CERTIFICATE OF ACCREDITATION

The ANSI National Accreditation Board

Hereby attests that

ARREGA TECNOLOGÍA, SAPI, DE CV/ARREGA INDUSTRIAL

Blvd. Tercera Oeste No. 17524, Fracc. Garita de Otay
Tijuana, Baja California Mexico

Fulfills the requirements of

ISO/IEC 17025:2017

and national standard

ANSI/NCSL Z540-1-1994 (R2002)

In the field (s) of

CALIBRATION and DIMENSIONAL MEASUREMENT

This certificate is valid only when accompanied by a current scope of accreditation document.
The current scope of accreditation can be verified at www.anab.org.

R. Douglas Leonard Jr., VP, PILR SBU

Expiry Date: 07 September 2022
Certificate Number: ACT-2077

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).

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

ARREGA TECNOLOGÍA, SAPI, DE CV/ ARREGA INDUSTRIAL

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CALIBRATION AND DIMENSIONAL MEASUREMENT

Valid to: **September 7, 2022** Certificate Number: **ACT-2077**

CALIBRATION

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
DC Voltage – Source [1]	Up to 330 mV (0.33 to 3.3) V (3.3 to 33) V (30 to 330) V (100 to 1 100) V	16 µV/V + 0.78 µV 9 µV/V + 1.6 µV 9.8 µV/V + 16 µV 15 µV/V + 0.12 mV 15 µV/V + 1.2 mV	Fluke 5522A Multi-Product Calibrator
DC Voltage – Measure [1]	(10 to 100) mV (0.1 to 1) V (1 to 10) V (10 to 100) V (100 to 1 000) V	9.2 µV/V + 0.3 µV 8 µV/V + 0.3 µV 8 µV/V + 0.5 µV 10 µV/V + 30 µV 10 µV/V + 0.1 mV	Agilent 3458A Opt. 002 8.5 Digit Multimeter
DC Voltage – Measure [1]	Up to 5 kV (5 to 10) kV (10 to 20) kV (20 to 30) kV (30 to 40) kV (40 to 50) kV	80 µV/V + 1.6 V 80 µV/V + 2.5 V 80 µV/V + 1.6 V 80 µV/V + 5.9 V 0.1 mV/V + 19 V 0.1 mV/V + 30 V	Vitrek 4700 High Voltage Meter
DC Current – Source [1]	(0 to 330 µA) (0.33 to 3.3) mA (3.3 to 33) mA (33 to 330) mA (0.33 to 1.1) A (1.1 to 3) A	0.12 mA/A + 16 nA 79 µA/A + 39 nA 79 µA/A + 0.19 µA 82 µA/A + 1.9 µA 0.16 mA/A + 31 µA 0.31 mA/A + 31 µA	Fluke 5522A Multi-Product Calibrator
DC Current – Source [1]	(3 to 11) A (11 to 20.5) A	0.4 mA/A + 0.39 mA 0.79 mA/A + 0.58 mA	Fluke 5522A Multi-Product Calibrator

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
DC Current Clamp Meters [1]	(10 to 550) A (550 to 1 025) A	2 mA/A + 0.13 A 2 mA/A + 0.13 A	Fluke 5522A Multi-Product Calibrator, Fluke 5500A/COIL 50-turn Coil
DC Current – Measure [1]	Up to 100 µA (0.1 to 1) mA (1 to 10) mA (10 to 100) mA (0.1 to 1) A	20 µA/A + 0.53 nA 19 µA/A + 3.3 nA 20 µA/A + 33 nA 40 µA/A + 0.33 µA 89 µA/A + 6.7 µA	Agilent 3458A Opt. 002 8.5 Digit Multimeter
DC Current – Measure [1]	(Up to 1 000) A	6.1 mA/A + 60 mA	Agilent-3458A Opt. 002 Digital Multimeter Empro B-1000-100 Shunt
Resistance – Source [1] (Fixed Values)	2 Ω 11 Ω 11.9 Ω 19 Ω 30 Ω 33 Ω 109 Ω 119 Ω 190 Ω 300 Ω 330 Ω 1.09 kΩ 1.19 kΩ 1.9 kΩ 3 kΩ 3.3 kΩ 10.9 kΩ 11.9 kΩ 19 kΩ 30 kΩ 33 kΩ 109 kΩ 119 kΩ 190 kΩ 300 kΩ	0.85 mΩ 1.1 mΩ 1.5 mΩ 1.6 mΩ 1.9 mΩ 2 mΩ 3.5 mΩ 4.2 mΩ 5.8 mΩ 8.3 mΩ 9 mΩ 26 mΩ 43 mΩ 59 mΩ 85 mΩ 92 mΩ 0.27 Ω 0.44 Ω 0.6 Ω 0.85 Ω 0.92 Ω 2.7 Ω 4.6 Ω 6.5 Ω 9.3 Ω	Fluke 5522A Multi-Product Calibrator

