



CERTIFICATE OF ACCREDITATION

The ANSI National Accreditation Board

Hereby attests that

Transcat Canada, Inc. - 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.

R. Douglas Leonard Jr., VP, PILR SBU

Expiry Date: 07 September 2023
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 Canada, Inc. - Ottawa

4043 Carling Avenue, Suite 110

Ottawa, ON K2K 2A4 Canada

Francis Kane 613-591-8140

CALIBRATION

Valid to: **September 7, 2023**

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 ¹	Up to 220 μ 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 μ A	
	(5 to 10) kHz	0.11 % of reading + 0.65 μ A	
	(2.2 to 22) mA		
	(10 to 20) Hz	0.039 % of reading + 0.4 μ A	
	(20 to 40) Hz	0.019 % of reading + 0.35 μ A	
	40 Hz to 1 kHz	0.014 % of reading + 0.35 μ A	
	(1 to 5) kHz	0.021 % of reading + 0.55 μ A	
	(5 to 10) kHz	0.11 % of reading + 5 μ A	
	(22 to 220) mA		
	(10 to 20) Hz	0.033 % of reading + 4 μ A	
(20 to 40) Hz	0.018 % of reading + 3.5 μ A		
40 Hz to 1 kHz	0.014 % of reading + 2.5 μ A		
(1 to 5) kHz	0.021 % of reading + 3.5 μ A		
(5 to 10) kHz	0.11 % of reading + 10 μ A		

