



CERTIFICATE OF ACCREDITATION

ANSI-ASQ National Accreditation Board

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

This is to certify that

Rothe Development, Inc. Metrology Services Division
1100 Hercules Ave, Suite 230
Houston, TX 77058

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

ISO/IEC 17025:2005

and national standards

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

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-1440

Certificate Number


ANAB Approval

Certificate Valid: 12/14/2017-03/11/2019
Version No. 006 Issued: 12/14/2017



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

Rothe Development, Inc. Metrology Services Division

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CALIBRATION

Valid to: **March 11, 2019**

Certificate Number: **AC-1440**

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
DC Voltage – Source ¹	Up to 330 mV 330 mV to 3.3 V (3.3 to 33) V (33 to 330) V 330 V to 1 kV	16 μ V/V + 1.2 μ V 8.5 μ V/V + 2.3 μ V 9.3 μ V/V + 23 μ V 14 μ V/V + 0.18 mV 14 μ V/V + 1.8 mV	Fluke 5520A SC1100 Multifunction Calibrator
DC Voltage – Measure ¹	(10 to 100) mV 100 mV to 1 V (1 to 10) V (10 to 100) V 100V to 1 kV	13 μ V/V + 0.36 μ V 12 μ V/V + 0.68 μ V 12 μ V/V + 5.8 μ V 14 μ V/V + 68 μ V 14 μ V/V + 0.59 mV	HP 3458A Multimeter
	(1 to 15) kV	1.2 mV/V + 1.2 V	Ross VD15 Divider with HP 3458A Multimeter
	Up to 150 kV	6.4 mV/V + 19 V	Ross VD150 Divider with HP 3458A Multimeter
DC Current - Source ¹	Up to 330 μ A 330 μ A to 3.3 mA (3.3 to 33) mA (33 to 330) mA 330 mA to 1.1 A (1.1 to 3) A (3 to 11) A (11 to 20.5) A	0.13 mA/A + 23 nA 90 μ A/A + 58 nA 86 μ A/A + 0.29 μ A 89 μ A/A + 2.9 μ A 0.22 mA/A + 74 μ A 0.34 mA/A + 74 μ A 0.46 mA/A + 0.58 mA 0.8 mA/A + 0.87 mA	Fluke 5520A SC1100 Multifunction Calibrator
	(25 to 120) A	4.7 mA + 85 μ A/A	52120A Transconductance Amplifier



Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
DC Current - Source ¹	(20 to 50) A (50 to 150) A (150 to 550) A 550 A to 1 kA	5.2 mA/A + 0.14 A 5.4 mA/A + 0.14 A 5.5 mA/A + 0.53 A 6 mA/A + 0.54 A	Fluke 5520A SC1100 Multifunction Calibrator with 5500A Coil
DC Current - Measure ¹	(10 to 100) nA 100 nA to 1 μA (1 to 10) μA (10 to 100) μA 100 μA to 1 mA (1 to 10) mA (10 to 100) mA 100 mA to 1 A	1.8 mA/A + 0.58 nA 0.17 mA/A + 0.58 nA 32 μA/A + 0.59 nA 30 μA/A + 1.1 nA 46 μA/A + 82 nA 0.13 mA/A + 0.13 μA 0.13 mA/A + 1.3 μA 0.14 mA/A + 13 μA	HP 3458A Multimeter
	1 mΩ (15 to 150) μA (1.5 to 150) mA (1.5 to 15) A	0.68 mA/A + 5.4 μA 0.13 mA/A + 15 μA 0.13 mA	HP 3458A Multimeter with Honeywell 2759 Shunt
	10 mΩ (1 to 100) A	11 mA/A	HP 3458A Multimeter with Rubicon 100 Resistor
	100 mΩ (1 to 100) A	9 mA/A	HP 3458A Multimeter with Deltec MSA101 Shunt
	100 μΩ (5 to 200) A	8.7 mA/A	HP 3458A Multimeter with Deltec MKBC408 Shunt
AC Voltage – Source ¹	Up to 33 mV (10 to 45) Hz 45 to 10 kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 500) kHz (33 to 330) mV (10 to 45) Hz 45 to 10 kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 500) kHz	0.62 mV/V + 6.9 μV 0.12 mV/V + 6.9 μV 0.16 mV/V + 6.9 μV 0.78 mV/V + 6.9 μV 2.7 mV/V + 14 μV 6.2 mV/V + 58 μV 0.23mV/V + 9.2 μV 0.11mV/V + 9.2 μV 0.12mV/V + 9.2 μV 0.27 mV/V + 9.2 μV 0.62 mV/V + 37 μV 1.6 mV/V + 81 μV	Fluke 5520A SC1100 Multifunction Calibrator



Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Source ¹	330 mV to 3.3 V		Fluke 5520A SC1100 Multifunction Calibrator
	(10 to 45) Hz	0.23 mV/V + 58 μV	
	45 to 10 kHz	0.12 mV/V + 69 μV	
	(10 to 20) kHz	0.15 mV/V + 69 μV	
	(20 to 50) kHz	0.23 mV/V + 58 μV	
	(50 to 100) kHz	0.54 mV/V + 0.14 mV	
	(100 to 500) kHz	1.9 mV/V + 0.69 mV	
	(3.3 to 33) V		
	(10 to 45) Hz	0.23 mV/V + 0.75 mV	
	45 to 10 kHz	0.12 mV/V + 0.69 mV	
	(10 to 20) kHz	0.19 mV/V + 0.69 mV	
	(20 to 50) kHz	0.27 mV/V + 0.69 mV	
	(50 to 100) kHz	0.7 mV/V + 1.8 mV	
	(33 to 330) V		
	(10 to 45) Hz	0.15 mV/V + 2.3 mV	
45 to 10 kHz	0.16 mV/V + 6.9 mV		
(10 to 20) kHz	0.19 mV/V + 6.9 mV		
(20 to 50) kHz	0.23 mV/V + 6.9 mV		
(50 to 100) kHz	1.6 mV/V + 58 mV		
AC Voltage - Measure ¹	330 V to 1.02 kV		HP 3458A Multimeter
	45 Hz to 1 kHz	0.23 mV/V + 12 mV	
	(1 to 5) kHz	0.19 mV/V + 12 mV	
	(5 to 10) kHz	0.23 mV/V + 12 mV	
	(1 to 10) mV		
(1 to 40) Hz	0.37 mV/V + 3.5 μV		
40 Hz to 1 kHz	0.27 mV/V + 1.3 μV		
(1 to 20) kHz	0.36 mV/V + 1.3 μV		
(20 to 50) kHz	1.2 mV/V + 1.3 μV		
(50 to 100) kHz	5.8 mV/V + 1.3 μV		
(100 to 300) kHz	40 mV/V + 2.3 μV		
300 kHz to 1MHz	14 mV/V + 5.8 μV		
(1 to 4) MHz	81 mV/V + 1.2 μV		
(4 to 8) MHz	0.23 V/V + 9.2 μV		



