



# CERTIFICATE OF ACCREDITATION

## The ANSI National Accreditation Board

Hereby attests that

**Transcat-Dayton**  
**2056 South Alex Road**  
**West Carrollton, OH 45449**

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).

R. Douglas Leonard Jr., VP, PILR SBU

Expiry Date: 07 September 2021  
Certificate Number: AC-2489.06



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

**Transcat – Dayton**  
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West Carrollton, OH 45449  
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**CALIBRATION**

Valid to: **September 7, 2021**

Certificate Number: **AC-2489.06**

**Chemical Quantities**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Conductivity Meters	4 pH	0.012 pH	Accredited Solutions
	7 pH	0.011 pH	
	10 pH	0.012 pH	
pH Meters	1 $\mu$ S	0.3 $\mu$ S	Accredited Solutions
	10 $\mu$ S	0.3 $\mu$ S	
	100 $\mu$ S	2.1 $\mu$ S	
	1 000 $\mu$ S	5 $\mu$ S	
	1 413 $\mu$ S	4 $\mu$ S	
	10 000 $\mu$ S	44 $\mu$ S	
	100 000 $\mu$ S	330 $\mu$ S	
150 000 $\mu$ S	570 $\mu$ S		
200 000 $\mu$ S	670 $\mu$ S		

**Electrical – DC/Low Frequency**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
DC Current – Measure <sup>1</sup>	(0 to 100) $\mu$ A	33 $\mu$ A/A + 0.9 nA	HP 3458A Opt. 2 8.5 Digit Multimeter
	(0.1 to 1) mA	29 $\mu$ A/A + 5.8 nA	
	(1 to 10) mA	29 $\mu$ A/A + 58 nA	
	(10 to 100) mA	46 $\mu$ A/A + 0.58 $\mu$ A	
	(0.1 to 1) A	0.13 mA/A + 12 $\mu$ A	

**Electrical – DC/Low Frequency**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
DC Current – Measure <sup>1</sup>	(1 to 100) A	0.012 % of reading + 0.53 mA	Ohms Labs CS-100 Precision Shunt, HP 3458A Opt. 2 8.5 Digit Multimeter
	(100 to 1 000) A	0.31 % of reading + 10 mA	Canadian Shunt LC-1000-50, HP 3458A Opt. 2 8.5 Digit Multimeter
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	45 $\mu$ A/A + 6.9 nA 39 $\mu$ A/A + 8.1 nA 39 $\mu$ A/A + 46 nA 58 $\mu$ A/A + 0.7 $\mu$ A 0.24 mA/A + 12 $\mu$ A	Fluke 5720A Multiproduct Calibrator
	(2.2 to 11) A	0.4 mA/A + 0.48 mA	Fluke 5720A Multiproduct Calibrator, Fluke 5725A Amplifier
	(11 to 20) A	0.084 % of reading + 0.58 mA	Fluke 5520A Multiproduct Calibrator
DC Clamp-on Ammeter (Non-Toroidal Type) Hall Effect Sensor <sup>1</sup>	20 to 150) A (150 to 1 000) A	0.58 % + 0.16 A 0.59 % + 0.58 A	Fluke 5520A Multiproduct Calibrator, Fluke 5500A/COIL 50-turn Coil
AC Current – Measure <sup>1</sup>	Up to 100 $\mu$ A (10 to 20) Hz (20 to 45) Hz 45 Hz to 5 kHz	0.46 % of reading + 35 nA 0.17 % of reading + 35 nA 0.072 % of reading + 35 nA	HP 3458A Opt. 2 8.5 Digit Multimeter
	(0.1 to 1) mA (10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz	0.46 % of reading + 0.23 $\mu$ A 0.17 % of reading + 0.23 $\mu$ A 0.071 % of reading + 0.23 $\mu$ A 0.039 % of reading + 0.23 $\mu$ A	
	(1 to 10) mA (10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz	0.46 % of reading + 2.3 $\mu$ A 0.17 % of reading + 2.3 $\mu$ A 0.071 % of reading + 2.3 $\mu$ A 0.039 % of reading + 2.3 $\mu$ A	

