CERTIFICATE OF ACCREDITATION

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Hereby attests that

Transcat – New England
149 River Street, Suite 3
Andover, MA 01810

Fulfills the requirements of

ISO/IEC 17025:2017

and national standards

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

In the field 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.

Jason Stine, Vice President

Expiry Date: 07 September 2027
Certificate Number: AC-2489.04

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)
ANSI/NCSL Z540.3-2006 (R2013)

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CALIBRATION AND DIMENSIONAL MEASUREMENT

Valid to: **September 7, 2027** Certificate Number: **AC-2489.04**

CALIBRATION

Chemical Quantities

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
pH – Measuring Equipment [1,10]	4 pH 7 pH 10 pH	0.011 pH 0.01 pH 0.012 pH	Comparison to Accredited Buffer Solutions

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current – Source [1]	Up to 220 µA (10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (0.22 to 2.2) mA (10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	 0.031 % of reading + 16 nA 0.019 % of reading + 10 nA 0.015 % of reading + 8 nA 0.03 % of reading + 12 nA 0.11 % of reading + 65 nA 0.03 % of reading + 40 nA 0.018 % of reading + 35 nA 0.014 % of reading + 35 nA 0.021 % of reading + 0.11 µA 0.11 % of reading + 0.65 µA	Comparison to Fluke 5720A Multiproduct Calibrator

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current – Source [1]	(2.2 to 22) mA (10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (22 to 220) mA (10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (0.22 to 2.2) A 20 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	 0.039 % of reading + 0.4 µA 0.019 % of reading + 0.35 µA 0.014 % of reading + 0.35 µA 0.021 % of reading + 0.55 µA 0.11 % of reading + 5 µA 0.033 % of reading + 4 µA 0.018 % of reading + 3.5 µA 0.014 % of reading + 2.5 µA 0.021 % of reading + 3.5 µA 0.11 % of reading + 10 µA 0.027 % of reading + 35 µA 0.046 % of reading + 80 µA 0.7 % of reading + 0.16 mA	Comparison to Fluke 5720A Multiproduct Calibrator
AC Current – Source [1]	(2.2 to 11) A 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (11 to 20.5) A (45 to 100) Hz 100 Hz to 1 kHz (1 to 5) kHz	 0.048 % of reading + 0.17 mA 0.096 % of reading + 0.38 mA 0.36 % of reading + 0.75 mA 0.11 % of reading + 3.9 mA 0.14 % of reading + 3.9 mA 2.7 % of reading + 3.9 mA	Comparison to Fluke 5720A Multiproduct Calibrator, Fluke 5725A Amplifier
AC Current – Source [1]	(20.5 to 40) A (45 to 100) Hz 100 Hz to 1 kHz (1 to 5) kHz	 0.14 % of reading + 11 mA 0.17 % of reading + 11 mA 3.3 % of reading + 11 mA	Comparison to Two Fluke 5522A Multiproduct Calibrators in Parallel
AC Current – Source [1]	(40 to 100) A (50 to 100) Hz 100 Hz to 1 kHz (1 to 5) kHz	 0.12 % of reading + 0.35 A 0.24 % of reading + 0.47 A 0.35 % of reading + 0.7 A	Comparison to Fluke 5522A Multiproduct Calibrator, Valhalla 2555A Amplifier
AC Current – Source [1] (Extended Frequency Ranges)	(29 to 330) µA (10 to 30) kHz (0.33 to 3.3) mA (10 to 30) kHz	 1.5 % of reading + 0.31 µA 0.92 % of reading + 0.47 µA	Comparison to Fluke 5522A Multiproduct Calibrator

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current – Source [1] (Extended Frequency Ranges)	(3.3 to 33) mA (10 to 30) kHz (33 to 330) mA (10 to 30) kHz	 0.37 % of reading + 3.1 µA 0.37 % of reading + 0.16 mA	Comparison to Fluke 5522A Multiproduct Calibrator
AC Clamp-on Ammeters (Toroidal Type) Transformer Type Sensor [1]	(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	 0.35 % of reading + 0.25 A 0.94 % of reading + 50 µA 0.34 % of reading + 0.13 A 1.2 % of reading + 0.23 A	Comparison to Fluke 5522A Multiproduct Calibrator, 5500A/COIL 50-turn Coil
AC Clamp-on Ammeters (Non-Toroidal Type) Hall Effect Sensor [1]	(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	 0.6 % of reading + 0.29 A 1 % of reading + 0.29 A 0.57 % of reading + 1 A 1.3 % of reading + 1.1 A	Comparison to Fluke 5522A Multiproduct Calibrator, 5500A/COIL 50-turn Coil
AC Current – Measure [1]	Up to 100 µA (10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 1 kHz (0.1 to 1) mA (10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz (1 to 10) mA (10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz (10 to 100) mA (10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz (0.1 to 1) A (10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz	 0.46 % of reading + 35 nA 0.18 % of reading + 35 nA 0.072 % of reading + 35 nA 0.072 % of reading + 35 nA 0.46 % of reading + 0.23 µA 0.17 % of reading + 0.23 µA 0.07 % of reading + 0.23 µA 0.038 % of reading + 0.23 µA 0.46 % of reading + 2.3 µA 0.17 % of reading + 2.3 µA 0.07 % of reading + 2.3 µA 0.038 % of reading + 2.3 µA 0.46 % of reading + 23 µA 0.17 % of reading + 23 µA 0.07 % of reading + 23 µA 0.037 % of reading + 23 µA 0.46 % of reading + 0.23 mA 0.19 % of reading + 0.23 mA 0.096 % of reading + 0.23 mA 0.12 % of reading + 0.23 mA	Comparison to Agilent 3458A/002 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 3) A 40 Hz to 1 kHz (1 to 5) kHz (3 to 30) A 40 Hz to 1 kHz (1 to 5) kHz	0.18 % of reading + 2.1 mA 0.2 % of reading + 2.1 mA 0.35 % of reading + 2.3 mA 5.8 % of reading + 2.3 mA	Comparison to Agilent 3458A/002 8.5 Digit Multimeter, Agilent 34330A Current Shunt
DC Current – Source [1]	(0.22 to 220) µA (0.22 to 2.2) mA (2.2 to 22) mA (22 to 220) mA (0.22 to 2.2) A	41 µA/A + 6 nA 36 µA/A + 7 nA 35 µA/A + 40 nA 48 µA/A + 0.7 µA 0.2 mA/A + 12 µA	Comparison to Fluke 5720A/EP Multiproduct Calibrator
DC Current – Source [1]	(2.2 to 11) A	0.4 mA/A + 12 µA	Comparison to Fluke 5720A/EP Multiproduct Calibrator, Fluke 5725A Amplifier
DC Current – Source [1]	(11 to 20.5) A	0.84 mA/A + 0.58 mA	Fluke 5522A/11 Multiproduct Calibrator
DC Current – Source [1]	(20.5 to 40) A	0.12 % of reading + 0.82 mA	Comparison to Two Fluke 5522A Multiproduct Calibrators in Parallel
DC Current – Source [1]	(40 to 100) A	0.037 % of reading + 35 mA	Comparison to Fluke 5522A Multiproduct Calibrator, Valhalla 2555A Amplifier
DC Clamp-on Ammeters (Non-Toroidal Type) Transformer Type Sensor [1]	(20 to 150) A (150 to 1 000) A	0.51 % of reading + 0.14 A 0.51 % of reading + 0.5 A	Comparison to Fluke 5522A Multiproduct Calibrator, 5500A/COIL 50-turn Coil

