



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

MSI-VIKING GAGE, LLC
 3130 Stanton Ct.
 N. Charleston, SC 29418
 Martin McKinnon Phone: 843 566 9106

CALIBRATION

Valid To: September 30, 2017

Certificate Number: 1780.01

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory to perform the following calibrations and dimensional inspections¹:

I. Dimensional

Parameter/Equipment	Range	CMC ^{2, 4} (±)	Comments
Bore Micrometers	Up to 12 in Up to 304.8 mm	(34 + 1.1D) μin (0.84 + 0.03D) μm	Master rings
Dial Bore Gages (bore gage w/Indicator)	Up to 12 in Up to 304.8 mm	0.60R μin 0.60R μm	Indicator calibrator
Calipers ³	Up to 80 in Up to 2032 mm	0.60R μin 0.60R μm	Caliper checker, gage blocks
Caliper Checkers	Up to 12 in (25 to 305) mm	(11 + 1.9L) μin (0.28 + 0.050L) μm	Electronic indicator amplifier, gage blocks
Caliper Gage ³ – Internal, External	Up to 20 in Up to 508 mm	0.60R μin 0.60R μm	Gage blocks, ring gages
Depth Step Gages	(0.5 to 11.5) in (12.7 to 290) mm	(14 + 0.49L) μin (0.55 + 0.020L) μm	Electronic indicator amplifier, gage blocks
Cylindrical Ring Gages ³	(0.6 to 10) in (15.25 to 250) mm	(26 + 0.81D) μin (0.65 + 0.020D) μm	828 CIM universal length machine, master rings, gage blocks

Parameter/Equipment	Range	CMC ^{2,4} (±)	Comments
Disc, Plug and Pin Gages ³	Up to 20.0 in Up to 508 mm	(11 + 0.70L) μin (0.30 + 0.020L) μm	Universal length machine (ULM), gage blocks
Electronic Indicator Amplifier ³	Up to 0.02 in Up to 0.508 μm	15 μin 0.38 μm	Gage blocks, optical flat
Flatness	Up to 12 in	7.0 μin 68 μin	Optical flat Indicator amplifier
	Up to 304.8 mm	0.18 μm 1.7 μm	
	Up to 6 in Up to 152.4 mm	7.0 μin 0.18 μm	Optical flat
Optical Flats	Up to 6 in Up to 152.4 mm	7.0 μin 0.18 μm	Master optical flat
Sine Bars – Flatness	Up to 12 in Up to 304.8 mm	28 μin 0.70 μm	Electronic indicator amplifier
Cylindrical Square – Straightness	Up to 12 in	37 μin	Roundness machine
Glass Scales	Up to 12 in Up to 304.6 mm	(76 + 3.7L) μin (1.9 + 0.10L) μm	Vision system
Height Gages ³	Up to 48 in Up to 1219.2 mm	0.60R μin 0.60R μm	Gage blocks

Parameter/Equipment	Range	CMC ^{2, 4} (±)	Comments
Indicators/LVDTs ³ , Fixed Points	0.00005 in 0.00001 in 0.0001 in 0.0005 in 0.001 in 0.00025 mm 0.001 mm 0.0025 mm 0.01 mm 0.025 mm	0.60R μin 7.1 μin 0.60R μin 0.60R μin 0.60R μin 0.18 μm 0.60R μm 0.60R μm 0.60R μm 0.60R μm	Gage blocks, Indicator calibrator
Length Standards	Up to 20 in (20 to 40) in Up to 508 μm (508 to 1016) mm	(6.6 + 0.88L) μin (16 + 0.89L) μin (0.17 + 0.022L) μm (0.41 + 0.030L) μm	Universal Length Machine (ULM), gage blocks
Levels	Up to 12 in Up to 304.8 mm	140 μin 3.6 μm	Surface plate, sine bar, gage blocks
Micrometers ³ –	Up to 48 in Up to 1219.2 mm	0.60R μin 0.60R μm	Gage blocks
Groove	Up to 4 in Up to 101.6 mm	0.60R μin 0.60R μm	Gage blocks
Depth	Up to 12 in Up to 304.8 mm	0.60R μin 0.60R μm	Gage blocks
Inside	Up to 16 in Up to 406.4 mm	0.60R μin 0.60R μm	Universal Length Machine
Specialty Micrometers	Up to 4 in Up to 101.6 mm	0.60R μin 0.60R μm	Master pins
Indicator Calibrators ³ – (Mic Head Type)	Up to 1 in Up to 25.4 mm	(19 + 0.10L) μin (0.48 + 0.0030L) μm	LVDT's
Parallelism	Up to 12 in Up to 304.8 mm	(6.6 + 0.88L) μin (0.17 + 0.022L) μm	Universal Length Machine (ULM), gage blocks