**Electrical – DC/Low Frequency**

<b>Parameter/Equipment</b>	<b>Range</b>	<b>Expanded Uncertainty of Measurement (+/-)</b>	<b>Reference Standard, Method, and/or Equipment</b>
AC Current – Measure <sup>1</sup>	(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 + 23 $\mu$ A 0.17 % of reading + 23 $\mu$ A 0.071 % of reading + 23 $\mu$ A 0.038 % of reading + 23 $\mu$ A	HP 3458A Opt. 2 8.5 Digit Multimeter
	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 + 0.23 mA 0.19 % of reading + 0.23 mA 0.1 % of reading + 0.23 mA 0.12 % of reading + 0.23 mA	
	(1 to 100) A 50 Hz to 1 kHz	0.12 % of reading + 2.3 mA	Ohms Labs CS-100 Precision Shunt, Agilent 3458A 8.5 Digit Multimeter
AC Current – Source <sup>1</sup>	Up to 220 $\mu$ A (10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.032 % of reading + 16 nA 0.019 % of reading + 10 nA 0.014 % of reading + 8 nA 0.026 % of reading + 10 nA 0.11 % of reading + 65 nA	Fluke 5720A Multiproduct Calibrator
	(0.22 to 2.2) mA (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 + 40 nA 0.018 % of reading + 35 nA 0.014 % of reading + 35 nA 0.026 % of reading + 0.11 $\mu$ A 0.11 % of reading + 0.65 $\mu$ A	
	(2.2 to 22) mA (10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.033 % of reading + 0.4 $\mu$ A 0.018 % of reading + 0.35 $\mu$ A 0.014 % of reading + 0.35 $\mu$ A 0.021 % of reading + 0.55 $\mu$ A 0.11 % of reading + 5 $\mu$ A	
	(22 to 220) mA (10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.033 % of reading + 4 $\mu$ A 0.018 % of reading + 3.5 $\mu$ A 0.014 % of reading + 2.5 $\mu$ A 0.021 % of reading + 3.5 $\mu$ A 0.11 % of reading + 10 $\mu$ A	
	(0.22 to 2.2) A 20 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.027 % of reading + 35 $\mu$ A 0.045 % of reading + 80 $\mu$ A 0.7 % of reading + 0.16 mA	

**Electrical – DC/Low Frequency**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current – Source <sup>1</sup>	(2.2 to 11) A 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz 11 A to 20 A (45 to 100) Hz 100 Hz to 1 kHz (1 to 5) kHz	0.047 % of reading + 0.17 mA 0.095 % of reading + 0.38 mA 0.36 % of reading + 0.75 mA  0.091 % of reading + 3.9 mA 0.12 % of reading + 3.9 mA 2.3 % of reading + 3.9 mA	Fluke 5720A Multiproduct Calibrator, Fluke 5725A Amplifier
AC Current – Source <sup>1</sup> (Extended Frequency Ranges)	(29 to 330) $\mu$ A (10 to 30) kHz (0.33 to 3.3) mA (10 to 30) kHz (3.3 to 33) mA (10 to 30) kHz (29 to 330) mA (10 to 30) kHz	1.2 % of reading + 0.31 $\mu$ A  0.78 % of reading + 0.47 $\mu$ A  0.31 % of reading + 3 $\mu$ A  0.31 % of reading + 0.16 mA	Fluke 5520A Multiproduct Calibrator
AC Clamp-on Ammeter (Toroidal Type) Transformer Type Sensor <sup>1</sup>	(20 to 150) A (45 to 65) Hz (65 to 440) Hz (150 to 1 000) A (45 to 65) Hz (65 to 440) Hz	0.34 % of reading + 30 mA 0.95 % of reading + 48 mA  0.38 % of reading + 0.12 A 1.2 % of reading + 0.22 A	Fluke 5520A Multiproduct Calibrator, Fluke 5500A/COIL 50-turn Coil
AC Clamp-on Ammeter (Non-Toroidal Type) Hall Effect Sensor <sup>1</sup>	(20 to 150) A (45 to 65) Hz (65 to 440) Hz	0.65 % of reading + 0.29 A 1.2 % of reading + 0.29 A	
DC Resistance – Source/Measure <sup>1</sup>	(0.01 to 10) $\Omega$ (10 to 100) $\Omega$ (0.1 to 1) k $\Omega$ (1 to 10) k $\Omega$ (10 to 100) k $\Omega$ (0.1 to 1) M $\Omega$ (1 to 10) M $\Omega$ (10 to 100) M $\Omega$ (0.1 to 1) G $\Omega$	20 $\mu\Omega/\Omega$ + 58 $\mu\Omega$ 15 $\mu\Omega/\Omega$ + 0.58 m $\Omega$ 13 $\mu\Omega/\Omega$ + 0.58 m $\Omega$ 12 $\mu\Omega/\Omega$ + 5.8 m $\Omega$ 13 $\mu\Omega/\Omega$ + 58 m $\Omega$ 21 $\mu\Omega/\Omega$ + 2.3 $\Omega$ 62 $\mu\Omega/\Omega$ + 0.12 k $\Omega$ 0.06 % of reading + 1.2 k $\Omega$ 0.58 % of reading + 12 k $\Omega$	HP 3458A Opt. 2 8.5 Digit Multimeter, Decade Resistor
DC Resistance – Source/Measure <sup>1</sup> (RTD Devices)	Up to 25 $\Omega$ (25 to 400) $\Omega$ (0.4 to 1) k $\Omega$ (1 to 40) k $\Omega$	56 $\mu\Omega$ 2.1 $\mu\Omega/\Omega$ 4.4 $\mu\Omega/\Omega$ 10 $\mu\Omega/\Omega$	Hart 1590 Thermometer Readout, Reference Resistors
DC Resistance – Source <sup>1</sup> (Fixed)	1 m $\Omega$ 10 m $\Omega$ 100 m $\Omega$	0.16 m $\Omega/\Omega$ 0.16 m $\Omega/\Omega$ 0.16 m $\Omega/\Omega$	Standard Resistors