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
DC Current – Source/Measure [1]	Up to 100 µA (0.1 to 1) mA (1 to 10) mA (10 to 100) mA (0.1 to 1) A	33 µA/A + 0.92 nA 29 µA/A + 5.8 nA 29 µA/A + 58 nA 46 µA/A + 0.58 µA 0.013 % of reading + 12 µA	Comparison to Agilent 3458A/002 8.5 Digit Multimeter w/ Current Source
DC Current – Measure [1]	Up to 10 µA (10 to 100) µA (0.1 to 1) mA (1 to 10) mA (10 to 100) mA (0.1 to 1) A	0.13 mA/A + 58 pA 0.12 mA/A + 0.58 nA 0.12 mA/A + 5.8 nA 0.12 mA/A + 58 nA 0.12 mA/A + 0.58 µA 0.12 mA/A + 5.8 µA	Comparison to Agilent 3458A/002 8.5 Digit Multimeter
DC Current – Measure [1]	(1 to 10) A (10 to 100) A (100 to 300) A	0.14 mA/A + 58 µA 0.59 mA/A + 0.58 mA 0.12 % of reading + 1.7 mA	Comparison to Guideline 9711A Current Shunt, Agilent 3458A/002 8.5 Digit Multimeter
DC Current – Measure [1]	(300 to 1 000) A	0.12 % of reading + 5.8 mA	Comparison to Metermaster 1000-100 Current Shunt, Agilent 3458A/002 8.5 Digit Multimeter
AC Voltage – Source [1]	Up to 2.2 mV (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 (2.2 to 22) mV (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	 0.16 % of reading + 4 µV 0.1 % of reading + 4 µV 0.078 % of reading + 4 µV 0.13 % of reading + 4 µV 0.17 % of reading + 5 µV 0.33 % of reading + 10 µV 0.47 % of reading + 20 µV 0.58 % of reading + 20 µV 0.042 % of reading + 4 µV 0.03 % of reading + 4 µV 0.014 % of reading + 4 µV 0.03 % of reading + 4 µV 0.058 % of reading + 5 µV 0.12 % of reading + 10 µV 0.16 % of reading + 20 µV 0.27 % of reading + 20 µV	Comparison to Fluke 5720A Multiproduct Calibrator

