



CERTIFICATE OF ACCREDITATION

The ANSI National Accreditation Board

Hereby attests that

Transcat – Charlotte
8334 Arrowridge Blvd., Suite B
Charlotte, NC 28273

Fulfills the requirements of

ISO/IEC 17025:2017

and the national standards

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

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.

R. Douglas Leonard Jr., VP, PILR SBU

Expiry Date: 07 September 2023

Certificate Number: AC-2489.07



This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017.
This accreditation demonstrates technical competence for a defined
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)

ANSI/NCSL Z540.3-2006 (R2013)

Transcat – Charlotte

8334 Arrowridge Blvd., Suite B

Charlotte, NC 28273

Damon Kegel 856-886-8719

CALIBRATION AND DIMENSIONAL MEASUREMENT

Valid to: **September 7, 2023**

Certificate Number: **AC-2489.07**

CALIBRATION

Acoustics and Vibration

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Sound Measuring Equipment			
125 Hz to 2 kHz	(74 to 104) dB	0.46 dB	GenRad 1986 Sound Level Calibrator
4 kHz	(74 to 104) dB	0.73 dB	
125 Hz to 2 kHz	114 dB	0.37 dB	
4 kHz	114 dB	0.62 dB	
Sound Level Measure			
125 Hz to 2 kHz	(74 to 104) dB	0.48 dB	GenRad 1986 Sound Level Calibrator, Sound Meters
4 kHz	(74 to 104) dB	0.74 dB	
125 Hz to 2 kHz	114 dB	0.38 dB	
4 kHz	114 dB	0.63 dB	
Acceleration			Master Accelerometer
	(5 to 9) Hz	1.7 % of reading	
	(10 to 99) Hz	1.2 % of reading	
	100 Hz	0.75 % of reading	
	(101 to 920) Hz	1 % of reading	
	(921 to 5 000) Hz	1.4 % of reading	
	(5 001 to 10 000) Hz	1.9 % of reading	
	(10 to 15) kHz	2.2 % of reading	
	(15 to 20) kHz	2.8 % of reading	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Sine Wave Flatness ¹ 50 Ω , 3 V Input	Up to 3 V 10 Hz to 1 MHz (1 to 10) MHz (10 to 30) MHz (30 to 50) MHz (50 to 80) MHz (80 to 100) MHz	0.06 % of reading 0.1 % of reading 0.18 % of reading 0.41 % of reading 0.71 % of reading 0.84 % of reading	Ballantine 1395B Thermal Voltage Converter
DC Current – Measure/Source ¹	(0 to 100) μ A 100 μ A to 1 mA (1 to 10) mA (10 to 100) mA 100 mA to 1 A	33 μ A/A + 0.92 nA 29 μ A/A + 5.8 nA 29 μ A/A + 58 nA 46 μ A/A + 0.58 μ A 0.13 mA/A + 12 μ A	Agilent 3458A 8.5 Digit Multimeter, Current Source
DC Current – Measure ¹	(1 to 100) A	0.06 % of reading	Leeds & Northrup 4363 Current Shunt, Digital Multimeter
DC Current – Source ¹	(0 to 220) μ A (0.22 to 2.2) mA (2.2 to 22) mA (22 to 220) mA (0.22 to 2.2) A (2.2 to 11) A	40 μ A/A + 6 nA 36 μ A/A + 7 nA 354 μ A/A + 40 nA 48 μ A/A + 0.7 μ A 84 μ A/A + 12 μ A 0.36 mA/A + 0.48 mA	Fluke 5700A-EP Multiproduct Calibrator, Fluke 5725A Amplifier
	(11 to 20) A	0.1 % of reading + 0.58 mA	Fluke 5520A Multiproduct Calibrator
DC Clamp-on Ammeters ¹ (Non-Toroidal Type)	(20 to 150) A (150 to 1 000) A	0.5 % of reading + 0.14 A 0.5 % of reading + 0.5 A	Fluke 5520A Multiproduct Calibrator, Fluke 5500A/Coil 50-turn Coil
AC Current – Measure ¹	Up to 100 μ A (10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz 100 μ A to 1 mA (10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz	0.46 % of reading + 35 nA 0.17 % of reading + 35 nA 0.072 % of reading + 35 nA 0.072 % of reading + 35 nA 0.46 % of reading + 0.23 μ A 0.17 % of reading + 0.23 μ A 0.071 % of reading + 0.23 μ A 0.038 % of reading + 0.23 μ A	Agilent 3458A 8.5 Digit Multimeter

