



# 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).

Jason Stine, Vice President

Expiry Date: 07 September 2027  
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**

ISO/IEC 17025 Accreditation Granted: **19 September 2025**

Certificate Number: **AC-2489.24** Certificate Expiry Date: **07 September 2027**

**Chemical Quantities**

<b>Parameter/Equipment</b>	<b>Range</b>	<b>Expanded Uncertainty of Measurement (+/-)</b>	<b>Reference Standard, Method, and/or Equipment</b>
Gas Detection Equipment <sup>1</sup> CO (Carbon Monoxide)	0.001 % CO Concentration 0.005 % CO Concentration 0.006 % CO Concentration 0.01 % CO Concentration 0.05 % CO Concentration 0.1 % CO Concentration 0.25 % CO Concentration 0.5 % CO Concentration	0.000 08 % CO Concentration 0.000 1 % CO Concentration 0.000 11 % CO Concentration 0.000 15 % CO Concentration 0.000 72 % CO Concentration 0.001 4 % CO Concentration 0.003 4 % CO Concentration 0.007 1 % CO Concentration	Comparisons to Certified Gas Mixtures



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**Chemical Quantities**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Gas Detection Equipment <sup>1</sup> CH <sub>4</sub> (Methane LEL)	29 % LEL Concentration 50 % LEL Concentration	0.4 % LEL Concentration 0.6 % LEL Concentration	Comparisons to Certified Gas Mixtures
C <sub>5</sub> H <sub>12</sub> (Pentane LEL)	58 % LEL Concentration 100 % LEL Concentration	0.8 % LEL Concentration 1.2 % LEL Concentration	
H <sub>2</sub> S (Hydrogen Sulfide)	0.001 % H <sub>2</sub> S Concentration 0.002 % H <sub>2</sub> S Concentration 0.002 5 % H <sub>2</sub> S Concentration	0.000 077 % H <sub>2</sub> S Concentration 0.000 084 % H <sub>2</sub> S Concentration 0.000 09 % H <sub>2</sub> S Concentration	
O <sub>2</sub> (Oxygen)	0.5 % O <sub>2</sub> Concentration 5 % O <sub>2</sub> Concentration 12 % O <sub>2</sub> Concentration 15 % O <sub>2</sub> Concentration 18 % O <sub>2</sub> Concentration 20.9 % O <sub>2</sub> Concentration	0.007 % O <sub>2</sub> Concentration 0.06 % O <sub>2</sub> Concentration 0.16 % O <sub>2</sub> Concentration 0.19 % O <sub>2</sub> Concentration 0.23 % O <sub>2</sub> Concentration 0.22 % O <sub>2</sub> Concentration	
CO <sub>2</sub> (Carbon Dioxide)	0.05 % CO <sub>2</sub> Concentration	0.001 9 % CO <sub>2</sub> Concentration	
	0.1 % CO <sub>2</sub> Concentration	0.002 2 % CO <sub>2</sub> Concentration	
	0.25 % CO <sub>2</sub> Concentration	0.003 8 % CO <sub>2</sub> Concentration	
	0.5 % CO <sub>2</sub> Concentration	0.007 2 % CO <sub>2</sub> Concentration	
	1 % CO <sub>2</sub> Concentration	0.014 % CO <sub>2</sub> Concentration	
	5 % CO <sub>2</sub> Concentration	0.099 % CO <sub>2</sub> Concentration	
10 % CO <sub>2</sub> Concentration	0.16 % CO <sub>2</sub> Concentration		
20 % CO <sub>2</sub> Concentration	0.28 % CO <sub>2</sub> Concentration		

**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 μA (10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.031 % of reading + 16 nA 0.019 % of reading + 10 nA 0.015 % of reading + 8 nA 0.03 % of reading + 12 nA 0.11 % of reading + 65 nA	Comparison to Fluke 5700A-EP Multiproduct Calibrator



