



# CERTIFICATE OF ACCREDITATION

**The ANSI National Accreditation Board**

Hereby attests that

**Alliance Calibration, A Transcat Company**  
**11402 Reading Road**  
**Cincinnati, OH 45241**

Fulfills the requirements of

**ISO/IEC 17025:2017**

and national standard

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

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).

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: 07 September 2023

Certificate Number: L2181-1



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**

**and**

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

**Alliance Calibration, A Transcat Company**

11402 Reading Road  
Cincinnati, OH 45241  
Sidney Taylor 513-769-1200

**CALIBRATION**

Valid to: **September 7, 2023**

Certificate Number: **L2181-1**

**Acoustics and Vibration**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Accelerometer Sensitivity	(0 to 5 000) mV/g		Comparison to Master Accelerometer per ISO 16063-21-2003
	(10 to 99) Hz	1.7 % of reading	
	100 Hz	1.4 % of reading	
	(101 to 920) Hz	1.4 % of reading	
	(921 to 5 000) Hz	1.5 % of reading	
	(5 001 to 10 000) Hz	1.7 % of reading	

**Chemical Quantities**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
pH Meters	4 pH	0.022 pH	Compared to Accredited Solutions
	7 pH	0.022 pH	
	10 pH	0.13 pH	
Conductivity Meters	1 µS/cm	0.69 µS/cm	Compared to Accredited Solutions
	10 µS/cm	0.77 µS/cm	
	100 µS/cm	3.1 µS/cm	
	1 000 µS/cm	23 µS/cm	
	10 000 µS/cm	226 µS/cm	
	100 000 µS/cm	2 140 µS/cm	



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Capacitance – Source <sup>3</sup>	1 kHz		Fluke 5522A Multiproduct Calibrator
	(220 to 400) pF	(0.002 + 0.004X) pF	
	(0.4 to 1.1) nF	(0.013 + 0.006X) nF	
	(1.1 to 3.3) nF	(0.012 + 0.006X) nF	
	(3.3 to 11) nF	(0.015 + 0.003X) nF	
	(11 to 33) nF	(0.12 + 0.003X) nF	
	(33 to 110) nF	(0.12 + 0.003X) nF	
	(110 to 330) nF	(0.34 + 0.003X) nF	
	(0.33 to 1.1) μF	(0.001 + 0.003 1X) μF	
	100 Hz		
	(0.33 to 1.1) μF	(0.001 + 0.003X) μF	
	(1.1 to 3.3) μF	(0.001 + 0.003X) μF	
	(3.3 to 11) μF	(0.012 + 0.003X) μF	
	(11 to 33) μF	(0.031 + 0.005X) μF	
	50 Hz		
(33 to 110) μF	(0.12 + 0.006X) μF		
(110 to 330) μF	(0.035 + 0.005 3X) μF		
(330 to 1 100) μF	(1.16 + 0.005 3X) μF		
(1.1 to 3.3) mF	(0.004 + 0.005 3X) mF		
(3.3 to 11) mF	(0.12 + 0.005 2X) mF		
(11 to 33) mF	(0.034 + 0.008 7X) mF		
(33 to 110) mF	(0.11 + 0.013X) mF		
Capacitance – Measure	(0.2 to 2) nF	0.7 % of reading + 23 pF	Tenma 72-8150 Capacitance Meter
	(2 to 20) nF	0.4 % of reading + 93 pF	
	(20 to 200) nF	0.9 % of reading + 34 pF	
	(0.2 to 2) μF	0.6 % of reading + 4 nF	
	(2 to 20) μF	0.9 % of reading + 0.6 nF	
	(20 to 200) μF	0.9 % of reading + 10 nF	
	(Up to 10) mF	1.3 % of reading + 10 nF	
(10 to 50) mF	2.5 % of reading + 70 nF		
DC Current – Measure <sup>3</sup>	(0.1 to 1) mA	(0.000 014 + 0.000 003X) mA	Transmille 8081 Digital Multimeter
	(1 to 10) mA	(0.006 + 0.000 4X) mA	
	(10 to 100) mA	(0.008 4 + 0.000 03X) mA	
	(100 to 1 000) mA	(0.016 + 0.000 2X) mA	Fluke 336 Clamp Meter
	(1 to 10) A	(0.000 4 + 0.000 5X) A	
	(10 to 30) A	(0.005 + 0.000 6X) A	
DC Current – Source <sup>3</sup>	(10 to 200) A	(0.34 + 0.018X) A	Fluke 5522A Multiproduct Calibrator
	(300 to 500) A	(0.57 + 0.023X) A	
DC Current – Source <sup>3</sup>	Up to 3.3 mA	(0.000 06 + 0.000 8X) mA	Fluke 5522A Multiproduct Calibrator
	(3.3 to 33) mA	(0.004 + 0.000 09X) mA	
	(33 to 330) mA	(0.006 + 0.000 1X) mA	
	(0.33 to 3) A	(0.000 04 + 0.000 5X) A	
	(3 to 20.5) A	(0.001 + 0.001 2X) A	

