



SCOPE OF ACCREDITATION TO ISO/IEC 17025:2017

CROSS TECHNOLOGIES, INC dba CROSS (FORMERLY J.A. KING)
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CALIBRATION

Valid To: September 30, 2022

Certificate Number: 1741.12

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory to perform the following calibrations^{1, 8}:

I. Chemical

Parameter/Equipment	Range	CMC ² (±)	Comments
pH Meters ³ – Fixed Points	4 pH 7 pH 10 pH	0.03 pH 0.03 pH 0.04 pH	Standard pH solutions
Conductivity Meters ³	10 µS/cm 100 µS/cm 1000 µS/cm 1413 µS/cm 10 000 µS/cm	0.56 µS/cm 2.2 µS/cm 5.2 µS/cm 4.7 µS/cm 46 µS/cm	Standard conductivity solutions

II. Dimensional

Parameter/Equipment	Range	CMC ^{2, 5} (±)	Comments
Pin Gage ³ – Class Z & Class ZZ	Up to 1 in	110 µin	Micrometer
Calipers ³	Up to 40 in	(4.5 + 9.9L) µin + 0.6R	Gage blocks
Micrometers ³	Up to 40 in	(4.5 + 9.9L) µin + 0.6R	Gage blocks

Parameter/Equipment	Range	CMC ^{2,5} (±)	Comments
Linear Indicators ³ – Dial, test & LVDT	Up to 4 in	(3.0 + 9.4 <i>L</i>) μin + 0.6 <i>R</i>	Gage blocks
Height Gages ³	Up to 20 in (20 to 48) in	(52 + 7.9 <i>L</i>) μin + 0.6 <i>R</i> (18 + 9.6 <i>L</i>) μin + 0.6 <i>R</i>	Gage blocks
Steel Rules ³	Up to 72 in	(1.5 + 10 <i>L</i>) μin + 0.6 <i>R</i>	Gage blocks
Tape Measures ³	Up to 25 ft	(1.5 + 10 <i>L</i>) μin + 0.6 <i>R</i>	Gage blocks
Angle Indicators & Protractors ³	30°, 45°, 60°, 75°, 90°	0.03°	Angle block set
Feeler/Thickness Gages ³	Up to 1 in	110 μin	Micrometer
Fixture Gages ³ – Localized Flatness	0.002 in	40 μin	Dial indicator
Surface Plates ³ – Grades AA, A, & B Repeatability Flatness	0.002 in Up to 60 <i>DL</i> in (>60 to 120) <i>DL</i> in	40 μin (31 + 0.2 <i>DL</i>) μin (30 + 0.3 <i>DL</i>) μin	Repeat-o-meter Federal level systems

Parameter/Equipment	Range	CMC ^{2,5} (±)	Comments
Auto Levels –			
Level (Level Set)		1.3 arcsec	Brunson 270BN
Auto Level Compensation		1.3 arcsec	
Line of sight		1.2 arcsec	
Horizontal Circle Setting	Through 360°	1 arcsec	
Optical Micrometer Test	(-0.2 to 0.2) in	0.0009 in	
Theodolites –			
Level (Level Test)		1.3 arcsec	
Reticle Rotation Orientation		1.3 arcsec	
Horizontal Collimation	Through 360°	1 arcsec	
Vertical Collimation		1 arcsec	
Focus Collimation (Line of Sight)		1.2 arcsec	
Optical Micrometer Test	(-0.2 to 0.2) in	0.0009 in	
Trunnion Axis		1 arcsec	

