



CERTIFICATE OF ACCREDITATION

The ANSI National Accreditation Board

Hereby attests that

Productivity Quality, Inc. / Advanced Inspection Services, LLC
15150 25th Ave. N., Suite 200
Plymouth, MN 55447

(and the satellite as listed on the scope)

Fulfills the requirements of

ISO/IEC 17025:2017

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.

R. Douglas Leonard Jr., VP, PILR SBU

Expiry Date: 15 January 2024
Certificate Number: ACT-1608



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

Productivity Quality, Inc. / Advanced Inspection Services, LLC

15150 25th Ave N. Suite 200

Plymouth, MN 55447

Adam Clark

763-249-8132

DIMENSIONAL MEASUREMENT

Valid to: **January 15, 2024**

Certificate Number: **ACT-1608**

1 Dimensional

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-) ²	Reference Standard, Method, and/or Equipment
Dimensional Measurement 1D	Up to 24 in Up to 12 in Up to 3.2 in Up to 0.008 in Up to 0.03 in Up to 2 in Up to 1 in	(590 + 0.2L) μin 514 μin 124 μin 120 μin 310 μin 120 μin 116 μin	Dial Height Gage Calipers Micrometers Dial Indicator Dial Indicator Drop Indicator Gage Pins
	Up to 6 in	590 μin	Depth Micrometer

2 Dimensional

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-) ²	Reference Standard, Method, and/or Equipment
Dimensional Measurement 2D	Small Hole Dia. 2-8μm	0.2 μm	Sensofar S-Neox
Single FOV (XY)	Up to 0.22 mm Up to 0.44 mm Up to 1.1 mm Up to 2.2 mm Up to 4.4 mm Up to 1 mm	(0.1 + 1.2L) μm (0.18 + 0.3L) μm (0.5 + 0.14L) μm (0.86 + 0.25L) μm (1.7 + 0.18L) μm (0.007 + 4.3L) μm	
Step (Z)			
Extended Range	Up to 11 in Up to 30 in	(45 + 1.3L) μin (60 + 2.1L) μin	View Summit 600 View Summit 600

3 Dimensional

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-) ²	Reference Standard, Method, and/or Equipment
Dimensional Measurement 3D ¹ Single Point Scanning Aluminums Plastics	8 ft spherical volume Up to 708 in	(500 + 2.7L) μin (1 100 + 3.2L) μin	Romer Absolute CMM Leica Laser Tracker (MR) w / T-probe
	Up to 99 in	(78 + 3.6L) μin (120 + 3.6L) μin	Hexagon 122210
	Up to 45 mm Up to 45 mm	(5 + 0.4L) μm (6 + 0.6L) μm	EasyTom CT

Dimensional Measurement - Other

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-) ²	Reference Standard, Method, and/or Equipment
Form Roundness	Up to 100 μin (100 to 500) μin	4.8 μin 53 μin	Mitutoyo RA2200 AH Roundness Tester
Cylindricity	Up to 100 μin (100 to 500) μin	39 μin 66 μin	Mitutoyo RA2200 AH Roundness Tester
Surface Finish (contact) Surface Finish (non-contact)	Up to 500 μin Up to 500 μin	3.9 μin 1.2 μin	Mitutoyo CV4500 Sensofar S Neox
Contour	Up to 4 in	(112 + 24L) μin	Mitutoyo Contracer

Satellite location

15300 25th Ave N. Suite 200
Plymouth, MN 55447

DIMENSIONAL MEASUREMENT

3 Dimensional

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-) ²	Reference Standard, Method, and/or Equipment
Dimensional Measurement 3D Single Point Scanning	Up to 67 in Up to 67 in	(12 + 0.73L) μin (38 + 0.42L) μin	Leitz Infinity Leitz Infinity

CALIBRATION

Chemical Quantities

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Conductivity Meters	84.2 μ S/cm 1 418 μ S/cm 10 010 μ S/cm 100 300 μ S/cm	0.7 μ S/cm + 0.6R 6 μ S/cm + 0.6R 37 μ S/cm + 0.6R 370 μ S/cm + 0.6R	Conductivity Solutions
pH Meters	4 pH 7 pH 10 pH	0.017 pH + 0.6R 0.014 pH + 0.6R 0.027 pH + 0.6R	pH Buffer Solutions
Refractometers	(1.345, 1.464) nD	0.000 55 nD + 0.6R	Refractive Index Solutions