**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) mA	0.03 % of reading + 40 nA	Comparison to Fluke 5700A-EP Multiproduct Calibrator
	(10 to 20) Hz	0.018 % of reading + 35 nA	
	(20 to 40) Hz	0.013 % of reading + 35 nA	
	40 Hz to 1 kHz	0.021 % of reading + 0.11 µA	
	(1 to 5) kHz	0.11 % of reading + 0.65 µA	
	(5 to 10) kHz		
	(2.2 to 22) mA	0.039 % of reading + 0.4 µA	
	(10 to 20) Hz	0.019 % of reading + 0.35 µA	
	(20 to 40) Hz	0.014 % of reading + 0.35 µA	
	40 Hz to 1 kHz	0.021 % of reading + 0.55 µA	
	(1 to 5) kHz	0.11 % of reading + 5 µA	
	(5 to 10) kHz		
	(22 to 220) mA	0.033 % of reading + 4 µA	
	(10 to 20) Hz	0.018 % of reading + 3.5 µA	
	(20 to 40) Hz	0.014 % of reading + 2.5 µA	
	40 Hz to 1 kHz	0.021 % of reading + 3.5 µA	
(1 to 5) kHz	0.11 % of reading + 10 µA		
(5 to 10) kHz			
(0.22 to 2.2) A	0.027 % of reading + 35 µA		
20 Hz to 1 kHz	0.046 % of reading + 80 µA		
(1 to 5) kHz	0.7 % of reading + 0.16 mA		
(5 to 10) kHz			
AC Current – Source <sup>1</sup>	(1.2 to 3.1) A	0.029 % of reading + 0.39 mA	Comparison to Fluke 5560A Multiproduct Calibrator
	(3 to 45) Hz	0.023 % of reading + 0.23 mA	
	45 Hz to 1 kHz	0.029 % of reading + 0.23 mA	
	(1 to 5) kHz	0.194 % of reading + 0.39 mA	
	(5 to 10) kHz		
	(3.1 to 12) A	0.029 % of reading + 0.78 mA	
	(3 to 45) Hz	0.023 % of reading + 0.39 mA	
	45 Hz to 1 kHz	0.029 % of reading + 0.62 mA	
	(1 to 5) kHz	0.194 % of reading + 0.78 mA	
	(5 to 10) kHz		
	(12 to 30.2) A	0.078 % of reading + 7.8 mA	
	(3 to 45) Hz	0.054 % of reading + 6.2 mA	
45 Hz to 1 kHz	0.39 % of reading + 6.2 mA		
(1 to 5) kHz			



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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> Extended Frequency Range	Up to 120 $\mu$ A (10 to 30) kHz (0.12 to 1.2) mA (10 to 30) kHz (1.2 to 12) mA (10 to 30) kHz (12 to 120) mA (10 to 30) kHz (0.12 to 1.2) A (10 to 30) kHz	0.39 % of reading + 0.8 $\mu$ A 0.39 % of reading + 3.9 $\mu$ A 0.39 % of reading + 7.8 $\mu$ A 0.39 % of reading + 78 $\mu$ A 0.39 % of reading + 0.23 mA	Comparison to Fluke 5560A Multiproduct Calibrator
AC Current – Source <sup>1</sup>	Up to 2A (10 to 40) Hz (40 to 850) Hz 850 Hz to 6 kHz (2 to 20) A (10 to 40) Hz (40 to 850) Hz 850 Hz to 6 kHz (20 to 120) A (10 to 40) Hz (40 to 850) Hz 850 Hz to 6 kHz	0.031 % of reading + 0.2 mA 0.026 % of reading + 60 $\mu$ A 0.13 % of reading + 0.1 mA 0.031 % of reading + 2 mA 0.026 % of reading + 0.6 mA 0.13 % of reading + 1 mA 0.031 % of reading + 20 mA 0.026 % of reading + 6 mA 0.13 % of reading + 10 mA	Comparison to Fluke 52120A Transconductance Amplifier, Fluke 5560A Multiproduct Calibrator (Closed-loop mode)
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	Comparison to 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	Comparison to Multiproduct Calibrator, 50-turn Coil