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current – Measure ¹	(1 to 10) mA		Agilent 3458A 8.5 Digit Multimeter
	(10 to 20) Hz	0.46 % of reading + 2.3 μ A	
	(20 to 45) Hz	0.17 % of reading + 2.3 μ A	
	(45 to 100) Hz	0.071 % of reading + 2.3 μ A	
	100 Hz to 5 kHz	0.038 % of reading + 2.3 μ A	
	(10 to 100) mA		
	(10 to 20) Hz	0.48 % of reading + 23 μ A	
	(20 to 45) Hz	0.17 % of reading + 23 μ A	
	(45 to 100) Hz	0.071 % of reading + 23 μ A	
	100 Hz to 5 kHz	0.038 % of reading + 23 μ A	
	100 mA to 1 A		
	(10 to 20) Hz	0.46 % of reading + 0.23 mA	
AC Current – Measure ¹	1 A to 2 A		Ballantine 1625A AC/DC Current Shunt, Agilent 3458A 8.5 Digit Multimeter
	50 Hz to 1 kHz	0.12 % of reading + 0.2 mA	
	2 A to 20 A		
	50 Hz to 1 kHz	0.12 % of reading + 0.3 mA	
AC Current – Source ¹	20 A to 100 A		Fluke 5700A-EP Multiproduct Calibrator
	50 Hz to 1 kHz	0.12 % of reading + 0.3 mA	
	Up to 220 μ A		
	(10 to 20) Hz	0.031 % of reading + 16 nA	
	(20 to 40) Hz	0.19 % of reading + 10 nA	
	40 Hz to 1 kHz	0.015 % of reading + 8 nA	
	(1 to 5) kHz	0.03 % of reading + 12 nA	
	(5 to 10) kHz	0.11 % of reading + 65 nA	
	(0.22 to 2.2) mA		
	(10 to 20) Hz	0.03 % of reading + 40 nA	
	(20 to 40) Hz	0.018 % of reading + 35 nA	
	40 Hz to 1 kHz	0.013 % of reading + 35 nA	
	(1 to 5) kHz	0.021 % of reading + 0.11 μ A	
	(5 to 10) kHz	0.11 % of reading + 0.65 μ A	
	(2.2 to 22) mA		
	(10 to 20) Hz	0.039 % of reading + 0.4 μ A	
	(20 to 40) Hz	0.019 % of reading + 0.35 μ A	
	40 Hz to 1 kHz	0.014 % of reading + 0.35 μ A	
	(1 to 5) kHz	0.021 % of reading + 0.55 μ A	
	(5 to 10) kHz	0.11 % of reading + 5 μ A	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current – Source ¹	(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	0.033 % of reading + 4 μ A 0.018 % of reading + 3.5 μ A 0.014 % of reading + 2.5 μ A 0.021 % of reading + 3.5 μ A 0.11 % of reading + 10 μ A	Fluke 5700A-EP Multiproduct Calibrator
	(0.22 to 2.2) A 20 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.027 % of reading + 35 μ A 0.046 % of reading + 80 μ A 0.7 % of reading + 0.16 mA	
AC Current – Source ¹	(2.2 to 11) A 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.048 % of reading + 0.17 mA 0.096 % of reading + 0.38 mA 0.36 % of reading + 0.75 mA	Fluke 5700A-EP Multiproduct Calibrator, Fluke 5725A Amplifier
	(11 to 20.5) A (45 to 100) Hz 100 Hz to 1 kHz (1 to 5) kHz	0.09 % of reading + 3.9 mA 0.12 % of reading + 3.9 mA 2.3 % of reading + 3.9 mA	Fluke 5520A Multiproduct Calibrator
	(20 to 100) A 50 Hz to 1 kHz	0.12 % of reading + 0.3 mA	Fluke 5520A Multiproduct Calibrator, Ballentine 1625A AC/DC Current Shunt, Agilent 3458A 8.5 Digit Multimeter
AC Current – Source ¹ Extended Frequency Ranges	29 μ A to 329.99 μ A (10 to 30) kHz 330 μ A to 3.299 mA (10 to 30) kHz 3.3 mA to 32.99 mA (10 to 30) kHz 33 mA to 329.99 mA (10 to 30) kHz	1.2 % of reading + 0.31 μ A 0.78 % of reading + 0.47 μ A 0.31 % of reading + 3.1 μ A 0.31 % of reading + 0.16 mA	Fluke 5520A Multiproduct Calibrator
AC Clamp-on Ammeters ¹ (Toroidal Type) Transformer Type Sensor	(20 to 150) A (45 to 65) Hz (65 to 440) Hz (150 to 1 000) A (45 to 65) Hz (65 to 440) Hz	0.3 % of reading + 26 mA 0.83 % of reading + 47 mA 0.35 % + 0.12 A 1.1 % of reading + 0.22 A	Fluke 5520A Multiproduct Calibrator, Fluke 5500A/Coil 50-turn Coil

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Clamp-on Ammeters ¹ (Non-Toroidal Type) Hall Effect Sensor	(20 to 150) A (45 to 65) Hz (65 to 440) Hz (150 to 1 000) A (45 to 65) Hz (65 to 440) Hz	0.57 % of reading + 0.25 A 1 % of reading + 0.25 A 0.60 % of reading + 0.9 A 1.3 % of reading + 0.92 A	Fluke 5520A Multiproduct Calibrator, Fluke 5500A/Coil 50-turn Coil
DC Resistance – Measure/Source ¹	(0 to 10) Ω (10 to 100) Ω 100 Ω to 1 k Ω (1 to 10) k Ω (10 to 100) k Ω 100 k Ω to 1 M Ω (1 to 10) M Ω (10 to 100) M Ω 100 M Ω to 1 G Ω	18 $\mu\Omega/\Omega$ + 58 $\mu\Omega$ 15 $\mu\Omega/\Omega$ + 0.58 m Ω 13 $\mu\Omega/\Omega$ + 0.58 m Ω 12 $\mu\Omega/\Omega$ + 5.8 m Ω 13 $\mu\Omega/\Omega$ + 58 m Ω 21 $\mu\Omega/\Omega$ + 2.3 Ω 62 $\mu\Omega/\Omega$ + 0.12 k Ω 0.059 % of reading + 1.2 k Ω 0.82 % of reading + 12 k Ω	Agilent 3458A 8.5 Digit Multimeter, Decade Resistor
DC Resistance – Source ¹ (Fixed Artifacts)	100 $\mu\Omega$ 1 m Ω 10 m Ω 100 m Ω 1 Ω	81 n Ω 0.5 $\mu\Omega$ 2 $\mu\Omega$ 8.6 $\mu\Omega$ 0.1 m Ω	Standard Resistors
DC Resistance – Source ¹ (Variable Artifact)	(10 to 100) M Ω 100 M Ω to 1 G Ω (1 to 10) G Ω (10 to 100) G Ω 100 G Ω to 1 T Ω	0.08 % of reading 0.24 % of reading 0.42 % of reading 0.83 % of reading 2.4 % of reading	IET HRRS-B-7-100K-5KV Decade Resistor
DC Voltage – Measure ¹	(0 to 100) mV (0.1 to 1) V (1 to 10) V (10 to 100) V (100 to 500) V (500 to 800) V (800 to 1 000) V	8.3 $\mu\text{V}/\text{V}$ + 0.58 μV 5.3 $\mu\text{V}/\text{V}$ + 0.58 μV 5.3 $\mu\text{V}/\text{V}$ + 0.58 μV 7.7 $\mu\text{V}/\text{V}$ + 35 μV 15 $\mu\text{V}/\text{V}$ + 0.12 mV 18 $\mu\text{V}/\text{V}$ + 0.12 mV 21 $\mu\text{V}/\text{V}$ + 0.12 mV	Agilent 3458A 8.5 Digit Multimeter
DC High Voltage – Measure ¹	(1 to 10) kV (10 to 20) kV (20 to 30) kV (30 to 40) kV (40 to 50) kV	0.039 % of reading + 92 mV 0.038 % of reading + 2.4 V 0.041 % of reading + 2.4 V 0.047 % of reading + 2.4 V 0.056 % of reading + 2.4 V	Vitretek 4600A High Voltage Meter; Vitretek HVL-35, HVL-70, HVL-100 High Voltage Probes

