



CERTIFICATE OF ACCREDITATION

ANSI-ASQ National Accreditation Board

500 Montgomery Street, Suite 625, Alexandria, VA 22314, 877-344-3044

This is to certify that

Fox Valley Metrology, Ltd.
30447 Stacy Pond Drive
Stacy MN 55079

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

ISO/IEC 17025:2005

and national standard

ANSI/NCSL Z540-1-1994 (R2002) &

ANSI/NCSL Z540.3-2006 (R2013)

while demonstrating technical competence in the fields of

TESTING AND CALIBRATION

Refer to the accompanying Scope of Accreditation for information regarding the types of calibrations and/or tests to which this accreditation applies.

ACT-1272.03

Certificate Number


ANAB Approval

Certificate Valid: 07/07/2017-06/15/2019
Version No. 001 Issued: 07/07/2017



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).



**SCOPE OF ACCREDITATION TO ISO/IEC 17025:2005,
ANSI/NCSL Z540-1-1994 (R2002), AND ANSI/NCSL Z540.3-2006 (R2013)**

Fox Valley Metrology, Ltd.
30447 Stacy Pond Drive
Stacy, MN 55079
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CALIBRATION

Valid to: **June 15, 2019**

Certificate Number: **ACT-1272.03**

Acoustics and Vibration

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
Sound Level – Source ¹ 100 Hz, 250 Hz, 500 Hz, 1 000 Hz, 2 000 Hz	114 dB	0.6 dB	Gen Rad 1562-A

Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
DC Voltage - Source ¹ Fixed Value	10 V	0.8 μ V/V	Fluke 732B
DC Voltage - Source ¹	Up to 220 mV 220 mV to 2.2 V (2.2 to 11) V (11 to 22) V (22 to 220) V 220 V to 1.1 kV	12 μ V/V + 0.4 μ V 5.8 μ V/V + 0.7 μ V 4.2 μ V/V + 2.5 μ V 4.1 μ V/V + 4 μ V 5.8 μ V/V + 40 μ V 7.6 μ V/V + 0.4 mV	Fluke 5720A
DC Voltage - Measure ¹	Up to 100 mV 100 mV to 1 V (1 to 10) V (10 to 100) V 100 V to 1 kV	7.8 μ V/V + 0.8 μ V 5.7 μ V/V + 0.8 μ V 5.6 μ V/V + 1 μ V 7.9 μ V/V + 80 μ V 7.9 μ V/V + 0.15 mV	Agilent 3458A Opt 002



Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
DC Voltage - Measure ¹	Up to 200 mV 200 mV to 2 V (2 to 20) V (20 to 200) V 200 V to 1.05 kV	5 μ V/V + 0.10 μ V 3.5 μ V/V + 0.4 μ V 3.5 μ V/V + 4 μ V 5.5 μ V/V + 40 μ V 5.5 μ V/V + 500 μ V	Fluke 8508A
DC High Voltage - Measure ¹	(1 to 10) kV (10 to 100) kV	60 V 0.6 kV	Hipotronics KVM-100
DC Current - Source ¹	Up to 220 μ A 220 μ A to 2.2 mA (2.2 to 22) mA (22 to 220) mA 220 mV to 2.2 A	0.12 mA/A + 6 nA 42 μ A/A + 7 nA 41 μ A/A + 40 nA 52 μ A/A + 0.7 μ A 93 μ A/A + 12 μ A	Fluke 5720A
	(2.2 to 11) A (11 to 20.5) A	0.58 mA/A + 0.5 mA 1.2 mA/A + 0.75 mA	Fluke 5520A
	(20.5 to 1 000) A	86 mA/A + 0.5 A	Fluke 5520A with 50-turn Coil
DC Current - Measure ¹	Up to 100 nA 100 nA to 1 μ A (1 to 10) μ A (10 to 100) μ A 100 μ A to 1 mA (1 to 10) mA (10 to 100) mA 100 mA to 1 A	48 μ A/A + 65 pA 35 μ A/A + 65 pA 35 μ A/A + 0.15 nA 35 μ A/A + 1.3 nA 35 μ A/A + 10 nA 36 μ A/A + 0.1 μ A 15 μ A/A + 1 μ A 0.14 mA/A + 20 μ A	Agilent 3458A Opt 002
DC Current - Measure ¹	Up to 200 μ A 200 μ A to 2 mA (2 to 20) mA (20 to 200) mA 200 mA to 2 A (2 to 20) A	12 μ A/A + 0.4 nA 12 μ A/A + 4 nA 14 μ A/A + 40 nA 48 μ A/A + 0.8 μ A 0.19 mA/A + 16 μ A 4 mA/A + 0.4 mA	Fluke 8508A
DC Current - Measure ¹	(1 to 10) A	2.4 mA/A + 0.7 mA	Fluke DMM



Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
Resistance - Measure ¹ Normal Mode	Up to 2 Ω	17 μΩ/Ω + 4 μΩ	Fluke 8508A
	(2 to 20) Ω	9.5 μΩ/Ω + 14 μΩ	
	(20 to 200) Ω	8 μΩ/Ω + 50 μΩ	
	200 Ω to 2 kΩ	8 μΩ/Ω + 0.5 mΩ	
	(2 to 20) kΩ	8 μΩ/Ω + 5 mΩ	
	(20 to 200) kΩ	8 μΩ/Ω + 50 mΩ	
	200 kΩ to 2 MΩ	9 μΩ/Ω + 1 Ω	
	(2 to 20) MΩ (20 to 200) MΩ	20 μΩ/Ω + 0.1 kΩ 0.12 mΩ/Ω + 10 kΩ	
Resistance - Measure ¹ High Voltage Mode	(2 to 20) MΩ	17 μΩ/Ω + 10 Ω	Fluke 8508A
	(20 to 200) MΩ	65 μΩ/Ω + 1 kΩ	
	200 mΩ to 2 GΩ	0.18 mΩ/Ω + 0.1 MΩ	
	(2 to 20) GΩ	15 mΩ/Ω + 10 MΩ	
Resistance - Source ¹	0 Ω	0.11 mΩ	Fluke 5720A
	1 Ω	0.11 mΩ	
	1.9 Ω	0.21 mΩ	
	10 Ω	0.27 mΩ	
	19 Ω	0.51 mΩ	
	100 Ω	1.4 mΩ	
	190 Ω	2.6 mΩ	
	1 kΩ	11 mΩ	
	1.9 kΩ	21 mΩ	
	10 kΩ	0.11 Ω	
	19 kΩ	0.21 Ω	
	100 kΩ	1.3 Ω	
	190 kΩ	2.7 Ω	
	1 MΩ	24 Ω	
	1.9 MΩ	48 Ω	
	10 MΩ	0.48 kΩ	
	19 MΩ	1.1 kΩ	
	100 MΩ	23 kΩ	
	1 GΩ	1.9 MΩ	IET Labs HRRS Decade Box
10 GΩ	47 MΩ		
100 GΩ	0.95 GΩ		



Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
Resistance - Measure ¹	Up to 10 Ω (10 to 100) Ω 100 Ω to 1 kΩ (1 to 10) kΩ (10 to 100) kΩ 100 kΩ to 1 MΩ (1 to 10) MΩ (10 to 100) MΩ 100 MΩ to 1 GΩ	24 μΩ/Ω + 0.1 mΩ 20 μΩ/Ω + 1 mΩ 18 μΩ/Ω + 1 mΩ 18 μΩ/Ω + 10 mΩ 18 μΩ/Ω + 0.1 Ω 24 μΩ/Ω + 7 mΩ 87 μΩ/Ω + 0.2 Ω 0.73 mΩ/Ω + 2 Ω 7.2 mΩ/Ω + 20 kΩ	Agilent 3458A Opt 002
AC Voltage - Source ¹	Up to 2.2 mV (10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz	2.4 mV/V + 4 μV 2.4 mV/V + 4 μV 2.2 mV/V + 4 μV 2.2 mV/V + 4 μV 2.3 mV/V + 5 μV 2.5 mV/V + 10 μV 2.7 mV/V + 20 μV 3.8 mV/V + 20 μV	Fluke 5720A
AC Voltage - Source ¹	(2.2 to 22) mV (10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz (22 to 220) mV (10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz	0.61 mV/V + 4 μV 0.56 mV/V + 4 μV 0.36 mV/V + 4 μV 0.42 mV/V + 4 μV 0.70 mV/V + 5 μV 1.3 mV/V + 10 μV 1.7 mV/V + 20 μV 3.4 mV/V + 20 μV 0.29 mV/V + 12 μV 0.13 mV/V + 7 μV 0.11 mV/V + 7 μV 0.24 mV/V + 7 μV 0.54 mV/V + 17 μV 1.1 mV/V + 20 μV 1.6 mV/V + 25 μV 3.3 mV/V + 45 μV	Fluke 5720A



Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
AC Voltage - Source ¹	(0.22 to 2.2) V		Fluke 5720A
	(10 to 20) Hz	0.28 mV/V + 40 μV	
	(20 to 40) Hz	0.11 mV/V + 15 μV	
	40 Hz to 20 kHz	55 μV/V + 8 μV	
	(20 to 50) kHz	0.12 mV/V + 10 μV	
	(50 to 100) kHz	0.13 mV/V + 30 μV	
	(100 to 300) kHz	0.49 mV/V + 80 μV	
	(300 to 500) kHz	1.2 mV/V + 0.2 mV	
	500 kHz to 1 MHz	2.0 mV/V + 0.3 mV	
	(2.2 to 22) V		
	(10 to 20) Hz	0.28 mV/V + 0.2 mV	
	(20 to 40) Hz	0.11 mV/V + 0.15 mV	
	40 Hz to 20 kHz	56 μV/V + 50 μV	
	(20 to 50) kHz	0.12 mV/V + 0.1 mV	
	(50 to 100) kHz	0.12 mV/V + 0.2 mV	
	(100 to 300) kHz	0.32 mV/V + 0.6 mV	
	(300 to 500) kHz	1.2 mV/V + 2 mV	
	500 kHz to 1 MHz	1.8 mV/V + 3.2 mV	
	(22 to 220) V		
	(10 to 20) Hz	0.28 mV/V + 4 mV	
(20 to 40) Hz	0.11 mV/V + 1.5 mV		
40 Hz to 20 kHz	65 μV/V + 0.6 mV		
(20 to 50) kHz	0.12 mV/V + 1 mV		
(50 to 100) kHz	0.18 mV/V + 2.5 mV		
(100 to 300) kHz	1.1 mV/V + 16 mV		
(300 to 500) kHz	5.1 mV/V + 40 mV		
500 kHz to 1 MHz	9.3 mV/V + 80 mV		
220 V to 1.1 kV			
(15 to 50) Hz	0.35 mV/V + 16 mV		
50 Hz to 1 kHz	88 μV/V + 3.5 mV		
AC Voltage Harmonics – Source (2 nd to 50 th) ¹			Fluke 5520A
(10 to 45) Hz	32 mV to 33 V	0.35 mV/V + 16 μV	
(45 to 65) Hz	33 mV to 1 kV	0.21 mV/V + 16 μV	
(65 to 500) Hz	33 mV to 1 kV	0.21 mV/V + 16 μV	
500 Hz to 5 kHz	330 mV to 1 kV	0.21 mV/V + 0.21 mV	
(5 to 10) kHz	3.3 V to 1 kV	0.21 mV/V + 1.2 mV	



Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
AC Voltage - Measure ¹ Bandwidth < 2 MHz	Up to 10 mV		Agilent 3458A Opt 002
	(1 to 40) Hz	0.46 mV/V + 13 μV	
	40 Hz to 1 kHz	0.35 mV/V + 11 μV	
	(1 to 20) kHz	0.46 mV/V + 11 μV	
	(20 to 50) kHz	1.3 mV/V + 11 μV	
	(50 to 100) kHz	5.9 mV/V + 11 μV	
	(100 to 300) kHz	46 μV/V + 12 μV	
	(10 to 100) mV		
	(1 to 40) Hz	0.14 mV/V + 4.5 μV	
	40 Hz to 1 kHz	0.14 mV/V + 2.5 μV	
	(1 to 20) kHz	0.22 mV/V + 2.5 μV	
	(20 to 50) kHz	0.41 mV/V + 2.5 μV	
	(50 to 100) kHz	0.99 mV/V + 2.5 μV	
	(100 to 300) kHz	3.5 mV/V + 11 μV	
	300 kHz to 1 MHz	12 mV/V + 11 μV	
	(1 to 2) MHz	18 mV/V + 11 μV	
	100 mV to 1 V		
	(1 to 40) Hz	0.14 mV/V + 45 μV	
	40 Hz to 1 kHz	0.14 mV/V + 25 μV	
	(1 to 20) kHz	0.22 mV/V + 25 μV	
	(20 to 50) kHz	0.41 mV/V + 25 μV	
	(50 to 100) kHz	0.99 mV/V + 25 μV	
	(100 to 300) kHz	3.5 mV/V + 0.11 mV	
	300 kHz to 1 MHz	12 mV/V + 0.11 mV	
	(1 to 2) MHz	18 mV/V + 0.11 mV	
	(1 to 10) V		
	(1 to 40) Hz	0.14 mV/V + 0.45 mV	
	40 Hz to 1 kHz	0.14 mV/V + 0.25 mV	
	(1 to 20) kHz	0.22 mV/V + 0.25 mV	
	(20 to 50) kHz	0.41 mV/V + 0.25 mV	
	(50 to 100) kHz	0.98 mV/V + 0.25 mV	
	(100 to 300) kHz	3.5 mV/V + 1.1 mV	
	300 kHz to 1 MHz	12 mV/V + 1.1 mV	
	(1 to 2) MHz	18 mV/V + 1.1 mV	
	(10 to 100) V		
	(1 to 40) Hz	0.29 mV/V + 4.5 mV	
40 Hz to 1 kHz	0.29 mV/V + 2.5 mV		
(1 to 20) kHz	0.29 mV/V + 2.5 mV		
(20 to 50) kHz	0.29 mV/V + 2.5 mV		
(50 to 100) kHz	1.5 mV/V + 2.5 mV		
(100 to 300) kHz	4.7 mV/V + 11 mV		
300 kHz to 1 MHz	18 mV/V + 11 mV		



Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
AC Voltage - Measure ¹ Bandwidth < 2 MHz	100 V to 1 kV (1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.52 mV/V + 45 mV 0.52 mV/V + 25 mV 0.75 mV/V + 25 mV 1.5 mV/V + 25 mV 3.5 mV/V + 25 mV	Agilent 3458A Opt 002
	(1 to 10) kV (50 to 60) Hz (10 to 100) kV (50 to 60) Hz	0.12 kV 1.2 kV	Hipotronics KVM-100
AC Voltage – Measure ¹ Bandwidth > 2 MHz	Up to 10 mV 45 Hz to 100 kHz 100 kHz to 1 MHz (1 to 4) MHz (4 to 8) MHz (10 to 100) mV 45 Hz to 100 kHz 100 kHz to 1 MHz (1 to 4) MHz (4 to 8) MHz (8 to 10) MHz	1.2 mV/V + 6 μV 14 mV/V + 5.1 μV 83 mV/V + 7.1 μV 0.24 V/V + 8.1 μV 1.1 mV/V + 61 μV 24 mV/V + 51 μV 47 mV/V + 71 μV 47 mV/V + 81 μV 0.18 V/V + 0.1 mV	Agilent 3458A Opt 002
	100 mV to 1 V 45 Hz to 100 kHz 100 kHz to 1 MHz (1 to 4) MHz (4 to 8) MHz (8 to 10) MHz (1 to 10) V 45 Hz to 100 kHz 100 kHz to 1 MHz (1 to 4) MHz (4 to 8) MHz (8 to 10) MHz	1.1 mV/V + 0.61 mV 24 mV/V + 0.51 mV 47 mV/V + 0.71 mV 47 mV/V + 0.81 mV 0.18 V/V + 1 mV 1.2 mV/V + 6.1 μV 24 mV/V + 5.1 μV 47 mV/V + 7.1 μV 47 mV/V + 8.1 μV 0.18 V/V + 10 μV	Agilent 3458A Opt 002
AC Voltage – Measure ¹ Bandwidth > 2 MHz	(10 to 100) V 45 Hz to 100 kHz 100 V to 1 kV 45 Hz to 100 kHz	1.5 mV/V + 2.5 mV 3.6 mV/V + 0.11 V	Hipotronics KVM-100



Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
AC Voltage - Measure ¹ Bandwidth < 1 MHz	Up to 200 mV		Fluke 8508A
	(1 to 10) Hz	0.17 mV/V + 14 μV	
	(10 to 40) Hz	0.14 mV/V + 4 μV	
	(40 to 100) Hz	0.12 mV/V + 4 μV	
	100 Hz to 2 kHz	0.11 mV/V + 2 μV	
	(2 to 10) kHz	0.14 mV/V + 4 μV	
	(10 to 30) kHz	0.34 mV/V + 8 μV	
	(30 to 100) kHz	0.77 mV/V + 20 μV	
	200 mV to 2 V		
	(1 to 10) Hz	0.15 mV/V + 0.12 mV	
	(10 to 40) Hz	0.12 mV/V + 20 μV	
	(40 to 100) Hz	90 μV/V + 20 μV	
	100 Hz to 2 kHz	75 μV/V + 20 μV	
	(2 to 10) kHz	0.11 mV/V + 20 μV	
	(10 to 30) kHz	0.22 mV/V + 0.84 mV	
	(30 to 100) kHz	0.57 mV/V + 0.2 mV	
	(100 to 300) kHz	3 mV/V + 2 mV	
	300 kHz to 1 MHz	10 mV/V + 2 mV	
	(2 to 20) V		
	(1 to 10) Hz	0.15 mV/V + 1.2 mV	
	(10 to 40) Hz	0.12 mV/V + 0.2 mV	
	(40 to 100) Hz	90 μV/V + 0.2 mV	
	100 Hz to 2 kHz	75 μV/V + 0.2 mV	
	(2 to 10) kHz	0.11 mV/V + 0.2 mV	
	(10 to 30) kHz	0.22 mV/V + 8.4 mV	
	(30 to 100) kHz	0.57 mV/V + 2 mV	
	(100 to 300) kHz	3 mV/V + 20 mV	
	300 kHz to 1 MHz	10 mV/V + 20 mV	
	(20 to 200) V		
	(1 to 10) Hz	0.15 mV/V + 12 mV	
(10 to 40) Hz	0.12 mV/V + 2 mV		
(40 to 100) Hz	90 μV/V + 2 mV		
100 Hz to 2 kHz	75 μV/V + 2 mV		
(2 to 10) kHz	0.11 mV/V + 2 mV		
(10 to 30) kHz	0.22 mV/V + 84 mV		
(30 to 100) kHz	0.57 mV/V + 20 mV		
(100 to 300) kHz	3 mV/V + 0.2 V		
300 kHz to 1 MHz	10 mV/V + 0.2 V		

Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
AC Voltage - Measure ¹ Bandwidth < 1 MHz	200 V to 1.05 kV (1 to 10) Hz (10 to 40) Hz 40 Hz to 10 kHz (10 to 30) kHz (30 to 100) kHz	0.15 mV/V + 70 mV 0.12 mV/V + 20 mV 0.12 mV/V + 20 mV 0.23 mV/V + 40 mV 0.58 mV/V + 0.2 V	Fluke 8508A
AC Current - Source ¹	Up to 220 µA (10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz 220 µA to 2.2 mA (10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.30 mA/A + 16 nA 0.20 mA/A + 10 nA 0.16 mA/A + 8 nA 0.22 mA/A + 12 nA 1.3 mA/A + 65 nA 0.31 mA/A + 40 nA 0.22 mA/A + 35 nA 0.15 mA/A + 35 nA 0.24 mA/A + 0.11 µA 1.3 mA/A + 0.65 µA	Fluke 5720A
AC Current - Source ¹	(2.2 to 22) mA (10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (22 to 220) mA (10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz 220 mA to 2.2 A 20 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (2 to 3) A (10 to 45) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.32 mA/A + 0.4 µA 0.23 mA/A + 0.35 µA 0.15 mA/A + 0.35 µA 0.24 mA/A + 0.55 µA 1.3 mA/A + 5 µA 0.30 mA/A + 4 µA 0.20 mA/A + 3.5 µA 0.15 mA/A + 2.5 µA 0.24 mA/A + 3.5 µA 1.3 mA/A + 10 µA 0.31 mA/A + 35 µA 0.53 mA/A + 80 µA 8.1 mA/A + 0.16 mA 2.1 mA/A + 0.1 mA 0.75 mA/A + 0.1 mA 6.9 mA/A + 1 mA 29 mA/A + 5 mA	Fluke 5720A



Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
AC Current - Source ¹	(3 to 11) A (45 to 100) Hz (0.1 to 1) kHz (1 to 5) kHz (11 to 20.5) A (45 to 100) Hz (0.1 to 1) kHz (1 to 5) kHz	0.74 mA/A + 2 mA 1.2 mA/A + 2 mA 35 mA/A + 2 mA 1.4 mA/A + 5 mA 1.8 mA/A + 5 mA 35 mA/A + 5 mA	Fluke 5520A
AC Current - Source ¹	(20.5 to 1 000) A (45 to 65) Hz (20.5 to 150) A (65 to 440) Hz	90 mA/A + 0.5 A 0.55 mA/A + 0.5 mA	Fluke 5520A w/ 50-turn Coil
AC Current Harmonics - Source ¹ (2 nd to 50 th) (10 to 45) Hz (45 to 65) Hz (65 to 500) Hz 500 Hz to 5 kHz (5 to 10) kHz	3.3 mA to 3 A 3.3 mA to 20.5 A 33 mA to 20.5 A 33 mA to 20.5 A (33 to 330) mA	1.1 mA/A + 4 μA 0.5 mA/A + 4 μA 1.2 mA/A + 0.1 mA 2.3 mA/A + 0.2 mA 4.6 mA/A + 0.4 mA	Fluke 5520A
AC Current - Measure ¹	Up to 100 μA (10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz 100 μA to 1 mA (10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz (5 to 20) kHz (20 to 50) kHz (50 to 100) kHz (1 to 10) mA (10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz (5 to 20) kHz (20 to 50) kHz (50 to 100) kHz	4.8 mA/A + 30 nA 1.9 mA/A + 30 nA 0.83 mA/A + 30 nA 0.83 mA/A + 30 nA 4.9 mA/A + 0.2 μA 1.9 mA/A + 0.2 μA 0.83 mA/A + 0.2 μA 0.47 mA/A + 0.2 μA 0.83 mA/A + 0.2 μA 4.9 mA/A + 0.4 μA 6.6 mA/A + 1.5 μA 4.9 mA/A + 2 μA 1.9 mA/A + 2 μA 0.83 mA/A + 2 μA 0.47 mA/A + 2 μA 0.83 mA/A + 2 μA 4.9 mA/A + 4 μA 6.6 mA/A + 15 μA	Agilent 3458A Opt 002



Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
AC Current - Measure ¹	(10 to 100) mA (10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz (5 to 20) kHz (20 to 50) kHz (50 to 100) kHz 100 mA to 1 A (10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz (5 to 20) kHz (20 to 50) kHz	4.9 mA/A + 20 μA 1.9 mA/A + 20 μA 0.83 mA/A + 20 μA 0.47 mA/A + 20 μA 0.47 mA/A + 20 μA 4.9 mA/A + 40 μA 6.6 mA/A + 0.15 mA 4.8 mA/A + 0.2 mA 2 mA/A + 0.2 mA 1.1 mA/A + 0.2 mA 1.3 mA/A + 0.2 mA 3.7 mA/A + 0.2 mA 12 mA/A + 0.4 mA	Agilent 3458A Opt 002
AC Current - Measure ¹	(1 to 10) A (20 to 50) Hz 50 Hz to 2 kHz	0.23 A/A + 10 mA 36 mA/A + 10 mA	Fluke DMM
AC Current - Measure ¹	Up to 200 μA (1 to 10) Hz 10 Hz to 10 kHz (10 to 30) kHz (30 to 100) kHz 200 μA 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	0.31 mA/A + 20 nA 0.3 mA/A + 20 nA 0.71 mA/A + 20 nA 4 mA/A + 20 nA 0.31 mA/A + 0.2 μA 0.3 mA/A + 0.2 μA 0.71 mA/A + 0.2 μA 4 mA/A + 0.2 μA 0.31 mA/A + 2 μA 0.3 mA/A + 2 μA 0.71 mA/A + 2 μA 4 mA/A + 2 μA 0.31 mA/A + 20 μA 0.3 mA/A + 20 μA 0.63 mA/A + 20 μA	Fluke 8508A



Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
AC Current - Measure ¹	200 mA to 2A 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	0.62 mA/A + 0.2 mA 0.73 mA/A + 0.2 mA 3 mA/A + 0.2 mA 0.82 mA/A + 2 mA 2.5 mA/A + 2 mA	Fluke 8508A
Capacitance - Measure ¹ 42 Hz to 5 MHz	0.32 pF to 370 mF	1.1 mF/F	Hioki 3532-50
Capacitance - Source ¹	130 pF to 3.3 nF (3.3 to 11) nF (11 to 110) nF (110 to 330) nF 330 nF to 1.1 μF (1.1 to 3.3) μF (3.3 to 11) μF (11 to 33) μF (33 to 110) μF (110 to 330) μF 330 μF to 1.1 mF (1.1 to 3.3) mF (3.3 to 11) mF (11 to 33) mF (33 to 110) mF	5.8 mF/F + 10 pF 2.9 mF/F + 10 pF 2.9 mF/F + 0.1 nF 2.9 mF/F + 0.3 nF 2.9 mF/F + 1 nF 2.9 mF/F + 3 nF 2.9 mF/F + 10 nF 4.7 mF/F + 30 nF 5.3 mF/F + 0.1 μF 1 mF/F + 0.3 μF 6 mF/F + 1 μF 5.3 mF/F + 3 μF 5.3 mF/F + 10 μF 8.9 mF/F + 30 μF 13 mF/F + 0.1 mF	Fluke 5520A
Phase - Measure ¹	(0 to 360) ° 10 Hz to 2 kHz (2 to 5) kHz (5 to 10) kHz (10 to 50) kHz (50 to 60) kHz (60 to 70) kHz (70 to 80) kHz (80 to 90) kHz (90 to 100) kHz (100 to 500) kHz 500 kHz to 1 MHz	0.026 ° 0.036 ° 0.048 ° 0.059 ° 0.07 ° 0.082 ° 0.093 ° 0.1 ° 0.12 ° 0.58 ° 1.2 °	Clark Hess 6000A



Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
Oscilloscopes ¹			Fluke 5520A SC1100
DC Voltage (50 Ω)	1 mV to 6.6 V	2.9 mV/V + 40 μV	
DC Voltage (1 MΩ)	1 mV to 130 V	0.55 mV/V + 40 μV	
AC Voltage (50 Ω)	1 mV to 6.6 V	2.9 mV/V + 40 μV	
AC Voltage (1 MΩ)	1 mV to 130 V	1.1 mV/V + 40 μV	
Leveled Sine Wave 50 kHz to 1.1 GHz	5 mV to 5.5 V	51 mV/V + 0.1 mV	
Time Markers	1 ns to 5 s	6.4 μs/s	
Wave Generator (50 Ω)	1.8 mV to 2.5 V p-p	35 mV/V + 0.10 mV	
Wave Generator (1 MΩ)	1.8 mV to 55 V p-p	35 mV/V + 0.10 mV	
Pulse Generator - Width	(4 to 45) nS (45 to 500) nS	58 mS/S + 0.5 ns 58 mS/S + 4 ns	
Pulse Generator - Period	200 ns to 20 mS	58 mS/S + 0.2 μs	
Input Impedance Measure	(50 to 60) Ω 500 kΩ to 1 MΩ	1.2 mΩ/Ω 1.2 mΩ/Ω	
DC Power - Source ¹	10 mW to 330 W 330 W to 3 kW (3 to 20.5) kW	0.27 mW/W 0.26 mW/W 0.82 mW/W	Fluke 5520A
AC Power - Source ¹	100 μW to 9 W (9 to 33) W (33 to 90) W (90 to 330) W (330 to 900) W 900 W to 2.2 kW	1.7 mW/W 1.2 mW/W 1.7 mW/W 1.2 mW/W 11 mW/W 4.6 mW/W	Fluke 5520A



Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
Electrical Simulation of RTDs ¹	Pt 385, 100 Ω		Fluke 5520A
	(-200 to -80) °C	0.05 °C	
	(-80 to 0) °C	0.05 °C	
	(0 to 100) °C	0.07 °C	
	(100 to 300) °C	0.09 °C	
	(300 to 400) °C	0.10 °C	
	(500 to 630) °C	0.12 °C	
	(630 to 800) °C	0.23 °C	
	Pt 3926, 100 Ω		
	(-200 to -80) °C	0.05 °C	
	(-80 to 0) °C	0.05 °C	
	(0 to 100) °C	0.07 °C	
	(100 to 300) °C	0.09 °C	
	(300 to 400) °C	0.10 °C	
	(500 to 630) °C	0.12 °C	
	Pt 3916 (JIS) 100 Ω		
	(-200 to -190) °C	0.25 °C	
	(-190 to -80) °C	0.04 °C	
	(-80 to 0) °C	0.05 °C	
	(100 to 260) °C	0.06 °C	
	(260 to 300) °C	0.07 °C	
	(300 to 400) °C	0.09 °C	
	(400 to 600) °C	0.10 °C	
	(600 to 630) °C	0.23 °C	
	Pt 385, 200 Ω		
	(-200 to -80) °C	0.04 °C	
	(-80 to 0) °C	0.04 °C	
	(0 to 100) °C	0.04 °C	
	(100 to 260) °C	0.05 °C	
	(260 to 300) °C	0.12 °C	
(300 to 400) °C	0.13 °C		
(400 to 600) °C	0.14 °C		
(600 to 630) °C	0.16 °C		
Pt 385, 500 Ω			
(-200 to -80) °C	0.04 °C		
(-80 to 0) °C	0.05 °C		
(0 to 100) °C	0.05 °C		
(100 to 260) °C	0.06 °C		
(260 to 300) °C	0.08 °C		
(300 to 400) °C	0.08 °C		
(400 to 600) °C	0.09 °C		
(600 to 630) °C	0.11 °C		



Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment	
Electrical Simulation of RTDs ¹	Pt 385, 1 000 Ω			
	(-200 to -80) °C	0.03 °C	Fluke 5520A	
	(-80 to 0) °C	0.03 °C		
	(0 to 100) °C	0.04 °C		
	(100 to 260) °C	0.05 °C		
	(260 to 300) °C	0.06 °C		
	(300 to 400) °C	0.07 °C		
	(400 to 600) °C	0.07 °C		
	(600 to 630) °C	0.23 °C		
	PtNi 385, 120 Ω, Ni 120			
	(-80 to 0) °C	0.08 °C		
	(0 to 100) °C	0.08 °C		
	(100 to 260) °C	0.14 °C		
Cu 427, 10 Ω				
(-100 to 260) °C	0.03 °C			
Electrical Simulation of Thermocouples ¹	Type K		Fluke 5520A	
	(-200 to -100) °C	0.33 °C		
	(-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	0.40 °C		
	Type J			
	(-210 to -100) °C	0.27 °C		
	(-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 E			
	(-250 to -100) °C	0.50 °C		
	(-100 to -35) °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 T			
	(-250 to -150) °C	0.63 °C		
(-150 to 0) °C	0.24 °C			
(0 to 120) °C	0.16 °C			
(120 to 400) °C	0.14 °C			
Type S				
(0 to 250) °C	0.47 °C			
(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			

Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
Electrical Simulation of Thermocouples ¹	Type B (600 to 800) °C	0.44 °C	Fluke 5520A
	(-100 to -25) °C	0.34 °C	
	(-25 to 120) °C	0.30 °C	
	(120 to 1 000) °C	0.33 °C	
	Type C (0 to 150) °C	0.30 °C	
	(150 to 650) °C	0.26 °C	
	(650 to 1 000) °C	0.31 °C	
	(1 000 to 1 800) °C	0.50 °C	
	(1 800 to 2 316) °C	0.84 °C	
	Type L (-200 to -100) °C	0.37 °C	
	(-100 to 800) °C	0.26 °C	
	(800 to 900) °C	0.17 °C	
	Type N (-200 to -100) °C	0.40 °C	
	(-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	
(250 to 400) °C	0.35 °C		
(400 to 1 000) °C	0.33 °C		
(1 000 to 1 767) °C	0.40 °C		
Type U (-200 to 0) °C	0.56 °C		
(0 to 600) °C	0.27 °C		
Inductance - Source ¹	(1 to 10) mH	22 mH/H	General Radio 1490-D
	(10 to 100) mH	11 mH/H	
	100 mH to 1 H	6 mH/H	
	(1 to 10) H	3 mH/H	
Ionizers ¹ Decay Time Float Voltage	(0.1 to 999.9) s	0.2 s	Trek 156A
	(-1 100 to 1 100) V	3.1 V	



Electrical - RF/Microwave

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
RF Power - Measure ^{1,4} Absolute Level 100 kHz to 3 GHz (3 to 18) GHz (18 to 26.5) GHz 100 kHz to 3 GHz (3 to 18) GHz (18 to 26.5) GHz	(+20 to +30) dBm (-20 to +20) dBm	0.37 dB 0.39 dB 0.4 dB 0.15 dB 0.18 dB 0.21 dB	Agilent N5531S Measuring Receiver with N5532A Sensor Modules
Amplitude Modulation - Source ^{1,4} Rate: DC to 100 kHz Depths: 0 % to 100 %	250 kHz to 40 GHz	7.1 % of setting + 1 %	Agilent E8257D
Amplitude Modulation - Measure ^{1,4} 100 kHz to 10 MHz 10 MHz to 3 GHz 10 MHz to 3 GHz (3 to 26.5) GHz (3 to 26.5) GHz	Rate: 50 Hz to 10 kHz Depths: 5 % to 99 % Rate: 50 Hz to 100 kHz Depths: 20 % to 99 % Rate: 50 Hz to 100 kHz Depths: 5 % to 20 % Rate: 50 Hz to 100 kHz Depths: 20 % to 99 % Rate: 50 Hz to 100 kHz Depths: 5 % to 20 %	2.2 % of reading 1.2 % of reading 4.2 % of reading 3.5 % of reading 6 % of reading	Agilent N5531S Measuring Receiver with N5532A Sensor Modules
Phase Modulation - Source ^{1,4} Rate: DC to 100 kHz	250 kHz to 40 GHz	5.9 % setting + 0.1 rad	Agilent E8257D



Electrical - RF/Microwave

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
Phase Modulation - Measure ^{1,4}			
100 kHz to 6.6 GHz	Rate: 200 Hz 20 kHz Dev.: > 0.7 rad	1.2 % of reading	Agilent N5531S Measuring Receiver with N5532A Sensor Modules
100 kHz to 6.6 GHz	Rate: 200 Hz 20 kHz Dev.: > 0.3 rad	3.6 % of reading	
(6.6 to 13.2) GHz	Rate: 200 Hz 20 kHz Dev.: > 2.0 rad	1.2 % of reading	
(6.6 to 13.2) GHz	Rate: 200 Hz 20 kHz Dev.: > 0.6 rad	3.6 % of reading	
(13.2 to 26.5) GHz	Rate: 200 Hz 20 kHz Dev.: > 2.0 rad	1.2 % of reading	
(13.2 to 26.5) GHz	Rate: 200 Hz 20 kHz Dev.: > 0.6 rad	3.6 % of reading	
Tuned RF Level - Measure ^{1,4} Absolute Level			
500 kHz to 3.05 GHz	(+16 to +30) dBm (-106 to +16) dBm (-129 to -106) dBm	0.37 dB + 0.005 dB/10 dB 0.15 dB + 0.005 dB/10 dB 0.15 dB + 0.12 dB/10 dB	Agilent N5531S Measuring Receiver with N5532A Sensor Modules
(3.05 to 6.6) GHz	(+20 to +30) dBm (-90 to +20) dBm (-114 to -90) dBm	0.39 dB + 0.005 dB/10 dB 0.18 dB + 0.005 dB/10 dB 0.23 dB + 0.12 dB/10 dB	
(6.6 to 13.2) GHz	(+20 to +30) dBm (-81 to +20) dBm (-104 to -81) dBm	0.39 dB + 0.005 dB/10 dB 0.18 dB + 0.005 dB/10 dB 0.23 dB + 0.12 dB/10 dB	
(13.2 to 19.2) GHz	(+20 to +30) dBm (-70 to +20) dBm (-93 to -70) dBm	0.4 dB + 0.005 dB/10 dB 0.21 dB + 0.005 dB/10 dB 0.25 dB + 0.12 dB/10 dB	
(19.2 to 26.5) GHz	(+20 to +30) dBm (-62 to +20) dBm (-85 to -62) dBm	0.4 dB + 0.005 dB/10 dB 0.21 dB + 0.005 dB/10 dB 0.24 dB + 0.12 dB/10 dB	
Tuned RF Level - Measure ^{1,4} Relative Level			
500 kHz to 3.05 GHz	(-90 to +30) dBm (-106 to -90) dBm (-129 to -106) dBm	0.026 dB + 0.005 dB/10 dB 0.067 dB + 0.12 dB/10 dB 0.076 dB + 0.12 dB/10 dB	Agilent N5531S Measuring Receiver with N5532A Sensor Modules