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Clamp-on Ammeters (Non-Toroidal Type) Hall Effect Sensor <sup>1</sup>	(100 to 1000) A (10 to 40) Hz (40 to 850) Hz 850 Hz to 1 kHz (1 to 6) kA (10 to 40) Hz (40 to 850) Hz 850 Hz to 1 kHz	0.54 % of reading + 0.1 A 0.55 % of reading + 30 mA 0.56 % of reading + 50 mA 0.54 % of reading + 1 A 0.55 % of reading + 0.3 A 0.56 % of reading + 0.5 A	Comparison to Fluke 52120A Transconductance Amplifier, Fluke 5560A 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 5 kHz 100 $\mu$ A 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 100 mA 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 0.071 % 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	Comparison to Keysight 3458A 8.5 Digit Multimeter

**Electrical – DC/Low Frequency**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current – Measure <sup>1</sup>	(1 to 2) A	0.11 % of reading + 4 mA	Comparison to Yokogawa WT310EH Digital Power Analyzer
	(10 to 45) Hz	0.11 % of reading + 1 mA	
	(45 to 66) Hz	0.11 % of reading + 4 mA	
	66 Hz to 1 kHz		
	(2 to 5) A	0.11 % of reading + 10 mA	
	(10 to 45) Hz	0.11 % of reading + 2.5 mA	
	(45 to 66) Hz	0.11 % of reading + 10 mA	
	66 Hz to 1 kHz		
	(5 to 10) A	0.11 % of reading + 20 mA	
	(10 to 45) Hz	0.11 % of reading + 5 mA	
	(45 to 66) Hz	0.11 % of reading + 20 mA	
	66 Hz to 1 kHz		
(10 to 20) A	0.11 % of reading + 40 mA		
(10 to 45) Hz	0.11 % of reading + 10 mA		
(45 to 66) Hz	0.11 % of reading + 40 mA		
66 Hz to 1 kHz			
(20 to 40) A	0.11 % of reading + 80 mA		
(10 to 45) Hz	0.11 % of reading + 20 mA		
(45 to 66) Hz	0.11 % of reading + 80 mA		
66 Hz to 1 kHz			
AC Current – Measure <sup>1</sup>	(40 to 120) A	0.29 % of reading + 60 mA	Comparison to Fluke 381 Current Clamp, Fluke 52120A Transconductance Amplifier, Fluke 5560A Multiproduct Calibrator
	(45 to 65) Hz		
DC Current – Source <sup>1</sup>	(0 to 220) $\mu$ A	0.004 % of reading + 6 nA	Comparison to Fluke 5700A-EP Multiproduct Calibrator
	(0.22 to 2.2) mA	0.003 6 % of reading + 7 nA	
	(2.2 to 22) mA	0.003 5 % of reading + 40 nA	
	(22 to 220) mA	0.004 8 % of reading + 0.7 $\mu$ A	
	(0.22 to 2.2) A	0.002 % of reading + 12 $\mu$ A	
DC Current – Source <sup>1</sup>	(1.2 to 3.1) A	0.023 % of reading + 0.12 mA	Comparison to Fluke 5560A Multiproduct Calibrator
	(3.1 to 12) A	0.023 % of reading + 0.19 mA	
	(12 to 30.2) A	0.078 % of reading + 0.39 mA	



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
DC Current – Source <sup>1</sup>	(0 to 2) A (2 to 20) A (20 to 100) A	0.012 % of reading + 0.2 mA 0.012 % of reading + 2 mA 0.012 % of reading + 20 mA	Comparison to Fluke 52120A Transconductance Amplifier, Fluke 5560A Multiproduct Calibrator (Closed-loop mode)
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	Comparison to Multiproduct Calibrator, 50-turn Coil
DC Clamp-on Ammeter (Non-Toroidal Type) Hall Effect Sensor <sup>1</sup>	(100 to 1 000) A (1 000 to 5 000) A	0.54 % of reading + 0.1 A 0.54 % of reading + 1 A	Comparison to Fluke 52120A Transconductance Amplifier, Fluke 5560A Multiproduct Calibrator, 3 kA or 6 kA 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	Comparison to Keysight 3458A 8.5 Digit Multimeter
DC Current – Measure <sup>1</sup>	(1 to 50) A	0.013 % of reading	Comparison to 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	Comparison to Empro HA-100-50 Current Shunt, Keysight 3458A 8.5 Digit Multimeter
DC Current – Measure <sup>1</sup>	(100 to 1 000) A	2.1 % of reading + 0.35 A	Comparison to Fluke 381 Current Clamp



