CERTIFICATE OF ACCREDITATION

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

This is to certify that

Technical Maintenance, Inc.

117 Jetplex Circle, Suite C4
Madison, AL 35758

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

ISO/IEC 17025:2017

and national standards

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

while demonstrating technical competence in the field of

CALIBRATION & DIMENSIONAL MEASUREMENT

Refer to the accompanying Scope of Accreditation for information regarding the types of activities to which this accreditation applies

AC-2080.02
Certificate Number

ANAB Approval

Certificate Valid Through: 09/20/2021
Version No. 007 Issued: 08/20/2019

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated April 2017).

ANSI National Accreditation Board

SCOPE OF ACCREDITATION TO ISO/IEC 17025:2017, ANSI/NCSL Z540-1-1994 (R2002) AND ANSI/NCSL Z540.3-2006 (R2013)

Technical Maintenance, Inc.
117 Jetplex Circle, Suite C4
Madison, AL 35758
Donny Prax (Branch Manager) Phone: 256-772-4115
Scott Chamberlain (Quality Manager Phone: 321-242-0890

CALIBRATION AND DIMENSIONAL MEASUREMENT

Valid to: **September 20, 2021** Certificate Number: **AC-2080.02**

CALIBRATION

Acoustics and Vibration

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Accelerometers – Acceleration	(0.01 to 10) g (7 to 100) Hz (100 to 2 500) Hz (2.5 to 10) kHz	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 Multiproduct Calibrator
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 Multimeter
	(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 Multiproduct Calibrator
	(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 Multiproduct Calibrator
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 Multimeter
	(1 to 600) A	0.3 % of reading	Current Shunts
Electrical Calibration of Thermocouple Indicating Devices[1]	Type B (600 to 800) °C (800 to 1 550) °C (1 550 °C to 1 820) °C Type C (0 to 1000) °C (1 000 to 1 800) °C (1 800 to 2 000) °C (2 000 to 2 316) °C	 0.27 °C 0.22 °C 0.17 °C 0.13 °C 0.18 °C 0.2 °C 0.27 °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 E		Fluke 7526A Process Calibrator
	(-250 to -200) °C	0.19 °C	
	(-200 to -100) °C	0.1 °C	
	(-100 to 0) °C	0.07 °C	
	(0 to 600) °C	0.07 °C	
	(600 to 1 000) °C	0.08 °C	
	Type J		
	(-210 to -100) °C	0.11 °C	
	(-100 to 800) °C	0.07 °C	
	(800 to 1 200) °C	0.08 °C	
	Type K		
	(-250 to -200) °C	0.35 °C	
	(-200 to -100) °C	0.13 °C	
	(-100 to 800) °C	0.08 °C	
	(800 to 1 372) °C	0.1 °C	
	Type L		
	(-200 to -100) °C	0.08 °C	
	(-100 to 900) °C	0.07 °C	
	Type N		
	(-250 to -200) °C	0.56 °C	
	(-200 to -100) °C	0.18 °C	
	(-100 to 0) °C	0.1 °C	
	(0 to 100) °C	0.09 °C	
	(100 to 800) °C	0.08 °C	
	(800 to 1 300) °C	0.1 °C	
	Type R		
	(-50 to -25) °C	0.42 °C	
	(-25 to 0) °C	0.34 °C	
	(0 to 100) °C	0.3 °C	
	(100 to 400) °C	0.22 °C	
	(400 to 600) °C	0.17 °C	
	(600 to 1 000) °C	0.16 °C	
	(1 000 to 1 600) °C	0.15 °C	
	(1 600 to 1 767) °C	0.18 °C	
	Type S		
	(50 to -25) °C	0.39 °C	
	(-25 to 0) °C	0.33 °C	
	(0 to 100) °C	0.29 °C	
	(100 to 400) °C	0.22 °C	
	(400 to 600) °C	0.18 °C	
	(600 to 1 600) °C	0.17 °C	
	(1 600 to 1 767) °C	0.2 °C	

