



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, 2019

Certificate Number: 1387.03

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 (0.86 + 0.0011D) μm	Master rings
Dial Bore Gages (Bore Gage w/ Indicator)	Up to 12 in Up to 304.8 mm	0.61R 0.61R	Indicator calibrator
Calipers ³	Up to 24 in (24 to 80) in Up to 610 mm (610 to 2032) mm	0.60R (16L - 25) μin 0.60R (0.016L - 0.62) μm	Caliper checker, gage blocks
Caliper Checkers	Up to 12 in (25 to 305) mm	(11 + 1.9L) μin (0.28 + 0.0019L) μm	Electronic indicator amplifier, gage blocks
Caliper Gage ³ – Internal, External	Up to 20 in Up to 508 mm	0.60R 0.60R	Gage blocks, ring gages
Depth Step Gages	(0.5 to 11.5) in (12.7 to 290) mm	(14 + 0.49L) μin (0.36 + 0.000 49L) μm	Electronic indicator amplifier, gage blocks

Parameter/Equipment	Range	CMC ^{2,4} (±)	Comments			
Cylindrical Ring Gages ³	Up to 0.43 in (0.43 to 17) in	4.3 μin (11 + 0.63D) μin	Universal length machine, master rings, gage blocks			
	Up to 10.80 mm (15.24 to 430) mm	0.11 μm (0.28 + 0.000 63D) μm				
	Up to 13 in Up to 330.2 mm	(2.5 + 6.5D) μin (0.07 + 0.0065D) μm	CMM			
	Up to 6 in Up to 152.4 mm	(11 + 0.89L) μin (0.28 + 0.023L) μm	Vision System			
Disc, Plug and Pin Gages ³	Up to 20.0 in Up to 508 mm	(11 + 0.70L) μin (0.28 + 0.0007L) μm	Universal length machine (ULM), gage blocks			
Electronic Indicator Amplifier ³	Up to 0.02 in Up to 0.508 mm	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 –	Up to 12 in Up to 304.6 mm	(11 + 0.89L) μin (0.28 + 0.023L) μm	Vision system			
			Flatness	Up to 12 in Up to 304.8 mm	28 μin 0.70 μm	Electronic indicator amplifier
			Parallelism	Up to 12 in Up to 304.8 mm	26 μin 0.66 μm	

Parameter/Equipment	Range	CMC ^{2,4} (±)	Comments
Cylindrical Square – Straightness Roundness	Up to 12 in Up to 10 in	37 μin (1.3 + 1.8D) μin	Roundness machine
Glass Scales	Up to 12 in Up to 304.6 mm	(11 + 0.89L) μin (0.28 + 0.023L) μm	Vision system
Height Gages ³	Up to 48 in Up to 1219.2 mm	0.60R μin 060R μm	Gage blocks
Indicators/LVDTs ³	0.00001 in 0.00005 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 0.60R μin 0.60R μin 0.60R μin 0.60R μin 0.60R μin 0.60R μin 0.60R μin 0.60R μin 0.60R μin	Gage blocks, Indicator calibrator
Length Standards	Up to 20 in (20 to 40) in Up to 508 mm (508 to 1016) mm	(6.6 + 0.88L) μin (16 + 0.89L) μin (0.17 + 0.00088L) μm (0.41 + 0.00089L) μm	Universal length machine (ULM), gage blocks, electronic ind amp
Levels	Up to 12 in Up to 304.8 mm	140 μin 3.6 μm	Surface plate, sine bar, gage blocks

Parameter/Equipment	Range	CMC ^{2,4} (\pm)	Comments
Micrometers ³ –	Up to 48 in Up to 1219.2 mm	0.60R μ m 0.60R μ m	Gage blocks
Groove	Up to 4 in Up to 101.6 mm	0.60R μ m 0.60R μ m	Gage blocks
Depth	Up to 12 in Up to 304.8 mm	0.60R μ m 0.60R μ m	Gage blocks
Inside	Up to 16 in Up to 406.4 mm	0.60R μ m 0.60R μ m	Universal length machine
Specialty Micrometers	Up to 4 in Up to 101.6 mm	0.60R μ m 0.60R μ m	Master pins
Indicator Calibrators ³ (Mic Head Type)	Up to 1 in Up to 25.4 mm	(19 + 0.10L) μ m (0.48 + 0.0001L) μ m	LVDT's
Parallels	Up to 12 in Up to 304.8 mm	26 μ m 0.66 μ m	Electronic Gage Amplifier
Plain Pins Class ZZ ³	Up to 2 in Up to 50.8 mm	29 μ m 0.73 μ m	Laser micrometer
	Up to 2 in Up to 50.8 mm	(6.6 + 0.88L) μ m (0.17 + 0.000 88L) μ m	Universal length machine
Protractor			
Bevel	Up to 180°	2.3 arcsec	Vision system
Digital	Up to 90°	27 arcsec	Sine plate, gage blocks
Spheres/Roundness	(1 to 10) in (25.4 to 254) mm	(1.4 + 1.8D) μ m (0.036 + 0.0018D) μ m	Roundness machine
Steel Rules	Up to 12 in Up to 304.8 mm	(11 + 0.89L) μ m (0.28 + 0.023L) μ m	Vision system, direct comparison
	(12 to 72) in (304.8 to 1828.8) mm	74 μ m 1.9 μ m	

Parameter/Equipment	Range	CMC ^{2,4} (±)	Comments
Steel Tapes	Up to 26 ft Up to 100 ft	0.04 in 0.06 in	Direct comparison
Pi Tapes	(8 to 17) in (203 to 432) mm	950 µin 24 µm	Master disc gage
	(17 to 36) in (432 to 914) mm	940 µin 24 µm	Vision machine
	(36 to 144) in (914 to 3600) mm	2200 µin 55 µm	Optical 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 + 0.000 88L) 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 (0.36 + 0.0014L) µm	Master pin gages
Screw Thread Micrometer	Up to 2 in	0.60R µin	Gage blocks, thread setting plug
	Up to 50.0 mm	0.60R µm	
Screw Thread Micrometer Standards	Up to 12 in Up to 304.8 µm	(11 + 0.89L) µin (0.28 + 0.023L) µm	Vision system
Snap Gage ³ –	Flatness of Anvils	Up to 3 in Up to 76.2 mm	6.9 µin 0.18 µm

Parameter/Equipment	Range	CMC ^{2,4} (±)	Comments
Universal Measuring Machines/Bench Micrometers ³	Up to 21.5 in Up to 546.1 mm	(6.6 + 0.88L) μin (0.17 + 0.000 88L) μm	Gage blocks
CMM/Articulating Arm CMM's ³ –			
Hysteresis Scale Displacement	Up to 0.500 in Up to 40 in	94 μin 270 μm	Ball bar set, gage blocks
Hysteresis Scale Displacement	Up to 12.5 mm Up to 1000 mm	2.4 μm 6.8 μm	
Volumetric Repeatability	Up to 40 in Up to 1000 mm	330 μin 8.3 μm	Ball bar tests
Radius Gages	Up to 12 in Up to 304.8 μm	(11 + 0.89L) μin (0.28 + 0.023L) μm	Vision system
Adjustable Thread Rings ⁸	Up to 2.5 in	W (Set Plug Tolerance)	Set using master plug gages. ASME/ANSI B1.2-1983 and ASME/ANSI B1.3-2007
NPT Tapered Thread Rings –			
Standoff	Up to 1.5 in Up to 38 mm	77 μin 2.0 μm	Electronic indicator, master NPT plug
Ring Thickness	Up to 1.5 in Up to 38 mm	(8.2 + 1.2L) μin (0.21 + 0.0012L) μm	Universal length machine (ULM)
Gapman Gages	Up to 1 in Up to 25 mm	58 μin 1.5 μm	Gage blocks