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
DC Voltage - Source	Up to 330 mV 330 mV to 3 V (3 to 33) V (30 to 330) V (100 to 1 020) V	0.78 μ V + 16 μ V/V 1.7 μ V + 8.6 μ V/V 17 μ V + 9.3 μ V/V 0.13 mV + 14 μ V/V 1.3 mV + 14 μ V/V	Fluke 5522A
DC Voltage - Measure	Up to 200 mV 200 mV to 2 V (2 to 20) V (20 to 200) V 200 V to 1 kV	0.1 μ V + 5 μ V/V 0.4 μ V + 3.5 μ V/V 4 μ V + 3.5 μ V/V 40 μ V + 5.5 μ V/V 0.5 mV + 5.5 μ V/V	Fluke 8508A
	(1 to 60) kV	0.51 mV/V	Fluke 8846A and Ross Eng Divider
DC Current - Source	Up to 330 μ A 330 μ A to 3.3 mA (3.3 to 33) mA (33 to 330) mA 330 mA to 1.1 A (1.1 to 3) A (3 to 11) A (11 to 20.5) A	16 nA + 0.12 mA/A 40 nA + 78 μ A/A 0.21 μ A + 78 μ A/A 2.1 μ A + 78 μ A/A 32 μ A + 0.16 mA/A 32 μ A + 0.3 mA/A 0.4 mA + 0.39 mA/A 0.59 mA + 0.78 mA/A	Fluke 5522A
	(20.5 to 150) A (150 to 550) A (550 to 1 000) A	0.14 A + 5.1 mA/A 0.5 A + 5.1 mA/A 0.5 A + 5.1 mA/A	Fluke 5522A and Fluke 50 Turn Current Coil



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
DC Current - Measure	Up to 100 nA (0.1 to 1) μ A (1 to 10) μ A	0.048 nA + 36 μ A/A 0.048 nA + 24 μ A/A 0.12 nA + 24 μ A/A	HP3458A
	(10 to 200) μ A 200 μ A to 2 mA (2 mA to 20) mA (20 to 200) mA 200 mA to 2 A (2 to 20) A	0.4 nA + 12 μ A/A 4 nA + 12 μ A/A 40 nA + 14 μ A/A 0.8 μ A + 48 μ A/A 16 μ A + 0.19 mA/A 0.4 mA + 0.4 mA/A	Fluke 8508A
	(20 to 100) A (100 to 600) A	0.9 mA/A 1.0 mA/A	Fluke 8508A with 100A Murata, and 600A Empro Shunts
AC Voltage - Source	(1 to 33) 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 (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 (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	4.7 μ V + 0.62 mV/V 4.7 μ V + 0.12 mV/V 4.7 μ V + 0.16 mV/V 4.7 μ V + 0.78 mV/V 9.4 μ V + 2.8 mV/V 39 μ V + 6.2 mV/V 6.3 μ V + 0.24 mV/V 6.3 μ V + 0.12 mV/V 6.3 μ V + 0.13 mV/V 6.3 μ V + 0.28 mV/V 25 μ V + 0.62 mV/V 55 μ V + 1.6 mV/V 40 μ V + 0.24 mV/V 47 μ V + 0.12 mV/V 47 μ V + 0.15 mV/V 40 μ V + 0.24 mV/V 97 μ V + 0.55 mV/V 0.47 mV + 1.9 mV/V 0.51 mV + 0.24 mV/V 0.47 mV + 0.12 mV/V 0.47 mV + 0.19 mV/V 0.47 mV + 0.28 mV/V 1.3 mV + 0.7 mV/V	Fluke 5522A

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage - Source	(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	1.7 mV + 0.15 mV/V 4.7 mV + 0.16 mV/V 4.7 mV + 0.2 mV/V 4.7 mV + 0.24 mV/V 39 mV + 1.6 mV/V	Fluke 5522A
	(330 to 1 020) V 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	9.7 mV + 0.24 mV/V 9.7 mV + 0.2 mV/V 9.7 mV + 0.24 mV/V	
AC Voltage – Measure	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 300 kHz to 1 MHz	3.6 μV + 0.36 mV/V 1.3 μV + 0.24 mV/V 1.3 μV + 0.36 mV/V 1.3 μV + 1.2 mV/V 1.3 μV + 6 mV/V 2.4 μV + 48 mV/V 4.8 + 83 μV/V 2.4 μV + 83 μV/V 2.4 μV + 0.17 mV/V 2.4 μV + 0.36 mV/V 2.4 μV + 0.95 mV/V 12 μV + 3.6 mV/V 12 μV + 12 mV/V	HP3458A
	Up to 200 mV (1 to 10) Hz (10 to 40) Hz (40 to 100) Hz 100 Hz to 2 kHz (2 to 10) kHz (10 to 30) kHz (30 to 100) kHz 200 mV to 2 V (1 to 10) Hz (10 to 40) Hz (40 to 100) Hz 100 Hz to 2 kHz (2 to 10) kHz (10 to 30) kHz (30 to 100) kHz (100 to 300) kHz 300 kHz to 1 MHz	14 μV + 0.17 mV/V 4 μV + 0.14 mV/V 4 μV + 0.12 mV/V 2 μV + 0.11 mV/V 4 μV + 0.14 mV/V 8 μV + 0.64 mV/V 20 μV + 0.77 mV/V 0.12 mV + 0.15 mV/V 20 μV + 0.12 mV/V 20 μV + 90 μV/V 20 μV + 75 μV/V 20 μV + 0.11 mV/V 40 μV + 0.22 mV/V 0.2 mV + 0.57 mV/V 2 mV + 3 mV/V 20 mV + 10 mV/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	(2 to 20) V	1.2 mV + 0.15 mV/V	Fluke 8508A
	(1 to 10) Hz	0.2 mV + 0.12 mV/V	
	(10 to 40) Hz	0.2 mV + 90 μV/V	
	(40 to 100) Hz	0.2 mV + 75 μV/V	
	100 Hz to 2 kHz	0.2 mV + 0.11 mV/V	
	(2 to 10) kHz	0.4 mV + 0.22 mV/V	
	(10 to 30) kHz	2 mV + 0.57 mV/V	
	(30 to 100) kHz	20 mV + 3 mV/V	
	(100 to 300) kHz	0.2 V + 10 mV/V	
	300 kHz to 1 MHz		
	(20 to 200) V		
	(1 to 10) Hz	12 mV + 0.15 mV/V	
	(10 to 40) Hz	2 mV + 0.12 mV/V	
	(40 to 100) Hz	2 mV + 90 μV/V	
	100 Hz to 2 kHz	2 mV + 75 μV/V	
(2 to 10) kHz	2 mV + 0.11 mV/V		
(10 to 30) kHz	4 mV + 0.22 mV/V		
(30 to 100) kHz	20 mV + 0.57 mV/V		
(100 to 300) kHz	0.2 V + 3 mV/V		
300 kHz to 1 MHz	2 V + 10 mV/V		
(200 to 1 000) V			
(1 to 10) Hz	70 mV + 0.15 mV/V		
(10 to 40) Hz	20 mV + 0.12 mV/V		
40 Hz to 10 kHz	20 mV + 0.12 mV/V		
(10 to 30) kHz	40 mV + 0.23 mV/V		
(30 to 100) kHz	0.2 V + 0.58 mV/V		
AC Voltage - Measure	(1 to 60) kV 60 Hz	2.8 mV/V	Fluke 8846A and Ross Eng Divider