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
DC High Voltage – Measure ¹	(50 to 60) kV (60 to 70) kV (70 to 80) kV (80 to 90) kV (90 to 100) kV	0.071 % of reading + 2.4 V 0.089 % of reading + 2.4 V 0.12 % of reading + 2.5 V 0.15 % of reading + 2.5 V 0.17 % of reading + 2.5 V	Vitretek 4600A High Voltage Meter; Vitretek HVL-35, HVL-70, HVL-100 High Voltage Probes
DC Voltage – Source 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	8.6 μ V/V + 0.4 μ V 5.1 μ V/V + 0.7 μ V 4 μ V/V + 2.5 μ V 3.9 μ V/V + 4 μ V 6.2 μ V/V + 40 μ V 7.6 μ V + 0.4 mV	Fluke 5700A-EP Multiproduct Calibrator
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 300 kHz to 1 MHz (1 to 4) MHz (10 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 (2 to 4) MHz (4 to 8) MHz (8 to 10) MHz	0.04 % of reading + 3.5 μ V 0.03 % of reading + 1.2 μ V 0.04 % of reading + 1.2 μ V 0.15 % of reading + 1.2 μ V 0.59 % of reading + 1.2 μ V 4.6 % of reading + 2.3 μ V 1.5 % of reading + 5.8 μ V 8.1 % of reading + 8.1 μ V 0.013 % of reading + 4.6 μ V 0.01 % of reading + 2.3 μ V 0.017 % of reading + 2.3 μ V 0.038 % of reading + 2.3 μ V 0.093 % of reading + 2.3 μ V 0.36 % of reading + 12 μ V 1.2 % of reading + 12 μ V 1.8 % of reading + 12 μ V 4.7 % of reading + 81 μ V 4.7 % of reading + 92 μ V 17 % of reading + 0.12 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
AC Voltage – Measure ¹	(0.1 to 1) V		Agilent 3458A Opt 002 8.5 Digit Multimeter
	(1 to 40) Hz	0.009 % of reading + 46 μ V	
	40 Hz to 1 kHz	0.008 % of reading + 23 μ V	
	(1 to 20) kHz	0.017 % of reading + 23 μ V	
	(20 to 50) kHz	0.036 % of reading + 23 μ V	
	(50 to 100) kHz	0.093 % of reading + 23 μ V	
	(100 to 300) kHz	0.35 % of reading + 0.12 mV	
	300 kHz to 1 MHz	1.2 % of reading + 0.12 mV	
	(1 to 2) MHz	1.8 % of reading + 0.12 mV	
	(2 to 4) MHz	4.6 % of reading + 0.81 mV	
	(4 to 8) MHz	4.6 % of reading + 0.92 mV	
	(8 to 10) MHz	17 % of reading + 1.2 mV	
	(1 to 10) V		
	(1 to 40) Hz	0.01 % of reading + 0.46 mV	
	40 Hz to 1 kHz	0.023 % of reading + 0.23 mV	
	(1 to 20) kHz	0.017 % of reading + 0.23 mV	
	(20 to 50) kHz	0.036 % of reading + 0.23 mV	
	(50 to 100) kHz	0.093 % of reading + 0.23 mV	
	(100 to 300) kHz	0.35 % of reading + 1.2 mV	
	300 kHz to 1 MHz	1.2 % of reading + 1.2 mV	
	(1 to 2) MHz	1.8 % of reading + 1.2 mV	
	(2 to 4) MHz	4.6 % of reading + 8.1 mV	
	(4 to 8) MHz	4.6 % of reading + 9.2 mV	
	(8 to 10) MHz	17 % of reading + 12 mV	
	(10 to 100) V		
	(1 to 40) Hz	0.024 % of reading + 4.6 mV	
	40 Hz to 1 kHz	0.024 % of reading + 2.3 mV	
	(1 to 20) kHz	0.024 % of reading + 2.3 mV	
	(20 to 50) kHz	0.041 % of reading + 2.3 mV	
	(50 to 100) kHz	0.14 % of reading + 2.3 mV	
	(100 to 300) kHz	0.46 % of reading + 12 mV	
	300 kHz to 1 MHz	1.7 % of reading + 12 mV	
	(100 to 700) V		
	(1 to 40) Hz	0.048 % of reading + 46 mV	
	40 Hz to 1 kHz	0.048 % of reading + 23 mV	
	(1 to 20) kHz	0.071 % of reading + 23 mV	
	(20 to 50) kHz	0.19 % of reading + 23 mV	
	(50 to 100) kHz	0.35 % of reading + 23 mV	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC High Voltage – Measure ¹	(0.7 to 5) kV		Vitrek 4600A High Voltage Meter; Vitrek HVL-35, HVL-70, HVL-100 High Voltage Probes
	10 mHz to 10 Hz	0.14 % of reading + 0.17 V	
	(10 to 30) Hz	0.12 % of reading + 0.29 V	
	(30 to 50) Hz	0.099 % of reading + 0.37 V	
	(50 to 70) Hz	0.068 % of reading + 0.37 V	
	(70 to 100) Hz	0.099 % of reading + 0.37 V	
	(100 to 200) Hz	0.099 % of reading + 0.37 V	
	(200 to 450) Hz	0.48 % of reading + 0.17 V	
	(450 to 600) Hz	0.47 % of reading + 0.17 V	
	(5 to 30) kV		
	10 mHz to 10 Hz	0.19 % of reading + 2.4 V	
	(10 to 30) Hz	0.13 % of reading + 2.4 V	
	(30 to 50) Hz	0.11 % of reading + 2.4 V	
	(50 to 70) Hz	0.077 % of reading + 2.4 V	
	(70 to 100) Hz	0.11 % of reading + 2.4 V	
	(100 to 200) Hz	0.11 % of reading + 2.4 V	
	(200 to 450) Hz	0.7 % of reading + 2.4 V	
	(450 to 600) Hz	1.4 % of reading + 2.4 V	
	(30 to 50) kV		
	10 mHz to 10 Hz	0.24 % of reading + 2.5 V	
	(10 to 30) Hz	0.18 % of reading + 2.5 V	
	(30 to 50) Hz	0.13 % of reading + 2.5 V	
	(50 to 70) Hz	0.1 % of reading + 2.5 V	
	(70 to 100) Hz	0.13 % of reading + 2.5 V	
	(100 to 200) Hz	0.69 % of reading + 2.5 V	
	(200 to 450) Hz	2.9 % of reading + 2.5 V	
	(50 to 70) kV		
	10 mHz to 10 Hz	0.37 % of reading + 2.6 V	
	(10 to 30) Hz	0.26 % of reading + 2.6 V	
	(30 to 50) Hz	0.16 % of reading + 2.6 V	
	(50 to 70) Hz	0.16 % of reading + 2.6 V	
	(70 to 100) Hz	1.2 % of reading + 2.6 V	
	(100 to 200) Hz	1.2 % of reading + 2.6 V	
	(200 to 450) Hz	17 % of reading + 2.6 V	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Source ¹	Up to 2.2 mV		Fluke 5700-EP Multiproduct Calibrator
	(10 to 20) Hz	0.16 % of reading + 4 μ V	
	(20 to 40) Hz	0.1 % of reading + 4 μ V	
	40 Hz to 20 kHz	0.078 % of reading + 4 μ V	
	(20 to 50) kHz	0.13 % of reading + 4 μ V	
	(50 to 100) kHz	0.17 % of reading + 5 μ V	
	(100 to 300) kHz	0.33 % of reading + 10 μ V	
	(300 to 500) kHz	0.47 % of reading + 20 μ V	
	500 kHz to 1 MHz	0.58 % of reading + 20 μ V	
	(2.2 to 22) mV		
	(10 to 20) Hz	0.042 % of reading + 4 μ V	
	(20 to 40) Hz	0.03 % of reading + 4 μ V	
	40 Hz to 20 kHz	0.014 % of reading + 4 μ V	
	(20 to 50) kHz	0.03 % of reading + 4 μ V	
	(50 to 100) kHz	0.058 % of reading + 5 μ V	
	(100 to 300) kHz	0.12 % of reading + 10 μ V	
	(300 to 500) kHz	0.16 % of reading + 20 μ V	
	500 kHz to 1 MHz	0.27 % of reading + 20 μ V	
	(22 to 220) mV		
	(10 to 20) Hz	0.028 % of reading + 12 μ V	
	(20 to 40) Hz	0.011 % of reading + 7 μ V	
	40 Hz to 20 kHz	0.009 % of reading + 7 μ V	
	(20 to 50) kHz	0.021 % of reading + 7 μ V	
	(50 to 100) kHz	0.047 % of reading + 17 μ V	
	(100 to 300) kHz	0.091 % of reading + 20 μ V	
	(300 to 500) kHz	0.14 % of reading + 25 μ V	
	500 kHz to 1 MHz	0.28 % of reading + 45 μ V	
	(0.22 to 2.2) V		
	(10 to 20) Hz	0.027 % of reading + 40 μ V	
	(20 to 40) Hz	0.01 % of reading + 15 μ V	
	40 Hz to 20 kHz	0.005 % of reading + 8 μ V	
	(20 to 50) kHz	0.008 % of reading + 10 μ V	
	(50 to 100) kHz	0.012 % of reading + 30 μ V	
	(100 to 300) kHz	0.043 % of reading + 80 μ V	
	(300 to 500) kHz	0.01 % of reading + 0.2 mV	
	500 kHz to 1 MHz	0.18 % of reading + 0.3 mV	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Source ¹	(2.2 to 22) 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	0.028 % of reading + 0.4 mV 0.01 % of reading + 0.15 mV 0.005 % of reading + 50 μ V 0.008 % of reading + 0.1 mV 0.011 % of reading + 0.2 mV 0.03 % of reading + 0.6 mV 0.1 % of reading + 2 mV 0.17 % of reading + 3.2 mV	Fluke 5700-EP Multiproduct Calibrator
	(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	0.028 % of reading + 4 mV 0.01 % of reading + 1.5 mV 0.006 % of reading + 0.6 mV 0.009 % of reading + 1 mV 0.016 % of reading + 2.5 mV 0.09 % of reading + 16 mV 0.44 % of reading + 40 mV 0.8 % of reading + 80 mV	
AC Voltage – Source ¹	(220 to 1 100) V 40 Hz to 1 kHz (1 to 20) kHz (20 to 30) kHz	0.011 % of reading + 4 mV 0.017 % of reading + 6 mV 0.061 % of reading + 11 mV	Fluke 5720A Multiproduct Calibrator, Fluke 5725A Amplifier
AC Voltage – Source ¹ Extended Frequency Ranges	(220 to 750) V (30 to 50) kHz (50 to 100) kHz	0.061 % of reading + 11 mV 0.23 % of reading + 45 mV	
Capacitance – Measure ¹	Up to 10 pF 60 Hz to 1 kHz	0.47 % of reading + 0.01 pF	GenRad 1689M Digibridge
	(10 to 100) pF 60 Hz to 1 kHz 100 pF to 1 μ F 60 Hz to 1 kHz (1 to 100) μ F 60 Hz to 1 kHz 100 μ F to 1 mF 60 Hz to 1 kHz	0.06 % of reading + 0.01 pF 0.02 % of reading + 0.01 pF 0.03 % of reading + 0.02 pF 0.24 % of reading + 0.02 pF	
Capacitance – Source ¹ (Fixed Artifacts)	(0.1 to 0.5) nF 100 Hz to 1 kHz	0.65 pF	Arco SS32 Standard Capacitor Kit
	0.5 nF to 1.4 μ F 100 Hz to 1 kHz	0.13 pF	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Capacitance – Source ¹ (Simulation)	190 pF to 1.1 nF (1.1 to 3.3) nF (3.3 to 11) nF (11 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 (110 to 330) μF 330 μF to 1.1 mF (1.1 to 3.3) mF (3.3 to 11) mF (11 to 33) mF (33 to 110) mF	3.9 pF/nF + 7.8 pF 3.9 pF/nF + 7.8 pF 2.1 pF/nF + 7.8 pF 2.1 pF/nF + 78 pF 2.1 pF/nF + 0.23 nF 2.1 nF/μF + 0.78 nF 2.1 nF/μF + 2.3 nF 2.1 nF/μF + 7.8 nF 3.2 nF/μF + 23 nF 3.6 nF/μF + 78 nF 3.6 nF/μF + 0.23 μF 3.6 μF/mF + 0.78 μF 3.6 μF/mF + 2.3 μF 3.6 μF/mF + 7.8 μF 6.1 μF/mF + 23 μF 9 μF/mF + 78 μF	Fluke 5520A Multiproduct Calibrator
Inductance – Measure ¹	60 Hz to 1 kHz (1 to 10) mH 10 mH to 1 H	0.03 % of reading + 0.1 μH 0.03 % of reading + 1.4 μH	GenRad 1689M Digibridge
Inductance – Source ¹ (Fixed Artifacts)	1 kHz 1 mH 10 mH 100 mH	0.12 % of reading 0.12 % of reading 0.12 % of reading	Standard Inductors
Electrical Simulation of Thermocouple Indicating Devices – Measure/Source ¹	Type B (250 to 350) °C (350 to 445) °C (445 to 580) °C (580 to 750) °C (750 to 1 000) °C (1 000 to 1 820) °C Type E (-270 to -245) °C (-245 to -195) °C (-195 to -155) °C (-155 to -90) °C (-90 to 0) °C (0 to 15) °C (15 to 890) °C (890 to 1 000) °C	1.2 °C 0.9 °C 0.71 °C 0.55 °C 0.45 °C 0.35 °C 1.6 °C 0.24 °C 0.12 °C 0.095 °C 0.08 °C 0.076 °C 0.064 °C 0.074 °C	Ectron 1140A Thermocouple Calibrator/Simulator