III. Electrical – DC/Low Frequency

Parameter/Equipment	Range	CMC ^{2,4,6} (±)	Comments		
DC Voltage – Measure ³	(0 to 100) mV	0.011 %	Agilent 34401A		
	100 mV to 1 V	0.0057 %			
	(1 to 10) V	0.0049 %			
	(10 to 100) V	0.0062 %	Fluke 80K-6 & DMM		
	(100 to 1000) V	0.0067 %			
	(1 to 6) kV	1.3 %			
	(6 to 7) kV	2.4 %	Fluke 80K-40 & DMM		
DC Voltage – Generate ³	(0 to 330) mV	25 µV/V + 1 µV	Fluke 5522A		
	(0 to 3.3) V	14 µV/V + 2 µV			
	(0 to 33) V	15 µV/V + 20 µV			
	(30 to 330) V	22 µV/V + 150 µV			
	(100 to 1000) V	22 µV/V + 1.5 mV			
DC Current – Measure ³	(1 to 10) mA	0.039 %	Agilent 34401A		
	(10 to 100) mA	0.043 %			
	100 mA to 1 A	0.1 %			
	(1 to 50) A	0.31 %	Empro shunt w/ DMM		
DC Current– Generate ³	(0 to 330) µA	0.018 % + 0.02 µA	Fluke 5522A		
	(0 to 3.3) mA	0.012 % + 0.05 µA			
	(0 to 33) mA	0.012 % + 0.25 µA			
	(0 to 330) mA	0.012 % + 2.5 µA			
	(0 to 1.1) A	0.024 % + 40 µA			
	(1.1 to 3) A	0.046 % + 40 µA			
	(0 to 11) A	0.06 % + 500 µA			
	(11 to 21) A	0.12 % + 750 µA			
	Clamp-On Meters ³ – Non-Toroidal	(20.5 to 1000) A		0.65 % + 0.5 A	Fluke 5522A w/5500 coil

Parameter/Equipment	Range	CMC ^{2, 4, 6} (±)	Comments
Resistance – Measure ³	(0 to 100) Ω 100 Ω to 1 kΩ (1 to 10) kΩ (10 to 100) kΩ 100 kΩ to 1 MΩ (1 to 10) MΩ (10 to 100) MΩ	0.017 % 0.014 % 0.014 % 0.014 % 0.014 % 0.05 % 0.98 %	Agilent 34401A
Resistance – Generate ³	(0 to 11) Ω (11 to 33) Ω (33 to 110) Ω 110 Ω to 1.1 kΩ (1.1 to 11) kΩ (11 to 110) kΩ 110 kΩ to 1.1 MΩ (1.1 to 3.3) MΩ (3.3 to 11) MΩ (11 to 33) MΩ (33 to 110) MΩ (110 to 330) MΩ (330 to 1100) MΩ	49 μΩ/Ω + 0.001 Ω 37 μΩ/Ω + 0.0015 Ω 34 μΩ/Ω + 0.0014 Ω 34 μΩ/Ω + 0.002 Ω 34 μΩ/Ω + 0.02 Ω 34 μΩ/Ω + 0.2 Ω 39 μΩ/Ω + 2 Ω 73 μΩ/Ω + 30 Ω 0.016 % + 50 Ω 0.03 % + 2.5 kΩ 0.06 % + 3 kΩ 0.36 % + 100 kΩ 1.8 % + 500 kΩ	Fluke 5522A

Parameter/Range	Frequency	CMC ^{2, 4, 6} (±)	Comments
Capacitance – Generate ³ (220 to 399.9) pF (0.4 to 1.0999) nF (1.1 to 3.2999) nF (3.3 to 10.9999) nF (11 to 109.999) nF (110 to 329.999) nF (0.33 to 1.099 99) μF (1.1 to 3.29999) μF (3.3 to 10.9999) μF (11 to 32.9999) μF (33 to 109.999) μF (110 to 329.999) μF (0.33 to 1.099 99) mF (1.1 to 3.299 99) mF (3.3 to 10.9999) mF (11 to 32.9999) mF (33 to 110) mF	(10 to 10 000) Hz (10 to 10 000) Hz (10 to 3000) Hz (10 to 1000) Hz (10 to 1000) Hz (10 to 1000) Hz (10 to 600) Hz (10 to 300) Hz (10 to 150) Hz (10 to 120) Hz (10 to 80) Hz (0 to 50) Hz (0 to 20) Hz (0 to 6) Hz (0 to 2) Hz (0 to 0.6) Hz (0 to 0.2) Hz	0.88 % + 10 pF 0.6 % + 0.01 nF 0.6 % + 0.01 nF 0.31 % + 0.1 nF 0.31 % + 0.1 nF 0.31 % + 0.3 nF 0.31 % + 1 nF 0.31 % + 3 nF 0.31 % + 10 nF 0.49 % + 30 nF 0.55 % + 100 nF 0.55 % + 300 nF 0.55 % + 1 μF 0.55 % + 3 μF 0.56 % + 10 μF 0.91 % + 30 μF 1.4 % + 100 μF	Fluke 5522A

