



THE AMERICAN ASSOCIATION FOR
LABORATORY ACCREDITATION

ACCREDITED LABORATORY

A2LA has accredited

NOVASTAR METROLOGY

Livonia, MI

for technical competence in the field of

Calibration

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005 *General Requirements for the Competence of Testing and Calibration Laboratories*. This laboratory also meets the requirements of ANSI/NCSL Z540-1-1994 and any additional program requirements in the field of calibration. 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 8 January 2009*).



Presented this 8th day of April 2009.

A handwritten signature in cursive script, reading "Peter Meyer".

President
For the Accreditation Council
Certificate Number 1277.01
Valid to March 31, 2011

For the calibrations to which this accreditation applies, please refer to the laboratory's Calibration Scope of Accreditation.

SCOPE OF ACCREDITATION TO ISO/IEC 17025:2005
& ANSI/NCSL Z540-1994

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CALIBRATION

Valid To: March 31, 2011

Certificate Number: 1277.01

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory to perform the following calibrations¹:

I. Acoustical Quantities

Parameter/Range	Frequency	Best Uncertainty ² (±)	Comments
Acoustic Level –			
Sensitivity			
¼ inch	114 dB @ 250 Hz	0.16 dB	2900 B Larson Davis sound level calibration system (comparison method)
½ inch	114 dB @ 250 Hz	0.16 dB	
1 inch	114 dB @ 250 Hz	0.17 dB	
Frequency Response			
¼ inch	20 Hz to 50 kHz (50 to 126) kHz	0.2 dB 0.63 dB	
½ inch	20 Hz to 50 kHz (50to 126) kHz	0.2 dB 0.63 dB	
1 inch	20 Hz to 50 kHz (50 to 126) kHz	0.2 dB 0.63 dB	

Parameter/Range	Frequency	Best Uncertainty ² (\pm)	Comments
Acoustic Level – (cont) Capacitance	< 100 pF	0.23 pF	2900 B Larson Davis sound level calibration system (comparison method)

II. Chemical

Parameter/Range	Range	Best Uncertainty ^{2,6} (\pm)	Comments
pH	4.01 pH 7.01 pH 10.01 pH	0.012 pH + 0.6R 0.015 pH + 0.6R 0.028 pH + 0.6R	Accredited solutions; <i>R</i> is the resolution of the unit under test in pH

III. Dimensional

Parameter/Equipment	Range	Best Uncertainty ^{2,6} (\pm)	Comments
Micrometers ³	(0 to 36) in	$(1.7 + 4.9L) \mu\text{in} + 0.6R$	Gage blocks / optical flat
Calipers ³	(0 to 36) in	$(1.6 + 11.4L) \mu\text{in} + 0.6R$	Gage blocks
Coordinate Measuring Machines (CMM) – Linear Displacement Volumetric Performance	(0 to 120) in 300 mm 600 mm	$(25 + 1.6L) \mu\text{in}$ 2.3 μm 3.9 μm	ASME B89.4.1, section 5.4 using laser w/environ- mental compensation w/ ball bar

Parameter/Equipment	Range	Best Uncertainty ^{2,4,6} (\pm)	Comments
Coordinate Measuring Machines (CMM) – (cont)			ASME B89.4.1, section 5.4 using laser w/environmental compensation
Squareness	300 mm 600 mm	2.3 μ m 3.9 μ m	w/ ball bar
Machine Repeatability	1 in	51 μ m	and 5.3.3 w/ sphere
Linear Velocity ³	\pm 14 in/s	0.066 %	Laser
Angle	\pm 90°	1.0'	Optical protractor
Optical Comparators ³	10 \times to 100 \times (0.001 to 6) in (30/60/90/120/150)°	440 μ m + 0.6R 130 μ m + 0.6R 0.0074° + 0.6R	Magnification scale Glass scale
Pin & Plug Gages	(0.003 to 1.0) in	(31 + 4.6L) μ m	Laser micrometer
Height Gages ³	(0 to 48) in	(2.4 + 12L) μ m + 0.6R	Gage blocks
Indicators ³ – Dial & Digital	(0 to 4) in (0 to 100) mm	(1.4 + 4.5L) μ m + 0.6R (54 + 7.6L) nm + 0.6R	Gage blocks
Gage Blocks –	(0 to 1) in (0.01 to 4) in (0.5 to 100) mm	4.6 μ m (1.6 + 3.7L) μ m (74 + 3.4L) nm	Twin head comparison

