



CERTIFICATE OF ACCREDITATION

The ANSI National Accreditation Board

Hereby attests that

Imperial Metrology, Inc.
301 Hurricane Creek Road
Piedmont, SC 29673

Fulfills the requirements of

ISO/IEC 17025:2017

and national standards

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

In the fields of

CALIBRATION and DIMENSIONAL MEASUREMENT

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.

A handwritten signature in black ink, appearing to read 'R. Douglas Leonard Jr.', is positioned above a horizontal line.

R. Douglas Leonard Jr., VP, PILR SBU

Expiry Date: 18 September 2022

Certificate Number: ACT-1235



This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017.
This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory
quality management system (refer to joint ISO-ILAC-IAF Communiqué dated April 2017).

**SCOPE OF ACCREDITATION TO ISO/IEC 17025:2017,
ANSI/NCSL Z540-1-1994 (R2002) AND ANSI/NCSL Z540.3-2006 (R2013)**

Imperial Metrology, Inc.
301 Hurricane Creek Road
Piedmont, SC 29673
Glen Morton 864-422-1435

CALIBRATION AND DIMENSIONAL MEASUREMENT

Valid to: **September 18, 2022**

Certificate Number: **ACT-1235**

CALIBRATION

Acoustics and Vibration

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Sound Level Meters 94 & 114 dB rev2 x 10 ⁻⁵ Pa @1kHz	94 dB 114 dB	0.6 dB 0.7 dB	Dwyer SMC-1 Sound Calibrator

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
DC Voltage – Source ¹	(0 to 330) mV 330 mV to 3.3 V (3.3 to 33) V (33 to 330) V (330 to 1 000) V	6 μV/V + 5 μV 11 μV/V + 2 μV 13 μV/V + 16 μV 18 μV/V + 13 μV 15 μV/V + 2 mV	Fluke 5520A/11 Multiproduct Calibrator
DC Voltage – Measure ¹	(0 to 100) mV 100 mV to 1V (1 to 10) V (10 to 100) V (100 to 1 000) V	57 μV/mV + 3.6 μV 7.9 μV/V + 1.7 μV 7.3 μV/V + 2.2 μV 5.3 μV/V + 37 μV 13 μV/V + 0.14 V	Keysight 3458A Multimeter
DC High Voltage Measure ¹	(1 to 35) kV (20 to 100) kV	3.8 V + 2.3 % of reading 6.4 V + 0.12 % of reading	Multimeter and High Voltage Probe
	(2.1 to 24) kV	7.4 V + 2 % of reading	Sensitive Research ESH-29 Electrostatic Voltmeter



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
DC Current – Source ¹ Range Locked	(0 to 330) μ A	12 nA/A + 16 nA	Fluke 5520A/11 Multiproduct Calibrator
	(0 to 3.3) mA	77 nA/A + 39 nA	
	(0 to 33) mA	78 nA/A + 0.2 μ A	
	(0 to 330) mA	78 nA/A + 2 μ A	
	(0 to 3) A	0.3 μ A/A + 66 μ A	
DC Current – Measure ¹	(0 to 100) μ A	12 pA/ μ A + 5.9 nA	Keysight 3458A Multimeter
	100 μ A to 1 mA	0.2 μ A/mA + 5.8 μ A	
	(1 to 10) mA	30 nA/mA + 62 nA	
	(10 to 100) mA	49 nA/mA + 0.6 μ A	
	100 mA to 1 A	0.2 mA/A + 12 μ A	Agilent 34401A Multimeter
(1 to 3) A	1.8 mA/A		
(3 to 10) A	1.5 mA/A + 77 μ A	Fluke 45 Multimeter	
(3 to 30) A	0.2 mA/A + 5.1 mA		
AC Voltage – Source ¹	(30 to 150) A	0.1 mA/A + 18 mA	Current Shunts w/ Agilent 34401A Multimeter
	(3.3 to 33) mV	0.2 μ V/V + 7.4 μ V	Fluke 5520A/11 Multiproduct Calibrator
	(10 to 45) Hz		
	45 Hz to 10 kHz		
	(10 to 20) kHz		
	(20 to 50) kHz		
	(50 to 100) kHz		
	(100 to 450) kHz		
	(33 to 330) mV		
	(10 to 45) Hz		
45 Hz to 10 kHz			
(10 to 20) kHz			
(20 to 50) kHz			
(50 to 100) kHz			
(100 to 500) kHz			
330 mV to 3.3 V	0.3 mV/V + 1 mV		
(10 to 45) Hz			
45 Hz to 10 kHz			
(10 to 20) kHz			
(20 to 50) kHz			
(50 to 90) kHz	0.2 mV/V + 0.5 mV		
(10 to 20) kHz	0.2 mV/V + 91 μ V		
(20 to 50) kHz	0.3 mV/V + 59 μ V		
(50 to 90) kHz	0.7 mV/V + 0.2 mV		