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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		Comparison to 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 (220 to 1 100) V 40 Hz to 1 kHz	0.028 % of reading + 0.4 mV 0.01 % of reading + 0.15 mV 0.005 % of reading + 50 μV 0.008 3 % 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 0.005 7 % of reading + 0.6 mV 0.009 3 % 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 0.011 % of reading + 4 mV	Comparison to Fluke 5700A-EP Multiproduct Calibrator
AC Voltage – Source <sup>1</sup>	(120 to 330) V 10 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (330 to 1 020) V 10 Hz to 10 kHz	0.011 % of reading + 6 mV 0.023 % of reading + 6 mV 0.12 % of reading + 10 mV 0.011 % of reading + 62 mV	Comparison to Fluke 5560A Multiproduct Calibrator
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	Comparison to Keysight 3458A 8.5 Digit Multimeter

**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	0.013 % of reading + 4.6 μV	Comparison to Keysight 3458A 8.5 Digit Multimeter
	(1 to 40) Hz	0.009 5 % of reading + 2.3 μV	
	40 Hz to 1 kHz	0.017 % of reading + 2.3 μV	
	(1 to 20) kHz	0.037 % of reading + 2.3 μV	
	(20 to 50) kHz	0.093 % of reading + 2.3 μV	
	(50 to 100) kHz	0.36 % of reading + 12 μV	
	(100 to 300) kHz	1.2 % of reading + 12 μV	
	300 kHz to 1 MHz	1.9 % of reading + 12 μV	
	(1 to 2) MHz	4.7 % of reading + 81 μV	
	(2 to 4) MHz	4.7 % of reading + 92 μV	
	(4 to 8) MHz	17 % of reading + 0.12 mV	
	(8 to 10) MHz		
	(0.1 to 1) V	0.009 8 % of reading + 46 μV	
	(1 to 40) Hz	0.009 4 % of reading + 23 μV	
	40 Hz to 1 kHz	0.017 % of reading + 23 μV	
	(1 to 20) kHz	0.036 % of reading + 23 μV	
	(20 to 50) kHz	0.093 % of reading + 23 μV	
	(50 to 100) kHz	0.35 % of reading + 0.12 mV	
	(100 to 300) kHz	1.2 % of reading + 0.12 mV	
	300 kHz to 1 MHz	1.9 % of reading + 0.12 mV	
	(1 to 2) MHz	4.7 % of reading + 0.81 mV	
	(2 to 4) MHz	4.7 % of reading + 0.92 mV	
	(4 to 8) MHz	17 % of reading + 1.2 mV	
	(8 to 10) MHz		
	(1 to 10) V	0.009 5 % of reading + 0.46 mV	
	(1 to 40) Hz	0.009 5 % of reading + 0.23 mV	
	40 Hz to 1 kHz	0.017 % of reading + 0.23 mV	
(1 to 20) kHz	0.036 % of reading + 0.23 mV		
(20 to 50) kHz	0.093 % of reading + 0.23 mV		
(50 to 100) kHz	0.35 % of reading + 1.2 mV		
(100 to 300) kHz	1.7 % of reading + 1.2 mV		
300 kHz to 1 MHz	1.8 % of reading + 1.2 mV		
(1 to 2) MHz	4.7 % of reading + 8.1 mV		
(2 to 4) MHz	4.7 % of reading + 9.3 mV		
(4 to 8) MHz	17 % of reading + 12 mV		
(8 to 10) MHz			