Parameter/Equipment	Range	CMC ^{2,4} (±)	Comments
Plain Pins Class ZZ ³	Up to 2 in Up to 50.8 mm	29 μin 0.73 μm	Laser micrometer
	Up to 2 in Up to 50.8 mm	(6.6 + 0.88L) μin (0.17 + 0.022L) μm	Universal length machine (ULM)
Protractor	Up to 90°	0.15°	Gage blocks, sine bar, surface plate
Spheres/Roundness	(1 to 10) in (25.4 to 254) mm	(1.4 + 1.8D) μin (0.035 + 0.050D) μm	Roundness machine
Steel Rules	Up to 72 in	74 μin 1.9 μm	Vision system, direct comparison
Steel Tapes	Up to 50 ft	74 μin 1.9 μm	Direct comparison
Straightness	Up to 12 in Up to 300.0 mm	37 μin 0.93 μm	Electronic indicator amplifier
Thickness and Feeler Gages	Up to 2 in Up to 50.8 mm	(6.6 + 0.88L) μin (0.17 + 0.022L) μm	Universal length machine (ULM)
Thread Measuring Wires	(4 to 80) TPI μin (0.35 to 4.0) TPI μm	6.0 μin 0.15 μm	Universal Length Machine (ULM), gage blocks
Laser Micrometers ³	Up to 4 in Up to 101.6 mm	(14 + 1.4L) μin (0.35 + 0.010L) μm	Class XXX master pins
Screw Thread Micrometer	Up to 2 in	0.60R	Gage blocks, thread setting plug
	Up to 50.0 mm	0.60R	
Screw Thread Micrometer Standards	Up to 2 in Up to 50.0 mm	(76 + 3.7L) μin (1.9 + 0.10L) μm	Vision system

Parameter/Equipment	Range	CMC ^{2,4} (±)	Comments
Snap Gage ³ – Flatness of Anvils Size	Up to 3 in Up to 76.2 mm Up to 1 in Up to 25.4 mm (1 to 20) in (25.4 to 508) mm	6.9 μin 0.18 μm 3.5 μin 0.088 μm (2.6 + 0.80L) μin (0.070 + 0.020L) μm	Optical flat Gage blocks
Universal Measuring Machines/Bench Micrometers ³	Up to 21.5 in Up to 546.1 μm	(6.6 + 0.88L) μin (0.17 + 0.022L) μm	Gage blocks
CMM/Articulating Arm CMM's ³ – Hysteresis Scale Displacement Hysteresis Scale Displacement Volumetric Repeatability	Up to 0.500 in Up to 40 in Up to 12.5 mm Up to 1000 mm Up to 40 in Up to 1000 mm	94 μin 270 μin 2.4 μm 6.8 μm 330 μin 8.3 μm	Ball bar set, gage blocks Ball bar tests
Radius Gages	Up to 1 in Up to 25.0 mm	80 μin 2.0 μm	Vision system
NPT Tapered Thread Rings – Standoff Ring Thickness	Up to 1.5 in Up to 38 mm Up to 1.5 in Up to 38 mm	77 μin 2.0 μm (8.2 + 1.2L) μin (0.21 + 0.030L) μm	Electronic indicator, master NPT plug Universal Length Machine (ULM)

Parameter/Equipment	Range	CMC ^{2,4} (±)	Comments
Geometry Measuring Machine ³ –			
Gage Head Amplifier	0.004 μin fine 0.036 μin course	7.0 μin 7.0 μin	Master sphere, gage blocks, cylindrical square, optical flat
	0.10 μm fine 0.90 μm course	0.18 μm 0.18 μm	
Radial Accuracy	3 in 75 mm	5.3 μin 0.14 μm	
Coning Accuracy	8 in 200 mm	5.3 μin 0.14 μm	
Axial Bearing Accuracy	3 in 75 mm	5.2 μin 0.13 μm	
Parallelism of Column to Table Axis Accuracy	Up to 12 in Up to 300 mm	5.3 μin 0.14 μm	
Straightness of Column	Up to 12 in Up to 300 mm	5.3 μin 0.14 μm	
R-Axis Perpendicularity	Up to 4 in Up to 101.6 mm	5.2 μin 0.14 μm	
Straightness	Up to 4 in Up to 101.6 mm	5.3 μin 0.14 μm	
Video Measurement System ³ –			
X, Y Axis	Up to 12 in Up to 304.8 μm	70 μin 1.8 μm	Calibration grid
Z Axis	Up to 6 in Up to 152.4 mm	(14 + 0.49L) μin (0.36 + 0.020L) μm	Gage blocks

Parameter/Equipment	Range	CMC ^{2,4} (±)	Comments
Surface Finish Testers ³ –	(2 to 500) μin (0.05 to 12.5) μm	5.0 μin 0.13 μm	Master surface finish patch
Surface Finish Standards –	(2 to 500) μin (0.05 to 12.5) μm	4.0 μin 0.10 μm	Direct comparison to master surface patch
Angle Blocks	Up to 90°	0.0°, 0', 77"	Vision system
Chamfer check gages	Set Ring Effective Diameter	49 μin	Chamfer check master, set ring
	Gage Probe Angle	0.0° 0' 77"	Vision system
Optical Comparators ³ –			
Horizontal Linearity	Up to 12 in Up to 304.8 mm	(160 + 3.3L) μin (4.1 + 0.090L) μm	Glass master
Vertical Linearity	Up to 9 in Up to 228.6 mm	(160 + 5.4L) μin (3.9 + 0.14L) μm	Glass master
Squareness	Up to 12 in Up to 304.8 mm	79 μin 2.1 μm	Glass master
Table Parallelism	Up to 12 in Up to 304.8 mm	170 μin 4.1 μm	Indicator
Distortion	Up to 10 in magnified image	170 μin	Glass master, 14" glass scale
	Up to 254 mm magnified image	4.3 μm	
Magnification – 10x to 100x	Up to 20 in image Up to 508 mm image	170 μin 4.3 μm	Glass master, 14" glass scale
Chart Angularity	90°	41 μin 1.1 μm	Glass master
Chart Rotation	180°	12 μin 0.30 μm	Glass master