IV. Electrical - DC/Low Frequency

Parameter/Range	Frequency	Best Uncertainty ² (±)	Comments
AC Current ³ – Generate			
(29 to 330) µA	(10 to 20) Hz	0.28 % + 0.1 µA	Fluke 5520A
	(20 to 45) Hz	0.22 % + 0.1 µA	
	45 Hz to 1 kHz	0.19 % + 0.1 µA	
	(1 to 5) kHz	0.37 % + 0.15 µA	
(29 to 330) mA	(5 to 10) kHz	0.93 % + 0.2 µA	
	(10 to 30) kHz	1.9 % + 0.4 µA	
(0.33 to 3.3) mA	(10 to 20) Hz	0.26 % + 0.15 µA	
	(20 to 45) Hz	0.15 % + 0.15 µA	
	45 Hz to 1 kHz	0.12 % + 0.15 µA	
	(1 to 5) kHz	0.24 % + 0.2 µA	
	(5 to 10) kHz	0.6 % + 0.3 µA	
	(10 to 30) kHz	1.3 % + 0.6 µA	
(3.3 to 33) mA	(10 to 20) Hz	0.23 % + 2 µA	
	(20 to 45) Hz	0.12 % + 2 µA	
	45 Hz to 1 kHz	0.10 % + 2 µA	
	(1 to 5) kHz	0.26 % + 2 µA	
	(5 to 10) kHz	0.27 % + 3 µA	
	(10 to 30) kHz	0.53 % + 4 µA	
(33 to 330) mA	(10 to 20) Hz	0.21 % + 20 µA	
	(20 to 45) Hz	0.11 % + 20 µA	
	45 Hz to 1 kHz	0.047 % + 20 µA	
	(1 to 5) kHz	0.12 % + 50 µA	
	(5 to 10) kHz	0.24 % + 0.1 mA	
	(10 to 30) kHz	0.47 % + 0.2 mA	
(0.33 to 1) A	(10 to 45) Hz	0.19 % + 0.1 mA	

Parameter/Range	Frequency	Best Uncertainty ² (±)	Comments
AC Current ³ – Generate (cont)			
(0.33 to 1) A	45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.052 % + 0.1 mA 0.62 % + 1 mA 2.6 % + 5 mA	Fluke 5520A
(1.1 to 3) A	(10 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.19 % + 0.1 mA 0.062 % + 0.1 mA 0.62 % + 1 mA 2.6 % + 5 mA	
(3 to 11) A	(45 to 100) Hz (0.1 to 1) kHz (1 to 5) kHz	0.074 % + 2 mA 0.11 % + 2 mA 3.1 % + 2 mA	
(11 to 20.5) A	(45 to 100) Hz (0.1 to 1) kHz (1 to 5) kHz	0.13 % + 5 mA 0.16 % + 5 mA 3.1 % + 5 mA	
AC Current ³ – Measure			
Up to 100 mA	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 1 kHz	0.51 % + 0.03 µA 0.21 % + 0.03 µA 0.13 % + 0.03 µA 0.13 % + 0.03 µA	HP 3458A, option II
0.1 mA to 1mA	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz (5 to 20) kHz	0.49 % + 0.2 µA 0.21 % + 0.2 µA 0.1 % + 0.2 µA 0.062 % + 0.2 µA 0.085 % + 0.2 µA	
(1 to 10) mA	(10 to 20) Hz	0.49 % + 2 µA	

Parameter/Range	Frequency	Best Uncertainty ^{2,4} (±)	Comments
AC Current ³ – Measure (cont)			
(1 to 10) mA	(20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz (5 to 20) kHz	0.17 % + 2 μA 0.085 % + 2 μA 0.061 % + 2 μA 0.069 % + 2 μA	HP 3458A, option II
(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	0.49 % + 20 μA 0.18 % + 20 μA 0.078 % + 20 μA 0.061 % + 20 μA 0.085 % + 20 μA	
100 mA to 1A	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz	0.5 % + 0.2 mA 0.24 % + 0.2 mA 0.15 % + 0.2 mA 0.18 % + 0.2 mA	
(1 to 10) A	(45 to 1000) Hz (1 to 5) kHz	0.03 % 0.08 %	HP 3458A with Fluke Y5020A current shunt
AC Voltage ³ – Generate			
(1 to 33) mV	(10 to 45) Hz 45 Hz to 10 kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 500) kHz	0.093 % + 6 μV 0.019 % + 6 μV 0.023 % + 6 μV 0.12 % + 6 μV 0.43 % + 12 μV 1.1 % + 50 μV	Fluke 5520A
(33 to 330) mV	(10 to 45) Hz 45 Hz to 10 kHz	0.033 % + 8 μV 0.018 % + 8 μV	