**Electrical – DC/Low Frequency**

<b>Parameter/Equipment</b>	<b>Range</b>	<b>Expanded Uncertainty of Measurement (+/-)</b>	<b>Reference Standard, Method, and/or Equipment</b>
DC Resistance – Source <sup>1,2</sup> (Variable)	(1 to 10) GΩ (10 to 100) GΩ (0.1 to 1) TΩ	0.58 % + 1.2 μΩ/Ω/V 1.2 % + 2.3 μΩ/Ω/V 1.2 % + 5.8 μΩ/Ω/V	IET HRRS-B-7-100k-5kV Decade Resistor
DC Voltage – Measure <sup>1</sup>	(0 to 100) mV (0.1 to 10) V (10 to 100) V (100 to 500) V (500 to 800) V (800 to 1 000) V	8.3 μV/V + 0.53 μV 5.3 μV/V + 0.53 μV 7.6 μV/V + 35 μV 11 μV/V + 0.12 mV 17 μV/V + 0.12 mV 21 μV/V + 0.12 mV	HP 3458A Opt. 2 8.5 Digit Multimeter
DC High Voltage – Measure <sup>1</sup>	(1 to 10) kV (10 to 20) kV (20 to 70) kV (70 to 100) kV	0.035 % of reading + 2.1 V 0.041 % of reading + 37 V 0.038 % of reading + 55 V 0.063 % of reading + 0.16 kV	Vitrek 4700 Digital HV Meter, Associated High Voltage Probes
DC Voltage – Source <sup>1</sup>	Up 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	0.1 μV/V + 0.4 μV 5.7 μV/V + 0.7 μV 4.4 μV/V + 2.5 μV 4 μV/V + 4 μV 6.3 μV/V + 40 μV 7.6 μV/V + 0.4 mV	Fluke 5720A 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 (10 to 100) 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 (0.1 to 1) 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	0.04 % of reading + 3.5 μV 0.03 % of reading + 1.3 μV 0.04 % of reading + 1.3 μV 0.16 % of reading + 1.3 μV 0.59 % of reading + 1.3 μV 4.6 % of reading + 2.3 μV 0.013 % of reading + 4.6 μV 0.009 7 % of reading + 2.3 μV 0.017 % of reading + 2.3 μV 0.038 % of reading + 2.3 μV 0.094 % of reading + 2.3 μV 0.37 % of reading + 12 μV 1.2 % of reading + 12 μV 0.008 8 % of reading + 46 μV 0.008 3 % of reading + 23 μV 0.017 % of reading + 23 μV 0.036 % of reading + 23 μV 0.094 % of reading + 23 μV 0.35 % of reading + 0.12 mV 1.2 % of reading + 0.12 mV	HP 3458A Opt. 2 8.5 Digit Multimeter





ANSI National Accreditation Board

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Measure <sup>1</sup>	(1 to 10) V		HP 3458A Opt. 2 8.5 Digit Multimeter
	(1 to 40) Hz	0.009 9 % of reading + 0.46 mV	
	40 Hz to 1 kHz	0.008 6 % of reading + 0.23 mV	
	(1 to 20) kHz	0.017 % of reading + 0.23 mV	
	(20 to 50) kHz	0.036 % of reading + 0.23 mV	
	(50 to 100) kHz	0.093 % of reading + 0.23 mV	
	(100 to 300) kHz	0.35 % of reading + 1.2 mV	
	300 kHz to 1 MHz	1.2 % of reading + 1.2 mV	
	(10 to 100) V		
	(1 to 40) Hz	0.025 % 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		
AC High Voltage – Measure <sup>1</sup>	(100 to 700) V		Vitrek 4700 Digital HV Meter, Associated High Voltage Probes
	(1 to 40) Hz	0.048 % of reading + 46 mV	
	40 Hz to 1 kHz	0.048 % of reading + 23 mV	
	(1 to 20) kHz	0.071 % of reading + 23 mV	
	(20 to 50) kHz	0.14 % of reading + 23 mV	
	(50 to 100) kHz	0.35 % of reading + 23 mV	
	(0.7 to 10) kV		
	(30 to 200) Hz	0.14 % of reading + 2.1 V	
	(200 to 450) Hz	0.46 % of reading + 2.1 V	
	(10 to 35) kV		
	(30 to 200) Hz	0.12 % of reading + 37 V	
	(200 to 450) Hz	0.71 % of reading + 37 V	
	(35 to 70) kV		
	(30 to 100) Hz	0.12 % of reading + 55 V	
	(100 to 200) Hz	0.69 % of reading + 55 V	
(70 to 100) kV			
(30 to 70) Hz	0.15 % of reading + 0.16 kV		
(70 to 200) Hz	1.2 % of reading + 0.16 kV		

