



# CERTIFICATE OF ACCREDITATION

**The ANSI National Accreditation Board**

Hereby attests that

**TLC Calibrations Company, LLC  
2720 Mounds View Blvd., Suite 400  
Mounds View, MN 55112**

Fulfills the requirements of

**ISO/IEC 17025:2017**

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: 28 January 2025

Certificate Number: AC-2949



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**

**TLC Calibrations Company, LLC**

2720 Mounds View Blvd., Suite 400

Mounds View, MN 55112

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**CALIBRATION**

Valid to: **January 28, 2025**

Certificate Number: **AC-2949**

**Electrical – DC/Low Frequency**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
DC Voltage – Source <sup>1</sup> (Ranges Locked)	(0 to 330) mV (0 to 3.3) V (0 to 33) V (30 to 330) V (100 to 1 020) V	20 $\mu$ V/V + 1 $\mu$ V 11 $\mu$ V/V + 2.1 $\mu$ V 12 $\mu$ V/V + 21 $\mu$ V 18 $\mu$ V/V + 0.15 mV 18 $\mu$ V/V + 1.6 mV	Fluke 5522 Multiproduct Calibrator
DC Voltage – Measure <sup>1</sup>	Up to 100 mV (0.1 to 1) V (1 to 10) V (10 to 100) V (100 to 1 000) V	89 $\mu$ V/V + 0.6 nV 27 $\mu$ V/V + 6.9 $\mu$ V 30 $\mu$ V/V + 3.9 $\mu$ V 48 $\mu$ V/V + 0.18 mV 50 $\mu$ V/V + 0.33 mV	Fluke 8588A 8.5 Digit Multimeter
DC Current – Source <sup>1</sup> (Ranges Locked)	(0 to 330) $\mu$ A (0 to 3.3) mA (0 to 33) mA (0 to 330) mA (0 to 1.1) A (1.1 to 3) A (0 to 11) A (11 to 20.5) A	0.15 mA/A + 20 nA 0.1 mA/A + 50 nA 0.1 mA/A + 0.26 $\mu$ A 0.1 mA/A + 2.6 $\mu$ A 0.2 mA/A + 40 $\mu$ A 0.38 A/A + 40 $\mu$ A 0.5 mA/A + 0.5 mA 1 mA/A + 0.75 mA	Fluke 5522 Multiproduct Calibrator
DC Current – Measure <sup>1</sup>	Up to 10 $\mu$ A (10 to 100) $\mu$ A (0.1 to 1) mA (1 to 10) mA (10 to 100) mA (0.1 to 1) A (1 to 10) A (10 to 30) A	67 $\mu$ A/A + 0.6 pA 7.9 $\mu$ A/A + 59.1 pA 1.3 $\mu$ A/A + 68 pA 19 $\mu$ A/A + 5.8 nA 72 $\mu$ A/A + 0.54 $\mu$ A 0.25 mA/A + 18 $\mu$ A 0.28 mA/A + 47 $\mu$ A 0.91 mA/A + 6.3 mA	Fluke 8588A 8.5 Digit Multimeter



