



SCOPE OF ACCREDITATION TO ISO/IEC 17025:2017
& ANSI/NCSL Z540-1-1994

GREAT LAKES CALIBRATION, INC.
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CALIBRATION

Valid until: June 30, 2024

Certificate Number: 3312.01

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory to perform the following calibrations^{1, 6}:

I. Chemical

Parameter/Equipment	Range	CMC ^{2, 7} (±)	Comments
pH ³ – Measure	4 pH unit 7 pH unit 10 pH unit	0.03 pH 0.04 pH 0.04 pH	NIST traceable buffer solutions
Conductivity ³ – Measure	(1 to 10) μS/cm (50 to 100) μS/cm (500 to 1000) μS/cm (5000 to 10 000) μS/cm (10 000 to 100 000) μS/cm	0.46 μS/cm 2.3 μS/cm 23 μS/cm 46 μS/cm 360 μS/cm	NIST traceable conductivity solutions
Refractometers ³	(10, 20, 30, 60) % Brix	0.094 % Brix	Sucrose solutions

II. Dimensional

Parameter/Equipment	Range	CMC ^{2, 4, 7} (±)	Comments
Angular ³ – Measure			
Displacement	(0.01 to 36 000) deg	0.043 degrees per revolution	Rotary encoder
Speed	Up to 1000 RPM	0.024 % rdg + 0.043 degrees per minute	Rotary encoder and stopwatch
Calipers ³	Up to 6 in (> 6 to 20) in (> 20 to 60 in	(27 + 0.6R) μin (82 + 0.6R + 25L) μin (220 + 0.6R + 25L) μin	Gage blocks, master rings
Dial/Digital Indicators ³ LVDT	Up to 2 in (2 to 10) in	(18 + 0.6R) μin (210 + 0.6R) μin	Gage blocks, indicator calibrator stand
Gage Blocks	Up to 6 in	(39 + 25L) μin	Grade K gage blocks and gage block comparator
Height Gages ³	Up to 6 in (> 6 to 24) in	(38 + 25L + 0.6R) μin (160 + 25L + 0.6R) μin	Gage blocks, height gage calibrator
Micrometers ³ –			
Inside, Depth, Outside	Up to 6 in (6 to 20) in (20 to 60) in	(36 + 0.6R) μin (82 + 25L + 0.6R) μin (290 + 25L + 0.6R) μin	Gage blocks
Microscopes ³ –			
Eyepiece Reticules and Video Systems	Up to 1 in Up to 25 mm	20 μin 2.1 μm	ASTM E1951 stage micrometers

Parameter/Equipment	Range	CMC ^{2, 4, 7} (\pm)	Comments
Optical Comparators ³ – Linear Magnification Angle	Up to 12 in Up to 100x (15,30,45,60,90, 120,150,180,270,360) deg	(120 + 3.8L + 0.6R) μ in 0.0035 in (0.16 + 0.6R) deg	Stage micrometer Magnification checker Stage micrometer
Surface Flatness ³ – Measure	Up to 1.0 in Up to 6.0 in	4.2 μ in 0.0008 in	Optical flat, monochromatic light Straight edge/feeler gauges
Vision Systems ³ – X-Y Linear Scale Z-Axis Scale Angularity Magnification	Up to 12 in Up to 2 in (45, 90, 135, 180, 270, 360) deg (10 to 100) x	(120 + 3.8L + 0.6R) μ in 160 μ in (0.16 + 0.6R) deg 0.0035 in	Stage micrometer Length probe, gage blocks Stage micrometer Magnification checker
Extensometer, COD Gage, Deflectometers ³ – Gage Length	Up to 2 in (> 2 to 25) in Up to 8 in	29 μ in 240 μ in (0.0025) μ in	ASTM E 83, ISO 9513 calibrator and encoder Calipers