Parameter/Equipment	Range	CMC ^{2,4} (±)	Comments
Bolt Protrusion Gauges	Up to 12 in	(76 + 3.7L) μin	Vision system
Thread Plugs ³ –			
Major Diameter	Up to 8 in Up to 203.2 mm	(8.2 + 1.2L) μin (0.21 + 0.040L) μm	Universal length machine
Pitch Diameter	Up to 80 TPI Up to 4.0 mm pitch	(65 + 0.32L) μin (1.7 + 0.010L) μm	Universal length machine, thread measuring wires
Tapered Thread Plug Gage – Pitch Diameter	Up to 4 in Up to 101.6 mm	(65 + 0.32L) μin (1.7 + 0.010L) μm	Universal length machine, gage blocks
Step	Up to 1 in Up to 25.4 mm	59 μin 1.5 μm	Gage blocks
Crimping Tools	Go/No Go	0.0010 in	Pin gages
	Crimp Height	0.00030 μin	Point micrometer
	Pullout Test	2.0 lb	Force gage, master weights
Gage Block Comparator ³	Up to 4 in Up to 100 mm	(5.1 + 0.80L) μin (0.20 + 0.040L) μm	Master gage blocks
ID/OD Comparator ³	Up to 10 in Up to 250 mm	(8.8 + 0.80L) μin (0.35 + 0.040L) μm	Gage blocks
Surface Plates ³ –			
Flatness	Up to 108 in diagonal line	6.8√DL	Electronic levels

	Range	CMC ² (±)	Comments
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Parameter/Equipment			
Tool Makers Microscopes ³ , Linearity	Up to 12 in Up to 304.8 mm	250 μin 6.4 μm	Glass master
Contour/Contour Systems ³ –			
Tracing Arm Length and Stylus Tip Height	Up to 14 in Up to 350 mm	7.8 μin 0.20 μm	Gage blocks, pin gages, optical flats
Pick-Up Sensitivity	2 in 50 mm	46 μin 1.2 μm	
Probe Deflection Repeatability	0 Base	0.15 μin 0.010 μm	
Stylus Tip Form and Radius	3 mm	9.1 μin 0.23 μm	

II. Dimensional Testing/Calibration¹

Parameter/Equipment	Range	CMC ^{2,4} (\pm)	Comments
Surface Finish ⁵ –	(2 to 500) μin (0.05 to 12.5) μm	4.0 μin 0.10 μm	Master surface finish patch
3D Inspection ⁵ –			
Volumetric Length (30 x 40 x 24)	Up to 40 in Up to 1000 mm	270 μin 6.8 μm	CMM
Roundness ⁵	Up to 10 in Up to 254 mm	(9.4 + 1.3D) μin (0.24 + 0.040D) μm	Roundness machine
Go/No-go Gages ⁵	Up to 6 in	0.00030 μin	Rings, plugs, pins, hand tools

Parameter/Equipment	Range	CMC ^{2,4} (±)	Comments
2D Optical Inspection ⁵ –			
Horizontal Linearity	Up to 12 in Up to 304.8 mm	(160 + 3.3L) μin (4.1 + 0.090L) μm	Optical comparator
Vertical Linearity	Up to 9 in Up to 228.6 mm	(160 + 5.4L) μin (3.9 + 0.14L) μm	
Chart Angularity	90°	4.1 μin 1.1 μm	
Chart Rotation	180°	12 μin 0.30 μm	
Go/No-go Gages ⁵	Up to 12 in Up to 304.8 mm Up to 21.5 in Up to 546.1 mm Ext. Measurement Up to 17 in Int. Measurement Step Gages	(76 + 3.7L) μin (1.9 + 0.10) um (6.6 + 0.88L) μin (0.17 + 0.022L) um (11 + 0.63D) μin (14 + 0.49L) μin (0.35 + 0.013L) um	Vision system Universal length machine (ULM) Electronic indicator amplifier, gage blocks
Flatness ⁵	Up to 12 in Up to 304.8 mm	68 μin 1.7 μm	Indicator amplifier
Parallelism ⁵	Up to 12 in Up to 304.8 mm	(6.6 + 0.88L) μin (0.17 + 0.022L) μm	Universal length machine (ULM)
Radius ⁵	Up to 1 in Up to 25.0 mm	80 μin 2.0 μm	Vision system
Straightness ⁵	Up to 12 in Up to 304.8 mm	37 μin 0.93 μm	Electronic indicator amplifier