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Electrical Simulation of Thermocouple Indicating Devices – Measure/Source ¹	Type J		Ectron 1140A Thermocouple Calibrator/Simulator
	(-210 to -180) °C	0.15 °C	
	(-180 to -120) °C	0.12 °C	
	(-120 to -50) °C	0.093 °C	
	(-50 to 990) °C	0.08 °C	
	(990 to 1 200) °C	0.094 °C	
	Type K		
	(-270 to -255) °C	2.5 °C	
	(-255 to -195) °C	0.85 °C	
	(-195 to -115) °C	0.16 °C	
	(-115 to -55) °C	0.12 °C	
	(-55 to 1 000) °C	0.087 °C	
	(1 000 to 1 372) °C	0.096 °C	
	Type N		
	(-270 to -260) °C	5.4 °C	
	(-260 to -200) °C	1.5 °C	
	(-200 to -140) °C	0.29 °C	
	(-140 to -70) °C	0.18 °C	
	(-70 to 25) °C	0.14 °C	
	(-25 to 160) °C	0.12 °C	
	(160 to 1 300) °C	0.11 °C	
	Type R		
	(-50 to -30) °C	0.8 °C	
	(-30 to 45) °C	0.69 °C	
	(45 to 160) °C	0.49 °C	
	(160 to 380) °C	0.35 °C	
	(380 to 775) °C	0.3 °C	
	(775 to 1 768) °C	0.26 °C	
	Type S		
	(-50 to -30) °C	0.76 °C	
	(-30 to 45) °C	0.68 °C	
	(45 to 105) °C	0.49 °C	
	(105 to 310) °C	0.41 °C	
	(310 to 615) °C	0.35 °C	
	(615 to 1 768) °C	0.31 °C	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Electrical Simulation of Thermocouple Indicating Devices – Measure/Source ¹	Type T (-270 to -255) °C (-255 to -240) °C (-240 to -210) °C (-210 to -150) °C (-150 to -40) °C (-40 to 100) °C (100 to 400) °C	1.9 °C 0.6 °C 0.36 °C 0.22 °C 0.15 °C 0.095 °C 0.08 °C	Ectron 1140A Thermocouple Calibrator/Simulator
Scope Voltage – Source ¹ DC Signal into 50 Ω into 1 MΩ	(-5.0 to 5.0) V (-200 to 200) V	0.023 % of reading + 19 μV 0.023 % of reading + 19 μV	Fluke 9500B Oscilloscope Calibrator
Scope Voltage – Source ¹ Square Wave into 50 Ω into 1 MΩ	10 Hz to 10 kHz 40 μVp-p to 1 mVp-p 10 Hz to 100 kHz 1 mVp-p to 5 Vp-p 10 Hz to 10 kHz 40 μVp-p to 1 mVp-p 10 Hz to 100 kHz 1 mVp-p to 200 Vp-p	0.78 % of reading + 7.8 μV 0.08 % of reading + 7.8 μV 0.78 % of reading + 7.8 μV 0.08 % of reading + 7.8 μV	Fluke 9500B Oscilloscope Calibrator
Scope – Time Markers ¹ 100 mVp-p to 1 Vp-p (into 50 Ω) Square Wave Sine Wave Pulse Triangle Wave	9.009 1 ns to 83 μs 83 μs to 55 s 450.5 ps to 9.009 ns 900.91 ns to 83 μs 83 μs to 55 s 900.91 ns to 83 μs 83 μs to 55 s	0.19 μs/s 2.3 μs/s 0.19 μs/s 0.19 μs/s 2.3 μs/s 0.19 μs/s 2.3 μs/s	Fluke 9500B Oscilloscope Calibrator
Scope Rise Time – Source ^{1,4} (into 50 Ω) 10 Hz to 2 MHz	5 mVp-p to 3 Vp-p 500 ps (Nominal) 150 ps (Nominal)	290 ps 34 ps	Fluke 9500B Oscilloscope Calibrator with Fluke 9530 Active Head