AC Voltage - Measure ¹	(10 to 100) mV		
	(1 to 40) Hz		86 μ V/V + 4.7 μ V
	40 Hz to 1 kHz		95 μ V/V + 2.4 μ V
	(1 to 20) kHz		0.17 mV/V + 2.4 μ V
	(20 to 50) kHz		0.35 mV/V + 2.4 μ V
	(50 to 100) kHz		0.93 mV/V + 2.4 μ V
	(100 to 300) kHz		3.5 mV/V + 12 μ V
	300 kHz to 1 MHz		12 mV/V + 12 μ V
	(1 to 2) MHz		17 mV/V + 12 μ V
	(2 to 4) MHz		46 mV/V + 81 μ V
	(4 to 8) MHz		46 mV/V + 92 μ V
	(8 to 10) MHz		0.17 V/V + 0.1 mV
	100 mV to 1 V		
	(1 to 40) Hz		86 μ V/V + 47 μ V
	40 Hz to 1 kHz		91 μ V/V + 24 μ V
	(1 to 20) kHz		0.17 mV/V + 24 μ V
	(20 to 50) kHz		0.35 mV/V + 24 μ V
	(50 to 100) kHz		0.93 mV/V + 24 μ V
	(100 to 300) kHz		3.5 mV/V + 0.12 mV
	300 kHz to 1 MHz		12 mV/V + 0.12 mV
	(1 to 2) MHz		17 mV/V + 0.12 mV
	(2 to 4) MHz		46 mV/V + 0.81 mV
	(4 to 8) MHz		46 mV/V + 0.92 mV
	(8 to 10) MHz		0.17 V/V + 1.2 mV
	(1 to 10) V		
	(1 to 40) Hz		0.11 mV/V + 0.47 mV
	40 Hz to 1 kHz		0.11 mV/V + 0.24 mV
	(1 to 20) kHz		0.18 mV/V + 0.24 mV
	(20 to 50) kHz		0.35 mV/V + 0.24 mV
	(50 to 100) kHz		0.93 mV/V + 0.24 mV
(100 to 300) kHz		3.5 mV/V + 1.2 mV	
300 kHz to 1 MHz		12 mV/V + 1.2 mV	
(1 to 2) MHz		17 mV/V + 1.2 mV	
(2 to 4) MHz		46 mV/V + 8.1 mV	
(4 to 8) MHz		46 mV/V + 9.2 mV	
(8 to 10) MHz		0.17 V/V + 12 mV	
(10 to 100) V			
(1 to 40) Hz		0.23 mV /V + 4.7 mV	
40Hz to 1 kHz		0.25 mV /V + 2.4 mV	
(1 to 20) kHz		0.25 mV /V + 2.4 mV	
(20 to 50) kHz		0.41 mV/V + 2.4 mV	
(50 to 100) kHz		1.4 mV/V + 2.4 mV	
(100 to 300) kHz		4.6 mV/V + 12 mV	
300 kHz to 1 MHz		0.2 V/V + 12 mV	
			HP 3458A Multimeter



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	0.46 mV V/V + 47 mV 0.46 mV /V + 24 mV 0.88 mV V + 24 mV 1.4 mV/V + 24 mV 3.5 mV/V + 24 mV	HP 3458A Multimeter
	(1 to 15) kV @ 60 Hz	4.9 mV/V + 6 V	Ross VD15 Divider with HP 3458A Multimeter
	Up to 100 kV @ 60 Hz	9.5 mV/V + 2.6 V	Ross VD150 Divider with HP 3458A Multimeter
AC Current - Source ¹	(29 to 330) μ A (10 to 20) Hz (20 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (10 to 30) kHz	1.6 mA/A + 0.12 μ A 1.2 mA/A + 0.12 μ A 1 mA/A + 0.12 μ A 2.3 mA/A + 0.17 μ A 6.2 mA/A + 0.23 μ A 12 mA/A + 0.46 μ A	Fluke 5520A SC1100 Multifunction Calibrator
	330 μ A to 3.3 mA (10 to 20) Hz (20 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (10 to 30) kHz	1.6 mA/A + 0.17 μ A 1 mA/A + 0.17 μ A 0.78 mA/A + 0.17 μ A 1.6 mA/A + 0.23 μ A 3.9 mA/A + 0.35 μ A 7.8 mA/A + 0.69 μ A	
	(3.3 to 33) mA (10 to 20) Hz (20 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (10 to 30) kHz	1.4 mA/A + 2.3 μ A 0.7 mA/A + 2.3 μ A 0.31 mA/A + 2.3 μ A 0.78 mA/A + 2.3 μ A 1.6 mA/A + 3.5 μ A 3.1 mA/A + 4.6 μ A	
	(33 to 330) mA (10 to 20) Hz (20 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (10 to 30) kHz	1.4 mA/A + 23 μ A 0.7 mA/A + 23 μ A 0.31mA/A + 23 μ A 0.78 mA/A + 58 μ A 1.6 mA/A + 0.12 mA 3.1 mA/A + 0.23 mA	



Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current - Source ¹	330 mA to 1.1 A (10 to 45) Hz	1.5 mA/A + 0.12 mA	Fluke 5520A SC1100 Multifunction Calibrator
	45 Hz to 1 kHz (1 to 5) kHz	0.39 mA/A + 0.12 mA 4.7 mA/A + 1.2 mA	
	(5 to 10) kHz	19 mA/A + 1.2 mA	
	(1.1 to 3) A 45 Hz to 1 kHz	1.7 mA/A + 0.12 mA	
	(3 to 11) A (40 to 100) Hz	1.2mA/A + 1.4mA	
	(11 to 20.5) A (40 to 100) Hz	1.2mA/A + 1.4mA	
AC Current - Source ¹	(25 to 120) A 60 Hz	13 mA/A + 19 mA	52120A Transconductance Amplifier
	400 Hz	0.78 mA/A + 94 mA	
	(20 to 50) A (45 to 65) Hz	3.3 mA/A + 30 mA	Fluke 5520A SC1100 Multifunction Calibrator With 5500 Coil
	(65 to 440) Hz	8.4 mA/A + 32 mA	
	(50 to 150) A (45 to 65) Hz	3.4 mA/A + 30 mA	
	(65 to 440) Hz	8.5 mA/A + 32 mA	
	(150 to 500) A (45 to 65) Hz	3.4 mA/A + 0.19 A	
	(65 to 440) Hz	8.9 mA/A + 0.2 A	
	(500 to 1 000) A (45 to 65) Hz	4 mA/A + 0.28 A	52120A Transconductance Amplifier with 25 turn Coil
	(65 to 440) Hz	9.4 mA/A + 0.35 A	
	(500 to 3 000) A 60 Hz	7.3 mA/A + 0.56 mA	
	400 Hz	7.3 mA/A + 0.5 mA	52120A Transconductance Amplifier with 50 turn Coil
(3 000 to 6 000) A 60 Hz	7.5 mA/A + 780 mA		
400 Hz	7.5 mA/A + 780 mA		
AC Current - Measure ¹	(5 to 100) μ A (10 to 20) Hz	4.6 mA/A + 35 nA	HP 3458A Multimeter
	(20 to 45) Hz	1.7 mA/A + 35 nA	
	(45 to 100) Hz	1.2 mA/A + 35 nA	
	100 Hz to 5 kHz	1.2 mA/A + 35 nA	
	(5 to 20) kHz	0.7 mA + 35 nA	



Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current - Measure ¹	100 μ A to 1 mA		HP 3458A Multimeter
	(10 to 20) Hz	4.6 mA/A + 0.24 μ A	
	(20 to 45) Hz	1.9 mA/A + 0.24 μ A	
	(45 to 100) Hz	1.9 mA/A + 0.24 μ A	
	100 Hz to 5 kHz	0.36 mA/A + 0.24 μ A	
	(5 to 20) kHz	0.7 mA/A + 0.24 μ A	
	(20 to 50) kHz	4.6 mA/A + 0.47 μ A	
	(50 to 100) kHz	6.4 mA/A + 1.7 μ A	
	(1 to 10) mA		
	(10 to 20) Hz	4.6 mA/A + 2.4 μ A	
	(20 to 45) Hz	1.7 mA/A + 2.4 μ A	
	(45 to 100) Hz	0.7 mA/A + 2.4 μ A	
	100 Hz to 5 kHz	0.35 mA/A + 2.4 μ A	
	(5 to 20) kHz	0.70 mA/A + 2.3 μ A	
	(20 to 50) kHz	4.6 mA/A + 4.6 μ A	
	(50 to 100) kHz	6.4 mA/A + 17 μ A	
	(10 to 100) mA		
	(10 to 20) Hz	4.6 mA/A + 23 μ A	
	(20 to 45) Hz	1.7 mA/A + 23 μ A	
	(45 to 100) Hz	0.7 mA/A + 23 μ A	
	100 Hz to 5 kHz	0.36 mA/A + 23 μ A	
(5 to 20) kHz	1.1 mA/A + 23 μ A		
(20 to 50) kHz	4.7 mA/A + 46 μ A		
(50 to 100) kHz	6.4 mA/A + 0.17 mA		
100 mA to 1 A			
(10 to 20) Hz	4.6 mA/A + 0.23 mA		
(20 to 45) Hz	1.8 mA/A + 0.23 mA		
(45 to 100) Hz	0.93 mA/A + 0.23 mA		
100 Hz to 5 kHz	1.2 mA/A + 0.23 mA		
(5 to 20) kHz	3.5 mA/A + 0.23 mA		
(20 to 50) kHz	10 mA/A + 0.4 mA		
(1 to 10) A			Keysight 34461A Multimeter
60 Hz to 400 Hz	2.5 mA/A + 1.2 mA		



Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Resistance - Source ¹	Up to 11 Ω (11 to 33) Ω (33 to 111) Ω (110 to 330) Ω 330 Ω to 1.1k Ω (1.1 to 3.3) kΩ (3.3 to 11) kΩ (11 to 33) kΩ (33 to 110) kΩ (110 to 330) kΩ 330 kΩ to 1.19 MΩ (1.1 to 3.3) MΩ (3.3 to 11) MΩ (11 to 33) MΩ (33 to 110) MΩ (110 to 330) MΩ 330 MΩ to 1.1 GΩ	0.12 mΩ/Ω + 1.2 mΩ 0.12 mΩ/Ω + 1.7 mΩ 27 μΩ/Ω + 1.6 mΩ 24 μΩ/Ω + 2.3 mΩ 25 μΩ/Ω + 2.3 mΩ 26 μΩ/Ω + 2.3 mΩ 25 μΩ/Ω + 2.3 mΩ 23 μΩ/Ω + 0.23 Ω 23 μΩ/Ω + 0.23 Ω 26 μΩ/Ω + 2.3 Ω 35 μΩ/Ω + 2.3 Ω 48 μΩ/Ω + 35 Ω 0.12 mΩ/Ω + 58 Ω 0.28 mΩ/Ω + 2.9 kΩ 0.47 mΩ/Ω + 3.5 kΩ 2.3 μΩ/Ω + 0.12 MΩ 12 μΩ/Ω + 0.5 MΩ	Fluke 5520A SC1100 Multifunction Calibrator
Resistance – Measure ¹	Up to 10 Ω (10 to 100) Ω 100 Ω to 1 kΩ (1 to 10) kΩ (10 to 100) kΩ 100 kΩ to 1 MΩ (1 to 10) MΩ (10 to 100) MΩ 100 MΩ to 1 GΩ	23 μΩ/Ω + 86 μΩ 17 μΩ/Ω + 0.64 mΩ 15 μΩ/Ω + 0.86 mΩ 15 μΩ/Ω + 8.6 μΩ 15 μΩ/Ω + 86 μΩ 21 μΩ/Ω + 2.4 Ω 61 μΩ/Ω + 0.12 kΩ 0.58 mΩ/Ω + 3.5 kΩ 5.8 mΩ/Ω + 0.33 MΩ	HP 3458A Multimeter
Electrical Simulation of Thermocouple Indicators - Source and Measure ¹	Type B (600 to 800) °C (800 to 1 000) °C (1 000 to 1 550) °C (1 550 to 1 820) °C Type C (0 to 150) °C (150 to 650) °C (650 to 1 000) °C (1 000 to 1 800) °C (1 800 to 2 316) °C	0.34 °C 0.26 °C 0.23 °C 0.26 °C 0.23 °C 0.2 °C 0.24 °C 0.39 °C 0.65 °C	Fluke 5520A SC1100 Multifunction Calibrator