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Source ¹	(3.3 to 33) V (10 to 45) Hz 45 Hz to 10 kHz (10 to 20) kHz (20 to 50) kHz (50 to 90) kHz (33 to 330) V 45 Hz to 1 kHz (1 to 10) kHz (10 to 20) kHz (20 to 50) kHz (330 to 1 000) V 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.3 mV/V + 1 mV 0.2 mV/V + 0.7 mV 0.2 mV/V + 1.1 mV 0.4 mV/V + 0.7 mV 1 mV/V + 2 mV 0.3 μV/V + 69 mV 0.2 mV/V + 7 mV 0.3 mV/V + 7 mV 0.4 mV/V + 4.4 mV 0.3 mV/V + 40 mV 0.3 mV/V + 14 mV 0.4 mV/V + 15 mV	Fluke 5520A/11 Multiproduct Calibrator
AC Voltage – Measure ¹	Up to 10 mV (1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (10 to 100) mV (1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz 100 mV to 1V (1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz 300 kHz to 1MHz	7.9 μV 0.13 μV/mV + 4.1 μV 0.25 μV/mV + 3.9 μV 1.2 μV/mV + 3.5 μV 5.6 μV/mV + 6.2 μV 50 μV/mV + 3.4 μV 0.5 μV/mV + 19 μV 0.3 μV/mV + 3.8 μV 0.3 μV/mV + 25 μV 0.4 μV/mV + 10 μV 0.5 μV/mV + 55 μV 4 mV/mV + 29 μV 0.4 mV 34 μV/V + 85 μV 0.2 mV/V + 1 μV 77 μV/V + 37 μV 1 mV/V + 5.4 μV 25 mV/V + 9 nV 27 mV/V + 10 nV	Keysight 3458A Multimeter