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Resistance – Source [1] (Fixed Values)	330 kΩ	10 Ω	Fluke 5522A Multi-Product Calibrator
	1.09 MΩ	71 Ω	
	1.19 MΩ	79 Ω	
	1.9 MΩ	0.12 kΩ	
	3 MΩ	0.17 kΩ	
	3.3 MΩ	0.19 kΩ	
	10.9 MΩ	1.2 kΩ	
	11.9 MΩ	4.4 kΩ	
	19 MΩ	5.7 kΩ	
	30 MΩ	8.1 kΩ	
	33 MΩ	9 kΩ	
	109 MΩ	46 kΩ	
	119 MΩ	0.36 MΩ	
	290 MΩ	0.8 MΩ	
	400 MΩ	5.1 MΩ	
	640 MΩ	7.9 MΩ	
	1.09 GΩ	13 MΩ	
Resistance – Measure [1]	Up to 10 Ω	17 μΩ/Ω + 50 μΩ	Agilent-3458A Opt. 002 Digital Multimeter
	(10 to 100) Ω	15 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	
	(1 to 10) kΩ	13 μΩ/Ω + 50 mΩ	
	(10 to 100) kΩ	17 μΩ/Ω + 2 Ω	
	(0.1 to 1) MΩ	52 μΩ/Ω + 0.1 kΩ	
	(1 to 10) MΩ	52 μΩ/Ω + 0.1 kΩ	
	(10 to 100) MΩ	0.53 mΩ/Ω + 1 kΩ	
AC Voltage – Source [1]	1 mV to 33 mV		Fluke 5522A Multi-Product Calibrator
	(10 to 45) Hz	0.63 mV/V + 4.7 μV	
	45 Hz to 10 kHz	0.14 mV/V + 4.7 μV	
	(10 to 20) kHz	0.17 mV/V + 4.7 μV	
	(20 to 50) kHz	0.79 mV/V + 4.7μV	
	(50 to 100) kHz	2.7 mV/V + 9.3 μV	
	(100 to 500) kHz	6.3 mV/V + 39 μV	
	(33 to 330) mV		
	(10 to 45) Hz	0.24 mV/V + 6.2 μV	
	45 Hz to 10 kHz	0.12 mV/V + 6.2 μV	
	(10 to 20) kHz	0.13 mV/V + 6.2 μV	
	(20 to 50) kHz	0.28 mV/V + 6.2 μV	
	(50 to 100) kHz	0.63 mV/V + 25 μV	
	(100 to 500) kHz	1.7 mV/V + 54 μV	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Source [1]	(0.33 to 3.3) V		Fluke 5522A Multi-Product Calibrator
	(10 to 45) Hz	0.24 mV/V + 40 µV	
	45 Hz to 10 kHz	0.12 mV/V + 50 µV	
	(10 to 20) kHz	0.15 mV/V + 50 µV	
	(20 to 50) kHz	0.24 mV/V + 40 µV	
	(50 to 100) kHz	0.55 mV/V + 0.1 mV	
	(100 to 500) kHz	1.9 mV/V + 0.47 mV	
	(3.3 to 33) V		
	(10 to 45) Hz	0.24 mV/V + 0.47 mV	
	45 Hz to 10 kHz	0.12 mV/V + 0.47 mV	
	(10 to 20) kHz	0.19 mV/V + 0.47 mV	
	(20 to 50) kHz	0.28 mV/V + 0.47 mV	
	(50 to 100) kHz	0.71 mV/V + 1.2 mV	
	(33 to 330) V		
	45 Hz to 1 kHz	0.15 mV/V + 1.6 mV	
	(1 to 10) kHz	0.16 mV/V + 4.7 mV	
	(10 to 20) kHz	0.21 mV/V + 4.7 mV	
	(20 to 50) kHz	0.27 mV/V + 4.7 mV	
	(50 to 100) kHz	1.6 mV/V + 39 mV	
	(330 to 1 020) V		
	45 Hz to 1 kHz	0.24 mV/V + 7.8 mV	
	(1 to 5) kHz	0.2 mV/V + 7.8 mV	
	(5 to 10) kHz	0.24 mV/V + 7.8 mV	
AC Voltage – Measure [1]	Up to 10 mV		Agilent 3458A Opt. 002 8.5 Digit Multimeter
	40 Hz to 1 kHz	0.34 mV/V + 1.1 µV	
	(1 to 20) kHz	0.42 mV/V + 1.1 µV	
	(20 to 100) kHz	5.1 mV/V + 1.1 µV	
	(100 to 300) kHz	41 mV/V + 2 µV	
	(10 to 100) mV		
	40 Hz to 1 kHz	91 µV/V + 2 µV	
	(1 to 20) kHz	0.16 mV/V + 2 µV	
	(20 to 100) kHz	0.9 mV/V + 2 µV	
	(100 to 300) kHz	3.1 mV/V + 10 µV	
	(0.1 to 1) V		
	40 Hz to 1 kHz	86 µV/V + 20 µV	
	(1 to 20) kHz	0.16 mV/V + 20 µV	
	(20 to 50) kHz	0.33 mV/V + 20 µV	
	(50 to 100) kHz	0.83 mV/V + 20 µV	
	(100 to 300) kHz	3 mV/V + 0.1 mV	
	(300 to 500) kHz	10 mV/V + 0.1 mV	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Measure [1]	(1 to 10) V		Agilent-3458A Opt. 002 Digital Multimeter
	(1 to 40) Hz	87 µV/V + 0.4 mV	
	40 Hz to 1 kHz	85 µV/V + 0.2 mV	
	(1 to 20) kHz	0.16 mV/V + 0.2 mV	
	(20 to 50) kHz	0.33 mV/V + 0.2 mV	
	(50 to 100) kHz	0.82 mV/V + 60 µV	
	(100 to 300) kHz	3 mV/V + 1 mV	
	(300 to 500) kHz	3.4 mV/V + 1 mV	
	500 kHz to 1 MHz	10 mV/V + 1 mV	
	(10 to 100) V		
	40 Hz to 1 kHz	0.22 mV/V + 2 mV	
	(1 to 20) kHz	0.23 mV/V + 2 mV	
	(20 to 50) kHz	0.38 mV/V + 2 mV	
	(50 to 100) kHz	1.3 mV/V + 2 mV	
	(100 to 1 000) V		
	(50 to 60) Hz	1 mV/V + 0.4 V	
	(100 to 1 000) V		
	(100 to 450) Hz	25 mV/V + 0.4 V	
AC Voltage – Measure [1]	(1 to 9) kV		Vitrek 4700 High Voltage Meter
	(50 to 60) Hz	1 mV/V + 0.4 V	
AC Current – Source [1]	(29 to 330) µA		Fluke 5522A Multi-Product Calibrator
	(10 to 20) Hz	1.6 mA/A + 80 nA	
	(20 to 45) Hz	1.2 mA/A + 80 nA	
	45 Hz to 1 kHz	0.98 mA/A + 80 nA	
	(1 to 5) kHz	2.3 mA/A + 0.12 µA	
	(5 to 10) kHz	6.2 mA/A + 0.16 µA	
	(10 to 30) kHz	12 mA/A + 0.31 µA	
	(0.33 to 3.3) mA		
	(10 to 20) Hz	1.6 mA/A + 0.12 µA	
	(20 to 45) Hz	0.98 mA/A + 0.12 µA	
	45 Hz to 1 kHz	0.78 mA/A + 0.12 µA	
	(1 to 5) kHz	1.6 mA/A + 0.16 µA	
	(5 to 10) kHz	3.9 mA/A + 0.23 µA	
	(10 to 30) kHz	7.8 mA/A + 0.47 µA	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current – Source [1]	(3.3 to 33) mA		Fluke 5522A Multi-Product Calibrator
	(10 to 20) Hz	1.4 mA/A + 1.6 µA	
	(20 to 45) Hz	0.71 mA/A + 1.6 µA	
	45 Hz to 1 kHz	0.32 mA/A + 1.6 µA	
	(1 to 5) kHz	0.64 mA/A + 1.6 µA	
	(5 to 10) kHz	1.6 mA/A + 2.3 µA	
	(10 to 30) kHz	3.1 mA/A + 3.1 µA	
	(33 to 330) mA		
	(10 to 20) Hz	1.4 mA/A + 16 µA	
	(20 to 45) Hz	0.71 mA/A + 16 µA	
	45 Hz to 1 kHz	0.32 mA/A + 16 µA	
	(1 to 5) kHz	0.79 mA/A + 39 µA	
	(5 to 10) kHz	1.6 mA/A + 78 µA	
	(10 to 30) kHz	3.2 mA/A + 0.16 mA	
	(0.33 to 1.1) A		
	(10 to 45) Hz	1.4 mA/A + 78 µA	
	45 Hz to 1 kHz	0.4 mA/A + 78 µA	
	(1 to 5) kHz	4.7 mA/A + 0.78 mA	
	(5 to 10) kHz	20 mA/A + 3.9 mA	
	(1.1 to 3) A		
	(10 to 45) Hz	1.4 mA/A + 78 µA	
	45 Hz to 1 kHz	0.55 mA/A + 78 µA	
	(1 to 5) kHz	4.7 mA/A + 0.78 mA	
	(5 to 10) kHz	19 mA/A + 3.9 mA	
	(3 to 11) A		
	(45 to 100) Hz	0.52 mA/A + 1.6 mA	
	100 Hz to 1 kHz	0.81 mA/A + 1.6 mA	
	(1 to 5) kHz	2.4 mA/A + 1.6 mA	
	(11 to 20.5) A		
	(45 to 100) Hz	0.96 mA/A + 3.9 mA	
	100 Hz to 1 kHz	1.2 mA/A + 3.9 mA	
	(1 to 5) kHz	24 mA/A + 3.9 mA	
AC Current Clamp Meters [1]	(16.5 to 55) A		Fluke 5522A Multi-Product Calibrator, Fluke 5500A/COIL 50-turn Coil
	(45 to 65) Hz	2.9 mA/A + 0.39 A	
	(65 to 440 Hz)	2.8 mA/A + 0.39 A	
	(55 to 150) A		
	(45 to 65) Hz	3.1 mA/A + 0.39 A	
	(65 to 440) Hz	2.8 mA/A + 0.39 A	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current Clamp Meters [1]	(150 to 550) A (45 to 65) Hz (65 to 440) Hz (550 to 1 000) A (45 to 65) Hz (65 to 440) Hz	 2.7 mA/A + 0.4 A 2.9 mA/A + 0.4 A 2.8 mA/A + 0.43 A 2.9 mA/A + 0.43 A	Fluke 5522A Multi-Product Calibrator Fluke 50 Turn Coil
AC Current – Measure [1]	Up to 10 µA 1 kHz (10 to 100) µA 1 kHz (0.1 to 1) mA 1 kHz (1 to 10) mA 1 kHz (10 to 100) mA 1kHz (0.1 to 1) A 1 kHz	 0.95 mA/A + 3 nA 0.62 mA/A + 30 nA 0.32 mA/A + 0.2 µA 0.32 mA/A + 2 µA 0.32 mA/A + 20 µA 1 mA/A + 0.2 mA	Agilent 3458A Opt. 002 8.5 Digit Multimeter
AC Current – Measure [1]	Up to 1 000 A (60 to 100) Hz	 0.62 mA/A + 0.61 A	Agilent 3458A Opt. 002 8.5 Digit Multimeter, Empro B-1000-100 Current Shunt
Electrical Simulation of Thermocouple Indicating Devices – Source/Measure [1]	Type B (600 to 800) °C (800 to 1 000) °C (1 000 to 1 550) °C (1 550 to 18 20) °C Type C (0 to 150) °C (150 to 650) °C (650 to 1 000) °C (1 000 to 1 800) °C (1 800 to 2 316) °C Type E (-250 to -100) °C (-100 to -25) °C (-25 to 350) °C (350 to 650) °C (650 to 1 000) °C	 0.52 °C 0.46 °C 0.36 °C 0.37 °C 0.36 °C 0.22 °C 0.26 °C 0.42 °C 0.67 °C 0.41 °C 0.17 °C 0.16 °C 0.17 °C 0.2 °C	Fluke 5522A Multi-Product Calibrator

