



CERTIFICATE OF ACCREDITATION

ANSI National Accreditation Board
11617 Coldwater Road, Fort Wayne, IN 46845 USA

This is to certify that

Alliance Calibration
11402 Reading Road
Cincinnati, OH 45241

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

ISO/IEC 17025:2017

and national standard

ANSI/NCSL Z540-1-1994 (R2002)

while demonstrating technical competence in the field of

CALIBRATION

Refer to the accompanying Scope of Accreditation for information regarding the types of activities to which this accreditation applies

L2181-1

Certificate Number


ANAB Approval

Certificate Valid Through: 09/15/2020
Version No. 006 Issued: 08/13/2019



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).



ANSI National Accreditation Board

SCOPE OF ACCREDITATION TO ISO/IEC 17025:2017 AND ANSI/NCSL Z540-1-1994 (R2002)

Alliance Calibration

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

CALIBRATION

Valid to: September 15, 2020

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	1.7 % of reading	Master Accelerometer
	(10 to 99) Hz	1.4 % of reading	
	100 Hz	1.6 % of reading	
	(101 to 920) Hz	1.8 % of reading	
	(921 to 5 000) Hz	2.3 % of reading	
(5 001 to 10 000) Hz			

Chemical Quantities

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
pH Meters	4 pH	0.022 pH	Compared to aqueous solutions
	7 pH	0.022 pH	
	10 pH	0.047 pH	
Conductivity Meters	1 μ S	0.58 μ S/cm	Compared to aqueous solutions
	10 μ S	0.64 μ S/cm	
	100 μ S	4.1 μ S/cm	
	1 000 μ S	26 μ S/cm	



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Capacitance – Source	(330 to 400) pF	14 pF	Fluke 5522A Multiproduct Calibrator
Capacitance – Source ³	@ 1 kHz (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 @ 100 Hz (1.1 to 3.3) μF (3.3 to 11) μF (11 to 33) μF @ 50 Hz (33 to 110) μF (110 to 330) μF (330 to 1 100) μF	(0.01 + 0.004X) nF (0.01 + 0.005X) nF (0.01 + 0.003X) nF (0.01 + 0.002X) nF (0.12 + 0.002X) nF (0.35 + 0.002X) nF (0.001 + 0.002X) μF (0.003 + 0.002X) μF (0.011 + 0.002 3X) μF (0.03 + 0.004X) μF (0.11 + 0.004X) μF (0.35 + 0.004X) μF (1.2 + 0.004X) μF	Fluke 5522A Multiproduct Calibrator
Capacitance - Measure	(0.2 to 2) nF (2 to 20) nF (20 to 200) nF (0.2 to 2) μF (2 to 20) μF (20 to 200) μF	0.017 nF + 0.85 % of Reading 0.066 nF + 1.2 % of Reading 1 nF + 0.74% of Reading 0.010 μF + 0.74 % of Reading 0.11 μF + 0.71 % of Reading 0.66 μF + 1.2 % of Reading	Tenma 72-8150 Capacitance Meter
DC Current – Measure ³	Up to 1A (1 to 10) A (10 to 30) A	(0.011 + 0.000 2X) mA (0.000 4 + 0.000 4) A (0.004 + 0.000 5X) A	Transmille 8081 Multimeter
DC Current – Measure ³	(30 to 200) A (200 to 500) A	(1 + 0.021X) A (0.51 + 0.023X) A	Fluke 336 Clamp Meter
DC Current – Source ³	Up to 3.3 mA (3.3 to 33) mA (33 to 330) mA (0.33 to 3) A (3 to 20.5) A (20.5 to 400) A (400 to 500) A	(0.000 1 + 0.000 8X) mA (0.004 + 0.000 1X) mA (0.006 + 0.000 1X) mA (0.000 04 + 0.000 4X) A (0.000 8 + 0.000 9X) A (0.04 + 0.000 5X) A (0.11 + 0.002X) A	Fluke 5522A Multiproduct Calibrator w/ Coil