Parameter/Equipment	Range	CMC ^{2,4} (\pm)	Comments
Video Measurement ⁵ – X, Y Axis	Up to 12 in Up to 304.8 mm	70 μ m 1.8 μ m	Vision system
Z Axis	Up to 6 in Up to 152.4 mm	(14 + 0.49L) μ m (0.36 + 0.020L) μ m	

III. Electrical – DC/Low Frequency

Parameter/Equipment	Range	CMC ^{2,6} (\pm)	Comments
DC Voltage – Measure ³	(0 to 100) mV 100 mV to 1 V (1 to 10) V (10 to 100) V (100 to 1000) V	6.2 μ V/V + 0.30 μ V 4.2 μ V/V + 0.30 μ V 4.2 μ V/V + 0.50 μ V 11 μ V/V + 0.30 mV 8 μ V/V + 1 mV	Agilent 3458A opt 002
DC High Voltage – Measure ³	1 kV to 10 kV 10 kV to 90 kV	0.50 % + 0.40 V 1.0 % + 4.0 V	Vitrek 4700 Vitrek 4700 w/ HL100 probe
DC Voltage – Generate ³	(0 to 329.9999) mV (330 mV to 3.299) V (3.3 to 32.9999) V (30 to 329.9999) V (100 to 1000) V	22 μ V/V + 1.0 μ V 13 μ V/V + 2.0 μ V 14 μ V/V + 20 μ V 20 μ V/V + 150 μ V 21 μ V/V + 1.6 mV	Fluke 5520A
DC Current – Measure ³	(0 to 100) μ A (0.1 to 1) mA (1 to 10) mA (10 to 100) mA (0.1 to 1) A	25 μ A/A + 0.80 nA 23 μ A/A + 5.0 nA 23 μ A/A + 50 nA 37 μ A/A + 500 nA 0.013 % + 10 μ A	Agilent 3458A Opt 002

Parameter/Equipment	Range	CMC ^{2,6} (±)	Comments
DC Current – Generate ³	(1 to 329.999) µA (0.33 to 3.29999) mA (3.3 to 32.9999) mA (33 to 329.999) mA (0.33 to 1.09999) A (1.1 to 2.99999) A (3 to 10.9999) A (11 to 20.5) A	0.016 % + 20 nA 0.011 % + 50 nA 0.010 % + 250 nA 0.011 % + 3.0 µA 0.021 % + 40 µA 0.039 % + 40 µA 0.051 % + 500 µA 0.12 % + 750 µA	Fluke 5520A
	(10 to 16.499) A (16.5 to 149.999) A (150 to 950) A	1.0 % + 50 mA 1.0 % + 75 mA 1.0 % + 75 mA	Fluke 5520A w/ Fluke 5500A Coil

Parameter/Range	Frequency	CMC ^{2,6} (±)	Comments
Resistance – Measure ³	(0 to 10) Ω (10 to 100) Ω 100 Ω to 1 kΩ (1 to 100) kΩ 100 kΩ to 1 MΩ (1 to 10) MΩ (10 to 100) MΩ	18 µΩ/Ω + 50 µΩ 13 µΩ/Ω + 500 µΩ 11 µΩ/Ω + 500 µΩ 11 µΩ/Ω + 50 mΩ 16 µΩ/Ω + 2.0 Ω 53 µΩ/Ω + 100 Ω 0.070 % + 1.0 kΩ	Agilent 3458A Opt 002
Resistance – Generate ³	(1 to 10.9999) Ω (11 to 32.9999) Ω (33 to 109.9999) Ω (110 to 329.9999) Ω (0.33 to 1.099999) k Ω (1.1 to 3.299999) kΩ (3.3 to 10.99999) kΩ (11 to 32.99999) kΩ (33 to 109.9999) kΩ (110 to 329.9999) kΩ (0.33 to 1.099999) MΩ (1.1 to 3.29999) MΩ (3.3 to 10.99999) MΩ (11 to 32.99999) MΩ (33 to 109.9999) MΩ (110 to 329.9999) MΩ (330 to 1100) MΩ	42 µΩ/Ω + 10 mΩ 34 µΩ/Ω + 15 mΩ 31 µΩ/Ω + 15 mΩ 31 µΩ/Ω + 20 mΩ 32 µΩ/Ω + 20 mΩ 34 µΩ/Ω + 200 mΩ 30 µΩ/Ω + 100 mΩ 31 µΩ/Ω + 1.0 Ω 30 µΩ/Ω + 1.0 Ω 36 µΩ/Ω + 10 Ω 37 µΩ/Ω + 10 Ω 62 Ω/Ω + 150 Ω 0.014 % + 250 Ω 0.026 % + 2.5 kΩ 0.052 % + 3.0 kΩ 0.34 % + 100 kΩ 1.7 % + 500 kΩ	Fluke 5520A