**Electrical – DC/Low Frequency**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
DC Current – Source <sup>3</sup>	(20.5 to 400) A (400 to 500) A	(0.1 + 0.000 3X) A 0.12 % of reading	Fluke 5522A Multiproduct Calibrator w/ Coil
AC Current – Measure <sup>3</sup>	Up to 100 μA (1 to 10) kHz (0.1 to 1) mA (1 to 10) kHz (1 to 10) mA (10 to 40) Hz 40 Hz to 1 kHz (1 to 10) kHz (0.01 to 1) A (10 to 40) Hz 40 Hz to 1 kHz (1 to 10) kHz (1 to 10) A (10 to 40) Hz 40 Hz to 1 kHz (10 to 30) A (10 to 40) Hz 40 Hz to 1 kHz	(0.094 + 0.000 7X) μA (0.000 2 + 0.000 4X) mA (0.002 + 0.000 6X) mA (0.001 4 + 0.000 4X) mA (0.003 4 + 0.0012X) mA (0.000 3 + 0.000 72X) A (0.000 2 + 0.000 5X) A (0.000 6 + 0.000 82X) A (0.005 + 0.001X) A (0.003 5 + 0.000 9X) A (0.014 + 0.001X) A (0.011 + 0.000 8X) A	Transmille 8081 Digital Multimeter
AC Current – Measure <sup>3</sup>	(30 to 600) A (45 to 65) Hz	(0.75 + 0.023) A	Fluke 336 Clamp Meter



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment	
AC Current – Source <sup>3</sup>	Up to 0.33 mA (1 to 10) kHz	(0.000 23 + 0.009 3X) mA	Fluke 5522A Multiproduct Calibrator	
	(0.33 to 3.3) mA (1 to 10) kHz	(0.000 31 + 0.006X) mA		
	(3.3 to 33) mA (20 to 45) Hz	(0.002 3 + 0.001 1X) mA		
	45 Hz to 1 kHz	(0.000 85 + 0.000 74X) mA		
	(1 to 5) kHz	(0.002 4 + 0.001X) mA		
	(5 to 10) kHz	(0.004 + 0.002 3X) mA		
	(10 to 30) kHz	(0.003 + 0.005X) mA		
	(33 to 330) mA (20 to 45) Hz	(0.024 + 0.001 1X) mA		
	45 Hz to 1 kHz	(0.022 + 0.000 5X) mA		
	(1 to 5) kHz	(0.063 + 0.001 2X) mA		
	(5 to 10) kHz	(0.12 + 0.002 3X) mA		
	(10 to 30) kHz	(0.22 + 0.005X) mA		
	(0.33 to 3) A (10 to 45) Hz	(0.000 14 + 0.002X) A		
	45 Hz to 1 kHz	(0.000 13 + 0.000 7X) A		
(1 to 5) kHz	(0.001 2 + 0.007X) A			
(5 to 10) kHz	(0.006 + 0.003 1X) A			
AC Current – Source <sup>3</sup>	(3 to 20.5) A (45 to 65) Hz	(0.006 + 0.002X) A	Fluke 5522A Multiproduct Calibrator w/ Coil	
	65 Hz to 1 kHz (1 to 5) kHz	(0.006 + 0.002X) A (0.006 4 + 0.035X) A		
	(20.5 to 500) A (45 to 100) Hz	(0.002 + 0.000 08X) A		
	DC Power – Measure <sup>3</sup>	Up to 33 W (33 to 330) W (330 to 11 000) W		(0.05 + 0.000 3X) W (0.001 5 + 0.000 4X) W (0.15 + 0.000 3X) W
AC Power – Measure <sup>3</sup> PF = 1	(10 to 45) Hz	3.3 mA to 3 A 0.11 μW to 99 W	0.21 % of reading + 0.9 mW	Fluke 5522A Multiproduct Calibrator
	(45 to 65) Hz	3.3 mA to 20.5 A 0.11 mW to 20.91 kW	0.19 % of reading + 0.9 mW	
	(65 to 500) Hz	33 mA to 3 A 0.11 μW to 99 W	0.19 % of reading + 23 mW	
		33 mA to 20.5 A 0.11 mW to 20.91 kW	0.17 % of reading + 0.2 W	