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Measure ¹	(1 to 10) V		Keysight 3458A Multimeter
	(1 to 40) Hz	57 μ V/V + 1.1 mV	
	40 Hz to 1 kHz	64 μ V/V + 0.5 mV	
	(1 to 20) kHz	53 μ V/V + 0.3 mV	
	(20 to 50) kHz	72 μ V/V + 0.3 mV	
	(50 to 100) kHz	0.9 mV/V + 0.2 mV	
	(100 to 300) kHz	3.5 mV/V + 1.1 mV	
	300 kHz to 2 MHz	12 mV/V + 1 mV	
	(10 to 100) V		
	(1 to 40) Hz	0.1 mV/V + 12 mV	
	40 Hz to 1 kHz	0.3 mV/V + 2 mV	
	(1 to 20) kHz	2.8 mV/V + 10 μ V	
	(20 to 50) kHz	0.1 mV/V + 3.5 mV	
	100 V to 1 kV		
40 Hz to 1 kHz	0.7 mV/V + 1 mV		
1 kHz to 20 kHz	1 mV/V + 1 mV		
AC High Voltage Measure ¹	(1 to 35) kV	3.3 V + 5.8% of reading	Multimeter and High Voltage Probe
	(20 to 90) kV	56 V + 1.1 % of reading	
	(2.1 to 24) kV	7 V + 2.1% of reading	Sensitive Research ESH-29 Electrostatic Voltmeter
AC Current – Source ¹	(33 to 330) μ A		Fluke 5520A/11 Multiproduct Calibrator
	(10 to 20) Hz	2.3 nA/A + 0.1 μ A	
	(20 to 45) Hz	1.4 nA/A + 0.1 μ A	
	45 Hz to 1 kHz	1.5 nA/A + 99 nA	
	(1 to 5) kHz	3.4 nA/A + 0.2 μ A	
	(5 to 30) kHz	18 nA/A + 0.5 μ A	
	330 μ A to 3.3 mA		
	(10 to 20) Hz	2.3 μ A/A + 0.2 μ A	
	(20 to 45) Hz	1.4 μ A/A + 0.3 μ A	
	45 Hz to 1 kHz	11 μ A/A + 0.3 μ A	
	(1 to 5) kHz	10 μ A/A + 0.7 μ A	
	(5 to 30) kHz	13 μ A/A + 33 nA	
	(3.3 to 33) mA		
	(10 to 20) Hz	2.1 μ A/A + 1.9 μ A	
	(20 to 45) Hz	1.1 μ A/A + 2.1 μ A	
	45 Hz to 1 kHz	0.5 μ A/A + 2.2 μ A	
	(1 to 5) kHz	1 μ A/A + 0.6 μ A	
	(5 to 30) kHz	4.1 μ A/A + 19 μ A	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current – Source ¹	(33 to 330) mA		Fluke 5520A/11 Multiproduct Calibrator
	(10 to 20) Hz	2.2 μ A/A + 20 μ A	
	(20 to 45) Hz	1.2 μ A/A + 17 μ A	
	45 Hz to 1 kHz	0.5 μ A/A + 23 μ A	
	(1 to 5) kHz	1.2 μ A/A + 58 μ A	
	(5 to 30) kHz	4.7 μ A/A + 0.2 mA	
	330 mA to 1.1 A		
	(10 to 45) Hz	2.1 mA/A + 0.1 mA	
	45 Hz to 1 kHz	0.6 mA/A + 0.1 mA	
	(1 to 5) kHz	6.9 mA/A + 1.2 mA	
	(5 to 10) kHz	29 mA + 5.8 mA	
	(1.1 to 3) A		
	(10 to 45) Hz	2.1 mA/A + 0.1 mA	
	45 Hz to 1 kHz	0.7 mA/A + 72 μ A	
	(1 to 5) kHz	6.9 mA/A + 1.2 mA	
	(5 to 10) kHz	26 mA/A + 8.9 mA	
	(3 to 10) A		
	(45 to 100) Hz	0.7 mA/A + 2.3 mA	
	100 Hz to 1 kHz	0.5 mA/A + 4.4 mA	
	(1 to 5) kHz	35 mA/A + 2.3 mA	
(10 to 20) A			
(45 to 100) Hz	1.6 mA/A + 5.2 mA		
100 Hz to 1 kHz	1.9 mA/A + 5.3 mA		
(1 to 5) kHz	35 mA/A + 5.8 mA		
AC Current – Measure ¹	Up to 100 μ A		Keysight 3458A Multimeter
	(10 to 20) Hz	4.6 nA/ μ A + 39 nA	
	(20 to 45) Hz	1.7 nA/ μ A + 42 nA	
	(45 to 100) Hz	0.6 nA/ μ A + 45 nA	
	100 Hz to 1 kHz	0.6 nA/ μ A + 45 nA	
	100 μ A to 1 mA		
	(10 to 20) Hz	8.5 μ A/A	
	(20 to 45) Hz	15 μ A/A	
	(45 to 100) Hz	15 μ A/A	
	100 Hz to 1 kHz	14 μ A/A	
	(1 to 10) mA		
	(10 to 20) Hz	5.6 nA/mA + 2 μ A	
	(20 to 45) Hz	5.7 nA/mA + 0.3 μ A	
	(45 to 100) Hz	5.8 μ A/mA + 80 nA	
	100 Hz to 1 kHz	5.8 μ A/mA + 15 nA	
	(1 to 5) kHz	5.8 μ A/mA + 30 nA	
