CERTIFICATE OF ACCREDITATION

ANSI-ASQ National Accreditation Board

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

This is to certify that

Technical Maintenance, Inc.
117 Jetplex Circle, Suite C-4
Madison, AL 35758

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

ISO/IEC 17025:2005

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 calibrations to which this accreditation applies.

AC-2080.02
Certificate Number

ANAB Approval

Certificate Valid: 09/27/2017-09/20/2019
Version No. 003 Issued: 09/27/2017

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).

ANSI-ASQ National Accreditation Board

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

Technical Maintenance, Inc.
117 Jetplex Circle, Suite C4
Madison, AL 35758
Scott Chamberlain Phone:256-772-4115

CALIBRATION

Valid to: **September 20, 2019** Certificate Number: **AC-2080.02**

Acoustics and Vibration

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Accelerometers – Acceleration (7 to 200) Hz (100 to 2 500) Hz (2.5 to 10) kHz	(0.01 to 10) g	1.5 % of reading 1.2 % of reading 2.5 % of reading	Accelerometer Calibrator

Chemical Quantities

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
pH[1]	(4, 7, & 10) pH units	0.019 pH	pH buffer solutions
Conductivity[1]	≈100 µS ≈1 410 µS ≈10 000 µS	0.069 µS 5.1 µS 34 µS	Conductivity solutions

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	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	11 µV/V + 0.4 µV 5.2 µV/V + 0.7 µV 3.5 µV/V + 2.5 µV 3.5 µV/V + 4 µV 5 µV/V + 40 µV 6.5 µV/V + 0.4 mV	Fluke 5730A
DC Voltage – Measure[1]	Up to 100 mV (0.1 to 1) V (1 to 10) V (10 to 100) V (100 to 1 000) V	11 µV/V + 0.3 µV 10 µV/V + 0.3 µV 10 µV/V + 0.5 µV 12 µV/V + 30 µV 12 µV/V + 0.1 mV	HP 3458A
	(1 to 30) kV (30 to 150) kV	0.13 % of reading 0.12 % of reading	Ross voltage dividers
DC Current – Generate[1]	Up to 220 µA (0.22 to 2.2) mA (2.2 to 22) mA (22 to 220) mA (0.22 to 2.2) A	40 µA/A + 6 nA 35 µA/A + 7 nA 36 µA/A + 40 nA 48 µA/A + 0.7 µA 81 µA/A + 12 µA	Fluke 5730A
	(2.2 to 11) A (11 to 20.5) A	0.059 % of reading + 0.5 mA 0.1 % of reading + 0.75 mA	Fluke 5522A
DC Current – Measure[1]	Up to 100 nA (0.1to 100) µA 100 µA to 10 mA (10 to 100) mA (0.1 to 1) A	31 µA/A + 0.04 nA 22 µA/A + 0.8 nA 23 µA/A + 50 nA 37 µA/A + 0.5 µA 0.011 % of reading + 10 µA	HP 3458A
	(1 to 600) A	0.3 % of reading	Current Shunts
Electrical Calibration of Thermocouple Indicating Devices[1] – Type C Type J Type K Type N Type R Type S Type T Type U	 (0 to 2 316) °C (-210 to 1 200) °C (-200 to 1 372) °C (-200 to 1 300) °C (0 to 1 767) °C (-250 to 400) °C (-250 to 400) °C (-200 to 600) °C	 0.38 °C 0.19 °C 0.21 °C 0.27 °C 0.45 °C 0.44 °C 0.18 °C 0.19 °C	Fluke 7526A

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Power Meters[1]	3 µW to 100 mW	0.25 % of reading	HP 11683A
Resistance – Generate, Fixed Points[1]	1, 1.9 Ω 10, 19 Ω 100, 190 Ω 1, 1.9 kΩ 10, 19 kΩ 100 kΩ 190 kΩ 1 MΩ 1.9 MΩ 10 MΩ 19 MΩ 100 MΩ	0.14 mΩ/Ω 33µΩ/Ω 35 µΩ/Ω 15 µΩ/Ω 13 µΩ/Ω 13 µΩ/Ω 15 µΩ/Ω 18 µΩ/Ω 25 µΩ/Ω 54 µΩ/Ω 66 µΩ/Ω 0.16 Ω/Ω	Fluke 5730A
Resistance – Generate[1]	Up to 11 Ω (11 to 33) Ω (33 to 110) Ω (110 to 330) Ω 330 Ω to 1.1 kΩ (1.1 to 3.3) kΩ (3.3 to 11) kΩ (11 to 33) kΩ (33 to 110) kΩ	40 µΩ/Ω + 10 mΩ 30 µΩ/Ω + 15 mΩ 28 µΩ/Ω + 15 mΩ 28 µΩ/Ω + 0.02 Ω 29 µΩ/Ω + 0.02 Ω 29 µΩ/Ω + 0.2 Ω 29 µΩ/Ω + 0.1 Ω 29 µΩ/Ω + 1 Ω 29 µΩ/Ω + 1 Ω	Fluke 5520A
Resistance – Measure[1]	Up to 10 Ω (10 to 100) Ω (0.1 to 1) kΩ (1 to 10) kΩ (10 to 100) kΩ (0.1 to 1) MΩ (1 to 10) MΩ (10 to 100) MΩ (0.1 to 1) GΩ	16 µΩ/Ω + 50 µΩ 14 µΩ/Ω + 0.5 mΩ 12 µΩ/Ω + 0.5 mΩ 12 µΩ/Ω + 5 mΩ 12 µΩ/Ω + 5 mΩ 16 µΩ/Ω + 2.0 Ω 50 µΩ/Ω + 0.1 kΩ 0.05 % of reading + 1 kΩ 0.51 % of reading + 10 kΩ	HP 3458A

