CERTIFICATE OF ACCREDITATION

The ANSI National Accreditation Board

Hereby attests that

Arrega Tecnologia, 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	(0 to 330) mV (0.33 to 3.3) V (3.3 to 33) V (30 to 330) V (100 to 1 100) V	5.4 µV/V + 0.19 µV 9.1 µV/V + 0.4 µV 10 µV/V + 3.9 µV 15 µV/V + 29 µV 15 µV/V + 0.3 mV	Fluke 5522A Multi-Product Calibrator
DC Voltage – Measure	(10 to 100) mV (0.1 to 1) V (1 to 10) V (10 to 100) V (100 to 1 000) V	2.8 µV/V + 80 nV 2 µV/V + 80 nV 2 µV/V + 0.13 µV 2.5 µV/V + 7.5 µV 2.5 µV/V + 25 µV	Agilent 3458A Opt. 002 8.5 Digit Multimeter
DC Voltage – Measure	Up to 20 kV (20 to 30) KV (30 to 40) kV (40 to 50) kV	0.11 mV/V + 0.3 V 0.11 mV/V + 1.6 V 0.13 mV/V + 3.5 V 0.13 mV/V + 6.1 V	Vitrek 4700 High Voltage Meter
DC Current – Source	(0 to 330 mA) (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 (1.1 to 3) A (3 to 11) A (11 to 20.5) A	29 µA/A + 4 nA 22 µA/A + 10 nA 34 µA/A + 49 nA 33 µA/A + 0.49 µA 54 µA/A + 8 µA 81 µA/A + 8 µA 81 µA/A + 8 µA 0.16 mA/A + 0.1 mA 0.4 mA/A + 0.15 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	(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	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 + 0.13 nA 17 µA/A + 0.83 nA 17 µA/A + 8.3 µA 24 µA/A + 80 nA 54 µA/A + 1.7 µA	Agilent 3458A Opt. 002 8.5 Digit Multimeter
DC Current – Measure	Up to 1 000 A	6 mA/A + 0.06 A	Agilent 3458A Opt. 002 8.5 Digit Multimeter, Empro B-1000-100 Current Shunt
Resistance – Source (Fixed Values)	2 Ω 11 Ω 12 Ω 19 Ω 30 Ω 33 Ω 110 Ω 120 Ω 190 Ω 300 Ω 330 Ω 1.1 kΩ 1.2 kΩ 1.9 kΩ 3.0 kΩ 3.3 kΩ 11 kΩ 12 kΩ 19 kΩ 30 kΩ 33 kΩ 110 kΩ 120 kΩ 190 kΩ 300 kΩ	0.27 mΩ 0.44 mΩ 1.8 mΩ 0.49 mΩ 0.64 mΩ 0.57 mΩ 1.2 mΩ 1.3 mΩ 1.7 mΩ 2.4 mΩ 2.7 mΩ 7.7 mΩ 12 mΩ 16 mΩ 24 mΩ 38 mΩ 85 mΩ 0.12 Ω 0.18 Ω 0.26 Ω 0.27 Ω 0.79 Ω 1.3 Ω 1.9 Ω 2.9 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 (Fixed Values)	330 kΩ	3 Ω	Fluke 5522A Multi-Product Calibrator
	1.1 MΩ	12 Ω	
	1.2 MΩ	22 Ω	
	1.90 MΩ	38 Ω	
	3 MΩ	55 Ω	
	3.3 MΩ	61 Ω	
	11 MΩ	0.3 kΩ	
	12 MΩ	1.1 kΩ	
	19 MΩ	1.6 kΩ	
	30 MΩ	2.3 kΩ	
	33 MΩ	4 kΩ	
	110 MΩ	25 kΩ	
	120 MΩ	92 kΩ	
	290 MΩ	0.2 MΩ	
	400 MΩ	1.3 MΩ	
	640 MΩ	2 MΩ	
	1.1 GΩ	3.5 MΩ	
Resistance – Measure	Up to 10 Ω	9.6 μΩ/Ω + 9.7 μΩ	Agilent 3458A Opt. 002 8.5 Digit Multimeter
	(10 to 100) Ω	9.2 μΩ/Ω + 97 μΩ	
	(0.1 to 10) kΩ	8 μΩ/Ω + 97 μΩ	
	(1 to 10) kΩ	8 μΩ/Ω + 0.97 mΩ	
	(10 to 100) kΩ	8 μΩ/Ω + 9.7 mΩ	
	(0.1 to 1) MΩ	8.7 μΩ/Ω + 0.39 Ω	
	(1 to 10) MΩ	18 μΩ/Ω + 0.19 kΩ	
	(10 to 100) MΩ	0.27 mΩ/Ω + 0.19 kΩ	
AC Voltage – Source	Up to 33 mV		Fluke 5522A Multi-Product Calibrator
	(10 to 45) Hz	0.18 mV/V + 1.2 μV	
	45 Hz to 10 kHz	91 μV/V + 1.2 μV	
	(10 to 20) kHz	91 μV/V + 1.2 μV	
	(20 to 50) kHz	0.23 mV/V + 1.2 μV	
	(50 to 100) kHz	0.7 mV/V + 2.3 μV	
	(100 to 500) kHz	1.8 mV/V + 9.7 μV	
	(33 to 330) mV		
	(10 to 45) Hz	66 μV/V + 1.6 μV	
	45 Hz to 10 kHz	38 μV/V + 1.6 μV	
	(10 to 20) kHz	45 μV/V + 1.6 μV	
	(20 to 50) kHz	80 μV/V + 1.6 μV	
	(50 to 100) kHz	0.17 mV/V + 6.2 μV	
	(100 to 500) kHz	0.7 mV/V + 14 μV	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Source	(0.33 to 3.3) V		Fluke 5522A Multi-Product Calibrator
	(10 to 45) Hz	66 µV/V + 9.7 µV	
	45 Hz to 10 kHz	37 µV/V + 12 µV	