III. Electrical – DC/Low Frequency

Parameter/Equipment	Range	CMC ^{2, 5} (\pm)	Comments
DC Voltage ³ – Measure	(0 to 100) mV 100 mV to 1.0 V (1.0 to 10) V (10 to 100) V (100 to 1000) V	5.8 μ V/V + 1.7 μ V 4.6 μ V/V + 5.1 μ V 4.6 μ V/V + 25 μ V 7.0 μ V/V + 290 μ V 7.1 μ V/V + 6.0 mV	Agilent 3458A w/ OPT-002
Resistance ³ – Measure	(0 to 10) Ω (10 to 100) Ω (100 Ω to 1.0) k Ω (1.0 to 10) k Ω (10 to 100) k Ω (100 k Ω to 1.0) M Ω (1.0 to 10) M Ω (10 to 100) M Ω 100 M Ω to 1 G Ω	17 $\mu\Omega/\Omega$ + 0.10 $\mu\Omega$ 14 $\mu\Omega/\Omega$ + 1.2 $\mu\Omega$ 12 $\mu\Omega/\Omega$ + 7.4 $\mu\Omega$ 12 $\mu\Omega/\Omega$ + 75 m Ω 12 $\mu\Omega/\Omega$ + 1.1 Ω 17 $\mu\Omega/\Omega$ + 8.0 Ω 58 $\mu\Omega/\Omega$ + 12 Ω 0.58 m Ω/Ω + 22 k Ω 0.58 % + 19 k Ω	Agilent 3458A w/ OPT-002
DC Current ³ – Measure	(0 to 100) μ A (0.1 to 1.0) mA (1.0 to 10) mA (10 to 100) mA (0.1 to 1.0) A (1 to 3) A (3 to 25) A (25 to 50) A	23 μ A/A + 32 pA 23 μ A/A + 34 nA 23 μ A/A + 140 nA 40 μ A/A + 6.4 μ A 130 μ A/A + 46 μ A 0.24 % + 0.66 μ A 0.12 % + 1.0 mA 0.31 % + 1.0 mA	Agilent 3458A w/ OPT-002 HP 34401A current shunt
DC Voltage ³ – Generate	(0 to 100) mV 100 mV to 1 V (1 to 10) V (10 to 100) V	35 μ V/V + 4.9 μ V 35 μ V/V + 50 μ V 35 μ V/V + 500 mV 37 μ V/V + 5.0 mV	Fluke 7526A
Resistance ³ – Generate	(5 to 400) Ω (400 to 4000) Ω	0.019 Ω 0.38 Ω	Fluke 7526A
DC Current ³ – Generate	(0 to 100) mA	58 μ A/A + 2.6 μ A	Fluke 7526A

Parameter/Equipment	Range	CMC ² (±)	Comments
Electrical Simulation of Thermocouple Indicating Devices ³ – Generate and Measure			
Type E	(-250 to -200) °C	0.39 °C	Fluke 7526A
	(-200 to -100) °C	0.18 °C	
	(-100 to 1000) °C	0.16 °C	
Type J	(-210 to -100) °C	0.20 °C	
	(-100 to 800) °C	0.20 °C	
	(800 to 1200) °C	0.19 °C	
Type K	(-250 to -100) °C	0.54 °C	
	(-100 to 1372) °C	0.19 °C	
Type N	(-250 to -200) °C	1.1 °C	
	(-200 to 100) °C	0.36 °C	
	(100 to 1300) °C	0.19 °C	
Type R	(-50 to 100) °C	0.74 °C	
	(100 to 1767) °C	0.50 °C	
Type S	(-50 to 100) °C	0.66 °C	
	(100 to 1767) °C	0.45 °C	
Type T	(-250 to -100) °C	0.42 °C	
	(100 to 400) °C	0.18 °C	
Electrical Calibration of RTD Indicators ³ – Generate and Measure			
Pt (385), 100 Ω	(-200 to 800) °C	0.06 °C	Fluke 7526A
Pt (385), 200 Ω	(-200 to 630) °C	0.58 °C	
Pt (385), 500 Ω	(-200 to 630) °C	0.20 °C	
Pt (385), 1000 Ω	(-200 to 630) °C	0.11 °C	

