



CERTIFICATE OF ACCREDITATION

ANSI National Accreditation Board

11617 Coldwater Road, Fort Wayne, IN 46845 USA

This is to certify that

Productivity Quality, Inc. /Advanced Inspection Services, LLC

15150 25th Ave. N. Suite 200

Plymouth, MN 55447

(and satellite location as listed on the scope)

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

ISO/IEC 17025:2017

while demonstrating technical competence in the fields of

CALIBRATION and DIMENSIONAL MEASUREMENT

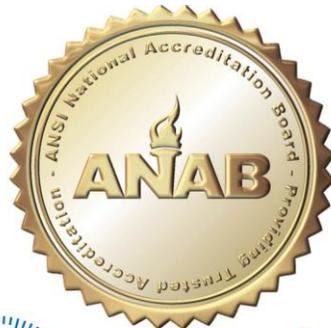
Refer to the accompanying Scope of Accreditation for information regarding the types of activities to which this accreditation applies

ACT-1608

Certificate Number

ANAB Approval

Certificate Valid Through: 01/15/2022
Version No. 006 Issued: 01/14/2020



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
 Diana McInerny
 763-249-8156

DIMENSIONAL MEASUREMENT

Valid to: January 15, 2022

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	Up to 11 in Up to 30 in Up to 8 in	(45 + 2.7L) μin (61 + 2.6L) μin (110 + 1.4L) μin	View Summit 600 View Summit 600 OGP Flash 200



3 Dimensional

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-) ²	Reference Standard, Method, and/or Equipment
Dimensional Measurement 3D ¹ Single Point Scanning	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	(88 + 6.2L) μin (280 + 4.1L) μin	B&S Xcel 122010

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 (RA)	Up to 500 μin	3.9 μin	Mitutoyo Surface Roughness Tester
Contour	Up to 4 in	(112 + 24L) μin	Mitutoyo Contracer

Satellite location

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

CALIBRATION

Chemical Quantities

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Conductivity Meters	84.2 μS/cm 1 418 μS /cm 10 010 μS /cm 100 300 μS /cm	0.7 μS /cm + 0.6R 6 μS /cm + 0.6R 37 μS /cm + 0.6R 370 μS /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



Chemical Quantities

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
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 20) kV (20 to 35) kV (35 to 40) kV	21 mV/V 11 mV/V 21 mV/V	Fluke 8508A and 80k-40 Probe
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
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



Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
	(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	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	Fluke 5522A
AC Voltage - Source	(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 1 020) V 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	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 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 9.7 mV + 0.24 mV/V 9.7 mV + 0.2 mV/V 9.7 mV + 0.24 mV/V	Fluke 5522A



Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
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 μ V + 0.36 mV/V 1.3 μ V + 0.24 mV/V 1.3 μ V + 0.36 mV/V 1.3 μ V + 1.2 mV/V 1.3 μ V + 6 mV/V 2.4 μ V + 48 mV/V 4.8 + 83 μ V/V 2.4 μ V + 83 μ V/V 2.4 μ V + 0.17 mV/V 2.4 μ V + 0.36 mV/V 2.4 μ V + 0.95 mV/V 12 μ V + 3.6 mV/V 12 μ V + 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 μ V + 0.17 mV/V 4 μ V + 0.14 mV/V 4 μ V + 0.12 mV/V 2 μ V + 0.11 mV/V 4 μ V + 0.14 mV/V 8 μ V + 0.64 mV/V 20 μ V + 0.77 mV/V 0.12 mV + 0.15 mV/V 20 μ V + 0.12 mV/V 20 μ V + 90 μ V/V 20 μ V + 75 μ V/V 20 μ V + 0.11 mV/V 40 μ V + 0.22 mV/V 0.2 mV + 0.57 mV/V 2 mV + 3 mV/V 20 mV + 10 mV/V	Fluke 8508A