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Source [1]	(22 to 220) mV		Comparison to Fluke 5720A Multiproduct Calibrator
	(10 to 20) Hz	0.028 % of reading + 12 µV	
	(20 to 40) Hz	0.011 % of reading + 7 µV	
	40 Hz to 20 kHz	0.008 5 % of reading + 7 µV	
	(20 to 50) kHz	0.021 % of reading + 7 µV	
	(50 to 100) kHz	0.047 % of reading + 17 µV	
	(100 to 300) kHz	0.091 % of reading + 20 µV	
	(300 to 500) kHz	0.14 % of reading + 25 µV	
	500 kHz to 1 MHz	0.28 % of reading + 45 µV	
	(0.22 to 2.2) V		
	(10 to 20) Hz	0.027 % of reading + 40 µV	
	(20 to 40) Hz	0.01 % of reading + 15 µV	
	40 Hz to 20 kHz	0.004 8 % of reading + 8 µV	
	(20 to 50) kHz	0.008 % of reading + 10 µV	
	(50 to 100) kHz	0.012 % of reading + 30 µV	
	(100 to 300) kHz	0.043 % of reading + 80 µV	
	(300 to 500) kHz	0.1 % of reading + 0.2 mV	
	500 kHz to 1 MHz	0.18 % of reading + 0.3 mV	
	(2.2 to 22) V		
	(10 to 20) Hz	0.028 % of reading + 0.4 mV	
	(20 to 40) Hz	0.01 % of reading + 0.15 mV	
	40 Hz to 20 kHz	0.004 9 % of reading + 50 µV	
	(20 to 50) kHz	0.008 3 % of reading + 0.1 mV	
	(50 to 100) kHz	0.012 % of reading + 0.2 mV	
	(100 to 300) kHz	0.03 % of reading + 0.6 mV	
	(300 to 500) kHz	0.1 % of reading + 2 mV	
	500 kHz to 1 MHz	0.17 % of reading + 3.2 mV	
	(22 to 220) V		
	(10 to 20) Hz	0.028 % of reading + 4 mV	
	(20 to 40) Hz	0.01 % of reading + 1.5 mV	
	40 Hz to 20 kHz	0.005 6 % of reading + 0.6 mV	
	(20 to 50) kHz	0.009 3 % of reading + 1 mV	
	(50 to 100) kHz	0.016 % of reading + 2.5 mV	
	(100 to 300) kHz	0.09 % of reading + 16 mV	
	(300 to 500) kHz	0.44 % of reading + 40 mV	
	500 kHz to 1 MHz	0.8 % of reading + 40 mV	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Source [1]	(220 to 750) V		Comparison to Fluke 5720A Multiproduct Calibrator, Fluke 5725A Amplifier
	(30 to 50) kHz	0.061 % of reading + 11 mV	
	(50 to 100) kHz	0.23 % of reading + 45 mV	
	(750 to 1 100) V		
	40 Hz to 1 kHz	0.011 % of reading + 4 mV	
	(1 to 20) kHz	0.017 % of reading + 6 mV	
	(20 to 30) kHz	0.061 % of reading + 11 mV	
AC Voltage – Measure [1]	Up to 10 mV		Comparison to Agilent 3458A/002 8.5 Digit Multimeter
	(1 to 40) Hz	0.04 % of reading + 3.5 µV	
	40 Hz to 1 kHz	0.03 % of reading + 1.2 µV	
	(1 to 20) kHz	0.04 % of reading + 1.2 µV	
	(20 to 50) kHz	0.15 % of reading + 1.2 µV	
	(50 to 100) kHz	0.59 % of reading + 1.2 µV	
	(100 to 300) kHz	4.6 % of reading + 2.3 µV	
	300 kHz to 1 MHz	1.5 % of reading + 5.8 µV	
	1 MHz to 4 MHz	8.1 % of reading + 8.1 µV	
	(10 to 100) mV		
	(1 to 40) Hz	0.013 % of reading + 4.6 µV	
	40 Hz to 1 kHz	0.009 7 % of reading + 2.3 µV	
	(1 to 20) kHz	0.017 % of reading + 2.3 µV	
	(20 to 50) kHz	0.038 % of reading + 2.3 µV	
	(50 to 100) kHz	0.093 % of reading + 2.3 µV	
	(100 to 300) kHz	0.36 % of reading + 12 µV	
	300 kHz to 1 MHz	1.2 % of reading + 12 µV	
	(1 to 2) MHz	1.8 % of reading + 12 µV	
	(2 to 4) MHz	4.7 % of reading + 81 µV	
	(4 to 8) MHz	4.7 % of reading + 92 µV	
	(8 to 10) MHz	17 % of reading + 0.12 mV	
	(0.1 to 1) V		
	(1 to 40) Hz	0.008 8 % of reading + 46 µV	
	40 Hz to 1 kHz	0.008 3 % of reading + 23 µV	
	(1 to 20) kHz	0.017 % of reading + 23 µV	
	(20 to 50) kHz	0.036 % of reading + 23 µV	
	(50 to 100) kHz	0.093 % of reading + 23 µV	
	(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	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Measure [1]	(1 to 10) V		Comparison to Agilent 3458A/002 8.5 Digit Multimeter
	(1 to 40) Hz	0.009 5 % 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	
AC Voltage – Measure [1]	Up to 1 mV		Comparison to Rohde & Schwarz URE3 RMS Voltmeter
	100 kHz to 1 MHz	2 % of reading + 2.4 µV	
	(1 to 3) MHz	3.8 % of reading + 2.4 µV	
	(3 to 10) MHz	10 % of reading + 2.4 µV	
	(10 to 20) MHz	25 % of reading + 2.4 µV	
	(1 to 3) mV		
	100 kHz to 1 MHz	1 % of reading + 2 µV	
	(1 to 3) MHz	3.8 % of reading + 2 µV	
	(3 to 10) MHz	11 % of reading + 2 µV	
	(10 to 20) MHz	25 % of reading + 2 µV	
	(3 to 100) mV		
	100 kHz to 1 MHz	0.98 % of reading + 3 µV	
	(1 to 3) MHz	1.9 % of reading + 3 µV	
	(3 to 10) MHz	3.2 % of reading + 3 µV	
	(10 to 20) MHz	7.6 % of reading + 3 µV	
	(20 to 30) MHz	16 % of reading + 3 µV	

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 10) kV 60 Hz	0.14 % of reading	Comparison to Vitrek 4700 High Voltage Meter
AC High Voltage – Measure [1]	(10 to 30) kV 60 Hz	0.095 % of reading + 17 V	Comparison to Vitrek 4700 High Voltage Meter, Vitrek HVP-35 High Voltage Probe
AC High Voltage – Measure [1]	(30 to 50) kV 60 Hz	0.16 % of reading + 4 V	Comparison to Vitrek 4700 High Voltage Meter, Vitrek HVP-70 High Voltage Probe
AC High Voltage – Measure [1]	(50 to 70) kV 60 Hz	0.23 % of reading + 1.4 V	Comparison to Vitrek 4700 High Voltage Meter, Vitrek HVP-100 High Voltage Probe
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	8.5 µV/V + 0.4 µV 5.1 µV/V + 0.7 µV 4 µV/V + 2.5 µV 3.9 µV/V + 4 µV 6.2 µV/V + 40 µV	Comparison to Fluke 5720A Multiproduct Calibrator
DC Voltage – Source [1]	220 V to 1.1 kV	7.6 µV/V + 0.4 mV	Comparison to Fluke 5720A Multiproduct Calibrator, Fluke 5725A Amplifier
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 µV/V + 0.58 µV 5.3 µV/V + 0.58 µV 5.3 µV/V + 0.58 µV 7.7 µV/V + 35 µV 15 µV/V + 0.12 mV 18 µV/V + 0.12 mV 21 µV/V + 0.12 mV	Comparison to Agilent 3458A/002 8.5 Digit Multimeter
DC High Voltage – Measure [1]	(1 to 10) kV	0.054 % of reading	Comparison to Vitrek 4700 High Voltage Meter

