



# CERTIFICATE OF ACCREDITATION

## ANSI-ASQ National Accreditation Board

500 Montgomery Street, Suite 625, Alexandria, VA 22314, 877-344-3044

This is to certify that

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

has been assessed by ANAB  
and meets the requirements of international standard

**ISO/IEC 17025:2005**

and national standard

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

while demonstrating technical competence in the field of

**CALIBRATION**

Refer to the accompanying Scope of Accreditation for information regarding the types of calibrations to which this accreditation applies.

AC-2489.06

Certificate Number

  
ANAB Approval

Certificate Valid: 09/29/2017-09/07/2019  
Version No. 001 Issued: 11/7/2017



This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005. 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 17025:2005 AND  
ANSI/NCSL Z540-1-1994 (R2002)**

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

Valid to: **September 7, 2019**

Certificate Number: **AC-2489.06**

**Electrical – DC/Low Frequency**

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) <sup>2</sup>	Reference Standard, Method and/or Equipment
AC Current – Measuring Equipment <sup>1</sup>	0 $\mu$ A to 220 $\mu$ A		Fluke 5720A
	10 Hz to 20 Hz	0.032 % + 16 nA	
	20 Hz to 40 Hz	0.019 % + 10 nA	
	40 Hz to 1 kHz	0.014 % + 8 nA	
	1 kHz to 5 kHz	0.026 % + 10 nA	
	5 kHz to 10 kHz	0.11 % + 65 nA	
	220 $\mu$ A to 2.2 mA		
	10 Hz to 20 Hz	0.031 % + 40 nA	
	20 Hz to 40 Hz	0.018 % + 35 nA	
	40 Hz to 1 kHz	0.014 % + 35 nA	
	1 kHz to 5 kHz	0.021 % + 0.11 $\mu$ A	
	5 kHz to 10 kHz	0.11 % + 0.65 $\mu$ A	



Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) <sup>2</sup>	Reference Standard, Method and/or Equipment
AC Current – Measuring Equipment <sup>1</sup>	2.2 mA to 22 mA		Fluke 5720A
	10 Hz to 20 Hz	0.033 % + 0.4 μA	
	20 Hz to 40 Hz	0.02 % + 0.35 μA	
	40 Hz to 1 kHz	0.015 % + 0.35 μA	
	1 kHz to 5 kHz	0.022 % + 0.55 μA	
	5 kHz to 10 kHz	0.11 % + 5 μA	
	22 mA to 220 mA		
	10 Hz to 20 Hz	0.033 % + 4 μA	
	20 Hz to 40 Hz	0.018 % + 3.5 μA	
	40 Hz to 1 kHz	0.014 % + 2.5 μA	
	1 kHz to 5 kHz	0.021 % + 3.5 μA	
	5 kHz to 10 kHz	0.11 % + 10 μA	
	220 mA to 2.2 A		
	20 Hz to 1 kHz	0.027 % + 35 μA	
	1 kHz to 5 kHz	0.045 % + 80 μA	
	5 kHz to 10 kHz	0.7 % + 0.16 mA	
	2.2 A to 11 A		
	40 Hz to 1 kHz	0.047 % + 0.17 mA	
1 kHz to 5 kHz	0.095 % + 0.38 mA		
5 kHz to 10 kHz	0.36 % + 0.75 mA		



Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) <sup>2</sup>	Reference Standard, Method and/or Equipment
AC Current – Measuring Equipment <sup>1</sup>	11 A to 20 A		Fluke 5520A
	45 Hz to 100Hz	0.091 % + 3.9 mA	
	100 Hz to 1 kHz	0.12 % + 3.9 mA	
	1 kHz to 5 kHz	2.3 % + 3.9 mA	
Extended Frequency Ranges <sup>1</sup>	29 μA to 330μA		Fluke 5520A
	10 kHz to 30 kHz	1.2 % + 0.31 μA	
	330 μA to 3.3 mA		
	10 kHz to 30 kHz	0.78 % + 0.47 μA	
	3.3 mA to 33 mA		
10 kHz to 30 kHz	0.31 % + 3 μA		
Clamp-on Ammeter Toroidal Type <sup>1</sup> Transformer Type	20 A to 150 A		Fluke 5520A with 5500A/Coil
	45 Hz to 65 Hz	0.34 % + 30 mA	
	65 Hz to 440 Hz	0.95 % + 48 mA	
	150 A to 1000 A		
	45 Hz to 65 Hz	0.38 % + 0.12 A	
	65 Hz to 440 Hz	1.2 % + 0.22 A	
Clamp-on Ammeter Non-Toroidal Type <sup>1</sup> Hall Effect Sensor	20 A to 150 A		Fluke 5520A with 5500A/Coil
	45 Hz to 65 Hz	0.65 % + 0.29 A	
	65 Hz to 440 Hz	1.2 % + 0.29 A	

