



# 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 fields 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](http://www.anab.org).

R. Douglas Leonard Jr., VP, PILR SBU

Expiry Date: 07 September 2024  
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, 2024**

Certificate Number: **ACT-2077**

**CALIBRATION**

**Chemical Quantities**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
pH Meters	4 pH 7 pH 10 pH	0.019 pH 0.028 pH 0.025 pH	Accredited Buffer Solutions

**Electrical – DC/Low Frequency**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
DC Voltage – Source <sup>1</sup>	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 <sup>1</sup>	(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

**Electrical – DC/Low Frequency**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
DC High Voltage – Measure <sup>1</sup>	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 $\mu$ V/V + 1.6 V 80 $\mu$ V/V + 2.5 V 80 $\mu$ V/V + 1.6 V 80 $\mu$ V/V + 5.9 V 0.1 mV/V + 19 V 0.1 mV/V + 30 V	Vitretek 4700 High Voltage Meter
DC Current – Source <sup>1</sup>	(0 to 330 $\mu$ A) (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 $\mu$ A/A + 39 nA 79 $\mu$ A/A + 0.19 $\mu$ A 82 $\mu$ A/A + 1.9 $\mu$ A 0.16 mA/A + 31 $\mu$ A 0.31 mA/A + 31 $\mu$ A	Fluke 5522A Multi-Product Calibrator
DC Current – Source <sup>1</sup>	(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
DC Current Clamp Meters <sup>1</sup>	(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 <sup>1</sup>	Up to 100 $\mu$ A (0.1 to 1) mA (1 to 10) mA (10 to 100) mA (0.1 to 1) A	20 $\mu$ A/A + 0.53 nA 19 $\mu$ A/A + 3.3 nA 20 $\mu$ A/A + 33 nA 40 $\mu$ A/A + 0.33 $\mu$ A 89 $\mu$ A/A + 6.7 $\mu$ A	Agilent 3458A Opt. 002 8.5 Digit Multimeter
DC Current – Measure <sup>1</sup>	Up to 1 000 A	6.1 mA/A + 60 mA	Agilent 3458A Opt. 002 8.5 Digit Multimeter, Empro B-1000-100 Shunt
Resistance – Source <sup>1</sup> (Simulated-Fixed Values)	2 $\Omega$ 11 $\Omega$ 11.9 $\Omega$ 19 $\Omega$ 30 $\Omega$ 33 $\Omega$ 109 $\Omega$ 119 $\Omega$ 190 $\Omega$ 300 $\Omega$ 330 $\Omega$ 1.09 k $\Omega$ 1.19 k $\Omega$ 1.9 k $\Omega$	0.85 m $\Omega$ 1.1 m $\Omega$ 1.5 m $\Omega$ 1.6 m $\Omega$ 1.9 m $\Omega$ 2 m $\Omega$ 3.5 m $\Omega$ 4.2 m $\Omega$ 5.8 m $\Omega$ 8.3 m $\Omega$ 9 m $\Omega$ 26 m $\Omega$ 43 m $\Omega$ 59 m $\Omega$	Fluke 5522A Multi-product Calibrator

**Electrical – DC/Low Frequency**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Resistance – Source <sup>1</sup> (Simulated-Fixed Values)	3 kΩ	85 mΩ	Fluke 5522A Multi-product Calibrator
	3.3 kΩ	92 mΩ	
	10.9 kΩ	0.27 Ω	
	11.9 kΩ	0.44 Ω	
	19 kΩ	0.6 Ω	
	30 kΩ	0.85 Ω	
	33 kΩ	0.92 Ω	
	109 kΩ	2.7 Ω	
	119 kΩ	4.6 Ω	
	190 kΩ	6.5 Ω	
	300 kΩ	9.3 Ω	
	330 kΩ	10 Ω	
	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 – Source <sup>1</sup> (Variable Artifact)	(1 to 10) Ω	0.92 mΩ/Ω	General Radio 1433-33 Decade Resistor
	(10 to 100) Ω	0.92 mΩ/Ω	
	(100 to 1 000) Ω	0.92 mΩ/Ω	
	(1 to 10) kΩ	0.92 mΩ/Ω	
	(10 to 100) kΩ	0.92 mΩ/Ω	
	(100 to 1 000) kΩ	0.9 mΩ/Ω	
(1 to 10) MΩ	0.93 mΩ/Ω		