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 + 0.000 49L) 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°	2.3 arcsec	Vision system
Chamfer Check Gages	Set Ring Effective Diameter	49 μin	Chamfer check master, set ring
	Gage Probe Angle	2.3 arcsec	Vision system
Optical Comparators ³ –			
Horizontal Linearity	Up to 12 in Up to 304.8 mm	(160 + 3.3L) μin (4.1 + 0.0033L) μm	Glass master
Vertical Linearity	Up to 9 in Up to 228.6 mm	(160 + 5.4L) μin (3.9 + 0.0054L) 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} (\pm)	Comments
Bolt Protrusion Gauges	Up to 12 in Up to 304.8 mm	(11 + 0.89L) μ in (0.28 + 0.023L) μ m	Vision system
Thread Plugs ³ –			
Major Diameter	Up to 8 in Up to 203.2 mm	(8.2 + 1.2L) μ in (0.21 + 0.0012L) μ m	Universal length machine
Pitch Diameter	Up to 80 TPI Up to 4.0 mm pitch	(65 + 0.32L) μ in (1.7 + 0.00032L) μ m	Universal length machine, thread measuring wires
Tapered Thread Plug Gage – Pitch Diameter	Up to 4 in Up to 101.6 mm	(65 + 0.32L) μ in (1.7 + 0.00032L) μ m	Universal length machine, gage blocks
Step	Up to 1 in Up to 25.4 mm	59 μ in 1.5 μ m	Gage blocks
Crimping Tools	Go/No Go Crimp Height Pullout Test	0.0010 in 0.00030 μ in 2.0 lb	Pin gages Point micrometer Force gage, master weights
Gage Block Comparator ³	Up to 4 in Up to 100 mm	(5.1 + 0.80L) μ in (0.13 + 0.0008L) μ m	Master gage blocks
ID/OD Comparator ³	Up to 10 in Up to 250 mm	(8.8 + 0.80L) μ in (0.22 + 0.0008L) μ m	Gage blocks
Electronic Levels	Angular: +/- 990 arcsec Linear: +/- 0.005 in (Differential Mode)	2.3 arcsec 19 μ in	Surface plate, sine bar, gage blocks

Parameter/Equipment	Range	CMC ^{2,4} (±)	Comments
Surface Plates ³ – Flatness Repeatability	Up to 108 in diagonal line Localized Up to 108 in diagonal line	(23 + 0.48DL) μin 38 μin	Electronic levels Repeat reading indicator
Tool Makers Microscopes ³ , Linearity	Up to 12 in Up to 304.8 mm	250 μin 6.1 μin	Glass master
Contour/Contour Systems ³ – Tracing Arm Length and Stylus Tip Height Pick-Up Sensitivity Probe Deflection Repeatability Stylus Tip Form and Radius	Up to 14 in Up to 350 mm 2 in 50 mm 0 Base 3 mm	7.8 μin 0.20 μm 46 μin 1.2 μm 0.15 μin 0.004 μm 9.1 μin 0.23 μm	Gage blocks, pin gages, optical flats

II. Dimensional Testing/Calibration¹

Parameter/Equipment	Range	CMC ^{2,4} (±)	Comments
Surface Finish ⁵ –	(2 to 500) μin (0.05 to 12.5) μm	4.0 μin 0.10 μm	Master surface finish patch

Parameter/Equipment	Range	CMC ^{2,4} (±)	Comments
Geometric Measurements ⁵	X (Up to 36 in) (Up to 900 mm)	(7.9 + 0.5L) μin (0.19 + 0.0005L) μm	CMM
	Y (Up to 48 in) (Up to 1200 mm)	(11 + 0.29L) μin (0.254 + 0.000 29L) μm	
	Z (Up to 32 in) (Up to 800 mm)	(7.7 + 1.3L) μin (0.19 + 0.0013L) μm	
	Volume (36 x 48 x 32 in) (900 x 1200 x 800 mm)	(3.8 + 1.3L) μin (0.08 + 0.0013L) μm	
Roundness ⁵	Up to 10 in Up to 254 mm	(9.4 + 1.3D) μin (0.24 + 0.00013D) μm	Roundness machine
Go/No-go Gages ⁵	Up to 6 in	0.00030 μin	Rings, plugs, pins, hand tools
2D Optical Inspection ⁵ –			
Horizontal Linearity	Up to 12 in Up to 304.8 mm	(160 + 3.3L) μin (4.1 + 0.0033L) μm	Optical comparator
Vertical Linearity	Up to 9 in Up to 228.6 mm	(160 + 5.4L) μin (4.1 + 0.0054L) μm	
Angle	Up to 180°	12 μin 0.30 μm	
Go/No-go Gages ⁵	Up to 12 in Up to 304.8 mm	(11 + 0.89L) μin (0.28 + 0.023L) μm	Vision system
	Up to 21.5 in Up to 546.1 mm Ext. Measurement	(6.6 + 0 .88L) μin (0.17 + 0.000 88L) um	Universal length machine
	Up to 17 in Int. Measurement	(11 + 0.63D) μin	Electronic indicator amplifier, gage blocks
	Step Gages	(14 + 0.49L) μin (0.36 + 0.000 49L) um	

Parameter/Equipment	Range	CMC ^{2,4} (±)	Comments
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	26 µin 0.66 µm	Electronic gage amplifier
Radius ⁵	Up to 12 in Up to 304.8 mm	(11 + 0.89L) µin (0.28 + 0.023L) µm	Vision system
Straightness ⁵	Up to 12 in Up to 304.8 mm	37 µin 0.93 µm	Electronic indicator amplifier
Video Measurement ⁵ – X, Y Axis Z Axis	Up to 12 in Up to 304.8 mm Up to 6 in Up to 152.4 mm	(11 + 0.89L) µin (0.28 + 0.023L) µm (14 + 0.49L) µin (0.36 + 0.000 49L) µm	Vision system
Angular Measurements ⁵	Up to 360 deg	2.3 arcsec	Vision system

III. Electrical – DC/Low Frequency

Parameter/Equipment	Range	CMC ^{2,6} (±)	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 µV/V + 0.30 µV 4.2 µV/V + 0.30 µV 4.2 µV/V + 0.50 µV 11 µV/V + 0.30 mV 8 µV/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

Parameter/Equipment	Range	CMC ^{2,6} (\pm)	Comments
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
High Current – Measure ³ DC Up to 60 Hz ³	(1 to 15) A (15 to 100) A (100 to 300) A (300 to 5000) A	1.9 mA/A + 4.5 μ A 0.029 % + 0.3 mA 0.015 % + 0.9 mA 0.012 % + 15 mA	Current shunt w/ 6.5 digit voltmeter
DC Current – Generate ³	(1 to 329.999) μ A (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 (10 to 16.499) A (16.5 to 149.999) A (150 to 950) A	0.016 % + 20 nA 0.011 % + 50 nA 0.010 % + 250 nA 0.011 % + 3.0 μ A 0.021 % + 40 μ A 0.039 % + 40 μ A 0.051 % + 500 μ A 0.12 % + 750 μ A 1.0 % + 50 mA 1.0 % + 75 mA 1.0 % + 75 mA	Fluke 5520A Fluke 5520A w/ Fluke 5500A Coil