**Electrical – DC/Low Frequency**

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) <sup>2</sup>	Reference Standard, Method and/or Equipment
Clamp-on Ammeter Non-Toroidal Type <sup>1</sup> Hall Effect Sensor	150 A to 1000 A		Fluke 5520A with 5500A/Coil
	45 Hz to 65 Hz	0.68 % + 1 A	
	65 Hz to 440 Hz	1.4 % + 1.1 A	
AC Current – Measure <sup>1</sup>	0 $\mu$ A to 100 $\mu$ A		HP 3458A
	10 Hz to 20 Hz	0.46 % + 35 nA	
	20 Hz to 45 Hz	0.17 % + 35 nA	
	45 Hz to 100 Hz	0.073 % + 35 nA	
	100 Hz to 1 kHz	0.073 % + 35 nA	
	100 $\mu$ A to 1 mA		
	10 Hz to 20 Hz	0.46 % + 0.23 $\mu$ A	
	20 Hz to 45 Hz	0.17 % + 0.23 $\mu$ A	
	45 Hz to 100 Hz	0.071 % + 0.23 $\mu$ A	
	100 Hz to 5 kHz	0.039 % + 0.23 $\mu$ A	
	1 mA to 10 mA		
	10 Hz to 20 Hz	0.46 % + 2.3 $\mu$ A	
	20 Hz to 45 Hz	0.17 % + 2.3 $\mu$ A	
	45 Hz to 100 Hz	0.071 % + 2.3 $\mu$ A	
	100 Hz to 5 kHz	0.039 % + 2.3 $\mu$ A	
	10 mA to 100 mA		
10 Hz to 20 Hz	0.46 % + 23 $\mu$ A		
20 Hz to 45 Hz	0.17 % + 23 $\mu$ A		

**Electrical – DC/Low Frequency**

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) <sup>2</sup>	Reference Standard, Method and/or Equipment
AC Current – Measure <sup>1</sup>	45 Hz to 100 Hz	0.071 % + 23 μA	HP 3458A
	100 Hz to 5 kHz	0.038 % + 23 μA	
	100 mA to 1 A		
	10 Hz to 20 Hz	0.46 % + 0.23 mA	
	20 Hz to 45 Hz	0.19 % + 0.23 mA	
	45 Hz to 100 Hz	0.098 % + 0.23 mA	
	100 Hz to 5 kHz	0.12 % + 0.23 mA	
DC Current – Measuring Equipment <sup>1</sup>	1 A to 100 A		CS-100 w/3458A
	50 Hz to 1 kHz	0.12 % + 2.3 mA	
DC Current – Measuring Equipment <sup>1</sup>	0 μA to 220 μA	45 μA/A + 6.9 nA	Fluke 5720A
	220 μA to 2.2 mA	39 μA/A + 8.1 nA	
	2.2 mA to 22 mA	39 μA/A + 46 nA	
	22 mA to 220 mA	58 μA/A + 0.7 μA	
	220 mA to 2.2 A	0.24 mA/A + 12 μA	
	2.2 A to 11 A	0.4 mA/A + 0.48 mA	Fluke 5720A with 5725A Amplifier
	11 A to 20 A	0.084 % + 0.58 mA	Fluke 5520A
Clamp-on Ammeter Non-Toroidal Type <sup>1</sup> Hall Effect Sensor	20 A to 150 A	0.58 % + 0.16 A	Fluke 5520A with 5500A/Coil
	150 A to 1000 A	0.59 % + 0.58 A	
DC Current – Measure <sup>1</sup>	0 μA to 100 μA	33 μA/A + 0.9 nA	Agilent 3458A opt. 2
	100 μA to 1 mA	29 μA/A + 5.8 nA	
	1 mA to 10 mA	29 μA/A + 58 nA	
	10 mA to 100 mA	46 μA/A + 0.58 μA	

**Electrical – DC/Low Frequency**

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) <sup>2</sup>	Reference Standard, Method and/or Equipment
DC Current – Measure <sup>1</sup>	100 mA to 1 A	0.13 mA/A + 12 μA	Agilent 3458A opt. 2
	1 A to 100 A	0.012 % + 0.53 mA	Ohm-Labs CS-100 w/3458A opt. 2
DC Resistance – Measuring Equipment <sup>1</sup> (where V is DUT voltage)	1 mΩ	0.16 mΩ/Ω	Standard Resistor
	10 mΩ	0.16 mΩ/Ω	
	100 mΩ	0.16 mΩ/Ω	
	1 GΩ to 10 GΩ	0.58 % + 1.2 μΩ/Ω/V	IET HRRS-B-7-100k-5kV
	10 GΩ to 100 GΩ	1.2 % + 2.3 μΩ/Ω/V	
	100 GΩ to 1 TΩ	1.2 % + 5.8 μΩ/Ω/V	
DC Resistance – Measuring Equipment and Measure <sup>1</sup>	0 Ω to 25 Ω	0.056 mΩ	Hart 1590 with Reference Resistor
	25 Ω to 400 Ω	2.1 μΩ/Ω	
	400 Ω to 1 kΩ	4.4 μΩ/Ω	
	1 kΩ to 40 kΩ	10 μΩ/Ω	
	0.01 Ω to 10 Ω	20 μΩ/Ω + 58 μΩ	Agilent 3458A opt. 2 with Decade Resistor
	10 Ω to 100 Ω	15 μΩ/Ω + 0.58 mΩ	
	100 Ω to 1 kΩ	13 μΩ/Ω + 0.58 mΩ	
	1 kΩ to 10 kΩ	12 μΩ/Ω + 5.8 mΩ	
	10 kΩ to 100 kΩ	13 μΩ/Ω + 58 mΩ	
	100 kΩ to 1 MΩ	21 μΩ/Ω + 2.3 Ω	
	1 MΩ to 10 MΩ	62 μΩ/Ω + 0.12 kΩ	
	10 MΩ to 100 MΩ	0.059 % + 1.2 kΩ	
	100 MΩ to 1 GΩ	0.58 % + 12 kΩ	