Parameter/Range	Frequency	Best Uncertainty ² (±)	Comments
AC Voltage ³ – Generate (cont.)			
(33 to 330) mV	(10 to 20) kHz	0.02 % + 8 μV	Fluke 5520A
	(20 to 50) kHz	0.047 % + 8 μV	
	(50 to 100) kHz	0.093 % + 32 μV	
	(100 to 500) kHz	0.26 % + 70 μV	
(0.3 to 3.3) V	(10 to 45) Hz	0.036 % + 50 μV	
	45 Hz to 10 kHz	0.018 % + 60 μV	
	(10 to 20) kHz	0.022 % + 60 μV	
	(20 to 50) kHz	0.04 % + 50 μV	
	(50 to 100) kHz	0.083 % + 0.13 mV	
	(100 to 500) kHz	0.28 % + 0.6 mV	
(3.3 to 33) V	(10 to 45) Hz	0.037 % + 0.65 mV	
	45 Hz to 10 kHz	0.018 % + 0.6 mV	
	(10 to 20) kHz	0.028 % + 0.6 mV	
	(20 to 50) kHz	0.04 % + 0.6 mV	
	(50 to 100) kHz	0.11 % + 1.6 mV	
(33 to 330) V	45 Hz to 1.0 kHz	0.024 % + 2 mV	
	(1 to 10) kHz	0.024 % + 6 mV	
	(10 to 20) kHz	0.03 % + 6 mV	
	(20 to 50) kHz	0.036 % + 6 mV	
	(50 to 100) kHz	0.24 % + 50 mV	
(330 to 1020) V	(0.45 to 1) kHz	0.031 % + 10 mV	
	(1 to 5) kHz	0.026 % + 10mV	
	(5 to 10) kHz	0.031 % + 10 mV	
AC Voltage ³ – Measure			
(0 to 10) mV	(10 to 20) Hz	0.46 % + 32 μV	HP3458A, option II

Parameter/Range	Frequency	Best Uncertainty ² (±)	Comments
AC Voltage ³ – Measure (cont.)			
(0 to 10) mV	(10 to 20) Hz (20 to 40) Hz (40 to 100) Hz 100 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 250) kHz	0.46 % + 32 µV 0.18 % + 25 µV 0.08 % + 25 µV 0.048 % + 25 µV 0.18 % + 25 µV 0.96 % + 35 µV 6.1 % + 70 µV	HP3458A, option II
(10 to 100) mV	(10 to 20) Hz (20 to 40) Hz (40 to 100) Hz 100 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 250) kHz (250 to 500) kHz	0.46 % + 20 µV 0.17 % + 20 µV 0.07 % + 10 µV 0.029 % + 10 µV 0.17 % + 40 µV 0.7 % + 80 µV 2.3 % + 0.5 mV 3.5 % + 0.6 mV	
100 mV to 1 V	(10 to 20) Hz (20 to 40) Hz (40 to 100) Hz 100 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 250) kHz (250 to 500) kHz	0.46 % + 0.2 mV 0.17 % + 0.2 mV 0.071 % + 0.1 mV 0.029 % + 0.1 mV 0.18 % + 0.4 mV 0.7 % + 0.8 mV 2.9 % + 5 mV 3.6 % + 6 mV	
(1 to 10) V	(10 to 20) Hz (20 to 40) Hz (40 to 100) Hz 100 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz	0.46 % + 2 mV 0.18 % + 2 mV 0.071 % + 1 mV 0.029 % + 1 mV 0.18 % + 4 mV 0.7 % + 8 mV	

Parameter/Range	Frequency	Best Uncertainty ² (±)	Comments
AC Voltage ³ – Measure (cont)			
(10 to 100) V	(40 to 100) Hz 100 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz	0.095 % + 10 mV 0.073 % + 10 mV 0.18 % + 40 mV 0.7 % + 80 mV	HP3458A, option II
(100 to 1000) V	(40 to 100) Hz	1.1 % + 0.2 V	
Capacitance ³ – Generate			
(0.19 to 0.4) nF	10 Hz to 10 kHz	0.7 % + 0.01 nF	Fluke 5520A
(0.4 to 1.1) nF	10 Hz to 10 kHz	0.58 % + 0.01 nF	
(1.1 to 3.3) nF	10 Hz to 3 kHz	0.52 % + 0.01 nF	
(3.3 to 11) nF	10 Hz to 1 kHz	0.28 % + 0.01 nF	
(11 to 33) nF	10 Hz to 1 kHz	0.26 % + 0.1 nF	
(33 to 110) nF	10 Hz to 1 kHz	0.26 % + 0.1 nF	
(110 to 330) nF	10 Hz to 1 kHz	0.26 % + 0.3 nF	
(0.33 to 1.1) μF	(10 to 600) Hz	0.26 % + 1 nF	
(1.1 to 3.3) μF	(10 to 300) Hz	0.26 % + 3 nF	
(3.3 to 11) μF	(10 to 150) Hz	0.26 % + 10 nF	
(11 to 33) μF	(10 to 120) Hz	0.41 % + 30 nF	
(33 to 110) μF	(10 to 80) Hz	0.46 % + 0.1 μF	
(110 to 330) μF	(10 to 50) Hz	0.46 % + 0.3 μF	
(0.33 to 1.1) mF	(0 to 20) Hz	0.45 % + 1 μF	
(1.1 to 3.3) mF	(0 to 6) Hz	0.45 % + 3 μF	
(3.3 to 11) mF	(0 to 2) Hz	0.45 % + 10 μF	
(11 to 33) mF	(0 to 0.6) Hz	0.75 % + 30 μF	
(33 to 110) mF	(0 to 0.2) Hz	1.1 % + 0.1 mF	
DC Current ³ – Generate	Up to 330 μA	0.017 % + 0.02 μA	Fluke 5520A