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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	0.024 % of reading + 4.6 mV	Comparison to Keysight 3458A 8.5 Digit Multimeter
	(1 to 40) Hz	0.024 % of reading + 2.3 mV	
	40 Hz to 1 kHz	0.024 % of reading + 2.3 mV	
	(1 to 20) kHz	0.042 % of reading + 2.3 mV	
	(20 to 50) kHz	0.14 % of reading + 2.3 mV	
	(50 to 100) kHz	0.46 % of reading + 12 mV	
	(100 to 300) kHz	1.7 % of reading + 12 mV	
	300 kHz to 1 MHz		
	(100 to 700) V	0.048 % of reading + 46 mV	
	(1 to 40) Hz	0.048 % of reading + 23 mV	
40 Hz to 1 kHz	0.071 % of reading + 23 mV	Comparison to Vitrek 4700 Digital High Voltage Meter w/ HVL-100 Probe	
(1 to 20) kHz	0.14 % of reading + 0.12 V		
(20 to 50) kHz	0.46 % of reading + 0.12 V		
(50 to 100) kHz	0.14 % of reading + 0.7 V		
(10 to 70) kV	1.2 % of reading + 0.7 V		
DC Voltage – Source <sup>1</sup>	(0.7 to 10) kV	0.000 9 % of reading + 0.44 μV	Comparison to Fluke 5700A-EP Multiproduct Calibrator
	(10 to 200) Hz	0.000 5 % of reading + 0.7 μV	
	(200 to 450) Hz	0.000 4 % of reading + 2.5 μV	
	(30 to 70) Hz	0.000 4 % of reading + 4 μV	
	(70 to 200) Hz	0.000 6 % of reading + 40 μV	
	(22 to 220) V	0.000 8 % of reading + 0.4 mV	
DC Voltage – Measure <sup>1</sup>	(0 to 220) mV	0.000 8 % of reading + 0.58 μV	Comparison to Keysight 3458A 8.5 Digit Multimeter
	(0.22 to 2.2) V	0.000 5 % of reading + 0.58 μV	
	(2.2 to 11) V	0.000 5 % of reading + 0.58 μV	
	(11 to 22) V	0.000 5 % of reading + 0.58 μV	
	(22 to 220) V	0.000 8 % of reading + 35 μV	
	(220 to 1 100) V	0.001 5 % of reading + 0.12 mV	
	(10 to 100) mV	0.001 5 % of reading + 0.12 mV	
	(10 to 100) V	0.001 8 % of reading + 0.12 mV	
DC High Voltage – Measure <sup>1</sup>	(1 to 10) kV	0.038 % of reading + 35 mV	Comparison to Vitrek 4700 Digital High Voltage Meter w/ HVL-100 Probe
	(10 to 100) kV	0.063 % of reading + 0.35 V	



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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	Comparison to 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	
Capacitance – Source <sup>1</sup> (Simulation)	DC to 6 Hz (1.1 to 3.3) mF	0.35 % of reading + 2.3 μF	Comparison to Multiproduct Calibrator
	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	Comparison to Standard Capacitors
	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	



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Resistance – Source <sup>1</sup> (Fixed Artifacts)	1 Ω	98 μΩ	Comparison to 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	Comparison to Standard Resistors
	500 μΩ	1.3 μΩ	
	1 mΩ	0.13 μΩ	
	10 mΩ	1.2 μΩ	
	100 mΩ	10 μΩ	
	1 Ω	39 μΩ	
Resistance – Source <sup>1</sup> (Variable Artifact)	(0.1 to 10) MΩ	0.03 % of reading	Comparison to IET HRRS-B-100K-5KV Standard Decade Resistor
	(10 to 100) MΩ	0.1 % of reading	
	(0.1 to 1) GΩ	0.21 % of reading	
	(1 to 10) GΩ	0.51 % of reading	
	(10 to 100) GΩ	1 % of reading	
	(0.1 to 1) TΩ	1.4 % of reading	
Resistance – Source/Measure <sup>1</sup>	(0 to 10) Ω	0.001 8 % of reading + 58 μΩ	Comparison to 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) <sup>o</sup> (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 <sup>o</sup> 0.2 <sup>o</sup> 0.39 <sup>o</sup> 1.9 <sup>o</sup> 3.9 <sup>o</sup> 7.8 <sup>o</sup>	Comparison to Multiproduct Calibrator
DC Power – Source <sup>1,7</sup> (0.12 to 120) mA (0.12 to 1.2) A (1.2 to 12) A (12 to 30.2) A	4.8 μW to 122 W 4.8 mW to 1.2 kW 48 mW to 12.2 kW 0.48 W to 30.8 kW	0.008 % of reading 0.013 % of reading 0.025 % of reading 0.079 % of reading	Comparison to Fluke 5560A Multiproduct Calibrator
AC Power – Source <sup>1,3</sup> PF = 1 (45 to 65) Hz	(1.2 to 12) mA 40 μW to 12.2 W (12 to 120) mA 0.4 mW to 122 W (0.12 to 1.2) A 4 mW to 1.22 kW (1.2 to 3.1) A 40 mW to 3.2 kW (3.1 to 12) A 0.1 W to 12.2 kW (12 to 20.5) A 0.4 W to 20.9 kW (20.5 to 30.2) A 2.5 W to 30.8 kW	0.028 % of reading 0.019 % of reading 0.025 % of reading 0.033 % of reading 0.029 % of reading 0.085 % of reading 0.076 % of reading	Comparison to Fluke 5560A Multiproduct Calibrator
AC Power – Source <sup>1,3</sup> PF = 1 65 Hz to 1 kHz	(12 to 120) mA 1.4 mW to 122 W (0.12 to 1.2) A 14 mW to 1.22 kW (1.2 to 3.1) A 144 mW to 3.2 kW (3.1 to 12) A 3.7 W to 12.2 kW (12 to 20.5) A 14.4 W to 20.9 kW (20.5 to 30.2) A 26.4 W to 30.8 kW	0.019 % of reading 0.025 % of reading 0.033 % of reading 0.029 % of reading 0.085 % of reading 0.076 % of reading	Comparison to Fluke 5560A 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		Comparison to 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		