**Electrical – DC/Low Frequency**

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) <sup>2</sup>	Reference Standard, Method and/or Equipment
DC Voltage – Measure <sup>1</sup>	0 mV to 100 mV	8.3 $\mu$ V/V + 0.53 $\mu$ V	Agilent 3458A opt. 2
	100 mV to 1 V	5.3 $\mu$ V/V + 0.53 $\mu$ V	
	1 V to 10 V	5.3 $\mu$ V/V + 0.53 $\mu$ V	
	10 V to 100 V	7.6 $\mu$ V/V + 35 $\mu$ V	
	100 V to 500 V	11 $\mu$ V/V + 0.12 mV	
	500 V to 800 V	17 $\mu$ V/V + 0.12 mV	
	800 V to 1 kV	21 $\mu$ V/V + 0.12 mV	
	1 kV to 10 kV	0.035 % + 2.1 V	Vitrek 4700A
	10 kV to 35 kV	0.041 % + 37 V	Vitrek 4700A/HVP-35
	35 kV to 70 kV	0.038 % + 55 V	Vitrek 4700A/HVL-70
	70 kV to 100 kV	0.063 % + 0.16 kV	Vitrek 4700A/ HVL-100
DC Voltage – Measuring Equipment <sup>1</sup>	0 mV to 220 mV	9.1 $\mu$ V/V + 0.4 $\mu$ V	Fluke 5720A
	220 mV to 2.2 V	5.7 $\mu$ V/V + 0.7 $\mu$ V	
	2.2 V to 11 V	4.4 $\mu$ V/V + 2.5 $\mu$ V	
	11 V to 22 V	4 $\mu$ V/V + 4 $\mu$ V	
	22 V to 220 V	6.3 $\mu$ V/V + 40 $\mu$ V	
	220 V to 1.1 kV	7.6 $\mu$ V/V + 0.4 mV	
AC Voltage – Measuring Equipment <sup>1</sup>	0 mV to 2.2 mV		Fluke 5720A
	10 Hz to 20 Hz	0.16 % + 4 $\mu$ V	
	20 Hz to 40 Hz	0.1 % + 4 $\mu$ V	
	40 Hz to 20 kHz	0.077 % + 4 $\mu$ V	
	20 kHz to 50 kHz	0.12 % + 4 $\mu$ V	



**Electrical – DC/Low Frequency**

<b>Parameter / Equipment</b>	<b>Range</b>	<b>Expanded Uncertainty of Measurement (+/-) <sup>2</sup></b>	<b>Reference Standard, Method and/or Equipment</b>
AC Voltage – Measuring Equipment <sup>1</sup>	50 kHz to 100 kHz	0.17 % + 5 μV	Fluke 5720A
	100 kHz to 300 kHz	0.33 % + 10 μV	
	300 kHz to 500 kHz	0.47 % + 20 μV	
	500 kHz to 1 MHz	0.58 % + 20 μV	
	2.2 mV to 22 mV		
	10 Hz to 20 Hz	0.044 % + 4 μV	
	20 Hz to 40 Hz	0.031 % + 4 μV	
	40 Hz to 20 kHz	0.015 % + 4 μV	
	20 kHz to 50 kHz	0.031 % + 4 μV	
	50 kHz to 100 kHz	0.059 % + 5 μV	
	100 kHz to 300 kHz	0.12 % + 10 μV	
	300 kHz to 500 kHz	0.16 % + 20 μV	
	500 kHz to 1 MHz	0.3 % + 20 μV	
	22 mV to 220 mV		
	10 Hz to 20 Hz	0.028 % + 12 μV	
20 Hz to 40 Hz	0.011 % + 7 μV		
40 Hz to 20 kHz	0.009 % + 7 μV		
20 kHz to 50 kHz	0.021 % + 7 μV		
50 kHz to 100 kHz	0.047 % + 17 μV		
100 kHz to 300 kHz	0.092 % + 20 μV		
300 kHz to 500 kHz	0.14 % + 25 μV		
500 kHz to 1 MHz	0.28 % + 45 μV		