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Generate[v]	(0.22 to 2.2) mV		Fluke 5730A
	(10 to 20) Hz	0.36 mV/V + 5 µV	
	(20 to 40) Hz	0.12 mV/V + 4 µV	
	40 Hz to 20 kHz	0.11 mV/V + 4 µV	
	(20 to 50) kHz	0.24 mV/V + 4 µV	
	(50 to 100) kHz	0.6 mV/V + 5 µV	
	(100 to 300) kHz	1.3 mV/V + 10 µV	
	(300 to 500) kHz	1.7 mV/V + 20 µV	
	500 kHz to 1 MHz	3.2 mV/V + 20 µV	
	(2.2 to 22) mV		
	(10 to 20) Hz	0.36 mV/V + 5 µV	
	(20 to 40) Hz	0.12 mV/V + 4 µV	
	40 Hz to 20 kHz	0.11 mV/V + 4 µV	
	(20 to 50) kHz	0.24 mV/V + 4 µV	
	(50 to 100) kHz	0.6 mV/V + 5 µV	
	(100 to 300) kHz	1.3 mV/V + 10 µV	
	(300 to 500) kHz	1.7 mV/V + 20 µV	
	500 kHz to 1 MHz	3.2 mV/V + 20 µV	
	(22 to 220) mV		
	(10 to 20) Hz	0.24 mV/V + 12 µV	
	(20 to 40) Hz	0.11 mV/V + 7 µV	
	40 Hz to 20 kHz	69 µV/V + 7 µV	
	(20 to 50) kHz	0.14 mV/V + 7 µV	
	(50 to 100) kHz	0.37 mV/V + 17 µV	
	(100 to 300) kHz	0.77 mV/V + 20 µV	
	(300 to 500) kHz	1.7 mV /V + 25 µV	
	500 kHz to 1 MHz	3.2 mV /V + 45 µV	
	(0.22 to 2.2) V		
	(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	50 µV/V + 8 µV	
	(20 to 50) kHz	78 µV/V + 10 µV	
	(50 to 100) kHz	0.1 mV/V + 30 µV	
	(100 to 300) kHz	0.4 mV/V + 80 µV	
	(300 to 500) kHz	1.2 mV /V + 0.2 mV	
	500 kHz to 1 MHz	0.2 mV/V + 0.3 mV	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Generate[1]	(2.2 to 22) V		Fluke 5730A
	(10 to 20) Hz	0.28 mV/V + 0.4 mV	
	(20 to 40) Hz	0.11 mV/V + 0.15 mV	
	40 Hz to 20 kHz	50 µV/V + 50 µV	
	(20 to 50) kHz	78 µV/V + 0.1 mV	
	(50 to 100) kHz	98 µV/V + 0.2 mV	
	(100 to 300) kHz	0.3 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	62 µV/V + 0.6 mV	
	(20 to 50) kHz	93 µV/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	
AC Voltage – Generate[1]	(220 to 750) V		Fluke 5730A/5725A
	(30 to 50) kHz	0.7 mV/V + 11 mV	
	(50 to 100) kHz	2.7 mV/V + 45 mV	
	(750 to 1 000) V		
	40 Hz to 1 kHz	0.11 mV/V + 4 mV	
	(1 to 20) kHz	0.2 mV/V + 6 mV	
	(20 to 30) kHz	0.7 mV/V + 11 mV	
AC Voltage – Measure[1]	Up to 10 mV		HP 3458A
	(1 to 40) Hz	0.044 % of reading + 0.003 mV	
	40 Hz to 1 kHz	0.026 % of reading + 0.0011 mV	
	(1 to 20) kHz	0.044 % of reading + 0.0011 mV	
	(20 to 50) kHz	0.11 % of reading + 0.0011 mV	
	(50 to 100) kHz	0.5 % of reading + 0.0011 mV	
	(100 to 300) kHz	4 % of reading + 0.002 mV	