IV. Mechanical

Parameter/Equipment	Range	CMC ^{2,4,7} (±)	Comments
Scales and Balances ³	(5 to 500) mg (0.5 to 5) g (5 to 200) g (200 to 500) g (500 to 1000) g (1 to 2) kg (2 to 5) kg (5 to 11) kg	0.02 mg 0.04 mg 0.58 mg 0.31 mg 3.1 mg 5.8 mg 15 mg 83 mg	Class 1 weights
	(0.001 to 0.1) lb (0.1 to 1.0) lb (1.0 to 10) lb (10 to 50) lb (50 to 500) lb (500 to 1000) lb	0.0001 lb 0.0002 lb 0.002 lb 0.008 lb 0.08 lb 0.17 lb	Class F weights
Verification of Test Weights ³	(0.001 to 50) lb	0.12 %	ASTM E-139
Force ³ – Tension Compression	Up to 1000lbf (1000 to 20 000) lbf (20 000 to 200 000) lbf (200 000 to 1 000 000) lbf (Up to 2000) lbf (2000 to 100 000) lbf (100 000 to 200 000) lbf (200 000 to 1 500 000) lbf	0.11 % 0.11 % 0.11 % 0.12% 0.09 % 0.13 % 0.13 % 0.12 %	ASTM E4 and Class A load cells
Force – Tension Compression	(50 to 1000) lbf (1000 to 10 000) lbf (3000 to 120 000) lbf (50 to 1000) lbf (1000 to 10 000) lbf (3000 to 120 000) lbf	0.16 % 0.18 % 0.18 % 0.17 % 0.17 % 0.18 %	ISO 7500-1 & 7500-2 w/ Class 0.5

Parameter/Equipment	Range	CMC ^{2, 4, 7} (\pm)	Comments
Force – Tension and Compression	(0.01 to 500) lbf 1 g to 10 kg	0.06 lbf 0.12 %	ASTM E-4 and ISO 7500-1, Class 6 dead weights Class 1 gram weights
Dynamic Force ³ –	(0.5 to 200 000) lbf	0.54 % of Force Indication	ASTM E-467 and NASM 1312, dynamometers and load cells
Verification of Test Frames ³ –			ASTM E2309, E2658
Crosshead Displacement	(0.01 to 1) in (1 to 25) in (25 to 50) in	160 μ m 0.001 in 0.06 in	Linear gage w/ digital encoder
Crosshead Speed	(0.1 to 1) in/min (0.1 to 25) in/min	0.0003 in/min 0.001 in/min	Linear gage w/ stopwatch Digital encoder w/ stopwatch
Crosshead Parallelism	Up to 1.0 in	0.001 in	Linear gage
Strain Rate	(0.001 to 1) in/in/min	0.17 %	Extensometer and stopwatch
Load Rate	(20 to 600 000) lb/min	0.34 %	Load cell and stopwatch
Specimen Alignment	(0 to 50) % Bending	1.0 % Bending	ASTM E1012, ISO 23788

Parameter/Equipment	Range	CMC ^{2, 4, 7} (±)	Comments
Torque – Measuring Equipment ³	(0.02 to 5000) lbf·in	0.11 %	ASTM E2624 using weights
	(47 to 2200) lbf·in	0.21 %	Torque cell
Indirect Verification of Rockwell Hardness Testers ³	HRA: Low Middle High HRBW: Low Middle High HRC: Low Middle High HREW: Low Middle High HRFW: Low Middle High HRHW: Low Middle HRLW: Low Middle HRGW: Low Middle High	0.30 HRA 0.23 HRA 0.27 HRA 0.78 HRBW 0.58 HRBW 0.45 HRBW 0.37 HRC 0.42 HRC 0.36 HRC 0.93 HREW 0.43 HREW 0.45 HREW 0.54 HRFW 0.44 HRFW 0.45 HRFW 0.68 HRHW 0.40 HRHW 0.45 HRLW 0.42 HRLW 0.55 HRGW 0.43 HRGW 0.42 HRGW	ASTM E18
Indirect Verification of Rockwell Superficial Hardness Testers ³	HR15TW: Low Middle High	0.60 HR15TW 0.44 HR15TW 0.36 HR15TW	ASTM E18

Parameter/Equipment	Range	CMC ² (±)	Comments
Indirect Verification of Rockwell Superficial Hardness Testers ³ (cont)	HR30TW:		ASTM E18
	Low	0.52 HR30TW	
	Middle	0.44 HR30TW	
	High	0.38 HR30TW	
	HR45TW:		
	Low	0.55 HR45TW	
	Middle	0.51 HR45TW	
	High	0.48 HR45TW	
	HR15N:		
	Low	0.44 HR15N	
	Middle	0.34 HR15N	
	High	0.26 HR15N	
	HR30N:		
	Low	0.46 HR30N	
	Middle	0.57 HR30N	
	High	0.33 HR30N	
	HR45N:		
	Low	0.75 HR45N	
	Middle	0.55 HR45N	
	High	0.46 HR45N	
	HR15Y		
Low	0.43 HR15Y		
High	0.39 HR15Y		
HRRW			
Low	0.76 HRRW		
High	0.55 HRRW		
HRMW			
Low	0.56 HRMW		
High	0.47 HRMW		