**Electrical – DC/Low Frequency**

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) <sup>2</sup>	Reference Standard, Method and/or Equipment	
AC Voltage – Measuring Equipment <sup>1</sup>	220 mV to 2.2 V		Fluke 5720A	
	10 Hz to 20 Hz	0.028 % + 40 μV		
	20 Hz to 40 Hz	0.01 % + 15 μV		
	40 Hz to 20 kHz	0.005 % + 8 μV		
	20 kHz to 50 kHz	0.008 % + 10 μV		
	50 kHz to 100 kHz	0.012 % + 30 μV		
	100 kHz to 300 kHz	0.043 % + 80 μV		
	300 kHz to 500 kHz	0.1 % + 0.2 mV		
	500 kHz to 1 MHz	0.18 % + 0.3 mV		
	2.2 V to 22 V			Fluke 5720A
	10 Hz to 20 Hz	0.028 % + 0.4 mV		
	20 Hz to 40 Hz	0.01 % + 0.15 mV		
	40 Hz to 20 kHz	0.005 % + 0.05 mV		
	20 kHz to 50 kHz	0.008 % + 0.1 mV		
	50 kHz to 100 kHz	0.011 % + 0.2 mV		
	100 kHz to 300 kHz	0.03 % + 0.6 mV		
	300 kHz to 500 kHz	0.10 % + 2 mV		
	500 kHz to 1 MHz	0.17 % + 3.2 mV		
	22 V to 220 V		Fluke 5720A with 5725A	
	10 Hz to 20 Hz	0.028 % + 4 mV		
	20 Hz to 40 Hz	0.01 % + 1.5 mV		
	40 Hz to 20 kHz	0.006 % + 0.6 mV		

**Electrical – DC/Low Frequency**

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) <sup>2</sup>	Reference Standard, Method and/or Equipment
AC Voltage – Measuring Equipment <sup>1</sup>	20 kHz to 50 kHz	0.009 % + 1 mV	Fluke 5720A with 5725A
	50 kHz to 100 kHz	0.016 % + 2.5 mV	
	100 kHz to 300 kHz	0.09 % + 16 mV	
	300 kHz to 500 kHz	0.44 % + 40 mV	
	500 kHz to 1 MHz	0.8 % + 80 mV	
	220 V to 750 V		
	30 kHz to 50 kHz	0.061 % + 11 mV	
	50 kHz to 100 kHz	0.23 % + 45 mV	
	220 V to 1100 V		
40 Hz to 1 kHz	0.011 % + 4 mV		
1 kHz to 20 kHz	0.017 % + 6 mV		
20 kHz to 30 kHz	0.061 % + 11 mV		
AC Voltage – Measure <sup>1</sup>	0 mV to 10 mV		HP 3458A opt. 2
	1 Hz to 40 Hz	0.04 % + 3.5 μV	
	40 Hz to 1 kHz	0.03 % + 1.3 μV	
	1 kHz to 20 kHz	0.04 % + 1.3 μV	
	20 kHz to 50 kHz	0.16 % + 1.3 μV	
	50 kHz to 100 kHz	0.59 % + 1.3 μV	
	100 kHz to 300 kHz	4.6 % + 2.3 μV	
	10 mV to 100 mV		
	1 Hz to 40 Hz	0.013 % + 4.6 μV	
40 Hz to 1 kHz	0.009 7 % + 2.3 μV		

**Electrical – DC/Low Frequency**

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) <sup>2</sup>	Reference Standard, Method and/or Equipment
AC Voltage – Measure <sup>1</sup>	1 kHz to 20 kHz	0.017 % + 2.3 μV	HP 3458A opt. 2
	20 kHz to 50 kHz	0.038 % + 2.3 μV	
	50 kHz to 100 kHz	0.094 % + 2.3 μV	
	100 kHz to 300 kHz	0.37 % + 12 μV	
	300 kHz to 1 MHz	1.2 % + 12 μV	
	100 mV to 1 V		
	1 Hz to 40 Hz	0.008 8 % + 46 μV	
	40 Hz to 1 kHz	0.008 3 % + 23 μV	
	1 kHz to 20 kHz	0.017 % + 23 μV	
	20 kHz to 50 kHz	0.036 % + 23 μV	
	50 kHz to 100 kHz	0.094 % + 23 μV	
	100 kHz to 300 kHz	0.35 % + 0.12 mV	
	300 kHz to 1 MHz	1.2 % + 0.12 mV	
	1 V to 10 V		
	1 Hz to 40 Hz	0.009 9 % + 0.46 mV	
	40 Hz to 1 kHz	0.008 6 % + 0.23 mV	
	1 kHz to 20 kHz	0.017 % + 0.23 mV	
	20 kHz to 50 kHz	0.036 % + 0.23 mV	
	50 kHz to 100 kHz	0.093 % + 0.23 mV	
	100 kHz to 300 kHz	0.35 % + 1.2 mV	
	300 kHz to 1 MHz	1.2 % + 1.2 mV	