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 -100) °C (-100 to 0) °C (0 to 400) °C Type U (-200 to 0) °C (0 to 600) °C	 0.26 °C 0.13 °C 0.09 °C 0.07 °C 0.13 °C 0.08 °C	Fluke 7526A Process Calibrator
Electrical Calibration of RTD Indicating Devices[1]	Pt 385, 100 Ω (-200 to 800) °C Pt 3926, 100 Ω (-200 to 630) °C Pt 3916, 100 Ω (-200 to 630) °C Pt 385, 200 Ω (-200 to 400) °C (400 to 630) °C Pt 385, 500 Ω (-200 to 630) °C Pt 385, 1000 Ω (-200 to 630) °C	 0.05 °C 0.05 °C 0.05 °C 0.4 °C 0.5 °C 0.17 °C 0.09 °C	Fluke 7526A Process Calibrator
Power Meters[1]	3 µW to 100 mW	0.25 % of reading	HP 11683A Range Calibrator
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 Multiproduct 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	40 μΩ/Ω + 10 mΩ	Fluke 5520A Multiproduct Calibrator
	(11 to 33) Ω	30 μΩ/Ω + 15 mΩ	
	(33 to 110) Ω	28 μΩ/Ω + 15 mΩ	
	(110 to 330) Ω	28 μΩ/Ω + 0.02 Ω	
	330 Ω to 1.1 kΩ	29 μΩ/Ω + 0.02 Ω	
	(1.1 to 3.3) kΩ	29 μΩ/Ω + 0.2 Ω	
	(3.3 to 11) kΩ	29 μΩ/Ω + 0.1 Ω	
	(11 to 33) kΩ	29 μΩ/Ω + 1 Ω	
	(33 to 110) kΩ	29 μΩ/Ω + 1 Ω	
	(110 to 330) kΩ	33 μΩ/Ω + 10 Ω	
	(0.33 to 1.1) MΩ	33 μΩ/Ω + 10 Ω	
	(1.1 to 3.3) MΩ	60 μΩ/Ω + 150 Ω	
	(3.3 to 11) MΩ	0.013 % of reading + 0.25 kΩ	
	(11 to 33) MΩ	0.025 % of reading + 2.5 kΩ	
	(33 to 110) MΩ	0.05 % of reading + 3.0 kΩ	
	(110 to 330) MΩ	0.3 % of reading + 100 kΩ	
	330 MΩ to 1.1 GΩ	1.5 % of reading + 500 kΩ	
Resistance – Measure[1]	Up to 10 Ω	16 μΩ/Ω + 50 μΩ	HP 3458A Multimeter
	(10 to 100) Ω	14 μΩ/Ω + 0.5 mΩ	
	(0.1 to 1) kΩ	12 μΩ/Ω + 0.5 mΩ	
	(1 to 10) kΩ	12 μΩ/Ω + 5 mΩ	
	(10 to 100) kΩ	12 μΩ/Ω + 5 mΩ	
	(0.1 to 1) MΩ	16 μΩ/Ω + 2.0 Ω	
	(1 to 10) MΩ	50 μΩ/Ω + 0.1 kΩ	
	(10 to 100) MΩ	0.05 % of reading + 1 kΩ	
	(0.1 to 1) GΩ	0.51 % of reading + 10 kΩ	
AC Voltage – Generate[1]	(0.22 to 2.2) mV		Fluke 5730A Multiproduct Calibrator
	(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	

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) mV		Fluke 5730A Multiproduct Calibrator
	(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	
	(2.2 to 22) V		
	(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	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Generate[1]	(22 to 220) V (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	 0.28 mV/V + 4 mV 0.11 mV/V + 1.5 mV 62 µV/V + 0.6 mV 93 µV/V + 1 mV 0.18 mV/V + 2.5 mV 1.1 mV/V + 16 mV 5.1 mV/V + 40 mV 9.3 mV/V + 80 mV	Fluke 5730A Multiproduct Calibrator
AC Voltage – Generate[1]	(220 to 750) V (30 to 50) kHz (50 to 100) kHz (750 to 1 000) V 40 Hz to 1 kHz (1 to 20) kHz (20 to 30) kHz	 0.7 mV/V + 11 mV 2.7 mV/V + 45 mV 0.11 mV/V + 4 mV 0.2 mV/V + 6 mV 0.7 mV/V + 11 mV	Fluke 5730A Multiproduct 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 100 mV (1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz 300 kHz to 1 MHz (1 to 2) MHz 100 mV to 1 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	 0.044 % of reading + 0.003 mV 0.026 % of reading + 0.0011 mV 0.044 % of reading + 0.0011 mV 0.11 % of reading + 0.0011 mV 0.5 % of reading + 0.0011 mV 4 % of reading + 0.002 mV 0.019 % of reading + 0.004 mV 0.019 % of reading + 0.002 mV 0.027 % of reading + 0.002 mV 0.045 % of reading + 0.002 mV 0.09 % of reading + 0.002 mV 0.31 % of reading + 0.01 mV 1 % of reading + 0.01 mV 1.5 % of reading + 0.01 mV 0.019 % of reading + 0.04 mV 0.019 % of reading + 0.02 mV 0.027 % of reading + 0.02 mV 0.045 % of reading + 0.02 mV 0.09 % of reading + 0.02 mV 0.31 % of reading + 0.1 mV 1 % of reading + 0.1 mV 1.5 % of reading + 0.1 mV	HP 3458A Multimeter

