



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 – New England

230 Ballardvale Street

Wilmington, MA 01887

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-2489.04

Certificate Number


ANAB Approval

Certificate Valid: 09/29/17-09/07/19
Version No. 001 Issued: 09/29/17



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 – New England

230 Ballardvale Street
Wilmington, MA 01887
Jeremy Kraft
978-988-3910

CALIBRATION

Valid to: **September 7, 2019**

Certificate Number: **AC-2489.04**

Chemical Quantities

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
pH – Measuring Equipment ¹	4 pH	0.011 pH	Standard Buffer Solutions
	7 pH	0.01 pH	
	10 pH	0.012 pH	

Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
AC Current Measuring Equipment ¹	0 μ A to 220 μ A		Fluke 5720A
	10 Hz to 20 Hz	0.031 % + 16 nA	
	20 Hz to 40 Hz	0.019 % + 10 nA	
	40 Hz to 1 kHz	0.015 % + 8 nA	
	1 kHz to 5 kHz	0.03 % + 12 nA	
	5 kHz to 10 kHz	0.11 % + 65 nA	



Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
AC Current Measuring Equipment ¹	220 μ A to 2.2 mA		Fluke 5720A
	10 Hz to 20 Hz	0.03 % + 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 % + 110 nA	
	5 kHz to 10 kHz	0.11 % + 650 nA	
	2.2 mA to 22 mA		
	10 Hz to 20 Hz	0.039 % + 0.4 μ A	
	20 Hz to 40 Hz	0.019 % + 0.35 μ A	
	40 Hz to 1 kHz	0.014 % + 0.35 μ A	
	1 kHz to 5 kHz	0.021 % + 0.55 μ A	
	5 kHz to 10 kHz	0.11 % + 5 μ A	
	22 mA to 220 mA		
	10 Hz to 20 Hz	0.033 % + 4 μ A	
	20 Hz to 40 Hz	0.018 % + 3.5 μ A	
	40 Hz to 1 kHz	0.014 % + 2.5 μ A	
	1 kHz to 5 kHz	0.021 % + 3.5 μ A	
	5 kHz to 10 kHz	0.11 % + 10 μ A	
	220 mA to 2.2 A		
	20 Hz to 1 kHz	0.027 % + 35 μ A	
	1 kHz to 5 kHz	0.046 % + 80 μ A	
	5 kHz to 10 kHz	0.7 % + 0.16 mA	

Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
AC Current Measuring Equipment ¹	2.2 A to 11 A		Fluke 5720A w/5725A
	40 Hz to 1 kHz	0.048 % + 0.17 mA	
	1 kHz to 5 kHz	0.096 % + 0.38 mA	
	5 kHz to 10 kHz	0.36 % + 0.75 mA	
	11 A to 20.5 A		Dual 5520A's in Parallel
	45 Hz to 100 Hz	0.11 % + 3.9 mA	
	100 Hz to 1 kHz	0.14 % + 3.9 mA	
	1 kHz to 5 kHz	2.7 % + 3.9 mA	
	20.5 A to 40 A		Valhalla 2555A w/Fluke 5520A
	45 Hz to 100 Hz	0.14 % + 11 mA	
	100 Hz to 1 kHz	0.17 % + 11 mA	
	1 kHz to 5 kHz	3.3 % + 11 mA	
Extended Frequency Ranges ¹	40 A to 100 A		Fluke 5520A
	50 Hz to 100 Hz	0.12 % + 0.35 A	
	100 Hz to 400 Hz	0.24 % + 0.47 A	
	400 Hz to 1 kHz	0.35 % + 0.70 A	
	29 µA to 330 µA		
	10 kHz to 30 kHz	1.5 % + 0.31 µA	
	0.33 mA to 3.3 mA		
	10 kHz to 30 kHz	0.92 % + 0.47 µA	
	3.3 mA to 33 mA		
	10 kHz to 30 kHz	0.37 % + 3.1 µA	



Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
Extended Frequency Ranges ¹	33 mA to 330 mA 10 kHz to 30 kHz	0.37 % + 0.16 mA	Fluke 5520A
Clamp-on Ammeter Toroidal Type ¹ Transformer Type	20 A to 150 A 45 Hz to 65 Hz	0.35 % + 0.25 A	Fluke 5520A w/5500A/Coil
	20 A to 150 A 65 Hz to 440 Hz	0.94 % + 0.050 mA	
	150 A to 1000 A 45 Hz to 65 Hz	0.34 % + 0.13 A	
	150 A to 1000 A 65 Hz to 440 Hz	1.2 % + 0.23 A	
Clamp-on Ammeter Non- Toroidal Type Hall Effect Sensor	20 A to 150 A 45 Hz to 65 Hz	0.60 % + 0.29 A	Fluke 5520A w/5500A/Coil
	20 A to 150 A 65 Hz to 440 Hz	1.0 % + 0.29 A	
	150 A to 1000 A 45 Hz to 65 Hz	0.57 % + 1.0 A	
	150 A to 1000 A 65 Hz to 440 Hz	1.3 % + 1.1 A	
AC Current – Measure ¹	0 μ A to 100 μ A 10 Hz to 20 Hz 20 Hz to 45 Hz 45 Hz to 100 Hz	0.46 % + 35 nA 0.18 % + 35 nA 0.072 % + 35 nA	Agilent 3458A opt 002

Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
AC Current – Measure ¹	100 Hz to 5 kHz	0.072 % + 35 nA	Agilent 3458A opt 002
	100 µA to 1 mA		
	10 Hz to 20 Hz	0.46 % + 0.23 µA	
	20 Hz to 45 Hz	0.17 % + 0.23 µA	
	45 Hz to 100 Hz	0.07 % + 0.23 µA	
	0.1 kHz to 5 kHz	0.038 % + 0.23 µA	
	1 mA to 10 mA		
	10 Hz to 20 Hz	0.46 % + 2.3 µA	
	20 Hz to 45 Hz	0.17 % + 2.3 µA	
	45 Hz to 100 Hz	0.07 % + 2.3 µA	
	0.1 kHz to 5 kHz	0.038 % + 2.3 µA	
	10 mA to 100 mA		
	10 Hz to 20 Hz	0.46 % + 23 µA	
	20 Hz to 45 Hz	0.17 % + 23 µA	
	45 Hz to 100 Hz	0.07 % + 23 µA	
	0.1 kHz to 5 kHz	0.037 % + 23 µA	
	0.1 A 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	0.096 % + 0.23 mA	
	0.1 kHz to 5 kHz	0.12 % + 0.23 mA	
	1 to 3 A		Agilent 34401A



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Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
AC Current – Measure ¹	40 Hz to 1 kHz	0.18 % + 2.1 mA	Agilent 3458A opt 002
	1 kHz to 5 kHz	0.20 % + 2.1 mA	
	3 to 30 A		Agilent 34330A w/3458A
	40 Hz to 1 kHz	0.35 % + 2.3 mA	
	1 kHz to 5 kHz	5.8 % + 2.3 mA	
AC Resistance– Measure ¹ 1 kHz	0 Ω to 6.25 Ω	0.70 % + 0.010 Ω	Gen Rad 1689-9700
	6.25 Ω to 100 k Ω	0.024 % + 0.010 Ω	
	100 k Ω to 410 k Ω	0.30 % + 0.010 Ω	
Measuring Equipment and Measure ¹	0 Ω to 10 Ω	19 $\mu\Omega/\Omega$ + 58 $\mu\Omega$	HP3458A w/Decade Resistor
	10 Ω to 100 Ω	15 $\mu\Omega/\Omega$ + 0.58 m Ω	
	100 Ω to 1 k Ω	12 $\mu\Omega/\Omega$ + 0.58 m Ω	
	1 k Ω to 10 k Ω	12 $\mu\Omega/\Omega$ + 5.8 m Ω	
	10 k Ω to 100 k Ω	13 $\mu\Omega/\Omega$ + 58 m Ω	
	100 k Ω to 1 M Ω	19 $\mu\Omega/\Omega$ + 2.3 Ω	
	1 M Ω to 10 M Ω	62 $\mu\Omega/\Omega$ + 0.12 k Ω	
	10 M Ω to 100 M Ω	0.059 % + 1.2 k Ω	
	100 M Ω to 1 G Ω	0.58 % + 12 k Ω	
Measuring Equipment ¹	333 $\mu\Omega$	0.12 %	Guildline 9711A
	1 m Ω	590 $\mu\Omega/\Omega$	
	10 m Ω	140 $\mu\Omega/\Omega$	
	100 m Ω	120 $\mu\Omega/\Omega$	
	1 Ω	120 $\mu\Omega/\Omega$	