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current – Measure ³	10 mA to 1 A (10 to 40) Hz (40 to 1000) Hz (1 to 10) kHz (1 to 10) A (10 to 40) Hz (40 to 1000) Hz (10 to 30) A (10 to 40 Hz) (40 to 1000 Hz)	(0.000 3 + 0.000 5X) A (0.000 2 + 0.000 4X) A (0.000 8 + 0.000 5X) A (0.007 + 0.000 6X) A (0.004 + 0.000 8X) A (0.02 + 0.000 5X) A (0.02 + 0.000 6X) A	Transmille 8081 Multimeter
AC Current – Measure ³ (45 to 65) Hz	(10 to 200) A (200 to 500) A	(1 + 0.021X) A (0.64 + 0.023X) A	Fluke 336 Clamp Meter
AC Current – Source ³	Up to 0.33 mA (1 to 10) kHz (0.33 to 3.3) mA (1 to 10) kHz (3.3 to 33) mA (20 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (10 to 30) kHz (33 to 330) mA (20 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (10 to 30) kHz (0.33 to 3) A (10 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	(0.000 2 + 0.007X) mA (0.000 3 + 0.005X) mA (0.002 + 0.000 9X) mA (0.002 + 0.000 4X) mA (0.002 + 0.000 8X) mA (0.000 4 + 0.002X) mA (0.005 + 0.004X) mA (0.03 + 0.000 8X) mA (0.02 + 0.000 4X) mA (0.06 + 0.000 9X) mA (0.11 + 0.002X) mA (0.23 + 0.004X) mA (0.000 1 + 0.002X) A (0.000 05 + 0.000 5X) A (0.001 + 0.006X) A (0.058 + 0.023X) A	Fluke 5522A Multiproduct Calibrator
AC Current – Source ³	(3 to 20.5) A (45 to 65) Hz 65 Hz to 1 kHz (1 to 5) kHz (20.5 to 500) A (45 to 100) Hz	(0.001 + 0.001 4X) A (0.009 + 0.009X) A (0.001 + 0.03X) A (0.12 + 0.001X) A	Fluke 5522A Multiproduct Calibrator w/ Coil



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
DC Power – Measure ³	Up to 33 W (33 to 330) W (330 to 11 000) W	(0.000 4 + 0.000 7X) W (0.003 + 0.000 7X) W (0.053 + 0.000 7X) W	Fluke 5522A Multiproduct Calibrator
AC Power – Measure ³	(45 to 65) Hz Up to 33 W (33 to 330) W (330 to 11 000) W	(0.000 4 + 0.001X) W 0.1 % of reading (0.000 1 + 0.001X) W	Fluke 5522A Multiproduct Calibrator
Resistance – Measure ³	Up to 1 Ω (1 to 10) Ω (10 to 100) Ω (100 to 1 000) Ω (1 to 10) kΩ (10 to 100) kΩ (0.1 to 1) MΩ (1 to 10) MΩ	0.0015 % reading 0.001 % reading (0.000 1 + 0.000 02X) Ω 0.001 % reading (0.000 01 + 0.000 01X) kΩ (0.000 2 + 0.000 01X) kΩ (0.000 004 + 0.000 01X) MΩ (0.000 1 + 0.000 01X) MΩ	Transmille 8081 Multimeter
Resistance – Measure ³	(10 to 100) MΩ (0 to 5 000) mΩ	(0.03 + 0.009 1X) MΩ (0.004 4 + 0.000 17X) mΩ	Agilent 34401A
Resistance – Source ³	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 + 0.000 04X) Ω (0.002 + 0.000 04X) Ω (0.002 + 0.000 03X) Ω (0.002 + 0.000 03X) Ω (0.000 002 + 0.000 03X) kΩ (0.000 02 + 0.000 03X) kΩ (0.000 02 + 0.000 03X) kΩ (0.000 2 + 0.000 03X) kΩ (0.000 2 + 0.000 03X) kΩ (0.003 + 0.000 03X) kΩ (0.000 002 + 0.000 03X) MΩ (0.000 03 + 0.000 05X) MΩ (0.000 08 + 0.000 1X) MΩ (0.000 6 + 0.001 2X) MΩ (0.006 + 0.006X) MΩ (0.01 + 0.006X) MΩ	Fluke 5522A Multiproduct Calibrator
Resistance – Source ³	500 μΩ 5 mΩ 50 mΩ 500 mΩ 5 Ω	(0.001 + 0.006X) mΩ	Fluke 5500A Multiproduct Calibrator, Agilent 34401A Multimeter Shunts
RTD Resistance Simulation Pt 385, 100 Ω	(-200 to 800) °C	0.058 °C	Fluke 5500A Multiproduct Calibrator