	(10 to 20) kHz	44 µV/V + 12 µV	
	(20 to 50) kHz	71 µV/V + 9.7 µV	
	(50 to 100) kHz	1.5 mV/V + 24 µV	
	(100 to 500) kHz	0.6 mV/V + 0.12 mV	
	(3.3 to 33) V		
	(10 to 45) Hz	65 µV/V + 0.13 mV	
	45 Hz to 10 kHz	38 µV/V + 0.12 mV	
	(10 to 20) kHz	56 µV/V + 0.12 mV	
	(20 to 50) kHz	92 µV/V + 0.12 mV	
	(50 to 100) kHz	0.2 mV/V + 0.31 mV	
	(33 to 330) V		
	45 Hz to 1 kHz	46 µV/V + 0.39 mV	
	(1 to 10) kHz	52 µV/V + 1.2 mV	
	(10 to 20) kHz	93 µV/V + 1.2 mV	
	(20 to 50) kHz	0.15 mV/V + 1.2 mV	
	(50 to 100) kHz	0.54 mV/V + 9.7 mV	
	(330 to 1 020) V		
	45 Hz to 1 kHz	69 µV/V + 1.9 mV	
	(1 to 5) kHz	64 µV/V + 1.9 mV	
	(5 to 10) kHz	78 µV/V + 1.9 mV	
AC Voltage – Measure	Up to 10 mV		Agilent 3458A Opt. 002 8.5 Digit Multimeter
	40 Hz to 1 kHz	0.29 mV/V + 0.3 µV	
	(1 to 20) kHz	0.31 mV/V + 0.3 µV	
	(20 to 100) kHz	2 mV/V + 0.3 µV	
	(100 to 300) kHz	12 mV/V + 0.5 µV	
	(10 to 100) mV		
	40 Hz to 1 kHz	61 µV/V + 0.5 µV	
	(1 to 20) kHz	88 µV/V + 0.5 µV	
	(20 to 100) kHz	0.43 mV/V + 0.5 µV	
	(100 to 300) kHz	1 mV/V + 2.5 µV	
	(0.1 to 1) V		
	40 Hz to 1 kHz	54 µV/V + 5 µV	
	(1 to 20) kHz	79 µV/V + 5 µV	
	(20 to 50) kHz	0.15 mV/V + 5 µV	
	(50 to 100) kHz	0.3 mV/V + 5 µV	
	(100 to 300) kHz	1 mV/V + 25 µV	
	(300 to 500) kHz	3 mV/V + 25 µV	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Measure	(1 to 10) V		Agilent 3458A Opt. 002 8.5 Digit Multimeter
	(1 to 40) Hz	56 µV/V + 0.1 mV	
	40 Hz to 1 kHz	53 µV/V + 50 µV	
	(1 to 20) kHz	78 µV/V + 50 µV	
	(20 to 50) kHz	0.15 mV/V + 50 µV	
	(50 to 100) kHz	0.26 mV/V + 15 µV	
	(100 to 300) kHz	1 mV/V + 0.25 mV/V	
	(300 to 500) kHz	2 mV/V + 0.25 mV/V	
	500 kHz to 1 MHz	3 mV/V + 0.25 mV/V	
	(10 to 100) V		
	40 Hz to 1 kHz	0.1 mV/V + 0.5 mV	
	(1 to 20) kHz	0.13 mV/V + 0.5 mV	
	(20 to 50) kHz	0.17 mV/V + 0.5 mV	
	(50 to 100) kHz	0.46 mV/V + 0.5 mV	
	(100 to 1 000) V		
	(50 to 60) Hz	0.25 mV/V + 0.5 V	
	(100 to 450) Hz	6.3 mV/V + 0.6 V	
AC Voltage – Measure	(1 to 9) kV (50 to 60) Hz	0.38 mV/V + 0.5 V	Vitrek 4700 High Voltage Meter
AC Current – Source	(33 to 330) µA		Fluke 5522A Multi-Product Calibrator
	(10 to 20) Hz	0.4 mA/A + 19 nA	
	(20 to 45) Hz	0.3 mA/A + 19 nA	
	45 Hz to 1 kHz	0.26 mA/A + 19 nA	
	(1 to 5) kHz	0.59 mA/A + 29 nA	
	(5 to 10) kHz	1.6 mA/A + 39 nA	
	(10 to 30) kHz	3.1 mA/A + 78 nA	
	(0.33 to 3.3) mA		
	(10 to 20) Hz	0.4 mA/A + 29 nA	
	(20 to 45) Hz	0.25 mA/A + 29 nA	
	45 Hz to 1 kHz	0.21 mA/A + 29 nA	
	(1 to 5) kHz	0.4 mA/A + 39 nA	
	(5 to 10) kHz	0.98 mA/A + 58 nA	
	(10 to 30) kHz	2 mA/A + 0.12 µA	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current – Source	(3.3 to 33) mA		Fluke 5522A Multi-Product Calibrator
	(10 to 20) Hz	0.38 mA/A + 0.39 µA	
	(20 to 45) Hz	0.2 mA/A + 0.39µA	
	45 Hz to 1 kHz	0.19 mA/A + 0.39µA	
	(1 to 5) kHz	0.23 mA/A + 0.39µA	
	(5 to 10) kHz	0.5 mA/A + 0.58 µA	
	(10 to 30) kHz	0.81 mA/A + 0.78 µA	
	(33 to 330) mA		
	(10 to 20) Hz	0.38 mA/A + 3.9 µA	
	(20 to 45) Hz	0.2 mA/A + 3.9 µA	
	45 Hz to 1 kHz	0.11 mA/A + 3.9 µA	
	(1 to 5) kHz	0.22 mA/A + 10 µA	
	(5 to 10) kHz	0.41 mA/A + 19 µA	
	(10 to 30) kHz	0.81 mA/A + 39 µA	
	(0.33 to 1.1) A		
	(10 to 45) Hz	0.37 mA/A + 19 µA	
	45 Hz to 1 kHz	0.16 mA/A + 19 µA	
	(1 to 5) kHz	1.4 mA/A + 0.19 mA	
	(5 to 10) kHz	4.9 mA/A + 0.97 mA	