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Resistance – Measure <sup>1</sup>	Up to 10 Ω (10 to 100) Ω (0.1 to 1) kΩ (1 to 10) kΩ (1 to 10) kΩ (10 to 100) kΩ (0.1 to 1) MΩ (1 to 10) MΩ (10 to 100) MΩ	17 μΩ/Ω + 50 μΩ 15 μΩ/Ω + 0.5 mΩ 12 μΩ/Ω + 0.5 mΩ 12 μΩ/Ω + 5 mΩ 13 μΩ/Ω + 50 mΩ 17 μΩ/Ω + 2 Ω 52 μΩ/Ω + 0.1 kΩ 52 μΩ/Ω + 0.1 kΩ 0.53 mΩ/Ω + 1 kΩ	Agilent 3458A Opt. 002 8.5 Digit Multimeter
AC Voltage – Source <sup>1</sup>	1 mV to 33 mV (10 to 45) Hz 45 Hz to 10 kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 500) kHz (33 to 330) mV (10 to 45) Hz 45 Hz to 10 kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 500) kHz (0.33 to 3.3) V (10 to 45) Hz 45 Hz to 10 kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 500) kHz (3.3 to 33) V (10 to 45) Hz 45 Hz to 10 kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.63 mV/V + 4.7 μV 0.14 mV/V + 4.7 μV 0.17 mV/V + 4.7 μV 0.79 mV/V + 4.7 μV 2.7 mV/V + 9.3 μV 6.3 mV/V + 39 μV 0.24 mV/V + 6.2 μV 0.12 mV/V + 6.2 μV 0.13 mV/V + 6.2 μV 0.28 mV/V + 6.2 μV 0.63 mV/V + 25 μV 1.7 mV/V + 54 μV 0.24 mV/V + 40 μV 0.12 mV/V + 50 μV 0.15 mV/V + 50 μV 0.24 mV/V + 40 μV 0.55 mV/V + 0.1 mV 1.9 mV/V + 0.47 mV 0.24 mV/V + 0.47 mV 0.12 mV/V + 0.47 mV 0.19 mV/V + 0.47 mV 0.28 mV/V + 0.47 mV 0.71 mV/V + 1.2 mV	Fluke 5522A Multi-product Calibrator

**Electrical – DC/Low Frequency**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Source <sup>1</sup>	(33 to 330) V 45 Hz to 1 kHz (1 to 10) kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.15 mV/V + 1.6 mV 0.16 mV/V + 4.7 mV 0.21 mV/V + 4.7 mV 0.27 mV/V + 4.7 mV 1.6 mV/V + 39 mV	Fluke 5522A Multi-product Calibrator
	(330 to 1 020) V 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.24 mV/V + 7.8 mV 0.2 mV/V + 7.8 mV 0.24 mV/V + 7.8 mV	
AC Voltage – Measure <sup>1</sup>	Up to 10 mV 40 Hz to 1 kHz (1 to 20) kHz (20 to 100) kHz (100 to 300) kHz (10 to 100) mV 40 Hz to 1 kHz (1 to 20) kHz (20 to 100) kHz (100 to 300) kHz	0.34 mV/V + 1.1 μV 0.42 mV/V + 1.1 μV 5.1 mV/V + 1.1 μV 41 mV/V + 2 μV 91 μV/V + 2 μV 0.16 mV/V + 2 μV 0.9 mV/V + 2 μV 3.1 mV/V + 10 μV	Agilent 3458A Opt. 002 8.5 Digit Multimeter
	(0.1 to 1) V 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz	86 μV/V + 20 μV 0.16 mV/V + 20 μV 0.33 mV/V + 20 μV 0.83 mV/V + 20 μV 3 mV/V + 0.1 mV 10 mV/V + 0.1 mV	
	(1 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 to 500) kHz 500 kHz to 1 MHz	87 μV/V + 0.4 mV 85 μV/V + 0.2 mV 0.16 mV/V + 0.2 mV 0.33 mV/V + 0.2 mV 0.82 mV/V + 60 μV 3 mV/V + 1 mV 3.4 mV/V + 1 mV 10 mV/V + 1 mV	
	(10 to 100) V 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.22 mV/V + 2 mV 0.23 mV/V + 2 mV 0.38 mV/V + 2 mV 1.3 mV/V + 2 mV	