Parameter/Range	Frequency	CMC ^{2, 6} (±)	Comments
AC Voltage – Generate ³			
(1 to 32.999) mV	(10 to 45) Hz 45 Hz to 10 kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 500) kHz	0.085 % + 6.0 μV 0.019 % + 6.0 μV 0.024 % + 6.0 μV 0.12 % + 6.0 μV 0.38 % + 12 μV 0.84 % + 50 μV	Fluke 5520A
(33 to 329.999) mV	(10 to 45) Hz 45 Hz to 10 kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 500) kHz	0.033 % + 8.0 μV 0.016 % + 8.0 μV 0.018 % + 8.0 μV 0.036 % + 8.0 μV 0.082 % + 32 μV 0.21 % + 70 μV	
(0.33 to 3.29999) V	(10 to 45) Hz 45 Hz to 10 kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 500) kHz	0.031 % + 50 μV 0.017 % + 60 μV 0.019 % + 60 μV 0.031 % + 50 μV 0.072 % + 125 μV 0.26 % + 600 μV	
(3.3 to 32.9999) V	(10 to 45) Hz 45 Hz to 10 kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.031 % + 650 μV 0.017 % + 600 μV 0.026 % + 600 μV 0.036 % + 600 μV 0.092 % + 1.6 mV	
(33 to 329.999) V	(10 to 45) Hz 45 Hz to 10 kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.021 % + 2.0 mV 0.021 % + 6.0 mV 0.026 % + 6.0 mV 0.031 % + 6.0 mV 0.21 % + 50 mV	
(330 to 1000) V	45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.031 % + 10 mV 0.026 % + 10 mV 0.031 % + 10 mV	

Parameter/Range	Frequency	CMC ^{2, 6} (±)	Comments
AC Voltage – Measure ³			
(1 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	0.030 % + 3.0 μV 0.020 % + 2.0 μV 0.040 % + 2.0 μV 0.11 % + 2.0 μV 0.50 % + 2.0 μV 4.1 % + 2.0 μV	Agilent 3458A opt 002
(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	0.0080 % + 4.0 μV 0.0080 % + 2.0 μV 0.016 % + 2.0 μV 0.031 % + 2.0 μV 0.081 % + 2.0 μV 0.34 % + 10 μV 1.1 % + 10 μV 1.6 % + 10 μV	
100 mV to 1V	(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	0.0090 % + 40 μV 0.0070 % + 20 μV 0.017 % + 20 μV 0.036 % + 20 μV 0.082 % + 20 μV 0.31 % + 100 μV 1.1 % + 100 μV 1.6 % + 100 μV	
(1 to 10) V	(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	0.0080 % + 400 μV 0.0080 % + 200 μV 0.015 % + 200 μV 0.031 % + 200 μV 0.080 % + 200 μV 0.30 % + 1.0 mV 1.0 % + 1.0 mV	
(10 to 100) V	(1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.030 % + 4.0 mV 0.030 % + 2.0 mV 0.030 % + 2.0 mV 0.040 % + 2.0 mV 0.13 % + 2.0 mV	
(100 to 750) V	(1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.040 % + 4.0 mV 0.040 % + 2.0 mV 0.060 % + 2.0 mV 0.14 % + 2.0 mV 0.40 % + 2.0 mV	

Parameter/Equipment	Range	CMC ^{2, 6} (\pm)	Comments	
AC Current – Generate ³				
(29 to 329.99) μ A	(10 to 20) Hz (20 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (10 to 30) kHz	0.30 % + 0.10 μ A 0.20 % + 0.10 μ A 0.20 % + 0.10 μ A 0.40 % + 0.20 μ A 1.0 % + 0.20 μ A 1.7 % + 0.40 μ A	Fluke 5520A	
(.33 to 3.2999) mA	(10 to 20) Hz (20 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (10 to 30) kHz	0.30 % + 0.20 μ A 0.20 % + 0.20 μ A 0.20 % + 0.20 μ A 0.30 % + 0.20 μ A 0.60 % + 0.30 μ A 1.1 % + 0.60 μ A		
(3.3 to 32.9999) mA	(10 to 20) Hz (20 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (10 to 30) kHz	0.20 % + 2.0 μ A 0.10 % + 2.0 μ A 0.050 % + 2.0 μ A 0.10 % + 2.0 μ A 0.30 % + 3.0 μ A 0.50 % + 4.0 μ A		
(33 to 329.99) mA	(10 to 20) Hz (20 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (10 to 30) kHz	0.20 % + 20 μ A 0.10 % + 20 μ A 0.060 % + 20 μ A 0.20 % + 50 μ A 0.30 % + 100 μ A 0.50 % + 200 μ A		
(.33 to 1.09999)A	(10 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.20 % + 100 μ A 0.10 % + 100 μ A 0.70 % + 1.0 mA 2.7 % + 5.0 mA		
(1.1 A to 2.99999)A	(10 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.20 % + 100 μ A 0.070 % + 100 μ A 0.70 % + 1.0 mA 2.6 % + 5.0 mA		
(3 to 10.9999) A	(45 to 100) Hz 100 Hz to 1 kHz (1 to 5) kHz	0.10 % + 2.0 mA 0.20 % + 2.0 mA 3.3 % + 2.0 mA		
(11 to 20.5) A	(45 to 100) Hz 100 Hz to 1 kHz (1 kHz to 5) kHz	0.18 % + 5.0 mA 0.17 % + 5.0 mA 3.2 % + 5.0 mA		
(20 to 150) A (151 to 1000) A	50 Hz 50 Hz	1.3 % + 1 90 mA 0.66 % + 1.1 A		Fluke 5520 w/ 50 turn coil