Parameter/Equipment	Range	Best Uncertainty ² (±)	Comments
DC Current ³ – Generate (cont.)	330 µA to 3.3 mA (3.3 to 33) mA (33 to 330) mA 330 mA to 1A (1.1 to 3) A (3 to 11) A (11 to 20) A	0.012 % + 0.05 µA 0.012 % + 0.25 µA 0.012 % + 2.5 µA 0.028 % + 40 µA 0.039 % + 40 µA 0.052 % + 0.5 mA 0.1 % + 0.75 mA	Fluke 5520A
DC Current ³ – Measure	(0 to 100) nA (0.1 to 1) mA (1 to 10) mA (10 to 100) mA (0.1 to 1) mA (1 to 10) mA (10 to 100) mA (0.1 to 1) A (1 to 10) A (10 to 100) A	0.061 % + 0.04 nA 0.0042 % + 0.04 nA 0.0023 % + 0.1 nA 0.0021 % + 0.8 nA 0.0021 % + 5 nA 0.0021 % + 50 nA 0.0035 % + 0.5 µA 0.011 % + 1 µA 0.21 % + 0.61 mA 0.21 % + 3.3 mA	HP 3458A, option II HP 3458A w/ L&N 4363 Shunt
DC Voltage ³ – Measure	(0 to 100) mV (0.1 to 1) V (1.0 to 10) V (10 to 100) V (100 to 1000) V	0.00052 % + 0.3 µV 0.00041 % + 0.3 µV 0.0004 % + 0.5 µV 0.00062 % + 30 µV 0.0063 % + 0.1 mV*	HP 3458A, option II *Add 12 mV/V· (V _{in} /1000) ² for input >100 V
DC Voltage ³ – Generate	(0 to 329.9999) mV (0 to 3.299999) V (0 to 32.99999) V (30 to 329.9999) V (100 to 1000) V	0.0021 % + 1 µV 0.0012 % + 2 µV 0.0014 % + 20 µV 0.0019 % + 0.15 mV 0.0019 % + 1.5 mV	Fluke 5520A

Parameter/Equipment	Range	Best Uncertainty ^{2,4} (±)	Comments
Inductance – Measure @ 100 Hz Fixed Values	0.1 nH to 0.1 µH 0.1 µH to 5.0 H	1 % 0.1 %	General Radio 1632A bridge with standard inductor set
Resistance ³ – Generate	(0 to 11) Ω (11 to 33) Ω (33 to 110) Ω (110 to 330) Ω (0.33 to 1.1) kΩ 1.1 to 3.3) kΩ (3.3 to 11) kΩ (11 to 33) kΩ (33 to 110) kΩ (110 to 330) kΩ (0.33 to 1.1) MΩ (0.50 to 3.3) MΩ (3.3 to 11) MΩ (11 to 33) MΩ (33 to 110) MΩ (110 to 330) MΩ (330 to 1100) MΩ	0.0046 % + 0.01 Ω 0.0032 % + 0.015 Ω 0.003 % + 0.015 Ω 0.0029 % + 0.02 Ω 0.0029 % + 0.02 Ω 0.0029 % + 0.2 Ω 0.0029 % + 0.1 Ω 0.0029 % + 1 Ω 0.0029 % + 1 Ω 0.0036 % + 10 Ω 0.0043 % + 10 Ω 0.0077 % + 0.15 kΩ 0.016 % + 0.25 kΩ 0.031 % + 2.5 kΩ 0.42 % + 3 kΩ 0.33 % + 0.1 MΩ 1.8 % + 0.5 MΩ	Fluke 5520A
Resistance ³ – Measure	(0 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	0.0015 % + 0.5 mΩ 0.0013 % + 0.5 mΩ 0.001 % + 5 mΩ 0.001 % + 50 mΩ 0.001 % + 0.5 Ω 0.0016 % + 2 Ω 0.0052 % + 100 Ω 0.051 % + 1 kΩ 0.5 % + 10 kΩ	HP 3458A, option II