	(1.1 to 3) A		
	(10 to 45) Hz	0.36 mA/A + 19 µA	
	45 Hz to 1 kHz	0.16 mA/A + 19 µA	
	(1 to 5) kHz	1.3 mA/A + 0.19 mA	
	(5 to 10) kHz	5 mA/A + 0.97 mA	
	(3 to 11) A		
	(45 to 100) Hz	0.2 mA/A + 0.39 mA	
	100 Hz to 1 kHz	0.25 mA/A + 0.39 mA	
	(1 to 5) kHz	2.3 mA/A + 0.39 mA	
	(11 to 20.5) A		
	(45 to 100) Hz	0.3 mA/A + 0.97 mA	
	100 Hz to 1 kHz	0.4 mA/A + 0.97 mA	
	(1 to 5) kHz	5.9 mA/A + 0.97 mA	
AC Current Clamp Meters	(16.5 to 55) A		Fluke 5522A Multi-Product Calibrator, Fluke 5500A/COIL 50-turn Coil
	(45 to 65) Hz	2.1 mA/A + 0.13 mA	
	(65 to 440 Hz)	2.1 mA/A + 0.13 mA	
	(55 to 150) A		
	(45 to 65) Hz	2.1 mA/A + 0.13 mA	
	(65 to 440) Hz	2.1 mA/A + 0.13 mA	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current Clamp Meters	(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	 1.9 mA/A + 0.13 mA 2.1 mA/A + 0.13 mA 1.9 mA/A + 0.14 mA 1.9 mA/A + 0.14 mA	Fluke 5522A Multi-Product Calibrator, Fluke 5500A/COIL 50-turn Coil
AC Current – Measure	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	 0.78 mA/A + 1 nA 0.35 mA/A + 6 nA 0.14 mA/A + 0.04 µA 0.2 mA/A + 0.4 µA 0.2 mA/A + 4 µA 0.29 mA/A + 40 µA	Agilent 3458A Opt. 002 8.5 Digit Multimeter
AC Current – Measure	Up to 1 000 A (60 to 100) Hz	 6.1 mA/A + 0.6 A	Agilent 3458A Opt. 002 8.5 Digit Multimeter, Empro B-1000-100 Current Shunt
Electrical Simulation of Thermocouple Indicating Devices – Source/Measure	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	 0.54 °C 0.49 °C 0.38 °C 0.39 °C 0.38 °C 0.25 °C 0.28 °C 0.44 °C 0.7 °C 0.43 °C 0.19 °C 0.18 °C 0.19 °C 0.22 °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	Type J		Fluke 5522A Multi-Product Calibrator
	(-210 to -100) °C	0.26 °C	
	(-100 to -30) °C	0.19 °C	
	(-30 to 150) °C	0.18 °C	
	(150 to 760) °C	0.2 °C	
	(760 to 1 200) °C	0.24 °C	
	Type K		
	(-200 to -100) °C	0.31 °C	
	(-100 to -25) °C	0.22 °C	
	(-25 to 120) °C	0.21 °C	
	(120 to 1 000) °C	0.27 °C	
	(1 000 to 1 372) °C	0.36 °C	
	Type L		
	(-200 to -100) °C	0.33 °C	
	(-100 to 800) °C	0.25 °C	
	(800 to 900) °C	0.2 °C	
	Type N		
	(-200 to -100) °C	0.41 °C	
	(-100 to -25) °C	0.31 °C	
	(-25 to 120) °C	0.3 °C	
	(120 to 410) °C	0.29 °C	
	(410 to 1 300) °C	0.34 °C	
	Type R		
	(0 to 250) °C	0.62 °C	
	(250 to 400) °C	0.37 °C	
	(400 to 1 000) °C	0.36 °C	
	(1 000 to 1 767) °C	0.41 °C	
	Type S		
	(0 to 250) °C	0.45 °C	
	(250 to 1 000) °C	0.38 °C	
	(1 000 to 1 400) °C	0.39 °C	
	(1 400 to 1 767) °C	0.44 °C	
	Type T		
	(-250 to -150) °C	0.54 °C	
	(-150 to 0) °C	0.27 °C	
	(0 to 120) °C	0.17 °C	
	(120 to 400) °C	0.16 °C	
	Type U		
	(-200 to 0) °C	0.49 °C	
	(0 to 600) °C	0.24 °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	Pt 385, 100 Ω		Fluke 5522A Multi-Product Calibrator
	(-200 to -80) °C	0.08 °C	
	(-80 to 0) °C	0.08 °C	
	(0 to 100) °C	0.09 °C	
	(100 to 300) °C	0.11 °C	
	(300 to 400) °C	0.11 °C	
	(400 to 630) °C	0.13 °C	
	(630 to 800) °C	0.21 °C	
	Pt 385, 200 Ω		
	(-200 to -80) °C	0.08 °C	
	(-80 to 0) °C	0.08 °C	
	(0 to 100) °C	0.08 °C	
	(100 to 260) °C	0.08 °C	
	(260 to 300) °C	0.13 °C	
	(300 to 400) °C	0.14 °C	
	(400 to 600) °C	0.16 °C	
	(600 to 630) °C	0.17 °C	
	Pt 385, 500 Ω		
	(-200 to -80) °C	0.08 °C	
	(-80 to 100) °C	0.08 °C	
	(0 to 100) °C	0.09 °C	