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current - Source	(29 to 330) μ A		Fluke 5522A
	(10 to 20) Hz	78 nA + 1.6 mA/A	
	(20 to 45) Hz	78 nA + 1.2 mA/A	
	45 Hz to 1 kHz	78 nA + 0.97 mA/A	
	(1 to 5) kHz	0.12 μ A + 2.4 mA/A	
	(5 to 10) kHz	0.16 μ A + 6.2 mA/A	
	(10 to 30) kHz	0.31 μ A + 13 mA/A	
	330 μ A to 3.3 mA		
	(10 to 20) Hz	0.12 μ A + 1.6 mA/A	
	(20 to 45) Hz	0.12 μ A + 0.97 mA/A	
	45 Hz to 1 kHz	0.12 μ A + 0.78 mA/A	
	(1 to 5) kHz	0.16 μ A + 1.6 mA/A	
	(5 to 10) kHz	0.24 μ A + 3.9 mA/A	
	(10 to 30) kHz	0.47 μ A + 7.8 mA/A	
	(3.3 to 33) mA		
	(10 to 20) Hz	1.6 μ A + 1.4 mA/A	
	(20 to 45) Hz	1.6 μ A + 0.7 mA/A	
	45 Hz to 1 kHz	1.6 μ A + 0.31 mA/A	
	(1 to 5) kHz	1.6 μ A + 0.62 mA/A	
	(5 to 10) kHz	1.6 μ A + 1.6 mA/A	
	(10 to 30) kHz	1.6 μ A + 3.1 mA/A	
	(33 to 330) mA		
	(10 to 20) Hz	16 μ A + 1.4 mA/A	
	(20 to 45) Hz	16 μ A + 0.7 mA/A	
	45 Hz to 1 kHz	16 μ A + 0.31 mA/A	
	(1 to 5) kHz	39 μ A + 0.78 mA/A	
	(5 to 10) kHz	78 μ A + 1.6 mA/A	
	(10 to 30) kHz	0.16 mA + 3.1 mA/A	
	(330 mA to 1.1) A		
	(10 to 45) Hz	78 μ A + 1.4 mA/A	
45 Hz to 1 kHz	78 μ A + 0.39 mA/A		
(1 to 5) kHz	0.78 mA + 4.7 mA/A		
(5 to 10) kHz	3.9 mA + 20 mA/A		
(1.1 to 3) A			
(10 to 45) Hz	78 μ A + 1.4 mA/A		
45 Hz to 1 kHz	78 μ A + 0.47 mA/A		
(1 to 5) kHz	78 μ A + 4.7 mA/A		
(5 to 10) kHz	3.9 mA + 20 mA/A		
(3 to 11) A			
(45 to 100) Hz	1.6 mA + 0.47 mA/A		
100 Hz to 1 kHz	1.6 mA + 0.78 mA/A		
(1 to 5) kHz	1.6 mA + 24 mA/A		
(11 to 20.5) A			
(45 to 100) Hz	3.9 mA + 0.93 mA/A		
100 Hz to 1 kHz	3.9 mA + 1.2 mA/A		
(1 to 5) kHz	3.9 mA + 24 mA/A		