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Measure[1]	1 V to 10 V		HP 3458A Multimeter
	(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	
AC Current – Generate[1]	(9 to 220) µA		Fluke 5730A Multiproduct Calibrator
	(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	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current – Generate[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 (0.22 to 2.2) A 20 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	 0.31 mA/A + 0.4 µA 0.2 mA/A + 0.35 µA 0.14 mA/A + 0.35 µA 0.26 mA/A + 0.55 µA 1.4 mA/A + 5 µA 0.3 mA/A + 4 µA 0.2 mA/A + 3.5 µA 0.14 mA/A + 2.5 µA 0.26 mA/A + 3.5 µA 1.4 mA/A + 10 µA 0.3 mA/A + 35 µA 0.54 mA/A + 80 µA 8.2 mA/A + 0.16 mA	Fluke 5730A Multiproduct Calibrator
AC Current – Generate[1]	(2.2 to 11) A 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	 0.56 mA/A + 0.17 mA 1.2 mA/A + 0.38 mA 4.3 mA/A + 0.75 mA	Fluke 5730A Multiproduct Calibrator /5725A Amplifier
AC Current – Generate[1]	(11 to 20.5) A 45 Hz to 100 Hz 100 Hz to 1 kHz (1 to 5) kHz	 0.19 % of reading + 5 mA 0.24 % of reading + 5 mA 4.6 % of reading + 5 mA	Fluke 5522A Multiproduct Calibrator
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	 0.41 % 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	HP 3458A Multimeter

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current – Measure[1]	(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 + 0.2 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 Multimeter
AC Current – Measure[1]	(1 to 600) A 30 Hz to 10 kHz	 3.5 % of reading	Current Clamp
Capacitance[1] – Generate	(220 to 400) pF (0.4 to 3.299 9) nF (3.3 to 10.999 9) nF (11 to 32.999 9) µF (33 to 109.999) nF (110 to 329.999) µF (0.33 to 1.099 99) µF (1.1 to 3.299 99) µF (3.3 to 10.999 9) µF (11 to 32.999 9) µF (33 to 109.999) µF (110 to 329.999) µF (0.33 to 1.099 99) mF (1.1 to 3.299 99) mF (3.3 to 10.999 9) mF (11 to 32.999 9) mF (33 to 110) mF	0.38% of Output + 7.6 pF 0.38 % of Output + 0.01 nF 0.19 % of Output + 0.01 nF 0.19 % of Output + 0.08 nF 0.19 % of Output + 0.08 nF 0.19 % of Output + 0.23 nF 0.19 % of Output + 0.76 nF 0.19 % of Output + 2.3 nF 0.19 % of Output + 7.6 nF 0.3 % of Output + 23 nF 0.34 % of Output + 76 nF 0.34 % of Output + 228 nF 0.34 % of Output + 0.76 µF 0.34 % of Output + 2.28 µF 0.34 % of Output + 7.6 µF 0.57 % of Output + 23 µF 0.84 % of Output + 76 µF	Fluke 5522A Multiproduct Calibrator