	(100 to 260) °C	0.09 °C	
	(260 to 300) °C	0.1 °C	
	(300 to 400) °C	0.1 °C	
	(400 to 600) °C	0.11 °C	
	(600 to 630) °C	0.12 °C	
	Pt 385, 1 000 Ω		
	(-200 to -80) °C	0.08 °C	
	(-80 to 100) °C	0.08 °C	
	(0 to 100) °C	0.08 °C	
	(100 to 260) °C	0.09 °C	
	(260 to 300) °C	0.09 °C	
	(300 to 400) °C	0.1 °C	
	(400 to 600) °C	0.1 °C	
	(600 to 630) °C	0.2 °C	
Electrical Simulation of RTD Indicating Devices – Source	Pt 3926, 100 Ω		Fluke 5522A Multi-Product Calibrator
	(-200 to -80) °C	0.08 °C	
	(-80 to 0) °C	0.08 °C	
	(0 to 100) °C	0.09 °C	
	(100 to 300) °C	0.11 °C	
	(300 to 400) °C	0.11 °C	
	(400 to 630) °C	0.13 °C	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Capacitance – Source			Fluke 5522A Multi-Product Calibrator
10 Hz to 10 kHz	(220 to 400) pF	15 mF/F + 1.9 pF	
10 Hz to 10 kHz	(0.4 to 1.1) nF	4.5 mF/F + 1.9 pF	
10 Hz to 3 kHz	(1.1 to 3.3) nF	2.4 mF/F + 1.9 pF	
10 Hz to 1 kHz	(3.3 to 11) nF	0.9 mF/F + 1.9 pF	
10 Hz to 1 kHz	(11 to 33) nF	0.87 mF/F + 1.9 pF	
10 Hz to 1 kHz	(33 to 110) nF	0.88 mF/F + 1.9 pF	
10 Hz to 1 kHz	(110 to 330) nF	0.9 mF/F + 5.8 pF	
(10 to 600) Hz	(0.33 to 1.1) µF	0.9 mF/F + 0.2 pF	
(10 to 300) Hz	(1.1 to 3.3) µF	0.9 mF/F + 0.6 pF	
(10 to 150) Hz	(3.3 to 11) µF	0.9 mF/F + 1.9 pF	
(10 to 120) Hz	(11 to 33) µF	1.1 mF/F + 5.8 pF	
(10 to 80) Hz	(33 to 110) µF	1.6 mF/F + 19 pF	
Capacitance – Measure (1 kHz)	(10 to 100) pF	3.2 mF/F + 0.02 pF	Fluke PM6303 RCL Meter
	(10 to 100) pF	3.2 mF/F + 0.02 pF	
	(100 to 1 000) pF	2.6 mF/F + 0.02 nF	
	(1 to 100) nF	2.6 mF/F + 0.2 pF	
	(0.1 to 1) mF	2.7 mF/F + 2.04 nF	
Inductance – Source Fixed (100 Hz to 10 kHz)	100 µH	0.39 µH	Genrad 1482B, 1482E, 1482L Standard Inductors
	1 mH	2.3 µH	
	100 mH	0.1 mH	
DC Power – Source	Up to 3 060 W	0.31 mW/W + 30 mW	Fluke 5522A Multi-Product Calibrator
	(3.06 to 20.9) kW	0.89 mW/W + 0.62 W	
AC Power – Source (45 to 65 Hz)	Up to 336.6 W	0.14 mW/W + 4 mW	
	(0.336 to 1.12) kW	0.18 mW/W + 20 mW	
	(1.12 to 3.06) kW	0.18 mW/W + 20 mW	
	(3.06 to 11.22) kW	0.21 mW/W + 0.41 W	
	(11.2 to 20.91) kW	0.31 mW/W + 1 W	
Phase Angle – Source	(0 to 90) °		Fluke 5522A Multi-Product Calibrator
	(65 to 500) Hz	1.5 °	
	500 Hz to 1 kHz	1.5 °	
	(1 to 5) kHz	1.6 °	
	(5 to 10) kHz	1.9 °	
	(10 to 30) kHz	2.7 °	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Oscilloscopes			
Amplitude Square Wave into 50 Ω load	1 kHz		
	Up to 5 mV	1.8 mV/V + 6.2 µV	
	(5 to 11) mV	2 mV/V + 14 µV	
	(11 to 45) mV	2 mV/V + 56 µV	
	(45 to 110) mV	2 mV/V + 0.14 mV	
	(0.11 to 0.45) V	2 mV/V + 0.56 mV	
	(0.45 to 1.09) V	2 mV/V + 1.4 mV	
Amplitude Square Wave into 1 MΩ load	1 kHz		
	Up to 5 mV	2.2 mV/V + 10 nV	
	(5 to 20) mV	2 mV/V + 30 nV	
	(20 to 89) mV	2 mV/V + 0.11 mV	
	(89 to 219) mV	2 mV/V + 0.27 mV	
	(219 to 890) mV	2 mV/V + 1.1 mV	
	(0.89 to 6.5) V	2 mV/V + 8 mV	Fluke 5502A Multi-Product Calibrator
	10 Hz		
	(6.5 to 55) V	2 mV/V + 0.14 V	
	100 Hz		
	(6.5 to 55) V	2 mV/V + 69 mV	
	1 kHz		
	(6.5 to 55) V	2 mV/V + 69 mV	
	10 kHz		
	(6.5 to 55) V	4 mV/V + 69 mV	
Leveled Sine Wave (50 kHz Reference)	10 mVp-p to 5.5 Vp-p		
	50 kHz to 100 MHz	28 mV/V + 58 mV/V	
	(100 to 300) MHz	33 mV/V + 58 mV/V	
Time Marker into 50 Ω load	2 ns to 50 ms	4.9 µs/s	
	50 ms to 5 s	14 µs/s	

