



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)

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

ISO/IEC 17025:2005

while demonstrating technical competence in the field 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: 01/15/2020
Version No. 005 Issued: 02/11/2019



This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005. 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 17025:2005

Productivity Quality, Inc. / Advanced Inspection Services, LLC

15150 25th Ave N. Suite 200
 Plymouth, MN 55447
 Diana McNerny
 763-249-8156

DIMENSIONAL MEASUREMENT

Valid to: **January 15, 2020**

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 (512 + 0.2L) 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 2 in Up to 10 in	(188 + 1L) μin (64 + 4.1L) μin	Tool makers Microscope OGP Quest 450
	Up to 25 in Up to 8 in	(48 + 4.6L) μin (110 + 1.4L) μin	OGP Quest 450 OGP Flash



3 Dimensional

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-) ²	Reference Standard, Method, and/or Equipment
Dimensional Measurement 3D ¹	8 ft spherical volume Up to 708 in	(678 + 0.9L) μin (1 100 + 3.2L) μin	Romer Absolute CMM Leica Laser Tracker (MR) w / T-probe
Single Point Scanning	Up to 99 in	(110 + 5.3L) μin (398 + 3.5L) 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 120 μin	3.7 μin	Mitutoyo Surface Roughness Tester
Contour	Up to 4 in	(162 + 11L) 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
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
	(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



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage - Source	(1 to 33) mV		Fluke 5522A
	(10 to 45) Hz	4.7 μ V + 0.62 mV/V	
	45 Hz to 10 kHz	4.7 μ V + 0.12 mV/V	
	(10 to 20) kHz	4.7 μ V + 0.16 mV/V	
	(20 to 50) kHz	4.7 μ V + 0.78 mV/V	
	(50 to 100) kHz	9.4 μ V + 2.8 mV/V	
	(100 to 500) kHz	39 μ V + 6.2 mV/V	
	(33 to 330) mV		
	(10 to 45) Hz	6.3 μ V + 0.24 mV/V	
	45 Hz to 10 kHz	6.3 μ V + 0.12 mV/V	
	(10 to 20) kHz	6.3 μ V + 0.13 mV/V	
	(20 to 50) kHz	6.3 μ V + 0.28 mV/V	
	(50 to 100) kHz	25 μ V + 0.62 mV/V	
	(100 to 500) kHz	55 μ V + 1.6 mV/V	
	330 mV to 3.3 V		
(10 to 45) Hz	40 μ V + 0.24 mV/V		
45 Hz to 10 kHz	47 μ V + 0.12 mV/V		
(10 to 20) kHz	47 μ V + 0.15 mV/V		
(20 to 50) kHz	40 μ V + 0.24 mV/V		
(50 to 100) kHz	97 μ V + 0.55 mV/V		
(100 to 500) kHz	0.47 mV + 1.9 mV/V		
AC Voltage - Source	(3.3 to 33) V		Fluke 5522A
	(10 to 45) Hz	0.51 mV + 0.24 mV/V	
	45 Hz to 10 kHz	0.47 mV + 0.12 mV/V	
	(10 to 20) kHz	0.47 mV + 0.19 mV/V	
	(20 to 50) kHz	0.47 mV + 0.28 mV/V	
	(50 to 100) kHz	1.3 mV + 0.7 mV/V	
	(33 to 330) V		
	45 Hz to 1 kHz	1.7 mV + 0.15 mV/V	
	(1 to 10) kHz	4.7 mV + 0.16 mV/V	
	(10 to 20) kHz	4.7 mV + 0.2 mV/V	
	(20 to 50) kHz	4.7 mV + 0.24 mV/V	
	(50 to 100) kHz	39 mV + 1.6 mV/V	
	(330 to 1 020) V		
	45 Hz to 1 kHz	9.7 mV + 0.24 mV/V	
	(1 to 5) kHz	9.7 mV + 0.2 mV/V	
(5 to 10) kHz	9.7 mV + 0.24 mV/V		