**Electrical – DC/Low Frequency**

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) <sup>2</sup>	Reference Standard, Method and/or Equipment
AC Voltage – Measure <sup>1</sup>	10 V to 100 V		HP 3458A opt. 2
	1 Hz to 40 Hz	0.025 % + 4.6 mV	
	40 Hz to 1 kHz	0.024 % + 2.3 mV	
	1 kHz to 20 kHz	0.024 % + 2.3 mV	
	20 kHz to 50 kHz	0.042 % + 2.3 mV	
	50 kHz to 100 kHz	0.14 % + 2.3 mV	
	100 kHz to 300 kHz	0.46 % + 12 mV	
	300 kHz to 1 MHz	1.7 % + 12 mV	
	100 V to 700 V		
	1 Hz to 40 Hz	0.048 % + 46 mV	
	40 Hz to 1 kHz	0.048 % + 23 mV	
	1 kHz to 20 kHz	0.071 % + 23 mV	
	20 kHz to 50 kHz	0.14 % + 23 mV	
	50 kHz to 100 kHz	0.35 % + 23 mV	
	0.7 kV to 10 kV		Vitrek 4700A
	30 Hz to 200 Hz	0.14 % + 2.1 V	
		200 Hz to 450 Hz	0.46 % + 2.1 V
	10 kV to 35 kV		Vitrek 4700A/HVP-35
	30 Hz to 200 Hz	0.12 % + 37 V	
	200 Hz to 450 Hz	0.71 % + 37 V	

**Electrical – DC/Low Frequency**

<b>Parameter / Equipment</b>	<b>Range</b>	<b>Expanded Uncertainty of Measurement (+/-) <sup>2</sup></b>	<b>Reference Standard, Method and/or Equipment</b>
AC Voltage – Measure <sup>1</sup>	35 kV to 70 kV 30 Hz to 100 Hz	0.12 % + 55 V	Vitretek 4700A/HVL-70
	35 kV to 70 kV 100 Hz to 200 Hz	0.69 % + 55 V	
	70 kV to 100 kV 30 Hz to 70 Hz	0.15 % + 0.16 kV	Vitretek 4700A/HVL-100
	70 kV to 100 kV 70 Hz to 200 Hz	1.2 % + 0.16 kV	
Capacitance – Measuring Equipment <sup>1</sup>	0.19 nF to 1.1 nF 10 Hz to 10 kHz	0.4 % + 7.8 pF	Fluke 5520A
	1.1 nF to 3.3 nF 10 Hz to 3 kHz	0.4 % + 7.8 pF	
	3.3 nF to 11 nF 10 Hz to 1 kHz	0.22 % + 7.8 pF	
	11 nF to 33 nF 10 Hz to 1 kHz	0.22 % + 78 pF	
	33 nF to 110 nF 10 Hz to 1 kHz	0.22 % + 78 pF	
	110 nF to 330 nF 10 Hz to 1 kHz	0.22 % + 0.23 nF	
	0.33 μF to 1.1 μF 10 Hz to 600 Hz	0.22 % + 0.78 nF	

**Electrical – DC/Low Frequency**

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) <sup>2</sup>	Reference Standard, Method and/or Equipment
Capacitance – Measuring Equipment <sup>1</sup>	1.1 $\mu$ F to 3.3 $\mu$ F 10 Hz to 300 Hz	0.22 % + 2.3 nF	Fluke 5520A
	3.3 $\mu$ F to 11 $\mu$ F 10 Hz to 150 Hz	0.22 % + 7.8 nF	
	11 $\mu$ F to 33 $\mu$ F 10 Hz to 120 Hz	0.33 % + 23 nF	
	33 $\mu$ F to 110 $\mu$ F 10 Hz to 80 Hz	0.42 % + 78 nF	
	110 $\mu$ F to 330 $\mu$ F DC to 50 Hz	0.42 % + 0.23 $\mu$ F	
	0.33 mF to 1.1 mF DC to 20 Hz	0.36 % + 0.78 $\mu$ F	
	1.1 mF to 3.3 mF DC to 6 Hz	0.35 % + 2.3 $\mu$ F	
	3.3 mF to 11 mF DC to 2 Hz	0.35 % + 7.8 $\mu$ F	
	11 mF to 33 mF DC to 0.6 Hz	0.58 % + 23 $\mu$ F	
	33 mF to 110 mF DC to 0.2 Hz	0.85 % + 78 $\mu$ F	

**Electrical – DC/Low Frequency**

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) <sup>2</sup>	Reference Standard, Method and/or Equipment
Electrical Simulation of Thermocouples <sup>1</sup> Type R	-50 °C to 1 768 °C	0.27 °C	Thermocouple Half-Junction with HP 3458A
Type S	-50 °C to 1 768 °C	0.23 °C	
Type E	-270 °C to 1 000 °C	0.067 °C	
Type T	-270 °C to 400 °C	0.076 °C	
Type K	-270 °C to 1 372 °C	0.07 °C	
Type J	-210 °C to 1 200 °C	0.068 °C	
Type N	-200 °C to -100 °C	0.31 °C	Fluke 5520A
	-100 °C to -25 °C	0.18 °C	
	-25 °C to 120 °C	0.15 °C	
	120 °C to 410 °C	0.15 °C	
	410 °C to 1 300 °C	0.21 °C	
Type B	600 °C to 800 °C	0.34 °C	
	800 °C to 1 000 °C	0.27 °C	
	1 000 °C to 1 550 °C	0.24 °C	
	1 550 °C to 1 820 °C	0.26 °C	
Type C	0 °C to 150 °C	0.24 °C	
	150 °C to 650 °C	0.21 °C	
	650 °C to 1 000 °C	0.24 °C	
	1 000 °C to 1 800 °C	0.39 °C	
	1 800 °C to 2 316 °C	0.65 °C	