Length – Dimensional Metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Calipers[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	Grade 0 Gage Blocks, Gage Block Accessories
Outside Micrometers[2]	Up to 12 in	(35 + 9.8*L*) µin	
Inside Micrometers[2]	Up to 12 in (12 to 40) in	(35 + 9.8*L*) µin (5.4 + 13*L*) µin	
Dial Indicators[2]	Up to 4 in	(27 + 7.4*L*) µin	
Test Indicators[2]	Up to 0.05 in	(29 + 0.12*L*) µin	
Height Gages[2]	Up to 12 in (12 to 40) in	(110 + 6*L*) µin (43 + 12*L*) µin	
Optical Comparator[1,2]	(0 to 50) mm	(2.5 + 0.004*l*) µm	Mitutoyo 172-116, 172-117 Glass Scales
Measuring Microscopes[1,2]	(0 to 50.8) mm	(1.7 + 0.023*l*) µm	Mitutoyo 172-116, 172-117 Glass Scales
Protractor, Angle	(30 to 90) °	1.8 ‘	Angle Blocks
Outside Diameter – Measure[2]	(1 to 60) mm	(1 + 0.004 3*D*) µm	Laser Micrometer
Laser Micrometer[1,2]	(1 to 25) mm	(0.5 + 0.004*D*) mm	Class XX Cylindrical Plug Gages and ASME B.89.1.5-1998 utilized in the calibration of these devices.
	(1 to 60) mm	(1 + 0.004 3*D*) µm	Mitutoyo 02AGD170 Calibration Gage Set
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 Measuring Machine, 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	Universal Measuring Machine, 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 Measuring Machine, Grade 00 Gage Blocks