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Source <sup>1,2</sup>	(1 to 33) mV		Fluke 5522 Multiproduct Calibrator
	(10 to 45) Hz	0.8 $\mu\text{V}/\text{mV} + 6 \mu\text{V}$	
	45 Hz to 10 kHz	0.15 $\mu\text{V}/\text{mV} + 6.1 \mu\text{V}$	
	(10 to 20) kHz	0.2 $\mu\text{V}/\text{mV} + 6.1 \mu\text{V}$	
	(20 to 50) kHz	1 $\mu\text{V}/\text{mV} + 6.1 \mu\text{V}$	
	(50 to 100) kHz	3.5 $\mu\text{V}/\text{mV} + 12 \mu\text{V}$	
	(100 to 500) kHz	8 $\mu\text{V}/\text{mV} + 50 \mu\text{V}$	
	(33 to 330) mV		
	(10 to 45) Hz	0.3 $\mu\text{V}/\text{mV} + 8.1 \mu\text{V}$	
	45 Hz to 10 kHz	0.15 $\mu\text{V}/\text{mV} + 8.1 \mu\text{V}$	
	(10 to 20) kHz	0.16 $\mu\text{V}/\text{mV} + 8.1 \mu\text{V}$	
	(20 to 50) kHz	0.35 $\mu\text{V}/\text{mV} + 8.1 \mu\text{V}$	
	(50 to 100) kHz	0.8 $\mu\text{V}/\text{mV} + 32 \mu\text{V}$	
	(100 to 500) kHz	2 $\mu\text{V}/\text{mV} + 70 \mu\text{V}$	
	(0.33 to 3.3) V		
	(10 to 45) Hz	0.3 mV/V + 50 $\mu\text{V}$	
	45 Hz to 10 kHz	0.15 mV/V + 60 $\mu\text{V}$	
	(10 to 20) kHz	0.19 mV/V + 60 $\mu\text{V}$	
	(20 to 50) kHz	0.3 mV/V + 50 $\mu\text{V}$	
	(50 to 100) kHz	0.7 mV/V + 0.13 mV	
	(100 to 500) kHz	2.4 mV/V + 0.6 mV	
	(3.3 to 33) V		
	(10 to 45) Hz	3 mV/V + 0.65 mV	
	45 Hz to 10 kHz	1.5 mV/V + 0.6 mV	
	(10 to 20) kHz	2.4 mV/V + 0.6 mV	
	(20 to 50) kHz	3.5 mV/V + 0.6 mV	
	(50 to 100) kHz	9 mV/V + 1.6 mV	
	(33 to 330) V		
45 Hz to 1 kHz	0.19 mV/V + 2.1 mV		
(1 to 10) kHz	0.2 mV/V + 6.1 mV		
(10 to 20) kHz	0.25 mV/V + 6.1 mV		
(20 to 50) kHz	0.3 mV/V + 6.1 mV		
(50 to 100) kHz	2 mV/V + 50 mV		
(330 to 1 020) V			
45 Hz to 1 kHz	0.3 mV/V + 10 mV		
(1 to 5) kHz	0.25 mV/V + 10 mV		
(5 to 10) kHz	0.3 mV/V + 10 mV		

**Electrical – DC/Low Frequency**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Measure <sup>1,2</sup>	Up to 10 mV		Fluke 8588A 8.5 Digit Multimeter
	1 Hz to 2 kHz	0.4 $\mu\text{V}/\text{V}$ + 0.6 nV	
	(2 to 10) kHz	0.48 $\mu\text{V}/\text{V}$ + 0.6 nV	
	(10 to 30) kHz	0.49 $\mu\text{V}/\text{V}$ + 0.6 nV	
	(30 to 100) kHz	3.1 $\mu\text{V}/\text{V}$ + 0.6 nV	
	(100 to 300) kHz	10 $\mu\text{V}/\text{V}$ + 0.6 nV	
	300 kHz to 1 MHz	20 $\mu\text{V}/\text{V}$ + 0.6 nV	
	(10 to 100) mV		
	1 Hz to 2 kHz	59 $\mu\text{V}/\text{V}$ + 3.5 $\mu\text{V}$	
	(2 to 10) kHz	97 $\mu\text{V}/\text{V}$ + 3.9 $\mu\text{V}$	
	(10 to 30) kHz	0.21 mV/V + 2.8 $\mu\text{V}$	
	(30 to 100) kHz	0.3 mV/V + 28 $\mu\text{V}$	
	(100 to 300) kHz	1.5 mV/V + 89 $\mu\text{V}$	
	300 kHz to 1 MHz	11 mV/V + 93 $\mu\text{V}$	
	(1 to 2) MHz	2 mV	
	(2 to 4) MHz	5.1 mV	
	(4 to 8) MHz	9.4 mV	
	(8 to 10) MHz	17 mV	
	(0.1 to 10) V		
	1 Hz to 2 kHz	81 $\mu\text{V}/\text{V}$	
	(2 to 10) kHz	0.13 mV/V	
	(10 to 30) kHz	0.24 mV/V	
	(30 to 100) kHz	0.58 mV/V	
	(100 to 300) kHz	2.4 mV/V	
	300 kHz to 1 MHz	11 mV/V + 0.1 mV	
	(1 to 2) MHz	20 mV/V	
	(2 to 4) MHz	50 mV/V	
	(4 to 8) MHz	92 mV/V	
	(8 to 10) MHz	0.16 V/V + 0.6 mV	
	(10 to 100) V		
1 Hz to 2 kHz	97 $\mu\text{V}/\text{V}$ + 0.16 mV		
(2 to 10) kHz	0.11 mV/V + 0.13 mV		
(10 to 30) kHz	0.35 mV/V + 0.23 mV		
(30 to 100) kHz	0.65 mV/V + 0.67 mV		
(100 to 300) kHz	4.4 mV/V + 20 mV		
300 kHz to 1 MHz	17 mV/V + 56 mV		
(100 to 1 000) V			
1 Hz to 2 kHz	0.14 mV/V + 4.44 mV		
(2 to 10) kHz	0.14 mV/V + 2.22 mV		
(10 to 30) kHz	0.25 mV/V + 1.67 mV		
(30 to 100) kHz	0.7 mV/V + 5.56 mV		