Electrical - RF/Microwave

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
RF Power Sensors- Calibration Factor ^{1,4} 100 kHz to 10 MHz 10 MHz to 10 GHz (10 to 18) GHz	(-20 to +14) dBm	1.5 % 1.5 % 1.7 %	Tegam 1827, Agilent 3458A, Agilent E8257D, Agilent E4419B, Agilent 3325B
Frequency Modulation - Measure ^{1,4} 250 kHz to 10 MHz 10 MHz to 3 GHz (3 to 26.5) GHz	Rate: 20 Hz to 10 kHz Dev.: ≤ 40 kHz peak Rate: 20 Hz to 200 kHz Dev.: ≤ 400 kHz peak Rate: 20 Hz to 200 kHz Dev.: ≤ 400 kHz peak	3.1 % of reading 3.1 % of reading 7.7 % of reading	Agilent N5531S Measuring Receiver with N5532A Sensor Modules
Frequency Modulation - Source ^{1,4} 250 kHz to 40 GHz	1 dB Rate: DC to 100 kHz 3 dB Rate: DC to 10 MHz Dev: ≤ (N X 800 kHz)	4.2 % setting + 20 Hz	Agilent E8257D
Pulse Generation - Measure ^{1,4} DC to 225 MHz Pulse Width Rise/Fall Time	5 ns to 10 ⁵ S 5 ns to 10 ⁵ S	1.1 nS 1.1 nS	Agilent 53132A
Pulse Generation - Source ^{1,4} Repetition Frequency: 0.024 Hz to 14.28 MHz Period: 70 ns to 42 s	10 ns to 42 s	17 ns	Agilent E8257D
Pulse Modulation - Source ^{1,4} Level Rise/Fall Time	(0 to 9) dBm 10 MHz to 40 GHz	0.59 dBm 12 ns	Agilent E8257D

Length – Dimensional Metrology

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
Cylindrical Rings ^{1,2}	(0.25 to 8) in	(12 + 3D) μin	Fowler Lab Concept ASME B89.1.6
Cylindrical Plugs ^{1,2}	(0.010 to 4) in	(53 + 0.4D) μin	Plug gage Comparator



Length – Dimensional Metrology

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
Threaded Plugs ^{1,2} Pitch Diameter Major Diameter	(0.01 to 4) in (0.01 to 4) in	(73 + 3.2D) μin (53 + 4.1D) μin	Plug gage Comparator
Calipers ^{1,2}	Up to 80 in	(380 + 15L) μin	Gage Blocks
Indicators ^{1,2}	Up to 4 in	(36 + 10L) μin	Indicator Checker
Test Indicators ¹	Up to 0.06 in	39 μin	Indicator Checker
OD Micrometers ^{1,2}	Up to 60 in	(72 + 12L) μin	Gage Blocks
ID Micrometer ^{1,2}	(1.5 to 40) in	(370 + 7L) μin	Gage Blocks
Height Gages ^{1,2}	Up to 40 in	(96 + 14L) μin	Gage Blocks
Bore Gages ¹	(0.25 to 12) in	350 μin	Cylindrical Rings
Crimpers ¹ Die Check Crimp Height	(0.011 to 0.5) in (0.01 to 0.5) in	230 μin 0.001 2 in	Pin Gages Micrometer
Profilometers ¹ Ra	(2 to 300) μin	2.2 μin	Roughness Specimen
Surface Plates ^{1,2} Repeat Reading Overall Flatness	(4 to 34) in Diagonal (34 to 175) in Diagonal	(30 + 0.2D) μin (66 + 0.2D) μin	Repeat – O – Meter Electronic Levels
CMM Calibration ^{1,2} Volumetric Linearity Linearity	(5 to 40) in (1 to 60) in Above 60 in	(12 + 14L) μin (7 + 14L) μin (20 + 0.4L) μin	Ball Bars Step Gage Renishaw Laser System B89.4.1
Linear Measurements ^{1,2}	Up to 1 560 in	(38 + 0.5L) μin	Laser
Optical Comparators ^{1,2} Linearity Magnification	Up to 12 in 10x, 20x, 31.25x, 50x, 62.5x, 100x, 200x	(97 + 12L) μin 0.000 46 in	Glass Scale Precision Balls Calibration Sphere
Roundness Testers ¹ Axial Error Radial Error	(-1 000 to 1 000) μm	0.15 μm 0.15 μm	Test Sphere
ULMs ¹ Length	(1 to 100) mm	0.19 μm	Gage Blocks
Film Thickness Gages ¹	(0.01 to 0.06) in	380 μin	Film Thickness Standards
Brinell Scopes ¹	(1 to 6) mm	11 μm	Stage Micrometer