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current – Source ¹	(0.22 to 2.2) A 20 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.027 % of reading + 35 μ A 0.046 % of reading + 80 μ A 0.7 % of reading + 0.16 mA	Fluke 5700A-EP Multiproduct Calibrator, Fluke 5725A Amplifier
	(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	
	(11 to 20.5) A (45 to 100) Hz 100 Hz to 1 kHz (1 to 5) kHz	0.097 % of reading + 3.9 mA 0.18 % of reading + 3.9 mA 2.3 % of reading + 3.9 mA	Fluke 5520A Multiproduct Calibrator
AC Current – Source ¹ Extended Frequency Range	(29 to 330) μ A (10 to 30) kHz	1.2 % of reading + 0.31 μ A	Fluke 5520A Multiproduct Calibrator
	(0.33 to 3.3) mA (10 to 30) kHz	0.78 % of reading + 0.47 μ A	
	(3.3 to 33) mA (10 to 30) kHz	0.31 % of reading + 3.1 μ A	
	(33 to 330) mA (10 to 30) kHz	0.31 % of reading + 0.16 mA	
AC Clamp-on Ammeters ¹ (Toroidal Type) Transformer Type Sensor	(20.5 to 150) A (45 to 65) Hz (65 to 440) Hz	0.3 % of reading + 26 mA 0.83 % of reading + 47 mA	Fluke 5520A Multiproduct Calibrator, Fluke 5500A/COIL 50-turn Coil
	(150 to 1 025) A (45 to 65) Hz (65 to 440) Hz	0.35 % of reading + 0.12 A 1.1 % of reading + 0.22 A	
AC Clamp-on Ammeters ¹ (Non-Toroidal Type) Hall Effect Sensor	(20.5 to 150) A (45 to 65) Hz (65 to 440) Hz	0.57 % of reading + 0.25 A 1 % of reading + 0.25 A	
	(150 to 1 025) A (45 to 65) Hz (65 to 440) Hz	0.6 % of reading + 0.9 A 1.3 % of reading + 0.92 A	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current – Measure ¹	Up to 100 μ A (10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz 100 μ 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	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 μ A 0.17 % of reading + 0.23 μ A 0.071 % of reading + 0.23 μ A 0.038 % of reading + 0.23 μ A 0.46 % of reading + 2.3 μ A 0.17 % of reading + 2.3 μ A 0.071 % of reading + 2.3 μ A 0.038 % of reading + 2.3 μ A 0.48 % of reading + 23 μ A 0.17 % of reading + 23 μ A 0.071 % of reading + 23 μ A 0.037 % of reading + 23 μ A	Keysight 3458A 8.5 Digit Multimeter
AC Current – Measure ¹	100 mA to 1 A (10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz (1 to 2) A (10 to 45) Hz (45 to 66) Hz 66 Hz to 1 kHz (2 to 5) A (10 to 45) Hz (45 to 66) Hz 66 Hz to 1 kHz (5 to 10) A (10 to 45) Hz (45 to 66) Hz 66 Hz to 1 kHz	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 0.12 % of reading + 4 mA 0.12 % of reading + 1 mA 0.12 % of reading + 4 mA 0.13 % of reading + 10 mA 0.13 % of reading + 2.5 mA 0.13 % of reading + 10 mA 0.13 % of reading + 20 mA 0.13 % of reading + 5 mA 0.13 % of reading + 20 mA	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 ¹	(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 ¹	(0 to 220) μ A (0.22 to 2.2) mA (2.2 to 22) mA (22 to 100) mA (100 to 150) mA (150 to 200) mA (200 to 220) mA	0.004 % of reading + 6 nA 0.003 6 % of reading + 7 nA 0.003 5 % of reading +40 nA 0.004 5 % of reading + 0.7 μ A 0.004 5 % of reading + 5.2 μ A 0.004 5 % of reading + 8.7 μ A 0.004 5 % of reading + 10 μ A	Fluke 5700A-EP Multiproduct Calibrator, Fluke 5725A Amplifier
	(0.22 to 1) A (1 to 1.5) A (1.5 to 2) A (2 to 2.2) A (2.2 to 11) A	0.008 % of reading + 12 μ A 0.008 % of reading + 35 μ A 0.008 % of reading + 52 μ A 0.008 % of reading + 60 μ A 0.036 % of reading + 0.48 mA	
	(11 to 20.5) A	0.084 % of reading + 0.58 mA	Fluke 5520A Multiproduct Calibrator
DC Clamp-on Ammeters ¹ (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	Fluke 5520A Multiproduct Calibrator, Fluke 5500A/COIL 50-turn Coil
DC Current – Measure ¹	(0 to 100) μ 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 μ A 0.013 % of reading + 12 μ A	Keysight 3458A 8.5 Digit Multimeter
	(1 to 50) A	0.03 % of reading	
	(50 to 100) A	0.3 % of reading	Yokogawa 2792A Standard Resistor Set, Keysight 3458A 8.5 Digit Multimeter
			Empro HA-100-50 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
DC Current – Measure ¹	(100 to 1 000) A	0.2 % of reading	Empro LAB-1000-50 Current Shunt, Keysight 3458A 8.5 Digit Multimeter
AC Voltage – Source ¹	Up to 2.2 mV (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 (2.2 to 22) mV (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) mV (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 (0.22 to 2.2) 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	0.16 % of reading + 4 μV 0.1 % of reading + 4 μV 0.078 % of reading + 4 μV 0.13 % of reading + 4 μV 0.17 % of reading + 5 μV 0.33 % of reading + 10 μV 0.47 % of reading + 20 μV 0.58 % of reading + 20 μV 0.042 % of reading + 4 μV 0.03 % of reading + 4 μV 0.014 % of reading + 4 μV 0.03 % of reading + 4 μV 0.058 % of reading + 5 μV 0.12 % of reading + 10 μV 0.16 % of reading + 20 μV 0.27 % of reading + 20 μV 0.028 % of reading + 12 μV 0.011 % of reading + 7 μV 0.008 5 % of reading + 7 μV 0.021 % of reading + 7 μV 0.047 % of reading + 17 μV 0.091 % of reading + 20 μV 0.14 % of reading + 25 μV 0.28 % of reading + 45 μV 0.027 % of reading + 40 μV 0.01 % of reading + 15 μV 0.004 8 % of reading + 8 μV 0.008 % of reading + 10 μV 0.012 % of reading + 30 μV 0.043 % of reading + 80 μV 0.01 % of reading + 0.2 mV 0.18 % of reading + 0.3 mV	Fluke 5700A-EP Multiproduct Calibrator