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Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
Measuring Equipment ¹	10 Ω	120 $\mu\Omega/\Omega$	Guildline 9711A
	100 Ω	120 $\mu\Omega/\Omega$	
	1 k Ω	120 $\mu\Omega/\Omega$	
	10 k Ω	130 $\mu\Omega/\Omega$	
230 V/100 k Ω maximum 1 kV/1 M Ω maximum 5 kV maximum (up to 1T Ω)	100 k Ω to 1 M Ω	0.18 % + 2.3 Ω	IET HRRS-B-7-100k-5kV
	1 M Ω to 10 M Ω	0.21 % + 120 Ω + 1.2 Ω/V	
	10 M Ω to 100 M Ω	0.22 % + 1.2 k Ω + 12 Ω/V	
	100 M Ω to 1 G Ω	0.30 % + 32 k Ω + 120 Ω/V	
	1 G Ω to 10 G Ω	0.58 % + 480 k Ω + 1.2 k Ω/V	
	10 G Ω to 100 G Ω	1.2 % + 62 M Ω + 23 k Ω/V	
	100 G Ω to 1 T Ω	2.6 % + 15 G Ω + 580 k Ω/V	
DC Current – Measuring Equipment ¹	0 mA to 0.22 mA	41 $\mu A/A$ + 6 nA	Fluke 5700A w/5725A
	0.22 mA to 2.2 mA	36 $\mu A/A$ + 7 nA	
	2.2 mA to 22 mA	35 $\mu A/A$ + 40 nA	
	22 mA to 220 mA	48 $\mu A/A$ + 0.7 μA	
	220 mA to 2.2 A	197 $\mu A/A$ + 12 μA	
	2.2 A to 11A	400 $\mu A/A$ + 12 μA	
	11 A to 20.5 A	840 $\mu A/A$ + 0.58 mA	Fluke 5520A/SC1100
	20.5 A to 40 A	0.12 % + 0.82 mA	Dual 5520A's in parallel
	40 A to 100 A	0.037 % + 35 mA	Valhalla 2555A w/5520A
DC Current – Measure & Measuring Equipment ¹	0 to 100 μA	26 $\mu A/A$ + 0.9 nA	HP 3458A with current source
	100 μA to 1 mA	26 $\mu A/A$ + 5.8 nA	

Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
DC Current – Measure & Measuring Equipment ¹	1 mA to 10 mA	26 μ A/A + 58 nA	HP 3458A with current source
	10 mA to 100 mA	43 μ A/A + 0.58 μ A	
	100 mA to 1 A	0.013 % + 12 μ A	
DC Current – Measure ¹	0 to 10 μ A	130 μ A/A + 58 pA	Guildline 9711A w/ 3458A
	10 μ A to 100 μ A	120 μ A/A + 580 pA	
	100 μ A to 1 mA	120 μ A/A + 5.8 nA	
	1 mA to 10 mA	120 μ A/A + 58 nA	
	10 mA to 100 mA	120 μ A/A + 580 nA	
	100 mA to 1 A	120 μ A/A + 5.8 μ A	
	1 A to 10 A	140 μ A/A + 58 μ A	
	10 A to 100 A	590 μ A/A + 580 μ A	
	100 A to 300 A	0.12 % + 0.0017 A	
	300 A to 1000 A	0.12 % + 0.0058 A	Meterman 1000-100 w/3458A
Clamp-on Ammeter Non-Toroidal Type ¹ Hall Effect Sensor	20 A to 150 A	0.51 % + 0.14 A	Fluke 5520A w/ 5500A/Coil
	150 A to 1000 A	0.51 % + 0.50 A	
DC Voltage – Measure ¹	0 mV to 100 mV	7.1 μ V/V + 0.58 μ V	3458A Opt 002 w/5700A
	0.1 V to 1 V	5.0 μ V/V + 0.58 μ V	
	1 V to 10 V	5.1 μ V/V + 0.58 μ V	
	10 V to 100 V	7.6 μ V/V + 35 μ V	
	100 V to 500 V	11 μ V/V + 0.12 mV	
	500 V to 800 V	16 μ V/V + 0.12 mV	
	800 V to 1 kV	21 μ V/V + 0.12 mV	



Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
DC Voltage – Measure ¹	1 kV to 10 kV	0.054 %	Vitretek 4700
	10 kV to 35 kV	0.093 %	Vitretek 4700 w/HVL-35
	35 kV to 70 kV	0.11 % + 8.1 V	Vitretek 4700 w/HVL-70
	70 kV to 100 kV	0.17 % + 1.3 V	Vitretek 4700 w/HVL-100
DC Voltage - Measuring Equipment ¹	0 V to 0.22 V	8.5 μ V/V + 0.40 μ V	Fluke 5720A w/5725A
	0.22 V to 2.2 V	5.1 μ V/V + 0.70 μ V	
	2.2 V to 11 V	4.0 μ V/V + 2.5 μ V	
	11 V to 22 V	3.9 μ V/V + 4.0 μ V	
	22 V to 220 V	6.2 μ V/V + 40 μ V	
	220 V to 1100 V	7.6 μ V/V + 0.40 mV	
AC Voltage – Measure ¹	0 mV to 10 mV		Agilent 3458A opt 002
	1 Hz to 40 Hz	0.039 % + 3.5 μ V	
	40 Hz to 1 kHz	0.028 % + 1.2 μ V	
	1 kHz to 20 kHz	0.038 % + 1.2 μ V	
	20 kHz to 50 kHz	0.15 % + 1.2 μ V	
	50 kHz to 100 kHz	0.59 % + 1.2 μ V	
	100 kHz to 300 kHz	4.6 % + 2.3 μ V	
	10 mV to 100 mV		
	1 Hz to 40 Hz	0.013 % + 4.6 μ V	
	40 Hz to 1 kHz	0.009 5 % + 2.3 μ V	
	1 kHz to 20 kHz	0.017 % + 2.3 μ V	
	20 kHz to 50 kHz	0.037 % + 2.3 μ V	



Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
AC Voltage – Measure ¹	50 kHz to 100 kHz	0.093 % + 2.3 μ V	Agilent 3458A opt 002
	100 kHz to 300 kHz	0.36 % + 12 μ V	
	300 kHz to 1 MHz	1.2 % + 12 μ V	
	100 mV to 1 V		
	1 Hz to 40 Hz	0.009 8 % + 46 μ V	
	40 Hz to 1 kHz	0.009 5 % + 23 μ V	
	1 kHz to 20 kHz	0.017 % + 23 μ V	
	20 kHz to 50 kHz	0.036 % + 23 μ V	
	50 kHz to 100 kHz	0.093 % + 23 μ V	
	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 5 % + 0.46 mV	
	40 Hz to 1 kHz	0.009 5 % + 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	
	10 V to 100 V		
	1 Hz to 40 Hz	0.024 % + 4.6 mV	
	40 Hz to 1 kHz	0.024 % + 2.3 mV	

Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
AC Voltage – Measure ¹	1 kHz to 20 kHz	0.024 % + 2.3 mV	Agilent 3458A opt 002
	20 kHz to 50 kHz	0.041 % + 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	0.047 % + 46 mV	Vitretek 4700
	40 Hz to 1 kHz	0.047 % + 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 60 Hz	0.14 %	Vitretek 4700 w/HVL-35
	10 kV to 30 kV 60 Hz	0.095 % + 17 V	
	30 kV to 50 kV 60 Hz	0.16 % + 4.0 V	Vitretek 4700 w/HVL-70
	50 kV to 70 kV 60 Hz	0.23 % + 1.4 V	
	0 mV to 1 mV 100 kHz to 1 MHz 1 MHz to 3 MHz	2.0 % + 2.4 μ V 3.8 % + 2.4 μ V	R&S URE3

Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
AC Voltage – Measure ¹	3 MHz to 10 MHz	10 % + 2.4 μ V	R&S URE3
	10 MHz to 20 MHz	25 % + 2.4 μ V	
	1 mV to 3 mV		
	100 kHz to 1 MHz	1.0 % + 2 μ V	
	1 MHz to 3 MHz	3.8 % + 2 μ V	
	3 MHz to 10 MHz	11 % + 2 μ V	
	10 MHz to 20 MHz	25 % + 2 μ V	
	3 mV to 100 mV		
	100 kHz to 1 MHz	0.98 % + 3 μ V	
	1 MHz to 3 MHz	1.9 % + 3 μ V	
	3 MHz to 10 MHz	3.2 % + 3 μ V	
	10 MHz to 20 MHz	7.6 % + 3 μ V	
	20 MHz to 30 MHz	16 % + 3 μ V	
AC Voltage – Measuring Equipment ¹	0 mV to 2.2 mV		Fluke 5720A
	10 Hz to 20 Hz	0.16 % + 4 μ V	
	20 Hz to 40 Hz	0.10 % + 4 μ V	
	40 Hz to 20 kHz	0.078 % + 4 μ V	
	20 kHz to 50 kHz	0.13 % + 4 μ V	
	50 kHz to 100 kHz	0.17 % + 5 μ V	
	100 kHz to 300 kHz	0.33 % + 10 μ V	
	300 kHz to 500 kHz	0.47 % + 20 μ V	
	500 kHz to 1 MHz	0.58 % + 20 μ V	



Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
AC Voltage – Measuring Equipment ¹	2.2 mV to 22 mV		Fluke 5720A
	10 Hz to 20 Hz	0.042 % + 4 μ V	
	20 Hz to 40 Hz	0.03 % + 4 μ V	
	40 Hz to 20 kHz	0.014 % + 4 μ V	
	20 kHz to 50 kHz	0.030 % + 4 μ V	
	50 kHz to 100 kHz	0.058 % + 5 μ V	
	100 kHz to 300 kHz	0.12 % + 10 μ V	
	300 kHz to 500 kHz	0.16 % + 20 μ V	
	500 kHz to 1 MHz	0.27 % + 20 μ V	
	22 mV to 220 mV		
	10 Hz to 20 Hz	0.028 % + 12 μ V	
	20 Hz to 40 Hz	0.011 % + 7 μ V	
	40 Hz to 20 kHz	0.008 5 % + 7 μ V	
	20 kHz to 50 kHz	0.021 % + 7 μ V	
	50 kHz to 100 kHz	0.047 % + 17 μ V	
	100 kHz to 300 kHz	0.091 % + 20 μ V	
	300 kHz to 500 kHz	0.14 % + 25 μ V	
	500 kHz to 1 MHz	0.28 % + 45 μ V	
	220 mV to 2.2 V		
	10 Hz to 20 Hz	0.027 % + 40 μ V	
	20 Hz to 40 Hz	0.01 % + 15 μ V	
	40 Hz to 20 kHz	0.004 8 % + 8 μ V	



Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
AC Voltage – Measuring Equipment ¹	20 kHz to 50 kHz	0.008 % + 10 μ V	Fluke 5720A
	50 kHz to 100 kHz	0.012 % + 30 μ V	
	100 kHz to 300 kHz	0.043 % + 0.08 mV	
	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		
	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	0.004 9 % + 50 μ V	
	20 kHz to 50 kHz	0.008 3 % + 0.1 mV	
	50 kHz to 100 kHz	0.012 % + 0.2 mV	
	100 kHz to 300 kHz	0.03 % + 0.6 mV	
	300 kHz to 500 kHz	0.1 % + 2 mV	
	500 kHz to 1 MHz	0.17 % + 3.2 mV	
	22 V to 220 V		
	10 Hz to 20 Hz	0.028 % + 4 mV	
	20 Hz to 40 Hz	0.01 % + 1.5 mV	
	40 Hz to 20 kHz	0.005 6 % + 0.6 mV	
	20 kHz to 50 kHz	0.009 3 % + 1 mV	
	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	



Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
AC Voltage – Measuring Equipment ¹	500 kHz to 1 MHz	0.8 % + 80 mV	Fluke 5720A
	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		Fluke 5720A w/ 5725A
	40 Hz to 1 kHz	0.011 % + 4.0 mV	
	1 kHz to 20 kHz	0.017 % + 6.0 mV	
	20 kHz to 30 kHz	0.061 % + 11 mV	
Capacitance Measure ¹	1 pF to 10 pF		GenRad 1689-9700
	1 kHz	0.47 % + 0.05 pF	
	10 pF to 100 pF		
	1 kHz	0.058 % + 0.05 pF	
	100 pF to 1 μ F		
	1 kHz	0.024 % + 0.05 pF	
	1 μ F to 100 μ F		
	1 kHz	0.035 %	
Capacitance Measure Equipment ¹	100 μ F to 1 mF		Arco SS32
	1 kHz	0.24 %	
	0.1 nF to 0.5 nF		
	0.1 kHz to 1 kHz	0.58 pF	
	0.5 nF to 1400 nF		
	0.1 kHz to 1 kHz	0.12 % + 0.018 pF	

Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
Capacitance Measure Equipment ¹	0.19 nF to 1.1 nF 10 Hz to 10 kHz	0.39 % + 6.1 pF	5520A
	1.1 nF to 3.3 nF 10 Hz to 3 kHz	0.39 % + 6.1 pF	
	3.3 nF to 11 nF 10 Hz to 1 kHz	0.21 % + 6.1 pF	
	11 nF to 110 nF 10 Hz to 1 kHz	0.21 % + 61 pF	
	110 nF to 330 nF 10 Hz to 1 kHz	0.21 % + 0.18 nF	
	0.33 µF to 1.1 µF 10 Hz to 600 Hz	0.2 % + 0.61 nF	
	1.1 µF to 3.3 µF 10 Hz to 300 Hz	0.2 % + 1.9 nF	
	3.3 µF to 11 µF 10 Hz to 150 Hz	0.2 % + 6.1 nF	
	11 µF to 33 µF 10 Hz to 120 Hz	0.32 % + 18 nF	
	33 µF to 110 µF 10 Hz to 80 Hz	0.35 % + 61 nF	
	110 µF to 330 µF DC to 50 Hz	0.35 % + 0.18 µF	

Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
Capacitance Measure Equipment ¹	0.33 mF to 1.1 mF DC to 20 Hz	0.35 % + 0.61 μ F	5520A
	1.1 mF to 3.3 mF DC to 6 Hz	0.35 % + 1.8 μ F	
	3.3 mF to 11 mF DC to 2 Hz	0.35 % + 6.1 μ F	
	11 mF to 33 mF DC to 0.6 Hz	0.58 % + 18 μ F	
	33 mF to 110 mF DC to 0.2 Hz	0.85 % + 61 μ F	
Inductance Measure ¹	1 mH to 10 mH 1 kHz	0.024 % + 0.10 μ H	GenRad 1689-9700
	10 mH to 10 H 1 kHz	0.024 % + 1.4 μ H	
Inductance Measuring Equipment ¹	50 mH 1 kHz	0.12 % + 1.4 μ H	Standard Inductor
	100 mH 1 kHz	0.12 % + 1.4 μ H	Standard Inductor
Electrical Simulation of Thermocouples ¹ Type E	-270 °C to -245 °C	2.1 °C	Ectron 1140A
	-245 °C to -195 °C	0.2 °C	
	-195 °C to -155 °C	0.11 °C	
	-155 °C to -90 °C	0.09 °C	

Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
Type E	-90 °C to 0 °C	0.08 °C	Ectron 1140A
	0 °C to 15 °C	0.08 °C	
	15 °C to 890 °C	0.07 °C	
	890 °C to 1000 °C	0.08 °C	
Type J	-210 °C to -180 °C	0.13 °C	
	-180 °C to -120 °C	0.11 °C	
	-120 °C to -50 °C	0.09 °C	
	-50 °C to 990 °C	0.08 °C	
	990 °C to 1200 °C	0.08 °C	
Type K	-270 °C to -255 °C	2.3 °C	
	-255 °C to -195 °C	0.73 °C	
	-195 °C to -115 °C	0.14 °C	
	-115 °C to -55 °C	0.10 °C	
	-55 °C to 1000 °C	0.08 °C	
	1000 °C to 1372 °C	0.09 °C	
Type N	-270 °C to -260 °C	5.1 °C	
	-260 °C to -200 °C	1.1 °C	
	-200 °C to -140 °C	0.25 °C	
	-140 °C to -70 °C	0.16 °C	
	-70 °C to 25 °C	0.13 °C	
	25 °C to 160 °C	0.11 °C	
	160 °C to 1300 °C	0.10 °C	



Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
Type R	-50 °C to -30 °C	0.68 °C	Ectron 1140A
	-30 °C to -45 °C	0.58 °C	
	-45 °C to 160 °C	0.42 °C	
	160 °C to 380 °C	0.31 °C	
	380 °C to 775 °C	0.28 °C	
	775 °C to 1768 °C	0.23 °C	
Type S	-50 °C to -30 °C	0.65 °C	
	-30 °C to 45 °C	0.59 °C	
	45 °C to 105 °C	0.42 °C	
	105 °C to 310 °C	0.35 °C	
	310 °C to 615 °C	0.31 °C	
	615 °C to 1768 °C	0.27 °C	
Type T	-270 °C to -255 °C	1.8 °C	
	-255 °C to -240 °C	0.52 °C	
	-240 °C to -210 °C	0.32 °C	
	-210 °C to -150 °C	0.19 °C	
	-150 °C to -40 °C	0.13 °C	
	-40 °C to 100 °C	0.09 °C	
	100 °C to 400 °C	0.08 °C	



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Electrical - RF/Microwave

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
Power – Measuring Equipment (for current range listed below) DC Power 0.33 mA to 330 mA	11 μ W to 1.1 mW	0.024 %	Fluke 5520A
	1.1 mW to 0.11 W	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	99 mW 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 ³ (PF = 1) 3.3 mA to 9 mA	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 10 Hz to 65 Hz	0.089 %	
	10 mW to 33 W 10 Hz to 65 Hz	0.077 %	
33 mA to 90 mA	1 mW to 30 mW 10 Hz to 65 Hz	0.071 %	
	30 mW to 90 W 10 Hz to 65 Hz	0.057 %	



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Electrical - RF/Microwave

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
90 mA to 330 mA	3 mW to 0.10 W 10 Hz to 65 Hz	0.089 %	Fluke 5520A
	0.1W to 300 W 10 Hz to 65 Hz	0.078 %	
0.33 A to 0.9 A	11 mW to 0.3 W 10 Hz to 65 Hz	0.071 %	
	0.3 W to 900 W 10 Hz to 65 Hz	0.081 %	
0.9 A to 2.2 A	30 mW to 0.72 W 10 Hz to 65 Hz	0.089 %	
	0.72 W to 2 kW 10 Hz to 65 Hz	0.079 %	
2.2 A to 4.5 A	80 mW to 1.4 W 10 Hz to 65 Hz	0.088 %	
	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 %	
Measuring Equipment ¹	0° to 90° 10 Hz to 65 Hz	0.10°	Fluke 5520A