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 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	1.2 mV + 0.15 mV/V 0.2 mV + 0.12 mV/V 0.2 mV + 90 μV/V 0.2 mV + 75 μV/V 0.2 mV + 0.11 mV/V 0.4 mV + 0.22 mV/V 2 mV + 0.57 mV/V 20 mV + 3 mV/V 0.2 V + 10 mV/V	Fluke 8508A
	(20 to 200) 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	12 mV + 0.15 mV/V 2 mV + 0.12 mV/V 2 mV + 90 μV/V 2 mV + 75 μV/V 2 mV + 0.11 mV/V 4 mV + 0.22 mV/V 20 mV + 0.57 mV/V 0.2 V + 3 mV/V 2 V + 10 mV/V	
	(200 to 1 000) V (1 to 10) Hz (10 to 40) Hz 40 Hz to 10 kHz (10 to 30) kHz (30 to 100) kHz	70 mV + 0.15 mV/V 20 mV + 0.12 mV/V 20 mV + 0.12 mV/V 40 mV + 0.23 mV/V 0.2 V + 0.58 mV/V	
	(1 to 40) kV 60 Hz	51 mV/V	Fluke 8508A and 80k-40 Probe



ANSI National Accreditation Board

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



Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
	(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 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	Fluke 8508A
AC Current - Measure	(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 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
	(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		Fluke 5522A
	(3.3 to 9) mA	1.1 mW/W	
	(9 to 33) mA	0.78 mW/W	
	(33 to 90) mA	1.1 mW/W	
	(90 to 330) mA	0.78 mW/W	
	(330 to 900) mA	1.1 mW/W	
	900 mA to 2.2 A	0.86 mW/W	
	(2.2 to 4.5) A	1.1 mW/W	
	(4.5 to 20.5) A	0.86 mW/W	
	330mV to 1 020 V		
	(3.3 to 9) mA	0.93 mW/W	
	(9 to 33) mA	0.62 mW/W	
	(33 to 90) mA	0.93 mW/W	
	(90 to 330) mA	0.62 mW/W	
(330 to 900) mA	0.86 mW/W		
900 mA to 2.2 A	0.7 mW/W		
(2.2 to 4.5) A	0.93 mW/W		
(4.5 to 20.5) A	0.78 mW/W		
Resistance - Source	(0 to 11) Ω	0.78 mΩ + 31 μΩ/Ω	Fluke 5522A
	(11 to 33) Ω	1.2 mΩ + 24 μΩ/Ω	
	(33 to 110) Ω	1.1 mΩ + 22 μΩ/Ω	
	(110 to 330) Ω	1.6 mΩ + 22 μΩ/Ω	
	330 Ω to 1.1 kΩ	1.7 mΩ + 22 μΩ/Ω	
	(1.1 to 3.3) kΩ	16 mΩ + 22 μΩ/Ω	
	(3.3 to 11) kΩ	17 mΩ + 22 μΩ/Ω	
	(11 to 33) kΩ	0.16 Ω + 22 μΩ/Ω	
	(33 to 110) kΩ	0.17 Ω + 22 μΩ/Ω	
	(110 to 330) kΩ	1.6 Ω + 25 μΩ/Ω	
	330 kΩ to 1.1 MΩ	1.7 Ω + 25 μΩ/Ω	
(1.1 to 3.3) MΩ	24 Ω + 47 μΩ/Ω		
(3.3 to 11) MΩ	40 Ω + 0.11 mΩ/Ω		
(11 to 33) MΩ	2 kΩ + 0.2 mΩ/Ω		
Resistance - Source	(33 to 110) MΩ	2.4 kΩ + 0.39 mΩ/Ω	Fluke 5522A
	(110 to 330) MΩ	78 kΩ + 2.4 mΩ/Ω	
	(330 to 1 100)MΩ	390 kΩ + 12 mΩ/Ω	
Resistance - Measure	Up to 500 mΩ	0.9 mΩ/Ω	Fluke 5522A and 8508A
Resistance - Measure	Up to 2 Ω	4 μΩ + 17 μΩ/Ω	Fluke 8508A
	(2 to 20) Ω	14 μΩ + 9.5 μΩ/Ω	
	(20 to 200) Ω	50 μΩ + 8 μΩ/Ω	
	(0.2 to 2) kΩ	0.5 mΩ + 8 μΩ/Ω	
	(2 to 20) kΩ	5 mΩ + 8 μΩ/Ω	
	(20 to 200) kΩ	50 mΩ + 8 μΩ/Ω	
	(0.2 to 2) MΩ	5.9 Ω + 9 μΩ/Ω	
	(2 to 20) MΩ	0.12 kΩ + 20 μΩ/Ω	
	(20 to 200) MΩ	10 kΩ + 0.12 mΩ/Ω	
	(0.2 to 2)GΩ	1 MΩ + 1.6 mΩ/Ω	



Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Capacitance - Source	(220 to 400) pF 10 Hz to 10kHz	7.8 pF + 3.9 mF/F	Fluke 5522A
	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 8)0 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	
	Capacitance - Source	(11 to 33) mF (0 to 0.6) Hz	
(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		



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Electrical Simulation of Thermocouple – Source	Type N		Fluke 5522A
	(-200 to -100) °C	0.31 °C	
	(-100 to -25) °C	0.18 °C	
	(-25 to 120) °C	0.15 °C	
	(120 to 410) °C	0.14 °C	
	(410 to 1 300) °C	0.21 °C	
	Type R		
	(0 to 250) °C	0.45 °C	
	(250 to 1 000) °C	0.28 °C	
	(1 000 to 1 400) °C	0.26 °C	
	(1 400 to 1 767) °C	0.31 °C	
	Type S		
	(0 to 250) °C	0.37 °C	
	(250 to 1 000) °C	0.28 °C	
	(1 000 to 1 400) °C	0.29 °C	
	(1 400 to 1 767) °C	0.36 °C	
Type T			
(-250 to -150) °C	0.49 °C		
(-150 to 0) °C	0.19 °C		
v0 to 120) °C	0.13 °C		
(120 to 400) °C	0.11 °C		
Type U			
(-200 to 0) °C	0.44 °C		
(0 to 600) °C	0.21 °C		
Electrical Simulation of RTDs – Source	Pt 385 100 Ω		Fluke 5522A
	(-200 to 0) °C	0.043 °C	
	(0 to 100) °C	0.057 °C	
	(100 to 300) °C	0.072 °C	
	(300 to 400) °C	0.08 °C	
	(400 to 630) °C	0.095 °C	
	(630 to 800) °C	0.18 °C	
	Pt 3926 100 Ω		
	(-200 to 0) °C	0.043 °C	
	(0 to 100) °C	0.057 °C	
	(100 to 300) °C	0.072 °C	
	(300 to 400) °C	0.08 °C	
	(400 to 630) °C	0.095 °C	
	Pt 3916 100 Ω		
	(-200 to -190) °C	0.2 °C	
	(-190 to -80) °C	0.036 °C	
	(-80 to 0) °C	0.043 °C	
	(0 to 100) °C	0.05 °C	
	(100 to 260) °C	0.057 °C	
	(260 to 300) °C	0.065 °C	
(300 to 400) °C	0.072 °C		
(400 to 600) °C	0.08 °C		
(600 to 630) °C	0.18 °C		



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Electrical – DC/Low Frequency

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



Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Oscilloscope Voltage – Source	(1 to 25) mV (25 to 110) mV 110 mV to 2.2 V	31 μ V + 2 mV/V 32 μ V + 2 mV/V 66 μ V + 2 mV/V	Fluke 5522A SC1100
DC Signal 50 Ω	(2.2 to 6.6) V	0.58 mV + 2 mV/V	
DC Signal 1 M Ω	(1 to 25) mV (25 to 110) mV 110 mV to 2.2 V (2.2 to 11) V (11 to 130) V	31 μ V + 0.39 mV/V 32 μ V + 0.39 mV/V 66 μ V + 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 μ V + 2 mV/V 32 μ V + 2 mV/V 66 μ V + 2 mV/V 0.58 mV + 2 mV/V	
Square Wave 1 M Ω	(1 to 25) mV (25 to 110) mV 110 mV to 2.2 V (2.2 to 11) V (11 to 130) V	31 μ V + 0.78 mV/V 32 μ V + 0.78 mV/V 66 μ V + 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 μ Hz/Hz 58 mHz + 2 μ Hz/Hz 0.58 Hz + 2 μ Hz/Hz	
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	Fluke 5522A SC1100
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	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Oscilloscope Wave Generator – Source	(1.8 to 100) mV (0.1 to 1) V	97 μ V + 24 mV/V 0.59 mV + 24 mV/V	Fluke 5522A SC1100
Amplitude p-p	(1 to 8) V (8 to 55) 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 μ Hz/Hz 59 mHz + 20 μ Hz/Hz 5.8 Hz + 20 μ Hz/Hz	