Electrical - RF/Microwave

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) <sup>2</sup>	Reference Standard, Method and/or Equipment
Power – Measuring Equipment <sup>1</sup> DC Power	0.33 mA to 330 mA		Fluke 5520A
	11 μW to 1.1 mW	0.024 %	
	1.1 mW to 110 mW	0.027 %	
	0.11W to 110 W	0.024 %	
	110 W to 330 W	0.018 %	
	0.33 A to 3 A		
	11 W to 110 mW	0.044 %	
	0.11 W to 990 W	0.053 %	
	1 W to 3 kW	0.009 6 %	
	3 A to 20.5 A		
	0.099 W to 0.99 W	0.088 %	
	0.99 W to 6.8 kW	0.07 %	
6.8 W to 20.5 kW	0.04 %		
AC Power <sup>4</sup> (PF = 1) <sup>1</sup>	3.3 mA to 9 mA		Fluke 5520A
	0.11 mW to 3 mW		
	10 Hz to 65 Hz	0.13 %	
	3 mW to 9 W		
	10 Hz to 65 Hz	0.077 %	
	9 mA to 33 mA		
0.3 mW to 10 mW		0.089 %	
10 Hz to 65 Hz			
10 mW to 33 W			
	10 Hz to 65 Hz	0.077 %	



Electrical - RF/Microwave

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) <sup>2</sup>	Reference Standard, Method and/or Equipment
AC Power <sup>4</sup> (PF = 1) <sup>1</sup>	33 mA to 90 mA	0.071 %	Fluke 5520A
	1 mW to 30 mW		
	10 Hz to 65 Hz	0.057 %	
	30 mW to 90 W		
	10 Hz to 65 Hz	0.089 %	
	90 mA to 330 mA		
	3 mW to 100 mW	0.078 %	
	10 Hz to 65 Hz		
	100 mW to 300 W	0.071 %	
	10 Hz to 65 Hz		
	0.33 A to 0.9 A	0.081 %	
	11 mW to 300 mW		
10 Hz to 65 Hz	0.089 %		
300 mW to 900 W			
10 Hz to 65 Hz	0.079 %		
0.9 A to 2.2 A			
30 mW to 720 mW	0.079 %		
10 Hz to 65 Hz			
720 mW to 2 kW	0.079 %		
10 Hz to 65 Hz			

**Electrical - RF/Microwave**

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) <sup>2</sup>	Reference Standard, Method and/or Equipment
AC Power <sup>4</sup> (PF = 1) <sup>1</sup>	2.2 A to 4.5 A 80 mW to 1.4 W 10 Hz to 65 Hz	0.088 %	Fluke 5520A
	1.4 W to 4.5 kW 10 Hz to 65 Hz	0.18 %	
	4.5 A to 20.5 A 150 mW to 6.7 W 10 Hz to 65 Hz	0.17 %	
	6.7 W to 20 kW 10 Hz to 65 Hz	0.17 %	
PHASE METERS Measuring Equipment <sup>1</sup>	0° to 179.99° 10 Hz to 65 Hz	0.09°	Fluke 5520A
	65 Hz to 500 Hz	0.2°	
	500 Hz to 1 kHz	0.39°	
	1 kHz to 5 kHz	1.9°	
	5 kHz to 10 kHz	3.9°	
	10 kHz to 30 kHz	7.8°	
Sine Wave Flatness <sup>1</sup>	50 kHz to 100 MHz	1.7 % + 0.1 mV	Fluke 5522A/SC1100
	100 MHz to 300 MHz	2 % + 0.1 mV	
	300 MHz to 600 MHz	3.5 % + 0.1 mV	
	600 MHz to 1100 MHz	4.2 % + 0.1 mV	



