to 10) kHz 1 mV p-p to 6.6 V p-p		0.22 % of reading + 31 μV
	Time Markers into 50 Ω load	1 ns to 20 ms		0.000 22 % of reading
		50 ms		0.005 9 % of reading
		0.1 s		0.009 8 % of reading
		0.2 s		0.018 % of reading
		0.5 s		0.041 % of reading
		1 s		0.08 % of reading
		2 s		0.16 % of reading
5 s		0.39 % of reading		
Rise Time into 50 Ω load	5 mV p-p to 2.5 V p-p	50 ps		
	Rate: 1 kHz to 2 MHz Rate: (2 to 10) MHz		50 ps	
Leveled Sine Wave into 50 Ω load	5 mV p-p to 5 V p-p 50 kHz	1.8 % of reading + 0.2 mV		
	50 kHz to 100 MHz	2.8 % of reading + 0.2 mV		
	(100 to 300) MHz	3.2 % of reading + 0.2 mV		
	(300 to 600) MHz	4 % of reading + 0.2 mV		
	5 mVp-p to 3.5 mVp-p (600 to 1 100) MHz	5.5 % of reading + 0.23 mV		
Bandwidth/Flatness (50 kHz Reference) into 50 Ω load	5 mV p-p to 5.5 V p-p 50 kHz to 100 MHz	1.4 % of reading + 78 μV		
	(100 to 300) MHz	1.8 % of reading + 78 μV		
	(300 to 600) MHz	3.2 % of reading + 78 μV		
	5 mV p-p to 3.5 V p-p (600 to 1 100) MHz	4 % of reading + 78 μV		

**Electrical – DC/Low Frequency**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Oscilloscopes <sup>1,4</sup> Input Impedance – Measure	(40 to 60) $\Omega$ (0.5 to 1.5) M $\Omega$	0.082 % of reading 0.081 % of reading	Multiproduct Calibrator with 1.1 GHz Scope Option
Input Capacitance – Measure	(5 to 50) pF	3.9 % of reading + 0.4 pF	
Waveform Generator (Sine, Square, Triangle) Amplitude into 50 $\Omega$ load into 1 M $\Omega$ load	10 Hz to 10 kHz 1.8 mV p-p to 2.5 V p-p 1.8 mV p-p to 55 V p-p	2.3 % of reading + 78 $\mu$ V 2.3 % of reading + 78 $\mu$ V	
Frequency	10 Hz to 10 kHz	0.002 % of reading + 12 mHz	

**Length – Dimensional Metrology**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Micrometers <sup>1,2,6</sup> Outside, Inside, Depth	Up to 0.05 in (0.05 to 0.45) in (0.45 to 1) in (1 to 4) in (4 to 40) in	7.5 $\mu$ in (7 + 7L) $\mu$ in (5 + 12L) $\mu$ in (2 + 15L) $\mu$ in (9 + 16L) $\mu$ in	Gage Blocks, Long Gage Blocks
Anvil Flatness	Up to 1 in <i>D</i> (0 to 100) $\mu$ in	6.3 $\mu$ in	Optical Flat
Calipers <sup>1,2,6</sup> Outside, Inside, Depth	Up to 0.05 in (0.05 to 0.45) in (0.45 to 1) in (1 to 4) in (4 to 40) in	7.5 $\mu$ in (7 + 7L) $\mu$ in (5 + 12L) $\mu$ in (2 + 15L) $\mu$ in (9 + 16L) $\mu$ in	Gauge Blocks, Long Gauge Blocks, Ring Gauges
Dial Indicators <sup>1,2,6</sup>	Up to 0.45 in (0.45 to 1) in (1 to 4) in (4 to 6) in	(18 + 3L) $\mu$ in (15 + 8L) $\mu$ in (9 + 14L) $\mu$ in (9 + 16L) $\mu$ in	Gauge Blocks, Dial Indicator Tester
Height Measuring Devices <sup>1,2,6</sup>	Up to 0.45 in (0.45 to 1) in (1 to 4) in (4 to 24) in	(48 + 1L) $\mu$ in (46 + 4L) $\mu$ in (40 + 10L) $\mu$ in (21 + 15L) $\mu$ in	Gage Blocks, Long Gage Blocks, Surface Plate