Parameter/Equipment	Range	CMC ² (±)	Comments
Indirect Verification of Brinell Hardness Testers ³ –			
10/3000/15	(100 to 499) HBW (500 to 650) HBW	2.9 HBW 8.7 HBW	ASTM E10 and ASTM E110, error uncertainty is given as a Brinell hardness number
10/1500/15	(45 to 199) HBW (200 to 345) HBW	0.68 HBW 3.0 HBW	
10/1000/15	(40 to 134) HBW (135 to 230) HBW	0.47 HBW 2.7 HBW	
10/500/15	(50 to 109) HBW (110 to 140) HBW	0.85 HBW 2.1 HBW	
5/750/15	(96 to 499) HBW (499 to 650) HBW	2.2 HBW 10 HBW	
2.5/187.5/10	(100 to 499) HBW (500 to 650) HBW	7.5 HBW 7.7 HBW	
2.5/62.5/10	(40 to 134) HBW (135 to 230) HBW	3.0 HBW 8.4 HBW	
Indirect Verification Leeb Hardness Testers ³	714 HLD	9.8 HLD	ASTM A956
Direct Verification of Brinell Hardness Testers ³ –			ASTM E10
Verification of Test Force	(62.5, 187.5, 500, 1000, 1500, 2000, 3000) kgf	0.28 %	ASTM E74 load cells
Verification of Brinell Scope	(0 to 10) mm	0.017 mm	Stage micrometer
Verification of Test Cycle	Up to 15 sec	0.02 sec	Stopwatch

Parameter/Equipment	Range	CMC ^{2, 4} (±)	Comments
Direct Verification of Rockwell Hardness Testers ³ –			
Verification of Test Force	Up to 150	0.28 %	ASTM E18
Verification of Depth Measuring	Up to 0.25 mm	0.51 µm	Load cells ASTM E74
Verification of Machine Hysteresis	Up to 2 HR	0.25 HR	Length gauge
Verification of Testing Cycle	Up to 8 sec	0.02 sec	Stopwatch
Direct Verification of Micro Hardness Testers ³ –			ASTM E92
Verification of Test Force	Up to 1 kg Over 1 kg	3.2 mg 0.28 %	Class 1 weights Load cells ASTM E74
Verification of Indentation Measuring System	Up to 1000 µm	1.3 µm	Stage micrometer
Verification of Testing Cycle	Up to 15 sec	0.02 sec	Stopwatch
Verification of Indenter Velocity	Up to 200 mm/sec	0.50 µm/sec	Stopwatch and linear gauge
Indirect Verification of Micro indentation Hardness Testers ³ – (Knoop & Vickers)			
Mean Hardness Value ≥ 1 kgf	(100 to 240) HV (240 to 600) HV (≥ 650) HV	0.79 % 0.50 % 0.37 %	ASTM E384/ ASTM E92/ISO 6507-2

Parameter/Equipment	Range	CMC ^{2, 4} (±)	Comments
Indirect Verification of Micro indentation Hardness Testers ³ – (Knoop & Vickers) (cont)			
Mean Hardness Value < 1 kgf	(100 to 240) HV (240 to 600) HV (≥ 650) HV	1.2 % 0.92 % 0.69 %	ASTM E384/ ASTM E92/ISO 6507- 2
	(100 to 250) HK (250 to 650) HK (≥ 650) HK	0.76 % 0.47 % 0.21 %	
Stage Micrometer Verification	(0 to 2) in (0 to 25) mm	24 μin 4.1 μm	Glass stage micrometer
Indirect Verification of Charpy Impact Testers ³	(9 to 20) J (65 to 100) J (175 to 250) J	1.2 % 1.5 % 1.5 %	ASTM E23 ISO 148-2
	Level Torque Radius Measurements	1.3° 5.5 % 0.005°	
	Distance Between Anvils	0.02 mm	
Pressure Gauges ³ –			
Pneumatic	(-14.5 to 1000) psig (1000 to 10 000) psig (-25 to 25) in·H ₂ O	0.04 psi 0.05 psi 0.0032 in·H ₂ O	Mensor CPG2500