Parameter/Range	Frequency	CMC ^{2, 6} (\pm)	Comments
Resistance – Measure ³	(0 to 10) Ω (10 to 100) Ω 100 Ω to 1 k Ω (1 to 100) k Ω 100 k Ω to 1 M Ω (1 to 10) M Ω (10 to 100) M Ω	18 $\mu\Omega/\Omega$ + 50 $\mu\Omega$ 13 $\mu\Omega/\Omega$ + 500 $\mu\Omega$ 11 $\mu\Omega/\Omega$ + 500 $\mu\Omega$ 11 $\mu\Omega/\Omega$ + 50 m Ω 16 $\mu\Omega/\Omega$ + 2.0 Ω 53 $\mu\Omega/\Omega$ + 100 Ω 0.070 % + 1.0 k Ω	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 1.099 999) k Ω (1.1 to 3.299 999) k Ω (3.3 to 10.999 99) k Ω (11 to 32.999 99) k Ω (33 to 109.9999) k Ω (110 to 329.9999) k Ω (0.33 to 1.099 999) M Ω (1.1 to 3.299 99) M Ω (3.3 to 10.999 99) M Ω (11 to 32.999 99) M Ω (33 to 109.9999) M Ω (110 to 329.9999) M Ω (330 to 1100) M Ω	42 $\mu\Omega/\Omega$ + 10 m Ω 34 $\mu\Omega/\Omega$ + 15 m Ω 31 $\mu\Omega/\Omega$ + 15 m Ω 31 $\mu\Omega/\Omega$ + 20 m Ω 32 $\mu\Omega/\Omega$ + 20 m Ω 34 $\mu\Omega/\Omega$ + 200 m Ω 30 $\mu\Omega/\Omega$ + 100 m Ω 31 $\mu\Omega/\Omega$ + 1.0 Ω 30 $\mu\Omega/\Omega$ + 1.0 Ω 36 $\mu\Omega/\Omega$ + 10 Ω 37 $\mu\Omega/\Omega$ + 10 Ω 62 Ω/Ω + 150 Ω 0.014 % + 250 Ω 0.026 % + 2.5 k Ω 0.052 % + 3.0 k Ω 0.34 % + 100 k Ω 1.7 % + 500 k Ω	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 3.299 99) 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 % + 130 μV 0.26 % + 600 μV	
3.3 V 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 1 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 (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} (±)	Comments	
AC Current – Generate ³				
(29 to 329.99) μA	(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 μA 0.20 % + 0.10 μA 0.20 % + 0.10 μA 0.40 % + 0.20 μA 1.0 % + 0.20 μA 1.7 % + 0.40 μA	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 μA 0.20 % + 0.20 μA 0.20 % + 0.20 μA 0.30 % + 0.20 μA 0.60 % + 0.30 μA 1.1 % + 0.60 μA		
(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 μA 0.10 % + 2.0 μA 0.050 % + 2.0 μA 0.10 % + 2.0 μA 0.30 % + 3.0 μA 0.50 % + 4.0 μA		
(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 μA 0.10 % + 20 μA 0.060 % + 20 μA 0.20 % + 50 μA 0.30 % + 100 μA 0.50 % + 200 μA		
(.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 μA 0.10 % + 100 μA 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 μA 0.070 % + 100 μA 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 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 % + 1.9 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 and Thermocouple Indicating Systems ³			
Type B	(600 to 800) °C (800 to 1000) °C (1000 to 1550) °C (1550 to 1820) °C	0.50 °C 0.35 °C 0.35 °C 0.34 °C	Fluke 5520A
Type C	(0 to 150) °C (150 to 650) °C (650 to 1000) °C (1000 to 1800) °C (1800 to 2316) °C	0.30 °C 0.28 °C 0.31 °C 0.55 °C 0.90 °C	
Type E	(-250 to -100) °C (-100 to -25) °C (-25 to 350) °C (350 to 650) °C (650 to 1000) °C	0.50 °C 0.23 °C 0.22 °C 0.23 °C 0.27 °C	
Type J	(-210 to -100) °C (-100 to -30) °C (-30 to 150) °C (150 to 760) °C (760 to 1200) °C	0.32 °C 0.23 °C 0.17 °C 0.20 °C 0.25 °C	
Type K	(-200 to -100) °C (-100 to -25) °C (-25 to 120) °C (120 to 1000) °C (1000 to 1372) °C	0.37 °C 0.25 °C 0.23 °C 0.31 °C 0.42 °C	
Type L	(-200 to -100) °C (-100 to 800) °C (800 to 900) °C	0.40 °C 0.31 °C 0.24 °C	
Type N	(-200 to -100) °C (-100 to -25) °C (-25 to 120) °C (120 to 410) °C (410 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 and Thermocouple Indicating Systems ³ – (cont)			
Type R	(0 to 250) °C (250 to 400) °C (400 to 1000) °C (1000 to 1767) °C	0.60 °C 0.40 °C 0.37 °C 0.42 °C	Fluke 5520A
Type S	(0 to 250) °C (250 to 1000) °C (1000 to 1400) °C (1400 to 1767) °C	0.48 °C 0.39 °C 0.40 °C 0.50 °C	
Type T	(-250 to -150) °C (-150 to 0) °C (0 to 120) °C (120 to 400) °C	0.65 °C 0.25 °C 0.20 °C 0.15 °C	
Type U	(-200 to 0) °C (0 to 600) °C	0.56 °C 0.32 °C	
Electrical Calibration of RTD Indicating System ³ –			
Pt 385, 100 Ω	(-200 to -80) °C (-80 to 0) °C (0 to 100) °C (100 to 300) °C (300 to 400) °C (400 to 630) °C (630 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 to -80) °C (-80 to 0) °C (0 to 100) °C (100 to 300) °C (300 to 400) °C (400 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 to 0) °C (0 to 100) °C (100 to 260) °C	0.090 °C 0.090 °C 0.15 °C	
Cu 427, 10 Ω	(-100 to 260) °C	0.30 °C	

Parameter/Equipment	Range	CMC ^{2, 6, 7} (\pm)	Comments	
Oscilloscopes ³				
DC:				
50 Ω	(0 to \pm 6.6) V	0.27 % + 40 μ V	Fluke 5520A/SC1100	
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	0.2 % + 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 % + 100 μ V 5 % + 100 μ V 7 % + 100 μ V 9 % + 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	(0 to 350) ADC (0 to 100) VDC	1 % 0.05 VDC	Loadbank and DMM/Shunt	

IV. Mechanical

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

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 and Compression ³	Up to 500 lbf	0.39 lbf	Tinius Olsen/weights
Load Cells	Up to 100 000 lb	1.2 % of indicated value	Tinius Olsen/weights
Pressure ³	Up to 4000 psi (2000 to 20 000) psi (4000 to 40 000) psi Up to 5 psi (5 to 50) psi (50 to 500) psi	0.03 + (0.000 015 × a) psi 0.04 + (0.000 029 × a) psi 0.06 + (0.000 043 × a) psi 0.0013 + (0.000 013 × a) psi 0.011 + (0.000 014 × a) psi 0.0045 + (0.000 017 × a) psi	Deadweight tester Primary pressure standard a = applied pressure at the calibration value
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
Vacuum – Measuring Equipment ³	(-30 to 0) in·Hg	0.030 in·Hg	Multifunction calibrator
Scales and Balances ³	(50 to 500) lb	0.98 lb	Weights
	(10 to 100) mg	0.35 mg	Weights
	(100 to 500) mg	0.35 mg	
	(1 to 5) g	0.34 mg	
	(5 to 10) g	0.31 mg	
	(10 to 20) g	0.32 mg	
	(20 to 50) g	1.7 mg	
	(50 to 100) g	3.0 mg	
	(100 to 200) g	3.1 mg	
	(200 to 500) g	3.5 mg	
	(500 to 1000) g	30 mg	
	(1 to 2) kg	49 mg	
(2 to 5) kg	120 mg		
(5 to 10) kg	230 mg		
(10 to 20) kg	450 mg		
Mass – Measure	(0.001 to 210) g	(0.15 + 0.004M) mg	Comparators w/std weights
	(210 to 30 000) g	(30 + 0.005M) mg	
Air Velocity – Measuring Equipment	(500 to 8000) fpm	(22 + 0.01V) fpm	Comparison of standard probe w/ UUT using wind tunnel