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
DC Voltage – Measure ³	Up to 1 V (1 to 10) V (10 to 100) V (100 to 1 000) V	(0.000 000 1 + 0.000 007X) V (0.000 001 + 0.000 006X) V (0.000 07 + 0.000 008X) V (0.000 7 + 0.000 008X) V	Transmille 8081 Multimeter
	(1 to 80) kV	0.12 % of reading	Ross Engineering HV Probe
DC Voltage – Source ³	(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 01X) mV (0.000 002 + 0.000 01X) V (0.000 03 + 0.000 01X) V (0.000 2 + 0.000 02X) V (0.002 + 0.000 02X) V	Fluke 5522A Multiproduct Calibrator
AC Voltage – Measure ³	Up to 100 mV		Transmille 8081 Multimeter
	(10 to 40) Hz	(0.03 + 0.000 5X) mV	
	(40 to 200) Hz	(0.03 + 0.000 1X) mV	
	200 Hz to 2 kHz	(0.03 + 0.000 09X) mV	
	(2 to 20) kHz	(0.03 + 0.000 1X) mV	
	(20 to 100) kHz	(0.13 + 0.000 3X) mV	
	(0.1 to 1) V		
	(10 to 40) Hz	(0.000 2 + 0.000 5X) V	
	(40 to 200) Hz	(0.000 1 + 0.000 2X) V	
	(200 to 1000) Hz	(0.000 1 + 0.000 1X) V	
	(1 to 2) kHz	(0.000 2 + 0.000 1X) V	
	(2 to 20) kHz	(0.001 + 0.000 08X) V	
	(20 to 100) kHz	(0.001 + 0.000 5X) V	
	(100 to 300) kHz	(0.000 6 + 0.000 05X) V	
	(1 to 10) V		
	(10 to 40) Hz	(0.001 + 0.000 4X) V	
(40 to 200) Hz	(0.001 + 0.000 1X) V		
(200 to 1000) Hz	(0.001 + 0.000 1 X) V		
(1 to 2) kHz	(0.002 + 0.000 08X) V		
(2 to 20) kHz	(0.009 + 0.000 06X) V		
(20 to 100) kHz	(0.01 + 0.000 4X) V		
(10 to 100) V			
(10 to 40) Hz	(0.03 + 0.000 4X) V		
(40 to 200) Hz	(0.03 + 0.000 08X) V		
(200 to 1000) Hz	(0.03 + 0.000 09X) V		
(1 to 2) kHz	(0.09 + 0.000 08X) V		
(2 to 20) kHz	(0.1 + 0.000 1X) V		
(20 to 50) kHz	(0.1 + 0.000 5X) V		



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Measure ³	(100 to 1 000) V (10 to 40) Hz (40 to 200) Hz 200 Hz to 2 kHz (2 to 10) kHz	(0.4 + 0.000 3X) V (0.4 + 0.000 09X) V (0.5 + 0.000 05X) V (0.7 + 0.000 1X) V	Transmille 8081 Multimeter
AC Voltage – Measure ³	(1 to 80) kV @ 60 Hz	(0.006 2 + 0.012X) kV	Ross Engineering HV Probe
AC Voltage – Source ³	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	(0.01 + 0.000 2X) mV (0.01 + 0.000 2X) mV (0.01 + 0.000 2X) mV (0.01 + 0.000 3X) mV (0.05 + 0.000 7X) mV (0.1 + 0.002X) mV (0.000 03X) V (0.000 09 + 0.000 2X) V (0.000 1 + 0.000 2X) V (0.000 1 + 0.000 3X) V (0.000 2 + 0.000 6X) V (0.001 + 0.002X) V (0.000 9 + 0.000 3X) V (0.000 8 + 0.000 1X) V (0.000 8 + 0.000 2X) V (0.001 + 0.000 3X) V (0.003 + 0.000 8X) V (0.01 + 0.000 1X) V (0.01 + 0.000 2X) V (0.01 + 0.000 2X) V (0.03 + 0.000 4X) V (0.007 + 0.002X) V (0.01 + 0.000 3X) V (0.01 + 0.000 2X) V (0.01 + 0.000 3X) V	Fluke 5522A Multiproduct Calibrator