Length – Dimensional Metrology

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) <sup>3</sup>	Reference Standard, Method and/or Equipment
Angles	0° to 75°	6.6 arc seconds	Angle Blocks
	90°	2.7 arc seconds	Master Square Comparison
Steel and Chrome Blocks	0.01 in to 1 in	3.3 μin	Comparison to Gage Blocks
	1 in to 4 in	(1.7 + 1.4L) μin	
Steel Blocks	4 in to 20 in	(5.5 + 1.4L) μin	
Micrometers and Calipers <sup>1</sup>	0 in to 0.4 in	(8 + 1L) μin	Comparison to Gage Blocks
	0.4 in to 1 in	(7 + 2L) μin	
	1 in to 4 in	(4 + 5L) μin	
	4 in to 40 in	(5 + 8L) μin	
Anvil Flatness <sup>1</sup>	0 in to 1 in	6.4 μin	Optical Flats
Length Measurement – Single Axis	0.001 in to 20 in	(9 + 4.9L) μin	Helios Supra 500 Comparator
Inner Diameter – Ring Gages	0.6 in to 10 in	(8 + 5.3L) μin	
Length Measuring Equipment – Linear Displacement	0 in to 144 in	(1 + 2.1L) μin	Laser Interferometer
Height Measuring Equipment – Height Gages, Dial and Digital Indicators <sup>1</sup>	0 in to 1 in	(31 + 0.3L) μin	Comparison to Gage Blocks
	1 in to 4 in	(29 + 3L) μin	
	4 in to 24 in	(25 + 4L) μin	
Height Measure – Height Masters 1-2-3 Blocks, Caliper Masters, Parallels	0 in to 4 in	(52 + 0.5L) μin	Gage Blocks with Amplifier
	4 in to 24 in	(41 + 3.7L) μin	
Optical Comparators <sup>1</sup> Length	0 in to 12 in	(80 + 19L) μin	Calibration Grids
Squareness	0.04 in to 0.5 in	(110 + 1L) μin	



**Length – Dimensional Metrology**

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) <sup>3</sup>	Reference Standard, Method and/or Equipment
	0.5 in to 1 in	(110 + 1.5L) μin	
Magnification Up to 12 in	10X to 50X	(240 + 21L) μin	Magnification Checker Scale, Magnification Reticle
Plug gage - Outer Spherical Diameter	0.1 in to 1 in	46 μin	Helios Supra 500 Comparator
Surface Plate Flatness <sup>1</sup>	12 in to 100 in	24 μin + √D μin	Differential Levels
Surface Plate Repeatability <sup>1</sup>	0 to +/- 0.001	32 μin	Supramess
Flatness, Straightness and Parallelism <sup>1</sup>	0 in to 18 in	36 μin	Gage Amplifier and Surface Plate
Threaded Plugs – Major Diameter	0 in to 6 in	(9 + 4.9L) μin	Comparator
Outer Pitch Diameter	0 in to 6 in	80 μin	Comparator with Thread Wires
Threaded Rings	0 in to 2 in	160 μin	Comparison to Master Setting Plugs

**Mass**

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) <sup>2</sup>	Reference Standard, Method and/or Equipment
Force Measuring Equipment Tension and Compression	0.1 lbf to 200 lbf	0.033 %	Dead Weight – Class F Weights
Mass - Metric	30 kg	0.3 g	Echelon III
	20 kg	0.3 g	
	10 kg	0.2 g	
Mass - Metric	5 kg	17 mg	Echelon III
	2 kg	15 mg	
	1 kg	11 mg	
	0.5 kg	11 mg	



Mass

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) <sup>2</sup>	Reference Standard, Method and/or Equipment
Mass - Avoirdupois	65 lb	0.3 g	Echelon III
	50 lb	0.2 g	
	30 lb	0.2 g	
	20 lb	0.2 g	
	10 lb	16 mg	
	5 lb	10 mg	
	3 lb	10 mg	
	2 lb	10 mg	
	1 lb	10 mg	
Rockwell Hardness – Measuring Equipment <sup>1</sup>	20 HRC to 40 HRC	0.42 HRC	Hardness Blocks
	40 HRC to 60 HRC	0.35 HRC	
	60 HRC to 70 HRC	0.34 HRC	
Tungsten Carbide Balls <sup>1</sup>	20 HRBW to 50 HRBW	0.46 HRBW	
	50 HRBW to 75 HRBW	0.36 HRBW	
	75 HRBW to 105 HRBW	0.43 HRBW	
Torque – Measuring Equipment <sup>1</sup>	2.5 lbf·in to 50 lbf·in	0.2 %	5 inch Torque Wheel with F Class Weights
	50 lbf·in to 250 lbf·ft	0.2 %	10 inch Torque Butterfly with F Class Weights
	250 lbf·in to 800 lbf·ft	0.2 %	40 inch Torque Arm with F Class Weights
Torque – Measure <sup>1</sup>	0.2 lbf·in to 5 lbf·in	1.9 % + 0.0023 lbf·in	Tohnichi TDT60CN3-G
	2 lbf·in to 50 lbf·in	1.4 % + 0.023 lbf·in	Tohnichi TDT600CN3-G
	18 lbf·in to 295 lbf·ft	1 %	Stahlwille Torque Cells with Loader
	295 lbf·ft to 740 lbf·ft	1.7 %	

**Mass**

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) <sup>2</sup>	Reference Standard, Method and/or Equipment
Scales and Balances – Metric <sup>1</sup>	20 kg	61 mg	Characterized ASTM Class 1 and 2 Mass Standards
	5 kg	3.7 mg	
	3 kg	2.3 mg	
	2 kg	1.5 mg	
	1 kg	3 mg	
	500 g	0.62 mg	
	300 g	0.62 mg	
	200 g	0.22 mg	
	100 g	0.22 mg	
	50 g	0.075 mg	
	30 g	0.04 mg	
	20 g	0.04 mg	
	10 g	0.02 mg	
	5 g	0.02 mg	
	2 g	0.02 mg	
	1 g	0.02 mg	
	500 mg	0.004 7 mg	
	200 mg	0.004 7 mg	
	100 mg	0.0047 mg	
	50 mg	0.0047 mg	
	20 mg	0.0047 mg	
10 mg	0.0047 mg		