V. Thermodynamics

Parameter/Equipment	Range	CMC ^{2, 6, 7} (\pm)	Comments
Relative Humidity Measuring Equipment – Fixed Points ³	11 % RH 33 % RH 53 % RH 75.5 % RH 90 % RH	(1.3 + 0.001H) % RH (1.3 + 0.001H) % RH (1.3 + 0.001H) % RH (1.3 + 0.001H) % RH (1.3 + 0.001H) % RH	Rotronic HygroPalm/ saturated salts
Relative Humidity – Measure ³	(10 to 90) % RH	(1.3 + 0.001H) % RH	Rotronic HygroPalm
Temperature – Measuring Equipment, Glass Thermometers ³	(-50 to 500) °C	0.20 °C	Dry block w/ RTD
Temperature / Humidity Recorders ³ – Environmental Monitors/Recorders	(-73 to 190) °C (11 to 90) % RH	0.45 °C (1.3 + 0.001H) % RH	Environmental chamber, temperature standards, humidity standards
Temperature- Measure Ovens, Furnaces, and Freezers ³	(-50 to 500) °C	0.20 °C	RTD w/ indicator
Temperature – IR Measuring Equipment ³	(50 to 500) °C	(0.77 + 0.007T) °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

Parameter/Equipment	Range	CMC ^{2, 6, 7} (\pm)	Comments
Stop Watches/Time Measurements ³	Up to 24 hours	0.35 s 0.04 s	Comparison Totalize w/GPS
Frequency – Measure	(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. V is the velocity of the reading. H is the Humidity of the reading. M is the mass of the reading in grams or pounds.

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/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 8 January 2009).



Presented this 27th day of October 2017

A handwritten signature in blue ink, written over a horizontal line.

President and CEO
For the Accreditation Council
Certificate Number 1387.03
Valid to September 30, 2019

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



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

MSI-VIKING GAGE, LLC.
321 Tucapau Road
Duncan, SC 29334
Martin McKinnon Phone: 864 433 9771

CALIBRATION

Valid To: September 30, 2019

Certificate Number: 1387.01

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 ^{2,4} (\pm)	Comments
Bore Micrometers	Up to 12 in Up to 304.8 mm	$(34 + 1.2D) \mu\text{in}$ $(0.86 + 0.0012D) \mu\text{m}$	Master rings
Dial Bore Gages (Bore Gage w/ Indicator)	Up to 12 in Up to 304.8 mm	0.61R 0.61R	Indicator calibrator
Calipers ³	Up to 24 in (24 to 80) in Up to 610 mm (610 to 2032) mm	0.60R (16L - 25) μin 0.60R (0.016L - 0.62) μm	Caliper checker, gage blocks
Caliper Checkers	Up to 12 in (25 to 305) mm	$(11 + 1.9L) \mu\text{in}$ $(0.28 + 0.0019L) \mu\text{m}$	Electronic indicator amplifier, gage blocks
Caliper Gage ³ – Internal, External	Up to 20 in Up to 508 mm	0.60R 0.60R	Gage blocks, ring gages
Depth Step Gages	(0.5 to 11.5) in (12.7 to 290) mm	$(14 + 0.49L) \mu\text{in}$ $(0.36 + 0.00049L) \mu\text{m}$	Electronic indicator amplifier, gage blocks

Parameter/Equipment	Range	CMC ^{2, 4} (±)	Comments	
Cylindrical Ring Gages ³	Up to 0.425 in (0.425 to 17) in	4.3 μin (11 + 0.63D) μin	828 CIM universal length machine, master rings, gage blocks	
	Up to 10.80 mm (15.24 to 430) mm	0.11 μm (0.28 + 0.000 63D) μm		
	Up to 13 in Up to 330.2 mm	(9.3 + 6.3D) μin (0.24 + 0.0063D) μm	CMM	
	Up to 6 in Up to 152.4 mm	(16 + 0.28D) μin (0.41 + 0.007D) μm	Vision system	
Disc, Plug and Pin Gages ³	Up to 21.5 in Up to 545 mm	(6.6 + 0.88L) μin (0.17 + 0.000 88L) μm	Universal length machine	
Electronic Indicator Amplifier ³	Up to 0.02 in Up to 0.508 mm	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 –				
	Length	Up to 12 in	(11 + 0.89L) μin	Vision system
	Flatness	Up to 12 in Up to 304.8 mm	28 μin 0.70 μm	Electronic indicator amplifier
Parallelism	Up to 12 in Up to 304.8 mm	26 μin 0.66 μm		

Parameter/Equipment	Range	CMC ^{2,4} (±)	Comments
Cylindrical Square – Straightness Roundness	Up to 12 in Up to 10 in	37 μin (1.3 + 1.8D) μin	Roundness machine
Glass Scales	Up to 12 in Up to 304.6 mm	(11 + 0.89L) μin (0.28 + 0.023L) μm	Vision system
Gage Blocks – Length Only	Up to 1 in (1 to 20) in Up to 25.4 mm (25.4 to 508) mm	3.5 μin (2.6 + 0.80L) μin 0.09 μm (0.07 + 0.0008L) μm	Master gage blocks (direct comparison)
Height Gages ³	Up to 36 in Up to 914.4 mm	0.60R μin 0.60R μm	Gage blocks
Indicators/LVDTs ³	Up to 4 in 0.00001 in 0.00005 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 0.60R μin 0.60R μin 0.60R μin 0.60R μin 0.60R μin 0.60R 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 mm (508 to 1016) mm	(6.6 + 0.88L) μin (16 + 0.89L) μin (0.17 + 0.022L) μm (0.41 + 0.000 89L) μm	Universal length machine (ULM), gage blocks, electronic ind amp

Parameter/Equipment	Range	CMC ^{2,4} (\pm)	Comments
Levels	Up to 12 in Up to 304.8 mm	0.60R μ in 0.60R μ m	Surface plate, sine bar, gage blocks
Micrometers ³ –	Up to 48 in Up to 1219.2 mm	0.60R μ in 0.60R μ m	Gage blocks
Groove	Up to 4 in Up to 101.6 mm	0.60R μ in 0.60R μ m	Gage blocks
Depth	Up to 12 in Up to 304.8 mm	0.60R μ in 0.60R μ m	Gage blocks
Inside	Up to 16 in Up to 406.4 mm	0.60R μ in 0.60R μ m	Universal length machine
Specialty Micrometers	Up to 4 in Up to 101.6 mm	0.60R μ in 0.60R μ m	Master pins
Indicator Calibrators ³ (Mic Head Type)	Up to 1 in Up to 25.4 mm	(19 + 0.10L) μ in (0.48 + 0.0001L) μ m	LVDT's
Parallelism	Up to 12 in Up to 304.8 mm	26 μ in 0.66 μ m	Electronic indicator amplifier
Plain Pins Class ZZ ³	Up to 2 in Up to 50.8 mm	29 μ in 0.73 μ m	Laser micrometer
	Up to 2 in Up to 50.8 mm	(6.6 + 0.88L) μ in (0.17 + 0.000 88L) μ m	Universal Length Machine
Protractor			
Bevel	Up to 180°	2.3 arcsec	Vision system
Digital	Up to 90°	27 arcsec	Sine plate, gage blocks