Parameter/Equipment	Range	Best Uncertainty ² (±)	Comments
Electrical Thermocouple Simulation ³ –			
Type B	600 °C to 800 °C	0.46 °C	Fluke 5520A
	800 °C to 1000 °C	0.36 °C	
	1000 °C to 1550 °C	0.32 °C	
	1550 °C to 1820 °C	0.35 °C	
Type C	0 °C to 150 °C	0.32 °C	
	150 °C to 650 °C	0.28 °C	
	650 °C to 1000 °C	0.33 °C	
	1000 °C to 1800 °C	0.52 °C	
	1800 °C to 2316 °C	0.86 °C	
Type E	-250 °C to -100 °C	0.52 °C	
	-100 °C to -25 °C	0.18 °C	
	-25 °C to 350 °C	0.16 °C	
	350 °C to 650 °C	0.18 °C	
	650 °C to 1000 °C	0.23 °C	
Type J	-210 °C to -100 °C	0.29 °C	
	-100 °C to -30 °C	0.18 °C	
	-30 °C to 150 °C	0.16 °C	
	150 °C to 760 °C	0.19 °C	
	760 °C to 1200 °C	0.25 °C	
Type K	-200 °C to -100 °C	0.35 °C	
	-100 °C to -25 °C	0.20 °C	
	-25 °C to 120 °C	0.18 °C	
	120 °C to 1000 °C	0.28 °C	
	1000 °C to 1372 °C	0.42 °C	
Type L	-200 °C to -100 °C	0.39 °C	
	-100 °C to 800 °C	0.28 °C	
	800 °C to 900 °C	0.19 °C	

Parameter/Equipment	Range	Best Uncertainty ² (±)	Comments
Electrical Thermocouple Simulation ³ – (cont.)			
Type N	-250 °C to -100 °C	0.42 °C	Fluke 5520A
	-100 °C to -25 °C	0.24 °C	
	-25 °C to 120 °C	0.21 °C	
	120 °C to 410 °C	0.20 °C	
	410 °C to 1300 °C	0.29 °C	
Type R	0 °C to 250 °C	0.59 °C	
	250 °C to 400 °C	0.37 °C	
	400 °C to 1000 °C	0.35 °C	
	1000 °C to 1767 °C	0.42 °C	
Type S	0 °C to 250 °C	0.49 °C	
	250 °C to 1000 °C	0.38 °C	
	1000 °C to 1400 °C	0.39 °C	
	1400 °C to 1767 °C	0.48 °C	
Type T	-250 °C to -150 °C	0.65 °C	
	-150 °C to 0 °C	0.22 °C	
	0 °C to 120 °C	0.18 °C	
	120 °C to 400 °C	0.16 °C	
Type U	-200 °C to 0 °C	0.58 °C	
	0 °C to 600 °C	0.29 °C	
Electrical RTD Simulation ³ –			
Pt 385, 100 Ω	-200 °C to -80 °C	0.07 °C	Fluke 5520A
	-80 °C to 0 °C	0.07 °C	
	0 °C to 100 °C	0.09 °C	
	100 °C to 300 °C	0.11 °C	

Parameter/Equipment	Range	Best Uncertainty ² (±)	Comments
Electrical RTD Simulation ³ – (cont.)			
Pt 385, 100 Ω	300 °C to 400 °C	0.12 °C	Fluke 5520A
	400 °C to 630 °C	0.14 °C	
	630 °C to 800 °C	0.25 °C	
Pt 3926, 100 Ω	-200 °C to -80 °C	0.07 °C	
	-80 °C to 0 °C	0.07 °C	
	0 °C to 100 °C	0.09 °C	
	100 °C to 300 °C	0.11 °C	
	300 °C to 400 °C	0.12 °C	
	400 °C to 630 °C	0.14 °C	
Pt 3916, 100 Ω	-200 °C to -190 °C	0.27 °C	
	-190 °C to -80 °C	0.06 °C	
	-80 °C to 0 °C	0.07 °C	
	0 °C to 100 °C	0.08 °C	
	100 °C to 260 °C	0.09 °C	
	260 °C to 300 °C	0.10 °C	
	300 °C to 400 °C	0.11 °C	
	400 °C to 600 °C	0.12 °C	
	600 °C to 630 °C	0.25 °C	
Pt 385, 200 Ω	-200 °C to -80 °C	0.06 °C	
	-80 °C to 0 °C	0.06 °C	
	0 °C to 100 °C	0.06 °C	
	100 °C to 260 °C	0.07 °C	
	260 °C to 300 °C	0.14 °C	
	300 °C to 400 °C	0.15 °C	
	400 °C to 600 °C	0.16 °C	
	600 °C to 630 °C	0.18 °C	