AC Voltage – Measure[1]	10 mV to 100 mV		HP 3458A
	(1 to 40) Hz	0.019 % of reading + 0.004 mV	
	40 Hz to 1 kHz	0.019 % of reading + 0.002 mV	
	(1 to 20) kHz	0.027 % of reading + 0.002 mV	
	(20 to 50) kHz	0.045 % of reading + 0.002 mV	
	(50 to 100) kHz	0.09 % of reading + 0.002 mV	
	(100 to 300) kHz	0.31 % of reading + 0.01 mV	
	300 kHz to 1 MHz	1 % of reading + 0.01 mV	
	(1 to 2) MHz	1.5 % of reading + 0.01 mV	
	100 mV to 1 V		
	(1 to 40) Hz	0.019 % of reading + 0.04 mV	
	40 Hz to 1 kHz	0.019 % of reading + 0.02 mV	
	(1 to 20) kHz	0.027 % of reading + 0.02 mV	
	(20 to 50) kHz	0.045 % of reading + 0.02 mV	
	(50 to 100) kHz	0.09 % of reading + 0.02 mV	
	(100 to 300) kHz	0.31 % of reading + 0.1 mV	
	300 kHz to 1 MHz	1 % of reading + 0.1 mV	
	(1 to 2) MHz	1.5 % of reading + 0.1 mV	
	1 V to 10 V		
	(1 to 40) Hz	0.019 % of reading + 0.0004 V	
	40 Hz to 1 kHz	0.019 % of reading + 0.0002 V	
	(1 to 20) kHz	0.027 % of reading + 0.0002 V	
	(20 to 50) kHz	0.045 % of reading + 0.0002 V	
	(50 to 100) kHz	0.09 % of reading + 0.0002 V	
	(100 to 300) kHz	0.31 % of reading + 0.001 V	
	300 kHz to 1 MHz	1 % of reading + 0.001 V	
	(1 to 2) MHz	1.5 % of reading + 0.001 V	
	(10 to 100) V		
	(1 to 40) Hz	0.026 % of reading + 0.002 V	
	40 Hz to 1 kHz	0.041 % of reading + 0.002 V	
	(1 to 20) kHz	0.038 % of reading + 0.002 V	
	(20 to 50) kHz	0.048 % of reading + 0.002 V	
	(50 to 100) kHz	0.13 % of reading + 0.002 V	
	(100 to 300) kHz	0.4 % of reading + 0.01 V	
	300 kHz to 1 MHz	1.5 % of reading + 0.01 V	
	(100 to 700) V		
	(1 to 40) Hz	0.05 % of reading + 0.04 V	
	40 Hz to 1 kHz	0.05 % of reading + 0.02 V	
	(1 to 20) kHz	0.07 % of reading + 0.02 V	
	(20 to 50) kHz	0.13 % of reading + 0.02 V	
	(50 to 100) kHz	0.3 % of reading + 0.02 V	
	(1 to 21) kV		Ross voltage dividers
	Up to 400 Hz	0.59 % of reading	
	(21 to 100) kV		
	Up to 400 Hz	0.62 % of reading	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current – Generate[1]	(9 to 220) µA		Fluke 5730A
	(10 to 20) Hz	0.31 mA/A + 16 nA	
	(20 to 40) Hz	0.21 mA/A + 10 nA	
	40 Hz to 1 kHz	0.15 mA/A + 8 nA	
	(1 to 5) kHz	0.35 mA/A + 12 nA	
	(5 to 10) kHz	1.3 mA/A + 65 nA	
	(0.22 to 2.2) mA		
	(10 to 20) Hz	0.3 mA/A + 40 nA	
	(20 to 40) Hz	0.16 mA/A + 35 nA	
	40 Hz to 1 kHz	0.14 mA/A + 35 nA	
	(1 to 5) kHz	0.25 mA/A + 0.11 µA	
	(5 to 10) kHz	1.3 mA/A + 0.65 µA	
	(2.2 to 22) mA		
	(10 to 20) Hz	0.31 mA/A + 0.4 µA	
	(20 to 40) Hz	0.2 mA/A + 0.35 µA	
	40 Hz to 1 kHz	0.14 mA/A + 0.35 µA	
	(1 to 5) kHz	0.26 mA/A + 0.55 µA	
	(5 to 10) kHz	1.4 mA/A + 5 µA	
	(22 to 220) mA		
	(10 to 20) Hz	0.3 mA/A + 4 µA	
	(20 to 40) Hz	0.2 mA/A + 3.5 µA	
	40 Hz to 1 kHz	0.14 mA/A + 2.5 µA	
	(1 to 5) kHz	0.26 mA/A + 3.5 µA	
	(5 to 10) kHz	1.4 mA/A + 10 µA	
	(0.22 to 2.2) A		
	20 Hz to 1 kHz	0.3 mA/A + 35 µA	
	(1 to 5) kHz	0.54 mA/A + 80 µA	
	(5 to 10) kHz	8.2 mA/A + 0.16 mA	
AC Current – Generate[1]	(2.2 to 11) A		Fluke 5730A/5725A
	40 Hz to 1 kHz	0.56 mA/A + 0.17 mA	
	(1 to 5) kHz	1.2 mA/A + 0.38 mA	
	(5 to 10) kHz	4.3 mA/A + 0.75 mA	
AC Current – Generate[1]	(11 to 20.5) A		Fluke 5522A
	45 Hz to 100 Hz	0.19 % of reading + 5 mA	
	100 Hz to 1 kHz	0.24 % of reading + 5 mA	
	(1 to 5) kHz	4.6 % of reading + 5 mA	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current – Measure[1]	Up to 100 µA (10 to 20) Hz (20 to 45) Hz 45 Hz to 1 kHz (1 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 (0.1 to 1) A (10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 Hz (5 to 20) kHz (20 to 50) kHz	 0.41 % of reading + 0.03 pA 0.16 % of reading + 0.03 pA 0.07 % of reading + 0.03 pA 0.41 % of reading + 20 µA 0.16 % of reading + 20 µA 0.069 % of reading + 20 µA 0.038 % of reading + 20 µA 0.069 % of reading + 20 µA 0.41 % of reading + 40 µA 0.56 % of reading + 0.15 mA 0.41 % of reading + 0.2 mA 0.17 % of reading + 0.2 mA 0.087 % of reading + 0.2 mA 0.11 % of reading + 0.2 mA 0.31 % of reading + 0.2 mA 1 % of reading + 0.4 mA	HP 3458A
AC Current – Measure[1]	(1 to 600) A 30 Hz to 10 kHz	3.5 % of reading	Current Clamp
Capacitance[1] – Generate 10 Hz to 10 kHz 10 Hz to 3 kHz 10 Hz to 1 kHz (10 to 600) Hz (10 to 300) Hz (10 to 150) Hz (10 to 120) Hz (10 to 80) Hz (0 to 50) Hz (0 to 20) Hz (0 to 6) Hz (0 to 2) Hz (0 to 0.6) Hz (0 to 0.2) Hz	 (0.19 to 0.1099) nF (1.1 to 3.2999) nF (3.3 to 329.999) nF (0.33 to 1.09999) µF (1.1 to 3.29999) µF (3.3 to 10.9999) µF (11 to 32.999) µF (33 to 109.999) µF (110 to 329.999) µF (0.33 to 1.09999) mF (1.1 to 3.2999) mF (3.3 to 10.9999) mF (11 to 32.9999) mF (33 to 110) mF	 1.2 % of reading + 0.01 nF 1.2 % of reading + 0.01 nF 0.39 % of reading + 0.3 nF 0.38 % of reading + 3 nF 0.37 % of reading + 3 nF 0.38 % of reading + 10 nF 0.53 % of reading + 30 nF 0.58 % of reading + 0.1 µF 0.58 % of reading + 0.3 µF 0.57 % of reading + 1 µF 0.58 % of reading + 3 µF 0.59 % of reading + 10 µF 0.65 % of reading + 30 µF 1.3 % of reading + 0.1 mF	Fluke 5522A

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Oscilloscopes[1] – Amplitude – Square Wave 50 Ω 1 MΩ	 1 mVpp to 6.6 Vpp 1 mVpp to 130 Vpp	 1.3 % of reading + 40 µV 1.3 % of reading + 40 µV	
Rise Time	<350 ps	+ 13 ps / -0.11 ps	
Flatness (50 kHz reference)	5 mV to 5.5 V 50 kHz to 100 MHz (100 to 300) MHz (300 to 600) MHz (600 to 1 100) MHz	 2.5 % of reading + 0.1 mV 3.4 % of reading + 0.1 mV 5.5 % of reading + 0.1 mV 6.9 of reading % + 0.1 mV	Fluke 5522A /SC1100
Time Marker[2]	1 ns to 20 ms 50 ms to 5 s	2.7 parts in 10^6 s (25 + 1 000*t*) parts in 10^6 s	
Low Frequency Power – Generate[1] (45 to 65) Hz 1 PF	Up to 20 kW	0.25 % of reading	Fluke 5522A
DC		0.21 % of reading	

Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
RF Attenuation[1]– Measure	100 kHz to 50 GHz (-10 to 0) dB (-20 to -11) dB (-30 to -21) dB (-40 to -31) dB (-50 to -41) dB (-60 to -51) dB (-70 to -61) dB (-80 to -71) dB (-90 to -81) dB	 0.019 dB 0.022 dB 0.027 dB 0.032 dB 0.037 dB 0.055 dB 0.06 dB 0.064 dB 0.069 dB	Agilent N5531S

Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
RF Attenuation[1]– Measure	100 kHz to 31.15 GHz (-100 to -91) dB 100 kHz to 26.5 GHz (-110 to -101) dB (-120 to -111) dB	 0.074 dB 0.086 dB 0.091 dB	Agilent N5531S
RF Power[1] – Measure 50 MHz	1 mW	0.003 2 mW	HP 432A & 8478B
RF Power – Generate	250 kHz to 20 GHz (-10 to 10) dBm (-70 to -10) dBm (-90 to -70) dBm (20 to 50) GHz (-10 to 10) dBm (-70 to -10) dBm (-90 to -70) dBm	 1.5 dBm 1.6 dBm 1.7 dBm 1.6 dBm 1.7 dBm 2.6 dBm	Agilent E8257D
Amplitude Modulation[1] – Measure	100 kHz to 10 MHz (5 to 99) % Depth 10 MHz to 3 GHz (5 to 20) % Depth (20 to 99) % Depth (3 to 26.5) GHz (5 to 20) % Depth (20 to 99) % Depth (26.5 to 31.5) GHz (5 to 20) % Depth (20 to 99) % Depth (31.5 to 50) GHz (5 to 20) % Depth (20 to 99) % Depth	 1 % Depth 2.9 % Depth 0.8 % Depth 5.2 % Depth 1.8 % Depth 7.9 % Depth 2.3 % Depth 30 % Depth 7 % Depth	Agilent N5531S
Frequency Modulation[1] – Measure	20 Hz to 10 kHz 250 kHz to 10 MHz (50 to 200) Hz 10 MHz to 6.6 GHz (6.6 to 13.2) GHz (13.2 to 31.15) GHz (31.15 to 50) GHz	 3.1 % of reading 3.1 % of reading 3.8 % of reading 5 % of reading 11 % of reading	Agilent N5531S
Phase Modulation[1] – Measure	100 kHz to 50 GHz	9.7 % of reading	Agilent N5531S

Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
RF Power[1]– 100 kHz to 2.6 GHz (0.1 to 26.5) GHz	(0.01 to 30) dBm	2 % of reading 3.4 % of reading	HP 8902A/HP 11722A HP 8902A/HP 11792A
AM Distortion[1] – Measure	(0.1 to 10) MHz 10 MHz to 26.5 GHz (26.5 to 50) GHz	0.8 % of reading 1 % of reading 6.2 % of reading	Agilent N5531S
FM Distortion[1] – Measure	1 MHz to 50 GHz	0.3 % of reading	Agilent N5531S

Length – Dimensional metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Calipers[1,2]	Up to 46 in	(26 + 10*L*) µin	Gage blocks (Grade 2)
Micrometers[1,2]	Up to 46 in	(30 + 6*L*) µin	
Height Gages[1,2]	Up to 46 in	(200 + 3*L*) µin	
Dial Indicators[1,2]	Up to 10 in	(5 + 57*L*) µin	
Rulers[1]	Up to 46 in	0.009 1 in	
Metal Tapes and Rules[1,2]	Up to 100 ft	(0.000 023*L* + 0.023) in	Standard rule
Feeler Gages[1]	Up to 1 in	73 µin	Mitutoyo 293-369 micrometer
Cylindrical gages[1,2] – Plain Pins, Plugs Rings	 Up to 1 in (1 to 10) in Up to 14 in	 11 µin (7 + 4*D*) µin (8.0 + 2*D*) µin	P&W LabMaster gage blocks (grade 1)
Surface Plates[1] – Overall Flatness Local Area Flatness	 (18 × 18) in to (6 × 6) ft Up to (18 × 18) in	 95 µin 74 µin	 Rahn Planekator Repeat-o-meter
Gage Blocks[2]	Up to 10 in	(2.9 + 2.2*L*) µin	Universal measuring machine, master gage block set

Length – Dimensional metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Thread Plugs – Major Diameter Pitch Diameter	 Up to 12 in Up to 12 in	 52 µin 110 µin	Gage blocks, P&W universal measuring machine, VanKeren thread wire set
Optical Comparators[1] – Linearity Magnification	 Up to 20 in (20 to 40) in 10x to 100x	 590 µin 790 µin 670 µin	Precision balls, Starrett Webber 81, SI Industries glass scales
Protractors[1]	(0 to 360) °	0.019 °	Angle blocks
Coating Thickness Gages[1] – Eddy Current & Magnetic Induction, Fixed Point	(0.48 to 38.9) mils	89 µin	Calibration foils, P&W Supermicrometer
Coating Thickness Shims[1]	(0 to 243) mils	80 µin	P&W Supermicrometer

Mass

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Scales & Balances[1,2]	(1 to 200) g	0.29 mg + 0.6*R*	Class 1 weights
	(0.022 to 2 000) lb	0.01 % of reading + 0.6*R*	Class F weights
Pressure[1]	(-14 to 5) psi	0.071 psi	Fluke 700PD6
	(5 to 10 000) psi	0.12 % of reading	Ametek R-100
	(0 to 30) psia	0.019 psi	Fluke 700GA5
	(0 to 100) cmH_2O	0.071 cmH_2O	Heise 710B
	(0 to 20) inH_2O	0.0018 inH_2O	Additel 681-DP20
	(20 to 150) inH_2O	0.11 inH_2O	Additel 681-DP150
Vacuum	(0 to 30) inHg	0.12 inHg	Fluke 700PD6