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Measure <sup>1</sup>	(100 to 1 000) V (50 to 60) Hz (100 to 450) Hz	1 mV/V + 0.4 V 25 mV/V + 0.4 V	Agilent 3458A Opt. 002 8.5 Digit Multimeter
AC High Voltage – Measure <sup>1</sup>	(1 to 9) kV (50 to 60) Hz	1 mV/V + 0.4 V	Vitrek 4700 High Voltage Meter
AC Current – Source <sup>1</sup>	(29 to 330) $\mu$ A (10 to 20) Hz (20 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (10 to 30) kHz (0.33 to 3.3) mA (10 to 20) Hz (20 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (10 to 30) kHz (3.3 to 33) mA (10 to 20) Hz (20 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (10 to 30) kHz (33 to 330) mA (10 to 20) Hz (20 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (10 to 30) kHz (0.33 to 1.1) A (10 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	1.6 mA/A + 80 nA 1.2 mA/A + 80 nA 0.98 mA/A + 80 nA 2.3 mA/A + 0.12 $\mu$ A 6.2 mA/A + 0.16 $\mu$ A 12 mA/A + 0.31 $\mu$ A 1.6 mA/A + 0.12 $\mu$ A 0.98 mA/A + 0.12 $\mu$ A 0.78 mA/A + 0.12 $\mu$ A 1.6 mA/A + 0.16 $\mu$ A 3.9 mA/A + 0.23 $\mu$ A 7.8 mA/A + 0.47 $\mu$ A 1.4 mA/A + 1.6 $\mu$ A 0.71 mA/A + 1.6 $\mu$ A 0.32 mA/A + 1.6 $\mu$ A 0.64 mA/A + 1.6 $\mu$ A 1.6 mA/A + 2.3 $\mu$ A 3.1 mA/A + 3.1 $\mu$ A 1.4 mA/A + 16 $\mu$ A 0.71 mA/A + 16 $\mu$ A 0.32 mA/A + 16 $\mu$ A 0.79 mA/A + 39 $\mu$ A 1.6 mA/A + 78 $\mu$ A 3.2 mA/A + 0.16 mA 1.4 mA/A + 78 $\mu$ A 0.4 mA/A + 78 $\mu$ A 4.7 mA/A + 0.78 mA 20 mA/A + 3.9 mA	Fluke 5522A Multi-product Calibrator

**Electrical – DC/Low Frequency**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current – Source <sup>1</sup>	(1.1 to 3) A (10 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (3 to 11) A (45 to 100) Hz 100 Hz to 1 kHz (1 to 5) kHz (11 to 20.5) A (45 to 100) Hz 100 Hz to 1 kHz (1 to 5) kHz	1.4 mA/A + 78 μA 0.55 mA/A + 78 μA 4.7 mA/A + 0.78 mA 19 mA/A + 3.9 mA 0.52 mA/A + 1.6 mA 0.81 mA/A + 1.6 mA 2.4 mA/A + 1.6 mA 0.96 mA/A + 3.9 mA 1.2 mA/A + 3.9 mA 24 mA/A + 3.9 mA	Fluke 5522A Multi-product Calibrator
AC Current Clamp Meters <sup>1</sup>	(16.5 to 55) A (45 to 65) Hz (65 to 440 Hz) (55 to 150) A (45 to 65) Hz (65 to 440) Hz (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	2.9 mA/A + 0.39 A 2.8 mA/A + 0.39 A 3.1 mA/A + 0.39 A 2.8 mA/A + 0.39 A 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 5500A/COIL 50-turn Coil
AC Current – Measure <sup>1</sup>	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 <sup>1</sup>	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 – DC/Low Frequency**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Electrical Simulation of Thermocouple Indicating Devices – Source/Measure <sup>1</sup>	Type B		Fluke 5522A Multi-product Calibrator
	(600 to 800) °C	0.52 °C	
	(800 to 1 000) °C	0.46 °C	
	(1 000 to 1 550) °C	0.36 °C	
	(1 550 to 18 20) °C	0.37 °C	
	Type C		
	(0 to 150) °C	0.36 °C	
	(150 to 650) °C	0.22 °C	
	(650 to 1 000) °C	0.26 °C	
	(1 000 to 1 800) °C	0.42 °C	
	(1 800 to 2 316) °C	0.67 °C	
	Type E		
	(-250 to -100) °C	0.41 °C	
	(-100 to -25) °C	0.17 °C	
	(-25 to 350) °C	0.16 °C	
	(350 to 650) °C	0.17 °C	
	(650 to 1 000) °C	0.2 °C	
	Type J		
	(-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		