Parameter/Equipment	Range	CMC ^{2, 6} (±)	Comments
AC High Voltage – Measure ³			
(1 to 10) kV	60 Hz	0.90 % + 0.40 V	Vitrek 4700
(10 to 90) kV	60 Hz	1.6 % + 6.0 V	Vitrek 4700 w/ HL100 probe
AC Current – Measure ³			
(5 to 100) μA	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz	0.45 % + 0.030 μA 0.17 % + 0.030 μA 0.070 % + 0.030 μA 0.10 % + 0.030 μA	Agilent 3458A opt 002
(1 to 100) mA	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz (5 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.47 % + 20 μA 0.18 % + 20 μA 0.080 % + 20 μA 0.050 % + 20 μA 0.080 % + 20 μA 0.50 % + 40 μA 0.70 % + 150 μA	
1 A	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz (5 to 20) kHz (20 to 50) kHz	0.47 % + 200 μA 0.19 % + 200 μA 0.10 % + 200 μA 0.12 % + 200 μA 0.37 % + 20 μA 1.2 % + 40 μA	
Capacitance – Generate ³	(0.19 to 0.3999) nF (0.4 to 1.0999) nF (1.1 to 3.2999) nF (3.3 to 10.9999) nF (11 to 32.9999) nF (33 to 109.999) nF (110 to 329.999) nF (0.33 to 1.09999) μF (1.1 to 3.29999) μF (3.3 to 10.9999) μF (11 to 32.9999) μF (33 to 109.9999) μF (110 to 329.999) μF (0.33 to 1.09999) mF (1.1 to 3.29999) mF	0.60 % + 10 pF 0.60 % + 10 pF 0.60 % + 10 pF 0.30 % + 10 pF 0.30 % + 100 pF 0.30 % + 100 pF 0.30 % + 300 pF 0.30 % + 1.0 nF 0.30 % + 3.0 nF 0.30 % + 10 nF 0.50 % + 30 nF 0.50 % + 100 nF 0.50 % + 300 nF 0.50 % + 1.0 μF 0.50 % + 3.0 μF	Fluke 5520

Parameter/Equipment	Range	CMC ² (±)	Comments
Electrical Calibration of Thermocouples & Thermocouple Indicating Systems ³			
Type B	600 °C to 800 °C 800 °C to 1000 °C 1000 °C to 1550 °C 1550 °C to 1820 °C	0.50 °C 0.35 °C 0.35 °C 0.34 °C	Fluke 5520A
Type C	0 °C to 150 °C 150 °C to 650 °C 650 °C to 1000 °C 1000 °C to 1800 °C 1800 °C to 2316 °C	0.30 °C 0.28 °C 0.31 °C 0.55 °C 0.90 °C	
Type E	-250 °C to -100 °C -100 °C to -25 °C -25 °C to 350 °C 350 °C to 650 °C 650 °C to 1000 °C	0.50 °C 0.23 °C 0.22 °C 0.23 °C 0.27 °C	
Type J	-210 °C to -100 °C -100 °C to -30 °C -30 °C to 150 °C 150 °C to 760 °C 760 °C to 1200 °C	0.32 °C 0.23 °C 0.17 °C 0.20 °C 0.25 °C	
Type K	-200 °C to -100 °C -100 °C to -25 °C -25 °C to 120 °C 120 °C to 1000 °C 1000 °C to 1372 °C	0.37 °C 0.25 °C 0.23 °C 0.31 °C 0.42 °C	
Type L	-200 °C to -100 °C -100 °C to 800 °C 800 °C to 900 °C	0.40 °C 0.31 °C 0.24 °C	
Type N	-200 °C to -100 °C -100 °C to -25 °C -25 °C to 120 °C 120 °C to 410 °C 410 °C to 1300 °C	0.42 °C 0.28 °C 0.26 °C 0.25 °C 0.32 °C	