V. Thermodynamics

Parameter/Equipment	Range	CMC ^{2, 7} (±)	Comments
Temperature – Measuring Equipment ³	(-196 to -45) °C (-45 to 25) °C (25 to 420) °C (420 to 500) °C (500 to 1200) °C	0.21 °C 0.093 °C 0.11 °C 0.21 °C 0.79 °C	Bath, dry well, furnace, Hart 5628 PRT, Fluke 7526, Type-S T/C
Temperature – Measure ³	(-196 to 500) °C (500 to 1200) °C (1200 to 1400) °C	0.076 °C 0.70 °C 3.7 °C	PRT w/Fluke 7526 Thermocouples w/ digital thermometer
Furnace Uniformity Survey ³	(32 to 2000) °F (2000 to 2400) °F	1.9 °F 3.7 °F	AMS 2750F or CQI-9 Thermocouple scanner / Type-K or N TC
Humidity ³ – Measuring Equipment	(15 to 80) % RH (80 to 97) % RH	1.5 % RH 2.2 % RH	Vaisala HM77B and chamber
Calibration of Thermocouples ³ – Measuring Equipment			
Type E	(-200 to 500) °C (500 to -1200) °C	0.24 °C 0.80 °C	ASTM E2846 / ASTM E220
Type J	(-196 to 500) °C (500 to 1200) °C	0.25 °C 0.80 °C	
Type K	(-200 to 500) °C (500 to -1200) °C	0.27 °C 0.80 °C	
Type N	(-200 to 500) °C (500 to -1200) °C	0.31 °C 0.80 °C	

Parameter/Equipment	Range	CMC ^{2,7} (±)	Comments
Calibration of Thermocouples ³ – Measuring Equipment (cont)			
Type R	(-50 to 100) °C (100 to 500) °C (500 to 1200) °C	0.59 °C 0.34 °C 0.83 °C	ASTM E2846 / ASTM E220
Type S	(-50 to 100) °C (100 to 500) °C (500 to 1200) °C	0.55 °C 0.30 °C 0.83 °C	
Type T	(-200 to 400) °C	0.27 °C	

VI. Time & Frequency

Parameter/Equipment	Range	CMC ^{2,4,7} (±)	Comments
Timing Devices ³	(0 to 24) hrs	0.10 sec/24 hrs 0.02 sec/min	Stopwatch
	(0 to 24) hrs	0.04 sec/24 hrs	Timometer
Frequency – Measuring Equipment ³	Up to 100 Hz	0.01 % + 0.1 mHz	Keysight 1202A monitoring generator
	Up to 30 MHz	0.012 % + 12 mHz	Keysight 3458A monitoring generator

¹ This laboratory offers commercial calibration service and field calibration service.

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.

³ Field calibration service is available for this calibration. Please note the actual measurement uncertainties achievable on a customer's site can normally be expected to be larger than the CMC found on the A2LA Scope. Allowance must be made for aspects such as the environment at the place of calibration and for other possible adverse effects such as those caused by transportation of the calibration equipment. The usual allowance for the actual uncertainty introduced by the item being calibrated, (e.g. resolution) must also be considered and this, on its own, could result in the actual measurement uncertainty achievable on a customer's site being larger than the CMC.

⁴ In the statement of CMC, the percentage is defined as the percentage of reading. L is defined as the length of the unit under test in inches. R is defined as the resolution of the unit under test in inches.

⁵ The stated measured values are determined using the indicated instrument (see Comments). This capability is suitable for the calibration of the devices intended to measure or generate the measured value in the ranges indicated. CMCs are expressed as either a specific value that covers the full range or as a percent or fraction of the reading plus a fixed floor specification.

⁶ This scope meets A2LA's *P112 Flexible Scope Policy*.

⁷ The type of instrument or material being calibrated is defined by the parameter. This indicates the laboratory is capable of calibrating instruments that measure or generate the values in the ranges indicated for the listed measurement parameter.



Accredited Laboratory

A2LA has accredited

GREAT LAKES CALIBRATION, INC.

Addison, IL

for technical competence in the field of

Calibration

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017 *General requirements for the competence of testing and calibration laboratories*. This laboratory also meets the requirements of ANSI/NCSL 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 20th day of July 2022.

A blue ink signature of the Vice President of Accreditation Services, written over a horizontal line.

Vice President, Accreditation Services
For the Accreditation Council
Certificate Number 3312.01
Valid to June 30, 2024

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