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Power – Measure <sup>3</sup> PF = 1 500 Hz to 1 kHz	33 mA to 20.5 A 0.11 μW to 20.91 kW	0.19 % of reading + 22 mW	Fluke 5522A Multiproduct Calibrator
Resistance – Measure <sup>3</sup>	(0.000 5 to 5 000) mΩ Up to 1 Ω (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	0.005 % of reading + 8.5 μΩ 0.006 3 % of reading + 34 μΩ 0.002 % of reading + 23 μΩ 0.002 % of reading + 0.35 mΩ 0.001 % of reading + 2 mΩ 0.002 % of reading + 3 mΩ 0.002 % of reading + 90 mΩ 0.002 3 % of reading + 3 Ω 0.004 % of reading + 11 Ω	Transmille 8081 Digital Multimeter
	(10 to 100) MΩ	1.2 % of reading	Agilent 34401A Digital Multimeter
Resistance – Source <sup>3</sup>	Up to 11 Ω (11 to 33) Ω (33 to 110) Ω (110 to 330) Ω (0.33 to 1.1) kΩ (1.1 to 3.3) kΩ (3.3 to 11) kΩ (11 to 33) kΩ (33 to 110) kΩ (110 to 330) kΩ (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	(0.001 2 + 0.000 05X) Ω (0.002 + 0.000 04X) Ω (0.001 6 + 0.000 04X) Ω (0.002 4 + 0.000 04X) Ω (0.000 023 + 0.000 04X) kΩ (0.000 02 + 0.000 04X) kΩ (0.000 03 + 0.000 04X) kΩ (0.000 3 + 0.000 04X) kΩ (0.000 3 + 0.000 04X) kΩ (0.002 5 + 0.000 04X) kΩ (0.000 002 + 0.000 04X) MΩ (0.000 04 + 0.000 07X) MΩ (0.000 06 + 0.000 2X) MΩ (0.000 7 + 0.001 2X) MΩ (0.006 4 + 0.006X) MΩ (0.005 5 + 0.006X) MΩ	Fluke 5522A Multiproduct Calibrator
Resistance – Source <sup>3</sup> Fixed	500 μΩ 5 mΩ 50 mΩ 500 mΩ 5 Ω	(0.001 + 0.006X) mΩ (0.001 + 0.006X) mΩ (0.001 + 0.006X) mΩ (0.001 + 0.006X) mΩ (0.001 + 0.006X) mΩ	Fluke 5500A Multiproduct Calibrator, Agilent 34401A Digital Multimeter, Current Shunts
Electrical Simulation of RTD Indicators	Pt 385, 100 Ω (-200 to 800) °C	0.06 °C	Fluke 5500A Multiproduct Calibrator
DC Voltage – Measure <sup>3</sup>	Up to 1 V (1 to 10) V (10 to 100) V (100 to 1 000) V	(0.000 001 + 0.000 01X) V (0.000 007 + 0.000 006X) V (0.000 07 + 0.000 01X) V (0.001 1 + 0.000 011X) V	Transmille 8081 Multimeter