**Mass and Mass Related**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Force Gauges (Push/Pull) Tension	(1 to 400) lbf	0.013 % of reading	NIST Class F Weights
Compression	(1 to 200) lbf	0.013 % of reading	
Torque Tools <sup>5</sup>	(20 to 100) ozf·in 4 lbf·in to 600 lbf·ft	0.6 % of reading + 0.06 ozf·in 0.51 % of reading	CDI Torque Calibration System
Balances <sup>1,6</sup>	1 mg to 500 mg 500 mg to 5 g (5 to 10) g (10 to 50) g (50 to 500) g 500 g to 30 kg (30 to 50) kg (50 to 60) kg (60 to 75) kg (75 to 95) kg	0.012 mg 0.041 mg 0.061 mg 0.094 mg 0.000 31 % of reading 0.000 33 % of reading 110 g 130 g 140 g 140 g	ASTM E617 Class 1 weights and internal calibration procedure utilized in the calibration of the weighing system.
Balances/Scales <sup>1,6</sup>	(1 to 400) lb	0.012 % of reading	NIST Class F weights and internal calibration procedure utilized in the calibration of the weighing system.
Pneumatic Absolute Pressure Devices <sup>1</sup>	Up to 7.5 psia (7.5 to 15) psia (15 to 24.7) psia (24.7 to 29.7) psia (29.7 to 48) psia (48 to 114.7) psia (114.7 to 179.7) psia (179.7 to 514.7) psia (514.7 to 1 015) psia	0.000 75 psi 0.01 % of reading 0.001 7 psi 0.002 1 psi 0.003 psi 0.008 1 % of reading 0.013 psi 0.008 % of reading 0.01 % of reading	Mensor CPC6050 Pressure Controller
Pneumatic Vacuum Devices <sup>1</sup>	(-15 to 0) psiv	0.000 75 psi	Mensor CPC6050 Pressure Controller
Pneumatic Gauge Pressure Devices <sup>1</sup>	Up to 7 inH <sub>2</sub> O	0.003 inH <sub>2</sub> O	Mensor CPC6050 Pressure Controller
Pneumatic Gauge Pressure Devices <sup>1</sup>	(7 to 40) inH <sub>2</sub> O	0.002 3 inH <sub>2</sub> O	Fluke P3012 Deadweight Tester
Pneumatic Gauge Pressure Devices <sup>1</sup>	(1.444 to 14.5) psig	0.006 % of reading	Fluke P3012 Deadweight Tester
Pneumatic Gauge Pressure Devices <sup>1</sup>	(14.5 to 15) psig	0.01 % of reading	Mensor CPC6050 Pressure Controller

**Mass and Mass Related**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Pneumatic Gauge Pressure Devices <sup>1</sup>	(15 to 33) psig (33 to 100) psig (100 to 165) psig (165 to 500) psig (500 to 1 000) psig	0.002 7 psi 0.008 % of reading 0.013 psi 0.008 % of reading 0.01 % of reading	Mensor CPC6050 Pressure Controller
Hydraulic Gauge Pressure Devices <sup>1</sup>	(10 to 50) psig (50 to 500) psig (500 to 1 000) psig (1 000 to 10 000) psig	0.004 psi 0.007 9 % of reading 0.08 psi 0.008 2 % of reading	Cosa W2200-3-P Deadweight Tester