**Electrical – DC/Low Frequency**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current – Source <sup>1,2</sup>	(29 to 330) $\mu$ A		Fluke 5522 Multiproduct Calibrator
	(10 to 20) Hz	2 mA/A + 0.1 $\mu$ A	
	(20 to 45) Hz	1.5 mA/A + 0.1 $\mu$ A	
	45 Hz to 1 kHz	1.3 mA/A + 0.1 $\mu$ A	
	(1 to 5) kHz	3 mA/A + 0.2 $\mu$ A	
	(5 to 10) kHz	8 mA/A + 0.2 $\mu$ A	
	(10 to 30) kHz	16 mA/A + 0.4 $\mu$ A	
	(0.33 to 3.3) mA		
	(10 to 20) Hz	2 mA/A + 0.15 $\mu$ A	
	(20 to 45) Hz	1.3 mA/A + 0.15 $\mu$ A	
	45 Hz to 1 kHz	1 mA/A + 0.15 $\mu$ A	
	(1 to 5) kHz	2 mA/A + 0.2 $\mu$ A	
	(5 to 10) kHz	5 mA/A + 0.3 $\mu$ A	
	(10 to 30) kHz	10 mA/A + 0.6 $\mu$ A	
	(3.3 to 33) mA		
	(10 to 20) Hz	1.8 mA/A + 2 $\mu$ A	
	(20 to 45) Hz	0.9 mA/A + 2 $\mu$ A	
	45 Hz to 1 kHz	0.4 mA/A + 2 $\mu$ A	
	(1 to 5) kHz	0.8 mA/A + 2 $\mu$ A	
	(5 to 10) kHz	2 mA/A + 3 $\mu$ A	
	(10 to 30) kHz	4 mA/A + 4 $\mu$ A	
	(33 to 330) mA		
	(10 to 20) Hz	1.8 mA/A + 20 $\mu$ A	
	(20 to 45) Hz	0.9 mA/A + 20 $\mu$ A	
	45 Hz to 1 kHz	0.4 mA/A + 20 $\mu$ A	
	(1 to 5) kHz	1 mA/A + 50 $\mu$ A	
	(5 to 10) kHz	2 mA/A + 0.1 mA	
	(10 to 30) kHz	4 mA/A + 0.2 mA	
	(0.33 to 1.1) A		
	(10 to 45) Hz	1.8 mA/A + 0.1 mA	
45 Hz to 1 kHz	0.5 mA/A + 0.1 mA		
(1 to 5) kHz	6 mA/A + 1 mA		
(5 to 10) kHz	25 mA/A + 5 mA		
(1.1 to 3) A			
(10 to 45) Hz	1.8 mA/A + 0.1 mA		
45 Hz to 1 kHz	0.6 mA/A + 0.1 mA		
(1 to 5) kHz	6 mA/A + 1 mA		
(5 to 10) kHz	25 mA/A + 5 mA		
(3 to 11) A			
(45 to 100) Hz	0.6 mA/A + 2 mA		
100 Hz to 1 kHz	1 mA/A + 2 mA		
(1 to 5) kHz	30 mA/A + 2 mA		