Electrical Simulation of Thermocouple Indicators - Source and Measure ¹	Type E		
	(-250 to -100) °C		0.39 °C
	(-100 to -25) °C		0.12 °C
	(-25 to 350) °C		0.11 °C
	(350 to 650) °C		0.12 °C
	(650 to 1 000) °C		0.16 °C
	Type B		
	(600 to 800) °C		0.34 °C
	(800 to 1 000) °C		0.26 °C
	(1 000 to 1 550) °C		0.23 °C
	(1 550 to 1 820) °C		0.26 °C
	Type C		
	(0 to 150) °C		0.23 °C
	(150 to 650) °C		0.2 °C
	(650 to 1 000) °C		0.24 °C
	(1 000 to 1 800) °C		0.39 °C
	(1 800 to 2 316) °C		0.65 °C
	Type E		
	(-250 to -100) °C		0.39 °C
	(-100 to -25) °C		0.12 °C
	(-25 to 350) °C		0.11 °C
	(350 to 650) °C		0.12 °C
	(650 to 1 000) °C		0.16 °C
	Type J		
(-210 to -100) °C		0.21 °C	
(-100 to -30) °C		0.13 °C	
(-30 to 150) °C		0.11 °C	
(150 to 760) °C		0.13 °C	
(760 to 1 200) °C		0.18 °C	
Type K			
(-200 to -100) °C		0.26 °C	
(-100 to -25) °C		0.14 °C	
(-25 to 120) °C		0.13 °C	
(120 to 1 000) °C		0.2 °C	
(1 000 to 1 372) °C		0.31 °C	
Type L			
(-200 to -100) °C		0.29 °C	
(-100 to 800) °C		0.2 °C	
(800 to 900) °C		0.13 °C	
			Fluke 5520A SC1100 Multifunction Calibrator



Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Electrical Simulation of Thermocouple Indicators - Source and Measure ^{1,2}	Type N		Fluke 5520A SC1100 Multifunction Calibrator
	(-200 to -100) °C	0.31 °C	
	(-100 to -25) °C	0.17 °C	
	(-25 to 120) °C	0.15 °C	
	(120 to 410) °C	0.14 °C	
	(410 to 1 300) °C	0.21 °C	
	Type R		
	(0 to 250) °C	0.44 °C	
	(250 to 400) °C	0.27 °C	
	(400 to 1 000) °C	0.26 °C	
	(1 000 to 1 767) °C	0.31 °C	
	Type R	(0.7 + 0.002 5Y) °C	
	(660 to 1 000) °C		
	Type S		
	(0 to 250) °C	0.47 °C	
	(250 to 1 000) °C	0.36 °C	
(1 000 to 1 400) °C	0.37 °C		
(1 400 to 1 767) °C	0.46 °C		
Type T			
(-250 to -150) °C	0.49 °C		
(-150 to 0) °C	0.19 °C		
(0 to 120) °C	0.12 °C		
(120 to 400) °C	0.11 °C		
Type U			
(-200 to 0) °C	0.56 °C		
(0 to 600) °C	0.27 °C		
Electrical Simulation of RTD Indicating Devices ¹	Pt 385 (100 Ω)		Fluke 5520A SC1100 Multifunction Calibrator
	(-200 to 0) °C	0.04 °C	
	(0 to 100) °C	0.06 °C	
	(100 to 300) °C	0.07 °C	
	(300 to 400) °C	0.08 °C	
	(400 to 630) °C	0.1 °C	
	(630 to 800) °C	0.18 °C	



Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
DC Power - Source ¹ (1 to 1 000) V	1.5 W 6 W 12 W 20 W 30 W 60 W 120 W 500 W 1.5 kW 6 kW 30 kW 50 kW	0.06 % of Watts Output 0.05 % of Watts Output 0.07 % of Watts Output 0.06 % of Watts Output 0.1 % of Watts Output 0.08 % of Watts Output 0.05 % of Watts Output 0.07 % of Watts Output 0.07 % of Watts Output 0.1 % of Watts Output 0.09 % of Watts Output 0.09 % of Watts Output	Fluke 5520A SC1100 Multifunction Calibrator
AC Power – Source ¹ (45 to 65) Hz P=1 (1 to 1 000) V	1.5 W 6 W 12 W 20 W 30 W 60 W 120 W 500 W 1500 W 6 kW 30 kW 50 kW	0.07 % of Watts Output 0.07 % of Watts Output 0.07 % of Watts Output 0.07 % of Watts Output 0.07 % of Watts Output 0.07 % of Watts Output 0.07 % of Watts Output 0.11 % of Watts Output 0.08 % of Watts Output 0.11 % of Watts Output 0.11 % of Watts Output 0.01 % of Watts Output	Fluke 5520A SC1100 Multifunction Calibrator
Capacitance – Source ¹ (4.7 to 470) nF 1 μF to 1.1 mF	10Hz to 1kHz (10 to 300) Hz	3.9 pF/nF + 42 pF 4.5 nF/uF + 2 nF	Fluke 5520A SC1100 Multifunction Calibrator
Wave Generator – Source ¹ Amplitude (10 Hz to 10 kHz) Square, Sine, Triangle into 1 MΩ Square, Sine, Triangle into 50 Ω Frequency	1.8 mV to 55 Vpp 1.8 mV to 2.5 Vpp 10 Hz to 100 kHz	30 mV/V + 0.1 mV 30 mV/V + 0.1 mV 25 parts in 10 ⁶ Hz + 15 mHz	Fluke 5520A SC1100 Multifunction Calibrator



Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Oscilloscopes ¹ DC Signal into 50 Ω Load into 1 MΩ Load	(-6.6 to 6.6) V (-130 to 130) V	1.9 mV/V + 46 μV 0.39 mV/V + 46 μV	Fluke 5520A SC1100 Multifunction Calibrator
Square Wave 50 Ω Load	1 mV to 6.6 V p-p 10 Hz to 10 kHz	1.9 mV/V + 46 μV	
1 MΩ Load	1 mV to 130 V p-p 10 Hz to 10 kHz	1.2 mV/V + 46 μV	
Leveled Sine Wave - Flatness Relative to 50 kHz	5 mV to 5.5 V 50 kHz to 100 MHz (100 to 300) MHz (300 to 600) MHz	12 mV/V + 0.12 mV 16 mV/V + 0.12 mV 31 mV/V + 0.12 mV	
	5mV to 3.5V (600 to 1 100) MHz	39 mV/V + 0.12 mV	
Time Marker ² into 50 Ω Load-Source	5 s to 50 ms 20 ms to 100 ns (50 to 20) ns 10 ns (5 to 1) ns	(25 + 1 000 <i>t</i>) parts in 10 ⁶ s 2.5 parts in 10 ⁶ s 2.5 parts in 10 ⁶ s 2.5 parts in 10 ⁶ s 2.5 parts in 10 ⁶ s	
Edge Specs into 50 Ω Load - Source Rise Time Amplitude Frequency	≤ 300 ps 5 mV to 2.5V 1 kHz to 10 MHz	0 ps /-120 ps 16 mV/V + 0.23 mV 1.9 parts in 10 ⁶ of setting	

Length – Dimensional metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Micrometers ¹	Up to 1 in (2 to 12) in (12 to 24) in	37 μin 150 μin 610 μin	Grade 2 Gage Blocks
Calipers ^{1,2}	Up to 6 in (6 to 12) in (12 to 24) in	(290 + 0.51 <i>L</i>) μin 300 μin 350 μin	Grade 2 Gage Blocks



Length – Dimensional metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Indicators	Up to 1 in	140 μ in	P&W Model C Supermicrometer
Plain Plug and Pin Gages	Up to 1 in	51 μ in	P&W Model C Supermicrometer, Grade 2 Gage Blocks
Gage Blocks ²	Up to 4 in (5 to 20) in	(3.7 + 0.97L) μ in (4.7 + 2.8L) μ in	P&W LMU 1000A Grade 2 Gage Blocks
Setting Standards ²	Up to 40 in	81 μ in	P&W Labmaster Universal 1000A Grade 2 Gage Blocks
Steel Tapes and Rules	Up to 25 ft	(590 +29L) μ in	P&W Labmaster Universal 1000A Grade 2 Gage Blocks
Surface Plates Flatness	Diagonal up to 5 ft	61 μ in	Mahr Federal EMD-832P-48-W2 Electronic Levels
Thread Plugs Pitch Diameter Major Diameter	Up to 5 in Up to 5 in	11 μ in 51 μ in	P&W Model C Supermicrometer, Grade 2 Gage Blocks, Thread Wires