Parameter/Equipment	Range	Best Uncertainty ² (±)	Comments
Electrical RTD Simulation ³ – (cont.)			
Pt 385, 500 Ω	-200 °C to -80 °C	0.06 °C	Fluke 5520A
	-80 °C to 0 °C	0.07 °C	
	0 °C to 100 °C	0.07 °C	
	100 °C to 260 °C	0.08 °C	
	260 °C to 300 °C	0.10 °C	
	300 °C to 400 °C	0.10 °C	
	400 °C to 600 °C	0.11 °C	
	600 °C to 630 °C	0.13 °C	
Pt 385, 1000 Ω	-200 °C to -80 °C	0.05 °C	
	-80 °C to 0 °C	0.05 °C	
	0 °C to 100 °C	0.06 °C	
	100 °C to 260 °C	0.07 °C	
	260 °C to 300 °C	0.08 °C	
	300 °C to 400 °C	0.09 °C	
	400 °C to 600 °C	0.09 °C	
	600 °C to 630 °C	0.25 °C	
PtNi 385, 120 Ω	-80 °C to 0 °C	0.10 °C	
	0 °C to 100 °C	0.10 °C	
	100 °C to 260 °C	0.16 °C	
Cu 427, 10 Ω	-100 °C to 260 °C	0.32 °C	

V. Electrical – RF/Microwave

Parameter/Range	Frequency	Best Uncertainty ^{2,4} (±)	Comments
RF Absolute Power ⁵ – Measure			
1 mW Reference	50 MHz	0.38 %	HP 8478B sensor with
	(0.01 to 0.05) GHz	2.1 % + 0.6 μW	HP 432A power meter and Type N connector
(-20 to +10) dBm	(0.05 to 1) GHz	1.3 % + 0.6 μW	
	(1 to 3) GHz	1.4 % + 0.6 μW	
	(3 to 7) GHz	1.8 % + 0.6 μW	
	(7 to 12.4) GHz	2.4 % + 0.6 μW	
	(12.4 to 15) GHz	2.6 % + 0.6 μW	
	(15 to 16) GHz	2.3 % + 0.6 μW	
	(16 to 18) GHz	4.2 % + 0.6 μW	
(-20 to +30) dBm	100 kHz to 2.6 GHz	0.13 dB	HP 11722A sensor with HP 8902A, HP 11793A and Type N connector
	50 MHz to 18 GHz	0.15 dB	HP 11792A sensor with HP 8902A, HP 11793A and APC 3.5 mm connector
(-60 to -50) dBm	0.2 MHz to 4 GHz	0.52 dB	Boonton 42BD with 41-4B power sensor and Type N connector
	(4 to 8.2) GHz	0.64 dB	
	(8.2 to 12.4) GHz	0.75 dB	
(-50 to 0) dBm	0.2 MHz to 4 GHz	0.29 dB	Boonton 42BD with 41-4B power sensor and Type N connector
	(4 to 8.2) GHz	0.40 dB	
	(8.2 to 12.4) GHz	0.52 dB	

Parameter/Range	Frequency	Best Uncertainty ^{2,4} (\pm)	Comments
RF Absolute Power ⁵ – Measure (cont.) (0 to +10) dBm	0.2 MHz to 4 GHz (4 to 8.2) GHz (8.2 to 12.4) GHz	0.29 dB 0.40 dB + 0.06 dB/mW 0.52 dB + 0.06 dB/mW	Boonton 42BD with 41-4B power sensor and Type N connector
RF Absolute Power ⁵ – Measuring Equipment Sine Wave into 50 W (10 to 3) V _{p-p} 2.99 V _{p-p} to 1 mV _{p-p} 2.99 V _{p-p} to 100 mV _{p-p} (99.9 to 1) mV _{p-p} (13.01 to -4.99) dBm (-6.99 to -44.99) dBm (-46.99 to -84.99) dBm	(0.001 to 100) kHz 100 kHz to 20 MHz 0.001 Hz to 100 kHz 100 kHz to 10 MHz (10 to 20) MHz (10 to 20) MHz 200 Hz to 80 MHz 200 Hz to 80 MHz 200 Hz to 80 MHz	0.11 dB 0.32 dB 0.21 dB 0.53 dB 0.53 dB 0.53 dB 0.17 dB 0.19 dB 0.26 dB	HP 3325 synthesized function generator with BNC connector HP3335A synthesized level generator in 2 dBm steps, with BNC connector
RF Tuned Power – Measure 0 dB (0 to -127) dB	Reference (2.5 to 1300) MHz	0.055 dB	HP 11722A sensor with HP 8902A, 11793A and type N or type APC 3.5 mm connector