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
DC High Voltage – Measure <sup>3</sup>	(1 to 80) kV	0.12 % of reading + 0.14 V	Ross Engineering HV Probe w/ Digital Multimeter
DC Voltage – Source <sup>3</sup>	(0 to 330) mV (0.33 to 3.3) V (3.3 to 33) V (33 to 330) V (330 to 1 020) V	(0.001 2 + 0.000 006X) mV (0.000 001 + 0.000 006X) V (0.000 02 + 0.000 003X) V (0.000 13 + 0.000 003X) V (0.0006 + 0.000 004X) V	Fluke 5522A Multiproduct Calibrator
AC Voltage – Measure <sup>3</sup>	Up to 100 mV (10 to 40) Hz (40 to 200) Hz 200 Hz to 2 kHz (2 to 20) kHz (20 to 100) kHz (0.1 to 1) V (10 to 40) Hz (40 to 200) Hz 200 Hz to 1 kHz (1 to 2) kHz (2 to 20) kHz (20 to 100) kHz 100 kHz to 1 MHz (1 to 10) V (10 to 40) Hz (40 to 200) Hz 200 Hz to 1 kHz (1 to 2) kHz (2 to 20) kHz (20 to 100) kHz (10 to 100) V (10 to 40) Hz (40 to 200) Hz 200 Hz to 1 kHz (1 to 2) kHz (2 to 20) kHz (20 to 50) kHz (100 to 1 000) V (10 to 40) Hz (40 to 200) Hz 200 Hz to 2 kHz (2 to 10) kHz	(0.02 + 0.000 6X) mV (0.02 + 0.000 3X) mV (0.02 + 0.000 3X) mV (0.03 + 0.000 3X) mV (0.13 + 0.000 4X) mV (0.000 2 + 0.000 5X) V (0.000 07 + 0.000 25X) V (0.000 07 + 0.000 2X) V (0.000 07 + 0.000 2X) V (0.000 12 + 0.000 33X) V (0.000 6 + 0.000 85X) V (0.03 + 0.012X) V (0.002 + 0.000 5X) V (0.000 73 + 0.000 25X) V (0.000 8 + 0.000 2 X) V (0.000 8 + 0.000 2X) V (0.001 2 + 0.000 4X) V (0.006 + 0.000 9X) V (0.02 + 0.000 6X) V (0.01 + 0.000 3X) V (0.009 + 0.000 3X) V (0.009 + 0.000 3X) V (0.01 + 0.000 5X) V (0.06 + 0.001X) V (0.2 + 0.000 6X) V (0.1 + 0.000 3X) V (0.09 + 0.000 2X) V (0.12 + 0.000 4X) V	Transmille 8081 Digital Multimeter



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC High Voltage – Measure <sup>3</sup>	60 Hz (1 to 80) kV	(0.01 + 0.012X) kV	Ross Engineering HV Probe w/ Digital Multimeter
AC Voltage – Source <sup>3</sup>	Up 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 (0.33 to 3.3) V (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 (3.3 to 33) V (10 to 45) Hz 45 Hz to 10 kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz (33 to 330) V 45 Hz to 1 kHz (1 to 10) kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz (330 to 1 000) V 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	(0.007 + 0.001X) mV (0.01 + 0.000 2X) mV (0.008 + 0.000 3X) mV (0.01 + 0.001 2X) mV (0.001 + 0.005X) mV (0.07 + 0.009 5X) mV (0.000 04 + 0.000 4X) V (0.000 07 + 0.000 2X) V (0.000 08 + 0.000 23X) V (0.000 04 + 0.000 4X) V (0.000 2 + 0.000 8X) V (0.001 2 + 0.003X) V (0.000 6 + 0.000 4X) V (0.000 7 + 0.000 2X) V (0.000 7 + 0.000 3X) V (0.000 8 + 0.000 4X) V (0.002 + 0.001X) V (0.003 + 0.000 3X) V (0.008 + 0.000 3X) V (0.007 + 0.000 3X) V (0.006 + 0.000 4X) V (0.064 + 0.002 3X) V (0.022 + 0.000 34X) V (0.03 + 0.000 3X) V (0.01 + 0.000 4X) V	Fluke 5522A Multiproduct Calibrator



**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>3</sup>	Type E		Fluke 5522A Multiproduct Calibrator
	(-250 to -100) °C	0.58 °C	
	(-100 to -25) °C	0.19 °C	
	(-25 to 350) °C	0.17 °C	
	(350 to 650) °C	0.19 °C	
	(650 to 1 000) °C	0.25 °C	
	Type J		
	(-210 to -30) °C	0.32 °C	
	(-30 to 150) °C	0.17 °C	
	(150 to 760) °C	0.2 °C	
	(760 to 1 200) °C	0.27 °C	
	Type K		
	(-200 to -100) °C	0.39 °C	
	(-100 to -25) °C	0.21 °C	
	(-25 to 120) °C	0.19 °C	
	(120 to 1 000) °C	0.22 °C	
	(1 000 to 1 372) °C	0.47 °C	
	Type N		
	(-200 to -100) °C	0.47 °C	
	(-100 to -25) °C	0.26 °C	
(-25 to 120) °C	0.22 °C		
(120 to 410) °C	0.21 °C		
(410 to 1 300) °C	0.32 °C		
Type R			
(0 to 250) °C	0.67 °C		
(250 to 1 767) °C	0.47 °C		
Type S			
(0 to 250) °C	0.55 °C		
(250 to 1 400) °C	0.44 °C		
(1 400 to 1 767) °C	0.54 °C		
Type T			
(-250 to -150) °C	0.73 °C		
(-150 to 0) °C	0.28 °C		
(0 to 120) °C	0.19 °C		
(120 to 400) °C	0.17 °C		
Oscilloscopes – Time Base	(2 to 10) ns 20 ns to 1 µs (2 to 50) µs (0.1 to 5 000) ms	0.000 3 % of reading + 3 fs 0.2 ns 0.000 2 % of reading + 4 ps 0.2 % of reading + 0.23 ms	Fluke 5500A-SC600 Multiproduct Calibrator
Oscilloscopes – Bandwidth	50 kHz to 100 MHz (100 to 300) MHz (300 to 600) MHz	4.3 % of reading 4.8 % of reading 7.2 % of reading	Fluke 5500A-SC600 Multiproduct Calibrator

### Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Oscilloscopes – Amplitude	(0 to 5) V <sub>p-p</sub>	2.3 % of reading + 0.35 mV	Fluke 5500A-SC600 Multiproduct Calibrator

### Length – Dimensional Metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Gage Blocks <sup>3</sup>	(0.005 to 4) in	(3.6 + 1.4L) μin	Gage Blocks, Gage Block Comparator
	(5 to 20) in	(3.8 + 1.6L) μin	Universal Length Measuring Machine, Gage Blocks
Plain Plug Gages <sup>3</sup>	(0.007 to 10) in	(7.9 + 4.2L) μin	Universal Length Measuring Machine, Gage Blocks
Height/Step Masters <sup>3</sup>	Up to 36 in	(17 + 3.3L) μin	Gage Blocks, Surface Plate, Indicator
Height Masters (Travel) <sup>3</sup>	(0 to 1) in	(17.2 + 2.7L) μin	Gage Blocks, Surface Plate, Indicator
Micrometer Standards <sup>3</sup>	(0.5 to 26) in	(27 + 3.5L) μin	P&W Supermic, Gage Blocks
Micrometer Standards <sup>3</sup>	(26 to 48) in	(93 + 1.5L) μin	Mu-Checker, Indicator, Gage Blocks, Surface Plate
Plain Ring Gages <sup>3</sup>	(0.15 to 10) in	(11.4 + 5.1L) μin	Precimar ULM
Thread Wires <sup>2</sup>	(0.007 to 0.2) in	11.4 μin	Universal Length Measuring Machine, XX Cylinder
Pin Gages <sup>3</sup>	(0.011 to 2) in	(32 + 0.3L) μin	Super Micrometer
Thickness Gages (Leaf) <sup>3</sup>	Up to 1 in	(31 + 2.9L) μin	Super Micrometer
Tape Measures	Up to 50 ft	(0.056 + 0.000 05L) in	Master Tape
Steel Rules <sup>3</sup>	Up to 72 in	(0.01 + 0.000 1L) in	Master Ruler
Plastic Shim Stock <sup>3,4</sup>	(1 to 50) mils	(0.03 + 3L) mils	Bench Micrometer
Thread Plug Gages <sup>3</sup> Major Diameter	(0.06 to 8) in	(27 + 23L) μin	Super Micrometer, Thread Wires
Pitch Diameter (4 to 80) TPI	(0.06 to 8) in	(61 + 7L) μin	