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Electrical Simulation of Thermocouple Indicating Devices – Source/Measure [1]	Type J		Fluke 5522A Multi-Product Calibrator
	(-210 to -100) °C	0.24 °C	
	(-100 to -30) °C	0.17 °C	
	(-30 to 150) °C	0.16 °C	
	(150 to 760) °C	0.18 °C	
	(760 to 1 200) °C	0.21 °C	
	Type K		
	(-200 to -100) °C	0.29 °C	
	(-100 to -25) °C	0.2 °C	
	(-25 to 120) °C	0.19 °C	
	(120 to 1 000) °C	0.25 °C	
	(1 000 to 1 372) °C	0.34 °C	
	Type L		
	(-200 to -100) °C	0.31 °C	
	(-100 to 800) °C	0.23 °C	
	(800 to 900) °C	0.18 °C	
	Type N		
	(-200 to -100) °C	0.39 °C	
	(-100 to -25) °C	0.29 °C	
	(-25 to 120) °C	0.28 °C	
	(120 to 410) °C	0.27 °C	
	(410 to 1 300) °C	0.32 °C	
	Type R		
	(0 to 250) °C	0.6 °C	
	(250 to 400) °C	0.35 °C	
	(400 to 1 000) °C	0.34 °C	
	(1 000 to 1767) °C	0.38 °C	
	Type S		
	(0 to 250) °C	0.43 °C	
	(250 to 1 000) °C	0.36 °C	
	(1 000 to 1400) °C	0.37 °C	
	(1 400 to 1767) °C	0.42 °C	
	Type T		
	(-250 to -150) °C	0.52 °C	
	(-150 to 0) °C	0.25 °C	
	(0 to 120) °C	0.15 °C	
	(120 to 400) °C	0.13 °C	
	Type U		
	(-200 to 0) °C	0.46 °C	
	(0 to 600) °C	0.22 °C	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Electrical Simulation of RTD Indicating Devices – Source [1]	Pt 385, 100 Ω		Fluke 5522A Multi-Product Calibrator
	(-200 to -80) °C	0.053 °C	
	(-80 to 0) °C	0.055 °C	
	(0 to 100) °C	0.066 °C	
	(100 to 300) °C	0.082 °C	
	(300 to 400) °C	0.089 °C	
	(400 to 630) °C	0.11 °C	
	(630 to 800) °C	0.19 °C	
	Pt 385, 200 Ω		
	(-200 to -80) °C	0.047 °C	
	(-80 to 0) °C	0.048 °C	
	(0 to 100) °C	0.049 °C	
	(100 to 260) °C	0.055 °C	
	(260 to 300) °C	0.11 °C	
	(300 to 400) °C	0.12 °C	
	(400 to 600) °C	0.13 °C	
	(600 to 630) °C	0.14 °C	
	Pt 385, 500 Ω		
	(-200 to -80) °C	0.047 °C	
	(-80 to 100) °C	0.055 °C	
	(0 to 100) °C	0.056 °C	
	(100 to 260) °C	0.064 °C	
	(260 to 300) °C	0.076 °C	
	(300 to 400) °C	0.078 °C	
	(400 to 600) °C	0.088 °C	
	(600 to 630) °C	0.1 °C	
	Pt 385, 1 000 Ω		
	(-200 to -80) °C	0.043 °C	
	(-80 to 100) °C	0.044 °C	
	(0 to 100) °C	0.049 °C	
	(100 to 260) °C	0.057 °C	
	(260 to 300) °C	0.063 °C	
	(300 to 400) °C	0.070 °C	
	(400 to 600) °C	0.073 °C	
	(600 to 630) °C	0.19 °C	
Electrical Simulation of RTD Indicating Devices – Source [1]	Pt 3926, 100 Ω		Fluke 5522A Multi-Product Calibrator
	(-200 to -80) °C	0.053 °C	
	(-80 to 0) °C	0.054 °C	
	(0 to 100) °C	0.066 °C	
	(100 to 300) °C	0.081 °C	
	(300 to 400) °C	0.089 °C	
	(400 to 630) °C	0.11 °C	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Capacitance – Source [1]			Fluke 5522A Multi-Product Calibrator
10 Hz to 10 kHz	(220 to 400) pF	5.6 mF/F + 7.8 pF	
10 Hz to 10 kHz	400 pF to 1.1 nF	4.3 mF/F + 7.8 pF	
10 Hz to 3 kHz	(1.1 to 3.3) nF	4.2 mF/F + 7.8 pF	
10 Hz to 1 kHz	(3.3 to 11) nF	2 mF/F + 7.8 pF	
10 Hz to 1 kHz	(11 to 33) nF	2 mF/F + 7.8 pF	
10 Hz to 1 kHz	(33 to 110) nF	2 mF/F + 7.8 pF	
10 Hz to 1 kHz	(110 to 330) nF	2 mF/F + 23 pF	
(10 to 600) Hz	330 nF to 1.1 µF	2 mF/F + 0.8 nF	
(10 to 300) Hz	(1.1 to 3.3) µF	2 mF/F + 2.3 nF	
(10 to 150) Hz	(3.3 to 11) µF	2.1 mF/F + 7.8 nF	
(10 to 120) Hz	(11 to 33) µF	3.2 mF/F + 23 nF	
(10 to 80) Hz	(33 to 110) µF	3.7 mF/F + 78 nF	
Capacitance – Measure [1] (1 kHz)	Up to 10 pF	3.1 mF/F + 0.01 pF	Fluke PM6303 RCL Meter
	(10 to 100) pF	3.1 mF/F + 0.1 pF	
	(100 to 1 000) pF	3.1 mF/F + 1 pF	
	(1 to 100) nF	3.6 mF/F + 0.01 nF	
	(0.1 to 1) mF	2.5 mF/F + 0.1 nF	
Inductance – Source [1] Fixed (100 Hz to 10 kHz)	100 µH	0.41 µH	GenRad 1482B, 1482E, 1482L Standard Inductors
	1 mH	1.2 µH	
	100 mH	0.1 mH	
DC Power – Source [1]	Up to 3 050 W	0.33 mW/W + 0.03 W	Fluke 5522A Multi-Product Calibrator
	(3.05 to 20.4) kW	0.87 mW/W + 0.6 W	
AC Power – Source [1] (45 to 65 Hz)	Up to 336.6 W	0.4 mW/W + 0.3 W	
	(0.336 to 1.12) kW	0.47 mW/W + 2.2 W	
	(1.12 to 3.06) kW	0.60 mW/W + 2.2 W	
	(3.06 to 11.22) kW	0.57 mW/W + 2.7 W	
	(11.2 to 20.91) kW	0.99 mW/W + 4.5 W	
Phase Angle – Source [1]	Up to 90 °		Fluke 5522A Multi-Product Calibrator
	(65 to 500) Hz	1.5 °	
	(500 to 1) kHz	1.5 °	
	(1 to 5) kHz	2.5 °	
	(5 to 10) kHz	4.2 °	
	(10 to 30) kHz	7.9 °	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Oscilloscopes [1]			
Amplitude Square Wave into 50 Ω load	1 kHz:		
	Up to 5 mV	2.3 mV/V + 25 µV	
	(5 to 11) mV	2 mV/V + 55 µV	
	(11 to 45) mV	2 mV/V + 0.23 mV	
	(45 to 110) mV	2 mV/V + 0.55 mV	
	(0.11 to 0.45) V	2 mV/V + 2.3 mV	
Leveled Sine Wave	(0.45 to 1.09) V	2 mV/V + 5.5 mV	
	10 Hz:		
	(1.09 to 2.2) V	1.9 mV/V + 22 mV	
	100 Hz:		
	(1.09 to 2.2) V	1.9 mV/V + 11 mV	
	1 kHz:		
	(1.09 to 2.2) V	2 mV/V + 11 mV	
Amplitude Square Wave into 1 MΩ load	1 kHz:		Fluke 5502A Multi-Product Calibrator
	Up to 5 mV	2.3 mV/V + 30 µV	
	(5 to 20) mV	2 mV/V + 0.1 mV	
	(20 to 89) mV	2 mV/V + 0.45 mV	
	(89 to 219) mV	1.9 mV/V + 1.1 mV	
	(219 to 890) mV	1.9 mV/V + 4.5 mV	
	(0.89 to 6.5) V	1.9 mV/V + 33 mV	
	10 Hz:		
	(6.5 to 55) V	2 mV/V + 0.55 V	
	100 Hz:		
	(6.5 to 55) V	1.9 mV/V + 0.28 V	
	1 kHz:		
	(6.5 to 55) V	1.9 mV/V + 0.28 V	
	10 kHz:		
	(6.5 to 55) V	3.9 mV/V + 0.28 V	
Oscilloscopes [1]	10 mV to 5.5 V		
Leveled Sine Wave (50 kHz Reference)	50 kHz to 100 MHz	28 mV/V + 0.23 mV/V	Fluke 5502A Multi-Product Calibrator
	(100 to 300) MHz	34 mV/V + 0.23 mV/V	
Time Marker into 50 Ω load	2 ns to 50 ms	20 µs/s	
	50 ms to 5 s	58 µs/s	