**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 <sup>1</sup>	Type R (0 to 250) °C (250 to 400) °C (400 to 1 000) °C (1 000 to 1767) °C Type S (0 to 250) °C (250 to 1 000) °C (1 000 to 1400) °C (1 400 to 1767) °C Type T (-250 to -150) °C (-150 to 0) °C (0 to 120) °C (120 to 400) °C Type U (-200 to 0) °C (0 to 600) °C	0.6 °C 0.35 °C 0.34 °C 0.38 °C 0.43 °C 0.36 °C 0.37 °C 0.42 °C 0.52 °C 0.25 °C 0.15 °C 0.13 °C 0.46 °C 0.22 °C	Fluke 5522A Multi-product Calibrator
Electrical Simulation of RTD Indicating Devices – Source <sup>1</sup>	Pt 385, 100 Ω (-200 to -80) °C (-80 to 0) °C (0 to 100) °C (100 to 300) °C (300 to 400) °C (400 to 630) °C (630 to 800) °C Pt 385, 200 Ω (-200 to -80) °C (-80 to 0) °C (0 to 100) °C (100 to 260) °C (260 to 300) °C (300 to 400) °C (400 to 600) °C (600 to 630) °C Pt 3926, 100 Ω (-200 to -80) °C (-80 to 0) °C (0 to 100) °C (100 to 300) °C (300 to 400) °C (400 to 630) °C	0.053 °C 0.055 °C 0.066 °C 0.082 °C 0.089 °C 0.11 °C 0.19 °C 0.047 °C 0.048 °C 0.049 °C 0.055 °C 0.11 °C 0.12 °C 0.13 °C 0.14 °C 0.053 °C 0.054 °C 0.066 °C 0.081 °C 0.089 °C 0.11 °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 RTD Indicating Devices – Source <sup>1</sup>	Pt 385, 500 Ω (-200 to -80) °C (-80 to 100) °C (0 to 100) °C (100 to 260) °C (260 to 300) °C (300 to 400) °C (400 to 600) °C (600 to 630) °C Pt 385, 1 000 Ω (-200 to -80) °C (-80 to 100) °C (0 to 100) °C (100 to 260) °C (260 to 300) °C (300 to 400) °C (400 to 600) °C (600 to 630) °C	0.047 °C 0.055 °C 0.056 °C 0.064 °C 0.076 °C 0.078 °C 0.088 °C 0.1 °C 0.043 °C 0.044 °C 0.049 °C 0.057 °C 0.063 °C 0.07 °C 0.073 °C 0.19 °C	Fluke 5522A Multi-product Calibrator
Capacitance – Source <sup>1</sup> (Simulation) 10 Hz to 10 kHz 10 Hz to 10 kHz 10 Hz to 3 kHz 10 Hz to 1 kHz 10 Hz to 1 kHz 10 Hz to 1 kHz 10 Hz to 1 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	(220 to 400) pF 400 pF to 1.1 nF (1.1 to 3.3) nF (3.3 to 11) nF (11 to 33) nF (33 to 110) nF (110 to 330) nF 330 nF to 1.1 μF (1.1 to 3.3) μF (3.3 to 11) μF (11 to 33) μF (33 to 110) μF	5.6 mF/F + 7.8 pF 4.3 mF/F + 7.8 pF 4.2 mF/F + 7.8 pF 2 mF/F + 7.8 pF 2 mF/F + 7.8 pF 2 mF/F + 7.8 pF 2 mF/F + 23 pF 2 mF/F + 0.8 nF 2 mF/F + 2.3 nF 2.1 mF/F + 7.8 nF 3.2 mF/F + 23 nF 3.7 mF/F + 78 nF	Fluke 5522A Multi-product Calibrator
Capacitance – Source <sup>1</sup> (Variable Artifact)	(10 to 100) pF (100 to 1 000) pF (1 to 10) nF (10 to 100) nF (100 to 1 000) nF	0.3 mF/F + 0.12 pF 0.9 mF/F + 0.074 pF 0.82 mF/F + 1.3 pF 0.89 mF/F + 4.9 pF 0.91 mF/F + 34 pf	General Radio 1412-BC Decade Capacitor
Capacitance – Measure <sup>1</sup> (1 kHz)	Up to 10 pF (10 to 100) pF (100 to 1 000) pF (1 to 100) nF (0.1 to 1) μF	3.1 mF/F + 0.01 pF 3.1 mF/F + 0.1 pF 3.1 mF/F + 1 pF 3.6 mF/F + 0.01 nF 2.5 mF/F + 0.1 nF	Fluke PM6303 RCL Meter



