



SCOPE OF ACCREDITATION TO ISO/IEC 17025:2005,
ANSI/NCSL Z540-1-1994

NATIONAL TECHNICAL SYSTEMS – (NTS)
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CALIBRATION

Valid To: December 31, 2019

Certificate Number: 0214.42

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory to perform the following calibrations¹:

I. Dimensional

Parameter/Equipment	Range	CMC ^{2,6} (±)	Comments
Micrometers & Depth Gages	Up to 24 in	$(60 + 5L + 0.6R) \mu\text{in}$	Gage blocks
Calipers	Up to 24 in	$(95 + 5L + 0.6R) \mu\text{in}$	Gage blocks
Height Gages	Up to 24 in	$(90 + 0.6R) \mu\text{in}$	Gage blocks
Dial Indicators	Up to 2 in	$(60 + 0.6R) \mu\text{in}$	Gage blocks

II. Electrical – DC/Low Frequency

Parameter/Equipment	Range	CMC ^{2, 5, 7} ($\pm$)	Comments
DC Voltage – Generate	Up to 220 mV 2.2 V 11 V 22 V 220 V 1100 V	10 μ V/V + 0.4 μ V 4 μ V/V + 0.4 μ V 6 μ V/V + 4.0 μ V 7 μ V/V + 4.0 μ V 6 μ V/V + 40 μ V 8 μ V/V + 400 μ V	Fluke 5730A
DC Voltage – Measure	Up to 100 mV (0.1 to 1) V (1 to 10) V (10 to 100) V (100 to 1000) V	13 μ V/V + 0.3 μ V 13 μ V/V + 0.3 μ V 14 μ V/V + 0.5 μ V 14 μ V/V + 40 μ V 19 μ V/V + 100 μ V	Agilent 3458A opt 002
DC Current – Generate	(2.2 to 20) A (20 to 120) A Up to 220 μ A 220 μ A 2.2 mA 22 mA 220 mA 2.2 A	0.1 % + 4.5 mA 0.02 % 0.005% + 6 nA 47 μ A/A + 6 nA 43 μ A/A + 7 nA 45 μ A/A + 40 nA 52 μ A/A + 0.7 nA 0.01 % + 12 nA	Wavetek 9100 Fluke 52120A Fluke 5730A
Clamp Meters (45 to 440) Hz	(0 to 1000) A	1.7 % + 900 mA	Fluke 5500 50-turn coil
DC Current – Measure	10 μ A to 10 mA (10 to 100) mA (0.1 to 1) A	31 μ A/A + 0.05 μ A 37 μ A/A + 0.5 μ A 0.012 % + 10 μ A	Agilent 3458A opt 002

Parameter/Equipment	Range	CMC ^{2, 5, 7} ($\pm$)	Comments
Resistance – Generate			
Fixed Points	1 Ω 1.9 Ω 10 Ω 19 Ω 100 Ω 190 Ω 1 k Ω 1.9 k Ω 10 k Ω 19 k Ω 100 k Ω 190 k Ω 1 M Ω 1.9 M Ω 10 M Ω 19 M Ω 100 M Ω	100 $\mu\Omega/\Omega$ 98 $\mu\Omega/\Omega$ 24 $\mu\Omega/\Omega$ 25 $\mu\Omega/\Omega$ 11 $\mu\Omega/\Omega$ 11 $\mu\Omega/\Omega$ 9 $\mu\Omega/\Omega$ 8 $\mu\Omega/\Omega$ 8 $\mu\Omega/\Omega$ 8 $\mu\Omega/\Omega$ 10 $\mu\Omega/\Omega$ 11 $\mu\Omega/\Omega$ 15 $\mu\Omega/\Omega$ 21 $\mu\Omega/\Omega$ 42 $\mu\Omega/\Omega$ 54 $\mu\Omega/\Omega$ 0.02 %	Fluke 5730A
Variable	Up to 11 Ω (11 to 33) Ω (33 to 110) Ω (110 to 330) Ω 330 Ω to 1.1k Ω (1.1 to 3.3) k Ω (3.3 to 33) k Ω (33 to 330) k Ω 330 k Ω to 3.3 M Ω (3.3 to 33) M Ω (33 to 110) M Ω (110 to 330) M Ω	0.02 % + 0.008 Ω 0.02 % + 0.015 Ω 0.01 % + 0.015 Ω 0.01 % + 0.015 Ω 0.02 % + 0.06 Ω 0.02 % + 0.06 Ω 0.01 % + 0.6 Ω 0.02 % + 6 Ω 0.02 % + 55 Ω 0.01 % + 55 Ω 0.6 % + 5.5 k Ω 0.6 % + 17 k Ω	Fluke 5500A
Resistance – Measure	(0.1 to 10) Ω (10 to 100) Ω 100 Ω to 1 k Ω (0.1 to 10) k Ω (10 to 100) k Ω (0.1 to 1) M Ω (1 to 10) M Ω (10 to 100) M Ω	21 $\mu\Omega/\Omega$ + 50 $\mu\Omega$ 18 $\mu\Omega/\Omega$ + 0.5 m Ω 11 $\mu\Omega/\Omega$ + 0.5 m Ω 11 $\mu\Omega/\Omega$ + 5 m Ω 11 $\mu\Omega/\Omega$ + 50 m Ω 17 $\mu\Omega/\Omega$ + 5 Ω 57 $\mu\Omega/\Omega$ + 200 Ω 0.052 % + 1 k Ω	Agilent 3458A opt 002