Length – Dimensional Metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	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) μ in 11 μ in 16 μ in	Gage Blocks w/ Optical Flats, and Parallels
Calipers ¹	Up to 72 in	(408 + 0.08L) μ in	Gage Blocks
Indicator Gages ¹	Up to 6 in	(14 + 0.21L) μ in	Gage Blocks
Electronic Indicator Gages/ LVDT ¹	Up to 4 in	(9 + 0.23L) μ in	Gage Blocks
Height Gages ¹	Up to 48 in	(31 + 0.53L) μ in	Gage Blocks
Height Masters ¹	Up to 24 in	(28 + 0.67L) μ in	Gage Blocks
Step Gages	Up to 48 in	(28 + 0.67L) μ in	Gage Blocks
Length – 1D ¹	Up to 40 in	(6.6 + 1.2L) μ in	Universal Measuring Machine
Long Gage Blocks	4 to 20 in	(3.4 + 1.2L) μ in	Universal Measuring Machine
Steel Rule	Up to 72 in	2 880 μ in (66 + 0.5L) μ in	Gage Block Video Measuring Machine
Tapes ¹	Up to 25 ft	(3 600 + 0.1L) μ in (133 + 0.6L) μ in	Master Tape Video Measuring Machine
Plug Gages ¹	Up to 40 in	(6.6 + 1.2D) μ in	Universal Measuring Machine



Length – Dimensional Metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Spherical Diameters ¹	Up to 8 in	$(7.1 + 0.87D) \mu\text{in}$	Universal Measuring Machine
Thread Wires	Up to .6 in	$(7.6 + 0.38D) \mu\text{in}$	Universal Measuring Machine
Thread Plug / Set Plugs ¹			
Major Diameter	Up to 12 in	$(12 + 0.67D) \mu\text{in}$	Universal Measuring Machine w/ Thread Wires
Pitch Diameter	Up to 12 in	$(69 + 0.23D) \mu\text{in}$	
Thread Rings Pitch Diameter	Up to 4 in	$(70 + 0.3D) \mu\text{in}$	Thread Setting Plug
Ring Gages / Internal Diameter ¹	(0.012 to 0.5) in (0.5 to 20) in	$(5.8 + 0.64D) \mu\text{in}$ $(4.5 + 1.2D) \mu\text{in}$	Universal Measuring Machine and Ring Gage Comparator
Feeler (Thickness) Gages	Up to 0.25 in	$(7.7+0.51L) \mu\text{in}$	Universal Measuring Machine
Gage Blocks	(0.01 to 4) in	$(1.4 + 0.61L) \mu\text{in}$	Gage Block Comparator w/ Master Gage Blocks
Optical Comparators ¹	Up to 12 in	$(70+ 3.3L) \mu\text{in}$	Glass scales
Machine Tools ¹			
Linearity Volume	Up to 3 200 in Up to 24 in	$(2.4 + 1.3L) \mu\text{in}$ 50 μin	Laser Interferometer Ball Bar System
Video Measuring Systems ¹			
X/Y Axes	Up to 30 in	35 μin	Glass grid Z step gage Reticle Z step Gage
Z Axis	Up to 6 in	$(24 + 0.8L) \mu\text{in}$	
PF(V)2D	Up to 0.2 in	25 μin	
Squareness	Up to 6 in	53 μin	
InspecVision 10360-4 (XY)	Table Center Table Edge	14 μm 17 μm	ISO Disk
Horizontal Measuring Machine ¹	(0 to 8) in	$(3 + 0.75L) \mu\text{in}$	Gage Blocks

