



CERTIFICATE OF ACCREDITATION

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

This is to certify that

Angel's Instrumentation, A Transcat Company
928 Canal Drive
Chesapeake, VA 23323

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

ISO/IEC 17025:2017

and national standards

ANSI/NCSL Z540-1-1994 (R2002) and
ANSI/NCSL Z540.3-2006 (R2013)

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

AC-2489.21

Certificate Number


ANAB Approval

Certificate Valid Through: 09/07/2021
Version No. 003 Issued: 02/28/2020



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 17025:2017, ANSI/NCSL Z540-1-1994 (R2002) AND ANSI/NCSL Z540.3-2006 (R2013)

ANGEL'S INSTRUMENTATION, A TRANSCAT COMPANY

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Chesapeake, VA 23323
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CALIBRATION

Valid to: **September 7, 2021**

Certificate Number: **AC-2489.21**

Acoustics and Vibration

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-) ²	Reference Standard, Method, and/or Equipment
Vibration – Measure Voltage Sensitivity 100 Hz	10 mV/g	2 %	Ref Accelerometer w/Calibrator
Frequency Response (20 to 100) Hz (100 to 2 500) Hz (2500 to 10 000) Hz	(0.8 to 20) g	1.6 % 1.4 % 2.8 %	
Frequency Response 7 Hz to 10 Hz 10 Hz to 30 Hz 300 Hz to 2.0 kHz 2.0 kHz to 10 kHz	(0.8 to 20) g pk	7.0 % 6 % 4.5 % 7 %	Vibration Calibrator
Sound – Generate 1 kHz	110 dB	0.42 dB	SPL Calibrator
Sound – Measure 20 Hz to 10 kHz	(50 to 120) dB	0.5 dB	Sound Meter



Chemical Quantities

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-) ²	Reference Standard, Method, and/or Equipment
pH Meters	4 pH 7 pH 10 pH	0.44 % 0.37 % 0.35 %	pH Solutions
Conductivity Meters	25 µS/cm 1 015 µS/cm 1 408 µS/cm	5.4 % 1.9 % 1.7 %	Conductivity Solutions
Gas Detection Equipment ¹			
CO (Carbon Monoxide)	0.002 % CO 0.01 % CO 0.1 % CO 0.5 % CO	0.82 % 0.84 % 0.87 % 0.60 %	Calibration Gas
CH ₄ (Methane LEL)	50 % LEL	0.66 %	Calibration Gas
H ₂ S (Hydrogen Sulfide)	0.002 5 % H ₂ S	1.5 %	Calibration Gas
O ₂ (Oxygen)	18 % O ₂	0.5 %	Calibration Gas
C ₄ H ₈ (Isobutylene)	0.01 % Isobutylene	1.1 %	Calibration Gas
CO ₂ (Carbon Dioxide)	0.5 % CO ₂ 5 % CO ₂	0.8 % 0.8 %	Calibration Gas

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-) ²	Reference Standard, Method, and/or Equipment
DC Voltage – Generate ¹	(0 to 220) mV (0.22 to 2.2) V (2.2 to 11) V (11 to 22) V (22 to 220) V (220 to 1 100) V	7.5 µV/V + 0.4 µV 5 µV/V + 0.7 µV 3.5 µV/V + 2.5 µV 3.5 µV/V + 4 µV 5 µV/V + 40 µV 6 µV/V + 400 µV	Fluke 5730A/03



Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-) ²	Reference Standard, Method, and/or Equipment
DC Voltage – Measure ¹	Up to 200 mV	5 μ V/V + 0.5 μ V	Fluke 8508A opt 001
	200 mV to 20 V	3.5 μ V/V + 0.2 μ V	
	(20 to 200) V	5.5 μ V/V + 0.2 μ V	
	(200 to 1 000) V	5.5 μ V/V + 0.5 μ V	
DC High Voltage – Measure ¹	Up to 40 kV	2 %	Fluke 80k40HV Probe, Fluke 8508A opt 001
DC Current – Generate ¹	(0 to 220) μ A	40 μ A/A + 6 nA	Fluke 5730A/03
	(0.22 to 2.2) mA	35 μ A/A + 7 nA	
	(2.2 to 22) mA	35 μ A/A + 40 nA	
	(22 to 220) mA	45 μ A/A + 0.7 μ A	
	(0.22 to 2.2) A	80 μ A/A + 12 μ A	Fluke 5522A/1100
	(2.2 to 3) A	0.038 % + 40 μ A	
	(3 to 11) A	0.050 % + 500 μ A	
	(11 to 20.5) A	0.1 % + 750 μ A	
	(20 to 1000) A	0.5 % + 0.5 A	
	(20 to 100) A	0.04 %	
DC Current – Measure ¹	Up to 2 mA	12 μ A/A + 2 μ A	Fluke 8508A opt 001
	(2 to 20) mA	14 μ A/A + 2 μ A	Reference DMM
	(20 to 100) mA	8.5 μ A/A	Fluke 8508A opt 001 w/ Shunts
	100 mA to 1 A	8.5 μ A/A + 6 μ A	
	(1 to 15) A	40 μ A/A + 8 μ A	
	(15 to 100) A	0.04 % + 24 μ A	



Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-) ²	Reference Standard, Method, and/or Equipment
Resistance – Measure ¹	Up to 2 Ω	17 μΩ/Ω + 2 μΩ	Fluke 8508A opt 001 Reference DMM
	(2 to 20) Ω	9.5 μΩ/Ω + 0.7 μΩ	
	(0.02 to 200) kΩ	8 μΩ/Ω + 0.25 μΩ	
	(0.2 to 2) MΩ	9 μΩ/Ω + 0.5 μΩ	
	(2 to 20) MΩ	20 μΩ/Ω + 5 μΩ	
	(20 to 200) MΩ	0.012 % + 50 μΩ	
	(0.2 to 2) GΩ	0.15 % + 2 μΩ	
Resistance ¹ – Generate	Up to 11 Ω	40 μΩ/Ω + 0.001 Ω	Fluke 5522A/1100
	(11 to 33) Ω	30 μΩ/Ω + 0.0015 Ω	
	(33 to 110) Ω	28 μΩ/Ω + 0.0014 Ω	
	(110 to 330) Ω	28 μΩ/Ω + 0.002 Ω	
	(0.33 to 1.1) kΩ	28 μΩ/Ω + 0.002 Ω	
	(1.1 to 3.3) kΩ	28 μΩ/Ω + 0.02 Ω	
	(3.3 to 11) kΩ	28 μΩ/Ω + 0.02 Ω	
	(11 to 33) kΩ	28 μΩ/Ω + 0.2 Ω	
	(33 to 110) kΩ	28 μΩ/Ω + 0.2 Ω	
	(110 to 330) kΩ	32 μΩ/Ω + 2 Ω	
	(0.33 to 1.1) MΩ	32 μΩ/Ω + 2 Ω	
	(1.1 to 3.3) MΩ	60 μΩ/Ω + 30 Ω	
	(3.3 to 11) MΩ	0.013 % + 50 Ω	
	(11 to 33) MΩ	0.025 % + 2.5 kΩ	
	(33 to 110) MΩ	0.050 % + 3 kΩ	
(110 to 330) MΩ	0.3 % + 100 kΩ		
(330 to 1 100) MΩ	1.5 % + 500 kΩ		
Resistance ¹ – Generate	0 Ω	40 μΩ	Fluke 5730A/03
	1 Ω	95 μΩ/Ω	
	1.9 Ω	95 μΩ/Ω	
	10 Ω	23 μΩ/Ω	
	19 Ω	23 μΩ/Ω	
	100 Ω	10 μΩ/Ω	
	190 Ω	10 μΩ/Ω	
	1 kΩ	6.5 μΩ/Ω	
	1.9 kΩ	6.5 μΩ/Ω	
	10 kΩ	6.5 μΩ/Ω	



Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-) ²	Reference Standard, Method, and/or Equipment
Resistance ¹ – Generate	19 kΩ	6.5 μΩ/Ω	Fluke 5730A/03
	100 kΩ	8.5 μΩ/Ω	
	190 kΩ	8.5 μΩ/Ω	
	1 MΩ	13 μΩ/Ω	
	1.9 MΩ	18 μΩ/Ω	
	10 MΩ	40 μΩ/Ω	
	19 MΩ	47 μΩ/Ω	
	100 MΩ	100 μΩ/Ω	
Resistance ¹ – Generate	1 Ω	7.1 μΩ/Ω	Fluke 742A-1
	10 kΩ	4.3 μΩ/Ω	Fluke 742A-10k
High Resistance – Generate ³	(1 to 1 000) MΩ	0.2 %	Biddle 72-6346-1 Decade resistor
	(1 to 100 GΩ)	1 %	
	1 GΩ	110 μΩ/Ω	Fluke 8508A-7000k Reference DMM
Capacitance – Generate ¹	(0.22 to 0.4) nF	0.39% + 0.007 7 nF	Fluke 5522A/SC1100
	(0.40 to 1.1) nF	0.39% + 0.007 7 nF	
	(1.1 to 3.3) nF	0.39% + 0.007 7 nF	
	(3.3 to 11) nF	0.19% + 0.007 7 nF	
	(11 to 33) nF	0.19% + 0.077 nF	
	(33 to 110) nF	0.19% + 0.077 nF	
	(110 to 330) nF	0.19% + 0.23 nF	
	(0.33 to 1.1) μF	0.19% + 0.77 nF	
	(1.1 to 3.3) μF	0.19% + 2.3 nF	
	(3.3 to 11) μF	0.19% + 7.7 nF	
	(11 to 33) μF	0.31% + 23 nF	
	(33 to 110) μF	0.35% + 77 nF	
	(110 to 330) μF	0.35% + 0.23 μF	
	(0.33 to 1.1) mF	0.35% + 0.77 μF	
	(1.1 to 3.3) mF	0.35% + 2.3 μF	
	(3.3 to 11) mF	0.35% + 7.7 μF	
(11 to 33) mF	0.58% + 23 μF		
(33 to 110) mF	0.85% + 77 μF		
Capacitance – Measure ¹ 12 Hz to 100 kHz	400 pF to 25 μF	0.02 % + 1 digit	Genrad 1689 RLC – The CMC is only valid at 1 kHz
	(25 to 100) μF	0.05 % + 1 digit	
	(100 to 500) μF (0.5 to 1) mF	0.05 % + 1 digit 0.09 % + 1 digit	



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-) ²	Reference Standard, Method, and/or Equipment
Inductance – Measure ¹ 12 Hz to 100 kHz	1 mH to 10 H	0.02 % + 1 digit	Genrad 1689 RLC – The CMC is only valid at 1 kHz
AC Voltage – Generate ¹	(0.0 to 2.2) mV (10 to 20) Hz (20 to 40) Hz (0.04 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (0.5 to 1) MHz	0.024 % + 4 μV 0.009 % + 4 μV 0.008 % + 4 μV 0.02 % + 4 μV 0.05 % + 5 μV 0.11 % + 10 μV 0.14 % + 20 μV 0.27 % + 20 μV	Fluke 5730A/03
	(2.2 to 22) mV (10 to 20) Hz (20 to 40) Hz (0.04 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (0.5 to 1) MHz	0.024 % + 4 μV 0.009 % + 4 μV 0.008 % + 4 μV 0.02 % + 4 μV 0.05 % + 5 μV 0.11 % + 10 μV 0.14 % + 20 μV 0.27 % + 20 μV	
	(22 to 220) mV (10 to 20) Hz (20 to 40) Hz (0.04 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (0.5 to 1) MHz	0.024 % + 12 μV 0.009 % + 7 μV 0.005 7 % + 7 μV 0.012 % + 7 μV 0.031 % + 17 μV 0.066 % + 20 μV 0.14 % + 25 μV 0.27 % + 45 μV	
	(220 mV to 2.2) V (10 to 20) Hz (20 to 40) Hz (0.04 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (0.5 to 1) MHz	0.024 % + 40 μV 0.009 % + 15 μV 0.004 2 % + 8 μV 0.006 7 % + 10 μV 0.008 5 % + 30 μV 0.034 % + 80 μV 0.1 % + 0.2 mV 0.17 % + 0.3 mV	



Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-) ²	Reference Standard, Method, and/or Equipment	
AC Voltage – Generate ¹	(2.2 to 22) V (10 to 20) Hz (20 to 40) Hz (0.04 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (0.5 to 1) MHz	0.024% + 0.4 mV 0.009% + 0.15 mV 0.004 2% + 0.05 mV 0.006 7% + 0.1 mV 0.008 3% + 0.2 mV 0.026% + 0.6 mV 0.1% + 2 mV 0.15% + 3.2 mV	Fluke 5730A/03	
	(22 to 220) V (10 to 20) Hz (20 to 40) Hz (0.04 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (0.5 to 1) MHz	0.024% + 4 mV 0.009% + 1.5 mV 0.005 2% + 0.6 mV 0.008% + 1 mV 0.015% + 2.5 mV 0.09% + 16 mV 0.44% + 40 mV 0.80% + 80 mV		
	(220 to 1100) V (15 to 50) Hz 50 Hz to 1 kHz	0.03 % + 16 mV 0.007 % + 3.5 mV		
	(220 to 330) V (1 to 10) kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.020 % + 6 mV 0.025 % + 6 mV 0.030 % + 6 mV 0.2 % + 50 mV		Fluke 5520A/SC1100
	(330 to 1020) V (1 to 5) kHz (5 to 10) kHz	0.025 % + 10 mV 0.030 % + 10 mV		
	AC Voltage – Generate ¹ Wideband Amplitude ¹ 30 Hz to 500 kHz	(0.3 to 1.1) mV (1.1 to 3.0) mV (3 to 11) mV (11 to 33) mV (33 to 110) mV (110 to 330) mV (0.33 to 1.1) V (1.1 to 3.5) V		0.8% + 2 μV 0.7% + 3 μV 0.7% + 8 μV 0.6% + 16 μV 0.6% + 40 μV 0.5% + 100 μV 0.5% + 400 μV 0.4% + 500 μV



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-) ²	Reference Standard, Method, and/or Equipment
Wideband Amplitude Flatness ¹ 1 kHz Reference	Up to 1.1 mV (10 to 30) Hz (30 to 120) Hz (0.12 to 1.2) kHz (1.2 to 12) kHz (12 to 120) kHz (0.12 to 1.2) MHz (1.2 to 2) MHz (2 to 12) MHz (12 to 20) MHz (20 to 30) MHz	0.3% 0.1% 0.1% 0.1% 0.1% 0.2% + 3 μV 0.2% + 3 μV 0.4% + 3 μV 0.6% + 3 μV 1.5% + 15 μV	Fluke 5730A/03
Wideband Flatness ¹ 1 kHz Reference	(1.1 to 3.3 mV) (10 to 30) Hz (30 to 120) Hz (0.12 to 1.2) kHz (1.2 to 12) kHz (12 to 120) kHz (0.12 to 1.2) MHz (1.2 to 2) MHz (2 to 12) MHz (12 to 20) MHz (20 to 30) MHz	0.3% 0.1% 0.1% 0.1% 0.1% 0.1% + 3 μV 0.1% + 3 μV 0.3% + 3 μV 0.5% + 3 μV 1.5% + 3 μV	Fluke 5730A/03
Wideband Flatness ¹ 1 kHz Reference	(3.3 to 11 mV) (10 to 30) Hz (30 to 120) Hz (0.12 to 1.2) kHz (1.2 to 12) kHz (12 to 120) kHz (0.12 to 1.2) MHz (1.2 to 2) MHz (2 to 12) MHz (12 to 20) MHz (20 to 30) MHz	0.3% 0.1% 0.1% 0.1% 0.1% 0.1% + 3 μV 0.1% + 3 μV 0.2% + 3 μV 0.4% + 3 μV 1% + 3 μV	Fluke 5730A/03



Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-) ²	Reference Standard, Method, and/or Equipment
AC Voltage ¹ – Measure	Up to 220 mV (1 to 10) Hz	0.017 % + 70 μV	Fluke 8508A opt 001
	220 mV to 220 V (1 to 10) Hz	0.015 % + 60 μV	
	(220 to 1000) V (1 to 10) Hz	0.015 % + 70 μV	
AC Voltage ¹ – Measure 600 μV to 2.2 mV	(10 to 20) Hz (20 to 40) Hz (0.04 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (0.5 to 1) MHz	0.17 % + 1.3 μV 0.074 % + 1.3 μV 0.042 % + 1.3 μV 0.081 % + 2 μV 0.12 % + 2.5 μV 0.23 % + 4 μV 0.24 % + 8 μV 0.35 % + 8 μV	Fluke 5790A-03
AC Voltage ¹ – Measure (2.2 to 7) mV	(10 to 20) Hz (20 to 40) Hz (0.04 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (0.5 to 1) MHz	0.085 % + 1.3 μV 0.037 % + 1.3 μV 0.021 % + 1.3 μV 0.04 % + 2 μV 0.06 % + 2.5 μV 0.12 % + 4 μV 0.13 % + 8 μV 0.23% + 8 μV	Fluke 5790A-03
AC Voltage ¹ – Measure (7 to 22) mV	(10 to 20) Hz (20 to 40) Hz (0.04 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (0.5 to 1) MHz	0.029 % + 1.3 μV 0.019 % + 1.3 μV 0.011 % + 1.3 μV 0.021 % + 2 μV 0.031 % + 2.5 μV 0.081 % + 4 μV 0.089 % + 8 μV 0.17 % + 8 μV	Fluke 5790A-03
AC Voltage ¹ – Measure (22 to 70) mV	(10 to 20) Hz (20 to 40) Hz (0.04 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (0.5 to 1) MHz	0.024 % + 1.5 μV 0.012 % + 1.5 μV 65 μV/V + 1.5 μV 0.013 % + 2 μV 0.026 % + 2.5 μV 0.051 % + 4 μV 0.067 % + 8 μV 0.11 % + 8 μV	Fluke 5790A-03



Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-) ²	Reference Standard, Method, and/or Equipment
AC Voltage ¹ – Measure (70 to 220) mV	(10 to 20) Hz (20 to 40) Hz (0.04 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (0.5 to 1) MHz	0.021 % + 1.5 μV 85 μV/V + 1.5 μV 38 μV/V + 1.5 μV 69 μV/V + 2 μV 0.016 % + 2.5 μV 0.025 % + 4 μV 0.038 % + 8 μV 0.1 % + 8 μV	Fluke 5790A-03
AC Voltage ¹ – Measure (220 to 700) mV	(10 to 20) Hz (20 to 40) Hz (0.04 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (0.5 to 1) MHz	0.021 % + 1.5 μV 76 μV/V + 1.5 μV 33 μV/V + 1.5 μV 51 μV/V + 2 μV 79 μV/V + 2.5 μV 0.018 % + 4 μV 0.03 % + 8 μV 0.096 % + 8 μV	Fluke 5790A-03
AC Voltage ¹ – Measure 700 mV to 2.2 V	(10 to 20) Hz (20 to 40) Hz (0.04 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (0.5 to 1) MHz	0.021 % + 1.5 μV 76 μV/V + 1.5 μV 33 μV/V + 1.5 μV 51 μV/V + 2 μV 79 μV/V + 2.5 μV 0.018 % + 4 μV 0.03 % + 8 μV 0.096 % + 8 μV	Fluke 5790A-03
AC Voltage ¹ – Measure (2.2 to 7) V	(10 to 20) Hz (20 to 40) Hz (0.04 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (0.5 to 1) MHz	0.02% 67 μV/V 24 μV/V 48 μV/V 81 μV/V 0.02 % 0.04 % 0.12 %	Fluke 5790A-03
AC Voltage ¹ – Measure (7 to 22) V	(10 to 20) Hz (20 to 40) Hz (0.04 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (0.5 to 1) MHz	0.02 % 67 μV/V 27 μV/V 48 μV/V 81 μV/V 0.02% 0.04% 0.12%	Fluke 5790A-03



Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-) ²	Reference Standard, Method, and/or Equipment
AC Voltage ¹ – Measure (22 to 70) V	(10 to 20) Hz (20 to 40) Hz (0.04 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (0.5 to 1) MHz	0.02% 68 μV/V 32 μV/V 57 μV/V 94 μV/V 0.02% 0.04% 0.12%	Fluke 5790A-03
AC Voltage ¹ – Measure (70 to 220) V	(10 to 20) Hz (20 to 40) Hz (0.04 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz	0.02% 68 μV/V 31 μV/V 69 μV/V 98 μV/V 0.02% 0.05%	Fluke 5790A-03
AC Voltage ¹ – Measure (220 to 700) V	(10 to 20) Hz (20 to 40) Hz (0.04 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.02% 99 μV/V 41 μV/V 0.01% 0.05%	Fluke 5790A-03
AC Voltage ¹ – Measure (700 to 1 000) V	(10 to 20) Hz (20 to 40) Hz (0.04 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.02% 99 μV/V 38 μV/V 0.01% 0.05%	Fluke 5790A-03
Wideband Flatness 1 kHz Reference	600 μV to 2.2 mV (0.5 to 1.2) MHz (1.2 to 2) MHz (2 to 10) MHz (10 to 20) MHz (20 to 30) MHz	 0.07 % + 1 μV 0.07 % + 1 μV 0.17 % + 1 μV 0.30 % + 1 μV 0.70 % + 2 μV	Fluke 5790A-03
Wideband Flatness 1 kHz Reference	(2.2 to 7) mV (0.5 to 1.2) MHz (1.2 to 2) MHz (2 to 10) MHz (10 to 20) MHz (20 to 30) MHz	 0.07 % + 1 μV 0.07 % + 1 μV 0.10 % + 1 μV 0.17 % + 1 μV 0.37 % + 1 μV	Fluke 5790A-03



Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-) ²	Reference Standard, Method, and/or Equipment
Wideband Flatness 1 kHz Reference	(7 to 22) mV		Fluke 5790A-03
	(0.5 to 1.2) MHz	0.07 %	
	(1.2 to 2) MHz	0.07 %	
	(2 to 10) MHz	0.1 %	
	(10 to 20) MHz	0.17 %	
Wideband Flatness 1 kHz Reference	(20 to 30) MHz	0.37 %	Fluke 5790A-03
	(22 to 700) mV		
	(0.5 to 1.2) MHz	0.05 %	
	(1.2 to 2) MHz	0.05 %	
	(2 to 10) MHz	0.10 %	
Wideband Flatness 1 kHz Reference	(10 to 20) MHz	0.15 %	Fluke 5790A-03
	(20 to 30) MHz	0.35 %	
	(70 to 220) mV		
	(0.5 to 1.2) MHz	0.05 %	
	(1.2 to 2) MHz	0.05 %	
Wideband Flatness 1 kHz Reference	(2 to 10) MHz	0.1 %	Fluke 5790A-03
	(10 to 20) MHz	0.15 %	
	(20 to 30) MHz	0.35 %	
	(220 to 700) mV		
	(0.5 to 1.2) MHz	0.05 %	
Wideband Flatness 1 kHz Reference	(1.2 to 2) MHz	0.05 %	Fluke 5790A-03
	(2 to 10) MHz	0.10 %	
	(10 to 20) MHz	0.15 %	
	(20 to 30) MHz	0.35 %	
	700 mV to 2.2 V		
Wideband Flatness 1 kHz Reference	(0.5 to 1.2) MHz	0.05 %	Fluke 5790A-03
	(1.2 to 2) MHz	0.05 %	
	(2 to 10) MHz	0.10 %	
	(10 to 20) MHz	0.15 %	
	(20 to 30) MHz	0.35 %	
Wideband Flatness 1 kHz Reference	(2.2 to 7) V		Fluke 5790A-03
	(0.5 to 1.2) MHz	0.05 %	
	(1.2 to 2) MHz	0.05 %	
	(2 to 10) MHz	0.10 %	
	(10 to 20) MHz	0.15 %	
Wideband Flatness 1 kHz Reference	(20 to 30) MHz	0.35 %	Fluke 5790A-03



Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-) ²	Reference Standard, Method, and/or Equipment
AC Current ¹ – Generate	Up to 220 μA (10 to 20) Hz (20 to 40) Hz (0.04 to 1) kHz (1 to 5) kHz (5 to 10) kHz	0.025 % + 16 nA 0.016 % + 10 nA 0.01 % + 8 nA 0.028 % + 12 nA 0.11 % + 65 nA	Fluke 5730A/03
AC Current ¹ – Generate	(0.22 to 2.2) mA (10 to 20) Hz (20 to 40) Hz (0.04 to 1) kHz (1 to 5) kHz (5 to 10) kHz	0.025 % + 40 nA 0.016 % + 35 nA 0.01 % + 35 nA 0.02 % + 110 nA 0.11 % + 650 nA	Fluke 5730A/03
AC Current ¹ – Generate	(2.2 to 22) mA (10 to 20) Hz (20 to 40) Hz (0.04 to 1) kHz (1 to 5) kHz (5 to 10) kHz	0.025 % + 400 nA 0.016 % + 350 nA 0.01 % + 350 nA 0.02 % + 550 nA 0.11 % + 5 000 nA	Fluke 5730A/03
	(22 to 220) mA (10 to 20) Hz (20 to 40) Hz (0.04 to 1) kHz (1 to 5) kHz (5 to 10) kHz	0.025 % + 4 μA 0.016 % + 3.5 μA 0.01 % + 2.5 μA 0.02 % + 3.5 μA 0.11 % + 10 μA	
	(0.22 to 2.2) A (0.02 to 1) kHz (1 to 5) kHz (5 to 10) kHz	0.024 % + 35 μA 0.045 % + 80 μA 0.7 % + 160 μA	
	(2.2 to 3) A (10 to 45) Hz (0.045 to 1) kHz (1 to 5) kHz (5 to 10) kHz	0.18 % + 100 μA 0.06 % + 100 μA 0.6 % + 1 mA 2.5 % + 5 mA	
AC Current ¹ – Generate	(3 to 11) A (45 to 100) Hz (0.1 to 1) kHz (1 to 5) kHz	0.06 % + 2 mA 0.1 % + 2 mA 3 % + 2 mA	Fluke 5522A/SC1100



Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-) ²	Reference Standard, Method, and/or Equipment
AC Current ¹ – Generate	(11 to 20.5) A (45 to 100) Hz (0.1 to 1) kHz (1 to 5) kHz	0.12 % + 5 mA 0.15 % + 5 mA 3 % + 5 mA	Fluke 5522A/SC1100
	(20 to 1000) A (45 to 65) Hz	0.28 % + 0.09 A	Fluke 5522A/Coil
	(20 to 150) A (65 to 440) Hz	0.79 % + 0.1 A	
AC Current ¹ – Measure	Up to 200 μ A (0.01 to 10) kHz (10 to 30) kHz (30 to 100) kHz	0.031 % + 100 μ A/A 0.071 % + 100 μ A/A 0.4 % + 100 μ A/A	Fluke 8508A opt 001 Reference DMM
	200 μ A to 20 mA (1 to 10) Hz (0.01 to 10) kHz (10 to 30) kHz (30 to 100) kHz	0.031 % + 100 μ A/A 0.03 % + 100 μ A/A 0.071 % + 100 μ A/A 0.4 % + 100 μ A/A	Fluke 8508A opt 001 Reference DMM
	(20 to 200) mA (1 to 10) Hz (0.01 to 10) kHz (10 to 30) kHz	0.031 % + 100 μ A/A 0.029 % + 100 μ A/A 0.063 % + 100 μ A /A	
	200 mA to 2 A (0.01 to 2) kHz (2 to 10) kHz (10 to 30) kHz	0.062 % + 100 μ A/A 0.074 % + 100 μ A/A 0.3 % + 100 μ A/A	
	(2 to 20) A (0.01 to 2) kHz (2 to 10) kHz	0.082 % + 100 μ A/A 0.25 % + 100 μ A/A	
	(1 to 10) mA (5 to 400) Hz (0.4 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.002 % 0.003 % 0.004 % 0.006 %	



Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-) ²	Reference Standard, Method, and/or Equipment
AC Current ¹ – Measure	(10 to 30) mA (5 to 400) Hz	0.002 %	Fluke 5790A-03 w/A40 Shunts AC Measurement Standard
	(0.4 to 20) kHz	0.003 %	
	(20 to 50) kHz	0.005 %	
	(50 to 100) kHz	0.007 %	
	(30 to 300) mA (5 to 400) Hz	0.003 %	
	(0.4 to 20) kHz	0.004 %	Fluke 5790A-03 w/A40 Shunts AC Measurement Standard
	(20 to 50) kHz	0.007 %	
	(50 to 100) kHz	0.01 %	
	300 mA to 3 A (5 to 400) Hz	0.002 %	
	(0.4 to 20) kHz	0.003 %	
Electrical Calibration of Thermocouple Indicating Devices ¹ Type B	(20 to 50) kHz	0.005 %	Fluke 5790A-03 w/A40 Shunts AC Measurement Standard
	(50 to 100) kHz	0.01 %	
	(3 to 10) A (5 to 400) Hz	0.002 %	
	(0.4 to 20) kHz	0.003 %	
	(20 to 50) kHz	0.005 %	
Electrical Calibration of Thermocouple Indicating Devices ¹ Type B	(10 to 20) A (5 to 400) Hz	0.007 %	Fluke 5522A SC1100
	(0.4 to 20) kHz	0.012 %	
	(20 to 50) kHz	0.018 %	
	(600 to 800) °C	0.44 °C	
	(800 to 1 000) °C	0.34 °C	
	(1 000 to 1 550) °C	0.3 °C	
	(1 550 to 1 820) °C	0.33 °C	



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-) ²	Reference Standard, Method, and/or Equipment
Electrical Calibration of Thermocouple Indicating Devices ¹ Type C	(0 to 150) °C	0.3 °C	Fluke 5522A SC1100
	(150 to 650) °C	0.26 °C	
	(650 to 1000) °C	0.31 °C	
	(1 000 to 1 800) °C	0.5 °C	
	(1 800 to 2 316) °C	0.84 °C	
Type E	(-250 to -100) °C	0.5 °C	Fluke 5522A SC1100
	(-100 to -25) °C	0.16 °C	
	(-25 to 350) °C	0.14 °C	
	(350 to 650) °C	0.16 °C	
	(650 to 1 000) °C	0.21 °C	
Type J	(-210 to -100) °C	0.27 °C	Fluke 5522A SC1100
	(-100 to -30) °C	0.16 °C	
	(-30 to 150) °C	0.14 °C	
	(150 to 760) °C	0.17 °C	
	(760 to 1 200) °C	0.23 °C	
Type K	(-200 to -100) °C	0.33 °C	Fluke 5522A SC1100
	(-100 to -25) °C	0.18 °C	
	(-25 to 120) °C	0.16 °C	
	(120 to 1 000) °C	0.26 °C	
	(1 000 to 1 372) °C	0.4 °C	
Type N	(-200 to -100) °C	0.4 °C	Fluke 5522A SC1100
	(-100 to -25) °C	0.22 °C	
	(-25 to 120) °C	0.19 °C	
	(120 to 410) °C	0.18 °C	
	(410 to 1 300) °C	0.27 °C	
Type R	(0 to 250) °C	0.57 °C	Fluke 5522A SC1100
	(250 to 400) °C	0.35 °C	
	(400 to 1 000) °C	0.33 °C	
	(1 000 to 1 767) °C	0.4 °C	
Type S	(0 to 250) °C	0.47 °C	Fluke 5522A SC1100
	(250 to 1 000) °C	0.36 °C	
	(1 000 to 1 400) °C	0.37 °C	
	(1 400 to 1 767) °C	0.46 °C	
Type T	(-250 to -150) °C	0.63 °C	Fluke 5522A SC1100
	(-150 to 0) °C	0.24 °C	
	(0 to 120) °C	0.16 °C	
	(120 to 400) °C	0.14 °C	



Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-) ²	Reference Standard, Method, and/or Equipment
Type U	(-200 to 0) °C (0 to 600) °C	0.56 °C 0.27 °C	Fluke 5522A SC1100
Electrical Calibration of RTD Indicators ¹ Pt 385, 100 Ω	(-200 to -80) °C (-80 to 0) °C (0 to 100) °C (100 to 300) °C (300 to 400) °C (400 to 630) °C (630 to 800) °C	0.05 °C 0.05 °C 0.07 °C 0.09 °C 0.1 °C 0.12 °C 0.23 °C	Fluke 5522A SC1100
Pt 385, 200 Ω	(-200 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	0.04 °C 0.04 °C 0.04 °C 0.05 °C 0.12 °C 0.13 °C 0.14 °C 0.16 °C	Fluke 5522A SC1100
Pt 385, 500 Ω	(-200 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	0.04 °C 0.05 °C 0.05 °C 0.06 °C 0.08 °C 0.08 °C 0.09 °C 0.11 °C	Fluke 5522A SC1100
Pt 385, 1 000 Ω	(-200 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	0.03 °C 0.03 °C 0.04 °C 0.05 °C 0.06 °C 0.07 °C 0.07 °C 0.23 °C	Fluke 5522A SC1100
Pt 3916, 100 Ω	(-200 to -190) °C (-190 to -80) °C (-80 to 0) °C (0 to 100) °C (100 to 260) °C	0.25 °C 0.04 °C 0.05 °C 0.06 °C 0.07 °C	Fluke 5522A SC1100



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-) ²	Reference Standard, Method, and/or Equipment
Pt 3916, 100 Ω	(260 to 300) °C (300 to 400) °C (400 to 600) °C (600 to 630) °C	0.08 °C 0.09 °C 0.1 °C 0.23 °C	Fluke 5522A SC1100
Pt 3926, 100 Ω	(-200 to -80) °C (-80 to 0) °C (0 to 100) °C (100 to 300) °C (300 to 400) °C (400 to 630) °C	0.05 °C 0.05 °C 0.07 °C 0.09 °C 0.1 °C 0.12 °C	Fluke 5522A SC1100
PtNi 385, 120 Ω	(-80 to 0) °C (0 to 100) °C (100 to 260) °C	0.08 °C 0.08 °C 0.14 °C	Fluke 5522A SC1100
Cu 427, 10 Ω	(-100 to 260) °C	0.3 °C	Fluke 5522A SC1100

Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-) ^{2,3}	Reference Standard, Method, and/or Equipment
Phase – Generate ¹ 0° to 180°	(10 to 65) Hz (65 to 500) Hz (0.5 to 1) kHz (1 to 5) kHz (5 to 10) kHz (10 to 30) kHz	0.1 ° 0.25 ° 0.5 ° 2.5 ° 5 ° 10 °	Fluke 5522A SC1100
Phase – Measure 0° to 360° Sine Wave	(5 to 10) Hz	0.23 °	Clarke-Hess Model 6000
10 mV to 350 V	10 Hz to 50 kHz	0.051 °	
10 mV to 12.5 V	(50 to 100) kHz	0.23 °	
12.5 V to 350 V	(0.01 to 10) kHz	0.051 °	



Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-) ^{2,3}	Reference Standard, Method, and/or Equipment
Oscilloscopes ¹ –Amplitude DC DC Signal 50 Ω Load 1 MΩ Load	(0 to ± 6.6) V (0 to ± 130) V	0.25 % + 40 μV 0.05 % + 40 μV	Fluke 5522A SC1100
Amplitude-Square Wave (Peak to Peak) 50 Ω Load 1 MΩ Load	± 1 mV to ± 6.6 V ± 1 mV to ± 130 V	0.25 % + 40 μV 0.1 % + 40 μV	Fluke 5522A SC1100
Time Marker (into 50 Ω)	5 s to 50 ms 20 ms to 1 ns	(25 + 1000t) μs/s 2.5 μs/s	t = time in Seconds
Edge Spec (Rise Time)	1 kHz to 10 MHz	<300 ps 5 mVp-p to 2.5Vp-p	
Bandwidth – Leveled Sine Wave (into 50 Ohm Load) 5 mV to 5.5 V	50 kHz reference 50 kHz to 100 MHz (100 to 300) MHz	2 % + 300 μV 3.5 % + 300 μV 4 % + 300 μV	Fluke 5522A SC1100
Pulse Characterization - Rise Time - Measure	30 ps to 1μs	21 ps	CSA803C w/ SD-26
RF Absolute Power ¹ – Generate (-35 to + 14) dBm	(0.1 to 2.4) GHz (2.4 to 8) GHz (8 to 18) GHz (18 to 26.5) GHz	0.08 dB + M 0.11 dB + M 0.14 dB + M 0.17 dB + M	Fluke 96270A w/ Rohde & Schwarz NRP-Z55 (x2), Agilent 11667B & Sucoflex 102EA
RF Absolute Power ¹ – Measure	1mW Ref @ 50 MHz	0.03%	HP 8478B Sensor w/ HP 432A Power Meter



Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-) ^{2,3}	Reference Standard, Method, and/or Equipment
RF Absolute Power ¹ – Measure (-65 to -35) dBm	(> 0.01 to ≤ 0.03) GHz (> 0.03 to ≤ 4.00) GHz (> 4.00 to ≤ 8.00) GHz (> 8.00 to ≤ 10.00) GHz (> 10.00 to ≤ 13.00) GHz (> 13.00 to ≤ 15.00) GHz (> 15.00 to ≤ 18.00) GHz	2.84% + <i>M</i> 1.9% + <i>M</i> 2.34% + <i>M</i> 2.44% + <i>M</i> 2.98% + <i>M</i> 3.48% + <i>M</i> 3.84% + <i>M</i>	HP 8484A sensor w/ Agilent E4419B Power Meter
RF Absolute Power ¹ – Measure (-35 to + 20) dBm	(DC to ≤ 0.1) GHz (> 0.1 to ≤ 2.4) GHz (> 2.4 to ≤ 8) GHz (> 8 to ≤ 12.4) GHz (> 12.4 to ≤ 18) GHz (> 18 to ≤ 26.5) GHz (> 26.5 to ≤ 33) GHz (> 33 to ≤ 40) GHz	0.04 dB + <i>M</i> 0.048 dB + <i>M</i> 0.054 dB + <i>M</i> 0.063 dB + <i>M</i> 0.082 dB + <i>M</i> 0.086 dB + <i>M</i> 0.11 dB + <i>M</i> 0.11 dB + <i>M</i>	Fluke 96270A w/ Rohde & Schwarz NRP-Z55
Tuned RF Power, Absolute – Measure	(+10 to 0) dBm (0 to -10) dBm	0.3 dB + <i>M</i> 0.3 dB + <i>M</i>	HP 8902A w/ HP 11722A, 11792A, and 11793A
2.5 MHz to 26.5 GHz	(-10 to -40) dBm (-40 to -50) dBm (-50 to -80) dBm (-80 to -90) dBm (-90 to -110) dBm (-110 to -127) dBm	0.31 dB + <i>M</i> 0.33 dB + <i>M</i> 0.34 dB + <i>M</i> 0.37 dB + <i>M</i> 0.39 dB + <i>M</i> 0.54 dB + <i>M</i>	HP 8902A w/ HP 11722A, 11792A, and 11793A



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Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-) ^{2,3}	Reference Standard, Method, and/or Equipment
Amplitude Modulation – Measure (0.15 to 10) MHz	Rate: 50 Hz to 10 kHz, Depth: 5 % to 99 %	3 % + 1 digit	HP 8902A w/ HP 11722A, 11792A, and 11793A
	Rate: 20 Hz to 10 kHz, Depth: to 99 %	3 % + 1 digit	
(10 to 1300) MHz	Rate: 50 Hz to 50 kHz, Depth: 5 % to 99 %	2 % + 1 digit	
	Rate: 20 Hz to 10 kHz, Depth: to 99 %	3 % + 1 digit	
(1.3 to 26.5) GHz	Rate: 50 Hz to 10 kHz, Depth: 5 % to 99 %	2 % + 1 digit	
10 MHz to 26.5 GHz	Rate: 20 Hz to 10 kHz, Depth: to 99 %	3 % + 1 digit	
Frequency Modulation – Measure (0.25 to 10) MHz	Rate: 20 Hz to 10 kHz, Dev: ≤ 40 kHz pk	2 % + 1 digit	
	Rate: 50 Hz to 100 kHz, Dev: ≤ 400 kHz pk	1 % + 1 digit	
10 MHz to 1.3 GHz	Rate: 20 Hz to 200 kHz, Dev: ≤ 400 kHz pk	6 % + 1 digit	
	Rate: 50 Hz to 100 kHz, Dev: ≤ 400 kHz pk	1 % + 1 digit	
10 MHz to 26.5 GHz	Rate: 20 Hz to 200 kHz, Dev: ≤ 400 kHz pk	6 % + 1 digit	
	Rate: 50 Hz to 100 kHz, Dev: ≤ 400 kHz pk	1 % + 1 digit	
Phase Modulation – Measure 150 kHz to 10 MHz	200 Hz to 10 kHz Rate	5 % + 1 digit	HP 8902A w/ HP11722A, 11792A, and 11793A
	10 MHz to 26.5 GHz	200 Hz to 20 kHz Rate	
Power – Range Accuracy	3 μW to 100 mW	0.15 μW	HP 11683A



Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-) ^{2,3}	Reference Standard, Method, and/or Equipment
Distortion – Measure (-80 to 0) dB (-65 to 0) dB	20 Hz to 20 kHz (20 to 100) kHz	1.2 dB 2.4 dB	HP 8903B
RF Amplitude Frequency Response – Measure	9 kHz to 2.9 GHz (2.90 to 6.46) GHz (6.46 to 13) GHz (13 to 19.7) GHz (19.7 to 22) GHz	1.01 dB 1.50 dB 2.01 dB 3.01 dB 3.01 dB	HP 8562A
VSWR – Measure	(0.01 to 18) GHz (0 to 60) dB	0.1 dB	VSWR of 1 to 1.4 Giga-tronics 8003 with 80501
Absolute Power Measure – Swept Mode	(0.01 to 1) GHz (1 to 2) GHz (2 to 4) GHz (4 to 6) GHz (6 to 8) GHz (8 to 12.4) GHz (12.4 to 18) GHz	0.082 dB 0.089 dB 0.096 dB 0.1 dB 0.11 dB 0.13 dB 0.14 dB	Giga-tronics 8003 with 80301A or 80302A and 80501
Levelled Sine Wave Output – Absolute Amplitude Accuracy Level (dBm) (+ 24 to - 17) dBm (- 17 to - 74) dBm (- 74 to - 94) dBm (- 94 to - 130) dBm	10 Hz to 4 GHz 10 Hz to 4 GHz 10 Hz to 4 GHz 10 Hz to 4 GHz	0.2 dB + <i>M</i> 0.34 dB + <i>M</i> 0.68 dB + <i>M</i> 1.1 dB + <i>M</i>	Fluke 96270A w/ Fluke 96040A-50



Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-) ^{2,3}	Reference Standard, Method, and/or Equipment
(+ 18 to - 80) dBm	10 Hz to 4 GHz	0.34 dB + <i>M</i>	Fluke 96270A w/ Fluke 96040A-75
(- 80 to - 100) dBm	10 Hz to 4 GHz	0.67 dB + <i>M</i>	
(- 100 to - 120) dBm	10 Hz to 4 GHz	1.1 dB + <i>M</i>	

Length – Dimensional Metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-) ³	Reference Standard, Method, and/or Equipment
Micrometers and Calipers - Outside, Inside, Depth, & Step ¹	(0.01 to 0.04) in (0.05 to 1) in (1 to 4) in (4 to 15) in (15 to 40) in	13 μin (13 + 1 <i>L</i>) μin (9 + 4 <i>L</i>) μin (12 + 4 <i>L</i>) μin (16 + 4 <i>L</i>) μin	Comparison to Gage Blocks
Flatness – Anvil ¹	Up to 1 in diameter	14 μin	Optical Flats
Parallelism – Spindle ¹	Up to 1 in diameter	14 μin	Optical Flats
Length Measurement Single Axis – Outside ¹	(0.05 to 1) in (1 to 4) in (4 to 15) in (15 to 20) in (20 to 40) in	(19 + 2 <i>L</i>) μin (15 + 4 <i>L</i>) μin (17 + 4 <i>L</i>) μin (5 + 5 <i>L</i>) μin (64 + 4 <i>L</i>) μin	ULM Gage Check & Gage Blocks
Ring Gages Plain Ring Gages Threaded Ring Gages	Up to 16 in Up to 6 in	(14 + 4.6 <i>L</i>) μin (22 + 4.7 <i>L</i>) μin	ULM Using set plugs
Plug Gages Plain Plugs Threaded Plugs (OD) Threaded Plugs (PD)	Up to 16 in Up to 6 in Up to 6 in	(13 + 4.6 <i>L</i>) μin (15 + 3.7 <i>L</i>) μin (19 + 3.4 <i>L</i>) μin	ULM ULM ULM w/ Thread Wire