Parameter/Equipment	Range	CMC ^{2,4} (\pm)	Comments
Snap Gage ³ – Flatness of Anvils	Up to 3 in Up to 76.2 mm	6.9 μ in 0.18 μ m	Optical flat
Size	Up to 1 in Up to 25.4 mm (1 to 20) in (25.4 to 508) mm	3.5 μ in 0.088 μ m (2.6 + 0.80L) μ in (0.066 + 0.0008L) μ m	Gage blocks
Spheres/Roundness	Up to 10 in Up to 254 mm	(1.3 + 1.8D) μ in (0.036 + 0.0018D) μ m	Roundness machine
Steel Rules	Up to 12 in Up to 304.8 mm (12 to 72) in (304.8 to 1828.8) mm	(11 + 0.89L) μ in (0.28 + 0.023L) μ m 74 μ in 1.9 μ m	Vision system Direct comparison
Steel Tapes	Up to 26 ft Up to 100 ft	0.04 in 0.06 in	Direct comparison
Pi Tapes	(8 to 17) in (203 to 432) mm (17 to 36) in (432 to 914) mm (36 to 144) in (914 to 3600) mm	950 μ in 24 μ m 940 μ in 24 μ m 2200 μ in 55 μ m	Master disc gage Vision system Optical comparison
Straightness	Up to 12 in Up to 304.8 mm	37 μ in 0.93 μ m	Electronic indicator amplifier
Thickness and Feeler Gage	Up to 2 in Up to 50.8 mm	(6.6 + 0.88L) μ in (0.17 + 0.022L) μ m	Universal length machine (ULM)
Thread Measuring Wires	(4 to 80) TPI (0.35 to 4.0) TP μ m	5.9 μ in 0.15 μ m	Universal length machine, gage blocks, master pins
Angle Blocks	Up to 90°	2.3 arcsec	Vision system

Parameter/Equipment	Range	CMC ^{2,4} (±)	Comments
Chamfer Check Gages	Set Ring Effective Diameter	49 μin	Chamfer check master, set ring
	Gage Probe Angle	2.3 arcsec	Vision system
Screw Thread Micrometer	Up to 2 in	0.60R μin	Gage blocks, thread setting plug
	Up to 50.0 mm	0.60R μm	
Screw Thread Micrometer Standards	Up to 12 in Up to 304.8 μm	(11 + 0.89L) μin (0.28 + 0.023L) μm	Vision system
Thread Plugs ³ –			
Major Diameter	Up to 8 in Up to 203.2 mm	(8.2 + 1.2L) μin (0.21 + 0.0012L) μm	Universal length machine
Pitch Diameter	Up to 80 TPI Up to 4.0 mm pitch	(65 + 0.32L) μin (1.7 + 0.00032L) 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 + 0.000 32L) μm	Universal length machine, gage blocks
Step	Up to 1 in Up to 25.4 mm	59 μin 1.5 μm	Gage blocks
Universal Measuring Machines/Bench Micrometers ³	Up to 21.5 in Up to 546.1 mm	(6.6 + 0.88L) μin (0.17 + 0.000 88L) μm	Gage blocks

Parameter/Equipment	Range	CMC ^{2,4} (±)	Comments
CMM/Articulating Arm CMM's ³ –			
Hysteresis Scale Displacement	Up to 0.500 in Up to 40 in	94 μin 270 μin	Ball bar set, gage blocks Ball bar tests
Hysteresis Scale Displacement	Up to 12.5 mm Up to 1000 mm	2.4 μm 6.8 μm	
Volumetric Repeatability	Up to 40 in Up to 1000 mm	330 μin 8.3 μm	
Laser Micrometers ³	Up to 4 in Up to 101.6 mm	(14 + 0.24L) μin (0.36 + 0.00024L) μm	Class XXX master pins
NPT Tapered Thread Rings –			
Standoff	Up to 1.5 in Up to 38 mm	77 μin 2.0 μm	Electronic indicator, master NPT plug
Ring Thickness	Up to 1.5 in Up to 38 mm	(8.2 + 1.2L) μin (0.21 + 0.0012L) μm	Universal length machine (ULM)
Video Measurement System ³ –			
X, Y Axis	Up to 12 in Up to 304.8 μm	(11 + 0.89L) μin (0.28 + 0.023L) μm	Calibration grid
Z Axis	Up to 6 in Up to 152.4 mm	(14 + 0.49L) μin (0.36 + 0.00049L) μm	Gage blocks
Radius Gages	Up to 12 in Up to 304.8 μm	(11 + 0.89L) μin (0.28 + 0.023L) μm	Vision system
Adjustable Thread Rings ⁸	Up to 2.5 in	W (Set Plug Tolerance)	Set using master plug gages. ASME/ANSI B1.2-1983 and ASME/ANSI B1.3- 2007

Parameter/Equipment	Range	CMC ² (±)	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	8.6 µin 0.22 µm	
Parallelism of Column to Table Axis Accuracy	Up to 12 in Up to 300 mm	8.3 µin 0.21 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	6.1 µin 0.16 µm	
Straightness	Up to 4 in Up to 101.6 mm	6.6 µin 0.17 µm	
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 0.004 µm	
Stylus Tip Form and Radius	3 mm	9.1 µin 0.23 µm	
Surface Finish Testers ³ – Ra, Ry, Rz	(2 to 500) µin (0.05 to 12.5) µm	5.0 µin 0.13 µm	Master surface finish patch

Parameter/Equipment	Range	CMC ^{2, 4} (±)	Comments
Surface Finish Standards – Ra, Ry, Rz	(2 to 500) μin (0.05 to 12.5) μm	4.0 μin 0.10 μm	Direct comparison to master surface patch
Crimping tools	Go/No Go Crimp Height Pullout Test	0.0010 in 0.00030 μin 2.0 lb	Pin gages Point micrometer Force gage, master weights
Gage Block Comparator ³	Up to 4 in Up to 100 mm	(5.1 + 0.80L) μin (0.13 + 0.0008L) μm	Master gage blocks
ID / OD Comparator ³	Up to 10 in Up to 250 mm	(8.8 + 0.80L) μin (0.22 + 0.0008L) μm	Gage blocks
Optical Comparators ³ –			
Horizontal Linearity	Up to 12 in Up to 304.8 mm	(160 + 3.3L) μin (4.1 + 0.0033L) μm	Glass master
Vertical Linearity	Up to 9 in Up to 228.6 mm	(160 + 5.4L) μin (4.1 + 0.0054L) 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 Up to 254 mm magnified image	170 μin 4.3 μm	Glass master, 14" glass scale
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 Up to 304.8 mm	(11 + 0.89L) μin (0.28 + 0.023L) μm	Vision system
Electronic Levels	Angular: +/- 990 arcsec Linear: +/- 0.005 in (Differential Mode)	2.3 arcsec 19 μin	Surface plate, sine bar, gage blocks
Surface Plates ³ – Flatness Repeatability	Up to 108 in diagonal line Localized up to 108 in diagonal line	(23 + 0.48DL) μin 38 μin	Electronic levels Repeat reading indicator
Tool Makers Microscopes ³ – Linearity	Up to 12 in Up to 304.8 mm	250 μin 6.4 μm	Glass master

II. Dimensional Testing/Calibration¹

Parameter/Equipment	Range	CMC ^{2,4} (±)	Comments
Surface Finish ⁵ –	(2 to 500) μin (0.05 to 12.5) μm	4.0 μin 0.10 μm	Master surface finish patch
Roundness ⁵	Up to 10 in Up to 254 mm	(9.4 + 1.3D) μin (0.24 + 0.0013D) μm	Roundness machine
Flatness ⁵	Up to 12 in Up to 304.8 mm	68 μin 1.7 μm	Indicator calibrator
Parallelism ⁵	Up to 12 in Up to 304.8 mm	26 μin 0.66 μm	Electronic indicator amplifier