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current - Source	(20.5 to 150) A (45 to 65) Hz (65 to 440) Hz (150 to 1 000) A (45 to 65) Hz (65 to 440) Hz	0.25 A + 5.7 mA/A 0.25 A + 11 mA/A 0.9 A + 5.7 mA/A 0.9 A + 11 mA/A	Fluke 5522A and Fluke 50 Turn Current Coil
AC Current - Measure	Up to 200 μ A (1 to 10) Hz 10 Hz to 10 kHz (10 to 30) kHz (30 to 100) kHz 200 μ A to 2 mA (1 to 10) Hz 10 Hz to 10 kHz (10 to 30) kHz (30 to 100) kHz (2 to 20) mA (1 to 10) Hz 10 Hz to 10 kHz (10 to 30) kHz (30 to 100) kHz 20 to 200) mA (1 to 10) Hz 10 Hz to 10 kHz (10 to 30) kHz 200 mA to 2 A 10 Hz to 2 kHz (2 to 10) kHz (10 to 30) kHz (2 to 20) A 10 Hz to 2 kHz (2 to 10) kHz	20 nA + 0.5 mA/A 20 nA + 0.5 mA/A 20 nA + 0.71 mA/A 20 nA + 4 mA/A 0.2 μ A + 0.31 mA/A 0.2 μ A + 0.3 mA/A 0.2 μ A + 0.71 mA/A 0.2 μ A + 4 mA/A 2 μ A + 0.31 mA/A 2 μ A + 0.3 mA/A 2 μ A + 0.71 mA/A 2 μ A + 4 mA/A 20 μ A + 0.31 mA/A 20 μ A + 0.29 mA/A 20 μ A + 0.63 mA/A 0.2 mA + 0.62 mA/A 0.2 mA + 0.74 mA/A 0.2 mA + 3 mA/A 2 mA + 0.82 mA/A 2 mA + 2.5 mA/A	Fluke 8508A
AC Current - Measure	(20 to 50) A 60 Hz	21 mA/A	Fluke 8508A and CTF-5RL
DC Power - Source	33mV to 1 020 V (0.33 to 330) mA 330 mA to 3 A (3 to 20.5) A	0.18 mW/W 0.18 mW/W 0.55 mW/W	Fluke 5522A

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Power - Source	(33 to 330) mV (3.3 to 9) mA (9 to 33) mA (33 to 90) mA (90 to 330) mA (330 to 900) mA 900 mA to 2.2 A (2.2 to 4.5) A (4.5 to 20.5) A 330mV to 1 020 V (3.3 to 9) mA (9 to 33) mA (33 to 90) mA (90 to 330) mA (330 to 900) mA 900 mA to 2.2 A (2.2 to 4.5) A (4.5 to 20.5) A	1.1 mW/W 0.78 mW/W 1.1 mW/W 0.78 mW/W 1.1 mW/W 0.86 mW/W 1.1 mW/W 0.86 mW/W 0.93 mW/W 0.62 mW/W 0.93 mW/W 0.62 mW/W 0.86 mW/W 0.7 mW/W 0.93 mW/W 0.78 mW/W	Fluke 5522A
Resistance - Source	(0 to 11) Ω (11 to 33) Ω (33 to 110) Ω (110 to 330) Ω 330 Ω 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 330 kΩ 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	0.78 mΩ + 31 μΩ/Ω 1.2 mΩ + 24 μΩ/Ω 1.1 mΩ + 22 μΩ/Ω 1.6 mΩ + 22 μΩ/Ω 1.7 mΩ + 22 μΩ/Ω 16 mΩ + 22 μΩ/Ω 17 mΩ + 22 μΩ/Ω 0.16 Ω + 22 μΩ/Ω 0.17 Ω + 22 μΩ/Ω 1.6 Ω + 25 μΩ/Ω 1.7 Ω + 25 μΩ/Ω 24 Ω + 47 μΩ/Ω 40 Ω + 0.11 mΩ/Ω 2 kΩ + 0.2 mΩ/Ω 2.4 kΩ + 0.39 mΩ/Ω 78 kΩ + 2.4 mΩ/Ω 390 kΩ + 12 mΩ/Ω	Fluke 5522A
Resistance - Measure	Up to 500 mΩ	0.9 mΩ/Ω	Fluke 5522A and 8508A
Resistance - Measure	Up to 2 Ω (2 to 20) Ω (20 to 200) Ω (0.2 to 2) kΩ (2 to 20) kΩ (20 to 200) kΩ (0.2 to 2) MΩ (2 to 20) MΩ (20 to 200) MΩ (0.2 to 2)GΩ	4 μΩ + 17 μΩ/Ω 14 μΩ + 9.5 μΩ/Ω 50 μΩ + 8 μΩ/Ω 0.5 mΩ + 8 μΩ/Ω 5 mΩ + 8 μΩ/Ω 50 mΩ + 8 μΩ/Ω 5.9 Ω + 9 μΩ/Ω 0.12 kΩ + 20 μΩ/Ω 10 kΩ + 0.12 mΩ/Ω 1 MΩ + 1.6 mΩ/Ω	Fluke 8508A