**Length – Dimensional Metrology**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Thread Ring Gages <sup>3</sup> Minor Diameter	(0.06 to 8) in (0.25 to 1) in	(161 + 2.2L) μin (179 + 32L) μin	Vision System, Intra-Micrometer
Thread Ring Gages <sup>3</sup> Pitch Diameter Solid (4 to 80) TPI	(0.06 to 8) in	(7.7 + 4.2L) μin	Precimar, Plain Ring
Pitch Diameter Adjustable (4 to 80) TPI	(0.06 to 8) in	<i>See Set Plug Uncertainty</i>	Set Plugs
Thread Rings, Adjustable <sup>5</sup> Pitch Diameter Tactile Fit (Set to Plug)	(0.06 to 8) in	See footnote	Set Plugs
Radius Gage	(0.010 to 2) in	(272 + 6.4) μin	Vision System
Spheres <sup>3</sup>	(0.013 2 to 2) in	(14 + 3.3L) μin	Universal Length Measuring Machine, Gage Blocks
Squares <sup>3</sup>	(2 to 24) in	(64.4 + 2.4L) μin	Grade 0 Square Gage Blocks
Surface Plates <sup>1,3</sup> Overall Flatness	(8 to 60) in diagonal (34 to 161) in diagonal	(50 + 0.7L) μin (124 + 0.3L) μin	Planekator Level System
Local Area Flatness (Repeat Reading)	Up to 0.001 in	46 μin	Repeat-o-Meter
Roughness Specimens	Up to 400 μin Ra	4.4 μin	Profilometers
Artifacts and Fixtures <sup>3</sup> Length	Up to 16 in	(125 + 16L) μin	Vision System
Diameter	Up to 12 in	(204 + 17L) μin	
Angle	Up to 360°	0.027°	
Height Gage <sup>1,3</sup>	Up to 36 in	(128 + 1.4L) μin	Gage Blocks, Surface Plate
Calipers <sup>1,3</sup>	Up to 60 in (60 to 120) in	(365 + 4.2L) μin (575 + 4.2L) μin	Gage Blocks
Outside Micrometers <sup>1,3</sup>	Up to 36 in	(34 + 4.3L) μin	Gage Blocks
Depth Micrometers <sup>1,3</sup>	Up to 12 in	(586 + 0.9L) μin	Gage Blocks, Surface Plate
Inside Micrometers <sup>1,3</sup>	(0.1 to 36) in	(574 + 0.6L) μin	
Bore Micrometers <sup>3</sup>	(0.15 to 10) in	(26 + 42L) μin	Ring Gages

**Length – Dimensional Metrology**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Bench Micrometer <sup>1,3</sup> Travel Anvil Flatness Anvil Parallelism	Up to 1 in	(13 + 2.7L) μin 8.2 μin 17 μin	Gage Blocks Optical Flat Sphere
Indicator <sup>1,3</sup> 0.001 in resolution 0.0005 in resolution 0.00025 in resolution 0.0001 in resolution 0.000 05 in resolution 0.000 02 in resolution 0.000 01 in resolution	Up to 4 in Up to 2 in Up to 0.25 in Up to 2 in Up to 2 in Up to 2 in Up to 0.5 in	578 μin (289 + 0.7L) μin 145 μin (58 + 0.7L) μin (34 + 7.4L) μin (31 + 7.3L) μin (16.1 + 20.1L) μin	Indicator Tester, Gage Blocks
Indicator <sup>1,3</sup> 0.001 in resolution 0.0005 in resolution	(0 to 1) in (0 to 1) in	(615 + 6L) μin (317 + 1.2L) μin	Indicator Tester
Universal Measuring Machine <sup>1,3</sup>	Up to 24 in	(4.1 + 3.4L) μin	Gage Blocks
Ultrasonic Thickness Gages	(0.005 to 2) in	578 μin	Gage Blocks
Magnetic Coating Thickness Gages <sup>3,4</sup>	(1 to 50) mils	(0.057 + 0.003L) mils	Precision Shims, Bench Micrometer
Profilometer (Ra) <sup>1</sup>	(0 to 200) μin	3.3 μin	Roughness Standard per ASME B46.1-2009
Protractor <sup>3</sup>	(0 to 180)°	(0.065 + 0.000 3X)°	Granite Squares, Sine Bar
Optical Comparators <sup>1,3</sup> Magnification Linearity Squareness	5x to 100x Up to 6 in Up to 6 in	(155 + 2.8L) μin (138 + 1.1) μin 76 μin	Glass Scale, Length Standards, Spheres
Microscopes <sup>3</sup> Stage Travel	Up to 1 in	(55 + 46L) μin	Gage Blocks
Vision Systems <sup>1,3</sup> Linearity Angles	Up to 6 in Up to 360°	(180 + 3L) μin (0.012 + 0.000 02A)°	Glass Scale
CMM <sup>1,3</sup> Linearity Repeatability	Up to 48 in Up to 48 in	(29 + 3.3L) μin (30 + 4.4L) μin	Step Gage or Gage Blocks in accordance with ASTM B89.4, ISO 10360-2
CMM <sup>1,3</sup> Volumetric Accuracy	Up to 48 in	(34 + 3.5L) μin	