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Thermocouple Millivolt Simulation	Type E		Fluke 5522A Multiproduct Calibrator
	(-250 to -100) °C	0.44 °C	
	(-100 to -25) °C	0.14 °C	
	(-25 to 350) °C	0.12 °C	
	(350 to 650) °C	0.14 °C	
	(650 to 1 000) °C	0.18 °C	
	Type J		
	(-210 to -30) °C	0.14 °C	
	(-30 to 150) °C	0.12 °C	
	(150 to 760) °C	0.15 °C	
	(760 to 1 200) °C	0.21 °C	
	Type K		
	(-200 to -100) °C	0.29 °C	
	(-100 to -25) °C	0.16 °C	
	(-25 to 120) °C	0.14 °C	
	(120 to 1 000) °C	0.22 °C	
	(1 000 to 1 372) °C	0.35 °C	
	Type N		
	(-200 to -100) °C	0.35 °C	
	(-100 to -25) °C	0.20 °C	
(-25 to 120) °C	0.17 °C		
(120 to 410) °C	0.16 °C		
(410 to 1 300) °C	0.24 °C		
Type R			
(0 to 250) °C	0.66 °C		
(250 to 1 767) °C	0.38 °C		
Type S			
(0 to 250) °C	0.54 °C		
(250 to 1 400) °C	0.32 °C		
(1 400 to 1 767) °C	0.39 °C		
Type T			
(-250 to -150) °C	0.56 °C		
(-150 to 0) °C	0.21 °C		
(0 to 120) °C	0.15 °C		
(120 to 400) °C	0.12 °C		
Oscilloscopes Time Base	(2 to 10) ns	0.003 ps	Fluke 5500A-SC600 Multiproduct Calibrator
	20 ns to 1 μs	0.003 ns	
	(2 to 50) μs	0.039 ns + 0.000 2 % of reading	
	(0.1 to 5 000) ms	0.2 ms + 0.2 % of reading	



ANSI National Accreditation Board

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Oscilloscopes Bandwidth	50 kHz to 100 MHz (100 to 300) MHz (300 to 600) MHz	4.3 % of reading 4.9 % of reading 7.3 % of reading	Fluke 5500A-SC600 Multiproduct Calibrator
Oscilloscopes Amplitude	(0 to 5) V pp	0.35 mV + 2.3 % of reading	Fluke 5500A-SC600 Multiproduct Calibrator

Length – Dimensional metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Gage Blocks ³	(0.005 to 4) in	$(4.5 + 0.7L) \mu\text{in}$	Gage Blocks, Gage Block Comparator
Gage Blocks ³	(5 to 20) in	$(8.6 + 0.6L) \mu\text{in}$	Universal Machine Gage Blocks
Plain Plug Gage ³	(0.007 to 10) in	$(8.0 + 2.8L) \mu\text{in}$	Universal Machine
Height/Step Master ³	(0 to 36) in	$(8.2 + 4.1L) \mu\text{in}$	Gage Blocks, Surface Plate, Indicator
Height Master (Travel) ³	(0 to 1) in	$(15 + 3.9L) \mu\text{in}$	Gage Blocks, Surface Plate, Indicator
Micrometer Standard ³	(0.5 to 26) in	$(0.09 + 5.3L) \mu\text{in}$	P&W Supermic, Gage Blocks,
Micrometer Standard ³	(26 to 48) in	$(65 + 2.3L) \mu\text{in}$	Mu-Checker, Indicator, Gage Blocks, Surface Plate
Plain Ring Gages ³	(0.15 to 10) in	$(12 + 2.3L) \mu\text{in}$	Precimar ULM
Thread Wire ²	(0.007 to 0.2) in	11.3 μin	Universal Machine XX Cylinder
Pin Gage ³	(0.011 to 2) in	$(30 + 0.4L) \mu\text{in}$	Super Micrometer
Thickness Gage (Leaf) ³	(0 to 1) in	$(31 + 3L) \mu\text{in}$	Super Micrometer
Tape Measures	Up to 50 ft	0.051 in	Master Tape
Steel Rules ³	Up to 72 in	$(0.01 + 0.000 1L) \text{ in}$	Master Ruler
Plastic Shim Stock ^{3,4}	(1 to 50) mils	$(0.007 + 0.004L) \text{ mils}$	Bench Micrometer