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Source ¹	(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	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	Fluke 5700A-EP Multiproduct Calibrator
	(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 + 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	
AC Voltage – Source ¹ Extended Frequency Ranges	(220 to 1 100) 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
	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	
AC Voltage – Measure ¹	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	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	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 ¹	(10 to 100) mV		Keysight 3458A 8.5 Digit Multimeter
	(1 to 40) Hz	0.013 % of reading + 4.6 μ V	
	40 Hz to 1 kHz	0.009 5 % of reading + 2.3 μ V	
	(1 to 20) kHz	0.017 % of reading + 2.3 μ V	
	(20 to 50) kHz	0.037 % of reading + 2.3 μ V	
	(50 to 100) kHz	0.093 % of reading + 2.3 μ V	
	(100 to 300) kHz	0.36 % of reading + 12 μ V	
	300 kHz to 1 MHz	1.2 % of reading + 12 μ V	
	(1 to 2) MHz	1.9 % of reading + 12 μ V	
	(2 to 4) MHz	4.7 % of reading + 81 μ V	
	(4 to 8) MHz	4.7 % of reading + 92 μ V	
	(0.1 to 1) V		
	(1 to 40) Hz	0.009 8 % of reading + 46 μ V	
	40 Hz to 1 kHz	0.009 4 % of reading + 23 μ V	
	(1 to 20) kHz	0.017 % of reading + 23 μ V	
	(20 to 50) kHz	0.036 % of reading + 23 μ V	
	(50 to 100) kHz	0.093 % of reading + 23 μ V	
	(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	
	(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	
	(10 to 100) V		
	(1 to 40) Hz	0.024 % of reading + 4.6 mV	
	40 Hz to 1 kHz	0.024 % of reading + 2.3 mV	
(1 to 20) kHz	0.024 % of reading + 2.3 mV		
(20 to 50) kHz	0.042 % of reading + 2.3 mV		
(50 to 100) kHz	0.14 % of reading + 2.3 mV		
(100 to 300) kHz	0.46 % of reading + 12 mV		
300 kHz to 1 MHz	1.7 % 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 ¹	(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	0.047 % of reading + 46 mV 0.047 % of reading + 23 mV 0.071 % of reading + 23 mV 0.14 % of reading + 23 mV 0.35 % of reading + 23 mV	Keysight 3458A 8.5 Digit Multimeter
AC High Voltage – Measure ¹	(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 ¹	(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 ¹	(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 ¹	(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
Capacitance – Source ¹ (Simulated)	10 Hz to 10 kHz (0.19 to 1.1) nF 10 Hz to 3 kHz (1.1 to 3.3) nF 10 Hz to 1 kHz (3.3 to 11) nF (11 to 33) nF (33 to 110) nF (110 to 330) nF (10 to 600) Hz (0.33 to 1.1) μF (10 to 300) Hz (1.1 to 3.3) μF	0.39 % of reading + 7.8 pF 0.39 % of reading + 7.8 pF 0.21 % of reading + 7.8 pF 0.21 % of reading + 78 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	Fluke 5520A Multiproduct Calibrator

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Capacitance – Source ¹ (Simulated)	(10 to 150) Hz (3.3 to 11) μ F	0.2 % of reading + 7.8 nF	Fluke 5520A Multiproduct Calibrator
	(10 to 120) Hz (11 to 33) μ F	0.32 % of reading + 23 nF	
	(10 to 80) Hz (33 to 110) μ F	0.35 % of reading + 78 nF	
	DC to 50 Hz (110 to 330) μ F	0.35 % of reading + 0.23 μ F	
	DC to 20 Hz (0.33 to 1.1) mF	0.35 % of reading + 0.78 μ F	
	DC to 6 Hz (1.1 to 3.3) mF	0.35 % of reading + 2.3 μ F	
	DC to 2 Hz (3.3 to 11) mF	0.35 % of reading + 7.8 μ F	
	DC to 0.6 Hz (11 to 33) mF	0.58 % of reading + 23 μ F	
	DC to 0.2 Hz (33 to 110) mF	0.86 % of reading + 78 μ F	
	Capacitance – Source ¹ (Fixed Artifacts)	1 kHz 0.001 μ F	
0.01 μ F		0.063 % of reading	
0.05 μ F		0.063 % of reading	
0.1 μ F		0.063 % of reading	
1 μ F		0.063 % of reading	
Resistance – Source ¹ (Simulated)	1 Ω	98 $\mu\Omega$	Fluke 5700A-EP Multiproduct Calibrator
	1.9 Ω	0.18 m Ω	
	10 Ω	0.24 m Ω	
	19 Ω	0.48 m Ω	
	100 Ω	1.1 m Ω	
	190 Ω	2.1 m Ω	
	1 k Ω	9.4 m Ω	
	1.9 k Ω	18 m Ω	
	10 k Ω	94 m Ω	
	19 k Ω	0.18 Ω	
	100 k Ω	1.2 Ω	
	190 k Ω	2.3 Ω	
	1 M Ω	22 Ω	
	1.9 M Ω	44 Ω	
	10 M Ω	0.43 k Ω	
	19 M Ω	0.93 k Ω	
100 M Ω	10.8 k Ω		