**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 5720A Multiproduct Calibrator
	(10 to 20) Hz	0.16 % of reading + 4 $\mu$ V	
	(20 to 40) Hz	0.1 % of reading + 4 $\mu$ V	
	40 Hz to 20 kHz	0.077 % of reading + 4 $\mu$ V	
	(20 to 50) kHz	0.12 % of reading + 4 $\mu$ V	
	(50 to 100) kHz	0.17 % of reading + 5 $\mu$ V	
	(100 to 300) kHz	0.33 % of reading + 10 $\mu$ V	
	(300 to 500) kHz	0.47 % of reading + 20 $\mu$ V	
	500 kHz to 1 MHz	0.58 % of reading + 20 $\mu$ V	
	(2.2 to 22) mV		
	(10 to 20) Hz	0.044 % of reading + 4 $\mu$ V	
	(20 to 40) Hz	0.031 % of reading + 4 $\mu$ V	
	40 Hz to 20 kHz	0.015 % of reading + 4 $\mu$ V	
	(20 to 50) kHz	0.031 % of reading + 4 $\mu$ V	
	(50 to 100) kHz	0.059 % of reading + 5 $\mu$ V	
	(100 to 300) kHz	0.12 % of reading + 10 $\mu$ V	
	(300 to 500) kHz	0.16 % of reading + 20 $\mu$ V	
	500 kHz to 1 MHz	0.3 % of reading + 20 $\mu$ V	
	(22 to 220) mV		
	(10 to 20) Hz	0.028 % of reading + 12 $\mu$ V	
	(20 to 40) Hz	0.011 % of reading + 7 $\mu$ V	
	40 Hz to 20 kHz	0.009 % of reading + 7 $\mu$ V	
	(20 to 50) kHz	0.021 % of reading + 7 $\mu$ V	
	(50 to 100) kHz	0.047 % of reading + 17 $\mu$ V	
(100 to 300) kHz	0.092 % of reading + 20 $\mu$ V		
(300 to 500) kHz	0.14 % of reading + 25 $\mu$ V		
500 kHz to 1 MHz	0.28 % of reading + 45 $\mu$ V		
(0.22 to 2.2) V			
(10 to 20) Hz	0.028 % of reading + 40 $\mu$ V		
(20 to 40) Hz	0.01 % of reading + 15 $\mu$ V		
40 Hz to 20 kHz	0.005 % of reading + 8 $\mu$ V		
(20 to 50) kHz	0.008 % of reading + 10 $\mu$ V		
(50 to 100) kHz	0.012 % of reading + 30 $\mu$ V		
(100 to 300) kHz	0.043 % of reading + 80 $\mu$ V		
(300 to 500) kHz	0.1 % of reading + 0.2 mV		
500 kHz to 1 MHz	0.18 % of reading + 0.3 mV		



**Electrical – DC/Low Frequency**

<b>Parameter/Equipment</b>	<b>Range</b>	<b>Expanded Uncertainty of Measurement (+/-)</b>	<b>Reference Standard, Method, and/or Equipment</b>
AC Voltage – Source <sup>1</sup>	(2.2 to 22) V		Fluke 5720A Multiproduct Calibrator
	(10 to 20) Hz	0.028 % of reading + 0.4 mV	
	(20 to 40) Hz	0.01 % of reading + 0.15 mV	
	40 Hz to 20 kHz	0.005 % of reading + 0.05 mV	
	(20 to 50) kHz	0.008 % of reading + 0.1 mV	
	(50 to 100) kHz	0.011 % of reading + 0.2 mV	
	(100 to 300) kHz	0.03 % of reading + 0.6 mV	
	(300 to 500) kHz	0.1 % of reading + 2 mV	
	500 kHz to 1 MHz	0.17 % of reading + 3.2 mV	
	(22 to 220) V		
	(10 to 20) Hz	0.028 % of reading + 4 mV	
	(20 to 40) Hz	0.01 % of reading + 1.5 mV	
	40 Hz to 20 kHz	0.006 % of reading + 0.6 mV	
	(20 to 50) kHz	0.009 % of reading + 1 mV	
(50 to 100) kHz	0.016 % of reading + 2.5 mV		
(100 to 300) kHz	0.09 % of reading + 16 mV		
(300 to 500) kHz	0.44 % of reading + 40 mV		
500 kHz to 1 MHz	0.8 % of reading + 80 mV		
	(220 to 750) V		Fluke 5720A Multiproduct Calibrator, Fluke 5725A Amplifier
	(30 to 50) kHz	0.061 % of reading + 11 mV	
	(50 to 100) kHz	0.23 % of reading + 45 mV	
	(220 to 1 100) V		
	40 Hz to 1 kHz	0.011 % of reading + 4 mV	
	(1 to 20) kHz	0.017 % of reading + 6 mV	
(20 to 30) kHz	0.061 % of reading + 11 mV		
Capacitance – Source <sup>1</sup>	(0.19 to 3.3) nF	0.4 % of reading + 7.8 pF	Fluke 5520A Multiproduct Calibrator
	(3.3 to 11) nF	0.22 % of reading + 7.8 pF	
	(11 to 110) nF	0.22 % of reading + 78 pF	
	(110 to 330) nF	0.22 % of reading + 0.23 nF	
	(0.33 to 1.1) μF	0.22 % of reading + 0.78 nF	
	(1.1 to 3.3) μF	0.22 % of reading + 2.3 nF	
	(3.3 to 11) μF	0.22 % of reading + 7.8 nF	
	(11 to 33) μF	0.33 % of reading + 23 nF	
	(33 to 110) μF	0.42 % of reading + 78 nF	
	(110 to 330) μF	0.42 % of reading + 0.23 μF	
	(0.33 to 1.1) mF	0.36 % of reading + 0.78 μF	
	(1.1 to 3.3) mF	0.35 % of reading + 2.3 μF	
	(3.3 to 11) mF	0.35 % of reading + 7.8 μF	
	(11 to 33) mF	0.58 % of reading + 23 μF	
(33 to 110) mF	0.85 % of reading + 78 μF		