**Mass**

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) <sup>2</sup>	Reference Standard, Method and/or Equipment
Scales and Balances – Metric <sup>1</sup>	5 mg	0.0047 mg	Characterized ASTM Class 1 and 2 Mass Standards
	2 mg	0.0047 mg	
	1 mg	0.0047 mg	
Scales and Balances – Avoirdupois <sup>1</sup>	0.5 lb to 500 lb	0.033 %	NIST Class F Weights
Pressure – Pneumatic <sup>1</sup>	-15 psi to 30 psi	0.0022 psi	DHI RPM4 with Pressure Controller
	30 psi to 300 psi	0.0075 %	
	300 psi to 1 000 psi	0.01 %	
	-60 inH <sub>2</sub> O to -22 inH <sub>2</sub> O	0.009 % + 150 µinH <sub>2</sub> O	DHI PPC4 Controller
	-22 inH <sub>2</sub> O to 22 inH <sub>2</sub> O	0.002 2 inH <sub>2</sub> O	
	22 inH <sub>2</sub> O to 60 inH <sub>2</sub> O	0.009 % + 150 µinH <sub>2</sub> O	
	60 inH <sub>2</sub> O to 72 inH <sub>2</sub> O	0.006 7 inH <sub>2</sub> O	
	72 inH <sub>2</sub> O to 832 inH <sub>2</sub> O	0.009 % + 150 µinH <sub>2</sub> O	
Pressure – Hydraulic <sup>1</sup>	100 psi to 1 500 psi	0.089 psi	Ametek T-150 Deadweight Tester
	1500 psi to 15 000 psi	0.006 %	
Pressure – Absolute <sup>1</sup>	0 psia to 30 psia	0.002 6 psia	DHI RPM4 with Pressure Controller
	30 psia to 300 psia	0.0089 %	
	300 psia to 1 000 psia	0.01 %	

**Thermodynamic**

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
Relative Humidity – Measuring Equipment	10 % RH to 95 % RH (-10 °C to 70 °C)	0.5 % RH	Thunder Scientific 2500



**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 % RH to 90 % RH (10 °C to 30 °C)	1.3 % RH	Vaisala HMI41/HMP46
Temperature – Measuring Equipment <sup>1</sup>	-80 °C to -40 °C	1.9 mK	Hart 5681 SPRT with Precision Bath
	-40 °C to 100 °C	1.4 mK	
	100 °C to 270 °C	2.4 mK	
	270 °C to 400 °C	4.8 mK	Hart 5699 SPRT With Precision Bath
	400 °C to 600 °C	21 mK	Hart 5699 SPRT with Furnace
Temperature – Measure <sup>1</sup>	-100 °C to 0.01 °C	11 mK	Hart Black Stack with PRT
	0.01 °C to 230 °C	19 mK	
	230 °C to 420 °C	25 mK	
	420 °C to 600 °C	36 mK	
Infrared Temperature - Measuring Equipment	-15 °C to 0 °C	0.8 °C	Fluke Black Body  $\epsilon = 0.9$ to $1.0$ $\lambda = (8$ to $14) \mu\text{m}$
	0 °C to 50 °C	0.75 °C	
	50 °C to 100 °C	0.7 °C	
	100 °C to 120 °C	0.76 °C	
	120 °C to 200 °C	0.95 °C	
	200 °C to 350 °C	1.6 °C	
	350 °C to 500 °C	2.1 °C	
Calibration of SPRT / PRTs	0.010 °C	0.6 mK	Comparison to 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

**Thermodynamic**

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
Calibration of SPRT / PRTs	660.323 °C	8.6 mK	Comparison to Al Cell
SPRT / PRT Comparison	-195 °C	2.4 mK	Hart 5681 SPRT with NBPLN <sub>2</sub>
	-80 °C	1.9 mK	Hart 5681 SPRT with 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 and Measure In-Lab	10 MHz	6.4 x 10 <sup>-10</sup> Hz/Hz	Rubidium Oscillator
Field <sup>1</sup>	10 MHz	2.8 x 10 <sup>-7</sup> Hz/Hz	Agilent 53132A
Rise Time – Measuring Equipment <sup>1</sup>	250 ps nominal	47 ps <sup>Note 5</sup>	5520A/SC1100
Rise Time – Measure <sup>1</sup>	≥ 5 ns	4 ns	Agilent DSO5012

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. Values listed with percent (%) are percent of reading or generated value unless otherwise noted.
3. L = Length in inches, D = the diagonal in inches
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 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.
6. This scope is formatted as part of a single document including Certificate of Accreditation No. AC-2489.06.



Vice President