Parameter/Range	Frequency	CMC ^{2, 4, 6} (±)	Comments
AC Voltage – Generate ³			
(1 to 33) 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	0.096 % + 6 μV 0.022 % + 6 μV 0.026 % + 6 μV 0.12 % + 6 μV 0.42 % + 12 μV 0.96 % + 50 μV	Fluke 5522A
(33 to 330) 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	0.036 % + 8 μV 0.018 % + 8 μV 0.02 % + 8 μV 0.042 % + 8 μV 0.096 % + 32 μV 0.24 % + 70 μV	
(0.33 to 3.3) 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	0.036 % + 50 μV 0.019 % + 60 μV 0.023 % + 60 μV 0.036 % + 50 μV 0.084 % + 130 μV 0.29 % + 600 μV	
(3.3 to 33) V	(10 to 45) Hz 45 Hz to 10 kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.036 % + 650 μV 0.019 % + 600 μV 0.029 % + 600 μV 0.042 % + 600 μV 0.11 % + 1.6 mV	
(33 to 330) V	45 Hz to 1 kHz (1 to 10) kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.023 % + 2 mV 0.025 % + 6 mV 0.03 % + 6 mV 0.036 % + 6 mV 0.24 % + 50 mV	
(330 to 1020) V	45 Hz to 10 kHz	0.036 % + 10 mV	
AC Voltage – Measure ³			
	10 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz	0.12 % 0.21 % 0.82 %	Agilent 34401A
	60 Hz	1.6 %	Fluke 80K-6 & DMM
	60 Hz	6 %	Fluke 80K-40 & DMM

Parameter/Range	Frequency	CMC ^{2, 4, 6} (±)	Comments
AC Current – Generate ³			
(0 to 0.33) 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	0.24 % + 0.1 μA 0.18 % + 0.1 μA 0.15 % + 0.1 μA 0.36 % + 0.15 μA 0.96 % + 0.2 μA 2 % + 0.4 μA	Fluke 5522A
(0.33 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 (10 to 30) kHz	0.24 % + 0.15 μA 0.16 % + 0.15 μA 0.13 % + 0.15 μA 0.25 % + 0.2 μA 0.6 % + 0.3 μA 1.2 % + 0.6 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 (10 to 30) kHz	0.22 % + 2 μA 0.11 % + 2 μA 0.05 % + 2 μA 0.097 % + 2 μA 0.24 % + 3 μA 0.48 % + 4 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 (10 to 30) kHz	0.22 % + 20 μA 0.11 % + 20 μA 0.05 % + 20 μA 0.12 % + 50 μA 0.24 % + 100 μA 0.48 % + 200 μA	
(0.33 to 1.1) A	(10 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.22 % + 100 μA 0.06 % + 100 μA 0.72 % + 1 mA 3 % + 5 mA	
(1.1 to 3) A	(10 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.22 % + 100 μA 0.073 % + 100 μA 0.72 % + 1 mA 3 % + 5 mA	
(3 to 11) A	45 Hz to 1 kHz (1 to 5) kHz	0.12 % + 2 mA 3.6 % + 2 mA	
(11 to 20.5) A	45 Hz to 1 kHz (1 to 5) kHz	0.18 % + 5 mA 3.6 % + 5 mA	