Parameter/Range	Frequency	Best Uncertainty ^{2,4} (±)	Comments
RF Tuned Power – Measure (cont.) (0 to -127) dB	2.5 MHz to 18 GHz	0.12 dB	HP 11792A with HP 8902A, 11793A and type N or type APC 3.5 mm connector
Amplitude Modulation – Measuring Equipment AM Flatness Carrier Frequency (11 to 13.5) MHz Depth 0 % to 99 %	Rate Frequency 50 Hz to 50 kHz 20 Hz to 100 kHz	0.11 % 0.26 %	HP 11715A AM/FM test source
Amplitude Modulation – Measure Carrier Frequency (0.15 to 10) MHz Depth 5 % to 99 % 0 % to 99 % (10 to 1300) MHz Depth 5 % to 99 % (1.3 to 18) GHz Depth 5 % to 99 % 10 MHz to 18 GHz Depth 0 % to 99 %	Rate Frequency 50 Hz to 10 kHz 20 Hz to 10 kHz 50 Hz to 50 kHz 50 Hz to 50 kHz 20 Hz to 100 kHz	4.1 % + 1 digit 3.3 % + 1 digit 1.6 % + 1 digit 3.2 % + 1 digit 4.2 % + 1 digit	HP 8902A with HP 11722A & 11792A sensors & HP 11793A converter

Parameter/Range	Frequency	Best Uncertainty ^{2,4} (±)	Comments
Frequency Modulation – Measure Carrier Frequency (0.25 to 10) MHz ≤ 40 kHz peak deviation 10 MHz to 18 GHz ≤ 400 kHz peak deviation	Rate Frequency 20 Hz to 10 kHz 50 Hz to 100 kHz 20 Hz to 200 kHz	2.5 % + 1 digit 3 % + 1 digit 6 % + 1 digit	HP 8902A with HP 11722A & 11792A sensors and 11793A converter
Frequency Modulation – Measuring Equipment FM Flatness Carrier Frequency (11 to 13.5) MHz (88 to 108) MHz (352 to 432) MHz	Rate Frequency DC to 100 kHz (100 to 200) kHz DC to 100 kHz (100 to 200) kHz DC to 100 kHz (100 to 200) kHz	0.11 % 0.26 % 0.11 % 0.26 % 0.11 % 0.26 %	HP 11715A AM/FM test source
Phase Modulation – Carrier Frequency (0.15 to 10) MHz 10 MHz to 18 GHz	Rate Frequency 200 Hz to 10 kHz 200 Hz to 20 kHz	4.3 % + 1 digit 4.2 % + 1 digit	HP 8902A with HP 11792A & 11722A sensors

Parameter/Range	Frequency	Best Uncertainty ^{2,4} (±)	Comments
RF Volts – Measure Fixes Points			
3 V	(1 to 10) MHz (10 to 30) MHz (30 to 50) MHz (50 to 70) MHz (70 to 80) MHz (80 to 100) MHz	0.084 % 0.18 % 0.43 % 0.65 % 0.65 % 0.88 %	HP 11049A thermal voltage converter

VI. Mechanical

Parameter/Equipment	Range	Best Uncertainty ² (±)	Comments
Torque Wrench	(10 to 3120) in·lb	1 % of rdg (10 to 100) % of FS	Larson STWCS
Torque – Measuring Equipment			
Transducers	(0.6 to 42) ft·lb (1.7 to 600) ft·lb	0.032 % of rdg 0.032 % of rdg	Torque arm/dead weight
Vibration	(5 to 2000) Hz (2 to 10) kHz	1.8 % of rdg 3 % of rdg	Back to back comparison method
Pressure Gages – Measuring Equipment			
Pneumatic	(1 to 200) psig	0.016 % of rdg	Deadweight tester / pressure calibrator

Parameter/Equipment	Range	Best Uncertainty ² (\pm)	Comments
Pressure Gages – Measuring Equipment (cont.)			
Pneumatic	(200 to 300) psig (300 to 600) psig (600 to 1000) psig	0.016 % of FS 0.016 % of FS 0.016 % of FS	Deadweight tester/ pressure calibrator
Hydraulic	(1000 to 10 000) psig (0 to 10) inH ₂ O	0.034 % of rdg 0.005 inH ₂ O	Incline manometer
Absolute Pressure – Measuring Equipment & Measure	(0 to 30) psia (30 to 60) psia (60 to 100) psia (100 to 300) psia (300 to 600) psia (600 to 1000) psia	0.016 % of FS 0.016 % of FS 0.016 % of FS 0.016 % of FS 0.016 % of FS 0.016 % of FS	Deadweight tester / pressure calibrator
Scales and Balances ³	(0.5 to 629) lb	0.01 % of rdg + 0.6R	ASTM Class 6 weights
Analytical Balances ³	(5 to 100) mg (100 to 500) mg (1 to 10) g (10 to 100) g (0.1 to 3) kg	0.05 mg + 0.6R 0.08 mg + 0.6R 0.051 mg + 0.6R 0.25 mg + 0.6R 15 mg + 0.6R	ASTM Class 3 weights ASTM Class 1 weights ASTM Class 2 weights
Force ^{3,7}	(0.5 to 500) lbf (100 to 1000) lbf (200 to 2000) lbf (1000 to 10 000) lbf (2500 to 25 000) lbf	0.01 % + 0.6R 0.031 % 0.031 % 0.041 % 0.046 %	ASTM Class 6 weights ASTM E74: tension & compression