	(5 to 10) kHz	5.8 μ A/mA + 79 nA	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current – Measure ¹	(10 to 100) mA		Agilent 34401A Multimeter
	(10 to 20) Hz	5.1 μ A/mA + 71 μ A	
	(20 to 45) Hz	5.8 μ A/mA + 40 nA	
	(45 to 100) Hz	5.8 μ A/mA + 12 nA	
	100 Hz to 1 kHz	5.8 μ A/mA + 7 nA	
	(1 to 5) kHz	5.8 μ A/mA + 0.2 μ A	
	(5 to 20) kHz	5.8 μ A/mA + 11 nA	
	100 mA to 1 A		
	(10 to 20) Hz	1.9 mA/A + 5.6 mA	
	(20 to 45) Hz	1.2 mA/A + 5.7 mA	
	(45 to 100) Hz	0.1 mA/A + 5.8 mA	
	100 Hz to 1 kHz	0.2 mA/A + 5.8 mA	
	(1 to 20) kHz	1.2 mA/A + 5.7 mA	
	(1 to 3) A		
	(10 to 20) Hz	4.2 mA/A + 2.8 mA	
(20 to 45) Hz	1.7 mA/A + 4.4 mA		
(45 to 100) Hz	1.7 mA/A + 4.4 mA		
100 Hz to 1 kHz	1.7 mA/A + 4.3 mA		
(1 to 5) kHz	1.7 mA/A + 4.3 mA		
AC Current – Measure ¹	(3 to 10) A		Fluke 45 Multimeter
	(10 to 20) Hz	3.9 mA/A + 52 mA	
	(20 to 45) Hz	3.9 mA/A + 52 mA	
	(45 to 100) Hz	1 mA/A + 60 mA	
	100 Hz to 1 kHz	1.5 mA/A + 55 mA	
(1 to 5) kHz	1 mA/A + 0.17 A		
Resistance – Source ¹ Simulation	Up to 11 Ω	46 $\mu\Omega/\Omega$ + 1.2 m Ω	Fluke 5520A/11 Multiproduct Calibrator
	(11 to 33) Ω	33 $\mu\Omega/\Omega$ + 1.8 m Ω	
	(33 to 110) Ω	27 $\mu\Omega/\Omega$ + 1.6 m Ω	
	(110 to 330) Ω	26 $\mu\Omega/\Omega$ + 2.3 m Ω	
	330 Ω to 1.1 k Ω	27 m Ω/Ω + 1.9 m Ω	
	(1.1 to 3.3) k Ω	26 m Ω/Ω + 23 m Ω	
	(3.3 to 11) k Ω	26 m Ω/Ω + 19 m Ω	
	(11 to 33) k Ω	26 m Ω/Ω + 0.2 Ω	
	(33 to 110) k Ω	27 m Ω/Ω + 0.2 Ω	
	(110 to 330) k Ω	30 m Ω/Ω + 2.8 Ω	
	330 k Ω to 1.1M Ω	36 $\Omega/M\Omega$ + 3.9 Ω	
	(1.1 to 3.3) M Ω	36 $\Omega/M\Omega$ + 65 Ω	
	(3.3 to 11) M Ω	130 $\Omega/M\Omega$ + 26 Ω	
	(11 to 33) M Ω	300 $\Omega/M\Omega$ + 2.7 k Ω	
	(33 to 110) M Ω	500 $\Omega/M\Omega$ + 3.5 k Ω	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Resistance – Source ¹ Simulation	(110 to 330) MΩ (330 to 1 100) MΩ	3.1 kΩ/MΩ + 89 kΩ 15 kΩ/MΩ + 200 kΩ	Fluke 5520A/11 Multiproduct Calibrator
Resistance – Source ¹ Fixed	0.001 Ω 0.01 Ω 0.1 Ω 1 Ω 10 Ω 100 Ω 1 kΩ 10 kΩ 100 kΩ 1 MΩ 10 MΩ 100 MΩ 1 GΩ 10 GΩ 100 GΩ 1 TΩ	0.000074 Ω 0.0006 Ω 0.0006 Ω 0.0017 mΩ 0.017 Ω 0.035 Ω 0.012 kΩ 0.12 kΩ 0.13 kΩ 0.027 MΩ 0.03 MΩ 0.24 MΩ 0.01 GΩ 0.12 GΩ 1.2 GΩ 0.2 TΩ	Standard Resistors
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 1MΩ (1 to 10) MΩ (10 to 100) MΩ 100 MΩ to 1GΩ	14 μΩ/Ω + 0.1 mΩ 17 μΩ/Ω + 0.6 mΩ 78 μΩ/Ω + 0.4 mΩ 15 mΩ/Ω + 5 mΩ 15 mΩ/Ω + 48 mΩ 19 mΩ/Ω + 2.5 Ω 78 Ω/Ω + 98 Ω 660 Ω/Ω + 1.1 kΩ 7.5 kΩ/MΩ + 0.3 MΩ	Keysight 3458A Multimeter (NPLC 100)
Capacitance – Source ¹ Simulation	(0.19 to 0.4) nF (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	5.3 pF/nF + 13 pF 5.4 pF/nF + 13 pF 6.1 pF/nF + 14 pF 3 pF/nF + 15 pF 2.9 pF/nF + 0.1 nF 3 pF/nF + 0.1 nF 3.9 pF/nF + 0.2 nF 2.7 nF/μF + 1.4 nF 3 nF/μF + 3.4 nF 2.7 nF/μF + 1.4 nF 4.5 nF/μF + 38 nF 5.1 nF/μF + 0.1 μF	Fluke 5520A/11 Multiproduct Calibrator