**Electrical – DC/Low Frequency**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current – Source <sup>1,2</sup>	(11 to 20.5) A (45 to 100) Hz 100 Hz to 1 kHz (1 to 5) kHz	1.2 mA/A + 5 mA 1.5 mA/A + 5 mA 30 mA/A + 5 mA	Fluke 5522 Multiproduct Calibrator
AC Current – Measure <sup>1,2</sup>	(1 to 10) $\mu$ A 1 Hz to 10 kHz (10 to 30) kHz (10 to 100) $\mu$ A 1 Hz to 2 kHz 10 $\mu$ A to 1 mA (2 to 10) kHz 10 $\mu$ A to 10 mA (10 to 30) kHz (0.1 to 100) mA 1 Hz to 2 kHz (1 to 100) mA (2 to 10) kHz (10 to 100) mA (10 to 30) kHz (0.1 to 1) A 1 Hz to 2 kHz (2 to 10) kHz (10 to 30) kHz (1 to 10) A 10 Hz to 2 kHz (10 to 30) A 10 Hz to 2 kHz (2 to 10) kHz	2.3 nA/ $\mu$ A 2.3 nA/ $\mu$ A 0.11 nA/ $\mu$ A + 22 nA 0.56 nA/ $\mu$ A + 17 nA 0.8 nA/ $\mu$ A + 16 nA 0.33 nA/ $\mu$ A + 1 nA 0.56 $\mu$ A/mA + 10 nA 72 nA/mA + 0.54 $\mu$ A 0.4 mA/A + 7.8 $\mu$ A 0.65 mA/A + 9 $\mu$ A 0.9 mA/A + 11 $\mu$ A 0.9 mA/A + 0.26 mA 2 mA/A + 11 mA 1.4 mA/A + 5.3 mA	Fluke 8588A 8.5 Digit Multimeter
Resistance – Source <sup>1</sup>	Up to 11 $\Omega$ (11 to 33) $\Omega$ (33 to 110) $\Omega$ (110 to 330) $\Omega$ (0.33 to 1.1) k $\Omega$ (1.1 to 3.3) k $\Omega$ (3.3 to 11) k $\Omega$ (11 to 33) k $\Omega$ (33 to 110) k $\Omega$ (110 to 330) k $\Omega$	40 $\mu\Omega/\Omega$ + 1 m $\Omega$ 30 $\mu\Omega/\Omega$ + 1.5 m $\Omega$ 28 $\mu\Omega/\Omega$ + 1.4 m $\Omega$ 28 $\mu\Omega/\Omega$ + 2 m $\Omega$ 28 $\mu\Omega/\Omega$ + 2 m $\Omega$ 28 $\mu\Omega/\Omega$ + 20 m $\Omega$ 28 $\mu\Omega/\Omega$ + 20.2 m $\Omega$ 28 $\mu\Omega/\Omega$ + 0.2 $\Omega$ 28 $\mu\Omega/\Omega$ + 0.2 $\Omega$ 32 $\mu\Omega/\Omega$ + 2 $\Omega$	Fluke 5522 Multiproduct Calibrator