Mass

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Torque Wrenches[1]	(5 to 1 000) lbf·in (25 to 250) lbf·ft (250 to 2 000) lbf·ft	0.35 % of reading 0.43 % of reading 0.49 % of reading	CDI torque system
Torque Analyzers	(5 to 80) ozf·in (5 to 600) lbf·in (50 to 2 000) lbf·ft	0.17 % of reading 0.15 % of reading 0.14 % of reading	Weights and Wheel
Mass	(1 to 10) lb	0.048 g	Master balance
Force – Tension[1]	(10 to 200) mgrf (0.2 to 1) grf (1 to 10) grf (10 to 500) grf (1 to 540) lbf	0.63 mgrf 1 mgrf 0.038 % of reading 0.025 % of reading 0.026 % of reading	Class F weights

Thermodynamic

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Temperature – Measuring Equipment[1]	(50 to 600) °C	0.11 °C	Hart 1502A w/5626 PRT and dry block
Temperature – Measure[1]	(-25 to 600) °C	0.026 °C	Hart 1502 with 5626 PRT
Relative Humidity – Measure[1]	(0 to 90) % RH	1.6 %RH	Vaisalla HM141/HMP46
IR Thermometry[1]	(20 to 100) °C (100 to 300) °C (300 to 500) °C	0.51 °C 0.61 °C 0.8 °C	Fluke 9132

Time and Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Frequency – Measure[1]	10 MHz	1 part in 10^{11} Hz/Hz	GPS 58503A/B
	10 Hz to 500 MHz	5 parts in 10^{7} Hz/Hz	HP 5345A

Time and Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Frequency – Measure[1]	500 MHz to 26.5 GHz (26.5 to 40) GHz	1.7 parts in 10^9 Hz/Hz 1 parts in 10^7 Hz/Hz	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. L = length in inches, D = diameter in inches, t = time in seconds, R = resolution of device under test.
3. This scope is formatted as part of a single document including Certificate of Accreditation No. AC-2080.02.

CERTIFICATE OF ACCREDITATION

ANSI-ASQ National Accreditation Board

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

This is to certify that

Technical Maintenance, Inc.

3060 Venture Lane

Melbourne, FL 32934

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

ISO/IEC 17025:2005

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 calibrations to which this accreditation applies.

AC-2080.08

Certificate Number

ANAB Approval

Certificate Valid: 11/10/2017-09/20/2019

Version No. 004 Issued: 11/10/2017

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).

ANSI-ASQ National Accreditation Board

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

Technical Maintenance, Inc.
3060 Venture Lane
Melbourne, FL 32934
Scott Chamberlain 321-242-0890

CALIBRATION

Valid to: **September 20, 2019** Certificate Number: **AC-2080.08**

Chemical Quantities

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
pH[1]	(4, 7, 10) pH	0.02 pH	pH buffer solutions
Conductivity, Liquid[1]	(2 to 10 000) µS	1 % of reading	Conductivity solutions

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
DC Current – Generate[1]	Up to 220 µA 220 µA to 2.2 mA (2.2 to 22) mA (22 to 220) mA 220 mA to 2.2 A	40 µA/A + 6 nA 35 µA/A + 7 nA 36 µA/A + 40 nA 48 µA/A + 0.7 µA 81 µA/A + 12 µA	Fluke 5730A/03 Multifunction Calibrator
	(2.2 to 11) A	0.36 mA/A + 0.48 mA	Fluke 5730A/03 Multifunction Calibrator 5725A Amplifier
	(11 to 20.5) A	0.76 mA/A + 0.75 mA	Fluke 5522A Multifunction Calibrator
DC Current – Generate[1] Clamp Only	(20.5 to 1 000) A	0.9 % of reading	Coil/ Fluke 5522A Multifunction Calibrator

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
DC Current – Measure[1]	Up to 220 µA 220 µA to 2.2 mA (2.2 to 22) mA (22 to 220) mA (0.22 to 1) A	6 µA/A 5 µA/A 6 µA/A 10 µA/A 37 µA/A	Agilent 3458A/002 Precision Multimeter
DC Voltage[1] – Generate	(0 to 220) mV 220 mV to 2.2 V (2.2 to 11) V (11 to 22) V (22 to 220) V (220 to 1 100) V	11 µV/V + 0.4 µV 5.2 µV/V + 0.7 µV 3.5 µV/V + 2.5 µV 3.5 µV/V + 4 µV 5 µV/V + 40 µV 6.5 µV/V + 400 µV	Fluke 5730A/03 Multifunction Calibrator
DC Voltage[1] – Measure	Up to 100 mV (0.1 to 1) V (1 to 10) V (10 to 100) V (100 to 1 000) V	10 µV/V + 0.3 µV 9.0 µV/V + 0.30 µV 9.0 µV/V + 50 µV 11 µV/V + 30 µV 11 µV/V + 0.1 mV	Agilent 3458A/002 Precision Multimeter
DC Voltage[1] – Measure	(1 to 120) kV	0.23 % of reading	Ross VD120 High Voltage Divider HP 34401A Precision Multimeter
AC Voltage – Generate[1]	(0.22 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 (2.2 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	 0.27 mV/V + 4 µV 0.14 mV/V + 4 µV 0.13 mV/V + 4 µV 0.22 mV/V + 4 µV 0.52 mV/V + 5 µV 1. 1 mV/V + 10 µV 1.4 mV/V + 20 µV 2.7 mV/V + 20 µV 0.24 mV/V + 4 µV 91 µV/V + 4 µV 81 µV/V + 4 µV 0.2 mV/V + 4 µV 0.5 mV/V + 5 µV 1.1 mV/V + 10 µV 1.4 mV/V + 20 µV 2.7 mV/V + 20 µV	Fluke 5730A/03 Multifunction Calibrator