Parameter/Range	Frequency	CMC ^{2, 4, 6, 7} (±)	Comments
AC Current – Generate ³ (cont)			
Clamp-On Meters ³ – (10 to 150) A			
Toroidal	(45 to 65) Hz (65 to 440) Hz	0.49 % + 0.025 A 1 % + 0.027 A	Fluke 5522A w/ 5500 coil
Non-Toroidal	(45 to 65) Hz (65 to 440) Hz	0.76 % + 0.25 A 1.3 % + 0.25 A	
(150 to 1025) A			
Toroidal	(45 to 65) Hz (65 to 440) Hz	0.49 % + 0.09 A 1 % + 0.1 A	
Non-Toroidal	(45 to 65) Hz (65 to 440) Hz	0.76 % + 0.9 A 1.3 % + 0.9 A	
AC Current – Measure ³			
(0 to 1) A	10 Hz to 5 kHz	0.18 %	Agilent 34401A
(1 to 3) A	10 Hz to 5 kHz	0.26 %	

Parameter/Equipment	Range	CMC ^{2,4} (±)	Comments
Thermocouple Simulation ³ –			
Type B	(600 to 800) °C (800 to 1820) °C	0.53 °C 0.43 °C	Fluke 5522A
Type E	(-250 to -100) °C (-100 to 650) °C (650 to 1000) °C	0.61 °C 0.21 °C 0.26 °C	
Type J	(-210 to -100) °C (-100 to 760) °C (760 to 1200) °C	0.33 °C 0.21 °C 0.28 °C	
Type K	(-200 to -100) °C (-100 to 1000) °C (1000 to 1372) °C	0.40 °C 0.32 °C 0.48 °C	
Type N	(-200 to -100) °C (-100 to 410) °C (410 to 1300) °C	0.50 °C 0.29 °C 0.35 °C	
Type R	(0 to 250) °C (250 to 1000) °C (1000 to 1767) °C	0.70 °C 0.42 °C 0.50 °C	
Type S	(0 to 250) °C (250 to 1400) °C (1400 to 1767) °C	0.58 °C 0.46 °C 0.57 °C	
Type T	(-250 to -150) °C (-150 to 0) °C (0 to 400) °C	0.76 °C 0.30 °C 0.21 °C	
Electrical Calibration of RTD's ³ –			
Generate	(-200 to 200) °C (200 to 600) °C (600 to 850) °C	0.19 °C 0.31 °C 0.43 °C	Beamex MC2-MF
Measure	(-200 to 200) °C (200 to 600) °C (600 to 850) °C	0.19 °C 0.31 °C 0.43 °C	

Parameter/Equipment	Range	CMC ^{2,4} (±)	Comments
Oscilloscopes ³ –			
Square Wave Signal:			
50 Ω Load @ 1 kHz	1 mV to 6.6 V _{pk-pk}	0.31 % + 40 μV	Fluke 5522A w/ SC1100
1 MΩ Load @ 1 kHz	1 mV to 130 V _{pk-pk}	0.14 % + 40 μV	
DC Volt Amplitude:			
50 Ω Load	(0 to 6.6) V	0.3 % + 40 μV	
1 MΩ Load	(0 to 130) V	0.06 % + 40 μV	
Level Sine Wave:			
Frequency	(0 to 1100) MHz	3.3 μHz/Hz	
Amplitude	50 kHz Reference	2.4 % + 300 μV	
	50 kHz to 100 MHz	4.2 % + 300 μV	
	(100 to 300) MHz	4.8 % + 300 μV	
	(300 to 600) MHz	7.2 % + 300 μV	
	(300 to 1100) MHz	8.4 % + 300 μV	
Flatness (Bandwidth)	0 kHz to 100 MHz	1.8 % + 100 μV	
	(100 to 300) MHz	2.4 % + 100 μV	
	(300 to 600) MHz	4.8 % + 100 μV	
	(300 to 1100) MHz	6 % + 100 μV	
Time Markers:			
Into a 50 Ω Load	5 s to 50 ms	(30 + 1000t) μs/s	
	20 ms to 2 ns	3.5 μs/s	
Rise Time:			
1 kHz to 2 MHz	≤ 300 ps	130 ps	
(2 to 10) MHz	≤ 350 ps	130 ps	