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Scope Leveled Sine Wave – Source ¹ (50 kHz Ref. Frequency) into 50 Ω	50 kHz to 10 MHz	1.2 % of reading	Fluke 9500B Oscilloscope Calibrator with Fluke 9530 Active Head
Scope Bandwidth/Flatness – Source ¹ into VSWR (1.2:1) (wrt Reference Frequency)	5 mVp-p to 5 Vp-p 100 Hz to 300 MHz (300 to 550) MHz 5 mVp-p to 3 Vp-p 550 MHz to 1.1 GHz (1.1 to 2.5) GHz 5 mVp-p to 2 Vp-p (2.5 to 3.2) GHz	1.6 % of reading 1.9 % of reading 2.7 % of reading 3.1 % of reading 3.1 % of reading	Fluke 9500B Oscilloscope Calibrator with Fluke 9530 Active Head
Scope Input Impedance – Measure ¹	(10 to 40) Ω (40 to 90) Ω (90 to 150) Ω (50 to 800) k Ω 800 k Ω to 1.2 M Ω (1.2 to 12) M Ω	0.39 % of reading 0.083 % of reading 0.39 % of reading 0.39 % of reading 0.083 % of reading 0.39 % of reading	Fluke 9500B Oscilloscope Calibrator
Scope Input Capacitance – Measure ¹	(1 to 35) pF (35 to 95) pF	1.6 % of reading + 0.19 pF 2.3 % of reading + 0.19 pF	Fluke 9500B/3200 Oscilloscope Calibrator
DC Power – Source ¹ (0.33 to 330) mA (0.33 to 3) A (3 to 20.5) A	11 μ W to 1.1 mW 1.1 mW to 110 mW 0.11W to 110 W 110 W to 330 W 11 W to 110 mW 0.11 W to 990 W 1 W to 3 kW 0.099 W to 0.99 W 0.99 W to 6.8 kW 6.8 W to 20.5 kW	0.02 % of reading 0.03 % of reading 0.02 % of reading 0.02 % of reading 0.04 % of reading 0.05 % of reading 0.01 % of reading 0.09 % of reading 0.07 % of reading 0.04 % of reading	Fluke 5520A Multiproduct Calibrator