Parameter/Equipment	Range	CMC ² (±)	Comments
Electrical Calibration of Thermocouples & Thermocouple Indicating Systems ³ – (cont)			
Type R	0°C to 250 °C 250°C to 400 °C 400 °C to 1000 °C 1000 °C to 1767 °C	0.60 °C 0.40 °C 0.37 °C 0.42 °C	Fluke 5520A
Type S	0°C to 250 °C 250 °C to 1000 °C 1000 °C to 1400 °C 1400 °C to 1767 °C	0.48 °C 0.39 °C 0.40 °C 0.50 °C	
Type T	-250 °C to -150 °C -150 °C to 0 °C 0 °C to 120 °C 120 °C to 400 °C	0.65 °C 0.25 °C 0.20 °C 0.15 °C	
Type U	-200 °C to 0 °C 0 °C to 600 °C	0.56 °C 0.32 °C	
Electrical Calibration of RTD Indicating System ³ –			
Pt 385, 100 Ω	-200 °C to -80 °C -80 °C to -0 °C 0°C to 100 °C 100°C to 300 °C 300°C to 400 °C 400°C to 630 °C 630°C to 800 °C	0.040 °C 0.040 °C 0.060 °C 0.080 °C 0.080 °C 0.10 °C 0.18 °C	Fluke 5520
Pt 3926, 100 Ω	-200°C to -80°C -80 °C to 0 °C 0°C to 100 °C 100°C to 300 °C 300°C to 400 °C 400°C to 630 °C	0.040 °C 0.040 °C 0.060 °C 0.080 °C 0.080 °C 0.10 °C	
PtNi 385, 120 Ω	-80 °C to 0 °C 0 °C to 100 °C 100 °C to 260 °C	0.090 °C 0.090 °C 0.15 °C	
Cu 427, 10 Ω	-100 °C to 260 °C	0.30 °C	

Parameter/Equipment	Range	CMC ^{2, 6, 7} (\pm)	Comments
Oscilloscopes ³			
DC:			Fluke 5520A/SC1100
50 Ω	(0 to \pm 6.6) V	0.27 % + 40 μ V	
1 M Ω	(0 to \pm 130) V	0.06 % + 40 μ V	
Square Wave:			
50 Ω	(0 to \pm 6.6) V (10 Hz to 10 kHz)	0.35 % + 40 μ V	
1 M Ω	(0 to \pm 130) V (10 Hz to 10 kHz)	0.20% + 40 μ V	
Leveled Sine Flatness (Relative to 50 kHz)	5 mV to 5.5 V 50 kHz to 100 MHz (100 to 300) MHz (300 to 600) MHz 600 MHz to 1.1 GHz	2.5 % + 100 μ V 3.0 % + 100 μ V 5.0 % + 100 μ V 7.0 % + 100 μ V 9.0 % + 300 μ V	
Time Mark (50 Ω)	(2 to 5) ns 10 ns (20 to 50) ns 100 ns to 20 ms 50 ms to 5 s	4 μ s/s 4 μ s/s 4 μ s/s 4 μ s/s (50 + 1000t) μ s/s	t = time in seconds
Frequency	1 kHz to 10 MHz	4 μ s/s of setting	
Radar Guns – Fixed Points ³			
K and KA Band	25.3 MPH	2.4 MPH	Tuning Forks
K and KA Band	40.3 MPH	2.4 MPH	
KA Band	55.3 MPH	2.4 MPH	
Welding Devices ^{3, 7}	(0 to 350) ADC (0 to 100) VDC	1 % 0.050 VDC	Loadbank and DMM

IV. Mechanical

Parameter/Equipment	Range	CMC ² (±)	Comments
Indirect Verification of Rockwell Hardness Testers ³	HRA: (60 to 69) HRA (70 to 79) HRA (80 to 93) HRA HRB: (1 to 50) HRB (51 to 79) HRB (80 to 130) HRB HRC: (20 to 39) HRC (40 to 59) HRC (60 to 70) HRC HR30N: (40 to 59) HR30N (60 to 76) HR30N (77 to 85) HR30N HR30T: (20 to 49) HR30T (50 to 56) HR30T (57 to 85) HR30T HR15N: (40 to 79) HR15N (80 to 89) HR15N (90 to 95) HR15N HR15T: (20 to 79) HR15T (80 to 87) HR15T (88 to 100) HR15T HR45N: (10 to 49) HR45N (50 to 66) HR45N (67 to 75) HR45N HR45T: (1 to 39) HR45T (40 to 49) HR45T (50 to 75) HR45T	0.78 HRA 0.43 HRA 0.38 HRA 0.73 HRB 0.93 HRB 0.95 HRB 0.60 HRC 0.61 HRC 0.75 HRC 0.56 HR30N 0.65 HR30N 0.67 HR30N 0.50 HR30T 0.48 HR30T 0.48 HR30T 0.59 HR15N 0.46 HR15N 0.44 HR15N 0.57 HR15T 0.45 HR15T 0.36 HR15T 0.94 HR45N 0.42 HR45N 0.75 HR45N 0.64 HR45T 0.71 HR45T 0.98 HR45T	Master hardness test blocks using an in-house procedure (Note this CAB does not meet ASTM E18-14)