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Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Resistance – Source ¹ (Fixed Artifacts)	100 μΩ 500 μΩ 1 mΩ 10 mΩ 100 mΩ	0.1 μΩ 1.3 μΩ 0.13 μΩ 1.2 μΩ 10 μΩ	Standard Resistors
Resistance – Source ¹ (Variable Artifact)	(10 to 100) MΩ (0.1 to 1) GΩ (1 to 10) GΩ (10 to 100) GΩ (0.1 to 1) TΩ	0.08 % of reading 0.24 % of reading 0.41 % of reading 0.84 % of reading 2.5 % of reading	IET HRRS-B-100K-5KV Standard Decade Resistor
Resistance – Source/Measure ¹	(0 to 10) Ω (10 to 100) Ω (0.1 to 1) kΩ (1 to 10) kΩ (10 to 100) kΩ (0.1 to 1) MΩ (1 to 10) MΩ (10 to 100) MΩ (0.1 to 1) GΩ	0.001 8 % of reading + 58 μΩ 0.001 5 % of reading + 0.58 mΩ 0.001 2 % of reading + 0.58 mΩ 0.001 2 % of reading + 5.8 mΩ 0.001 2 % of reading + 58 mΩ 0.002 % of reading + 2.3 Ω 0.006 % of reading + 0.12 kΩ 0.059 % of reading + 1.2 kΩ 0.58 % of reading + 12 kΩ	Keysight 3458A 8.5 Digit Multimeter, Standard Decade Resistors
Phase – Source ¹	(0.01 to 179.99) ^o (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 ^o 0.2 ^o 0.39 ^o 1.9 ^o 3.9 ^o 7.8 ^o	Fluke 5520A Multiproduct Calibrator
DC Power – Source ¹ (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	Fluke 5520A Multiproduct Calibrator



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AC Power – Source ^{1,3} PF = 1 (10 to 65) Hz	(3.3 to 9) mA		Fluke 5520A Multiproduct Calibrator
	110 μW to 3 mW	0.13 % of reading	
	3 mW to 9 W	0.077 % of reading	
	(9 to 33) mA		
	300 μW to 10 mW	0.089 % of reading	
	10 mW to 33 W	0.077 % of reading	
	(33 to 90) mA		
	(1 to 30) mW	0.071 % of reading	
	30 mW to 90 W	0.057 % of reading	
	(90 to 330) mA		
	(3 to 100) mW	0.089 % of reading	
	100 mW to 300 W	0.078 % of reading	
	(0.33 to 0.9) A		
	(11 to 300) mW	0.071 % of reading	
	300 mW to 900 W	0.081 % of reading	
	(0.9 to 2.2) A		
30 mW to 0.72 W	0.089 % of reading		
0.72 W to 2 kW	0.079 % of reading		
(2.2 to 4.5) A			
80 mW to 1.4 W	0.09 % of reading		
1.4 W to 4.5 kW	0.18 % of reading		
(4.5 to 20.5) A			
(0.15 to 6.7) W	0.17 % of reading		
6.7 W to 20 kW	0.17 % of reading		
Electrical Simulation of Thermocouple Indicating Devices – Measure/Source ¹	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	

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 ¹	Type E		Ectron 1140A Thermocouple Calibrator/Simulator
	(-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	
	Type N		
	(-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		

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 ¹	Type S		Ectron 1140A Thermocouple Calibrator/Simulator	
		(-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 ^{1,4}	Amplitude – DC into 50 Ω load into 1 MΩ load	(-6 to 6) V	0.2 % of reading + 31 μV	Fluke 5520A/11 Multiproduct Calibrator
		(-130 to 130) V	0.04 % 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	0.19 % of reading + 31 μV	
		into 1 MΩ load	10 Hz to 1 kHz 1 mV p-p to 6.6 V p-p (1 kHz to 10) kHz 1 mV p-p to 6.6 V p-p	
	Time Markers into 50 Ω load	1 ns to 20 ms	0.000 2 % of reading	
		50 ms	2.3 μs	
		0.1 s	7.6 μs	
		0.2 s	28 μs	
		0.5 s	0.2 ms	
		1 s	0.6 ms	
2 s		2.4 ms		
5 s	15 ms			