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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		Comparison to 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		

**Electrical – DC/Low Frequency**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment	
Electrical Simulation of RTD Indicators – Source <sup>1</sup>	Pt 385, 100 Ω (-200 to 0) °C	0.005 °C	Comparison to IET 1433-39 Decade Box characterized with Keysight 3458A 8.5 Digit Multimeter	
	(0 to 100) °C	0.008 °C		
	(100 to 400) °C	0.013 °C		
	(400 to 800) °C	0.021 °C		
	Pt 385, 200 Ω (-200 to 630) °C	0.013 °C		
	Pt 385, 500 Ω (-200 to 630) °C	0.016 °C		
	Pt 385, 1 000 Ω (-200 to 630) °C	0.014 °C		
	Pt 3916, 100 Ω (-200 to 630) °C	0.014 °C		
	Pt 3926, 100 Ω (-200 to 630) °C	0.014 °C		
	PtNi 385, 120 Ω (-80 to 260) °C	0.014 °C		
	Cu 427, 100 Ω (-100 to 260) °C	0.008 °C		
	Oscilloscopes <sup>1,4</sup> Amplitude – DC into 50 Ω load into 1 MΩ load	(-6 to 6) V		0.22 % of reading + 31 μV
(-130 to 130) V		0.12 % of reading + 31 μV		
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	
		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	



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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> Time Markers 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 22 % of reading 0.005 9 % of reading 0.009 8 % of reading 0.018 % of reading 0.041 % of reading 0.08 % of reading 0.16 % of reading 0.39 % of reading	Comparison to Multiproduct Calibrator with 1.1 GHz Scope Option
Rise Time into 50 Ω load Rate: 1 kHz to 2 MHz Rate: (2 to 10) MHz	5 mV p-p to 2.5 V p-p 250 ps (nominal) 250 ps (nominal)	50 ps 50 ps	
Leveled Sine Wave into 50 Ω load	5 mV p-p to 5 V p-p 50 kHz 50 kHz to 100 MHz (100 to 300) MHz (300 to 600) MHz 5 mVp-p to 3.5 mVp-p (600 to 1 100) MHz	1.8 % of reading + 0.2 mV 2.8 % of reading + 0.2 mV 3.2 % of reading + 0.2 mV 4 % of reading + 0.2 mV 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 (100 to 300) MHz (300 to 600) MHz 5 mV p-p to 3.5 V p-p (600 to 1 100) MHz	1.4 % of reading + 78 μV 1.8 % of reading + 78 μV 3.2 % of reading + 78 μV 4 % of reading + 78 μV	
Input Impedance – Measure	(40 to 60) Ω (0.5 to 1.5) MΩ	0.082 % of reading 0.081 % of reading	
Input Capacitance – Measure	(5 to 50) pF	3.9 % of reading + 0.4 pF	