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Capacitance – Source ¹ Simulation	(110 to 330) μ F (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	5.1 nF/ μ F + 0.4 μ F 86 nF/ μ F + 0.6 mF 4.8 μ F/mF + 5.7 μ F 4 μ F/mF + 25 μ F 8.4 μ F/mF + 49 μ F 14 μ F/mF + 75 μ F	Fluke 5520A/11 Multiproduct Calibrator
Capacitance – Source ¹ Fixed 1 kHz	0.001 μ F (0.01 to 1) μ F	0.000 02 μ F 23 nF/ μ F + 0.2 nF	Standard Capacitor Decade Capacitor
Inductance – Source ¹ Variable 1 kHz	(1 to 1 000) mH (1 to 10) H	0.01 mH/mH + 0.015 mH 9 mH/H + 7 mH	Decade Inductor
Electrical Simulation of RTD Indicating Devices ¹	Pt 385, 100 Ω (-200 to -80) $^{\circ}$ C (-80 to 0) $^{\circ}$ C (0 to 100) $^{\circ}$ C (100 to 300) $^{\circ}$ C (300 to 400) $^{\circ}$ C (400 to 630) $^{\circ}$ C (630 to 800) $^{\circ}$ C Pt 385, 1000 Ω (-200 to 0) $^{\circ}$ C (0 to 100) $^{\circ}$ C (100 to 260) $^{\circ}$ C (260 to 300) $^{\circ}$ C (300 to 600) $^{\circ}$ C (600 to 630) $^{\circ}$ C Pt 3916, 100 Ω (-200 to -190) $^{\circ}$ C (-190 to -80) $^{\circ}$ C (-80 to 0) $^{\circ}$ C (0 to 100) $^{\circ}$ C (100 to 260) $^{\circ}$ C (260 to 300) $^{\circ}$ C (300 to 400) $^{\circ}$ C (400 to 600) $^{\circ}$ C (600 to 630) $^{\circ}$ C	0.07 $^{\circ}$ C 0.07 $^{\circ}$ C 0.08 $^{\circ}$ C 0.09 $^{\circ}$ C 0.10 $^{\circ}$ C 0.13 $^{\circ}$ C 0.23 $^{\circ}$ C 0.03 $^{\circ}$ C 0.05 $^{\circ}$ C 0.05 $^{\circ}$ C 0.09 $^{\circ}$ C 0.08 $^{\circ}$ C 0.26 $^{\circ}$ C 0.28 $^{\circ}$ C 0.07 $^{\circ}$ C 0.08 $^{\circ}$ C 0.09 $^{\circ}$ C 0.07 $^{\circ}$ C 0.09 $^{\circ}$ C 0.11 $^{\circ}$ C 0.11 $^{\circ}$ C 0.24 $^{\circ}$ C	Fluke 5520A/11 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 ¹	Pt 3926, 100 Ω		Fluke 5520A/11 Multiproduct Calibrator
	(-200 to 0) °C	0.06 °C	
	(0 to 100) °C	0.08 °C	
	(100 to 300) °C	0.09 °C	
	(300 to 400) °C	0.1 °C	
	(400 to 630) °C	0.13 °C	
Electrical Simulation of Thermocouples - Measure/Source ¹	Cu 427, 10 Ω		Fluke 5520A/11 Multiproduct Calibrator
	(-100 to 260) °C	0.45 °C	
	Type B		
	(600 to 800) °C	0.46 °C	
	(800 to 1 000) °C	0.43 °C	
	(1 000 to 1 550) °C	0.34 °C	
	(1 550 to 1 820) °C	0.35 °C	
	Type C		
	(0 to 150) °C	0.33 °C	
	(150 to 650) °C	0.29 °C	
	(650 to 1 000) °C	0.35 °C	
	(1 000 to 1 800) °C	0.52 °C	
	(1 800 to 2 316) °C	0.86 °C	
	Type E		
	(-250 to -100) °C	0.51 °C	
	(-100 to -25) °C	0.25 °C	
	(-25 to 350) °C	0.21 °C	
	(350 to 650) °C	0.21 °C	
	(650 to 1 000) °C	0.31 °C	
	Type J		
	(-210 to -100) °C	0.28 °C	
	(-100 to -30) °C	0.18 °C	
	(-30 to 150) °C	0.19 °C	
	(150 to 760) °C	0.2 °C	
	(760 to 1 200) °C	0.28 °C	
	Type K		
	(-200 to -100) °C	0.34 °C	
	(-100 to -25) °C	0.18 °C	
(-25 to 120) °C	0.2 °C		
(120 to 1 000) °C	0.29 °C		
(1 000 to 1 372) °C	0.47 °C		
Type L			
(-200 to -100) °C	0.39 °C		
(-100 to 800) °C	0.30 °C		
(800 to 900) °C	0.21 °C		