Mass

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
Bench and Floor Scales ¹	(0.001 to 5 000) lb	0.000 7 lb/lb	NIST 105 Class F Weights NIST Handbook 44
Analytical Balances ¹	(0.001 mg to 13 kg)	0.19 µg/g	ASTM E617 Class 1 Weights NIST Handbook 44
Pressure ¹	(-13 to 300) psi (300 to 1 000) psi	0.1 psi 1.3 psi	Pressure Calibrator
	(1 000 to 10 000) psi	3.9 psi	Pressure Transducers
Environmental Pressure Gage ¹	(0 to 100) in H ₂ O	0.017 in H ₂ O	Pressure Module
Direct Verification per ASTM D2240 of Durometers ¹	Up to 100 duro	0.35 duro	Durometer Calibrator
Spring Force Indenter Angle	(0.1 to 45) N (20 to 40) °	0.05 N 0.07 °	Triple Beam Balance, Video Measuring Machine
Indenter Length Indenter Radius	(0.049 to 0.198) in (0.05 to 0.1) in	330 µin 340 µin	Gage Blocks
Direct Verification per ASTM E10 of Brinell Hardness Testers ¹ Verification of Test Force	(500, 750, 1 500, 2 000, 3 000) kgf	7.2 Kgf	Morehouse Proving Ring
Verification of Indenter Mean Diameter	10 mm 5 mm	0.002 mm 0.002 mm	
Indirect Verification per ASTM E10 of Brinell Hardness Testers ¹	(1 to 7) mm	0.03 mm	Brinell Test Blocks & Brinell Scope
Indirect Verification per ASTM E384 of Knoop and Vickers Hardness Testers ¹	(1 to 200) µm (1 to 200) µm	0.25 µm 0.17 µm	Knoop & Vickers Test Blocks
Indirect Verification per ASTM A596 of Leeb Hardness Tester ¹	550 LD, 836 LD	20 LD	Leeb Test Block



Mass

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
Indirect Verification per ASTM E18 of Rockwell Hardness Testers ¹	HRA Low	1.2 HRA	Rockwell Test Blocks
	HRA Med	1.2 HRA	
	HRA High	0.75 HRA	
	HRBW Low	1.4 HRBW	
	HRBW Med	1.4 HRBW	
	HRBW High	1.3 HRBW	
	HRC Low	1.2 HRC	
	HRC Med	1.2 HRC	
	HRC High	0.7 HRC	
	HRE Low	1.3 HRE	
	HRE Med	1.4 HRE	
	HRE High	1.4 HRE	
	HRF Low	1.4 HRF	
	HRF Med	1.4 HRF	
	HRF High	1.4 HRF	
	HRH Low	1.4 HRH	
	HRH Med	1.4 HRH	
	HRH High	1.4 HRH	
	HRKW Low	1.4 HRKW	
	HRKW Med	1.3 HRKW	
	HRKW High	1.3 HRKW	
	HRMW Low	1.4 HRMW	
	HRMW Med	1.4 HRMW	
	HRMW High	1.3 HRMW	



Mass

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
Indirect Verification per ASTM E18 of Rockwell Superficial Hardness Testers ¹	HR15N Low	1.5 HR15N	Rockwell Test Blocks
	HR15N Med	1.3 HR15N	
	HR15N High	0.9 HR15N	
	HR30N Low	1.3 HR30N	
	HR30N Med	1.3 HR30N	
	HR30N High	0.9 HR30N	
	HR45N Low	1.4 HR45N	
	HR45N Med	1.3 HR45N	
	HR45N High	0.95 HR45N	
	HR15TW Low	2 HR15TW	
	HR15TW Med	1.4 HR15TW	
	HR15TW High	1.5 HR15TW	
	HR30TW Low	2 HR30TW	
	HR30TW Med	1.5 HR30TW	
HR30T High	1.3 HR30TW		
HR45TW Low	2.0 HR45TW		
HR45TW Med	1.3 HR45TW		
HR45TW High	1.4 HR45TW		
Force ¹	(0.001 to 200) lb (200 to 10 000) lb (10 000 to 50 000) lb	0.05 % of reading 0.07 % of reading 0.1 % of reading	Dead Weight Load Cell Load Cell
Torque Tools ¹	4 lbf-in to 2 500 lbf-ft	0.3 % of reading	AKO Torque System
Viscosity Rotational Viscometers	500 cP 5 000 cP	0.02 cP/cP	Viscosity Solutions, Temperature Bath
Viscosity Cups	17.82 cP 65.28 cP 231 cP	0.03 cP/cP	Viscosity Solutions, Temperature Bath, Stopwatch ASTM D4212



Photometry and Radiometry

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
Optical Power - Measure ¹ (800 to 1 650) nm	(+20 to -70) dBm	0.03 dB/dBm	Agilent 81533B, 81525A
Optical Power - Source ¹ (820, 1 310, 1 550) nm	(0 to -60) dB	0.05 dB/dB	Agilent 81554SM, 81533B, 81525A, 81655A, 81570A, and 81578A
Optical Attenuation - Source ¹ (700 to 1 650) nm	(0 to -60) dB	0.04 dB/dB	Agilent 81570A and 81578A
Optical Wavelength - Measure ¹	(700 to 1 650) nm	0.05 nm	Agilent 86120B

Thermodynamic

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
Immersion Probes ¹	(-95 to 140) °C	0.03 °C	Fluke 9190A with PRT
Temperature - Measure ¹	(-30 to 600) °C	0.03 °C	Hart Scientific 1502 with PRT
System Accuracy Test ¹ (SAT)	(0 to 2 200) °F	2.6 °F	Certified Thermocouple
Temperature Uniformity Survey ¹ (TUS)	(0 to 2 200) °F	4.9 °F	MV 1000 Data Logger or Equivalent

Time and Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
Time Interval ¹	(1 to 86 400) s	0.000 45 s	Agilent 53132A & Spectracom 8197B
Frequency Measure ¹	0.1 Hz to 225 MHz	6.7 parts in 10 ⁻¹¹ Hz	Agilent 53132A, SRS FS725
	0.1 Hz to 26.5 GHz	6.7 parts in 10 ⁻¹¹ Hz	Agilent N5531S, SRS FS725
Frequency Source ¹	10 MHz	6.7 parts in 10 ⁻¹¹ Hz	SRS FS725

Time and Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
	0.1 mHz to 40 GHz	6.7 parts in 10^{-11} Hz	Agilent 3325B, Agilent E8257D, SRS FS725
Tachometers ¹ Contact Non-Contact	(1 to 6 500) rpm (500 to 40 000) rpm	0.08 % of reading	King Nutronics 3711-B
Tachometers ¹ Non-Contact	(0.01 to 100 000) rpm	0.005 % of reading	Fluke 5520A

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. This scope is formatted as part of a single document including Certificate of Accreditation No. ACT-1272.03.



Vice President