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Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Gas Flow Speed (Anemometers)	(490 to 3 300) ft/min	4 % of reading + 1.6 ft/min	TSI 9535 VelociCalc Air Velocity Meter
Gas Flow Meter	(50 to 500) sccm Up to 50 slm (50 to 250) slm	0.7 % of reading + 1.2 sccm 0.6 % of reading + 0.13 slm 0.7 % of reading + 1.4 slm	Alicat Flow Standard
Liquid Flow (gravimetric)	(0.3 to 50) gpm	0.5 % of reading + 0.002 gpm	Digital Scale
Bench Micrometer Measuring Force	(4 to 40) ozf	0.22 ozf	Force Gage
Force Gages <sup>3</sup>	1 gf to 45 kgf	(0.015 + 0.000 8 <i>F</i> ) kgf	NIST Class F Weights
Force Gages <sup>3</sup>	(0.5 to 50) lbf (50 to 250) lbf	(0.006 + 0.000 3 <i>W</i> ) lbf (0.018 + 0.000 06 <i>W</i> ) lbf	ASTM Class 7 Weights
Force Gages <sup>3</sup> (Tension)	(6 to 100) lbf	(0.03 + 0.000 6 <i>F</i> ) lbf	ASTM E74 Load Cell
Force Gage s <sup>3</sup> (Compression)	(6 to 100) lbf	(0.025 + 0.000 7 <i>F</i> ) lbf	ASTM E74 Load Cell
Force Gages / Load Cells (Tension)	(6 to 300) lbf (40 to 2 000) lbf	(0.12 + 0.000 1 <i>F</i> ) lbf (0.18 + 0.000 1 <i>F</i> ) lbf	ASTM E74 Load Cell
Force Gages / Load Cells (Compression)	(6 to 300) lbf (40 to 2 000) lbf	(0.12 + 0.000 12 <i>F</i> ) lbf (0.04 + 0.000 3 <i>F</i> ) lbf	ASTM E74 Load Cell
Load Cells	(1 001 to 5 000) lbf (5 001 to 20 000) lbf	(6 + 0.000 3 <i>F</i> ) lbf (59 + 0.000 01 <i>F</i> ) lbf	Master Load Cells
Rockwell and Rockwell Superficial Hardness Testers <sup>1</sup>	HRBW Low Middle High HRC Low Middle High HRFW Low Middle High	2 HRBW 1.5 HRBW 1.4 HRBW 1.3 HRC 1.3 HRC 0.7 HRC 1.4 HRFW 1.4 HRFW 1.5 HRFW	Indirect Verification per ASTM E18 using test blocks.



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Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Rockwell and Rockwell Superficial Hardness Testers <sup>1</sup>	HR15N		Indirect Verification per ASTM E18 using test blocks.
	Low	1.4 HR15N	
	Middle	1.4 HR15N	
	High	1.1 HR15N	
	HR30N		
	Low	1.4 HR30N	
	Middle	1.4 HR30N	
	High	1.1 HR30N	
	HR45N		
	Low	1.4 HR45N	
	Middle	1.4 HR45N	
	High	1 HR45N	
	HR15TW		
	Low	2 HR15TW	
	Middle	1.4 HR15TW	
	High	1.3 HR15TW	
	HR30TW		
	Low	1.9 HR30TW	
Middle	2 HR30TW		
High	1.3 HR30TW		
HR45TW			
Low	1.4 HR45TW		
Middle	1.3 HR45TW		
High	1.4 HR45TW		
Mass Determination	1g	0.14 mg	ASTM Class 1 Weights, Electronic Balance
	2g	0.22 mg	
	5g	0.2 mg	
	10g	0.22 mg	
	20g	0.25 mg	
	50g	0.5 mg	
	100g	0.73 mg	
	200g	1.2 mg	
Low Pressure Gages <sup>1</sup> (Magnehelic/Photohelic)	Up to 30 inH <sub>2</sub> O	0.006 % of reading + 0.021 inH <sub>2</sub> O	ABB 364DS Differential Pressure Transmitter
	(30 to 200) inH <sub>2</sub> O	0.006 % of reading + 0.056 inH <sub>2</sub> O	ABB DDN0200 Differential Pressure Transmitter
Pressure Gage <sup>1</sup>	Up to 30 psig	0.003 % of reading + 0.019 psi 0.07 % of reading + 0.024 psi	Druck DPI 802 Pressure Calibrator – Pneumatic
Pressure Gage <sup>1</sup>	(10 001 to 15 000) psig	0.12 % of reading + 1.7 psi	Keller Gage – Hydraulic
Vacuum Gage <sup>1</sup>	(-14.5 to 0) psiv	0.018 psi	Druck DPI 802 Pressure Calibrator – Pneumatic

### Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Pressure Devices <sup>1</sup>	(2 to 500) psig (500 to 10 000) psig	0.04 % of reading + 0.003 psi 0.033 % of reading + 0.72 psi	Dead Weight Tester – Hydraulic
Precision Scales / Balances <sup>1,6</sup>	(0.000 01 to 1 100) g	(0.000 37 + 0.000 002M) g	OIML Class E2 Mass and NIST Handbook 44 utilized for the calibration of the weighing system.
Scales / Balances <sup>1,6</sup>	(0.5 to 38) kg	(0.18 + 0.000 6M) g	NIST Class F Weights and NIST Handbook 44 utilized for the calibration of the weighing system.
	(0.5 to 500) lb	(0.005 + 0.000 07M) lb	ASTM Class 7 Weights and NIST Handbook 44 utilized for the calibration of the weighing system.
Torque Tools	0.5 ozf·in to 1 000 lbf·ft (1 000 to 2 000) lbf·ft	0.35 % of reading 0.2 % of reading + 17 lbf·ft	CDI Torque Tester
Torque Transducers	(5 to 1 000) lbf·ft	0.08 % of reading	Torque Arms, NIST Class F Weights
Pipettes <sup>3</sup>	(10 to 1 000) μL	(0.21 + 0.000 64X) μl	Gravimetric Method using Precision Balance

### Thermodynamic


Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Relative Humidity – Measure <sup>1</sup>	(0 to 80) % RH	0.6 % of reading + 1.2 %RH	Vaisala MI70 / HMP77 Temperature/Humidity Indicator
Temperature – Measure <sup>1</sup>	(-70 to 180) °C	0.25 °C	
Temperature Probes and Systems <sup>1,3</sup>	(-20 to 600) °C	(0.004 + 0.000 7T) °C	Hart Scientific Baths and Drywells w/ Fluke 5609 PRT
Liquid-in-Glass Thermometers <sup>3</sup> (Partial and Total Immersion)	(-20 to 600) °C	(0.08 + 0.000 6T) °C	Hart Scientific Bath w/ Fluke 5609 PRT
Temperature – Measure <sup>3</sup>	(-195 to 420) °C (420 to 600) °C	(0.012 + 0.000 04T) °C (0.008 + 0.000 12T) °C	Fluke 5609 PRT w/ Display
Infrared Source <sup>1,3</sup>	50 °C 100 °C 200 °C 300 °C 400 °C	0.75 °C 0.9 °C 1.2 °C 1.5 °C 1.8 °C	ICI 500 Blackbody Source (flat plate) ε = 0.95, λ = (8 to 14) μm

**Time and Frequency**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Frequency – Source <sup>1</sup>	1 Hz to 50 MHz (50 to 600) MHz	0.003 % of reading + 1.1 mHz 0.003 % of reading	Fluke 5500A Multiproduct Calibrator, Fluke PM 5193 Function Generator
Frequency – Measure <sup>1</sup>	1 Hz to 225 MHz 225 MHz to 3 GHz	0.47 Hz 0.16 Hz	HP 53131A Frequency Counter
Timers and Stopwatches <sup>1</sup>	(0.1 to 60) min	0.006 % of reading + 35 ms	HP 53131A Frequency Counter
Tachometer – Source <sup>3</sup>	Up to 60 000 rpm	0.003 % of reading + 0.001 1 rpm	Fluke 5500A Multiproduct Calibrator
Tachometer – Measure <sup>3</sup>	Up to 1 800 rpm	0.3 % of reading + 0.05 rpm	Ametek 1726 Digital Tachometer

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 shown is per wire for thread wire sets.
  3.  $L$  = length in inches;  $D$  = diameter in inches;  $T$  = temperature applied;  $X$  = flow / frequency / volts / ohms / amps / capacitance applied;  $M$  = mass applied;  $F$  = force in kg;  $V$  = volume;  $W$  = weight in lb;  $A$  = angle in degrees; rpm = revolutions per minute.
  4. 1 mil = 0.001 in.
  5. The setting of an adjustable thread ring is not a measurement for which an uncertainty can be estimated. The method for this activity is an accredited activity.
  6. The uncertainties for scales and balances are highly dependent upon the resolution of the unit under test. The uncertainties presented here does not include the resolution of the unit under test. The resolution will be included in the reported measurement uncertainty at the time of calibration.
  7. This scope is formatted as part of a single document including Certificate of Accreditation No. L2181-1.



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