**Electrical – DC/Low Frequency**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Oscilloscopes <sup>1,4</sup> Waveform Generator (Sine, Square, Triangle) Amplitude into 50 Ω load into 1 MΩ load  Frequency	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  10 Hz to 10 kHz	2.3 % of reading + 78 μV 2.3 % of reading + 78 μV  0.002 % of reading + 12 mHz	Comparison to Multiproduct Calibrator with 1.1 GHz Scope Option

**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 μin (7 + 7L) μin (5 + 12L) μin (2 + 15L) μin (9 + 16L) μin	Comparisons to Gage Blocks, Long Gage Blocks
Anvil Flatness	Up to 1 in	6.6 μin	Optical Flat
Parallelism	Up to 1 in	7.2 μin	Optical Parallel
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 μin (7 + 7L) μin (5 + 12L) μin (2 + 15L) μin (9 + 16L) μin	Comparison to 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) μin (15 + 8L) μin (9 + 14L) μin (9 + 16L) μin	Comparison to 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) μin (46 + 4L) μin (40 + 10L) μin (21 + 15L) μin	Comparison to 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	Comparison to 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	Comparison to 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	12 µg 41 µg 61 µg 94 µg 0.000 31 % of reading 0.000 33 % of reading 0.11 kg 0.13 kg 0.14 kg 0.14 kg	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	0.013 % of reading	NIST Class F weights and internal calibration procedure utilized in the calibration of the weighing system.
Pneumatic Pressure Devices <sup>1</sup> (Absolute)	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	Comparison to Mensor CPC6050 Pressure Controller
Pneumatic Vacuum Devices <sup>1</sup>	(-15 to 0) psig	0.000 75 psi	Comparison to Mensor CPC6050 Pressure Controller
Pneumatic Pressure Devices <sup>1</sup> (Gauge)	Up to 7 inH <sub>2</sub> O	0.003 inH <sub>2</sub> O	Comparison to Mensor CPC6050 Pressure Controller
Pneumatic Pressure Devices <sup>1</sup> (Gauge)	(7 to 40) inH <sub>2</sub> O	0.002 3 inH <sub>2</sub> O	Comparison to Fluke P3012 Deadweight Tester

**Mass and Mass Related**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Pneumatic Pressure Devices <sup>1</sup> (Gauge)	(1.444 to 14.5) psig	0.006 % of reading	Comparison to Fluke P3012 Deadweight Tester
Pneumatic Pressure Devices <sup>1</sup> (Gauge)	(14.5 to 15) psig	0.01 % of reading	Comparison to Mensor CPC6050 Pressure Controller
Pneumatic Pressure Devices <sup>1</sup> (Gauge)	(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	Comparison to Mensor CPC6050 Pressure Controller
Hydraulic Pressure Devices <sup>1</sup> (Gauge)	(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	Comparison to 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 420) °C (420 to 660) °C	0.013 °C 0.015 °C 0.02 °C 0.035 °C 0.059 °C	Comparison to 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	Comparison to Triple Point of Water Cell
Dial/Digital Thermometers, PRT, RTD, Thermistor <sup>1</sup>	-195 °C	0.01 °C	Comparison to Fluke 7196B LN <sub>2</sub> Comparator, Hart 5628 Secondary Standard PRT with Blackstack
Drywell Calibrators, Liquid Baths, Temperature Controlled Chambers <sup>1</sup>	(-195 to 0) °C (0 to 150) °C (150 to 300) °C (300 to 420) °C (420 to 660) °C	0.01 °C 0.014 °C 0.019 °C 0.022 °C 0.032 °C	Comparison to Hart 5628 Secondary Standard PRT, Blackstack