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Resistance – Source <sup>1</sup>	(0.33 to 1.1) 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 to 1 100) MΩ	32 μΩ/Ω + 2 Ω 60 μΩ/Ω + 30 Ω 0.13 mΩ/Ω + 50.2 Ω 0.25 mΩ/Ω + 2.5 kΩ 500 μΩ/Ω + 3 kΩ 3 mΩ/Ω + 0.1 MΩ 15 mΩ/Ω + 0.5 MΩ	Fluke 5522 Multiproduct Calibrator
Resistance – Measure <sup>12</sup>	(1 to 10) Ω (10 to 100) Ω (0.1 to 1) kΩ (1 to 10) kΩ (10 to 100) kΩ (0.1 to 1) MΩ (1 to 10) MΩ (10 to 100) MΩ (0.1 to 1) GΩ	1.3 mΩ/Ω + 1.3 mΩ 9.5 μΩ/Ω + 20 mΩ 9.6 μΩ/Ω + 11.1 mΩ 9.7 μΩ/Ω + 0.11 mΩ 9.8 μΩ/Ω + 1.11 mΩ 12 μΩ/Ω + 0.2 Ω 0.13 mΩ/Ω + 0.12 kΩ 0.23 mΩ/Ω + 1.2 kΩ 2.5 mΩ/Ω + 0.23 mΩ	Fluke 8588A 8.5 Digit Multimeter
Capacitance – Source <sup>2</sup> 10 Hz to 10 kHz 10 Hz to 10 kHz 10 Hz to 3 kHz 10 Hz to 1 kHz 10 Hz to 1 kHz 10 Hz to 1 kHz 10 Hz to 1 kHz (10 to 600) Hz (10 to 300) Hz (10 to 150) Hz (10 to 120) Hz (10 to 80 Hz (0 to 50) Hz (0 to 20) Hz (0 to 6) Hz (0 to 2) Hz (0 to 0.6) Hz (0 to 0.2) Hz	(220 to 400) pF (0.4 to 1.1) nF (1.1 to 3.3) nF (3.3 to 11) nF (11 to 33) nF (33 to 110) nF (110 to 330) nF (0.33 to 1.1) μF (1.1 to 3.3) μF (3.3 to 11) μF (11 to 33) μF (33 to 110) μF (110 to 330) μF (0.33 to 1.1) mF (1.1 to 3.3) mF (3.3 to 11) mF (11 to 33) mF (33 to 110) mF	5 pF/pF + 10 pF 5 pF/pF + 10 pF 5 pF/pF + 10 pF 2.5 pF/nF + 10 pF 2.5 pF/nF + 0.1 nF 2.5 pF/nF + 0.1 nF 2.5 pF/nF + 0.3 nF 2.5 nF/μF + 1 nF 2.5 nF/μF + 3 nF 2.5 nF/μF + 10 nF 4 nF/μF + 30 nF 4.5 nF/μF + 0.1 μF 4.5 nF/μF + 0.3 μF 4.5 μF/mF + 1 μF 4.5 μF/mF + 3 μF 4.5 μF/mF + 10 μF 7.5 μF/mF + 30 μF 11 μF/mF + 0.1 mF	Fluke 5522 Multiproduct Calibrator





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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Capacitance – Measure <sup>1,2</sup>	(1 to 10) nF (10 to 100) nF (0.1 to 1) μF (1 to 10) μF (10 to 100) μF (0.1 to 1) mF (1 to 10) mF (10 to 100) mF	8.1 pF/nF + 2.1 pF 0.54 pF/nF + 4.7 pF 0.51 pF/μF + 8.3 pF 0.52 pF/μF + 4.5 pF 0.73 nF/μF + 2.2 nF 0.72 nF/mF + 0.22 nF 0.8 μF/mF + 0.11 μF 1 μF/mF + 0.2 μF	Fluke 8588A 8.5 Digit Multimeter
Electrical Simulation of RTD Indicating Devices – Source <sup>1,2</sup>	Pt 385, 100 Ω (-200 to 0) °C (0 to 100) °C (100 to 300) °C (300 to 400) °C (400 to 630) °C (630 to 800) °C Pt 3926, 100 Ω (-200 to 0) °C (0 to 100) °C (100 to 300) °C (300 to 400) °C (400 to 630) °C Pt 3916, 100 Ω (-200 to -190) °C (-190 to -80) °C (-80 to 0) °C (0 to 100) °C (100 to 260) °C (260 to 300) °C (300 to 400) °C (400 to 600) °C (600 to 630) °C Pt 385, 200 Ω (-200 to 100) °C (100 to 260) °C (260 to 300) °C (300 to 400) °C (400 to 600) °C (600 to 630) °C	0.05 °C 0.07 °C 0.09 °C 0.1 °C 0.12 °C 0.23 °C 0.05 °C 0.07 °C 0.09 °C 0.1 °C 0.12 °C 0.25 °C 0.04 °C 0.05 °C 0.06 °C 0.07 °C 0.08 °C 0.09 °C 0.1 °C 0.23 °C 0.04 °C 0.05 °C 0.12 °C 0.13 °C 0.14 °C 0.16 °C	Fluke 5522 Multiproduct Calibrator