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**Electrical – DC/Low Frequency**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Inductance – Source <sup>1</sup> Fixed (100 Hz to 10 kHz)	100 $\mu$ H 1 mH 100 mH	0.41 $\mu$ H 1.2 $\mu$ H 0.1 mH	GenRad 1482B, 1482E, 1482L Standard Inductors
DC Power – Source <sup>1</sup>	Up to 3 050 W (3.05 to 20.4) kW	0.33 mW/W + 0.03 W 0.87 mW/W + 0.6 W	Fluke 5522A Multi-Product Calibrator
AC Power – Source <sup>1</sup>	65 Hz Up to 336.6 W (0.336 to 1.12) kW (1.12 to 3.06) kW (3.06 to 11.22) kW (11.2 to 20.91) kW 5 kHz Up to 336.6 W (0.336 to 1.12) kW (1.12 to 3.06) kW (3.06 to 11.22) kW (11.2 to 20.91) kW	0.4 mW/W + 0.3 W 0.47 mW/W + 2.2 W 0.6 mW/W + 2.2 W 0.57 mW/W + 2.7 W 0.99 mW/W + 4.5 W 1.6 mW/W + 0.31 W 19 mW/W + 4.5 W 19 mW/W + 4.5 W 20 mW/W + 2.7 W 23 mW/W + 4.5 W	Fluke 5522A Multi-Product Calibrator
Phase Angle – Source <sup>1</sup>	Up to 90° (65 to 500) Hz (500 to 1) kHz (1 to 5) kHz (5 to 10) kHz (10 to 30) kHz	1.5° 1.5° 2.5° 4.2° 7.9°	Fluke 5522A Multi-product Calibrator
Oscilloscopes <sup>1</sup> Amplitude Square Wave into 50 $\Omega$ load  Leveled Sine Wave	1 kHz: Up to 5 mV (5 to 11) mV (11 to 45) mV (45 to 110) mV (0.11 to 0.45) V (0.45 to 1.09) V  10 Hz: (1.09 to 2.2) V 100 Hz: (1.09 to 2.2) V 1 kHz: (1.09 to 2.2) V	2.3 mV/V + 25 $\mu$ V 2 mV/V + 55 $\mu$ V 2 mV/V + 0.23 mV 2 mV/V + 0.55 mV 2 mV/V + 2.3 mV 2 mV/V + 5.5 mV  1.9 mV/V + 22 mV 1.9 mV/V + 11 mV 2 mV/V + 11 mV	Fluke 5522A Multi-product Calibrator