Parameter/Equipment	Range	CMC ^{2, 4} (\pm)	Comments
Radius ⁵	Up to 12 in Up to 304.8 mm	(11 + 0.89L) μ in (0.28 + 0.023L) μ m	Vision system
Straightness ⁵	Up to 12 in Up to 304.8 mm	37 μ in 0.93 μ m	Electronic indicator amplifier
Go/No-go Gages ⁵	Up to 12 in Up to 304.8 mm Up to 21.5 in Ext. Measurement Up to 17 in Int. Measurement Step Gages	(11 + 0.89L) μ in (0.28 + 0.023L) μ m (6.6 + 0.88L) μ in (0.17 + 0.000 88L) μ m (11 + 0.63D) μ in (14 + 0.49L) μ in (0.36 + 0.000 49L) μ m	Vision system Universal length machine Electronic indicator amplifier, gage blocks
Go/No-go Gages ⁵	Up to 6 in	0.000 30 μ in	Rings, plugs, pins, hand tools
Video Measurement ⁵ – X, Y Axis Z Axis	Up to 12 in Up to 304.8 μ m Up to 6 in Up to 152.4 mm	(11 + 0.89L) μ in (0.28 + 0.023L) μ m (14 + 0.49L) μ in (0.36 + 0.000 49L) μ m	Vision system
Angular Measurements ⁵	Up to 360 deg	2.3 arcsec	Vision system
Contour ⁵ – Tracing Arm Length	Up to 14 in Or 350 mm	7.8 μ in 0.20 μ m	Contour system

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 + 0.0033L) μm	Optical comparator
Vertical Linearity	Up to 9 in Up to 228.6 mm	(160 + 5.4L) μin (4.1 + 0.0054L) μm	
Angle	Up to 180°	12 μin 0.30 μm	
Geometric Measurements ⁵	X: Up to 39 in Up to 1000 mm Y: Up to 48 in Up to 1200 mm Z: Up to 24 in Up to 600 mm Volume (39 x 48 x 24 in) (1000 x 1200 x 600 mm)	(18 + 0.12L) μin (0.47 + 0.00012L) μm (9.9 + 0.26L) μin (0.25 + 0.00026L) μm (6.9 + 1.0L) μin (0.19 + 0.0010L) μm (6.9 + 1.1L) μin (0.08 + 0.0011L) μm	CMM

III. Electrical – DC/Low Frequency

Parameter/Equipment	Range	CMC ^{2,7} (±)	Comments
DC Voltage – Generate ³	(0 to 219.999) mV (0.220 to 2.1999) V (2.2 to 10.9999) V (11 to 21.9999) V (22 to 219.999) V (220 to 1100) V	9.9. μV/V + 0.40 μV 5.8 μV/V + 0.70 μV 4.1 μV/V + 2.5 μV 4.2 μV/V + 4.0 μV 5.9 μV/V + 40 μV 7.6 μV/V + 400 μV	Fluke 5720A w/ Fluke 5725A

Parameter/Equipment	Range	CMC ^{2,7} (±)	Comments
DC Voltage – Measure ³	(0 to 100) mV (0.1 to 1) V (1 to 10) V (10 to 100) V (100 to 1000) V	4.2 μV/V + 0.30 μV 3.2 μV/V + 0.30 μV 3.3 μV/V + 0.50 μV 5.2 μV/V + 30 μV 5.2 μV/V + 0.10 mV	Agilent 3458A opt 002
DC High Voltage – Measure ³	(1 to 10) kV (10 to 90) kV	0.50 % + 0.40 V 1.0 % + 4.0 V	Vitrek 4700 Vitrek 4700 w/ HL100 probe
DC Current – Generate ³	(0 to 3.29999) mA (3.3 to 33) mA (33 to 330) mA 330 mA to 2.2 A (0 to 11) A (11 to 110) A (110 to 550) A	0.015 % + 0.050 μA 0.010 % + 0.25 μA 0.010 % + 3.3 μA 0.030 % + 44 μA 0.070 % + 330 μA 1.0 % + 50 mA 1.0 % + 75 mA	Fluke 5720 w/ Fluke 5500 coil
DC Current – Measure ³	(10 to 100) μA 100 μA to 1 mA (1 to 10) mA (10 to 100) mA (0.1 to 1) A	20 μA/A + 0.80 nA 19 μA/A + 5.0 nA 17 μA/A + 50 nA 37 μA/A + 0.50 μA 0.013 % + 10 μA	Agilent 3458A opt 002
High Current – Measure ³ DC up to 60 Hz ³	(1 to 15) A (15 to 100) A (100 to 300) A (300 to 5000) A	1.9 mA/A + 4.5 μA 290 μA/A + 0.3 mA 150 μA/A + 0.9 mA 120 μA/A + 15 mA	Current shunt w/ 6.5 digit voltmeter

Parameter/Range	Frequency	CMC ^{2,7} (±)	Comments
AC Voltage – Generate ³			
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	0.028 % + 4.0 μV 0.011 % + 4.0 μV 91 μV/V + 4.0 μV 0.024 % + 4.0 μV 0.056 % + 5.0 μV 0.11 % + 10 μV	Fluke 5720A
(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	0.025 % + 4.0 μV 91 μV/V + 4.0 μV 85 μV/V + 4.0 μV 0.021 % + 4.0 μV 0.051 % + 5.0 μV 0.11 % + 10 μV	
(22 to 220) 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	0.025 % + 12 μV 0.011 % + 7.0 μV 0.011 % + 7.0 μV 0.021 % + 7.0 μV 0.047 % + 17 μV 0.091 % + 20 μV	
220 mV to 2.2 V	(10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz	0.025 % + 40 μV 91 μV/V + 15 μV 46 μV/V + 8.0 μV 76 μV/V + 10 μV 0.012 % + 30 μV 0.043 % + 80 μV	
(2.2 to 22) V	(10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz	0.025 % + 400 μV 91 μV/V + 150 μV 46 μV/V + 50 μV 76 μV/V + 100 μV 0.011 % + 200 μV 0.028 % + 600 μV	
(22 to 220) V	10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz	0.024 % + 4.0 mV 91 μV/V + 1.5 mV 53 μV/V + 0.60 mV 81 μV/V + 1.0 mV 0.016 % + 2.5 mV 0.091 % + 16 mV	
(220 to 1100) V	40 Hz to 1 kHz (1 to 20) kHz	0.014 % + 4.0 mV 0.018 % + 6.0 mV	w/Fluke 5725

Parameter/Range	Frequency	CMC ^{2,7} (±)	Comments
AC Voltage – Measure ³			
Up to 10 mV	(1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz	0.030 % + 3.0 μV 0.020 % + 1.1 μV 0.040 % + 1.1 μV 0.11 % + 1.1 μV 0.51 % + 1.1 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 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 1 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 (1 to 2) MHz	0.0090 % + 40 μV 0.0070 % + 20 μV 0.017 % + 20 μV 0.036 % + 20 μV 0.82 % + 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 to 1 MHz	0.0080 % + 0.40 mV 0.0080 % + 0.20 mV 0.015 % + 0.20 mV 0.031 % + 0.20 mV 0.080 % + 0.20 mV 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/Range	Frequency	CMC ^{2,7} (±)	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 – Generate ³			
(29 to 330) µA	(10 to 20) Hz (20 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.30 % + 0.15 µA 0.15 % + 0.15 µA 0.15 % + 0.25 µA 0.28 % + 0.15 µA 1.5 % + 0.15 µA	Fluke 5720A
330 µA to 3.3 mA	(10 to 20) Hz (20 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.24 % + 0.30 µA 0.12 % + 0.30 µA 0.12 % + 0.30 µA 0.24 % + 0.30 µA 0.72 % + 0.30 µA	
(3.3 to 33) mA	(10 to 20) Hz (20 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.24 % + 3.0 µA 0.12 % + 3.0 µA 0.11 % + 30 µA 0.24 % + 30 nA 0.74 % + 30 µA	
(33 to 330) mA	(10 to 20) Hz (20 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.24 % + 30 µA 0.12 % + 30 µA 0.11 % + 30 µA 0.24 % + 30 µA 0.72 % + 30 µA	
330 mA to 3.3 A	(10 to 45) Hz 40 Hz to 1 kHz (1 to 5) kHz	0.24 % + 300 µA 0.12 % + 300 µA 0.40 % + 2.0 mA	
(2.2 to 11) A	(45 to 65) Hz (65 to 500) Hz 500 Hz to 1 kHz	0.080 % + 2.0 mA 0.12 % + 2.0 mA 0.40 % + 2.0 mA	
(11 to 110) A (110 to 550) A	50 Hz 50 Hz	1.3 % + 1.9 mA 0.66 % + 1.1 A	Fluke 5720 w/ 50 turn coil