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Capacitance[1] – Measure	100 Hz /120 Hz (16 to 400) pF (0.4 to 1) nF (1 to 100) nF (0.1 to 1) µF (1 to 100) µF (0.1 to 1) mF 1 000 Hz (16 to 400) pF (0.4 to 1) nF (1 to 100) nF (0.1 to 1) µF (1 to 100) µF (0.1 to 1) mF 10 kHz (16 to 400) pF (0.4 to 1) nF (1 to 100) nF (0.1 to 1) µF (1 to 100) µF (0.1 to 1) mF 20 kHz (16 to 400) pF (0.4 to 1) nF (1 to 100) nF (0.1 to 1) µF (1 to 100) µF	 2 % of reading + 0.3 pF 0.17 % of reading 0.13 % of reading 0.12 % of reading 0.18 % of reading 0.2 % of reading 0.43 % of reading + 0.3pF 0.1 % of reading 0.08 % of reading 0.07 % of reading 0.13 % of reading 0.45 % of reading 0.56 % of reading + 0.3pF 0.15 % of reading 0.12 % of reading 0.17 % of reading 0.69 % of reading 3.5 % of reading 2.1 % of reading + 0.3pF 0.62 % of reading 0.62 % of reading 0.43 % of reading 1.7 % of reading	Agilent 4263B LCR Meter
Capacitance[1] – Measure	100 kHz (16 to 400) pF (0.4 to 1) nF (1 to 100) nF (0.1 to 1) µF (1 to 10) µF	 1.6 % of reading + 0.3 pF 1 % of reading 0.98 % of reading 1.4 % of reading 4.1 % of reading	Agilent 4263B LCR Meter
Oscilloscopes Calibration[1] – Generate Voltage DC - 50Ω DC - 1MΩ Square Wave 1 kHz - 50Ω Square Wave 1 kHz - 1MΩ	 (0 to 6.6) V (0 to 130) V 1 mV to 6.6 Vpp 1 mV to 130 Vpp	 0.19 % of reading + 31 µV 0.019 % of reading + 19 µV 0.19 % of reading + 31 µV 0.038 % of reading + 4 µV	Fluke 5820A Oscilloscope Calibrator w/ GHz Option

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Oscilloscopes Calibration[1] – Generate			Fluke 5820A Oscilloscope Calibrator w/ GHz Option
	(5 to 20) mVpp		
Leveled Sine Flatness 50 kHz to 10 MHz Reference	50 kHz to 100 MHz	0.35 dB	
	(100 to 300) MHz	0.37 dB	
	(300 to 500) MHz	0.43 dB	
	(500 to 600) MHz	0.45 dB	
	(600 to 1 600) MHz	0.51 dB	
	(1 600 to 2 100) MHz	0.56 dB	
	50 mV to 3.5 Vpp		
	50 kHz to 100 MHz	0.23 dB	
	(100 to 300) MHz	0.25 dB	
	(300 to 500) MHz	0.31 dB	
	(500 to 600) MHz	0.34 dB	
	(600 to 1 600) MHz	0.39 dB	
	(1 600 to 2 100) MHz	0.45 dB	
	(3.5 to 5) Vpp		
	50 kHz to 100) MHz	0.23 dB	
	(100 to 300) MHz	0.25 dB	
	(300 to 500) MHz	0.31 dB	
	(500 to 600) MHz	0.34 dB	
Oscilloscopes Calibration[1] – Generate	50 mV to 3.5Vpp		EPM Power Meter w/ E Series Power Sensors
	(2 100 to 4 000) MHz	0.28 dB	
	(4 000 to 8 000) MHz	0.4 dB	
	(8 000 to 18 000) MHz	0.59 dB	
Oscilloscopes Calibration[1] – Generate			Fluke 5820A Oscilloscope Calibrator w/ GHz Option
Time Marker	500 ps to 20 ms	0.25 µs/s	
	50 ms to 5 s	1.9 µs/s + 3.9 µHz	
Rise Time	< 150 ps	+0 / -50 ps	
Oscilloscopes Calibration[1] – Measure			Fluke 5820A Oscilloscope Calibrator w/ GHz Option
Input Impedance	(40 to 60) Ω	0.08 % of reading	
Resistance	500 kΩ to 1.5MΩ	0.08 % of reading	
Capacitance	(5 to 50) pF	3.8 % of reading + 0.4pF	
Leakage	(0 to 5.99) V	0.038 % of reading + 0.8 mV	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Low Frequency Power – Generate[1] (45 to 65) Hz 1 PF DC	Up to 20 kW	0.25 % of reading 0.21 % of reading	Fluke 5522A Multiproduct Calibrator

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 Measuring Receiver
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 Measuring Receiver
RF Power[1] – Measure 50 MHz	1 mW	0.003 2 mW	HP 432A Power Meter & 8478B Power Sensor
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 dB 1.6 dB 1.7 dB 1.6 dB 1.7 dB 2.6 dB	Agilent E8257D Signal Generator

Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
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 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 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 Measuring Receiver
Phase Modulation[1] – Measure	100 kHz to 50 GHz	9.7 % of reading	Agilent N5531S Measuring Receiver
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 Measuring Receiver /HP 11722A, HP 11792A Power Sensors
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 Measuring Receiver
FM Distortion[1] – Measure	1 MHz to 50 GHz	0.3 % of reading	Agilent N5531S Measuring Receiver

Length – Dimensional metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Calipers[1,2]	Up to 80 in	$(24 + 11L)$ µin	Gage blocks (Grade 2)
Micrometers[1,2]	Up to 46 in	$(19 + 5L)$ µin	

Length – Dimensional metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
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 12 in	(2.8 + 2.6*L*) µin	Universal measuring machine, master gage block set
Micrometer Standards Length Rods	Up to 46 in	(3.2 + 4L) µin	Gage blocks (grade 2), P&W universal measuring Machine, MAHR Supramess Dial Comparator
Thread Plugs – Major Diameter Pitch Diameter	 Up to 12 in Up to 12 in	 40 µin 91 µin	Gage blocks, P&W universal measuring machine, Van Keuren 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 81pc Gage Block Set, SI Industries glass scales
Protractors[1]	(0 to 360) °	0.019 °	Angle blocks

Length – Dimensional metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
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 and Mass Related

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]	(0 to 30) psia (0 to 61) inHg	0.018 psi 0.037 inHg	Fluke 700GA5 Pressure Gage
	(0 to 30) psi	0.007 psi	Additel 681-GP30 Pressure Gage
	(-15 to 100) psi	0.03 psi	Additel 681- CP100 Pressure Gage
	(0 to 300) psi	0.08 psi	Additel 681- GP300 Pressure Gage
	(0 to 1 000) psi	0.27 psi	Additel 681- GP1K Pressure Gage
	(0 to 3 000) psi	0.9 psi	Additel 681- GP3K Pressure Gage
	(0 to 10 000) psi	3.2 psi	Additel 681- GP10K Pressure Gage
	(-150 to 150) inH_2O	0.094 inH_2O	Additel 681-DP150 Pressure Gage
	(-20 to 20) inH_2O	0.0012 inH_2O	Additel 681-DP20 Pressure Gage
Torque Wrenches[1]	(5 to 1 000) lbf·in (25 to 250) lbf·ft (250 to 2 000) lbf·ft	0.35 % of reading 0.39 % of reading 0.41 % of reading	CDI torque system

Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
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 Class F	(0.5 to 10) lb (10 to 50) lb	0.049 g, (0.00 011) lb 0.45 g, (0.000 99) lb	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
Rockwell Hardness Testers[1]	(< 60) HRBW (≥ 60 to < 80) HRBW (≥ 35 to < 60) HRC (≥ 60) HRC < 70 HA > 80 HA	1.9 HRBW 1.4 HRBW 1.3 HRC 0.7 HRC 1.4 HRA 0.7 HRA	Indirect verification per ASTM E18
Durometers Scale (Force) Accuracy Types A, B, C, D, M Indenter Geometry Length Diameter Angle	(0 to 100) duros 0.1 in 0.05 in (30 to 35) °	0.01 duros 311 µin 311 µin 0.085 °	Direct Verification Master balance Optical comparator

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 Indicator w/5626 PRT and dry block
Temperature – Measure[1]	(-25 to 600) °C	0.026 °C	Hart 1502 Indicator with 5626 PRT
Relative Humidity – Measure[1]	(0 to 90) % RH	1.6 %RH	Vaisala HM141/HMP46 Humidity Indicator and Probe

Thermodynamic

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
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 Infrared Calibrator 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[1]	10 MHz	1 part in 10^{11} Hz/Hz	GPS Receiver 58503A/B
	10 Hz to 500 MHz	5 parts in 10^{7} Hz/Hz	HP 5345A Counter
Frequency – Measure[1]	500 MHz to 26.5 GHz (26.5 to 40) GHz	1.7 parts in 10^{9} Hz/Hz 1 part in 10^{7} Hz/Hz	HP 5343A Counter

DIMENSIONAL MEASUREMENT

1 Dimensional

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Length	X Axis (0.01 to 5.0) in Y Axis (0.01 to 3.0) in	311 µin	Optical comparator

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.

Vice President