**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	0.093 °C	
	(-90 to 0) °C	0.083 °C	
	(0 to 15) °C	0.082 °C	
	(15 to 890) °C	0.073 °C	
	(890 to 1 000) °C	0.082 °C	
	Type J		
	(-170 to -180) °C	0.13 °C	
	(-180 to -120) °C	0.11 °C	
	(-120 to -50) °C	0.092 °C	
(-50 to 990) °C	0.082 °C		
(990 to 1 200) °C	0.082 °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	0.084 °C		
(1 000 to 1 372) °C	0.093 °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 R		Ectron 1140A Thermocouple Calibrator/Simulator
	(-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	0.092 °C		
(100 to 400) °C	0.083 °C		
Scope Voltage – Source <sup>1</sup> Amplitude DC into 50 Ω load into 1 MΩ load	(-6 to 6) V (-130 to 130) V	0.2 % of reading + 31 μV 0.039 % of reading + 31 μV	Fluke 5520A/11 Multiproduct Calibrator
Scope Voltage – Source <sup>1</sup> Square Wave into 50 Ω load  into 1 MΩ load	10 Hz to 100 kHz 1 mV p-p to 6.6 Vp-p	0.19 % of reading + 31 μV	Fluke 5520A/11 Multiproduct Calibrator
	10 Hz to 1 kHz 1 mV p-p to 6.6 Vp-p (1 kHz to 10) kHz	0.078 % of reading + 31 μV	
	1 mV p-p to 6.6 Vp-p	0.19 % of reading + 31 μV	

**Electrical – DC/Low Frequency**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Scope – Time Markers <sup>1</sup> into 50 Ω load	1 ns to 20 ms 50 ms 0.1 s 0.2 s 0.5 s 1 s 2 s 5 s	0.000 2 % of reading 2.3 μs 7.6 μs 28 μs 0.16 ms 0.62 ms 2.4 ms 15 ms	Fluke 5520A/11 Multiproduct Calibrator
Scope Rise Time – Source <sup>1,3</sup> into 50 Ω load Rate: 1 kHz to 2 MHz Rate: 2 MHz to 10 MHz	5 mVp-p to 2.5 Vp-p 250 ps (nominal) 250 ps (nominal)	50 ps 50 ps	Fluke 5520A/11 Multiproduct Calibrator
Rise Time – Measure <sup>1</sup>	≥ 5 ns	4 ns	Agilent DSO5012 Digital Oscilloscope
Scope Levelled Sine Wave – Source <sup>1</sup> into 50 Ω load	5 mVp-p to 5 Vp-p 50 kHz 50 kHz to 100 MHz (100 to 300) MHz (300 to 600) MHz (600 to 1 100) MHz	1.8 % of reading + 0.23 mV 2.8 % of reading + 0.23 mV 3.2 % of reading + 0.23 mV 4 % of reading + 0.23 mV 4.9 % of reading + 0.23 mV	Fluke 5520A/11 Multiproduct Calibrator
Scope Bandwidth/Flatness – Source <sup>1</sup> into 50 Ω load (50 kHz Reference)	5 mVp-p to 5.5 Vp-p 50 kHz to 100 MHz (100 to 300) MHz (300 to 600) MHz (600 to 1 100) MHz	1.4 % of reading + 78 μV 1.8 % of reading + 78 μV 3.2 % of reading + 78 μV 3.9 % of reading + 78 μV	Fluke 5520A/11 Multiproduct Calibrator
Input Impedance – Measure <sup>1</sup> into 50 Ω load into 1 MΩ load	(40 to 60) Ω (0.5 to 1.5) MΩ	0.082 % of reading 0.081 % of reading	Fluke 5520A/11 Multiproduct Calibrator
Input Capacitance – Measure <sup>1</sup>	(5 to 50) pF	3.9 % of reading + 0.39 pF	Fluke 5520A/11 Multiproduct Calibrator

**Electrical – DC/Low Frequency**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Scope Waveform Generator – Source <sup>1</sup> Amplitude (Sine, Square, Triangle) into 50 Ω load into 1 MΩ load  Frequency (Sine, Square, Triangle)	10 Hz to 10 kHz 1.8 mVp-p to 2.5 Vp-p 1.8 mVp-p to 55 Vp-p  10 Hz to 10 kHz	2.3 % of reading + 78 μV 2.3 % of reading + 78 μV  0.001 9 % of reading + 12 mHz	Fluke 5520A/11 Multiproduct Calibrator
LF Phase – Source <sup>1</sup>	(0 to 180) ° (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 ° 0.4 ° 1.9 ° 3.9 ° 7.8 °	Fluke 5520A/1100 Calibrator
DC Power – Source <sup>1</sup> (0.33 to 330) mA  (0.33 to 3) A  (3 to 20.5) A	11 μW to 1.1 mW 1.1 mW to 0.11 W (0.11 to 110) W (110 to 330) W  11 μW to 110 mW (0.11 to 990) W (0.99 to 3) kW  99 mW to 0.99 W 0.99 W to 6.8 kW (6.8 to 20.5) kW	0.024 % of reading 0.027 % of reading 0.024 % of reading 0.018 % of reading  0.044 % of reading 0.053 % of reading 0.009 6 % of reading  0.088 % of reading 0.07 % of reading 0.04 % of reading	Fluke 5520A/1100 Calibrator
AC Power – Source <sup>1,4</sup> PF = 1 (3.3 to 9) mA  (9 to 33) mA  (33 to 90) mA	(10 to 65) Hz (0.11 mW to 3) mW 3 mW to 9 W (10 to 65) W (0.3 to 10) mW 10 mW to 33 W (10 to 65) Hz (1 mW to 30) mW 30 mW to 9 W	0.13 % of reading 0.077 % of reading  0.089 % of reading 0.077 % of reading  0.71 % of reading 0.057 % of reading	Fluke 5520A/1100 Calibrator

### Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Power – Source <sup>1,4</sup> PF = 1			
(90 to 330) mA	(10 to 65) Hz (3 to 100) mW 100 mW to 300 W	0.089 % of reading 0.078 % of reading	Fluke 5520A/1100 Calibrator
(0.33 to 0.9) A	(10 to 65) Hz (11 to 300) mW (0.3 to 900) W	0.071 % of reading 0.081 % of reading	
(0.9 to 2.2) A	(10 to 65) Hz (30 to 720) mW 0.72 W to 2 kW	0.089 % of reading 0.079 % of reading	
(2.2 to 4.5) A	(10 to 65) Hz 80 mW to 1.4 W 1.4 W to 4.5 kW	0.088 % of reading 0.18 % of reading	
(4.5 to 20.5) A	(10 to 65) Hz 150 mW to 6.7 W 6.7 W to 20 kW	0.17 % of reading 0.17 % of reading	

### Length – Dimensional Metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Angle <sup>1</sup>			
Measure	Up to 360 °	0.25 °	Digital Protractor
Generate	Up to 75 ° 90 °	6.6 ” 2.7 ”	Angle Blocks Master Square
Gage Blocks <sup>2</sup> (Chrome or Steel)	(0.01 to 1) in (1 to 4) in	3.3 μin (1.7 + 1.4L) μin	Gage Block Comparator, Master Gage Blocks
Long Gage Blocks <sup>2</sup> (Steel)	(4 to 20) in	(5.5 + 1.4L) μin	
Calipers, Micrometers <sup>1,2</sup> (Outside, Inside, Depth, Step)	Up to 0.4 in (0.4 to 1.1) in (1 to 4) in (4 to 40) in	(8 + 1L) μin (7 + 2L) μin (4 + 5L) μin (5 + 8L) μin	Gage Blocks, Long Gage Blocks
Anvil Flatness <sup>1</sup>	Up to 1 in Diameter	4.7 μin	Optical Flats
Anvil Parallelism <sup>1</sup>	Up to 1 in	11 μin	Optical Parallels



**Length – Dimensional Metrology**

<b>Parameter/Equipment</b>	<b>Range</b>	<b>Expanded Uncertainty of Measurement (+/-)</b>	<b>Reference Standard, Method, and/or Equipment</b>
Indicators <sup>1,2</sup> (Dial, Digital, Drop, Snap)	(0 to 1) in (1 to 4) in (4 to 24) in	(31 + 0.3L) μin (29 + 3L) μin (25 + 4L) μin	Gage Blocks, Gage Amplifier, Surface Plate
Test Indicators	Up to 0.05 in	5.6 μin	Universal Length Measuring Machine
Height Gages	Up to 1 in (1 to 4) in (4 to 24) in	(31 + 0.3L) μin (29 + 3L) μin (25 + 4L) μin	Gage Blocks, Gage Amplifier, Surface Plate
Master 1-2-3 Blocks, Caliper Masters, Parallels	Up to 4 in (4 to 24) in	(52 + 0.5L) μin (41 + 3.7L) μin	Gage Blocks, Surface Plate, Gage Amplifier
Single Axis Length – Inside <sup>2</sup>	(0.04 to 0.125) in (0.125 to 0.25) in (0.25 to 1) in (1 to 2.5) in (2.5 to 10) in (10 to 14) in	11 μin 11 μin 11 μin 18 μin (18 + 3L) μin (39 + 3L) μin	Universal Length Measuring Machine
Single Axis Length – Outside <sup>2</sup>	Up to 1 in (1 to 7) in (7 to 12) in	(6.1 + 1.3L) μin (4.5 + 4L) μin (2 + 4L) μin	
Length Measuring Equipment <sup>1,2</sup> (Linear Displacement)	Up to 144 in	(1 + 2.1L) μin	Laser Interferometer
Flatness, Straightness, Parallelism <sup>1</sup>	Up to 18 in	36 μin	Gage Amplifier, Surface Plate
Optical Comparators <sup>1,2</sup> Length (X, Y axis)	Up to 12 in	(80 + 19L) μin	Calibration Grids
Squareness	(0.04 to 0.5) in (0.5 to 1) in	(110 to 1L) μin (110 to 1.L) μin	Calibration Grids
Magnification	(10 to 50) X Up to 12 in	(240 + 21L) μin	Magnification Scale, Reticle
Cylindrical Plug Gages <sup>2</sup> (Outside Diameter)	Up to 1 in (1 to 7) in	12 μin (11 + 3L) μin	Universal Length Measuring Machine, Master Gage Blocks
Cylindrical Ring Gages <sup>2</sup> (Inside Diameter)	(0.04 to 1) in (1 to 2.5) in (2.5 to 10) in (10 to 14) in	11 μin 18 μin (18 + 3L) μin (39 + 3L) μin	Universal Length Measuring Machine, Master Ring Gages, Master Gage Blocks