**Thermodynamic**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Dial/Digital Thermometers, PRT, RTD, Thermistor <sup>1</sup>	(-80 to 0) °C (0 to 150) °C (150 to 300) °C (300 to 660) °C	0.018 °C 0.033 °C 0.042 °C 0.24 °C	Liquid Baths, Drywell Calibrators, Hart 5628 Secondary Standard PRT with Blackstack
Dial/Digital Thermometers, PRT, RTD, Thermistor <sup>1</sup>	0.01 °C	0.001 8 °C	Triple Point of Water Cell
Drywell Calibrators, Liquid Baths, Temperature Controlled Chambers <sup>1</sup>	(-195 to 0) °C (0 to 420) °C (420 to 660) °C	0.012 °C 0.026 °C 0.037 °C	Hart 5628 Secondary Standard PRT, Blackstack
Drywell Calibrators, Liquid Baths, Temperature Controlled Chambers <sup>1</sup>	(660 to 800) °C (800 to 950) °C (950 to 1 200) °C	1.1 °C 1.3 °C 1.6 °C	Type S Reference Thermocouple Probe, Digital Readout
Thermocouple Wires and Probes <sup>1</sup> (Types E, J, K, N, R, S, T only)	(-80 to 0) °C (0 to 100) °C (100 to 150) °C (150 to 300) °C (300 to 660) °C	0.22 °C 0.22 °C 0.26 °C 0.41 °C 0.74 °C	Liquid Baths, Drywell Calibrators, Hart 5628 Secondary Standard PRT with Blackstack, and Ectron 1140A or equivalent standard.
Thermocouple Wires and Probes <sup>1</sup> (Types E, J, K, N, R, S, T only)	(660 to 800) °C (800 to 950) °C (950 to 1 200) °C	1.7 °C 2 °C 2.3 °C	Drywell Calibrators, Type S Reference Thermocouple Probe, Digital Readout

**Thermodynamic**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Infrared Thermometers	(-15 to 0) °C (0 to 50) °C (50 to 100) °C	0.79 °C 0.53 °C 0.68 °C	Fluke 4180 Blackbody Source (flat plate) $\lambda = (8 \text{ to } 14) \mu\text{m}$ , $\epsilon = (0.9 \text{ to } 1)$
Infrared Thermometers	(100 to 120) °C (120 to 200) °C (200 to 350) °C (350 to 500) °C	0.75 °C 0.98 °C 1.7 °C 2.3 °C	Fluke 4181 Blackbody Source (flat plate) $\lambda = (8 \text{ to } 14) \mu\text{m}$ , $\epsilon = (0.9 \text{ to } 1)$
Humidity – Measuring Devices	(0 to 15) °C (10 to 75) %RH (75 to 95) %RH (15 to 35) °C (10 to 95) %RH (35 to 70) °C (10 to 50) %RH (50 to 75) %RH (75 to 95) %RH	0.5 %RH 0.65 %RH 0.5 %RH 0.5 %RH 0.7 %RH 0.85 %RH	Thunder Scientific 2500 Two Pressure Generation System
Humidity Controlled Chambers <sup>1</sup>	(0 to 15) °C (10 to 95) %RH (15 to 25) °C (10 to 90) %RH (90 to 95) %RH (25 to 40) °C (10 to 95) %RH (40 to 85) °C (10 to 50) %RH (50 to 95) %RH	2.5 %RH 1.3 %RH 2 %RH 2.2 %RH 2.6 %RH 3.5 %RH	Vaisala HM70/HMP77 Temp/Humidity Indicator/Probe

**Time and Frequency**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Frequency – Source	10 MHz	0.59 nHz	Rubidium Frequency Oscillator
Frequency – Source	1 $\mu\text{Hz}$ to 80 MHz	2.3 $\mu\text{Hz}/\text{Hz}$	Function/Arbitrary Waveform Generator or equivalent

**Time and Frequency**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Frequency – Measure <sup>1</sup>	10 MHz	2.3 nHz	Keysight 53132A Universal Counter
Timer/Stopwatches <sup>1</sup>	Up to 86 400 s	58 ms/d	Vibrograf 4500 Timometer

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.  $L$  = length in inches;  $D$  = diameter in inches.
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 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.
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. For the 4 ozf·in to 600 lbf·ft Range,  $0.6R$  will be added to the Uncertainty, where  $R$  = resolution of the device under test.
6. The CMC uncertainty 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.
7. The legal entity name for this location is Transcat, Inc.
8. This scope is formatted as part of a single document including Certificate of Accreditation No. AC-2489.24.



Jason Stine, Vice President