Parameter/Equipment	Range	CMC ² (±)	Comments
Electrical Simulation of Thermocouple Indicators –			
Type E	(-270 to -260) °C (-260 to -70) °C (-70 to 1000) °C	0.8 °C 0.7 °C 0.7 °C	Xitron 2000
Type J	(-210 to -140) °C (-140 to 760) °C	0.7 °C 0.7 °C	
Type K	(-140 to 1372) °C	0.7 °C	
Type T	(-200 to 100) °C (100 to 400) °C	0.7 °C 0.7 °C	

Parameter/Range	Frequency	CMC ^{2,7} (±)	Comments
AC Voltage – Generate			
(0 to 2.2) mV	(10 to 40) Hz 20 Hz to 40 kHz (0.04 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (0.5 to 1) MHz	0.03 % + 4 µV 0.03 % + 4 µV 0.02 % + 4 µV 0.03 % + 4 µV 0.06 % + 5 µV 0.11 % + 10 µV 0.15 % + 20 µV 0.28 % + 20 µV	Fluke 5730A
(2.2 to 22) mV	(10 to 20) Hz (20 to 40) Hz (0.04 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (0.5 to 1) MHz	0.03 % + 4 µV 0.02 % + 4 µV 0.01 % + 4 µV 0.03 % + 4 µV 0.06 % + 5 µV 0.13 % + 10 µV 0.79 % + 20 µV 0.83 % + 20 µV	Fluke 5730A

Parameter/Range	Frequency	CMC ^{2,5,7} (±)	Comments
AC Voltage – Generate (cont)			
(22 to 220) mV	(10 to 20) Hz (20 to 40) Hz (0.04 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (0.5 to 1) MHz	0.03 % + 12 µV 0.03 % + 7 µV 0.01 % + 7 µV 0.02 % + 7 µV 0.04 % + 17 µV 0.08 % + 20 µV 0.16 % + 25 µV 0.29 % + 45 µV	Fluke 5730A
(0.22 to 2.2) V	(10 to 20) Hz (20 to 40) Hz (0.04 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (0.5 to 1) MHz	0.04 % + 40 µV 0.02 % + 15 µV 0.01 % + 8 µV 0.01 % + 10 µV 0.02 % + 30 µV 0.04 % + 80 µV 0.11 % + 200 µV 0.81 % + 300 µV	
(2.2 to 22) V	(10 to 20) Hz (20 to 40) Hz (0.04 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (0.5 to 1) MHz	0.04 % + 400 µV 0.02 % + 150 µV 0.01 % + 50 µV 0.02 % + 100 µV 0.03 % + 200 µV 0.07 % + 600 µV 0.15 % + 2 mV 0.2 % + 3.2 mV	
(22 to 220) V	(10 to 20) Hz (20 to 40) Hz (0.04 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (0.5 to 1) MHz	0.04 % + 4 mV 0.02 % + 1.5 mV 0.02 % + 0.6 mV 0.01 % + 1 mV 0.02 % + 2.5 mV 0.1 % + 16 mV 0.45 % + 40 mV 0.82 % + 80 mV	
(220 to 1100) V	(15 to 50) Hz (0.5 to 1) kHz	0.04 % + 16 mV 0.01 % + 3.5 mV	