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Generate[1]	(22 to 220) mV		Fluke 5730A/03 Multifunction Calibrator
	(10 to 20) Hz	0.24 mV/V + 12 µV	
	(20 to 40) Hz	90 µV/V + 7 µV	
	40 Hz to 20 kHz	58 µV/V + 7 µV	
	(20 to 50) kHz	0.12 mV/V + 7 µV	
	(50 to 100) kHz	0.31 mV/V + 17 µV	
	(100 to 300) kHz	0.66 mV/V + 20 µV	
	(300 to 500) kHz	1.4 mV /V + 25 µV	
	500 kHz to 1 MHz	2.7 mV /V + 45 µV	
	220 mV to 2.2 V		
	(10 to 20) Hz	0.24 mV/V + 40 µV	
	(20 to 40) Hz	90 µV/V + 15 µV	
	40 Hz to 20 kHz	43 µV/V + 8 µV	
	(20 to 50) kHz	67 µV/V + 10 µV	
	(50 to 100) kHz	85 µV/V + 30 µV	
	(100 to 300) kHz	0.34 mV/V + 80 µV	
	(300 to 500) kHz	1 mV /V + 0.2 mV	
	500 kHz to 1 MHz	1.7 mV/V + 0.3 mV	
	(2.2 to 22) V		
	(10 to 20) Hz	0.24 mV/V + 0.4 mV	
	(20 to 40) Hz	91 µV/V + 0.15 mV	
	40 Hz to 20 kHz	43 µV/V + 50 µV	
	(20 to 50) kHz	67 µV/V + 0.1 mV	
	(50 to 100) kHz	83 µV/V + 0.2 mV	
	(100 to 300) kHz	0.25 mV/V + 0.6 mV	
	(300 to 500) kHz	1 mV/V + 2 mV	
	500 kHz to 1 MHz	1 5 mV/V + 3.2 mV	
	(22 to 220) V		
	(10 to 20) Hz	0.24 mV /V + 4 mV	
	(20 to 40) Hz	90 µV/V + 1.5 mV	
	40 Hz to 20 kHz	52 µV/V + 0.6 mV	
	(20 to 50) kHz	80 µV/V + 1 mV	
	(50 to 100) kHz	0.15 mV /V + 2.5 mV	
	(220 to 750) V		
	40 Hz to 1 kHz	91 µV/V + 4 mV	
	(1 to 20) kHz	0.17 mV /V + 6 mV	
	(20 to 50) kHz	0.6 mV /V + 11 mV	
	(50 to 100) kHz	2 3 mV /V + 45 mV	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Generate[1]	(750 to 1 000) V 40 Hz to 1 kHz (1 to 20) kHz (20 to 30) kHz	 91 µV/V + 4 mV 0.17 mV /V + 6 mV 0.6 mV /V + 11 mV	Fluke 5730A/03 Multifunction Calibrator 5725A Amplifier
AC Voltage – Measure[1]	Up to 10 mV (1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz 10 mV to 10 V (1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz 300 kHz to 1 MHz (1 to 2) MHz (10 to 100) V (1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz 300 kHz to 1 MHz	 0.03 % of reading + 0.03 % of range 0.02 % of reading + 0.011 % of range 0.03 % of reading + 0.011 % of range 0.1 % of reading + 0.011 % of range 0.5 % of reading + 0.011 % of range 4 % of reading + 0.02 % of range 0.007 % of reading + 0.004 % of range 0.007 % of reading + 0.002 % of range 0.014 % of reading + 0.002 % of range 0.03 % of reading + 0.002 % of range 0.8 % of reading + 0.002 % of range 0.3 % of reading + 0.01 % of range 1 % of reading + 0.01 % of range 1.5 % of reading + 0.01 % of range 0.02 % of reading + 0.004 % of range 0.02 % of reading + 0.002 % of range 0.02 % of reading + 0.002 % of range 0.04 % of reading + 0.002 % of range 0.12 % of reading + 0.002 % of range 0.4 % of reading + 0.002 % of range 1.5 % of reading + 0.01 % of range	Agilent 3458A/002 Precision Multimeter
AC Voltage – Measure[1]	(100 to 1 000) V (1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz	 0.05 % of reading + 0.004 % of range 0.04 % of reading + 0.002 % of range 0.06 % of reading + 0.002 % of range 0.12 % of reading + 0.002 % of range 0.3 % of reading + 0.002 % of range	Agilent 3458A/002 Precision Multimeter
AC Voltage – Measure[1]	(1 to 85) kHz (50, 60) Hz	 0.7 % of reading	Ross VD120 High Voltage Divider HP 34401A Precision Multimeter

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current – Generate[1]	(9 to 220) µA (10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	 0.25 mA/A + 16 nA 0.16 mA /A + 10 nA 0.1 mA /A + 8 nA 0.28 mA /A + 12 nA 1.1 mA /A + 65 nA	Fluke 5730A/03 Multifunction Calibrator
AC Current – Generate[1]	(0.22 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 (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	 0.25 mA /A + 40 nA 0.16 mA /A + 35 nA 0.1 mA /A + 35 nA 0.2 mA /A + 0.110 µA 1.1 mA /A + 0.650 µA 0.25 mA /A + 0.4 µA 0.16 mA /A + 0.35 µA 0.1 mA /A + 0.35 µA 0.2 mA /A + 0.55 µA 1.1 mA /A + 5 µA 0.25 mA /A + 4 µA 0.16 mA /A + 3.5 µA 0.1 mA /A + 2.5 µA 0.2 mA /A + 3.5 µA 1.1 mA /A + 10 µA	Fluke 5730A/03 Multifunction Calibrator
AC Current – Generate[1]	(0.22 A to 2.2) A 20 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	 0.25 mA/A + 35 µA 0.45 mA /A + 80 µA 7 mA /A + 0.16 mA	Fluke 5730A/03 Multifunction Calibrator 5725A Amplifier
AC Current – Generate[1]	(2.2 to 11) A 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (11 to 20.5) A (45 to 100) Hz 100 Hz to 1 kHz (1 to 5) kHz	 0.46 mA /A + 0.17 mA 0.95 mA /A + 0.38 mA 3.6 mA /A + 0.75 mA 0.1 % of reading + 2 mA 0.12 % of reading + 5 mA 2.3 % of reading + 5 mA	Fluke 5522A Multifunction Calibrator
AC Current – Generate[1] Clamp Only	(20.5 to 500) A (45 to 440) Hz	 1.8 % of reading	Coil / Fluke 5522A Multifunction Calibrator