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Electrical - RF/Microwave

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
Measuring Equipment ¹	65 Hz to 500 Hz	0.20°	Fluke 5520A
	500 Hz to 1 kHz	0.37°	
	1 kHz to 5 kHz	1.8°	
	5 kHz to 10 kHz	3.6°	
	10 kHz to 30 kHz	7.3°	
Sinewave Flatness/ Oscilloscope Bandwidth ¹ (50 kHz reference)	50 kHz to 100 MHz	1.7 % + 100 μ V	Fluke 5520A/SC1100
	100 MHz to 300 MHz	2.2 % + 100 μ V	
	300 MHz to 600 MHz	4.1 % + 100 μ V	
	600 MHz to 1.1 GHz	5.1 % + 100 μ V	

Length – Dimensional Metrology

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) ⁵	Reference Standard, Method and/or Equipment
Angle	< 90 °	12 arc seconds	Sine Bar, surface plate
	90°	3.7 arc seconds	Granite Square, surface plate
Micrometers & Calipers – Outside, Inside, Depth ¹	0.01 in to 0.4 in	(9.5 + 0.6L) μ in	Comparison to Gage Blocks
	0.4 in to 1.0 in	(9.2 + 1.4L) μ in	
	1 in to 9 in	(5 + 4.1L) μ in	
	9 in to 40 in	(7.9 + 4.3L) μ in	
Anvil Flatness ¹	0 in to 4 in	5 μ in	Optical Flats
Anvil Parallelism ¹	0 in to 1 in	16 μ in	Optical Parallels
Bore Gages	0.04 in to 1 in	83 μ in	Characterized Rings
	1 in to 5 in	(82 + 1.9L) μ in	

Length – Dimensional Metrology

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) ⁵	Reference Standard, Method and/or Equipment
Digital/Dial Indicators, LVDT's, Gage amplifiers	0 in to 1 in	$(6.1 + 1.1L) \mu\text{in}$	Pratt & Whitney Labmaster
	1 in to 2 in	$(4.2 + 3L) \mu\text{in}$	
	2 in to 6 in	$(0.9 + 4.8L) \mu\text{in}$	
Single Axis - Outside	0 in to 1 in	$(3.7 + 2L) \mu\text{in}$	Pratt & Whitney Labmaster
	1 in to 2 in	$(2.1 + 3.6L) \mu\text{in}$	
	2 in to 4 in	$(1.6 + 4.3L) \mu\text{in}$	
	4 in to 12 in	$(0.7 + 5L) \mu\text{in}$	
Micrometer Heads	0 in to 1 in	29 μin	Gaging amplifier/Blocks
	1 in to 2 in	31 μin	
Height Measuring Equipment	0 in to 12 in	$(63 + 2L) \mu\text{in}$	Gage Blocks/Surface Plate
	12 in to 24 in	$(37 + 4.2L) \mu\text{in}$	
Parallelism & Straightness	0 in to 36 in	89 μin	Gage Amp/Surface Plate
Crimp Tools – Crimp Height	0 in to 1 in	0.001 in	Crimp Height Micrometer
Squareness	90 °	$(160 + 4.8L) \mu\text{in}$	Granite square, surface plate w/gage amplifier
Length Measuring Equipment – Linear Displacement	0 ft to 12 ft	$(1 + 2.1L) \mu\text{in}$	Laser Interferometer
Thread Wire Sets	2 TPI to 120 TPI	12 μin	ULM
Plug Gages – Outer Diameter	0 in to 5 in	$(8.8 + 2.9L) \mu\text{in}$	ULM
Ring Gage – Inner Diameter	0.04 in to 0.5 in	$(2.6 + 7.8L) \mu\text{in}$	ULM
	0.5 in to 1 in	$(9.1 + 1L) \mu\text{in}$	
	1 in to 3 in	$(2.6 + 7.8L) \mu\text{in}$	
	3 in to 11 in	$(2.8 + 6L) \mu\text{in}$	



Length – Dimensional Metrology

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) ⁵	Reference Standard, Method and/or Equipment
Laser Micrometers	0.011 in to 1 in	(13 + 1.8L) μ in	Master Pins
Rulers	0 in to 12 in	(200 + 50L) μ in	OGP Smartscope Flash 302
	12 in to 18 in	(210 + 71L) μ in	
Thread Plug Gages Pitch Diameter 60° Thread	0 in to 4 in	83 μ in	ULM
Major Diameter	0 in to 4 in	(8.8 + 2.9L) μ in	ULM
Thread Ring Gage Inner Pitch Diameter	0 in to 4 in	83 μ in	Master Plug Uncertainty
Gauges/Fixtures Two Axis (X-Y)	0 in to 12 in	(85 + 50L) μ in	OGP Smartscope Flash 302
	12 in to 18 in	(120 + 71L) μ in	
Z Axis	0 in to 10 in	(140 + 75L) μ in	
Angle	0 to 12 in	0.003 3 °	
	12 in to 18 in	0.004 5 °	
Gauges/Fixtures Two Axis Perpendicularity	0 in to 12 in	(120 + 48L) μ in	OGP Smartscope Flash 302
	12 in to 18 in	(123 + 71L) μ in	
Radius	0 in to 5 in	(440 + 50L) μ in	