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Power – Source ^{1,2} (PF=1) (45 to 65) Hz			
(3.3 to 9) mA	(0.11 to 3) mW	0.13 % of reading	Fluke 5520A Multiproduct Calibrator
	3.0 mW to 9.0 W	0.08 % of reading	
(9 to 33) mA	(0.3 to 10) mW	0.09 % of reading	
	10 mW to 33 W	0.08 % of reading	
(33 to 90) mA	(1 to 30) mW	0.07 % of reading	
	30 mW to 90 W	0.06 % of reading	
(90 to 330) mA	(3 to 100) mW	0.09 % of reading	
	100 mW to 300 W	0.08 % of reading	
(0.33 to 0.9) A	(11 to 300) mW	0.07 % of reading	
	300 mW to 900 W	0.08 % of reading	
(0.9 to 2.2) A	30 mW to 0.72 W	0.09 % of reading	
	0.72 W to 2 kW	0.08 % of reading	
(2.2 to 4.5) A	80 mW to 1.4 W	0.09 % of reading	Fluke 5520A Multiproduct Calibrator
	1.4 W to 4.5 kW	0.18 % of reading	
(4.5 to 20.5) A	150 mW to 6.7 W	0.17 % of reading	
	6.7 W to 20 kW	0.17 % of reading	
LF Phase – Source ¹	(0 to 180)°		
	(10 to 65) Hz	0.1°	Fluke 5520A Multiproduct Calibrator
	(65 to 500) Hz	0.2°	
	500 Hz to 1 kHz	0.4°	
	(1 to 5) kHz	1.9°	
	(5 to 10) kHz	3.9°	
	(10 to 20) kHz	7.8°	

Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
RF Absolute Power – Measure (50 Ω Load) 100 kHz to 4.2 GHz	(-30 to 20) dBm 1 μ W to 100 mW	1.7 % of reading	Agilent 437 RF Power Meter, Agilent 8482A Power Sensor

Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Total Harmonic Distortion – Measure 5 Hz to 600 kHz Fundamental Input Voltage: < 30 V Level: (0.3 to 100) % 0.1 % Input Voltage: > 30 V Level: (0.3 to 100) % 0.1 %	10 Hz to 1 MHz (1 to 3) MHz (10 to 20) Hz (20 to 30) Hz 30 Hz to 300 kHz (300 to 500) kHz 500 kHz to 1.2 MHz	3.5 % Distortion 6.9 % Distortion 14 % Distortion 6.9 % Distortion 3.5 % Distortion 6.9 % Distortion 14 % Distortion	Agilent 334A Distortion Analyzer
	10 Hz to 300 kHz (300 to 500) kHz 500 kHz to 3 MHz (10 to 20) Hz (20 to 30) Hz 30 Hz to 300 kHz (300 to 500) kHz 500 kHz to 1.2 MHz	3.5 % Distortion 6.9 % Distortion 14 % Distortion 14 % Distortion 6.9 % Distortion 3.5 % Distortion 6.9 % Distortion 14 % Distortion	
Total Harmonic Distortion	(-110 to 0) dBm 100 Hz to 1.5 GHz	1.8 dB	Rigol DSA815 Spectrum Analyzer

Length – Dimensional Metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Gage Blocks ³	(0.05 to 1) in (1 to 4) in	(1.5 + 1.4L) μin (0.7 + 1.9L) μin	Federal Gage Block Comparator, Grade 1 Gage Blocks
	(1 to 10) mm (10 to 100) mm	(0.028 + 4X) μm (0.075 + 1.5X) μm	
Angles ³	(0 to 75)°	5.3"	Angle Blocks, Master Square, Surface Plate
	90°	1.2"	