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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Electrical Simulation of RTD Indicating Devices – Source <sup>1,2</sup>	Pt 385, 500 Ω		Fluke 5522 Multiproduct Calibrator
	(-200 to -80) °C	0.04 °C	
	(-80 to 100) °C	0.05 °C	
	(100 to 260) °C	0.06 °C	
	(260 to 400) °C	0.08 °C	
	(400 to 600) °C	0.09 °C	
	(600 to 630) °C	0.11 °C	
	Pt 385, 1 kΩ		
	(-200 to 0) °C	0.03 °C	
	(0 to 100) °C	0.04 °C	
	(100 to 260) °C	0.05 °C	
	(260 to 300) °C	0.06 °C	
	(300 to 600) °C	0.07 °C	
	(600 to 630) °C	0.23 °C	
Electrical Simulation of Thermocouple Indicating Devices – Source/Measure <sup>1,2</sup>	Type B		Fluke 5522 Multiproduct Calibrator
	(600 to 800) °C	0.44 °C	
	(800 to 1 000) °C	0.34 °C	
	(1 000 to 1 550) °C	0.3 °C	
	(1 550 to 1 820) °C	0.33 °C	
	Type C		
	(0 to 150) °C	0.3 °C	
	(150 to 650) °C	0.26 °C	
	(650 to 1 000) °C	0.31 °C	
	(1 000 to 1 800) °C	0.5 °C	
	(1 800 to 2 316) °C	0.84 °C	
	Type E		
	(-250 to -100) °C	0.5 °C	
	(-100 to -25) °C	0.16 °C	
	(-25 to 350) °C	0.14 °C	
	(650 to 650) °C	0.16 °C	
	(650 to 1 000) °C	0.21 °C	
	Type J		
	(-210 to -100) °C	0.27 °C	
	(-100 to -30) °C	0.16 °C	
(-30 to 150) °C	0.14 °C		
(150 to 760) °C	0.17 °C		
(760 to 1 200) °C	0.23 °C		



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Electrical Simulation of Thermocouple Indicating Devices – Source/Measure <sup>1,2</sup>	Type K		Fluke 5522 Multiproduct Calibrator
	(-200 to -100) °C	0.33 °C	
	(-100 to -25) °C	0.18 °C	
	(-25 to 120) °C	0.16 °C	
	(120 to 1 000) °C	0.26 °C	
	(1 000 to 1 372) °C	0.4 °C	
	Type L		
	(-200 to -100) °C	0.37 °C	
	(-100 to 800) °C	0.26 °C	
	(800 to 900) °C	0.17 °C	
	Type N		
	(-200 to -100) °C	0.4 °C	
	(-100 to -25) °C	0.22 °C	
	(25 to 120) °C	0.19 °C	
	(120 to 410) °C	0.18 °C	
	(410 to 1 300) °C	0.27 °C	
	Type R		
	(0 to 250) °C	0.57 °C	
	(250 to 400) °C	0.35 °C	
	(400 to 1 000) °C	0.33 °C	
	(1 000 to 1 767) °C	0.4 °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	0.34 °C		
Type T			
(-250 to 150) °C	0.63 °C		
(150 to 0) °C	0.24 °C		
(0 to 120) °C	0.16 °C		
(120 to 400) °C	0.14 °C		
Type U			
(-200 to 0) °C	0.56 °C		
(0 to 600) °C	0.27 °C		

**Mass and Mass Related**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Pressure Devices <sup>1</sup>	(0 to 2.9) psig (2.9 to 14.5) psig (14.5 to 290) psig (290 to 1 015) psig	0.005 7 % of reading + 0.000 2 psi 0.005 5 % of reading + 0.000 4 psi 0.004 2 % of reading + 0.012 psi 0.006 % of reading + 0.027 psi	Fluke 6270 Pressure Controller/Calibrator with Modules
Absolute Pressure Devices	Up to 150 psia	0.024 % of reading + 0.036 psi	Pace 5000 Pressure Controller
Barometric Pressure – Measure	(11.5 to 17.5) psia	0.003 4 psi	Pace 5000 Pressure Controller
Vacuum Devices <sup>1</sup>	(-13.5 to 0) psiv	0.012 psi	Fluke 6270 Pressure Controller/Calibrator with Modules
Analytical Balances <sup>1</sup>	(1 to 500) mg (0.5 to 5) g (5 to 10) g (10 to 20) g (20 to 50) g (50 to 100) g (100 to 500) g (500 to 1 000) g (1 000 to 2 000) g (2 000 to 4 000) g (4 000 to 5 000) g (5 000 to 10 000) g	11 µg 40 µg 58 µg 86 µg 0.14 mg 0.29 mg 0.58 mg 1.4 mg 2.9 mg 8.2 mg 13.9 mg 16.4 mg	ASTM E617 Class 1 weights and internal calibration procedure CP-500-0001 utilized in the calibration of the weighing system.
Mass Determination	(0.1 to 220) g (220 to 2 200) g (2 200 to 10 000) g	1 mg 11 mg 0.1 g	Class 1 Weights, Electronic Analytical Balances
Pipettes	(0.2 to 2) µl 10 µl 20 µl 100 µl 200 µl 1 000 µl 5 000 µl 10 000 µl	8.5 nl 15 nl 21 nl 84 nl 0.3 µl 1.2 µl 5.8 µl 12 µl	Sartorius Cubis MPS Pipette Calibrator
Mass Flow – Gas	(500 to 5 000) sccm (5 000 to 50 000) sccm (50 to 500) slpm	0.25 % of reading + 0.052 sccm 0.23 % of reading + 1.2 sccm 0.4 % of reading + 0.003 slpm	MesaLab DryCal Primary Volumetric Piston Prover System
Torque Measuring Instruments <sup>1</sup>	(5 to 50) lbf·in (50 to 400) lbf·in (400 to 1 000) lbf·in (80 to 250) lbf·ft	0.29 % of reading + 0.011 lbf·in 0.13 % of reading + 1.4 lbf·in 0.29 % of reading + 0.29 lbf·in 0.31 % of reading + 0.002 lbf·ft	CDI 5000 Torque Calibration System