Parameter/Range	Frequency	CMC ^{2,5,7} (±)	Comments
AC Voltage – Measure			
Up to 10 mV	(40 to 100) Hz (0.1 to 1) kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.02 % + 0.03 % range 0.02 % + 0.011 % range 0.02 % + 0.011 % range 0.1 % + 0.011 % range 0.6 % + 0.011 % range	Agilent 3458A opt 002
(10 to 100) V	(40 to 100) Hz (0.1 to 1) kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz	87 µV/V + 0.04 % range 0.009 % + 0.02 % range 0.015 % + 0.02 % range 0.031 % + 0.02 % range 0.08 % + 0.02 % range	
100 V	(1 to 40) Hz (0.04 to 1) kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.022 % + 0.04 % range 0.021 % + 0.02 % range 0.021 % + 0.02 % range 0.036 % + 0.02 % range 0.13 % + 0.02 % range	
1000 V	(40 to 100) Hz (0.1 to 1) kHz (1 to 20) kHz	0.04 % + 0.04 % range 0.04 % + 0.02 % range 0.06 % + 0.02 % range	
AC Current – Generate			
(10.5 to 20) A	10 Hz to 3 kHz (3 to 10) kHz	0.5 % + 6.9 mA 1.1 % + 23 mA	Wavetek 9100
(10 to 220) µA	(10 to 200) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.04 % + 16 nA 0.02 % + 10 nA 0.02 % + 8 nA 0.03 % + 12 nA 0.13 % + 65 nA	Fluke 5730A

Parameter/Range	Frequency	CMC ^{2,5,7} (±)	Comments
AC Current – Generate (cont)			
220 µA 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	0.04 % + 4 nA 0.02 % + 35 nA 0.02 % + 35 nA 0.03 % + 110 nA 0.13 % + 650 nA	Fluke 5730A
(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	0.04 % + 400 nA 0.02 % + 350 nA 0.02 % + 350 nA 0.03 % + 550 nA 0.13 % + 5 µA	
(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	0.04 % + 4 µA 0.02 % + 3.5 µA 0.02 % + 2.5 µA 0.03 % + 3.5 µA 0.13 % + 10 µA	
220 mA to 2.2 A	20 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.03 % + 35 µA 0.05 % + 80 µA 0.71 % + 160 µA	
Clamp Meters (0 to 1000) A	(45 to 440) Hz	1.5 %	Fluke 5500 50-turn coil
AC Current – Measure			
Up to 100 µA	(20 to 45) Hz 45 Hz to 1 kHz	0.16 % + 30 nA 0.06 % + 30 nA	Agilent 3458A opt 002
(1 to 100) mA	(20 to 45) Hz (45 to 100) Hz (0.1 to 5) kHz	0.15 % + 20 µA 0.06 % + 20 µA 0.03 % + 20 µA	
100 mA to 1 A	(20 to 45) Hz (45 to 100) Hz (0.1 to 5) kHz	0.16 % + 0.2 mA 0.08 % + 0.2 mA 0.1 % + 0.2 mA	

III. Mechanical

Parameter/Equipment	Range	CMC ^{2,4} (±)	Comments
Torque Wrenches – Measure	(10 to 500) in·ozf (30 to 300) in·lbf (25 to 500) ft·lbf (500 to 2000) ft·lbf	2 % 2 % 1 % 2 %	Sturtevant Richmond system 5AC AKO TSD600
Scales & Balances	(100 to 200) g 200 g to 2 kg (2 to 10) kg (25 to 50) lb (50 to 100) lb (100 to 300) lb	2.3 mg 200 mg 1 g 0.014 lb 0.035 lb 0.078 lb	Verification with NIST S and ASTM Class 1 weights Verification with NIST Class F weights
Pressure Gauges & Transducers – Hydraulic Pneumatic	(5 to 15 000) psig (14.5 to 300) psig (1 to 24) in·H ₂ O	0.07 % 0.04 % 0.002 in·H ₂ O	Mansfield Green TQ150 GE Druck PACE6000 Hook gage w/ gage blocks
Vacuum Gauges	(0 to 750) torr	0.18 %	GE Druck PACE6000
Acceleration	(5 to 9) Hz (10 to 99) Hz 100 Hz (100 to 920) Hz 920 Hz to 5 kHz 5 Hz to 10 kHz	2.3 % 1.6 % 1.2 % 1.4 % 1.8 % 2.3 %	Standard accelerometer TMS9155C
Acceleration – Shock	(20 to 10 000) g	2.0 %	TMS9155C