Length – Dimensional Metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Length Standards	(4 to 6) in	(2.7 + 9.6*L*) µin	Mitutoyo QVT1-X404P1L Vision Measuring Machine, Grade 0 Gage Blocks
Length Standards	(6 to 12) in	(5.6 + 9.3*L*) µin	Faro EDGE 14000 Articulating Arm CMM, Grade 0 Long Gage Blocks
Cylindrical Pin/Plug Gages	Up to 1 in (1 to 4) in	(6.7 + 5.3*L*) µin (4.3 + 7.9*L*) µin	LabMaster Universal Measuring Machine, Grade 00 Gage Blocks
Cylindrical Pin & Plug Gages	Up to 1 in	(12 + 2.5*L*) µin	Laser Micrometer, Class XX Plug Gages
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 Measuring Machine, Grade 00 Gage Blocks, Class XX Ring Gages
Thread Wires (4 – 80) TPI	(0.005 to 0.2) in	(5.1 + 7.5*L*) µin	LabMaster Universal Measuring Machine, Grade 00 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 Measuring Machine, Grade 00 Gage Blocks
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 Measuring Machine, Grade 00 Gage Blocks
Coordinate Measuring Machines[1] Linear Measurement (X-axis, Y-axis, Z-axis)	Up to 2 in (2 to 4) in (4 to 6) in (6 to 12) in (12 to 20) in	(3.4 + 5.8*L*) µin (3.7 + 5.8*L*) µin (2.3 + 6.2*L*) µin (7 + 5.7*L*) µin (14 + 5.6*L*) µin	Grade 00 Gage Blocks, Grade 0 Long Gage Blocks
Vision Measuring System[1] (non-contact) Linear Measurement (X-axis, Y-axis, Z-axis)	Up to 2 in (2 to 4) in (4 to 6) in (6 to 12) in (12 to 20) in	(15 + 2.8*L*) µin (12 + 4.6*L*) µin (8.7 + 5.6*L*) µin (11 + 5.5*L*) µin (16 + 5.5*L*) µin	Grade 0 Gage Blocks, Grade 0 Long Gage Blocks, 50 mm Standard Scale, 2 in Standard Scale, 6 in Standard Scale