Parameter/Range	Frequency	CMC ^{2,7} (±)	Comments
AC Current – Measure ³			
(5 to 100) μA	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5kHz	0.45 % + 0.030 μA 0.17 % + 0.030 μA 0.070 % + 0.030 μA 0.10 % + 0.003 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	

Parameter/Equipment	Range	CMC ^{2,7} (±)	Comments	
Resistance – Generate ³	(0 to 10.999) Ω	0.014 % + 8.0 mΩ	Fluke 5500A, 4-wire	
	(11 to 32.999) Ω	0.014 % + 15 mΩ		
	(33 to 109.999) Ω	0.14 % + 15 mΩ		
	(110 to 329.999) Ω	0.11 % + 15 mΩ		
	(0.330 to 1.09999) kΩ	0.12 % + 60 mΩ		
	(1.1 to 3.29999) kΩ	0.11 % + 60 mΩ		
	(3.3 to 10.9999) kΩ	0.12 % + 600 mΩ		
	(11 to 32.9999) kΩ	0.11 % + 600 mΩ		
	(33 to 109.999) kΩ	0.13 % + 6.0 Ω		
	(110 to 329.999) kΩ	0.15 % + 6.0 Ω		
	(0.33 to 1.09999) MΩ	0.20 % + 55 Ω		Fluke 5500A, 2-wire
	(1.1 to 3.29999) MΩ	0.20 % + 55 Ω		
	(3.3 to 10.9999) MΩ	0.70 % + 550 Ω		
	(11 to 32.9999) MΩ	1.4 % + 550 Ω		
(33 to 109.999) MΩ	5.9 % + 5.5 kΩ			

Parameter/Equipment	Range	CMC ^{2,7} (±)	Comments
Resistance – Generate (Fixed Points) ³	0 Ω 1 Ω 1.9 Ω 10 Ω 19 Ω 100 Ω 190 Ω 1.0 kΩ 1.9 kΩ 10 kΩ 19 kΩ 100 kΩ 190 kΩ 1 MΩ 1.9 MΩ 10 MΩ 19 MΩ 100 MΩ	51 μΩ 110 μΩ 110 μΩ 280 μΩ 550 μΩ 1.3 mΩ 2.3 mΩ 9.9 mΩ 19 mΩ 99 mΩ 190 mΩ 1.3 Ω 2.5 Ω 24 Ω 47 Ω 470 Ω 1.1 kΩ 12 kΩ	Fluke 5720A
	1 Ω 10 Ω 100 Ω 10 kΩ	6.0 μΩ 60 μΩ 590 μΩ 48 mΩ	Fluke 742A1 Fluke 742A-10 Fluke 742A-100 Fluke 742A-10 k
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
Capacitance – Generate ³	(0.33 to 0.499) nF (0.5 to 1.0999) nF (1.1 to 3.2999) nF (3.3 to 10.999) nF (11 to 32.999) nF (33 to 109.99) nF (110 to 329.99) nF (0.33 to 1.0999) μF (1.1 to 3.2999) μF (3.3 to 10.999) μF (11 to 32.999) μF (33 to 109.99) μF (110 to 329.99) μF 330 μF to 1.1 mF	0.58 % + 0.010 nF 0.58 % + 0.010 nF 0.61 % + 0.010 nF 0.58 % + 0.010 nF 0.33 % + 0.10 nF 0.29 % + 0.10 nF 0.27 % + 0.30 nF 0.29 % + 1.0 nF 0.41 % + 3.0 nF 0.41 % + 10 nF 0.47 % + 30 nF 0.58 % + 100 nF 0.94 % + 300 nF 1.2 % + 300 nF	Fluke 5500A

Parameter/Equipment	Range	CMC ² (±)	Comments
Electrical Calibration of Thermocouples and Thermocouple Indicating Systems ³			
Type B	(600 to 800) °C (800 to 1000) °C (1000 to 1550) °C (1550 to 1820) °C	0.59 °C 0.45 °C 0.39 °C 0.39 °C	Fluke 5500A
Type C	(0 to 150) °C (150 to 650) °C (650 to 1000) °C (1000 to 1800) °C (1800 to 2316) °C	0.37 °C 0.32 °C 0.38 °C 0.59 °C 0.97 °C	
Type E	(-250 to -100) °C (-100 to -25) °C (-25 to 350) °C (350 to 650) °C (650 to 1000) °C	0.57 °C 0.19 °C 0.16 °C 0.18 °C 0.24 °C	
Type J	(-210 to -100) °C (-100 to -30) °C (-30 to 150) °C (150 to 760) °C (760 to 1200) °C	0.31 °C 0.19 °C 0.16 °C 0.20 °C 0.27 °C	
Type K	(-200 to -100) °C (-100 to -25) °C (-25 to 120) °C (120 to 1000) °C (1000 to 1372) °C	0.37 °C 0.21 °C 0.19 °C 0.30 °C 0.46 °C	
Type L	(-200 to -100) °C (-100 to 800) °C (800 to 900) °C	0.43 °C 0.30 °C 0.20 °C	
Type N	(-200 to -100) °C (-100 to -25) °C (-25 to 120) °C (120 to 410) °C (410 to 1300) °C	0.45 °C 0.27 °C 0.22 °C 0.21 °C 0.31 °C	
Type R	(0 to 250) °C (250 to 400) °C (400 to 1000) °C (1000 to 1767) °C	0.70 °C 0.43 °C 0.40 °C 0.43 °C	

Parameter/Equipment	Range	CMC ² (±)	Comments
Electrical Calibration of Thermocouples and Thermocouple Indicating Systems ³ (cont)			
Type S	(0 to 250) °C (250 to 1000) °C (1000 to 1400) °C (1400 to 1767) °C	0.58 °C 0.44 °C 0.44 °C 0.51 °C	Fluke 5500A
Type T	(-250 to -150) °C (-150 to 0) °C (0 to 120) °C (120 to 400) °C	0.70 °C 0.28 °C 0.19 °C 0.16 °C	
Type U	(-200 to 0) °C (0 to 600) °C	0.65 °C 0.31 °C	
Electrical Calibration of RTD Indicating Systems ³ –			
Pt 395, 100 Ω	(-200 to -80) °C (-80 to 0) °C (0 to 100) °C (100 to 300) °C (300 to 400) °C (400 to 630) °C (630 to 800) °C	0.060 °C 0.060 °C 0.090 °C 0.11 °C 0.12 °C 0.14 °C 0.26 °C	Fluke 5500A
Pt 3926, 100 Ω	(-200 to -80) °C (-80 to 0) °C (0 to 100) °C (100 to 300) °C (300 to 400) °C (400 to 630) °C	0.060 °C 0.060 °C 0.090 °C 0.10 °C 0.12 °C 0.14 °C	
Pt 3916, 100 Ω	(-200 to -190) °C (-190 to -80) °C (-80 to 0) °C (0 to 100) °C (100 to 260) °C (260 to 300) °C (300 to 400) °C (400 to 600) °C (600 to 630) °C	0.29 °C 0.050 °C 0.060 °C 0.070 °C 0.090 °C 0.090 °C 0.10 °C 0.12 °C 0.26 °C	