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Electrical Simulation of Thermocouples - Measure/Source ¹	Type N		Fluke 5520A/11 Multiproduct Calibrator
	(-200 to -100) °C	0.42 °C	
	(-100 to -25) °C	0.24 °C	
	(-25 to 120) °C	0.22 °C	
	(120 to 410) °C	0.21 °C	
	(410 to 1 300) °C	0.29 °C	
	Type R		
	(0 to 250) °C	0.8 °C	
	(250 to 400) °C	0.7 °C	
	(400 to 1 000) °C	0.7 °C	
	(1 000 to 1 767) °C	0.7 °C	
	Type S		
	(0 to 250) °C	0.7 °C	
	(250 to 1 000) °C	0.7 °C	
	(1 000 to 1 400) °C	0.7 °C	
	(1 400 to 1767) °C	0.7 °C	
Type T			
(-250 to -150) °C	0.62 °C		
(-150 to 0) °C	0.25 °C		
(0 to 120) °C	0.19 °C		
(120 to 400) °C	0.18 °C		
Type U			
(-200 to 0) °C	0.58 °C		
(0 to 600) °C	0.32 °C		

Length – Dimensional Metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Gage Blocks	Up to 1 in (1 to 4) in	3.4 μin (1.7 + 1.5L) μin	Mahr 130B-24 Gage Block Comparator, Grade 00 Gage Blocks
Calipers ^{1,2}	(0 to 24) in (24 to 48) in (48 to 80) in	(590 + 7.6L) μin (780 + 1.4L) μin (780 + 8.9L) μin	Gage Blocks
Outside Micrometer ^{1,2}	Up to 36 in	(55 + 27L) μin	
Inside Micrometer 3-point ^{1,2}	Up to 10 in	(93 + 12L) μin	Ring Gages



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Length – Dimensional Metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Tubular Inside Micrometer ^{1,2}	Up to 18 in Up to 48 in	(120 + 4.1L) μin (360 + 3.5L) μin	Trimos Horizon ULM Trimos V4 Electronic Height Gage
Length Standards ^{1,2}	(0 to 10) in (0 to 40) in (0 to 240) in	(96 + 4.6L) μin (120 + 6.2L) μin (59 + 22L) μin	Trimos Horizon ULM Trimos V4 Elect Height Gage B & S Validator CMM
Feeler Gages/Thickness Shims ^{1,2}	Up to 0.2 in	(25 + 8.7L) μin	Trimos THV
Indicators ^{1,2} Dial/Digital/Test Incremental Probes/LVDT's	Up to 4 in Up to 1 in	(85 + 12L) μin (69 + 1.6L) μin	Gage Blocks
Linear Measurement Devices ^{1,2}	Up to 48 in	(530 + 12L) μin	
Height Gages ^{1,2}	Up to 48 in	(55 + 3.7L) μin	
Inclinometers/ Levels ²	Up to 45 °	(1.1 + 0.06L) sec/°	Gage Blocks, Sine Plate
CMM Spheres & Gage ² Balls (Diameter)	(0.1 to 1) in	21 μin	Trimos LabConcept Premium ULM
Roundness ² (Geometric Form)	Up to 10 in	3.3 μin	Federal 6100 Form Scan
Radius Gages ²	Up to 3 in	(120 + 30L) μin	OGP SmartScope Vision System
Thread Rings – Adjustable ² Minor Diameter Pitch	Up to 6.5 in Up to 6.5 in	(50 + 6.6L) μin (240 + 79L) μin	Thread Set Plug or Trimos V4 Thread Set Plug
Thread Pitch Gages – Leaf Style ²	Up to 0.25 in	(130 + 2 400L) μin	OGP SmartScope Vision System
Thread and Gear Wires ²	Up to 0.15 in	(15 + 15L) μin	Trimos LabConcept
Ring Gages ² X Class XX Class	(0.38 to 8) in (0.38 to 8) in	(28 + 6.5L) μin (15 + 5L) μin	Trimos Horizon Trimos LabConcept
Ring Gages ^{1,2} X Class	(0.18 to 4) in	(19 + 6.9L) μin	Trimos THV
Pin Gages ² Z & ZZ Class	Up to 1 in	(38 + 5.9L) μin	Lasermike
Pin Gages ^{1,2} ZZ Class	Up to 1 in	(19 + 8.5L) μin	Trimos THV