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
DC High Voltage – Measure [1]	(10 to 35) kV	0.093 % of reading	Comparison to Vitrek 4700 High Voltage Meter, Vitrek HVP-35 High Voltage Probe
DC High Voltage – Measure [1]	(35 to 70) kV	0.11 % of reading + 8.1 V	Comparison to Vitrek 4700 High Voltage Meter, Vitrek HVP-70 High Voltage Probe
DC High Voltage – Measure [1]	(70 to 100) kV	0.17 % of reading + 1.3 V	Comparison to Vitrek 4700 High Voltage Meter, Vitrek HVP-100 High Voltage Probe
Resistance – Source [1] (Artifact)	333 µΩ 1 mΩ 10 mΩ 100 mΩ 1 Ω 10 Ω 100 Ω 1 kΩ 10 kΩ	0.12 % of reading 0.59 mΩ/Ω 0.14 mΩ/Ω 0.12 mΩ/Ω 0.12 mΩ/Ω 0.12 mΩ/Ω 0.12 mΩ/Ω 0.12 mΩ/Ω 0.13 mΩ/Ω	Comparison to Guideline 9711A Multi-tap Current Shunt
Resistance – Source [1] (Fixed Artifact)	25 Ω	9.4 µΩ/Ω	Comparison to IET SRL-25 Standard Resistor
Resistance – Source [1,2] (Variable Artifact)	(0.1 to 1) MΩ (1 to 10) MΩ (10 to 100) MΩ (0.1 to 1) GΩ (1 to 10) GΩ (10 to 100) GΩ (0.1 to 1) TΩ	0.18 % of reading + 2.3 Ω 0.21 % of reading + 120 Ω + 1.2 Ω/V 0.22 % of reading + 1.2 kΩ + 12 Ω/V 0.3 % of reading + 32 kΩ + 0.12 kΩ/V 0.58 % of reading + 0.48 MΩ + 1.2 kΩ/V 1.2 % of reading + 62 MΩ + 23 kΩ/V 2.6 % of reading + 15 GΩ + 0.58 MΩ/V	Comparison to IET HRRS-B-7-100k-5kV High Resistance Decade Box

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Resistance – Source/Measure [1]	Up to 10 Ω (10 to 100) Ω (0.1 to 1) kΩ (1 to 10) kΩ (10 to 100) kΩ (0.1 to 1) MΩ (1 to 10) MΩ (10 to 100) MΩ (0.1 to 1) GΩ	18 µΩ/Ω + 58 µΩ 15 µΩ/Ω + 0.58 mΩ 12 µΩ/Ω + 0.58 mΩ 12 µΩ/Ω + 5.8 mΩ 13 µΩ/Ω + 58 mΩ 21 µΩ/Ω + 2.3 Ω 62 µΩ/Ω + 0.12 kΩ 0.059 % of reading + 1.2 kΩ 0.82 % of reading + 12 kΩ	Comparison to Decade Resistance Box, HP 3458A 8.5 Digit Multimeter
Resistance – Measure [1]	Up to 1 Ω (1 to 10) Ω 10 Ω to 10 kΩ (10 to 40) kΩ (40 to 100) kΩ (100 to 500) kΩ	42 µΩ/Ω + 30 nΩ 16 µΩ/Ω 13 µΩ/Ω 16 µΩ/Ω 23 µΩ/Ω 81 µΩ/Ω	Comparison to Fluke 1595A Super Thermometer
AC Resistance – Measure [1]	1 kHz Up to 6.25 Ω 6.25 Ω to 100 kΩ (100 to 410) kΩ	 0.7 % of reading + 10 mΩ 0.024 % of reading + 10 mΩ 0.3 % of reading + 10 mΩ	Comparison to General Radio 1689-9700 LCR Meter
Capacitance – Source [1,3] (Artifacts)	100 Hz to 1 kHz (0.1 to 0.5) nF 0.5 nF to 1.4 µF	 0.58 pF 0.12 % of reading + 0.02 pF	Comparison to Arco SS32 Precision Standard Capacitor Set
Capacitance – Source [1] (Simulation)	10 Hz to 10 kHz (0.19 to 3.3) pF 10 Hz to 1 kHz (3.3 to 11) nF (11 to 110) nF (110 to 330) nF (10 to 600) Hz (0.33 to 1.1) µF (10 to 300) Hz (1.1 to 3.3) µF (10 to 150) Hz (3.3 to 11) µF (10 to 120) Hz (11 to 33) µF	 0.39 % of reading + 6.1 pF 0.21 % of reading + 6.1 pF 0.21 % of reading + 61 pF 0.21 % of reading + 0.18 nF 0.2 % of reading + 0.61 nF 0.2 % of reading + 1.9 nF 0.2 % of reading + 6.1 nF 0.32 % of reading + 18 nF	Comparison to Fluke 5522A Multiproduct Calibrator