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Capacitance - Source	(220 to 400) pF		Fluke 5522A
	10 Hz to 10kHz	7.8 pF + 3.9 mF/F	
	400 pF to 1.1 nF		
	10 Hz to 10 kHz	7.8 pF + 3.9 mF/F	
	(1.1 to 3.3) nF		
	10 Hz to 3 kHz	7.8 pF + 3.9 mF/F	
	(3.3 to 11) nF		
	10 Hz to 1 kHz	7.8 pF + 2 mF/F	
	(11 to 33) nF		
	10 Hz to 1 kHz	7.8 pF + 2 mF/F	
	(33 to 110) nF		
	10 Hz to 1 kHz	7.8 pF + 2 mF/F	
	(110 to 330) nF		
	10 Hz to 1 kHz	24 pF + 2 mF/F	
	330 nF to 1.1 μF		
	(10 to 60) 0 Hz	0.78 nF + 2 mF/F	
	(1.1 to 3.3) μF		
	(10 to 300) Hz	2.4 nF + 2 mF/F	
	(3.3 to 11) μF		
	(10 to 150) Hz	7.8 nF + 2 mF/F	
(11 to 33) μF			
(10 to 120) Hz	24 nF + 3.1 mF/F		
(33 to 110) μF			
(10 to 80) Hz	78 nF + 3.5 mF/F		
(110 to 330) μF			
(0 to 50) Hz	0.24 μF + 3.5 mF/F		
(330 to 1.1) mF			
(0 to 20) Hz	0.78 μF + 3.5 mF/F		
(1.1 to 3.3) mF			
(0 to 6) Hz	2.4 μF + 3.5 mF/F		
(3.3 to 11) mF			
(0 to 2) Hz	7.8 μF + 3.5 mF/F		
(11 to 33) mF			
(0 to 0.6) Hz	24 μF + 5.9 mF/F		
(33 to 110) mF			
(0 to 0.2) Hz	78 μF + 8.6 mF/F		
Capacitance - Measure	Up to 1 nF	30 pF + 20 mF/F	Fluke 8846A
	(1 to 10) nF	62 pF + 10 mF/F	
	(10 to 100) nF	0.62 nF + 10 mF/F	
	100 nF to 1 μF	8.5 nF + 10 mF/F	
	(1 to 10) μF	62 nF + 10 mF/F	
	(10 to 100) μF	0.76 μF + 10 mF/F	
	100 μF to 1 mF	9.5 μF + 10 mF/F	
	(1 to 10) mF	76 μF + 10 mF/F	
(10 to 100) mF	1.3 mF + 10 mF/F		

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Electrical Simulation of Thermocouple – Source	Type B		Fluke 5522A
	(600 to 800) °C	0.35 °C	
	(800 to 1 000) °C	0.27 °C	
	(1 000 to 1 550) °C	0.24 °C	
	(1 550 to 1 820) °C	0.26 °C	
	Type C		
	(0 to 150) °C	0.24 °C	
	(150 to 650) °C	0.21 °C	
	(650 to 1 000) °C	0.24 °C	
	(1 000 to 1 800) °C	0.39 °C	
	(1 800 to 2 316) °C	0.66 °C	
	Type E		
	(-250 to -100) °C	0.39 °C	
	(-100 to -25) °C	0.13 °C	
	(-25 to 350) °C	0.11 °C	
	(350 to 650) °C	0.13 °C	
	(650 to 1 000) °C	0.17 °C	
	Type J		
	(-210 to -100) °C	0.21 °C	
	(-100 to -30) °C	0.13 °C	
	(-30 to 150) °C	0.11 °C	
(150 to 760) °C	0.14 °C		
(760 to 1 200) °C	0.18 °C		
Type K			
(-200 to -100) °C	0.26 °C		
(-100 to -25) °C	0.14 °C		
(-25 to 120) °C	0.13 °C		
(120 to 1 000) °C	0.21 °C		
(1 000 to 1 372) °C	0.31 °C		
Type L			
(-200 to -100) °C	0.29 °C		
(-100 to 800) °C	0.21 °C		
(800 to 900) °C	0.14 °C		

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Electrical Simulation of Thermocouple – Source	Type N (-200 to -100) °C (-100 to -25) °C (-25 to 120) °C (120 to 410) °C (410 to 1 300) °C Type R (0 to 250) °C (250 to 1 000) °C (1 000 to 1 400) °C (1 400 to 1 767) °C Type S (0 to 250) °C (250 to 1 000) °C (1 000 to 1 400) °C (1 400 to 1 767) °C Type T (-250 to -150) °C (-150 to 0) °C (0 to 120) °C (120 to 400) °C Type U (-200 to 0) °C (0 to 600) °C	0.31 °C 0.18 °C 0.15 °C 0.14 °C 0.21 °C 0.45 °C 0.28 °C 0.26 °C 0.31 °C 0.37 °C 0.28 °C 0.29 °C 0.36 °C 0.49 °C 0.19 °C 0.13 °C 0.11 °C 0.44 °C 0.21 °C	Fluke 5522A
Electrical Simulation of RTDs – Source	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	0.043 °C 0.057 °C 0.072 °C 0.08 °C 0.095 °C 0.18 °C 0.043 °C 0.057 °C 0.072 °C 0.08 °C 0.095 °C 0.2 °C 0.036 °C 0.043 °C 0.05 °C 0.057 °C 0.065 °C 0.072 °C 0.08 °C 0.18 °C	Fluke 5522A