**Length – Dimensional Metrology**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Thread Wires (2 to 120) TPI	(0.008 33 to 0.5) in	12 μin	Universal Length Measuring Machine, Master Gage Blocks
Thread Plugs <sup>2</sup> Pitch Diameter (60 ° Thread)	Up to 1 in (1 to 4) in (4 to 7) in	79 μin 81 μin 84 μin	Universal Length Measuring Machine, Master Thread Wires, Master Gage Blocks
Major Diameter	Up to 1 in (1 to 7) in	13 μin (10 + 3L) μin	
Plain Thread Ring Gages	Up to 1 in (1 to 4) in (4 to 7) in	79 μin 81 μin 84 μin	Master Set Plug (Based on the Uncertainty of the Master Set Plug)
Surface Plates <sup>1,2</sup>  Overall Flatness	Up to 100.7 inDL	24 √DL + 5.5 μin	In accordance with Fed Spec GGG-P-463 using Electronic Levels
Local Area Flatness (Repeat Readings)	Up to ± 0.001 in	32 μin	Suprames

**Mass and Mass Related**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Kinematic Viscosity, Viscosity Cups	18 mm <sup>2</sup> /s (cSt)	0.57 % of reading	Accredited Viscosity Standards (Nominal at 25°C)
	32 mm <sup>2</sup> /s (cSt)	0.78 % of reading	
	65 mm <sup>2</sup> /s (cSt)	0.62 % of reading	
	117 mm <sup>2</sup> /s (cSt)	0.75 % of reading	
	230 mm <sup>2</sup> /s (cSt)	0.91 % of reading	
	392 mm <sup>2</sup> /s (cSt)	1.1 % of reading	
	734 mm <sup>2</sup> /s (cSt)	0.82 % of reading	
Force Gages – Tension/Compression	(0.1 to 200) lbf	0.033 % of reading	NIST Class F Weights
Mass (Metric)	0.5 kg	11 mg	Echelon III
	1 kg	11 mg	
	2 kg	15 mg	
	5 kg	22 mg	
	10 kg	0.2 g	
	20 kg	0.3 g	
	30 kg	0.3 g	

**Mass and Mass Related**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Mass (Avoirdupois)	1 lb 2 lb 3 lb 5 lb 10 lb 20 lb 30 lb 50 lb 65 lb	0.000 022 lb 0.000 022 lb 0.000 022 lb 0.000 022 lb 0.000 044 lb 0.000 441 lb 0.000 441 lb 0.000 441 lb 0.000 661 lb	Echelon III
Balances and Scales <sup>1,5</sup> (Metric)	Up to 500 mg (0.5 to 10) g (10 to 30) g (30 to 50) g (50 to 200) g (200 to 500) g (0.5 to 5) kg (5 to 25) kg	4.7 µg 20 µg 40 µg 75 µg 0.22 mg 0.62 mg 3.7 mg 61 mg	ASTM E617 Class 1 & Class 2 weights and internal calibration procedure utilized for the calibration of the weighing system.
Balances and Scales <sup>1,5</sup>	(0.5 to 500) lb	0.033 % of reading	NIST Class F weights and internal calibration procedure utilized for the calibration of the weighing system.
Rockwell Hardness Testers <sup>1</sup>	HRC Low Middle High HRBW Low Middle High	0.42 HRC 0.35 HRC 0.34 HRC 0.46 HRBW 0.36 HRBW 0.43 HRBW	Indirect verification per ASTM E18 using Test Blocks
Pressure – Absolute <sup>1</sup>	(0 to 30) psia (30 to 300) psia (300 to 1 000) psia	0.002 6 psi 0.008 9 % of reading 0.01 % of reading	DHI RPM4 Pressure Calibrator, Pressure Controller
Pressure – Hydraulic <sup>1</sup>	(200 to 1 600) psig (1 600 to 16 200) psig	0.091 psi 0.006 % of reading	Fluke P3125-PSI Deadweight Tester
Pressure – Pneumatic <sup>1</sup>	(-15 to 30) psig (30 to 300) psi (300 to 1 000) psig	0.002 2 psi 0.0075 % of reading 0.01 % of reading	DHI RPM4 Pressure Calibrator, Pressure Controller
Pressure – Pneumatic <sup>1</sup>	(-60 to -22) inH <sub>2</sub> O (-22 to 22) inH <sub>2</sub> O (22 to 60) inH <sub>2</sub> O	0.01 % of reading 0.002 2 inH <sub>2</sub> O 0.01 % of reading	DHI PPC4 Pressure Controller