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Capacitance – Source [1] (Simulation)	(10 to 80) Hz (33 to 110) µF DC to 50 Hz (110 to 330) µF DC to 20 Hz (0.33 to 1.1) mF DC to 6 Hz (1.1 to 3.3) mF DC to 2 Hz (3.3 to 11) mF DC to 0.6 Hz (11 to 33) mF DC to 0.2 Hz (33 to 110) mF	 0.35 % of reading + 61 nF 0.35 % of reading + 0.18 µF 0.35 % of reading + 0.61 µF 0.35 % of reading + 1.8 µF 0.35 % of reading + 6.1 µF 0.58 % of reading + 18 µF 0.85 % of reading + 61 µF	Comparison to Fluke 5522A Multiproduct Calibrator
Capacitance – Measure [1]	1 kHz (1 to 10) pF (10 to 100) pF (0.1 to 1) µF (1 to 100) µF (0.1 to 1) mF	 0.47 % of reading + 0.05 pF 0.058 % of reading + 0.05 pF 0.024 % of reading + 0.05 pF 0.035 % of reading 0.24 % of reading	Comparison to GR 1689-9700 Precision Impedance Meter
Inductance – Source [1] (Artifacts)	1 kHz 50 mH 100 mH	 0.12 % of reading + 1.4 µH 0.12 % of reading + 1.4 µH	Comparison to Standard Inductors
Inductance – Measure [1]	1 kHz (1 to 10) mH 10 mH to 10 H	 0.024 % of reading + 0.1 µH 0.024 % of reading + 1.4 µH	Comparison to GR 1689-9700 Precision Impedance Meter
Electrical Simulation of Thermocouple Indicating Devices – Measure/Source [1]	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 Type J (-210 to -180) °C (-180 to -120) °C (-120 to -50) °C (-50 to 990) °C (990 to 1 200) °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 0.15 °C 0.12 °C 0.093 °C 0.08 °C 0.094 °C	Comparison to 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 K		Comparison to Ectron 1140A Thermocouple Calibrator/Simulator
	(-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	
	Type T		
	(-270 to -255) °C	1.9 °C	
	(-255 to -240) °C	0.6 °C	
	(-240 to -210) °C	0.36 °C	
	(-210 to -150) °C	0.22 °C	
	(-150 to -40) °C	0.15 °C	
	(-40 to 100) °C	0.095 °C	
	(100 to 400) °C	0.08 °C	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Power – Source [1,4]			Comparison to Fluke 5522A Multiproduct Calibrator
PF = 1			
(3.3 to 9) mA	(10 to 65) Hz		
	(0.11 to 3) mW	0.13 % of reading	
	3 mW to 9 W	0.077 % of reading	
(9 to 33) mA	(10 to 65) Hz		
	(0.3 to 10) mW	0.089 % of reading	
	10 mW to 33 W	0.077 % of reading	
(33 to 90) mA	(10 to 65) Hz		
	(1 to 30) mW	0.071 % of reading	
	30 mW to 90 W	0.057 % of reading	
(90 to 330) mA	(10 to 65) Hz		
	(3 to 100) mW	0.089 % of reading	
	100 mW to 300 W	0.078 % of reading	
(0.33 to 0.9) A	(10 to 65) Hz		
	(11 to 300) mW	0.071 % of reading	
	(0.3 to 900) W	0.081 % of reading	
(0.9 to 2.2) A	(10 to 65) Hz		
	(30 to 720) mW	0.089 % of reading	
	0.72 W to 2 kW	0.079 % of reading	
(2.2 to 4.5) A	(10 to 65) Hz		
	80 mW to 1.4 W	0.088 % of reading	
	1.4 W to 4.5 kW	0.18 % of reading	
(4.5 to 20.5) A	(10 to 65) Hz		
	150 mW to 20 kW	0.17 % of reading	
DC Power – Source [1]			Comparison to Fluke 5522A Multiproduct Calibrator
(0.33 to 330) mA	11 µW to 1.1 mW	0.024 % of reading	
	1.1 mW to 0.11 W	0.027 % of reading	
	(0.11 to 110) W	0.024 % of reading	
	(110 to 330) W	0.018 % of reading	
(0.33 to 3) A	11 µW to 110 mW	0.044 % of reading	
	(0.11 to 990) W	0.053 % of reading	
	(0.99 to 3) kW	0.009 6 % of reading	
(3 to 20.5) A	99 mW to 0.99 W	0.088 % of reading	
	0.99 W to 6.8 kW	0.07 % of reading	
	(6.8 to 20.5) kW	0.04 % of reading	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Phase – Source [1]	Up to 180° (10 to 65) Hz (65 to 500) Hz 500 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (10 to 20) kHz	 0.11° 0.2° 0.4° 1.9° 3.9° 7.8°	Comparison to Fluke 5522A Multiproduct Calibrator
Oscilloscopes [1,5,6]			Comparison to Fluke 5522A/11 Multiproduct Calibrator with 1.1 GHz Scope Option
Amplitude DC			
into 50 Ω load	(-6 to 6) V	0.22 % of reading + 31 µV	
into 1 MΩ load	(-130 to 130) V	0.12 % of reading + 31 µV	
Square Wave			
into 50 Ω load	10 Hz to 100 kHz 1 mV p-p to 6.6 Vp-p	0.22 % of reading + 31 µV	
into 1 MΩ load	10 Hz to 1 kHz 1 mV p-p to 130 Vp-p	0.14 % of reading + 31 µV	
	(1 to 10) kHz 1 mV p-p to 130 Vp-p	0.22 % of reading + 31 µV	
Time Markers			
into 50 Ω load	1 ns to 20 ms	0.000 2 % of reading	
	50 ms	2.3 µs	
	0.1 s	7.6 µs	
	0.2 s	28 µs	
	0.5 s	0.16 ms	
	1 s	0.62 ms	
	2 s	2.4 ms	
	5 s	15 ms	
Rise Time – Source			
into 50 Ω load	5 mVp-p to 2.5 Vp-p		
Rate: 1 kHz to 2 MHz	250 ps (nominal)	50 ps	
Rate: (2 to 10) MHz	250 ps (nominal)	50 ps	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Oscilloscopes [1,5,6]			
Leveled Sine Wave			
into 50 Ω load	5 mVp-p to 5.5 Vp-p		
	50 kHz	1.8 % of reading + 0.23 mV	
	50 kHz to 100 MHz	2.8 % of reading + 0.23 mV	
	(100 to 300) MHz	3.2 % of reading + 0.23 mV	
	(300 to 600) MHz	4 % of reading + 0.23 mV	
	5 mVp-p to 3.5 Vp-p		
	(600 to 1 100) MHz	5.5 % of reading + 0.23 mV	
Bandwidth/Flatness (50 kHz Reference)			
into 50 Ω load	5 mVp-p to 5.5 Vp-p		
	50 kHz to 100 MHz	1.4 % of reading + 78 µV	
	(100 to 300) MHz	1.8 % of reading + 78 µV	Comparison to Fluke 5522A/11 Multiproduct Calibrator with 1.1 GHz Scope Option
	(300 to 600) MHz	3.2 % of reading + 78 µV	
	5 mVp-p to 3.5 Vp-p		
	(600 to 1 100) MHz	4 % of reading + 78 µV	
Input Impedance – Measure			
into 50 Ω load	(40 to 60) Ω	0.082 % of reading	
into 1 MΩ load	(0.5 to 1.5) MΩ	0.081 % of reading	
Input Capacitance – Measure	(5 to 50) pF	3.9 % of reading + 0.39 pF	
Waveform Generator Amplitude (Sine, Square, Triangle)	10 Hz to 10 kHz		
into 50 Ω load	1.8 mVp-p to 2.5 Vp-p	2.3 % of reading + 78 µV	
into 1 MΩ load	1.8 mVp-p to 55 Vp-p	2.3 % of reading + 78 µV	
Frequency (Sine, Square, Triangle)	10 Hz to 10 kHz	0.001 9 % of reading + 12 mHz	