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
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 – Measure (Tension and Compression)	(0.002 to 100) lbf	0.013 % of reading	NIST Class F Weight
	(100 to 500) lbf (200 to 1 000) lbf (1 000 to 5 000) lbf	0.05 % of reading 0.37 % of reading 0.28 % of reading	Futek Indicator, Load Cell
Analytical Balances/Scales[1,2,3]	Up to 200 g Up to 1 000 g	0.37 mg 0.52 mg	ASTM E617 Class 1 Weights and internal procedure utilized in the calibration of the weighing system.
Balances/Scales[1,2,3]	Up to 50 g (50 to 200) g 200 g to 10 kg (25 to 500) kg	0.04 mg 2.3 mg 8.5 mg 7.6 g	NIST Class F Weights and internal procedure utilized in the calibration of the weighing system.
Pressure Gauges[1]	(-12 to 0) psig (0 to 300) psig	0.025 psi 0.004 7 psi/psi + 0.017 psi	Fluke 3130 Pressure Calibrator
	(-1 to 1) psig Up to 1 000 psig (1 000 to 10 000) psig	0.000 2 psi 0.44 psi 3.3 psi/psi + 1.5 psi	Fluke 750 Process Calibrator, Fluke 750 Series Pressure Modules
Low Pressure Gauges[1] (Pneumatic)	(-13.75 to 0) psig (0 to 36) psig	0.007 5 psi 0.004 1 psi/psi + 0.018 psi	Fluke 721-PD2 (Port 1) Pressure Calibrator
High Pressure Gauges (Hydraulic)	(1 000 to 10 000) psig	1.2 psi	Comparison to Fluke 2700G-G70M Pressure Gauge
Pressure Measuring Equipment	(20 to 1 434) psig (200 to 10 000) psig	0.06 % of reading 0.17 % of reading	Deadweight Pressure System

Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Flow Measuring Devices[2]	(3 to 30) sccm (30 to 300) sccm (0.1 to 1) slpm	(0.032 + 0.078*X*) sccm (0.037 + 0.084*X*) sccm (0.005 + 0.08*X*) slpm	CME DIVISION 60B-75-.03-1000(SP) Master Flowmeter
Rockwell Hardness Testing Machines[1]	22.9 HRC 33.1 HRC 43.6 HRC 54.4 HRC 60.7 HRC 62.9 HRC 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 with Rockwell Hardness Block Standards.

Thermodynamic

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Humidity	(0 to 100) %RH	1.2 %RH	Vaisala MI70/HMP76B Thermo-hygrometer
Temperature – Radiation Thermometers	35 °C 100 °C 200 °C 350 °C 500 °C	0.65 °C 0.67 °C 0.72 °C 0.84 °C 1 °C	Fluke 4181 Infrared Calibrator (flat plate) ε = (0.9 to 1), λ = (8 to 14) µm
Temperature – Thermometers, Temperature Probes	(-200 to 0) °C (0 to 100) °C (100 to 300) °C (300 to 420) °C (429 to 650) °C	0.03 °C 0.03 °C 0.05 °C 0.11 °C 0.12 °C	Fluke 1523 Handheld Thermometer, Fluke 5628 Secondary PRT, Fluke 9144 Field Metrology Well

Time and Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Stopwatches	(1 to 86 400) s	70 ms	Agilent 53132A Frequency Counter
Frequency – Measure	(1 to 225) MHz Up to 3 GHz	0.64 mHz/Hz 62 mHz/Hz	Agilent 53132A Frequency Counter
Frequency – Source	5.5 Vp-p 50 kHz 500 kHz 5 MHz 50 MHz 2 Vp-p 300 MHz	 0.21 Hz 0.32 Hz 3.1 Hz 31 Hz 0.19 kHz	Fluke 5502A Multi-Product Calibrator

DIMENSIONAL MEASUREMENT

1 Dimensional

Specific Tests and / or Properties Measured	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
Dimensional Measurement 1D	Up to 1.8 m	41 µm	Faro EDGE 14000 Articulating Arm CMM and Software utilized as Reference Standard for 1D Dimensional Measurement.
Linear Measurement	X = Up to 320 mm Y = Up to 320 mm Z = Up to 150 mm	5.3 µm	Mitutoyo QVT1-L404Z1L-D Q CNC Vision Measuring System and software utilized as Reference Standard for Dimensional Measurement.

3 Dimensional

Specific Tests and / or Properties Measured	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
Dimensional Measurement 3D	3D Length: Up to 1.8 m	52 µm	Faro EDGE 14000 Articulating Arm CMM and Software utilized as Reference Standard for 3D Dimensional Measurement.

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, l = length in millimeters, D = diameter in millimeters, X = indicated value in specific unit.
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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