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment	
Oscilloscopes ^{1,4} Rise Time into 50 Ω load Rate: 1 kHz to 2 MHz Rate: 2 MHz to 10 MHz	5 mV p-p to 2.5 V p-p 250 ps (nominal) 250 ps (nominal)	50 ps 50 ps	Fluke 5520A/11 Multiproduct Calibrator	
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 (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 + 0.2 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	1.4 % of reading + 78 μV 1.8 % of reading + 78 μV 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		
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		
Waveform Generator (Sine, Square, Triangle) Amplitude	10 Hz to 10 kHz into 50 Ω load into 1 MΩ load	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 μV 2.3 % of reading + 78 μV
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 ^{1,2} 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	Gage Blocks, Long Gage Blocks
Anvil Flatness	Up to 1 in <i>D</i> (0 to 100) μin	6.3 μin	Optical Flat
Calipers ^{1,2} 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	Gauge Blocks, Long Gauge Blocks, Ring Gauges
Dial Indicators ^{1,2}	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	Dial Indicator Tester
Height Measuring Devices ^{1,2}	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	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			
Tension	(1 to 400) lbf	0.013 % of reading	NIST Class F Weights
Compression	(1 to 200) lbf	0.013 % of reading	
Torque Tools ⁵	(20 to 100) ozf·in 4 lbf·in to 600 lbf·ft	0.06 % of reading + 0.06 ozf·in 0.3 % of reading	CDI 5000-ST/CDI 1001-O-ETT Torque Calibration System

Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Balances ^{1,6}	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 ^{1,6}	(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 ¹	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 ¹	(-15 to 0) psig	0.000 75 psi	Mensor CPC6050 Pressure Controller
Pneumatic Pressure Devices ¹	Up to 7 inH ₂ O	0.003 inH ₂ O	Mensor CPC6050 Pressure Controller
	(7 to 40) inH ₂ O	0.002 3 inH ₂ O	Fluke P3012 Deadweight Tester
	(1.444 to 14.5) psig	0.006 % of reading	
	(14.5 to 15) psig	0.01 % of reading	Mensor CPC6050 Pressure Controller
Pneumatic Pressure Devices ¹	(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



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Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Hydraulic Pressure Devices ¹	(10 to 50) psig	0.004 psi	Cosa W2200-3-P Deadweight Tester
	(50 to 500) psig	0.007 9 % of reading	
	(500 to 1 000) psig	0.08 psi	
	(1 000 to 10 000) psig	0.008 2 % of reading	

Thermodynamic

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Thermometers, PRT, RTD, and Thermistor Probes ¹	(-80 to 0) °C	0.018 °C	Liquid Baths, Drywell Calibrators, Hart 5628 Secondary Standard PRT with Blackstack
	(0 to 150) °C	0.033 °C	
Drywell Calibrators, Liquid Baths, Temperature Controlled Chambers ¹	(150 to 300) °C	0.042 °C	Hart 5628 Secondary Standard PRT, Blackstack
	(300 to 660) °C	0.24 °C	
	0.01 °C	0.001 8 °C	
Thermocouple Wires and Probes ¹ (Types J, K, E, and T only)	(-80 to 0) °C	0.22 °C	Liquid Baths, Drywell Calibrators, Hart 5628 Secondary Standard PRT with Blackstack, and Ectron 1140A or equivalent standard.
	(0 to 100) °C	0.22 °C	
	(100 to 150) °C	0.26 °C	
	(150 to 300) °C	0.41 °C	
	(300 to 660) °C	0.74 °C	
Infrared Thermometers	(-15 to 0) °C	0.79 °C	Fluke 4180 Blackbody Source (flat plate) $\lambda = (8 \text{ to } 14) \mu\text{m}$, $\epsilon = (0.9 \text{ to } 1)$
	(0 to 50) °C	0.53 °C	
	(50 to 100) °C	0.68 °C	
	(100 to 120) °C	0.75 °C	Fluke 4181 Blackbody Source (flat plate) $\lambda = (8 \text{ to } 14) \mu\text{m}$, $\epsilon = (0.9 \text{ to } 1)$
	(120 to 200) °C	0.98 °C	
	(200 to 350) °C	1.7 °C	
	(350 to 500) °C	2.3 °C	

Thermodynamic

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Humidity – Measuring Devices	(0 to 15) °C		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 ¹	(-40 to -20) °C		Vaisala HM70/HMP77 Temp/Humidity Probe
	(8 to 97) %RH	1.8 %RH	
	(-20 to 40) °C		
	(8 to 90) %RH	1.3 %RH	
	(90 to 97) %RH	2 %RH	
	(40 to 100) °C		
	(8 to 97) %RH	1.8 %RH	

Time and Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Frequency – Source	10 MHz	0.59 nHz	Rubidium Oscillator
	1 μHz to 80 MHz	2.3 μHz/Hz	Keysight 33250A Function/Arbitrary Waveform Generator
Frequency – Measure ¹	10 MHz	2.3 nHz	Keysight 53132A Universal Counter
Timer/Stopwatches ¹	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 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 for scales and balances is highly dependent upon the resolution of the unit 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.
7. This scope is formatted as part of a single document including Certificate of Accreditation No. AC-2489.24.



R. Douglas Leonard Jr., VP, PILR SBU