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



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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		Fluke 8508A
	(1 to 10) Hz	1.2 mV + 0.15 mV/V	
	(10 to 40) Hz	0.2 mV + 0.12 mV/V	
	(40 to 100) Hz	0.2 mV + 90 μV/V	
	100 Hz to 2 kHz	0.2 mV + 75 μV/V	
	(2 to 10) kHz	0.2 mV + 0.11 mV/V	
	(10 to 30) kHz	0.4 mV + 0.22 mV/V	
	(30 to 100) kHz	2 mV + 0.57 mV/V	
	(100 to 300) kHz	20 mV + 3 mV/V	
	300 kHz to 1 MHz	0.2 V + 10 mV/V	
	(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 V 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		



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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
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



ANSI National Accreditation Board

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 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) 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			
	Capacitance - Source	(11 to 33) mF (0 to 0.6) Hz		24 μF + 5.9 mF/F	Fluke 5522A
		(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



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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 Levelled 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 μHz/Hz
		(600 to 1 100) MHz		58 kHz + 2 μHz/Hz



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Oscilloscope Voltage – Source DC Signal 50 Ω DC Signal 1 MΩ Square Wave 50 Ω Square Wave 1 MΩ Square Wave Frequency	(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	Fluke 5522A SC1100
	(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	
	(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	
	(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	
	(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	
Oscilloscope Pulse Generator – Source Pulse Width Pulse Period	(4 to 10) nS (10 to 500) nS	1.8 nS + 39 mS/S 1.9 nS + 39 mS/S	Fluke 5522A SC1100
	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 Frequency	(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	Fluke 5522A SC1100
	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 (+/-)	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 .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 (+/-)	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	Up to 30 in Up to 4 in	35 μin $(24 + 0.8L)$ μin	Glass grid Z step gage
Horizontal Measuring Machine ¹	(0 to 8) in	$(3 + 0.75L)$ μin	Gage Blocks
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 120 μin	3.7 μin	Mitutoyo Surface Roughness Tester
Surface Plates ^{1,2} Overall Flatness Repeat Reading	(0 to 140) in (0 to 140) in	$(0.27 + 0.3d)$ μin 19 μin	Renishaw Laser Repeat-O-Meter



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Length – Dimensional Metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Vision (Z)	Up to 10 in	(64+ 4.1L) μ in	OGP Quest 450
Two Dimensions (Vision) (X & Y) TouchProbe	Up to 25 in Up to 1 in Up to 8 in	(48 + 4.6L) μ in 116 μ in (110 +1.4L) μ in	OGP Quest 450 Gage Pins OGP Flash
Three Dimensions Single Point Scanning Form	Up to 67 in Up to 99 in Up to 67 in Up to 99 in Up to 100 μ in (100 to 500) μ in	(0.25 + 0.73L) μ m (110 + 5.3L) μ in (0.96 + 0.42L) μ m (398 +3.5 L) μ in 4.8 μ in 53 μ in	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 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 – Wrenches	(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
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 to 1 000) PSI (0 to 3 000) PSI (0 to 10 000) PSI	0.005 3 inH ₂ O 0.011 inH ₂ O 0.023 PSI 0.033 PSI 0.16 PSI 0.54 PSI 2.5 PSI 8.8 PSI	Ashcroft ATE-2 / AM2-1 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	0.23 °C 0.24 °C 0.035 °C 0.037 °C 0.046 °C 0.061 °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	0.023 °C 0.023 °C 0.032 °C 0.032 °C 0.036 °C 0.045 °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 0.3 °C 0.42 °C	Fluke 9144
Infrared Temperature	(31 to 400) °C	1.8 °C	Omega BB703
Humidity – Source/Measure	(5 to 20) %RH (20 to 70) %RH (70-95) %RH	3.3%RH 2.4 %RH 3.3 %RH	Fluke Dewk with 1602A

Time and Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Stop Watches Timers	1s to 24 Hr	0.36 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



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 1 702 mm	$(0.25 + 0.73L) \mu\text{m}$	Leitz Infinity
Scanning	Up to 1 702 mm	$(0.96 + 0.42L) \mu\text{m}$	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