Length – Dimensional Metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-) ³	Reference Standard, Method, and/or Equipment
Surface Plates Local Area Flatness	Up to 0.001	29 μin	Repeat-o-meter
Overall Flatness	Up to (72 × 144) in	95 μin	Planekator
Coating Thickness Gages ¹ Eddy Current & Magnetic Induction, Fixed Point	Up to 3 000 μm Up to 118 mils	(0.59 + 0.03L) μm (0.023 + 0.001L) mils	ULM
Dial Indicator ¹	(0.05 to 1) in (1 to 4) in	(22 + 2L) μin (21 + 3L) μin	ULM

Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-) ^{2,3}	Reference Standard, Method, and/or Equipment
Air/Nitrogen Flow ¹	Up to 100 SLM	0.73%	CME FCS Laminar Flow Elements
Liquid Flow	Up to 250 GPM	0.33%	FT-32 turbine flow system
Air Velocity – Measuring Equipment	Up to 5 800 ft/min	1.7%	Alnor RVA801 with Wind Tunnel
Pressure and Vacuum Gauges Pneumatic - Gauge	-30 inHg to 1 000 psig	0.02 % of span	DHI PPC4EX-7M
Pneumatic - Absolute	(0.1 to 1 000) psia	0.02 % of span + 0.007 psia	DHI PPC4EX-7M
Pneumatic	(0.2 to 718) psia/psig	0.003%	Ruska 2465
Hydraulic	(100 to 50 000) psig	0.008 %	DHI 5306
Pressure and Vacuum Gauges Hydraulic & Pneumatic ¹	(0 to 900) mmHg (15 to 30) psig (30 to 300) psig (300 to 500) psig (500 to 3 000) psig (3 000 to 10 000) psig	0.23 mmHg 0.08 psig 0.15 psig 0.13 psig 1.5 psig 8 psig	Fluke PPH Calibrator



Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-) ^{2,3}	Reference Standard, Method, and/or Equipment
Scales and Balances ¹ Metric	Up to 20 g	0.024 mg	ASTM Class 1 weights
	Up to 200 g	0.18 mg	
	Up to 1 000 g	2.9 mg	ASTM Class 2 weights
	Up to 5 000 g	10 mg	
Up to 10 000 g	58 mg		
	Up to 50 000 g	1.4 g	
Scales and Balances ¹ English	Up to 10 lb	0.0012 lb	ASTM Class F weights
	Up to 25 lb	0.002 lb	
	Up to 50 lb	0.009 lb	
	Up to 150 lb	0.023 lb	
	Up to 250 lb	0.065 lb	
	Up to 500 lb	0.13 lb	
Force ¹ – Measuring Equipment Compression	(0 to 500) lbf	0.13 lbf	ASTM class F weights
	(500 to 5 000) lbf	2.4 lbf	South Ocean MS-1
	(5 000 to 20 000) lbf	9.1 lbf	Transcell BSS-20K
Tension	(0 to 500) lbf	0.13 lbf	ASTM class F weights
	(500 to 5000) lbf	2.4 lbf	South Ocean MS-1
	(5000 to 10 000) lbf	6.8 lbf	Transcell BSS-10K
	(10 000 to 20 000) lbf	9.1 lbf	Transcell BSS-20K
	(20 000 to 100 000) lbf	42 lbf	Rinstrum TLWS-100K
Optical Rotational Speed, RPM ³ – Measure & Generate	(1 to 100 000) rpm	0.015 RPM	Agilent 33250A
Rotational Speed, RPM ³ – Measure & Generate	(0 to 5 500) rpm	0.015 %+ 0.6R	Quantum Dynamics N-11-FCS/3



Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-) ^{2,3}	Reference Standard, Method, and/or Equipment
Torque Transducers	20 ozf·in to 100 lbf·in	0.05%	Various torque arms and weights
	100 lbf·in to 125 lbf·ft	0.06%	
	(125 to 2 000) lbf·ft	0.08%	
Torque Devices	2 ozf·in to 2 000 lbf·ft	0.5 %	AKO TSD2050 Torque Master

Photometry and Radiometry

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-) ²	Reference Standard, Method, and/or Equipment
Illuminance – Lux meters	(423 to 15 000) Lux	1.8 %	FEL 1000W lamp with PSU

Thermodynamic

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Relative Humidity – Measure & Measuring Equipment	(10 to 90) %RH	1.3 %RH	Vaisala HMI-41 w/HMP-46
Temperature ¹ – Measure & Measuring Equipment	(-196 to 0) °C	0.042 °C	Hart Scientific 1521 w/5618B / 5627A
	(0 to 100) °C	0.042 °C	
	(100 to 420) °C	0.06 °C	Hart Scientific 1523 w/5624
	(420 to 960) °C	0.064 °C	
Infrared Devices ¹	Ambient to 212 °F	0.92 °F	Fluke 9132 ε = 0.95 λ = (8 to 14) μm
	(212 to 572) °F	1.3 °F	
	(572 to 932) °F	1.5 °F	



Time and Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Frequency ¹ – Generate	1 MHz to 27 GHz	0.05 μ Hz/Hz	Fluke 96270A
Frequency ¹ – Measure	1 Hz to 160 MHz	3.2 μ Hz/Hz	Racal Dana 1992
	(0.4 to 1.3) GHz	5.9 μ Hz/Hz	
	(1.3 to 26.5) GHz	0.05 μ Hz/Hz + 1 count	HP 5343A

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. Values listed with percent (%) are percent of reading or generated value unless otherwise noted.
3. R = resolution of the unit under test, L = value of the nominal length of the device measured, and M = the mismatched value.
4. This scope is formatted as part of a single document including Certificate of Accreditation No. AC-2489.21.



Vice President