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current – Measure[1]	Up to 100 µA (10 to 20) Hz (20 to 45) Hz 45 Hz to 1 kHz	 0.41 % of reading + 0.03 pA 0.16 % of reading + 0.03 pA 0.07 % of reading + 0.03 pA	Agilent 3458A/002 Precision Multimeter
AC Current – Measure[1]	(0.1 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 (0.1 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	 0.41 % of reading + 20 µA 0.16 % of reading + 20 µA 0.07 % of reading + 20 µA 0.04 % of reading + 20 µA 0.08 % of reading + 20 µA 0.41 % of reading + 40 µA 0.56 % of reading + 150 µA 0.41 % of reading + 0.2 mA 0.17 % of reading + 0.2 mA 0.09 % of reading + 0.2 mA 0.11 % of reading + 0.2 mA 0.31 % of reading + 0.2 mA 1 % of reading + 0.4 mA	Agilent 3458A/002 Precision Multimeter
Resistance – Generate, Fixed Points[1]	1, 1.9 Ω 10, 19 Ω 100, 190 Ω 1, 1.9 kΩ 10, 19 kΩ 100, 190 kΩ 1 MΩ 1.9 MΩ 10 MΩ 19 MΩ 100 MΩ	98 µΩ/Ω 23 µΩ/Ω 10 µΩ/Ω 6.5 µΩ/Ω 6.5 µΩ/Ω 8.5 µΩ/Ω 13 µΩ/Ω 18 µΩ/Ω 40 µΩ/Ω 48 µΩ/Ω 0.1 mΩ/Ω	Fluke 5730A/03 Multifunction Calibrator

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Resistance – Generate[1]	Up to 11 Ω (11 to 33) Ω (33 to 110) Ω (110 to 330) Ω 330 Ω 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 (1.1 to 3.3) MΩ (3.3 to 11) MΩ (11 to 33) MΩ (33 to 110) MΩ (110 to 330) MΩ 330 MΩ to 1.1 GΩ	40 μΩ/Ω + 0.01 Ω 30 μΩ/Ω + 0.015 Ω 28 μΩ/Ω + 0.015 Ω 28 μΩ/Ω + 0.02 Ω 29 μΩ/Ω + 0.02 Ω 29 μΩ/Ω + 0.2 Ω 29 μΩ/Ω + 0.1 Ω 29 μΩ/Ω + 1 Ω 29 μΩ/Ω + 1 Ω 33 μΩ/Ω + 10 Ω 33 μΩ/Ω + 10 Ω 60 μΩ/Ω + 150 Ω 0.013 % of reading + 0.25 kΩ 0.025 % of reading + 2.5 kΩ 0.05 % of reading + 3.0 kΩ 0.3 % of reading + 100 kΩ 1.5 % of reading + 500 kΩ	Fluke 5522A Multifunction Calibrator
Resistance – Measure[1] Fixed Points	Up to 10 Ω (10 to 100) Ω 100 Ω to 100 kΩ 100 kΩ to 1 MΩ (1 to 10) MΩ (10 to 100) MΩ 100 MΩ to 1 GΩ	16 μΩ/Ω + 50 μΩ 14 μΩ/Ω + 0.5 mΩ 12 μΩ/Ω + 5 mΩ 16 μΩ/Ω + 2 Ω 50 μΩ/Ω + 100 Ω 0.05% of reading + 1 kΩ 9.2 μΩ/Ω + 1 Ω	Agilent 3458A/002 Precision Multimeter
Capacitance – Generate[1]	(0.19 to 0.1099) nF (1.1 to 3.299) nF (3.3 to 329.999) nF (0.33 to 1.09999) μF (1.1 to 3.29999) μF (3.3 to 10.9999) μF (11 to 32.999) μF (33 to 109.999) μF (110 to 329.999) μF (0.33 to 1.09999) mF (1.1 to 3.2999) mF (3.3 to 10.9999) mF (11 to 32.9999) mF (33 to 110) mF	1.2 % of reading + 0.01 nF 1.2 % of reading + 0.01 nF 0.39 % of reading + 0.3 nF 0.38 % of reading + 3 nF 0.37 % of reading + 3 nF 0.38 % of reading + 10 nF 0.53 % of reading + 30 nF 0.58 % of reading + 0.1 μF 0.58 % of reading + 0.3 μF 0.57 % of reading + 1 μF 0.58 % of reading + 3 μF 0.59 % of reading + 10 μF 0.65 % of reading + 30 μF 1.3 % of reading + 0.1 mF	Fluke 5522A Multifunction Calibrator

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Oscilloscope Calibration – Vertical Deflection[1]			Fluke 5522A/SC1100 Multifunction Calibrator
50 Ω, 1 kHz square wave	1 mV to 6.6 V	0.59 % of reading + 40 µV	
1 MΩ, 1 kHz square wave	1 mV to 130 V	0.44 % of reading + 40 µV	
Flatness – Leveled Sine Wave	5 mV to 5.5 V 50 kHz to 100 MHz (100 to 300) MHz (300 to 600) MHz (600 to 1 100) MHz	 2.5 % of reading + 0.1 mV 2.2 % of reading + 0.1 mV 4.6 % of reading + 0.1 mV 6.4 % of reading + 0.1 mV	
Bandwidth	<300 ps	+ 13 ps / -110 ps	
Rise Time	1 ns to 20 ms	3 µs/s	
Time Interval[2]	50 ms to 5 s	(26 + 1 000*t*) µs/s	
Power Meter Range Calibration[1]	3 µW to 100 mW	0.25 % of reading	HP 11683A Power Meter Calibrator
Electrical Calibration of Thermocouple Indicating Devices[1] –	Type B (600 to 1 820) °C Type C (0 to 2 316) °C Type E (-250 to 1 000) °C Type J (-210 to 1 200) °C Type K (-200 to 1 372) °C Type L (-200 to 900) °C Type N (-200 to 1 300) °C Type R (0 to 1 767) °C Type S (0 to 1 767) °C	 0.41 °C 0.38 °C 0.29 °C 0.19 °C 0.21 °C 0.12 °C 0.26 °C 0.45 °C 0.44 °C	Fluke 7526A Process Calibrator

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Electrical Calibration of Thermocouple Indicating Devices[1] –	Type T (-250 to 200) °C (-200 to 400) °C Type U (-200 to 600) °C	 0.41 °C 0.2 °C 0.19 °C	Fluke 7526A Process Calibrator

Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Attenuation[1] – Measure	10 MHz to 26.5 GHz (-10 to 0) dB (-20 to -11) dB (-30 to -21) dB (-40 to -31) dB (-50 to -41) dB (-60 to -51) dB (-70 to -61) dB (-80 to -71) dB (-90 to -81) dB (-100 to -91) dB (-110 to -101) dB 10 MHz to 3.05 GHz (-120 to -111) dB	 0.06 dB 0.06 dB 0.06 dB 0.06 dB 0.06 dB 0.07 dB 0.06 dB 0.08 dB 0.08 dB 0.08 dB 0.08 dB 0.08 dB	Agilent N5531S Measuring Receiver
Amplitude Modulation[1] – Measure	100 kHz to 10 MHz (5 to 99) % Depth 10 MHz to 3 GHz (5 to 20) % Depth (20 to 99) % Depth (3 to 26.5) GHz (5 to 20) % Depth (20 to 99) % Depth	 1 % of reading 2.9 % of reading 0.8 % of reading 5.2 % of reading 1.8 % of reading	Agilent N5531S Measuring Receiver
Frequency Modulation[1] – Measure	20 Hz to 10 kHz 250 kHz to 10 MHz (50 to 200) Hz 10 MHz to 6.6 GHz (6.6 to 13.2) GHz (13.2 to 26.5) GHz	 3.1 % of reading 3.1 % of reading 3.8 % of reading 5 % of reading	Agilent N5531S Measuring Receiver

Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
RF Power – Generate	10 MHz to 40 GHz (-10 to 10) dBm (-60 to -10) dBm (-110 to -60) dBm	1.3 dBm 1.7 dBm 2.4 dBm	Keysight E8257D Signal Generator
RF Power[1] – Measure	1 mW @ 50 MHz	0.003 2 mW	HP 478A Power Meter
	1 mW @ 50 MHz	0.003 2 mW	HP 8482A HP 8481A/E9300A Power Sensors
	(-30 to 20) dBm 100kHz to 4.2GHz 10MHz to 18GHz	0.068 dB 0.068 dB	Agilent N5531S Measuring Receiver
Phase Noise[1] – SSB Measure	(-30 to 20) dBm 10MHz to 26.5GHz	0.11 dB	Agilent E4440A Spectrum Analyzer
AM/FM Distortion[1]	(-180 to 0) dB 1 MHz to 50 GHz	0.39 dB	HP 8903B Audio Analyzer
Harmonic Distortion	20 Hz to 20 kHz	1.2 dB	HP 8903B Audio Analyzer
	(-120 to 0) dB 20 Hz to 200 kHz	1.2 dB	Agilent E4448 Spectrum Analyzer

Length – Dimensional metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Gage Blocks[2]	Up to 13 in	(1.7+2.1*L*) µin	Master gage blocks, P&W universal measuring machine
Micrometers[1,2]	Up to 20 in	(32 + 4*L*) µin	Gage blocks (grade 2)
Calipers[1,2]	Up to 20 in	(48 + 7.2*L*) µin	
Dial Indicators[1,2]	Up to 10 in	(86 + 46*L*) µin	
Height Gages[1,2]	Up to 20 in	(194 + 3*L*) µin	Gage blocks (grade 2)
Rulers[1]	Up to 20 in	0.009 in	

Length – Dimensional metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Feeler Gage[1]	Up to 1 in	74 µin	Pratt & Whitney Supermicrometer C
Cylindrical Gages[2] – Plain Pins, Plugs Rings	(0.04 to 14) in (0 to 13) in	(8 + 2*D*) µin (2 + 3*D*) µin	Master gage blocks, P&W universal measuring machine
Thread Plugs[1] – Major Diameter Pitch Diameter	Up to 12 in Up to 12 in	52 µin 110 µin	B & S 599-246-00, Van Keuren thread wire set, Gage blocks, P & W Model C
Thread Rings	Up to 12 in	57 µin	Thread setting plug gages
Surface Plates[1] – Overall Flatness Only	Up to 6 ft × 6 ft	50 µin	Mahr Federal level system
Optical Comparators[1] – Linearity Magnification	Up to 20 in (20 to 40) in (10 to 100) X	590 µin 790 µin 590 µin	Gage blocks, SI Industries glass scales

Mass

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Scales & Balances[1,2]	(0.5 to 500) lb	0.013 % of reading + 0.6*R*	Class F Weights
Force – Tension and Compression[1]	(0.5 to 500) lbf	0.09 % of reading	Class F weights
Pressure[1]	(0 to 100) psi	0.028 psi	Additel ADT681-02-GP100 Digital Pressure Gage
	(100 to 1 000) psi	0.026 psi	Additel ADT681-02-GP1K Digital Pressure Gage
	(1 000 to 15 000) psi	3 psi	Additel ADT681-05-GP15K Digital Pressure Gage
Torque Tools[1]	4 lbf·in to 600 lbf·ft	0.32 % of reading	CDI 5000 ST torque tester

Thermodynamic

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Relative Humidity – Measure	(0 to 90) %RH	1.7 %RH	Vaisala MI70 / HMP75 Thermohygrometer
Temperature – Measuring Equipment[1]	(-25 to 350) °C	0.12 °C	Hart 1502A with 5616 PRT and dry block
Temperature – Measure[1]	(-25 to 600) °C	0.025 °C	Hart 1502A with 5616 PRT
IR Thermometry[1]	(20 to 100) ºC (100 to 300) ºC (300 to 500) ºC	0.51 ºC 0.61 ºC 0.8 ºC	Fluke 9132 Blackbody ε = 0.95, λ= (8 to 14) µm

Time and Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Frequency – Measure	10 MHz	1×10^{-11} Hz/Hz	HP 58503A/B GPS
Frequency – Measure[1]	10 Hz to 26.5 GHz	1×10^{-8} Hz/Hz	HP 53131A Counter, Agilent E4440A Spectrum Analyzer

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. L = length in inches, t = time in seconds, D = diameter in inches, R = resolution of the device under test
3. This scope is formatted as part of a single document including Certificate of Accreditation No. AC-2080.08.

Vice President