Length – Dimensional Metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Angle Measuring Devices Protractors, Inclinometers, Squares, Angle Gages [7]	0.005 6" to 5° (5 to 20)° (20 to 35)° (35 to 45)° (45 to 60)° (60 to 75)° (75 to 85)° 90°	6.5″ 7.4″ 9.4″ 11.7″ 18″ 37″ 111″ 3.7″	Comparisons to 10 in Sine Bar, Gage Blocks Granite Master Square
Calipers and Micrometers [1,7] (Outside, Inside, Depth)	(0.01 to 1) in (1 to 9) in	13 µin (9 + 4*L*) µin	Comparison to Gage Blocks
Calipers and Micrometers [1,7] (Outside, Inside, Depth)	(4 to 15) in (15 to 40) in	(10 + 4*L*) µin (14 + 4*L*) µin	Comparison to Long Gage Blocks
Anvil Flatness [1]	Up to 4 in	5 µin	Comparison to Optical Flats
Anvil Parallelism [1]	Up to 1 in	16 µin	Comparison to Optical Parallels
Bore Gages [7]	(0.04 to 1) in (1 to 5) in	83 µin (82 + 1.9*L*) µin	Comparison to Characterized Ring Gages
Dial/Digital Indicators, LVDT's, Gage Amplifiers [7]	Up to 1 in (1 to 2) in (2 to 6) in	(6.1 + 1.1*L*) µin (4.2 + 3*L*) µin (0.9 + 4.8*L*) µin	Comparison to Pratt & Whitney Labmaster®
Single Axis Measurement – Outside [7]	Up to 1 in (1 to 7) in (7 to 12) in	(6 + 1*L*) µin (4.3 + 3.5*L*) µin (11 + 4*L*) µin	Comparison to Pratt & Whitney Labmaster®
Single Axis Measurement – Outside [7]	(12 to 24) in	(1+ 5.8*L*) µin	Comparison to Pratt & Whitney Supermicrometer®
Single Axis Measurement – Inside [7]	(0.04 to 1) in (1 to 2.5) in (2.5 to 10) in (10 to 14) in	(9 + 1*L*) µin (10 + 3*L*) µin (14 + 3*L*) µin (25 + 3*L*) µin	Comparison to Pratt & Whitney Labmaster®
Micrometer Heads	Up to 1 in (1 to 2) in	29 µin 31 µin	Comparison to Gage Amplifier, Gage Blocks
Height Measuring Equipment [1,7]	Up to 12 in (12 to 24) in	(63 + 2*L*) µin (37 + 4.2*L*) µin	Comparison to Gage Blocks, Surface Plate
Parallelism & Straightness	Up to 36 in	89 µin	Comparison to Gage Amplifier, Surface Plate

Length – Dimensional Metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Crimp Tools – Crimp Height	Up to 1 in	0.001 in	Comparison to Crimp Height Micrometer
Squareness [7]	90°	(160 + 4.8*L*) µin	Comparison to Granite Square, Surface Plate, Gage Amplifier
Length Measuring Equipment – Linear Displacement [7]	Up to 12 ft	(1 + 2.1*L*) µin	Comparison to Laser Interferometer
Thread Wire Sets	(2 to 120) TPI (0.008 33 to 0.5) in	12 µin	Comparison to Pratt & Whitney Supermicrometer®
Cylindrical Plug Gages [7] (Outside Diameter)	Up to 5 in	(8.8 + 2.9*L*) µin	Comparison to Pratt & Whitney Supermicrometer®
Cylindrical Ring Gages [7] (Inside Diameter)	(0.04 to 0.5) in (0.5 to 1) in (1 to 3) in (3 to 11) in	(8.1 + 1.5*L*) µin (8.5 + 1*L*) µin (1.5 + 8.4*L*) µin (16.6 + 4.2*L*) µin	Comparison to Pratt & Whitney Supermicrometer®
Laser Micrometers [7]	(0.011 to 1) in	(13 + 1.8*L*) µin	Comparison to Master Cylindrical Pin Gages
Rulers [7]	Up to 12 in (12 to 18) in	(200 + 50*L*) µin (210 + 71*L*) µin	Comparison to OGP Smartscope Flash 302 Measuring System
Thread Plug Gages [7] Pitch Diameter, 60 ° Thread Major Diameter	Up to 4 in Up to 4 in	83 µin (8.8 + 2.9*L*) µin	Comparison to Pratt & Whitney Supermicrometer®, Thread Measuring Wires
Thread Ring Gages Inner Pitch Diameter	Up to 4 in	83 µin	Tactile Fit, Thread Plug Uncertainty

Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Balances and Scales [1,8] (SI)	(1 to 5) g (5 to 10) g (10 to 20) g (20 to 50) g (50 to 100) g (100 to 150) g (150 to 250) g (250 to 300) g (300 to 320) g	40 µg 59 µg 89 µg 0.15 mg 0.31 mg 0.35 mg 0.64 mg 0.69 mg 0.7 mg	ASTM E617 Class 1 weights and internal calibration procedure utilized for the calibration of the weighing system.
Balances and Scales [1,8] (SI)	(1 to 5) g (5 to 10) g 10 g to 10 kg (10 to 15) kg (15 to 20) kg (20 to 31) kg	63 µg 87 µg 0.000 59 % of reading 0.000 44 % of reading 0.000 42 % of reading 0.000 31 % of reading	ASTM E617 Class 2 weights and internal calibration procedure utilized for the calibration of the weighing system.
Balances and Scales [1,8] (SI)	(2 to 5) mg (5 to 10) mg (10 to 20) mg (20 to 50) mg (50 to 100) mg (100 to 200) mg (200 to 500) mg (0.5 to 1) g (1 to 2) g (2 to 5) g (5 to 10) g (10 to 20) g (20 to 50) g (50 to 100) g (100 to 200) g (200 to 210) g	51 µg 53 µg 57 µg 63 µg 70 µg 80 µg 92 µg 0.12 mg 0.15 mg 0.21 mg 0.29 mg 0.41 mg 0.70 mg 1.2 g 1.4 g 1.7 g	ASTM E617 Class 3 weights and internal calibration procedure utilized for the calibration of the weighing system.
Balances and Scales [1,8] (SI)	(1 to 2) g (2 to 5) g (5 to 10) g (10 to 20) g (20 to 50) g (50 to 100) g (100 to 150) g (150 to 200) g (200 to 210) g	0.13 mg 0.15 mg 0.17 mg 0.20 mg 0.28 mg 0.59 mg 0.65 mg 0.74 mg 0.78 mg	NIST Class S weights and internal calibration procedure utilized for the calibration of the weighing system.

Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Balances and Scales [1,8]			
Avoirdupois	0.5 lb	0.024 % of reading	NIST Class F weights and internal calibration procedure utilized for the calibration of the weighing system.
	1 lb	0.018 % of reading	
	(1 to 700) lb	0.012 % of reading	
SI	227 g	0.024 % of reading	
	454 g	0.018 % of reading	
	(0.454 to 318) kg	0.012 % of reading	
Durometers [7]			Direct Verification per ASTM D2240-02B using Durometer Calibrator
Spring Force			
Type A, B, E, O	Up to 100 Duro	0.57 Duro	
Type D, C, DO	Up to 100 Duro	0.51 Duro	
Indenter Dimensions			OGP Smartscope Flash 302
Length	Up to 1 in	(85 + 50*L*) µin	
Angle	Up to 40°	0.006°	
Radius	Up to 5 in	(440 + 50*L*) µin	
Force Measuring Equipment [1]	(0.5 to 100) lb	0.025 % of reading	Comparison to NIST Class F Weights
Mass Determination (SI)	1 g	10 µg	Double Substitution Method; Reference Weights, Electronic Balances
	2 g	7.8 µg	
	3 g	12 µg	
	5 g	26 µg	
	10 g	37 µg	
	20 g	60 µg	
	30 g	70 µg	
	50 g	69 µg	
	100 g	0.13 mg	
	200 g	0.16 mg	
	300 g	0.21 mg	
	500 g	0.26 mg	
	1 kg	0.5 mg	
Mass Determination (SI)	1 g	17 µg	Single Substitution Method; Reference Weights, Electronic Balances
	2 g	14 µg	
	3 g	21 µg	
	5 g	28 µg	
	10 g	41 µg	
	20 g	64 µg	
	30 g	78 µg	
	50 g	78 µg	

Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Mass Determination (SI)	100 g 200 g 300 g 500 g 1 kg 10 kg 20 kg 25 kg	0.16 mg 0.22 mg 0.28 mg 0.45 mg 0.94 mg 0.29 g 0.29 g 0.32 g	Single Substitution Method; Reference Weights, Electronic Balances
Mass Determination (Avoirdupois)	20 lb 25 lb 50 lb	0.000 64 lb 0.000 64 lb 0.000 71 lb	Single Substitution Method; Reference Weights, Electronic Balances
Absolute Pressure Devices (Pneumatic)	Up to 25 psia (25 to 500) psia	0.001 9 psi 0.006 8 % of reading	Comparison to Ruska 7250xi Pressure Controller/Calibrator
Absolute Pressure Devices (Hydraulic)	(50 to 150) psia (150 to 15 000) psia	0.014 % of reading 0.013 % of reading	Comparison to Ametek T150 Deadweight Tester w/ Ruska 7250xi Pressure Controller/Calibrator
Gage Pressure Devices (Pneumatic)	(-60 to -22) inH_2O (-22 to 22) inH_2O (22 to 60) inH_2O (60 to 72) inH_2O (72 to 804) inH_2O	0.009 % of reading + 0.000 15 inH_2O 0.002 2 inH_2O 0.009 % of reading + 0.000 15 inH_2O 0.006 7 inH_2O 0.009 % of reading + 0.000 15 inH_2O	Comparison to DHI PPC4 Pressure Controller
Gage Pressure Devices (Pneumatic)	(-15 to 25) psig (25 to 500) psig	0.001 7 psi 0.006 5 % of reading	Comparison to Ruska 7250xi Pressure Controller/Calibrator
Gage Pressure Devices (Hydraulic)	(50 to 150) psig (150 to 15 000) psig	0.012 % of reading + 0.012 psi 0.012 % of reading	Comparison to Ametek T150 Deadweight Tester
Torque Measuring Devices [1] (Wrenches, Electronic, etc.)	(3.2 to 80) ozf·in (4 to 50) lbf·in (30 to 1 000) lbf·in (20 to 250) lbf·ft (60 to 600) lbf·ft	1.2 % of reading + 0.002 3 ozf·in 0.7 % of reading 0.4 % of reading 0.4 % of reading 0.37 % of reading	Comparison to Torque Calibrator

Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Torque Calibration Systems (Analyzers, Transducers, etc.)	2.5 ozf·in to 50 lbf·ft	0.12 % of reading	Comparison to Torque Wheels, NIST Class F Weights

Thermodynamic

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
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 70) %RH (70 to 95) %RH	 0.5 %RH 0.65 %RH 0.5 %RH 0.5 %RH 0.7 %RH 0.85 %RH	Comparison to Thunder Scientific 2500 Two-Pressure Humidity Generator
Relative Humidity – Measure [1]	(10 to 60) °C (10 to 90) %RH	 1.3 %RH	Direct Measure using Vaisala Thermohygrometer
SPRT/PRT/RTD Probes [9]	-195 °C	5.4 mK	Comparison to Fluke 1595A Super Thermometer, PRT, $NBPLN_2$
SPRT/PRT/RTD Probes [9]	-78 °C -38.8 °C	4.4 mK 4 mK	Comparison to Fluke 1595A Super Thermometer, PRT, Precision Bath
SPRT/PRT/RTD Probes [9]	0.01 °C	2.9 mK	Direct Measure using Triple Point of Water (Fixed Cell)
SPRT/PRT/RTD Probes [9]	29.8 °C 100 °C 156 °C 232 °C 300 °C 420 °C 500 °C	3.3 mK 3.9 mK 7.6 mK 8.2 mK 8.8 mK 9.9 mK 14 mK	Comparison to Fluke 1595A Super Thermometer, PRT, Precision Bath

Thermodynamic

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Temperature – Measure [1]	(-195 to 0) °C (0 to 660) °C	0.002 7 % of reading + 7.2 mK 0.002 7 % of reading + 10 mK	Comparison to Hart Scientific 5628 Secondary PRT, Black Stack
Temperature – Measure [1]	(660 to 1 200) °C	0.46 % of reading + 2.9 °C	Comparison to Druck DPI 620 Calibrator, Geo Corp Type N Thermocouple Probe

Time and Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Frequency Reference	10 MHz	5.8 nHz/Hz	Comparison to Stanford Research FS725 Rubidium Frequency Oscillator
Period – Source	(1 to 100) s	58 ns/s	Comparison to Keysight 33250A Function/Arbitrary Waveform Generator, Stanford Research FS725 Rubidium Frequency Oscillator
Period – Measure	(1 to 100) s	4.5 µs/s	Comparison to HP 53220A Universal Counter, Stanford Research FS725 Rubidium Frequency Oscillator
Frequency – Source	1 Hz to 80 MHz	58 nHz/Hz	Comparison to Keysight 33250A Function/Arbitrary Waveform Generator, Stanford Research FS725 Rubidium Frequency Oscillator

Time and Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Frequency – Measure	(1 to 10) Hz (10 to 100) Hz 100 Hz to 1kHz 1 kHz to 350 MHz	4.5 µHz 1.8 µHz 6.7 µHz 6 nHz/Hz + 0.26 µHz	Comparison to HP 53220A Universal Counter, Stanford Research FS725 Rubidium Frequency

DIMENSIONAL MEASUREMENT

2 Dimensional

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
2-D Measurements [7]			
Angle	(0 to 360)°		
	Up to 2 in to angle	0.007 2°	OGP Smartscope Flash 302 Measuring System utilized in the Dimensional Measurements of Customer Gages and Fixtures.
	(2 to 16) in to angle	(0.000 5*L*) + 0.006 2°	
Perpendicularity	Up to 12 in	(120 + 48*L*) µin	
	(12 to 18) in	(123 + 71*L*) µin	
Radius	Up to 5 in	(440 + 50*L*) µin	

3 Dimensional

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
3-D Measurements [7]	X-axis: Up to 12 in Y-axis: Up to 12 in Z-axis: Up to 10 in	(85 + 50*L*) µin (85 + 50*L*) µin (140 + 75*L*) µin	OGP Smartscope Flash 302 Measuring System utilized in the Dimensional Measurements of Customer Gages and Fixtures.

3 Dimensional

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
3-D Measurements [7]	X-axis: (12 to 18) in Y-axis: (12 to 18) in Z-axis: Up to 10 in	(120 + 71*L*) µin (120 + 71*L*) µin (140 + 75*L*) µin	OGP Smartscope Flash 302 Measuring System utilized in the Dimensional Measurements of Customer Gages and Fixtures.

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. 230 V maximum up to 100 kΩ; 1 kV maximum up to 1 MΩ; 5 kV maximum up to 1 TΩ.
3. As frequency deviates from the listed values, uncertainty may be higher than stated. If needed, contact laboratory for more information regarding uncertainties at frequency and range combinations other than the ones shown.
4. 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.
5. As frequency & amplitude deviate from the listed values, uncertainty may be higher than stated. If needed, contact laboratory for more information regarding uncertainties at frequency and range combinations other than the ones shown.
6. The stated uncertainty is the laboratory's ability to source a fast rise pulse that is approximately 250 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. The known source rise time is mathematically removed from the total measured rise time measured on the DUT.
7. ″ = arc-second; L = length in inches;
8. 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.
9. $NBPLN_2$ = boiling point of liquid nitrogen.
10. The value in the Range column represents the Nominal value. The Actual Value will be utilized at the time of calibration along with the inherent Measurement Uncertainty.
11. Unless otherwise specified in the far-right hand column, the calibration procedure being utilized by the laboratory was written internally.
12. The legal entity for this location is Transcat, Inc.
13. This scope is formatted as part of a single document including Certificate of Accreditation No. AC-2489.04.

Jason Stine, Vice President