Length – Dimensional metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Thread Plug Gages ³ Major Diameter Pitch Diameter (4 to 80) TPI	(0.06 to 8) in	(30 + 20L) in (82 + 2.2L) μin	Super Micrometer Thread Wires
Thread Ring Gages ³ Minor Diameter	(0.06 to 0.25) in (0.25 to 2) in (1 to 8) in	(140 + 1L) μin (186 + 18L) μin (140 + 1L) μin	Tri-anvil Micrometers Vision System
Thread Rings, Solid Pitch Diameter (4 to 80) TPI	(0.06 to 8) in	(9 + 4.6L) μin	Precimar, Plain Ring
Thread Rings, Adjustable Pitch Diameter Tactile Fit (Set to Plug)	(0.06 to 8) in	See footnote ⁵	Set Plugs
Radius Gage ³	(0.010 to 2) in	(200 + 3L) in	Vision System
Spheres ³	(0.013 2 to 2) in	(14 + 2.5L) μin	Universal Machine
Squares ³	(2 to 24) in	66 μin	Grade 0 Square Gage Blocks
Surface Plate Overall Flatness ^{1,3} Local Area Flatness (Repeat Reading) ¹	(8 to 68) in diagonal (34 to 161) in diagonal Up to 0.001 in	41 μin (49 + 0.3L) μin 38 μin	Planekator Level System Repeat-o-meter
Roughness Specimens	Up to 400 μin Ra	3.8 μin	Profilometers
Gages and Fixtures ³ , 2D Length	Up to 16 in	(201 + 10L) μin	Vision System
Gages and Fixtures ³ , 2D Diameter	Up to 12 in	(215 + 12.4L) μin	Vision System
Gages and Fixtures, 2D Angle	(0 to 360) °	0.027 °	Vision System
Height Gage ³	(0 to 36) in	(95 + 1.4L) μin	Gage Blocks Surface Plate
Calipers ³	(0 to 60) in (60 to 120) in	(390 + 5L) μin (320 + 6.5L) μin	Gage Blocks
Outside Micrometers ³	(0 to 36) in	(31 + 3L) μin	Gage Blocks
Depth Micrometers ³	(0 to 12) in	(596 + 0.11L) μin	Gage Blocks