Parameter/Equipment	Range	CMC ² (±)	Comments
Indirect Verification of Brinell Hardness Testers at Test Conditions ³ – HBW 5/750 HBW 10/3000	(100 to 200) HBW (300 to 400) HBW (500 to 600) HBW	2.4 HBW 4.8 HBW 14 HBW	Master hardness test blocks using an in-house procedure (Note this CAB does not meet ASTM E18-14)
Indirect Verification of Vickers Hardness Testers ³ (@ 500 gf)	(200 to 400) HV (400 to 750) HV	5.9 HV 7.4 HV	Master hardness test blocks using in-house procedure (Note this CAB does not meet ASTM E18-14)
Indirect Verification of Knoop Hardness Testers ³ (@ 500 gf)	(100 to 200) HK (300 to 400) HK (500 to 600) HK	2.1 HK 4.0 HK 6.1 HK	Master hardness test blocks using an in-house procedure (Note this CAB does not meet ASTM E18-14)
Force Gages – Tension & Compression ³	Up to 500 lbf	0.39 lbf	Weights
Load Cells	Up to 100 000 lb	1.2 % of indicated value	Tinius Olsen
Pressure ³	Up to 4000 psi (2000 to 20000) psi (4000 to 40000) psi Up to 5 psi (5 to 50) psi (50 to 500) psi	0.030 + (0.000015 × a) psi 0.040 + (0.000029 × a) psi 0.060 + (0.000043 × a) psi 0.0013 + (0.0000133 × a) psi 0.011 + (0.0000138 × a) psi 0.0045 + (0.0000169 × a) psi	Deadweight tester a = applied pressure at the calibration value Primary pressure standard
Pressure Measuring Equipment ³	(0 to 30) psi (30 to 100) psi (100 to 200) psi (200 to 300) psi	0.011 psi 0.11 psi 0.15 psi 0.21 psi	Multifunction calibrator

Parameter/Equipment	Range	CMC ² (±)	Comments
Torque Transducers	Up to 4000 ft·lbf	0.45 % of full scale	Torque arms, weights
Torque Wrenches ³	Up to 2000 ft·lbf (2000 to 4000) ft·lbf	0.80 % of indicated value 1.0 % of indicated value	Torque transducers
Gapman Gages	Up to 1 in Up to 25 mm	58 μin 1.5 μm	Gage blocks
Vacuum – Measuring Equipment ³	(-30 to 0) inHg	0.030 inHg	Multifunction calibrator

V. Thermodynamics

Parameter/Equipment	Range	CMC ^{2, 7} (±)	Comments
Relative Humidity Measuring Equipment – Fixed Points ³	11 % RH 33 % RH 53 % RH 75.5 % RH 90 % RH	2.8 % RH 2.7 % RH 2.8 % RH 2.8 % RH 2.8 % RH	Rotronic HygroPalm/ saturated salts
Relative Humidity – Measure ³	(10 to 90) % RH	3.4 % RH	Rotronic HygroPalm
Temperature – Measuring Equipment, Glass Thermometers ³	(33 to 600) °C	1.1 °C	Instrulab 4202/ Ametek CTC-660
Temperature / Humidity Recorders ³ – Environmental Monitors/Recorders	(-73 to 190) °C (11 to 90) % RH	0.45 °C 3.6 %	Environmental Chamber, temperature standards Salts

Parameter/Equipment	Range	CMC ^{2, 6} (\pm)	Comments
Ovens, Furnaces, & Freezers ³	(33 to 600) °C	1.1 °C	Temperature/ humidity standards and probe
Temperature – IR Measuring Equipment ³	(50 to 500) °C	1.5 °C	Fluke 9132

VI. Time & Frequency

Parameter/Equipment	Range	CMC ^{2, 6, 7} (\pm)	Comments
Tachometers	Up to 10 000 RPM	0.030 %	Frequency counter
Tachometers – Non-Contact ³	Up to 199 999 RPM	0.030 %	Function generator
Stop Watches ³	Up to 24 hours	0.35 s	Comparison
Frequency – Measure ⁷	(1 to 40) Hz 40 Hz to 10 MHz	0.43 % 0.18 %	Agilent 3458
Frequency – Measuring Equipment ³	0.01 Hz to 2 MHz 2 MHz to 1.1 GHz	3.4 μ Hz/Hz + 5.0 μ Hz 5.0 μ Hz/Hz	Fluke 5520A Fluke 5520A w/ SC1100

¹ This laboratory offers commercial dimensional testing/calibration service and field calibration service.

² Calibration and Measurement Capability Uncertainty (CMC) uncertainty 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. CMC's 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 uncertainty 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 and this laboratory meets A2LA R104 – *General Requirements: Accreditation of Field Testing and Field Calibration Laboratories* for these calibrations. 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, L is the numerical value of the nominal length of the device measured in inches or meters. DL is the diagonal length measured in inches or meters. R is the resolution of the unit under test. D is the numerical value of the nominal diameter of the device measured in inches or meters.
- ⁵ This laboratory meets R205 – *Specific Requirements: Calibration Laboratory Accreditation Program* for the types of dimensional tests listed above and is considered equivalent to that of a calibration.
- ⁶ 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. CMC uncertainties are expressed as either a specific value that covers the full range or as a percent/fraction of the reading plus a fixed floor specification.
- ⁷ In the statement of CMC, percentage (%) refers to percent of reading, unless otherwise noted.



Accredited Laboratory

A2LA has accredited

MSI-VIKING GAGE, LLC

N. Charleston, SC

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/NC SLI Z540-1-1994 and any additional program requirements in the field of calibration. 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 8 January 2009).



Presented this 13th day of November, 2015.

A handwritten signature in black ink, appearing to read "Peter Abney".

President & CEO

For the Accreditation Council

Certificate Number 1780.01

Valid to September 30, 2017

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