**Electrical – DC/Low Frequency**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Oscilloscopes <sup>1</sup> Amplitude Square Wave into 1 MΩ load	1 kHz: Up to 5 mV (5 to 20) mV (20 to 89) mV (89 to 219) mV (219 to 890) mV (0.89 to 6.5) V	2.3 mV/V + 30 μV 2 mV/V + 0.1 mV 2 mV/V + 0.45 mV 1.9 mV/V + 1.1 mV 1.9 mV/V + 4.5 mV 1.9 mV/V + 33 mV	Fluke 5522A Multi-product Calibrator
	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	
Leveled Sine Wave (50 kHz Reference)	10 mV to 5.5 V 50 kHz to 100 MHz (100 to 300) MHz	28 mV/V + 0.23 mV/V 34 mV/V + 0.23 mV/V	
Time Marker into 50 Ω load	2 ns to 50 ms 50 ms to 5 s	20 μs/s 58 μs/s	

**Length – Dimensional Metrology**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Calipers <sup>1,2</sup>	Up to 12 in (12 to 40) in (40 to 80) in	(290 + 2.9L) μin (200 + 9.6L) μin (110 + 12L) μin	ASME Grade 0 Gage Blocks, Length Standards, Ring Gauges
OD Micrometers <sup>1,2</sup>	Up to 12 in	(35 + 9.8L) μin	
ID Micrometers <sup>1,2</sup>	Up to 12 in (12 to 40) in	(35 + 9.8L) μin (5.4 + 13L) μin	
Dial Indicators <sup>1,2</sup>	Up to 4 in	(27 + 7.4L) μin	
Test Indicators <sup>1,2</sup>	Up to 0.05 in	(29 + 0.12L) μin	

### Length – Dimensional Metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Height Gages <sup>1,2</sup>	Up to 12 in (12 to 40) in	$(110 + 6.1L) \mu\text{in}$ $(42 + 12 L) \mu\text{in}$	ASME Grade 0 Gage Blocks, Length Standards
Optical Comparators <sup>1,2</sup>	Up to 50 mm Up to 200 mm	$(0.73 + 0.25L) \mu\text{m}$ $(0.45 + 0.25L) \mu\text{m}$	Mitutoyo Glass Scales
Microscopes <sup>1,2</sup>	Up to 50 mm	$(0.73 + 0.25L) \mu\text{m}$	Mitutoyo Glass Scales
	Up to 2 in	$(22 + 260L) \mu\text{in}$	
Protractor/Angle <sup>1,2</sup>	(30 to 90)°	1.8'	Angle Block Set
Outside Diameter <sup>2</sup>	(0.5 to 25) mm (25 to 60) mm	$(2.6 + 0.005D) \mu\text{m}$ $(9.3 - 0.039D) \mu\text{m}$	Laser Micrometer
Laser Micrometers <sup>1,2</sup>	0.5 mm to 25 mm	0.3 $\mu\text{m}$	Cylindrical Plug Gages per ASME B.89.1.5-1998 Class XX
Laser Micrometers <sup>1,2</sup>	1 mm	1.5 $\mu\text{m}$	Mitutoyo Calibration Gage Set 02AGD170
	60 mm	2.9 $\mu\text{m}$	
Gage Blocks <sup>2</sup>	(0.05 to 2) in	$(3.4 + 1.3L) \mu\text{in}$	LabMaster Universal, ASME Grade 00 Gage Blocks
	(2 to 4) in	$(6 + 0.9L) \mu\text{in}$	
	(4 to 6) in	$(9.6 + 0.5L) \mu\text{in}$	
	(6 to 12) in	$(13 + 0.9L) \mu\text{in}$	
Length Standards <sup>2</sup>	(0.05 to 2) in	$(4 + 1.5L) \mu\text{in}$	LabMaster Universal, ASME Grade 00 Gage Blocks
	(2 to 4) in	$(7 + 0.9L) \mu\text{in}$	
	(4 to 6) in	$(11 + 0.6L) \mu\text{in}$	
	(6 to 12) in	$(14 + 0.9L) \mu\text{in}$	
Cylindrical Pin/Plug Gages <sup>2</sup>	(0.05 to 1) in	$(4.2 + 0.7L) \mu\text{in}$	LabMaster Universal, ASME Grade 00 Gage Blocks
	(1 to 2) in	$(4.9 + 0.7L) \mu\text{in}$	
	(2 to 4) in	$(6.4 + 0.5L) \mu\text{in}$	
Cylindrical Pin/Plug Gages <sup>2</sup>	Up to 1 in	$(12 + 2.5L) \mu\text{in}$	Laser Micrometer, XX Plug Gages
Cylindrical Ring Gages (Plain)	(0.05 to 0.5) in	$(17 + 0.15L) \mu\text{in}$	LabMaster Universal, ASME Grade 00 Gage Blocks, XX Ring Gages
	(0.5 to 1) in	$(17 + 1.1L) \mu\text{in}$	
	(1 to 2) in	$(17 + 1.2L) \mu\text{in}$	
	(2 to 4) in	$(20 + 1.2L) \mu\text{in}$	
Thread Wires (4 – 80) TPI	(0.005 to 0.2) in	$(3.5 + 2.7L) \mu\text{in}$	LabMaster Universal ASME Grade 0 Gage Blocks