Mass

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) ²	Reference Standard, Method and/or Equipment
Force Measuring Equipment ¹	0.5 lb to 100 lb	0.025 %	NIST Class F
Torque Measure ¹	3.2 ozf·in to 80 ozf·in	1.2 % + 0.002 3 ozf·in	Torque Calibrator
	2 lbf·in to 10 lbf·in	1.4 %	Torque Calibrator
	10 lbf·in to 812 lbf·ft	1 %	



Mass

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) ²	Reference Standard, Method and/or Equipment
Balances & Scales ¹	5 kg	11 mg	ASTM Class 2
	2 kg	11 mg	
	1 kg	0.76 mg	
	500 g	0.78 mg	
	200 g	0.21 mg	ASTM Class 1
	100 g	0.29 mg	
	50 g	0.15 mg	
	20 g	50 µg	
	10 g	62 µg	
	5 g	23 µg	
	2 g	27 µg	
	1 g	23 µg	
	500 mg	20 µg	
	200 mg	20 µg	
	100 mg	20 µg	
	50 mg	20 µg	
	20 mg	20 µg	
	10 mg	20 µg	
	5 mg	20 µg	
	2 mg	20 µg	
	1 mg	20 µg	
Avoirdupois - Variable Points	1 lb to 100 lb	0.016 %	NIST Class F



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Mass

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-) ²	Reference Standard, Method and/or Equipment
Avoirdupois - Variable Points	100 lb to 200 lb	0.027 %	NIST Class F
	200 lb to 300 lb	0.036 %	
Fixed Points	10 lb	0.000 97 lb	ASTM Class 5
	20 lb	0.002 4 lb	
Absolute Pressure Source - Pneumatic	0 psia to 25 psia	0.0019 psia	Ruska 7250xi
	25 psia to 500 psia	0.006 6 % + 0.001 psia	
Absolute Pressure Source - Hydraulic	50 psia to 150 psia	0.012 % + 0.012 psi	Ametek T150 w/7250xi
	150 psia to 15 000 psia	0.012 % + 0.002 psi	
Gage Pressure - Pneumatic	-36 inH ₂ O to -22 inH ₂ O	0.009 % + 150 µinH ₂ O	DHI PPC4-ui
	-22 inH ₂ O to 22 inH ₂ O	0.002 inH ₂ O	
	22 inH ₂ O to 60 inH ₂ O	0.009 % + 150 µinH ₂ O	
	60 inH ₂ O to 72 inH ₂ O	0.006 5 inH ₂ O	
	72 inH ₂ O to 804 inH ₂ O	0.009 % + 150 µinH ₂ O	
	-15 psig to 25 psig	0.001 7 psi	Ruska 7250xi
	25 psig to 500 psig	0.006 5 %	
Pressure - Hydraulic	50 psig to 150 psig	0.012 % + 0.012 psi	Ametek T150
	150 psig to 15 000 psig	0.012 %	

Thermodynamic

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



Thermodynamic

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
Measure ¹ (10°C to 60°C)	10 % RH to 90 % RH	1.3 % RH	Vaisala HMI41
Temperature – Measure ¹	-195 °C to 0 °C	7.2 mK + 0.002 7 %	Hart 5628 w/Black Stack
	0 °C to 660 °C	10 mK + 0.002 7 %	
Temperature – Measuring Equipment ¹	-80 °C to 0 °C	13 mK + 0.002 7 %	Hart 5628 w/Black Stack & Liquid Bath
	0 °C to 100 °C	15 mK + 0.002 7 %	
	100 °C to 200 °C	25 mK + 0.002 7 %	
	200 °C to 300 °C	0.17 °C + 0.002 7 %	Hart 5628 w/Black Stack & Dry Block
	300 °C to 400 °C	0.22 °C + 0.002 7 %	

Time and Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
Frequency Dissemination Source and Measure	10 MHz	5.8×10^{-10}	Rubidium Standard
Rise time (Generate) ¹	250 ps (Nominal)	51 ps ^{NOTE 4}	Fluke 5520A/SC1100
Rise Time (Measure)	≥ 700 ps	140 ps	TDS 3052C
Time – Measure	Up to 599 sec/month	0.058 sec/day	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. Values listed with percent (%) are percent of reading or generated value unless otherwise noted.
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. The known source rise time is mathematically removed from the total measured rise time measured on the DUT.
5. L = length in inches.
6. This scope is formatted as part of a single document including Certificate of Accreditation No. AC-2489.04.



Vice President