**Thermodynamic**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Humidity – Source/Measure	(0 to 95) %RH	0.32 % of reading + 1.3 %RH	Comparison to Vaisala HMT333 Temp/Humidity Transmitter.
Temperature – Source	(-25 to 50) °C (50 to 140) °C (140 to 150) °C	0.037 °C 0.042 °C 0.058 °C	Fluke 7109 Portable Calibration Bath, Fluke 9142 Dry-well Calibrator, Fluke 1502A/5615-6 Temperature Indicator w/RTD
Temperature – Measure <sup>1</sup>	(-40 to 50) °C (50 to 150) °C	0.026 °C 0.033 °C	Fluke 1502A/5615-6 Temperature Indicator w/RTD
Infrared Thermometers <sup>1</sup>	-15 °C 0 °C 50 °C 100 °C 120 °C	1.1 °C 1.1 °C 1.2 °C 1.2 °C 1.2 °C	Fluke 4180 Blackbody Source (Flat Plate) $\epsilon = (0.9 \text{ to } 1)$ , $\lambda = (8 \text{ to } 14) \mu\text{m}$

**Time and Frequency**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Frequency – Source <sup>1,2</sup>	10 mHz to 120 Hz 120 Hz to 1.2 kHz (1.2 to 12) kHz (12 to 120) kHz 120 kHz to 1.2 MHz (1.2 to 2) MHz	5.8 mHz 57.7 mHz 0.58 Hz 5.8 Hz 57.8 Hz 0.6 kHz	Fluke 5522 Multiproduct Calibrator
Frequency – Measure <sup>1</sup>	Up to 10 Hz 10 Hz to 1 kHz (1 to 10) kHz (10 to 100) kHz 100 kHz to 1 MHz (1 to 10) MHz (10 to 100) MHz	12 $\mu$ Hz 1.2 $\mu$ Hz/Hz 0.12 mHz/kHz 1.2 mHz/kHz 12 mHz/MHz 0.12 Hz/MHz 1.2 Hz/MHz	Fluke 8588A 8.5 Digit Multimeter
Stopwatches/Timers <sup>1</sup>	Up to 24 hr	35 ms/24 hr	Helmut Klein 4500 Timometer

Calibration and Measurement Capability (CMC) is expressed in terms of the measurement parameter, measurement range, expanded uncertainty of measurement and reference standard, method, and/or equipment. The expanded uncertainty of measurement is expressed as the standard uncertainty of the measurement multiplied by a coverage factor of 2 ( $k=2$ ), corresponding to a confidence level of approximately 95%.

Notes:

1. On-site calibration service is available for this parameter, since on-site conditions are typically more variable than those in the laboratory, larger measurement uncertainties are expected on-site than what is reported on the accredited scope.
2. Uncertainty budget does not contain the Repeatability contributor for the DUT. Repeatability will be added the Measurement Uncertainty at time of calibration.
3. This scope is formatted as part of a single document including Certificate of Accreditation No. AC-2949.



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