**Thermodynamic**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
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	Comparison to Type S Reference Thermocouple Probe, Digital Readout
Thermocouple Wires and Probes <sup>1</sup> (Types E, J, K, N, 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	Comparison to 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 R, S only)	(0 to 300) °C (300 to 660) °C	0.6 °C 0.8 °C	Comparison to 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	Comparison to Drywell Calibrators, Type S Reference Thermocouple Probe, Digital Readout
Infrared Thermometers	(-15 to 0) °C (0 to 50) °C (50 to 100) °C (100 to 120) °C	0.79 °C 0.53 °C 0.68 °C 0.75 °C	Comparison to Fluke 4180 Blackbody Source (flat plate) $\lambda = (8 \text{ to } 14) \mu\text{m}$ , $\epsilon = (0.9 \text{ to } 1)$
Infrared Thermometers	(120 to 200) °C (200 to 350) °C (350 to 500) °C	0.98 °C 1.7 °C 2.3 °C	Comparison to Fluke 4181 Blackbody Source (flat plate) $\lambda = (8 \text{ to } 14) \mu\text{m}$ , $\epsilon = (0.9 \text{ to } 1)$

**Thermodynamic**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Humidity Measuring Devices	(0 to 15) °C		Comparison to Thunder Scientific 2500 Two Pressure Generation System
	(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		
Humidity Controlled Chambers <sup>1</sup>	(0 to 15) °C		Comparison to Vaisala HM70/HMP77 Temp/Humidity Indicator/Probe
	(10 to 95) %RH	2.5 %RH	
	(15 to 25) °C		
	(10 to 90) %RH	1.3 %RH	
	(90 to 95) %RH	2 %RH	
	(25 to 40) °C		
(10 to 95) %RH	2.2 %RH		
	(40 to 85) °C		
	(10 to 50) %RH	2.6 %RH	
	(50 to 95) %RH	3.5 %RH	

**Time and Frequency**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Frequency – Reference	10 MHz	23 pHz/Hz	Comparison to GPS Disciplined Rubidium Frequency Oscillator
Frequency – Source <sup>1</sup>	1 μHz to 80 MHz	58 nHz/Hz	Comparison to Function/Arbitrary Waveform Generator or equivalent
Frequency – Measure <sup>1</sup>	10 μHz to 10 kHz	0.64 nHz/Hz + 4.5 μHz	Comparison to Keysight 53132A Universal Counter, Rubidium Frequency Oscillator
	10 kHz to 10 MHz	0.64 nHz/Hz + 5 μHz	
	(10 to 100) MHz	0.64 nHz/Hz	

**Time and Frequency**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Period – Source <sup>1</sup>	(1 to 100) s	58 ns/s	Comparison to Keysight 33250A Function/Arbitrary Waveform Generator, Rubidium Frequency Oscillator
Period – Measure <sup>1</sup>	(1 to 100) s	45 μs	Comparison to Keysight 53132A Universal Counter, Rubidium Frequency Oscillator
Timers, Stopwatches <sup>1</sup>	Up to 86 400 s	58 ms/d	Comparison to 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:
- 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.
  - $L$  = length in inches;  $D$  = diameter in inches.
  - The uncertainties shown represent the most favorable conditions and are presented as ranges, dependent on the combination of voltage and current. Uncertainty may increase under conditions not listed, particularly due to the laboratory's AC voltage and current uncertainties at frequencies other than those shown. Power factor (PF), which is related to the cosine of the phase angle, also contributes significantly to power measurement uncertainty. Uncertainty tends to track the laboratory's phase uncertainty closely when PF is near 1 but increases substantially as PF approaches 0. The laboratory may also report reactive power, apparent power, and power factor under this accreditation. To know the uncertainties at any specific combination of voltage and current, or at different power factors and frequency conditions, please contact the laboratory.
  - 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.
  - For the 4 lbf·in to 600 lbf·ft Range,  $0.6R$  will be added to the Uncertainty, where  $R$  = resolution of the device under test.
  - 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.
  - The uncertainties shown represent the most favorable conditions and are presented as ranges, dependent on the combination of voltage and current. To know the uncertainties at any specific combination of voltage and current, please contact the laboratory.
  - Unless otherwise specified in the far-right column, the calibration method/procedure utilized by the laboratory was internally developed.
  - The legal entity name for this location is Transcat, Inc.



Jason Stine, Vice President