Parameter/Equipment	Range	Best Uncertainty ^{2,4} (±)	Comments
Force ^{3,7} (cont)	(5 000 to 50 000) lbf	0.051 %	ASTM E74: tension & compression
	(10 000 to 100 000)	0.051 %	
	(50 000 to 500 000) lbf	0.051 %	Compression only
Rockwell Hardness – Indirect Verification of Superficial Hardness Testers ³	HRA		ASTM E18
	Low	0.55 HRA	
	Medium	0.44 HRA	
	High	0.33 HRA	
	HRBW		
	Low	0.50 HRBW	
	Medium	0.52 HRBW	
	High	0.35 HRBW	
	HRC		
	Low	0.44 HRC	
	Medium	0.44 HRC	
	High	0.44 HRC	
	HRR		
	Low	1.7 HRR	
	Medium	1.7 HRR	
	High	1.7 HRR	
	HR15N		
	Low	1.20 HR15N	
	Medium	0.85 HR15N	
	High	1.40 HR15N	
	HR30N		
Low	0.50 HR30N		
Medium	0.90 HR30N		
High	0.39 HR30N		

Parameter/Equipment	Range	Best Uncertainty ² (±)	Comments
Rockwell Hardness – Indirect Verification of Superficial Hardness Testers ³ (cont.)	HR15T Low Medium High HR30T Low Medium High	0.53 HR15T 0.62 HR15T 0.49 HR15T 1.0 HR30T 0.75 HR30T 0.58 HR30T	ASTM E18

VII. Thermodynamics

Parameter/Equipment	Range	Best Uncertainty ² (±)	Comments
Temperature ³ – Measuring Equipment	(-25 to 400) °C	0.022 °C + 30.1 µ°C / °C	Hart 1502 w/ PRT
Temperature ³ – Measure	(-200 to 420) °C (-20 to 1000) °C	0.025 °C + 0.003 % rdg 2.4 °C + 5.1 m°C/°C	PRT Type K thermocouple
Relative Humidity ³ – Measuring Equipment	11.3 % RH 33 % RH 75.5 % RH 97.7 % RH	1.5 % RH 1.3 % RH 1.6 % RH 2.5 % RH	Vaisala HMK 15
Relative Humidity ³ – Measure	(10 to 90) % RH (90 to 99) % RH	2.8 % RH 3.9 % RH	Vaisala HMP231

VIII. Time and Frequency

Parameter/Range	Frequency	Best Uncertainty ^{2,4} (\pm)	Comments
Frequency – Measuring Equipment	10 MHz	7.8 nHz/Hz	Spectracom 8161 WWB receiver

¹ This laboratory offers commercial calibration service and field calibration service.

² “Best Uncertainty” is the smallest uncertainty of measurement that a laboratory can achieve within its scope of accreditation when performing more or less routine calibrations of nearly ideal measurement standards of nearly ideal measuring equipment. Best uncertainties represent expanded uncertainties expressed at approximately the 95 % level of confidence, usually using a coverage factor of $k = 2$. The best uncertainty of a specific calibration performed by the laboratory may be greater than the best uncertainty due to the behavior of the customer’s device and to influences from the circumstances of the specific calibration.

³ Field calibration service is available for this calibration and this laboratory meets A2LA R104 – General Requirements: Accreditation of Field Testing and Field Calibration Laboratories for these calibrations. Please note the uncertainties achievable on a customer's site can normally be expected to be larger than the Best Measurement Capabilities (BMC) that the accredited laboratory has been assigned as Best Uncertainty on the A2LA Scope. Allowance must be made for aspects such as the environment at the place of calibration and for other possible adverse effects such as those caused by transportation of the calibration equipment. The usual allowance for the uncertainty introduced by the item being calibrated, (e.g. resolution) must also be considered and this, on its own, could result in the calibration uncertainty being larger than the BMC.

⁴ All uncertainties not expressed in units are of indicated value.

⁵ Uncertainty does not include mismatch.

⁶ L is the length of the unit under test in inches or millimeters, where appropriate. R is the resolution of the unit under test in inches or millimeters, where appropriate.

⁷ Greater than 25 000 lbf, field service available only.