Mass

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Torque Wrenches ^{1,2}	5 to 50) lbf·in (40 to 400) lbf·in (100 to 1 000) lbf·in (25 to 250) lbf·ft	(0.25 + 0.026T) lbf·in (2.1 + 0.005 3T) lbf·in (3.8 + 0.001 5T) lbf·in (0.7 + 0.023T) lbf·ft	CDI 5000ST Torque System and 2000-400-02 Transducer Kit
Pressure Gages, Transducers – Measure ^{1,2}	(3 to 30) psi (20 to 100) psi (100 to 500) psi (200 to 1 000) psi (1 000 to 5 000) psi (2 000 to 10 000) psi	(0.008 6 + 0.000 92P) psi (0.038 + 0.000 87P) psi (0.04 + 0.001 1P) psi (0.076 + 0.001 1P) psi (0.4 + 0.001 1P) psi (0.69 + 0.001 1P) psi	Digital Pressure Gages Crystal 30PSIXP2I Crystal 100PSIXP2I Crystal 500PSIXP2I Crystal 1KPSIXP2I Crystal 5KPSIXP2I Crystal 10KPSIXP2I



Mass

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Pressure Gages, Transducers – Measure ²	(-15 to 0) psi (0 to 30) psi (0 to 100) psi	(0.006 - 0.000 72 <i>P</i>) psi (0.003 6 + 0.000 048 <i>P</i>) psi (0.004 2 + 0.000 11 <i>P</i>) psi	GE Druck Pace 1002 Pressure Indicator
	(100 to 1 500) psi (1 500 to 15 000) psi	(0.004 9 + 0.000 076 <i>P</i>) psi (0.000 075 + 0.000 086 <i>P</i>) psi	Mensor CPB5000 Pressure Balance

Thermodynamic

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Temperature - Source	(-45 to 155) °C	0.05 °C	Ametek RTC 157B Temperature Calibrator, STS 200 B915 PRT
Temperature - Measure ¹	(-250 to 660) °C	(0.03 + 0.000 42 <i>Y</i>) °C	Advanced Sensing Products WSP660 PRT and HP 3458A Multimeter
	@ Ambient	0.3 °C	Rotronic Hygropalm
IR Temperature - Source ¹	(122 to 932) °F	17 °F	Hart 9132 Infrared Calibrator
Humidity	11 %RH 33 %RH 75 %RH	1.2 %RH 1.2 %RH 1.6 %RH	Saturated Salt Solutions LiCl MgCl NaCl
	@ Ambient	1.8 %RH	Rotronic Hygropalm

Time and Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Frequency - Source ¹	0.01 Hz to 2 MHz	2 μHz/Hz + 8 μHz	Fluke 5520A SC1100 Multifunction Calibrator
	10 MHz	1 part in 10 ⁻¹¹ Hz	Spectracom 8194 GPS Oscillator

Time and Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Stopwatches /Timers ¹	Up to 24 hours	5.8 ms	Fluke 5520A SC1100 Multifunction Calibrator with Spectracom 8194 GPS Oscillator and Fluke PM6680B Counter
Tachometers ¹	(60 to 99 999) rpm	0.58 rpm	Fluke 5520A SC1100 Multifunction Calibrator with Spectracom 8194 GPS Oscillator

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, P = pressure in psi, t = time in seconds, T = torque in applicable units of measurement, Y = temperature in degrees Celsius.
3. This scope is formatted as part of a single document including Certificate of Accreditation No. AC-1440.



Vice President