Parameter/Equipment	Range	CMC ^{2,6} (±)	Comments
Electrical Calibration of RTD Indicating Systems ³ – (cont)			
Pt 385, 200 Ω	(-200 to -80) °C (-80 to 0) °C (0 to 100) °C (100 to 260) °C (260 to 300) °C (300 to 400) °C (400 to 600) °C (600 to 630) °C	0.050 °C 0.050 °C 0.050 °C 0.060 °C 0.15 °C 0.17 °C 0.18 °C 0.19 °C	Fluke 5500A
Pt 385, 500 Ω	(-200 to -80) °C (-80 to 0) °C (0 to 100) °C (100 to 260) °C (260 to 300) °C (300 to 400) °C (400 to 600) °C (600 to 630) °C	0.050 °C 0.070 °C 0.070 °C 0.080 °C 0.10 °C 0.10 °C 0.10 °C 0.12 °C	
Pt 385, 1000 Ω	(-200 to -80) °C (-80 to 0) °C (0 to 100) °C (100 to 260) °C (260 to 300) °C (300 to 400) °C (400 to 600) °C (600 to 630) °C	0.040 °C 0.040 °C 0.050 °C 0.070 °C 0.070 °C 0.090 °C 0.090 °C 0.27 °C	
PtNi 385, 120 Ω (Ni120)	(-80 to 0) °C (0 to 100) °C (100 to 260) °C	0.10 °C 0.10 °C 0.17 °C	
Cu 427, 10 Ω	(-100 to 260) °C	0.35 °C	
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	(0 to 350) ADC (0 to 100) VDC	1.0 % 0.05 VDC	Loadbank and DMM

IV. Mechanical

Parameter/Equipment	Range	CMC ^{2, 6} (±)	Comments
Pressure ³	Up to 4000 psi (2000 to 20 000) psi (4000 to 40 000) psi	(0.03 + 0.000 015 × a) psi (0.04 + 0.000 029 × a) psi (0.06 + 0.000 043 × a) psi	Deadweight tester a = applied pressure at the calibration value
	Up to 5 psi	(0.0013 + 0.000 013 × a) psi	Primary pressure standard
	(5 to 50) psi	(0.011 + 0.000 014 × a) psi	
	(50 to 500) psi	(0.0045 + 0.000 017 × a) psi	
Pressure – Measuring Equipment ³	(0 to 1) psi (0 to 5) psi (0 to 50) psi (0 to 100) psi (0 to 300) psi	0.0016 psi 0.0041 psi 0.0089 psi 0.019 psi 0.036 psi	Multifunction calibrator
	Up to 10 000 psi	0.16 % of range	Deadweight tester
Vacuum – Measuring Equipment ³	(-30 to 0) in Hg	0.030 in Hg	Multifunction calibrator
Force Gages ³ – Tension and Compression (Force Gages, Dynamometers, etc.)	(0 to 5) lbf (0 to 25) lbf (0 to 50) lbf (0 to 200) lbf (0 to 500) lbf	0.033 lbf 0.033 lbf 0.053 lbf 0.14 lbf 0.39 lbf	Weights
	(0 to 10 000) lbf	0.0014 % IV	Moorehouse load cell
Torque Wrenches ³	Up to 2000 ft·lbf	0.76 % of indicated value	Torque transducers
Torque Transducers	(20 to 200) in·ozf (0 to 50) in·lbf (50 to 250) in·lbf (250 to 1000) in·lbf (0 to 250) ft·lbf (250 to 2000) ft·lbf	0.23 % 0.81 % 0.18 % 0.051 % 0.20 % 0.075 %	Torque arms, weights
Scales ³	(50 to 500) lb	0.98 lb	ASTM Class F weights

Parameter/Equipment	Range	CMC ² (±)	Comments
Scales and Balances ³	(10 to 100) mg (100 to 500) mg (1 to 5) g 10 g 20 g 50 g 100 g 200 g 500 g	0.35 mg 0.35 mg 0.34 mg 0.31 mg 0.32 mg 1.7 mg 3.0 mg 3.1 mg 3.5 mg	ASTM Class 4 weights
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 in-house procedure (Note: this CAB does not meet ASTM E18)

Parameter/Equipment	Range	CMC ² (±)	Comments
Indirect Verification of Brinell Hardness Testers at Test Conditions ³ – HBW 5/750 HBW 10/3000	(200 to 400) HBW (400 to 750) HBW	15 HBW 21 HBW	Master hardness test blocks using an in-house procedure (Note: this CAB does not meet ASTM E10)
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 E384)
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 E384)
Mass	1 g 2 g 5 g 10 g 20 g 50 g 100 g 200 g 500 g 1 lb 2 lb 5 lb 10 lb 20 lb 50 lb 500 lb	0.34 mg 0.33 mg 0.32 mg 0.31 mg 0.32 mg 0.32 mg 0.33 mg 3.1 mg 3.5 mg 0.0020 oz 0.0020 oz 0.0020 oz 0.014 oz 0.014 oz 0.014 oz 0.65 lb	ASTM Class 6 and 7 weights

V. Thermodynamics

Parameter/Equipment	Range	CMC ^{2,4,6} (±)	Comments
Relative Humidity – Measuring Equipment, Fixed Points ³	11 % RH 33 % RH 53 % RH 75.5 % RH 90 % RH	(1.3 + 0.001H) % RH (1.3 + 0.001H) % RH (1.3 + 0.001H) % RH (1.3 + 0.001H) % RH (1.3 + 0.001H) % RH	Rotronic HygroPalm/ saturated salts
Relative Humidity – Measure ³	(10 to 90) % RH	(1.3 + 0.001H) % RH	Rotronic HygroPalm
Temperature – Measuring Equipment, Glass Thermometers ³	(-50 to 500) °C	0.20 °C	Dry block w/ RTD
Temperature / Humidity Recorders ³	(-73 to 190) °C (11 to 90) % RH	0.45 °C (1.34 + 0.001H) % RH	Temperature meter, Rotronic HygroPalm
Temperature- Measure Ovens, Furnaces, and Freezers ³	(-50 to 500) °C	0.20 °C	RTD w/ indicator
Temperature – IR Measuring Equipment ³	(50 to 500) °C	(0.77 + 0.007T) °C	Fluke 9132

VI. Time & Frequency

Parameter/Equipment	Range	CMC ^{2,6} (±)	Comments
Tachometers	Up to 10 000 RPM	0.18 %	Function generator
Stop Watches/Time Measurement ³	Up to 24 hours	0.35 s 0.04 s	Comparison Totalize w/GPS
Frequency – Measuring Equipment	10 Hz to 20.999999 MHz (21 to 60.999999) MHz	2.0 parts in 10 ⁶ Hz/Hz 4.0 parts in 10 ⁸ Hz/Hz	HP 3325A sync w GPS
Fixed Point	10 MHz	6.0 parts in 10 ¹¹ Hz/Hz	Novis NR2310 GPS

Parameter/Equipment	Range	CMC ^{2,6} (\pm)	Comments
Frequency – Measure ³	0.01 Hz to 100 MHz	4.0 parts in 10 ⁸ Hz/Hz	HP 5334B

¹ This laboratory offers commercial dimensional testing/calibration and on-site 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.

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. DL is the diagonal length. R is the resolution of the unit under test. D is the numerical value of the nominal diameter of the device measured in inches. Pitch diameter is measured by the three-wire method. Major diameter is calibrated by direct measurement. In the statement of CMC, T indicates temperature in degrees Celsius. In the statement of CMC, H is the Humidity of the reading.

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 In the statement of CMC, a percent refers to a percentage of reading unless otherwise noted.

⁷ 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. CMC's 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.



Accredited Laboratory

A2LA has accredited

MSI-VIKING GAGE, LLC.

Duncan, 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/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 8 January 2009).



Presented this 27th day of October 2017.

A handwritten signature in black ink, written over a horizontal line.

President and CEO
For the Accreditation Council
Certificate Number 1387.01
Valid to September 30, 2019

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