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Length – Dimensional metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Inside Micrometer ³	(0.1 to 36) in	$(575 + 0.6L) \mu\text{in}$	Surface Plate
Bore Micrometers ³	(0.15 to 10) in	$(26 + 42L) \mu\text{in}$	Ring Gages
Bench Micrometer Travel Anvil Flatness Anvil Parallelism	(0 to 1) in	13 μin 6.8 μin 8.6 μin	Gage Blocks Optical Flat Sphere
Indicator ³ 0.001 in resolution 0.00025 in resolution 0.000 5 in resolution 0.000 1 in resolution 0.000 05 in resolution 0.000 01 in resolution	(0 to 4) in	$(614 + 0.02L) \mu\text{in}$ $(144 + 2L) \mu\text{in}$ $(357 + 0.04L) \mu\text{in}$ $(58 + 0.5L) \mu\text{in}$ $(29 + 0.98L) \mu\text{in}$ $(5.3 + 3.2L) \mu\text{in}$	Indicator Tester Gage Blocks
Universal Measuring Machine ³	(0 to 24) in	$(2.3 + 3.4L) \mu\text{in}$	Gage Blocks
Ultrasonic Thickness Gages	(0.005 to 2) in	580 μin	Gage Blocks
Magnetic Coating Thickness Gages ^{3,4}	(1 to 50) mils	$(0.055 + 0.003L)$ mils	Precision Shims Bench Micrometer
Profilometer (Ra)	(0 to 200) μin	2.9 μin	Roughness Standard ASME B46.1-2009
Protractor ³	(0 to 180) °	$(0.06 + 0.000 6L) °$	Granite Squares Sine Bar
Optical Comparators ³ Magnification Linearity Squareness	5x to 100x (0 to 6) in (0 to 6) in	$(197 + 2.6L) \mu\text{in}$ 140 μin 76 μin	Glass Scale Length Standards Spheres
Microscopes ³ Stage Travel	(0 to 1) in	$(54 + 45L) \mu\text{in}$	Gage Blocks
Vision Systems ³ Linearity Angles	(0 to 6) in (0 to 360) °	$(114 + 4.6L)$ in $(0.012 + 0.000 02A) °$	Glass Scale
CMM Linearity ³	Up to 48 in	$(12 + 4.7L) \mu\text{in}$	Step Gage and Gage Blocks in accordance with B89.4.10360-2



ANSI National Accreditation Board

Length – Dimensional metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
CMM Repeatability	Up to 48 in	87 μ in	Step Gage and Gage Blocks in accordance with B89.4.10360-2
CMM Volumetric Accuracy	Up to 48 in	96 μ in	Ball Bar in accordance with B89.4.1-1997

Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Gas Flow Speed (Anemometers)	(490 to 3300) ft/min	2 ft/min + 3.8 % of reading	TSI 9535 VelociCalc Air Velocity Meter
Gas Flow Meter	(50 to 500) CCM Up to 50 SLM (50 to 250) SLM	1.2 CCM + 0.5 % of reading 0.12 SLM + 0.5 % of reading 1.2 SLM + 0.8 % of reading	Alicat Flow Standard
Liquid Flow (gravimetric)	(0.3 to 50) gpm	0.02 gpm + 0.6 % of reading	Scale
Bench Micrometer Measuring Force	(4 to 40) ozf	0.21 ozf	Force Gage
Force Gages ³	1 grf to 45 kgf	(5.7 + 1.1 <i>F</i>) gf	Class F Masses
	(0.5 to 50) lbf (50 to 250) lbf	(0.003 + 0.000 2 <i>W</i>) lbf (0.01 + 0.000 1) lbf	Class 7 Masses
Load Cells	(10 to 500) lbf (501 to 1 000) lbf (1 001 to 5 000) lbf (5 001 to 20 000) lbf	0.83 lbf + 0.1 % of reading 1.1 lbf + 0.051 % of reading 5.9 lbf + 0.032 % of reading 58 lbf + 0.003 % of reading	Load Cells

Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Rockwell and Rockwell Superficial Hardness Testers	HRBW		Indirect Verification per ASTM E18
	Low	1.9 HRBW	
	Middle	1.5 HRBW	
	High	1.4 HRBW	
	HRC		
	Low	1.3 HRC	
	Middle	1.3 HRC	
	High	0.7 HRC	
	HRFW		
	Low	1.4 HRFW	
	Middle	1.4 HRFW	
	High	1.5 HRFW	
Rockwell and Rockwell Superficial Hardness Testers	HR15N		Indirect Verification per ASTM E18
	Low	1.4 HR15N	
	Middle	1.4 HR15N	
	High	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 and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Masses	1g 2g 5g 10g 20g 50g 100g 200g	0.14 mg 0.22 mg 0.2 mg 0.22 mg 0.25 mg 0.5 mg 0.8 mg 1.3 mg	Class 1 Masses
Pressure Gage	(0 to 30) psig	0.0083 psi + 0.005 % of reading	Druck DPI 802 Pressure Calibrator - Pneumatic
Pressure Gage	(10 001 to 15 000) psig	17 psi + 0.005 5 % of reading	Keller Gage-Hydraulic
Vacuum Gage	(-14.5 to 0) psig	0.002 psi + 0.026 % of reading	Druck DPI 802 Pressure Calibrator - Pneumatic
Pressure Devices	(2 to 500) psig (500 to 10 000) psig	0.000 5 psi + 0.037 % of reading 0.7 psi + 0.033 % of reading	Dead Weight Tester-Hydraulic
Scales & Balances	(0.000 01 to 1 100) g	(0.15 mg + 0.000 2M) g	Class 1 Weights and NIST Handbook 44 utilized for the calibration of the weighing system.
Scales & Balances	(0.5 to 38) kg	(8.3 mg + 0.012M) g	Class F Weights and NIST Handbook 44 utilized for the calibration of the weighing system.
Scales & Balances	(0.5 to 500) lb	(0.002 lb + 0.000 1M) lb	Class 7 Weights and NIST Handbook 44 utilized for the calibration of the weighing system.
Torque Tools	(0.5 to 400) ozf·in (4 to 50) lbf·in (10 to 150) lbf·in (30 to 400) lbf·in (80 to 1 000) lbf·in (10 to 125) lbf·ft (60 to 600) lbf·ft (100 to 1 000) lbf·ft (1 000 to 2 000) lbf·ft	0.33 % of reading 0.38 % of reading 0.33 % of reading 0.33 % of reading 0.33 % of reading 0.36 % of reading 0.34 % of reading 0.59 % of reading 18 lbf·ft + 0.13 % of reading	CDI Torque Tester
Torque Transducers	(5 to 1 000) lbf·ft	0.11 % of reading	Torque Arms & Class F Weights



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Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Pipettes	(10 to 1 000) μ L	0.1 μ L + 0.000 7 % of reading	Gravimetric

Thermodynamic

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Relative Humidity ³	(0 to 80) % RH	(1.2 + 0.005T) % RH	Vasaila MI70 / HMP77 Temperature/Humidity Indicator
Temperature Measure	(-70 to 180) $^{\circ}$ C	0.29 $^{\circ}$ C	
Temperature Probes and Systems	(-20 to 600) $^{\circ}$ C	(0.028 + 0.000 64T) $^{\circ}$ C	Hart Scientific Baths and Drywells and 5609 PRT
Liquid in Glass Thermometers (Partial and Total Immersion)	(-20 to 600) $^{\circ}$ C	(0.087 + 0.000 55T) $^{\circ}$ C	Hart Scientific Bath, Furnace, and 5609 PRT
Temperature Measure	(-195 to 420) $^{\circ}$ C (420 to 660) $^{\circ}$ C	0.069 $^{\circ}$ C 0.38 $^{\circ}$ C	5609 PRT
Infrared Source ^{1,3}	50.0 $^{\circ}$ C 100.0 $^{\circ}$ C 200.0 $^{\circ}$ C 300.0 $^{\circ}$ C 400.0 $^{\circ}$ C	1.1 $^{\circ}$ C 1.2 $^{\circ}$ C 1.4 $^{\circ}$ C 1.6 $^{\circ}$ C 1.8 $^{\circ}$ C	ICI 500 Blackbody Source $\epsilon = 0.95, \lambda = (8 \text{ to } 14) \mu\text{m}$

Time and Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Frequency – Source	1 Hz to 50 MHz (50 to 600) MHz	0.001 8 Hz + 0.000 1% of reading 0.000 2 Hz + 0.000 3% of reading	Fluke 5500A Multiproduct Calibrator, PM5193 Function Generator
	10 MHz	0.002 Hz	GPS Disciplined Oscillator
Frequency – Measure ³	1 Hz to 225 MHz 225 MHz to 3 GHz	(0.008 1 + 0.000 000 000 4X) Hz (0.011 + 0.000 000 000 1X) Hz	HP 53132 Counter
Timers and Stopwatches	(0.1 to 60) min	0.034 s + 0.006 % of reading	HP 53132 Counter

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 = diameters in inches, T = temperature / RH applied, X = flow / frequency / volts / ohms / amps / capacitance applied, M = mass applied, F = force in kg, P = pressure applied, V = volume, W = weight in lb A = angle in degrees.
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. This scope is formatted as part of a single document including Certificate of Accreditation No. L2181-1.



Vice President