Length – Dimensional Metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Calipers [1,2]	Up to 12 in (12 to 40) in (40 to 80) in	(290 + 2.9*L*) µin (200 + 9.6*L*) µin (110 + 12*L*) µin	ASME Grade 0 Gage Blocks, Length Standard and Ring Gauge
OD Micrometers [1,2]	Up to 12 in	(35 + 9.8*L*) µin	
ID Micrometers [1,2]	Up to 12 in (12 to 40) in	(35 + 9.8*L*) µin (5.4 + 13*L*) µin	
Dial Indicators [1,2]	Up to 4 in	(27 + 7.4*L*) µin	
Test Indicators [1,2]	Up to 0.05 in	(29 + 0.12*L*) µin	
Height Gages [1,2]	Up to 12 in (12 to 40) in	(110 + 6.1*L*) µin (42 + 12 *L*) µin	
Optical Comparators [1]	(0 to 200) mm	(0.45 + 0.25*L*) µin	Mitutoyo 182-514-10 Glass Scale
Microscopes [1,2]	(0 to 50) mm (0 to 2) in	(0.73 + 0.25*L*) µm (22 + 260*L*) µin	Mitutoyo 172-116 / 172-117 Glass Scale
Protractor/Angle [1,2]	(30 to 90) °	1.8′	Angle Block Set
Outside Diameter [2]	(0.5 to 25) mm (25 to 60) mm	(2.6 + 0.005*D*) µm (9.3 - 0.039*D*) µm	Laser Micrometer
Laser Micrometers [1,2]	0.5 mm to 25 mm	0.3 µm	Cylindrical Plug Gages per ASME B.89.1.5-1998 Class XX
Laser Micrometers [1,2]	(1 to 60) mm	2.9 µm	Mitutoyo Calibration Gage Set 02AGD170
Gage Blocks [2]	Up to 1 in (1 to 4) in	(6.7 + 5.3*L*) µin (4.3 + 7.9*L*) µin	LabMaster Universal, ASME Grade 00 Gage Blocks
Long Gage Blocks [2]	(4 to 6) in (6 to 12) in	(2.7 + 9.6*L*) µin (5.6 + 9.3*L*) µin	ASME Grade 0 Gage Blocks
Length Standards [2]	Up to 1 in (1 to 4) in	(6.7 + 5.3*L*) µin (4.3 + 7.9*L*) µin	LabMaster Universal, ASME Grade 00 Gage Blocks
Length Standards [2]	(4 to 6) in	(2.7 + 9.6*L*) µin	LabMaster Universal, ASME Grade 0 Gage Blocks