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Electrical Simulation of RTDs – Source	Pt 385 200 Ω		
	(-200 to -80) $^{\circ}\text{C}$	0.31 $^{\circ}\text{C}$	Fluke 5522A
	(-80 to 100) $^{\circ}\text{C}$	0.036 $^{\circ}\text{C}$	
	(100 to 260) $^{\circ}\text{C}$	0.043 $^{\circ}\text{C}$	
	(260 to 300) $^{\circ}\text{C}$	0.095 $^{\circ}\text{C}$	
	(300 to 600) $^{\circ}\text{C}$	0.11 $^{\circ}\text{C}$	
	(600 to 630) $^{\circ}\text{C}$	0.13 $^{\circ}\text{C}$	
	Pt 385 500 Ω		
	(-200 to -80) $^{\circ}\text{C}$	0.036 $^{\circ}\text{C}$	
	(-80 to 100) $^{\circ}\text{C}$	0.043 $^{\circ}\text{C}$	
	(100 to 260) $^{\circ}\text{C}$	0.05 $^{\circ}\text{C}$	
	(260 to 300) $^{\circ}\text{C}$	0.065 $^{\circ}\text{C}$	
	(300 to 400) $^{\circ}\text{C}$	0.065 $^{\circ}\text{C}$	
	(400 to 600) $^{\circ}\text{C}$	0.072 $^{\circ}\text{C}$	
	(600 to 630) $^{\circ}\text{C}$	0.087 $^{\circ}\text{C}$	
Pt 385 1000 Ω			
(-200 to 0) $^{\circ}\text{C}$	0.029 $^{\circ}\text{C}$		
(0 to 100) $^{\circ}\text{C}$	0.036 $^{\circ}\text{C}$		
(100 to 260) $^{\circ}\text{C}$	0.043 $^{\circ}\text{C}$		
(260 to 300) $^{\circ}\text{C}$	0.05 $^{\circ}\text{C}$		
(300 to 600) $^{\circ}\text{C}$	0.057 $^{\circ}\text{C}$		
(600 to 630) $^{\circ}\text{C}$	0.18 $^{\circ}\text{C}$		
PtNi 385 120 Ω			
(-80 to 0) $^{\circ}\text{C}$	0.065 $^{\circ}\text{C}$		
(0 to 100) $^{\circ}\text{C}$	0.065 $^{\circ}\text{C}$		
(100 to 260) $^{\circ}\text{C}$	0.11 $^{\circ}\text{C}$		
Cu 427 10 Ω			
(-100 to 260) $^{\circ}\text{C}$	0.24 $^{\circ}\text{C}$		
Oscilloscope Leveled Sine Wave – Source			Fluke 5522A SC1100
	Amplitude		
	5 mV to 5.5 V		
	50 kHz (Reference)	0.24 mV + 16 mV/V	
	50 kHz to 100 MHz	0.24 mV + 28 mV/V	
	(100 to 300) MHz	0.24 mV + 31 mV/V	
	(300 to 600) MHz	0.24 mV + 47 mV/V	
	Frequency		
	5 mV to 3.5 V		
	(600 to 1 100) MHz	0.24 mV + 55 mV/V	
	50 kHz to 600) MHz	5.8 kHz + 2 $\mu\text{Hz}/\text{Hz}$	
	(600 to 1100) MHz	58 kHz + 2 $\mu\text{Hz}/\text{Hz}$	



ANSI National Accreditation Board

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Oscilloscope Voltage – Source			
DC Signal 50 Ω	(1 to 25) mV (25 to 110) mV 110 mV to 2.2 V (2.2 to 6.6) V	31 μV + 2 mV/V 32 μV + 2 mV/V 66 μV + 2 mV/V 0.58 mV + 2 mV/V	
DC Signal 1 MΩ	(1 to 25) mV (25 to 110) mV 110 mV to 2.2 V (2.2 to 11) V (11 to 130) V	31 μV + 0.39 mV/V 32 μV + 0.39 mV/V 66 μV + 0.39 mV/V 0.58 mV + 0.39 mV/V 5.8 mV + 0.39 mV/V	
Square Wave 50 Ω	(1 to 25) mV (25 to 110) mV 110 mV to 2.2 V (2.2 to 6.6) V	31 μV + 2 mV/V 32 μV + 2 mV/V 66 μV + 2 mV/V 0.58 mV + 2 mV/V	
Square Wave 1 MΩ	(1 to 25) mV (25 to 110) mV 110 mV to 2.2 V (2.2 to 11) V (11 to 130) V	31 μV + 0.78 mV/V 32 μV + 0.78 mV/V 66 μV + 0.78 mV/V 0.58 mV + 0.78 mV/V 5.8 mV + 0.78 mV/V	
Square Wave Frequency	(10 to 100) Hz 100 Hz to 1 kHz (1 to 10) kHz	5.8 mHz + 2 μHz/Hz 58 mHz + 2 μHz/Hz 0.58 Hz + 2 μHz/Hz	Fluke 5522A SC1100
Oscilloscope Pulse Generator – Source Pulse Width	(4 to 10) nS (10 to 500) nS	1.8 nS + 39 mS/S 1.9 nS + 39 mS/S	
Pulse Period	200 nS to 1 uS (1 to 10) uS (10 to 100) uS 100 uS to 1 mS (1 to 10) mS (10 to 20) mS	58 pS + 2 uS/S 0.58 nS + 2 uS/S 5.8 nS + 2 uS/S 58 nS + 2 uS/S 0.58 uS + 2 uS/S 5.8 uS + 2 uS/S	
Oscilloscope Wave Generator – Source Amplitude p-p	(1.8 to 100) mV (0.1 to 1) V (1 to 8) V (8 to 55) V	97 μV + 24 mV/V 0.59 mV + 24 mV/V 5.8 mV + 24 mV/V 58 mV + 24 mV/V	
Frequency	10 Hz to 1 kHz (1 to 10) kHz (10 to 100) kHz	13 mHz + 20 μHz/Hz 59 mHz + 20 μHz/Hz 5.8 Hz + 20 μHz/Hz	