IV. Thermodynamic

Parameter/Equipment	Range	CMC ^{2, 5} ($\pm$)	Comments
Relative Humidity – Measuring Equipment	(10 to 20) % RH (20 to 80) % RH (80 to 95) % RH	0.61 % RH 0.62 % RH 0.65 % RH	Thunder Scientific 2500
Temperature – Measuring Equipment			
Fixed Point	0 °C	0.1 °C	Hart Scientific 5699-S PRT and ice bath
Thermocouples –			
Type E	(0 to 400) °C	1.6 °C	Hart Scientific 5699-S PRT in dry block calibrator and/or Rosemount 910C oil bath and Agilent 3458A
Type J	(0 to 400) °C	1.5 °C	
Type K	(0 to 400) °C	1.4 °C	
Type T	(0 to 400) °C	0.8 °C	
RTDs			
Pt 385, 100 Ω	(0 to 400) °C	0.4 °C	opt 002 Scientific 2566 Black Stack
Temperature – Measure	(-200 to 600) °C	0.023 °C	Fluke 5699 SPRT

V. Time & Frequency

Parameter/Equipment	Frequency	CMC ² ($\pm$)	Comments
Frequency – Generate	DC to 500 MHz	6 parts in 10^{-11} Hz/Hz	Arbiter 1083B and multi-function calibrator
Stopwatches	Up to 24 Hrs	0.34 sec/day	Arbiter 1083B and multi-function calibrator

¹ This laboratory offers commercial calibration services.

² Calibration and Measurement Capability Uncertainty (CMC) is the smallest uncertainty of measurement that a laboratory can achieve within its scope of accreditation when performing more or less routine calibrations of nearly ideal measurement standards or nearly ideal measuring equipment. CMCs represent expanded uncertainties expressed at approximately the 95 % level of confidence, usually using a coverage factor of $k = 2$. The actual measurement uncertainty of a specific calibration performed by the laboratory may be greater than the CMC due to the behavior of the customer's device and to influences from the circumstances of the specific calibration.

⁴ In the statement of CMC, percentages are percent of reading, unless otherwise indicated.

⁵ Based on using the standard at the temperature the Agilent 3458A was calibrated ($t_{cal} \pm 5^{\circ}\text{C}$) and an auto calibration (ACAL) was performed within the previous 24 hours ($\pm 1^{\circ}\text{C}$ of ambient temperature). The CMC is expressed as either a specific value that covers the full range, a combination of the fraction of the reading/output plus a range specification, or as a combination of the fraction of the reading/output plus a fraction of the range specification. For factory traceability to NIST, add $5\text{ }\mu\text{A/A}$ additional error to AC/DC Current and $2\text{ }\mu\text{V/V}$ additional error for AC Voltage.

⁶ In the statement of CMC, L represents the nominal length of the device in inches; R represents the resolution of the device in microinches.

⁷ The measurands stated are generated using the indicated instrument (see Comments). This capability is suitable for the calibration of the devices intended to measure the measurand in the ranges indicated. CMCs are expressed as either a specific value that covers the full range or as a fraction of the reading plus a fixed floor specification.



Accredited Laboratory

A2LA has accredited

NATIONAL TECHNICAL SYSTEMS - HUNTSVILLE

Huntsville, AL

for technical competence in the field of

Calibration

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005 *General requirements for the competence of testing and calibration laboratories*. This laboratory also meets the requirements of ANSI/NCSLI Z540-1-1994 and R205 – Specific Requirements: Calibration Laboratory Accreditation Program. 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).



Presented this 21st day of February 2018.

A handwritten signature in black ink, appearing to read 'L. Sen', written over a horizontal line.

President and CEO
For the Accreditation Council
Certificate Number 0214.42
Valid to December 31, 2019

For the calibrations to which this accreditation applies, please refer to the laboratory's Calibration Scope of Accreditation.