Length – Dimensional Metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Cylindrical Plugs and Pin Gages ² (Z, ZZ, X, Y class)	Up to 8 in	(32 + 3.5L) μin	Trimos Horizon
Cylindrical Plugs and Pin Gages ² (X, XX class)	Up to 8 in	(14 + 6.2L) μin	Trimos LabConcept
Thread Plug Gages ^{1,2} Pitch Diameter Major Diameter	Up to 6 in	(54 + 17L) μin (50 + 17L) μin	Trimos Horizon ULM Trimos Horizon ULM
Steel Rules ^{1,2}	Up to 72 in	(5100 + 15L) μin	Gage Blocks
Tape Measures ²	Up to 120 in	(2200 + 11L) μin	Renishaw LM15 Linear Measuring Device
Optical Comparators ^{1,2}	Up to 12 in X Axis Y Axis	(80 + 23L) μin (77 + 20L) μin	Glass Scales Magnification Scales
Measuring Microscopes ^{1,2}	Up to 2 in X Axis Y Axis	(57 + 10L) μin (61 + 3.3L) μin	Glass Scales
Surface Finish ² (Roughness Gages)	Up to 120 μin	(3.5 + 0.03L) μin	Mahr Contour/Surface Analyzer
Surface Plate ¹ Overall Flatness	(43 to 161) in diagonal	1.5 μin/in + 0.85 μin	Wyler Level System
Local Area Flatness (Repeat Reading)	Up to 0.001 in	33 μin	Indicator/Probe
Surface Texture	(0 to 32) μin (cutoff: 0.03 in)	4.5 μin	Mahr Pocket Surf using ASME B89.3.7-2013
Vision Systems ^{1,2}	12 X 12 in X Axis Y Axis	(65 + 4.2L) μin (69 + 2L) μin	Glass Scales
Torque Arms/Wheels	2.5-inch Arm 5-inch Arm 20-inch Arm 40-inch Arm	1 200 μin 840 μin 1 300 μin 1 400 μin	B & S CMM

Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Pressure – Pneumatic ¹	(0 to 200) psig (0 to 300) psig	0.006 4 psi/psi + 0.02 psi 0.000 014 psi/psi + 0.06 psi	Pneumatic Deadweight Tester (Nitrogen) Druck DPI 611 Calibrator
Vacuum ¹	(0 to -30) inHg	0.000 6 inHg/inHg + 0.06 inHg	Druck DPI 611 Calibrator
Pressure – Hydraulic ¹	(0 to 5 000) psig (0 to 10 000) psig (0 to 40 000) psig	0.000 24 psi/psi + 2.6 psi 0.000 4 psi/psi + 0.059 psi 0.000 52 psi/psi + 25 psi	Druck iDOS UPM Deadweight Tester Additel ADT681 Hydraulic Pressure Test Gauge
Rockwell Hardness and Superficial Testers ¹	HRBW Low Middle High HRC Low Middle High HR15N Low Middle High HR30N Low Middle High HR45N Low Middle High HR15YW Low Mid High	1.5 HRBW 0.9 HRBW 0.6 HRBW 0.5 HRC 0.4 HRC 0.4 HRC 0.6 HR15N 0.3 HR15N 0.7 HR15N 0.6 HR30N 0.6 HR30N 0.3 HR30N 0.5 HR45N 0.5 HR45N 0.4 HR45N 0.4 HR15YW 0.4 HR15YW 0.5 HR15YW	Indirect Verification per ASTM E18 using Test Blocks
Vickers Hardness Testers ¹	272 HV 774 HV	9.1 HV 21.9 HV	Indirect Verification per ASTM E92 using Test Blocks
Knoop Hardness Testers ¹	290 HK 741 HK	15 HK 24 HK	
Brinell Hardness Testers ¹	87 HBW 201 HBW 216 HBW 437 HBW	(1.9 + 0.03 % of Applied) HBW	Indirect Verification per ASTM E10 using Test Blocks

Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Air Velocity	2.5 m/s 5.0 m/s 10.0 m/s 15.0 m/s	0.041 m/s 0.13 m/s 0.32 m/s 0.51 m/s	Omega WTM-1000 Wind Tunnel w/ Alnor 9535 Air Velocity Meter
Force Gages ¹ Tension and Compression	Up to 250 lbf	0.000 2 lbf/lbf + 0.21 lbf	Class F Weights
Torque Tools ¹	(5 to 50) ozf·in (15 to 200) ozf·in (4 to 50) lbf·in (30 to 400) lbf·in (80 to 1 000) lbf·in (20 to 250) lbf·ft (60 to 600) lbf·ft (100 to 1 000) lbf·ft (200 to 2 000) lbf·ft	0.045 ozf·in + 0.11 % of reading 0.17 ozf·in + 0.4 % of reading 0.045 lbf·in + 0.48 % of reading 0.41 lbf·in + 0.1 % of reading 0.5 lbf·in + 0.1 % of reading 0.17 lbf·ft + 0.1 % of reading 0.51 lbf·ft + 0.15 % of reading 0.65 lbf·ft + 0.1 % of reading 1.6 lbf·ft + 0.1 % of reading	Reference Transducers, Digital Torque Tester
Torque Transducers Testers ¹	(5 to 50) ozf·in (15 to 200) ozf·in (4 to 50) lbf·in (30 to 400) lbf·in (80 to 1 000) lbf·in (20 to 250) lbf·ft (60 to 600) lbf·ft (100 to 1 000) lbf·ft (200 to 2 000) lbf·ft	0.0063 ozf·in + 0.13 % of reading 0.0032 ozf·in + 0.11 % of reading 0.12 % of reading 0.013 lbf·in + 0.02% of reading 0.15 lbf·in + 0.01 % of reading 0.01 lbf·ft + 0.025 % of reading 0.017 lbf·ft + 0.01 % of reading 0.27 lbf·ft + 0.01 % of reading 0.55 lbf·ft + 0.01 % of reading	Lever Arms & Wheels, Dead Weights
Scales and Balances ¹ Class 6 Weight Set Class 6 & Class F Weights Class F Weights Class F Weights	Up to 2 110 g (0.500 to 30.000) lb (0.5 to 250.0) lb (250 to 1 000) lb	0.000 14 g/g + 0.003 g 0.000 3 lb/lb + 0.003 lb 0.000 03 lb/lb + 0.024 lb 0.000 1 lb/lb + 0.3 lb	Weights NIST HB 44