Length – Dimensional Metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-) ²	Reference Standard, Method, and/or Equipment
Micrometers- O.D., Blade, Point, Spline, Tube, Disc, Depth, Indicating, Interchangeable, Bench and Pitch ¹	Up to 48 in Flatness Parallelism	(42 + 0.44L) μin 11 μin 16 μin	Gage Blocks w/ Optical Flats, and Parallels
Calipers ¹	Up to 72 in	(408 + 0.08L) μin	Gage Blocks
Indicator Gages ¹	Up to 6 in	(14 + 0.21L) μin	Gage Blocks
Electronic Indicator Gages/ LVDT ¹	Up to 4 in	(9 + 0.23L) μin	Gage Blocks
Height Gages ¹	Up to 48 in	(31 + 0.53L) μin	Gage Blocks
Height Masters ¹	Up to 24 in	(28 + 0.67L) μin	Gage Blocks
Step Gages	Up to 48 in	(28 + 0.67L) μin	Gage Blocks
Length – 1D ¹	Up to 40 in	(6.6 + 1.2L) μin	Universal Measuring Machine
Long Gage Blocks	4 to 20 in	(3.4 + 1.2L) μin	Universal Measuring Machine
Steel Rule	Up to 72 in	2 880 μin (66 + 0.5L) μin	Gage Block Video Measuring Machine
Tapes ¹	Up to 25 ft	(3 600 + 0.1L) μin (133 + 0.6L) μin	Master Tape Video Measuring Machine
Plug Gages ¹	Up to 40 in	(6.6 + 1.2D) μin	Universal Measuring Machine
Spherical Diameters ¹	Up to 8 in	(7.1 + 0.87D) μin	Universal Measuring Machine
Thread Wires	Up to 0.6 in	(7.6 + 0.38D) μin	Universal Measuring Machine
Thread Plug / Set Plugs ¹			
Major Diameter	Up to 12 in	(12 + 0.67D) μin	Universal Measuring Machine w/ Thread Wires
Pitch Diameter	Up to 12 in	(69 + 0.23D) μin	
Thread Rings Pitch Diameter	Up to 4 in	(70 + 0.3D) μin	Thread Setting Plug
Ring Gages / Internal Diameter ¹	(0.012 to 0.5) in (0.5 to 20) in	(5.8 + 0.64D) μin (4.5 + 1.2D) μin	Universal Measuring Machine and Ring Gage Comparator
Feeler (Thickness) Gages	Up to 0.25 in	(7.7 + 0.51L) μin	Universal Measuring Machine

Length – Dimensional Metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-) ²	Reference Standard, Method, and/or Equipment
Gage Blocks	(0.01 to 4) in	(1.4 + 0.61L) μin	Gage Block Comparator w/ Master Gage Blocks
Optical Comparators ¹	Up to 12 in	(70+ 3.3L) μin	Glass scales
Machine Tools ¹ Linearity Volume	Up to 3 200 in Up to 24 in	(2.4 + 1.3L) μin 50 μin	Laser Interferometer Ball Bar System
Video Measuring Systems ¹ X/Y Axes Z Axis PF(V)2D Squareness	Up to 30 in Up to 6 in Up to 0.2 in Up to 6 in	35 μin (24 + 0.8L) μin 25 μin 53 μin	Glass grid Z step gage Reticle Z step Gage
Sensofar (Single FOV) XY Z	2 μm 50 μm 500 μm 100 nm	0.031 μm 0.104 μm 0.250 μm 0.005 μm	Glass Pitch Pattern Step Gage
Surface Finish	2 μm, 10 μm Up to 500 μin	0.050 μm 1.2 μin	Surface Finish Standard
Inspec Vision 10360-4 (XY)	Table Center Table Edge	14 μm 17 μm	ISO Disk
Horizontal Measuring Machine ¹	(0 to 8) in	(3 + 0.75L) μin	Gage Blocks
Coordinate Measuring Machines (CMM) ¹ Linear Displacement Accuracy	Up to 26 in Up to 24.41 in Up to 3 200 in	(41 + 0.8L) μin 14 μin (2.4 + 1.3L) μin	Step Gage Step Gage (Koba) Laser Interferometer
Volumetric Performance Sphere Repeatability Probing and Scanning Form	Up to 36 in (0.75 to 1) in	19 μin 6.7 μin	Ball Bar Sphere
Surface Finish Analyzers ¹	1 to 1.18 in 120 μin at 0.03 in cut-off	(12 + 0.3L) μin 3.8 μin	Sphere Master Specimens
Surface Finish Specimen	(2 to 300) μin	3.7 μin	Surface Finish Analyzer
Surface Finish (RA)	Up to 500 μin	3.9 μin	Mitutoyo Surface Roughness Tester