**Length – Dimensional Metrology**

<b>Parameter/Equipment</b>	<b>Range</b>	<b>Expanded Uncertainty of Measurement (+/-)</b>	<b>Reference Standard, Method, and/or Equipment</b>
Thread Plug Gages, 60° Threads Major Diameter	(0.05 to 0.5) in (0.5 to 1) in (1 to 2) in (2 to 4) in	(20 + 0.3L) μin (19 + 0.1L) μin (19 + 0.21L) μin (20 + 0.2L) μin	LabMaster Universal, ASME Grade 00 Gage Blocks, Thread Wires
Pitch Diameter	(0.05 to 0.5) in (0.5 to 1) in (1 to 2) in (2 to 4) in	(16 + 0.4L) μin (16 + 0.12L) μin (16 + 0.26L) μin (17 + 0.23L) μin	
Fixed Internal Thread Ring Gages Minor Diameter	(0.05 to 0.5) in (0.5 to 1) in (1 to 2) in (2 to 4) in	(25 + 0.25L) μin (25 + 0.08L) μin (25 + 0.17L) μin (25 + 0.16L) μin	LabMaster Universal, ASME Grade 00 Gage Blocks
Pitch Diameter	(0.05 to 0.5) in (0.5 to 1) in (1 to 2) in (2 to 4) in	(25 + 0.24L) μin (25 + 0.08L) μin (25 + 0.16L) μin (25 + 0.15L) μin	
Coordinate Measuring Machines (CMMs) <sup>1,2</sup>	(0.05 to 2) in (2 to 4) in (4 to 6) in (6 to 12) in (12 to 20) in	(3.7 + 6.3L) μin (4.1 + 5.8L) μin (19 + 4.6L) μin (13 + 5.4L) μin (20 + 5.4L) μin	Check Master per ISO 10360-2.
Vision Measuring System (non-contact) <sup>1,2</sup> 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 + 6.3L) μin (4.1 + 5.8L) μin (19.0 + 4.6L) μin (13.0 + 5.4L) μin (20 + 5.4L) μin  (0.4 + 0.26L) μm (16 + 257L) μin (0.3 + 0.26L) 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, Glass Scales <sup>2</sup>	Up to 50 mm (50 to 200) mm  Up to 2 in	(1.1 to 0.013L) μm (0.07 + 0.022L) μm  (10.1 + 42L) μin	Mitutoyo QVT1-L404Z1L-D Quick Vision Active

**Length – Dimensional Metrology**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Rough Testers <sup>1</sup>	Ra 0.43 μm Rz 1.6 μm	0.065 μm 0.21 μm	Roughness Specimens
	Ra 3 μm Rz 11.6 μm	0.065 μm 0.3 μm	

**Mass and Mass Related**

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



**Mass and Mass Related**

<b>Parameter/Equipment</b>	<b>Range</b>	<b>Expanded Uncertainty of Measurement (+/-)</b>	<b>Reference Standard, Method, and/or Equipment</b>
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
	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 <sup>1,3</sup>	Up to 200 g Up to 1 000 g	0.1 mg 1.4 mg	ASTM E617 Class 1 Weights and internal calibration procedure utilized in the calibration of the weighing system.
Scales / Balances <sup>1,3</sup>	Up to 50 g (50 to 200) g (200 to 500) g 500 g to 1 kg (1 to 5) kg (5 to 10) kg (10 to 25) kg (25 to 100) kg (100 to 300) kg (300 to 500) kg	2.6 mg 6 mg 8 mg 7.6 mg 1.5 g 3 g 10 g 39 g 120 g 200 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	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	Electronic Balances, NIST Class F Weights