Length – Dimensional Metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Length Standards [2]	(6 to 12) in	(5.6 + 9.3*L*) µin	LabMaster Universal, ASME Grade 0 Gage Blocks
Cylindrical Pin/Plug Gages [2]	Up to 1 in (1 to 4) in	(6.7 + 5.3*L*) µin (4.3 + 7.9*L*) µin	LabMaster Universal, ASME Grade 00 Gage Blocks
Cylindrical Pin/Plug Gages [2]	Up to 1 in	(12 + 2.5*L*) µin	Plug Gages XX
Cylindrical Ring Gages	Up to 0.5 in (0.5 to 1) in (1 to 4) in	(17 + 1.7*L*) µin (17 + 4.4*L*) µin (12 + 8.1*L*) µin	LabMaster Universal, ASME Grade 00 Gage Block, Ring Gage XX
Thread Wires (4 – 80) TPI	(0.005 to 0.2) in	(5.1 + 7.5*L*) µin	LabMaster Universal ASME Grade 0 Gage Blocks
Thread Plug Gages, 60° Threads: Pitch Diameter Major Diameter	 (0.05 to 4) in (0.05 to 4) in	 (34 + 2.2*L*) µin (36 + 2.1*L*) µin	LabMaster Universal, ASME Grade 00 Gage Blocks, Thread Wires
Fixed Internal Thread Ring Gages: Pitch Diameter Major Diameter	 (0.05 to 4) in (0.05 to 4) in	 (34 + 2.2*L*) µin (36 + 2.1*L*) µin	LabMaster Universal, ASME Grade 00 Gage Blocks
Coordinate Measuring Machines (CMMs) [1,2]	(0.05 to 2) in (2 to 4) in (4 to 6) in (6 to 12) in (12 to 20) in	(3.7 + 6.3*L*) µin (4.1 + 5.8*L*) µin (19 +4.6*L*) µin (13 + 5.4*L*) µin (20 + 5.4*L*) µin	ASME Grade 00 Gage Block Set, ASME Grade 0 Gage Blocks, per ISO 10360-2.
Vision Measuring System (non-contact) [1,2] Linear Measurement (Axis X, Axis Y, Axis Z)	(0.05 to 2) in (2 to 4) in (4 to 6) in (6 to 12) in (12 to 20) in Up to 50 mm Up to 2 in Up to 200 mm	(3.7 + 6.3*L*) µin (4.1 + 5.8*L*) µin (19.0 +4.6*L*) µin (13.0 + 5.4*L*) µin (20 + 5.4*L*) µin (0.4 + 0.26*L*) µm (16 + 257*L*) µin (0.3 + 0.26*L*) µm	ASME Grade 00 Gage Blocks, Grade 0 Long Gage Blocks, Glass Scale Up to 50 mm, Glass Scale Up to 2 in, Glass Scale Up to 200 mm
Stage Micrometer Scales [2]	Up to 50 mm (50 to 200) mm Up to 2 in	(1.1 to 0.013*L*) µm (0.07 + 0.022*L*) µm (10.1 + 42*L*) µin	Mitutoyo QVT1-L404Z1L-D Quick Vision Active

Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Torque Tools [1]	(5 to 50) ozf·in (5 to 50) lbf·in (40 to 400) lbf·in (100 to 1 000) lbf·in (25 to 250) lbf·ft (100 to 1 000) lbf·ft	0.13 % of reading 0.12 % of reading 0.13 % of reading 0.21 % of reading 0.14 % of reading 0.13 % of reading	CDI Torque Transducers, Readout
Torque Calibration Systems	(5 to 50) ozf·in (5 to 50) lbf·in (40 to 400) lbf·in (100 to 1 000) lbf·in (25 to 250) lbf·ft (100 to 1 000) lbf·ft	0.066 % of reading 0.066 % of reading 0.044 % of reading 0.044 % of reading 0.025 % of reading 0.034 % of reading	CDI Torque Calibration Radius Arms, Hangers, Weights
Force Gauges – Tension	Up to 100 lbf (100 to 200) lbf (200 to 300) lbf (300 to 400) lbf (400 to 500) lbf	0.77 % of reading 0.44 % of reading 0.26 % of reading 0.31 % of reading 0.05 % of reading	Futek Indicator, 500 lbf Load Cell
Force Gauges – Tension	Up to 200 lbf (200 to 400) lbf (400 to 600) lbf (600 to 800) lbf (800 to 1 000) lbf	1.1 % of reading 0.39 % of reading 0.32 % of reading 0.15 % of reading 0.11 % of reading	Futek Indicator, 1 000 lbf Load Cell
Force Gauges – Tension	Up to 1 000 lbf (1 000 to 2 000) lbf (2 000 to 3 000) lbf (3 000 to 4 000) lbf (4 000 to 5 000) lbf	0.44 % of reading 0.22 % of reading 0.19 % of reading 0.16 % of reading 0.17 % of reading	Futek Indicator, 5 000 lbf Load Cell
Force Gauges – Compression	Up to 100 lbf (100 to 200) lbf (200 to 300) lbf (300 to 400) lbf (400 to 500) lbf	0.78 % of reading 0.51 % of reading 0.17 % of reading 0.17 % of reading 0.15 % of reading	Futek Indicator, 500 lbf Load Cell
	Up to 200 lbf (200 to 400) lbf (400 to 600) lbf (600 to 800) lbf (800 to 1 000) lbf	0.72 % of reading 0.57 % of reading 0.27 % of reading 0.39 % of reading 0.3 % of reading	Futek Indicator, 1 000 lbf Load Cell

Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Force Gauges – Compression	Up to 1 000 lbf (1 000 to 2 000) lbf (2 000 to 3 000) lbf (3 000 to 4 000) lbf (4 000 to 5 000) lbf	1.3 % of reading 0.59 % of reading 0.5 % of reading 0.34 % of reading 0.25 % of reading	Futek Indicator, 5 000 lbf Load Cell
Analytical Scales [1,3]	Up to 200 g Up to 1 000 g	0.37 mg 0.52 mg	ASTM E617 Class 1 Weights and internal calibration procedure utilized in the calibration of the weighing system.
Scales / Balances [1,3]	Up to 50 g (50 to 200) g 200 g to 5 kg (10 to 500) kg	0.14 g 0.15 g 1 g 250 g	NIST Class F Weights and internal calibration procedure utilized in the calibration of the weighing system.
Mass Determination (SI Units)	1 mg 2 mg 5 mg 10 mg 20 mg 50 mg 100 mg 200 mg 500 mg 1 g 2 g 5 g 10 g 20 g 50 g 100 g 200 g 500 g 1 kg 2 kg 5 kg 25 kg	0.17 mg 0.18 mg 0.23 mg 0.27 mg 0.33 mg 0.43 mg 0.52 mg 0.64 mg 0.84 mg 1.1 mg 1.3 mg 1.8 mg 2.3 mg 4.7 mg 12 mg 23 mg 46 mg 81 mg 0.12 g 0.23 g 0.58 g 2.9 g	Electronic Balances, NIST Class F Weights

Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Mass Determination (Avoirdupois)	1/32 oz 1/16 oz 1/8 oz 1/4 oz 1/2 oz 1 oz 2 oz 4 oz 8 oz 1 lb 2 lb 5 lb 10 lb 20 lb	1 mg 1.3 mg 1.5 mg 2 mg 3.3 mg 6.3 mg 13 mg 27 mg 52 mg 81 mg 0.11 g 0.27 g 0.52 g 60 mg	Electronic Balances, NIST Class F Weights
Pressure Gauges [1] (Pneumatic)	(-12 to 300) psi	0.08 psi	Fluke 3130 Pressure Calibrator
	(-1 to 1) psi Up to 1 000 psi	0.000 2 psi 0.77 psi	Fluke 750 Process Calibrator, 750 series Pressure Modules
Low Pressure Gauges (Pneumatic)	(-13.75 to 0) psi (0 to 36) psi	0.007 5 psi 0.000 41 psi/psi + 0.001 8 psi	Fluke 721-3603 (PORT 1) Pressure Calibrator
High Pressure Gauges (Pneumatic/Hydraulic)	(1 000 to 10 000) psig	1.2 psi	Fluke 2700G-G70M Pressure Gauge
Pressure Measuring Equipment (Hydraulic)	(20 to 1 434) psig (200 to 10 000) psig	0.06 % of reading 0.17 % of reading	Dead Weight Pressure Generation (Piston Cylinder and Masses)
Volumetric Flow Meters [2]	(3 to 30) sccm (30 to 300) sccm (0.1 to 1) l/min	$(0.032 + 7.8 \times 10^{-03}X)$ sccm $(0.037 + 8.4 \times 10^{-03}X)$ sccm $(5.1 \times 10^{-04} + 8 \times 10^{-03}X)$ l/min	CME DIVISION 60B-75-.03-1000(SP) Flowmeter

Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Rockwell Hardness Testing Machines [1]	HRC 22.9 HRC 33.1 HRC 43.6 HRC 54.4 HRC 60.7 HRC 62.9 HRC HR30N 43.6 HR30N 53.7 HR30N 62.6 HR30N 76.1 HR30N 79.3 HR30N	 0.43 HRC 0.42 HRC 0.42 HRC 0.42 HRC 0.36 HRC 0.36 HRC 0.38 HR30N 0.38 HR30N 0.36 HR30N 0.38 HR30N 0.37 HR30N	Indirect Verification per ASTM E18 using Rockwell Hardness Test Blocks.

Thermodynamic

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Humidity – Measuring Devices	(11 to 91) %RH	1.5 % RH	Vaisala HMP77B Thermo-hygrometer
Temperature – Thermo-hygrometers	(-40 to 30) °C	0.25 °C	Vaisala HMP77B Thermo-hygrometer
Temperature – Radiation Thermometers	35 °C 100 °C 200 °C 350 °C 500 °C	1.1 °C 1.2 °C 1.3 °C 1.8 °C 2.2 °C	Fluke 4181 IR Calibrator (Flat Plate) λ = (8 to 14) µm, ε = ~ 0.95
Temperature - Thermometers (Digital, Bimetallic) and Temperature Probes	(-200 to 0) °C (0 to 100) °C (100 to 300) °C (300 to 420) °C (429 to 650) °C	0.054 °C 0.055 °C 0.065 °C 0.12 °C 0.13 °C	Fluke 5628 PRT sensor and Fluke 1523 readout, and Fluke 9144 Dry Well

Time and Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Stopwatch	(1 to 86 400) s	73 ms	Agilent 53132A Frequency Counter

Time and Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Frequency – Measure [2]	1 MHz to 225 MHz 225 MHz to 3 GHz	6.4×10^{-05} Hz + 0.6*R* 6.2×10^{-03} Hz + 0.6*R*	Agilent 53132A Frequency Counter
Frequency – Source [1]	50 kHz @ 5.5 V 500 kHz @ 5.5 V 5 MHz @ 5.5 V 50 MHz @ 5.5 V 300 MHz @ 2 Vp-p	0.3 Hz 1.3 Hz 13 Hz 0.13 kHz 0.75 kHz	Fluke 5502A Multi-Product Calibrator

DIMENSIONAL MEASUREMENT

3 Dimensional

Specific Tests and / or Properties Measured	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
3D Dimensional Measurement	X = Up to 320 mm Y = Up to 320 mm Z = Up to 150 mm	5.3 µm	Mitutoyo QVT1-L404Z1L-D Quick Vision Active, CNC Vision Measuring System, Customer Drawings
3D Dimensional Measurement [1]	Up to 1.8 m	52 µm	Faro Articulated Arm Coordinate Measuring Machines (AACMM), Customer Drawings

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. D = diameter in millimeters, L = length in inches or millimeters, R = resolution of unit under test, X = indicated value, $'$ = arc-minute.
3. The CMC for scales and balances is highly dependent upon the resolution of the unit under test. The CMC presented here does not include the resolution of the unit under test. The resolution will be included in the reported measurement uncertainty at the time of calibration.
4. This scope is formatted as part of a single document including Certificate of Accreditation No. ACT-2077.

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