Length – Dimensional Metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-) ²	Reference Standard, Method, and/or Equipment
Surface Plates ^{1,3} Overall Flatness Repeat Reading	(0 to 140) in (0 to 140) in	(0.27+0.3 <i>d</i>) μin 19 μin	Renishaw Laser Repeat-O-Meter
Vision (Z) Two Dimensions (Vision) (X & Y)	Up to 10 in Up to 11 in Up to 25 in	(64+ 4.1 <i>L</i>) μin (45 + 1.3 <i>L</i>) μin (60 + 2.1 <i>L</i>) μin	View Summit 600 View Summit 600 View Summit 600
Two Dimensions (Vision)(XY – Single FOV)	Small Hole Dia. 2-8μm Up to 0.22 mm Up to 0.44 mm Up to 1.1 mm Up to 2.2 mm Up to 4.4 mm Up to 1 mm	0.2 μm (0.1 + 1.2 <i>L</i>) μm (0.18 + 0.3 <i>L</i>) μm (0.5 + 0.14 <i>L</i>) μm (0.86 + 0.25 <i>L</i>) μm (1.7 + 0.18 <i>L</i>) μm (0.005 + 4.3 <i>L</i>) μm	Sensofar S-Neox
Step (Z)	Up to 67 in Up to 99 in	(12 + 0.73 <i>L</i>) μin (78 + 3.6 <i>L</i>) μin	Leitz Infinity Hexagon 122210
Three Dimensions Single Point	Up to 67 in Up to 99 in	(38 + 0.42 <i>L</i>) μin (120 + 3.6 <i>L</i>) μin	Leitz Infinity Hexagon 122210
Scanning	Up to 100 μin (100 to 500) μin	4.8 μin 53 μin	Mitutoyo RA2200 AH Roundness Tester

Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Rockwell Hardness Testers ¹	HRBw Low Middle High HRC Low Middle High	0.71 HRBw 0.71 HRBw 0.71 HRBw 0.71 HRC 0.71 HRC 0.71 HRC	Indirect Verification per ASTM E18 using Hardness Test Blocks
Torque	(5 to 50) 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	0.45% of reading 0.37% of reading 0.29% of reading 0.35% of reading 0.44% of reading 0.50% of reading	Torque Tester

Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Pressure Gages Pressure Transducers ¹	(0 to 1) inH ₂ O (0 to 10) inH ₂ O (0 to 10) PSI (0 to 100) PSI (-14.7 to 200) PSI	0.005 3 inH ₂ O 0.011 inH ₂ O 0.023 PSI 0.033 PSI 0.16 PSI	Ashcroft ATE-2 / AM2-1
	(0 to 1 000) PSI (0 to 3 000) PSI (0 to 10 000) PSI	0.54 PSI 2.5 PSI 8.8 PSI	Fluke 525A / 700 Series

Thermodynamic

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Temperature - Measure	(-197 to -38) °C (-38 to 0) °C (0 to 157) °C (157 to 232) °C (232 to 420) °C (420 to 660) °C	0.03 °C 0.03 °C 0.044 °C 0.045 °C 0.054 °C 0.071 °C	Fluke 5609 with Fluke 914X-P
	(-197 to -38) °C (-38 to 0) °C (0 to 157) °C (157 to 232) °C (232 to 420) °C (420 to 660) °C	0.029 °C 0.029 °C 0.042 °C 0.042 °C 0.046 °C 0.058 °C	Fluke 5609 with Fluke 8508A
Temperature - Source	(-25 to -12) °C (-12 to 75) °C (75 to 150) °C	0.069 °C 0.069 °C 0.084 °C	Fluke 9142
Temperature - Source	(50 to 200) °C (200 to 330) °C (330 to 540) °C (540 to 660) °C	0.092 °C 0.22 °C 0.30 °C 0.42 °C	Fluke 9144
Infrared Temperature	31 °C 50 °C 100 °C 200 °C 300 °C 400 °C	1.4 °C 1.4 °C 1.6 °C 1.8 °C 3 °C 3.7 °C	Omega BB703
Humidity – Source/Measure	(1 to 40) %RH (40 to 90) %RH (90 to 99) %RH	1.6%RH 1.7 %RH 2.3 %RH	Vaisala MI70 with MPH77B

Time and Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Stop Watches Timers	1s to 24 Hr	36 ms	Helmut Klien Timometer
Frequency - Measure	0.1 Hz to 1 kHz (1 to 10) kHz (10 to 100) kHz (0.1 to 1) MHz (1 to 10) MHz (10 to 100) MHz (100 to 225) MHz	0.12 mHz + 9 uHz/Hz 0.12 mHz + 16 uHz/Hz 0.12 mHz + 0.11 mHz/Hz 0.12 mHz + 1.1 mHz/Hz 5.8 mHz + 2.6 mHz/Hz 5.8 mHz + 27 mHz/Hz 10 mHz + 80 mHz/Hz	Agilent 53131A

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 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. The use of (L) represents length in inches or millimeters based on unit of measure, the use of (D) represents diameter in inches, the use of (d) represents diagonal in inches
3. The expanded uncertainty for Surface Plate Overall Flatness represents the maximum closure error acceptable for Surface Plate Calibrations.
4. The expanded uncertainties for electrical parameters do not contain a contributor for a "best existing device. Reported uncertainties will reflect the resolution of the device under test.
5. This scope is formatted as part of a single document including Certificate of Accreditation No. ACT-1608.



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