Length – Dimensional Metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Angle Measuring Devices ³ (Protractors, Inclinometers, Squares, Angle Gages)	(0.000 001 6 to 5)° (5 to 20)° (20 to 35)° (35 to 45)° (45 to 60)° (60 to 75)° (75 to 85)° 90°	9.7" 10.7" 13" 15.7" 23.5" 47" 141" 1.2"	Comparison to 10-inch Sine Plate, Gage Blocks, Surface Plate Master Square
Calipers ^{1,3} (Outside, Inside, Depth & Step)	Up to 8 in (8 to 48) in	(20 + 5L) μin (13 + 7L) μin	Gage Blocks
Micrometers ^{1,3} (Outside, Inside, & Depth)	Up to 8 in (8 to 48) in	(20 + 5L) μin (13 + 7L) μin	Gage Blocks
Anvil Flatness ¹	Up to 3 in	6.7 μin	Optical Flats
Length Single Axis ³ Outside Dimension	Up to 1 in (1 to 10) in	33 μin (33 + 3L) μin	Supermicrometer Model C
Height Gages ^{1,3}	Up to 8 in (8 to 44) in	(30 + 2L) μin (10 + 4L) μin	Gage Blocks
Height – Measure ^{1,3}	Up to 8 in (8 to 44) in	(37 + 2L) μin (11 + 4L) μin	Comparison to Gage Blocks using Test Indicator with Electronic Amplifier
Indicators ^{1,3}	Up to 6 in	(4 + 7L) μin	Comparison to Gage Blocks or to Supermicrometer Model C
Parallelism & Straightness ³	Up to 3 in (3 to 24) in	(20 + 3L) μin (30 + 3L) μin	Gage Amplifier, Surface Plate
Pin Gages (Outside Diameter)	Up to 1 in	33 μin	Laser Micrometer
Plug Gages ³ Outside Diameter	Up to 1 in (1 to 6) in	48 μin (46 + 2L) μin	Supermicrometer Model C
Thread Wires	(2 to 120) TPI (0.008 to 0.5) in	35 μin	Supermicrometer Model C

Length – Dimensional Metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Thread Plugs ³ (60 ° Thread) Pitch Diameter	Up to 1 in (1 to 4) in (4 to 6) in	82 µin 84 µin 88 µin	Thread Wires, Supermicrometer Model C
Major Diameter	Up to 1 in (1 to 6) in	36 µin (36 + 3L) µin	
Measuring Tapes, Rulers ^{1,2}	Up to 1 ft (1 to 3) ft (3 to 1 000) ft	(463 + 2L) µin (410 + 6L) µin (18L) µin	Single-axis Vision System
Laser Micrometers ^{1,3}	Up to 1 in	(13 + 3L) µin	Master Gage Pins
Optical Comparators ¹ (Linearity)	(0.05 to 12) in X-Axis Y-Axis X-Y Axis	200 µin 200 µin 260 µin	Glass Scale, Cylindrical Square

Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Force Gages – Tension and Compression ¹	(0 to 500) lbf	0.025 % of reading + 0.000 15 lbf	NIST Class F Weights
	(50 to 500) lbf (500 to 2 000) lbf (2 000 to 5 000) lbf (5 000 to 10 000) lbf (10 000 to 25 000) lbf (25 000 to 50 000) lbf (50 000 to 100 000) lbf	0.31 lbf 0.19 lbf 2.3 lbf 1.5 lbf 4 lbf 0.024 % of reading + 18 lbf 0.024 % of reading + 66 lbf	Interface Gold System

Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Mass Determination (Metric)	30 kg 25 kg 20 kg 10 kg 5 kg 2 kg 1 kg 500 g 200 g 100 g 50 g 20 g 10 g 5 g 2 g 1 g	33 mg 33 mg 19 mg 9 mg 3.7 mg 3.3 mg 1.1 mg 0.37 mg 0.18 mg 0.23 mg 97 µg 70 µg 35 µg 21 µg 27 µg 29 µg	Echelon III
Mass Determination (Metric)	500 mg 200 mg 100 mg 50 mg 20 mg 10 mg 5 mg 2 mg 1 mg	17 µg 17 µg 16 µg 16 µg 16 µg 16 µg 16 µg 16 µg 16 µg	Echelon III
Mass Determination (Avoirdupois)	50 lb 30 lb 20 lb 10 lb 5 lb 3 lb 2 lb 1 lb 8 oz 4 oz 2 oz 1 oz 0.5 oz	45 mg 45 mg 45 mg 8.2 mg 8.2 mg 7.3 mg 6.8 mg 6.8 mg 6.8 mg 2.31 mg 2.31 mg 2.31 mg 2.31 mg	Echelon III

Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Rockwell Hardness and Superficial Testers ¹	HRC High Middle Low HRBW High Middle Low	0.53 HRC 0.73 HRC 0.92 HRC 1.2 HRBW 1.2 HRBW 1.3 HRBW	Indirect Verification per ASTM E18 using Test Blocks
Durometers ¹ Spring Force Only Types A, B, O Types C, D, DO	Up to 822 g Up to 4 536 g	2.3 g 7.2 g	Partial Verification per ASTM D2240 using Duro Calibrator
Torque – Measure ¹	2.5 ozf·in to 1 000 lbf·ft (1 000 to 2 000) lbf·ft	0.50 % of reading 0.39 % of reading	CDI Torque Measuring System
Torque Measuring Equipment	2.5 ozf·in to 500 lbf·ft 500 lbf·in to 1 000 lbf·ft	0.06 % of reading 0.07 % of reading	Torque Wheels/Arms, NIST Class F Weights
Torque Angle ¹	45° 90° 135° 180°	0.38° 0.39° 0.36° 0.36°	Torque Angle Fixture
Scales and Balances ^{1,5} (SI)	30 kg 25 kg 20 kg 10 kg 5 kg 2 kg 1 kg 500 g 200 g 100 g 50 g 20 g 10 g 5 g 2 g 1 g	36 mg 33 mg 27 mg 7.2 mg 4.5 mg 6.3 mg 1 mg 0.35 mg 0.27 mg 0.38 mg 0.21 mg 0.16 mg 83 µg 42 µg 35 µg 21 µg	ASTM E617 Class 1 Weights and internal calibration procedure utilized in the calibration of the weighing device.

Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Scales and Balances ^{1,5} (SI)	500 mg 200 mg 100 mg 50 mg 20 mg 10 mg 5 mg 2 mg 1 mg	14 µg 14 µg 11 µg 11 µg 11 µg 11 µg 11 µg 11 µg 11 µg	ASTM E617 Class 1 Weights and internal calibration procedure utilized in the calibration of the weighing device.
Scales and Balances ^{1,5} (Avoirdupois)	(1 to 500) lb	0.013 % of reading	NIST Class F Weights and internal calibration procedure utilized in the calibration of the weighing device.
Pneumatic Absolute Pressure – Source	(0.1 to 30) psia (30 to 1 000) psia	0.002 4 psi 0.007 % of reading + 0.000 5 psi	DHI PPC4 Pressure Controller, RPM4 Indicator
Pneumatic Pressure – Source ¹	(-14.2 to 30) psig (30 to 1 000) psig	0.002 psi 0.007 % of reading + 0.000 1 psi	DHI PPC4 Pressure Controller, RPM4 Indicator
	(0.14 to 0.36) inH ₂ O	0.06 % of reading + 44 µinH ₂ O	Ametek RK-1100 WC Deadweight Tester
	(-36 to -22) inH ₂ O (-22 to 22) inH ₂ O (22 to 60) inH ₂ O (60 to 72) inH ₂ O (72 to 804) inH ₂ O	0.009 % of reading + 0.000 15 inH ₂ O 0.002 2 inH ₂ O 0.009 % of reading + 0.000 15 inH ₂ O 0.007 inH ₂ O 0.009 % of reading + 0.000 15 inH ₂ O	DHI PPC4 Pressure Controller
Hydraulic Pressure – Source ¹	(10 to 16 000) psig	0.01 % of reading	Pressurements P3125-3 Hydraulic Deadweight Tester

Thermodynamic

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Relative Humidity – Measure ¹	(10 to 30) °C (20 to 80) %RH	1.3 %RH	Vaisala HMI41/HMP46 Temperature/Humidity Probe with Indicator
Relative Humidity – Source	(-10 to 15) °C (10 to 75) %RH (75 to 95) %RH (15 to 35) °C (10 to 95) %RH (35 to 70) °C (10 to 50) %RH (50 to 75) %RH (75 to 95) %RH	0.5 %RH 0.65 %RH 0.5 %RH 0.5 %RH 0.7 %RH 0.85 %RH	Humidity Generator
Temperature – Measure ¹	(-195 to 0) °C (0 to 420) °C (420 to 600) °C	0.001 % of reading + 0.012 °C 0.001 % of reading + 0.026 °C 0.001 % of reading + 0.036 °C	Hart 5628 Secondary PRT with Indicator
Temperature – Source	(-80 to 100) °C (100 to 200) °C	0.022 °C 0.023 °C	Liquid Bath, Hart 5628 Secondary PRT with Indicator
	(200 to 300) °C (300 to 600) °C	0.07 °C 0.085 °C	Dry Block Calibrator, Hart 5628 Secondary PRT with Indicator
Infrared Temperature Measuring Equipment	(-15 to 0) °C (0 to 50) °C (50 to 100) °C (100 to 120) °C (120 to 200) °C (200 to 350) °C (350 to 500) °C	0.8 °C 0.65 °C 0.7 °C 0.76 °C 0.95 °C 1.6 °C 2.1 °C	Black Body Source (flat plate) $\epsilon = 0.95, \lambda = (8 \text{ to } 14) \mu\text{m}$

Time and Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Frequency – Source/Measure	10 MHz	5.9 nHz/Hz	Rubidium Oscillator
Frequency – Source/Measure ¹	10 MHz	29 nHz/Hz	Universal Frequency Counter
Time Measuring Equipment (Error)	Up to 599 s/mon	58 ms/day	Vibrograf TM-4500 Timometer

Time and Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Rise Time – Measure ¹	800 ps to 1 μ s	0.93 ns	Tektronix TDS 5054 Digital Oscilloscope
AC Duty Cycle – Source ¹ Square-wave < 3.3 V _{p-p} Freq: 0.1 Hz to 100 kHz	(1 to 10) % Duty Cycle 10 μ s to 100 s (10 to 49) % Duty Cycle 10 μ s to 100 s 50 % Duty Cycle 10 μ s to 100 s (51 to 90) % Duty Cycle 10 μ s to 100 s (91 to 99) % Duty Cycle 10 μ s to 100 s	0.039 % of reading + 78 ns 0.62 % of reading + 78 ns 0.001 6 % of reading + 78 ns 0.62 % of reading + 78 ns 0.039 % of reading + 78 ns	Fluke 55xxA Multiproduct Calibrator

DIMENSIONAL MEASUREMENT

1 Dimensional

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Dimensional Measurement – 1D	X-axis Up to 1 in (1 to 3) in (3 to 6) in Y-axis Up to 2 in (2 to 3) in (3 to 5) in	190 μ in 300 μ in 430 μ in 290 μ in 400 μ in 520 μ in	Optical Comparator utilized as Reference for Length Measurement Inspection.

2 Dimensional

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Dimensional Measurement – 2D	Up to 180°	0.008°	Optical Comparator utilized as Reference for Angle Measurement Inspection.

2 Dimensional

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
	Up to 1 in (1 to 3) in (3 to 6) in	350 μ in 610 μ in 610 μ in	Optical Comparator utilized as Reference for Radius Measurement Inspection.

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. The uncertainties shown are for the most favorable conditions. There is an increase in uncertainty that corresponds to the laboratory's AC voltage and current uncertainties at different frequencies other than the ones shown. Power factors (PF) other than the one shown contribute to the power uncertainty. PF is related to the cosine of phase. Therefore, uncertainties track the laboratory's phase uncertainty closely at PF near one but are magnified heavily as PF approaches zero. The lab may also report reactive power, apparent power, and power factor under this accreditation. If needed, contact laboratory for more information regarding uncertainties at frequency and power factor combinations other than the ones shown.
3. L = length in inches or millimeters; " = arc-second.
4. The stated uncertainty is the laboratory's ability to source a fast rise pulse that is approximately 500 ps or 150 ps. In the typical application of measuring rise time of an oscilloscope, this value is one of the contributing factors, but other factors are derived from the DUT.
5. 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.
6. This scope is formatted as part of a single document including Certificate of Accreditation No. AC-2489.07.



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