Thermodynamic

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Humidity - Source/ Measure	(10 to 90) %RH	0.9% RH + 0.2% of reading	Vaisala HM40/HMP113 Humidity Indicator and Probe



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Thermodynamic

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Temperature – Measure ¹	(-190 to 420) °C	0.000 9 °C/°C + 0.082 °C	Pt100-385 4-wire RTD w/ Process Calibrator
	(0 to 660) °C	0.000 06 °C/°C + 0.09 °C	Pt100-385 4-wire RTD w/ Keysight 3458A Multimeter
Temperature – Source/Measure ¹	(-10 to 350) °C	0.001 2 °C/°C + 0.23 °C	Fluke 5520A Multiproduct Calibrator w/ Pt100-385 4-wire RTD Ice Point/Dry Block Calibrator
Infrared Thermometers ¹	50 °C 100 °C 200 °C 300 °C 400 °C 500 °C	0.62 °C 0.7 °C 0.78 °C 0.91 °C 1.1 °C 1.4 °C	Blackbody Source (Cavity) ε = 0.95, λ = (8 to 14) μm

Time and Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Stopwatches and Timers ¹	Up to 1 200 s	480 ms	NIST Time Signal
Frequency - Source ¹	(0.01 to 119.99) Hz (120 to 1 199.9) Hz (1.2 to 11.999) kHz (12 to 119.99) kHz (120 to 1199.9) kHz (1.2 to 2) MHz (2 to 100) MHz	0.8 μHz/Hz + 0.3 mHz 3.1 μHz/Hz + 51 μHz 2.9 Hz/kHz + 5.8 mHz 2.9 Hz/kHz + 6 mHz 2.9 Hz/kHz + 6 mHz 0.2 Hz/MHz + 58 Hz 3.2 Hz/MHz	Fluke 5520A/11 Multiproduct Calibrator
Frequency – Measure	1 Hz to 10 MHz	0.6 mHz/Hz + 5.4 mHz	Keysight 3458A Multimeter
Tachometers – Non Contact (Photo) ¹	(60 to 96 000) rpm	0.000 03 rpm/rpm + 0.2 rpm	Fluke 5520A/11 Multiproduct Calibrator
Tachometers – Contact ¹	(250 to 5 000) rpm	0.000 15 rpm/rpm + 2.8 rpm	Ideal Tachometer Tester

DIMENSIONAL MEASUREMENT

2 Dimensional

Specific Tests and / or Properties Measured	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
Inspection by CMM B & S Excel 7-10-7 PC-DMIS CAD ++	X Axis (0 to 28) in Y Axis (0 to 40) in Z Axis (0 to 28) in	10 $\mu\text{in/in}$ – 6.2 μin -7.3 $\mu\text{in/in}$ + 21 μin -7 $\mu\text{in/in}$ + 20 μin	Customer Drawing or CAD Model CMM Application Software
Inspection by CMM B & S Validator PC-DMIS CAD ++	X Axis (0 to 240) in Y Axis (0 to 72) in Z Axis (0 to 96) in	-0.5 $\mu\text{in/in}$ + 2 300 μin -4.2 $\mu\text{in/in}$ + 2 300 μin -1.2 $\mu\text{in/in}$ + 2 400 μin	Customer Drawing or CAD Model CMM Application Software
Inspection by CMM B & S Global PC-DMIS CAD ++	X Axis (0 to 36) in Y Axis (0 to 48) in Z Axis (0 to 32) in	5.7 $\mu\text{in/in}$ + 23 μin 7.3 $\mu\text{in/in}$ + 21 μin 6.1 $\mu\text{in/in}$ + 31 μin	Customer Drawing or CAD Model CMM Application Software

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.
3. This scope is formatted as part of a single document including Certificate of Accreditation No. ACT-1235.



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