Length – Dimensional Metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Coordinate Measuring Machines (CMM) ¹ Linear Displacement Accuracy Volumetric Performance Sphere Repeatability Probing and Scanning Form	Up to 26 in Up to 24.41 in Up to 3 200 in Up to 36 in (0.75 to 1) in 1 to 1.18 in	(41 + 0.8L) μin 14 μin (2.4 + 1.3L) μin 19 μin 6.7 μin (12 + 0.3L) μin	Step Gage Step Gage (Koba) Laser Interferometer Ball Bar Sphere Sphere
Surface Finish Analyzers ¹	120 μin at 0.03 in cut-off	3.8 μin	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
Surface Plates ^{1,3} Overall Flatness Repeat Reading	(0 to 140) in (0 to 140) in	(0.27+0.3d) μin 19 μin	Renishaw Laser Repeat-O-Meter
Vision (Z) Two Dimensions (Vision) (X & Y) TouchProbe Three Dimensions Single Point Scanning Form	Up to 10 in Up to 11 in Up to 25 in Up to 8 in Up to 67 in Up to 99 in Up to 67 in Up to 99 in Up to 100 μin (100 to 500) μin	(64+ 4.1L) μin (45 + 2.7L) μin (61 + 2.6L) μin (110 +1.4L) μin (9.9 + 0.73L) μin (88 + 6.2L) μin (38 + 0.42L) μin (280 + 4.1 L) μin 4.8 μin 53 μin	View Summit 600 View Summit 600 View Summit 600 OGP Flash 200 Leitz Infinity B&S Xcel 122010 Leitz Infinity B&S Xcel 122010 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		Indirect Verification per ASTM E18 using Hardness Test Blocks
	Low	0.71 HRBw	
	Middle	0.71 HRBw	
	High	0.71 HRBw	
	HRC		
	Low	0.71 HRC	
	Middle	0.71 HRC	
	High	0.71 HRC	
Torque – Wrenches	(5 to 50) ozf·in	0.45% of reading	Torque Tester
	(4 to 50) lbf·in	0.37% of reading	
	(30 to 400) lbf·in	0.29% of reading	
	(80 to 1 000) lbf·in	0.35% of reading	
	(20 to 250) lbf·ft	0.44% of reading	
	(60 to 600) lbf·ft	0.50% of reading	
Pressure Gages Pressure Transducers ¹	(0 to 1) inH ₂ O	0.005 3 inH ₂ O	Ashcroft ATE-2 / AM2-1
	(0 to 10) inH ₂ O	0.011 inH ₂ O	
	(0 to 10) PSI	0.023 PSI	
	(0 to 100) PSI	0.033 PSI	
	(-14.7 to 200) PSI	0.16 PSI	Fluke 525A / 700 Series
	(0 to 1 000) PSI	0.54 PSI	
	(0 to 3 000) PSI	2.5 PSI	
	(0 to 10 000) PSI	8.8 PSI	

Thermodynamic

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment	
Temperature - Measure	(-197 to -38) °C	0.03 °C	Fluke 5609 with Fluke 914X-P	
	(-38 to 0) °C	0.03 °C		
	(0 to 157) °C	0.044 °C		
	(157 to 232) °C	0.045 °C		
	(232 to 420) °C	0.054 °C		
	(420 to 660) °C	0.071 °C		
	(-197 to -38) °C	0.029 °C		Fluke 5609 with Fluke 8508A
	(-38 to 0) °C	0.029 °C		
	(0 to 157) °C	0.042 °C		
	(157 to 232) °C	0.042 °C		
	(232 to 420) °C	0.046 °C		
	(420 to 660) °C	0.058 °C		
	Temperature - Source	(-25 to -12) °C	0.069 °C	
		(-12 to 75) °C	0.069 °C	
(75 to 150) °C		0.084 °C		



Thermodynamic

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Temperature - Source	(50 to 200) °C	0.092 °C	Fluke 9144
	(200 to 330) °C	0.22 °C	
	(330 to 540) °C	0.30 °C	
	(540 to 660) °C	0.42 °C	
Infrared Temperature	31 °C	1.4 °C	Omega BB703
	50 °C	1.4 °C	
	100 °C	1.6 °C	
	200 °C	1.8 °C	
	300 °C	3 °C	
Humidity – Source/Measure	(5 to 20) %RH	3.3%RH	Fluke Dewk with 1602A
	(20 to 70) %RH	2.4 %RH	
	(70-95) %RH	3.3 %RH	

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	0.12 mHz + 9 uHz/Hz	Agilent 53131A
	(1 to 10) kHz	0.12 mHz + 16 uHz/Hz	
	(10 to 100) kHz	0.12 mHz + 0.11 mHz/Hz	
	(0.1 to 1) MHz	0.12 mHz + 1.1 mHz/Hz	
	(1 to 10) MHz	5.8 mHz + 2.6 mHz/Hz	
	(10 to 100) MHz	5.8 mHz + 27 mHz/Hz	
	(100 to 225) MHz	10 mHz + 80 mHz/Hz	

DIMENSIONAL MEASUREMENT

2 Dimensional

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-) ²	Reference Standard, Method, and/or Equipment
Dimensional Measurement 2D			
Single Point	Up to 67 in	(9.9 + 0.73L) μin	Leitz Infinity
Scanning	Up to 67 in	(38 + 0.42L) μin	Leitz Infinity

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.



Vice President