**Mass and Mass Related**

<b>Parameter/Equipment</b>	<b>Range</b>	<b>Expanded Uncertainty of Measurement (+/-)</b>	<b>Reference Standard, Method, and/or Equipment</b>
Pressure – Pneumatic <sup>1</sup>	(22 to 60) inH <sub>2</sub> O (60 to 72) inH <sub>2</sub> O (72 to 832) inH <sub>2</sub> O	0.01 % of reading 0.006 7 inH <sub>2</sub> O 0.01 % of reading	DHI PPC4 Pressure Controller
Torque Devices <sup>1</sup>	(0.2 lbf·in to 5) lbf·in	1.7 % of reading + 0.002 3 lbf·in	Tohnichi TDT60CN3-G Digital Torque Driver Tester
	(2 to 50) lbf·in	1.4 % of reading + 0.023 lbf·in	Tohnichi TDT600CN3-G Digital Torque Driver Tester
Torque Devices <sup>1</sup>	(1.5 to 295) lbf·ft (295 to 740) lbf·ft	1 % of reading 1.7 % of reading	Stahlwille Torque Calibration System
Torque Calibration Systems	(2.5 to 50) lbf·in (4.2 to 250) lbf·ft (250 to 800) lbf·ft	0.2 % of reading 0.2 % of reading 0.2 % of reading	Torque Wheels, Torque Arm, NIST Class F Weights

**Thermodynamic**

<b>Parameter/Equipment</b>	<b>Range</b>	<b>Expanded Uncertainty of Measurement (+/-)</b>	<b>Reference Standard, Method, and/or Equipment</b>
Relative Humidity – Measure <sup>1</sup>	(-10 to 15) °C Up to 95 %RH	2.1 %RH	Thermohygrometer
	(15 to 25) °C (0 to 90) %RH (90 to 95) %RH	1.3 %RH 2 %RH	
	(25 to 40) °C Up to 50 %RH (50 to 75) %RH (75 to 95) %RH	1.7 %RH 2 %RH 2.3 %RH	
Relative Humidity – Source	(-10 to 15) °C (10 to 75) %RH (75 to 95) %RH	0.5 %RH 0.65 %RH	Humidity Generator
	(15 to 35) °C (10 to 95) %RH	0.5 %RH	
	(35 to 70) °C (10 to 50) %RH (50 to 70) %RH (70 to 95) %RH	0.5 %RH 0.7 %RH 0.85 %RH	

**Thermodynamic**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Temperature – Measure <sup>1</sup>	(-100 to 0.01) °C (0.01 to 230) °C (230 to 420) °C (420 to 600) °C	11 mK 19 mK 25 mK 36 mK	PRT, Precision Indicator
	(600 to 980) °C	0.87 % of reading + 1 °C	Type K Thermocouple Probe, Thermocouple Indicator
Temperature – Source	(-80 to -40) °C (-40 to 100) °C (100 to 270) °C (270 to 400) °C	1.9 mK 1.4 mK 2.4 mK 5.6 mK	Precision Bath, SPRT
	(400 to 600) °C	22 mK	Furnace, SPRT
Infrared Temperature Measuring Devices	(-15 to 0) °C (0 to 50) °C (50 to 100) °C (100 to 120) °C (120 to 200) °C (200 to 350) °C (350 to 500) °C	0.8 °C 0.75 °C 0.7 °C 0.76 °C 0.95 °C 1.6 °C 2.1 °C	Black Body (flat plate) $\epsilon = (0.9 \text{ to } 1)$ , $\lambda = (8 \text{ to } 14) \mu\text{m}$
SPRT/PRT Calibration by Fixed Point	0.01 °C	0.6 mK	Comparison TPW Cell
	156.598 °C	1.9 mK	Comparison to In Cell
	231.928 °C	2.1 mK	Comparison to Sn Cell
	419.527 °C	3.5 mK	Comparison to Zn Cell
	660.323 °C	8.6 mK	Comparison to Al Cell
SPRT/PRT Calibration by Comparison	-195 °C	2.4 mK	Hart 5681 SPRT, NBPLN <sub>2</sub>
	-80 °C	1.9 mK	Hart 5681 SPRT, Precision Bath
	-38.8 °C	1.2 mK	

**Time and Frequency**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Frequency – Source/Measure	10 MHz	6.4 nHz/Hz	Rubidium Frequency Oscillator
Frequency – Source/Measure <sup>1</sup>	10 MHz	2.8 μHz/Hz	Agilent 53132A Frequency Counter

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.  $V$  = voltage of the DUT;  $L$  = length in inches;  $DL$  = diagonal length in inches.
3. The stated uncertainty is the laboratory’s ability to source a fast rise pulse that is approximately 250 ps. In the typical application of measuring rise time of an oscilloscope, this value is one of the contributing factors, but other factors are derived from the DUT. The known source rise time is mathematically removed from the total measured rise time measured on the DUT.
4. 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.
5. The CMC for scales and balances is highly dependent upon the resolution of the unit under test. The CMC presented here does not include the resolution of the unit under test. The resolution will be included in the reported measurement uncertainty at the time of calibration.
6. This scope is formatted as part of a single document including Certificate of Accreditation No. AC-2489.06.



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