**Mass and Mass Related**

<b>Parameter/Equipment</b>	<b>Range</b>	<b>Expanded Uncertainty of Measurement (+/-)</b>	<b>Reference Standard, Method, and/or Equipment</b>
Mass Determination (SI Units)	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	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 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 0.6 g	Electronic Balances, NIST Class F Weights
Pressure Gauges <sup>1</sup> (Pneumatic)	(-12 to 300) psi	0.08 psi	Fluke 3130 Pressure Calibrator
Pressure Gauges <sup>1</sup> (Pneumatic)	(-1 to 1) psi Up to 1 000 psi	0.000 5 psi 0.77 psi	Fluke 750 Process Calibrator, Fluke 750 Series Pressure Modules, Meriam Instruments ZM1004-DN0001 Digital Manometer
Low Pressure Gauges (Pneumatic)	(-13.75 to 0) psi Up to 36 psi	0.007 5 psi 0.041 % of reading + 0.001 8 psi	Fluke 721-3603 (PORT 1) Pressure Calibrator
High Pressure Gauges (Pneumatic/Hydraulic)	Up to 3 000 psi	0.42 psi	Comparison to Fluke 2700G-G20M Pressure Gauge

**Mass and Mass Related**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
High Pressure Gauges (Pneumatic/Hydraulic)	Up to 10 000 psi	1.2 psi	Dead Weight Pressure Generation (Piston Cylinder and Masses), Fluke 2700G-G70M Pressure Gauge
Volumetric Flow Meters <sup>2</sup>	(3 to 30) sccm (30 to 300) sccm (0.1 to 1) slpm (1 to 10) slpm	(0.05 + 0.002 2X) sccm (0.05 + 0.003 2X) sccm (0.000 72 + 0.002 7X) slpm (0.004 + 0.002 5X) slpm	CME DIVISION 60B-75-.03-1000(SP) Flowmeter
Rockwell Hardness Testing Machines <sup>1</sup>	HRC Low Medium High	0.42 HRC 0.42 HRC 0.36 HRC	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 – Measure	(-40 to 30) °C	0.25 °C	Vaisala HMP77B Thermo-hygrometer
Temperature – Radiation Thermometers	35 °C 100 °C 200 °C 350 °C 500 °C	0.7 °C 1 °C 1.7 °C 2.8 °C 4.1 °C	Fluke 4181 IR Calibrator (Flat Plate) $\lambda = (8 \text{ to } 14) \mu\text{m}$ , $\epsilon = \sim 0.95$
Temperature – Thermometers (Digital, Bimetallic) and Temperature Probes	(50 to 100) °C (100 to 300) °C (300 to 420) °C (429 to 650) °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
Temperature – Measure	(-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, Fluke 1523 Readout

### 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
Frequency – Measure <sup>2,4</sup>	1 MHz to 225 MHz 225 MHz to 3 GHz	64 $\mu$ Hz 0.83 mHz	Agilent 53132A Frequency Counter
Frequency – Source <sup>1</sup>	10 mHz to 100 kHz	2 $\mu$ Hz/Hz + 4 $\mu$ Hz	Fluke 5522A Multi-Product Calibrator
Frequency – Source <sup>1</sup>	50 kHz 500 kHz 5 MHz 50 MHz 300 MHz	1.3 Hz 13 Hz 0.13 kHz 1.3 kHz 7.5 kHz	Fluke 5502A/3 Multi-Product Calibrator with 300 MHz Scope Option

## 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 $\mu$ m	Mitutoyo QVT1-L404Z1L-D Quick Vision Active, CNC Vision Measuring System, Customer Drawings
3D Dimensional Measurement <sup>1</sup>	Up to 1.8 m	52 $\mu$ m	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. The Best Measurement Capability presented here does not include Resolution of the Measurand.  $0.6R$  will be added at the time of calibration, where  $R$  = resolution
5. This scope is formatted as part of a single document including Certificate of Accreditation No. ACT-2077.



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