IV. Mechanical

Parameter/Equipment	Range	CMC ^{2, 5, 6, 7} (\pm)	Comments
Scales & Balances ³	(1 to 500) mg Up to 5 g Up to 10 g Up to 30 g Up to 50 g Up to 100 g Up to 200 g Up to 300 g Up to 500 g Up to 1000 g (> 1 to 35) kg (5 to 10) g (10 to 500) g 501 g to 20 kg (> 20 to 5000) kg Up to 1000 lb (1000 to 120 000) lb	0.013 mg + 0.6R 0.043 mg + 0.6R 0.062 mg + 0.6R 0.096 mg + 0.6R 0.17 mg + 0.6R 0.31 mg + 0.6R 0.63 mg + 0.6R 0.92 mg + 0.6R 1.5 mg + 0.6R 3.1 mg + 0.6R 3.1 mg per 1000 g + 0.6R 0.04 % + 0.6R 0.025 % + 0.6R 0.017 % + 0.6R 0.017 % per 20 kg + 0.6R 0.017 % + 0.6R 0.017 % per 1000 lb + 0.6R	ASTM Class 1 weights (applied load) Class F weights (applied load) Class F weights (applied load)
Force ³	Up to 1000 lbf Up to 10 000 lbf	0.017 % + 0.6R 0.14 % of Applied	Class F weights Load cells w/ indicator
Tensile Tester ³ – Speed / Rate Displacement	Up 50 in/min Up to 20 Inches	0.025 % 0.00 025 in	Timer & caliper Gage blocks w/ indicator
Torque – Measure ³ – Wrenches – Click, Dial, Adjustable, Screwdrivers	5 in·lbf to 600 ft·lbf	0.65 %	CDI Suretest 5000-ST
Rotary Torque– Measure ³ – Pneumatic, DC, Pulse	(0 to 180) N·m	1.3 % Full Scale	Crane-Torquestar w/ rotary transducers

Parameter/Equipment	Range	CMC ^{2, 6} (±)	Comments
Pressure – Measure & Measuring Equipment ³			
Pneumatic	(0 to 1) in H ₂ O	0.002 in·H ₂ O	Heise HM2-1
	(0 to 4) in H ₂ O	0.025 in·H ₂ O	Dwyer 475
	(0.01 to 30) psig	0.07 % Full Scale	Beamex MC2-IPM2C
Hydraulic	(0 to 300) psig	0.07 % Full Scale	Druck DPI-104
	(0 to 1000) psig	0.07 % Full Scale	
	(5 to 10 000) psig	0.07 % Full Scale	
Atmospheric Pressure – Measure & Measuring Equipment (Vacuum) ³	(0.01 to 28.5) in·Hg	0.02 in·Hg	Beamex MC2-IPM2C
	(1 to 10) Torr	0.7 % + 0.001 Torr	MKS pressure transducers
	(10 to 100) Torr	0.64 % + 0.01 Torr	
Speed ³ –			
Optic/Non-contact: RPM Totalizer/Rate Meters	(6 to 100 000) rpm (2 to 3300) fpm	0.017 % 0.017 %	Monarch PLT200
Contact: RPM Totalizer/Rate Meters	(6 to 20 000) rpm (2 to 3300) fpm	0.22 % 0.22 %	Shimpo 105A

V. Thermodynamics

Parameter/Equipment	Range	CMC ^{2,7} (±)	Comments
Relative Humidity – Measure ³	(10 to 80) % RH	1.5 % RH	Rotronic HP22A w/ HC2 Probe
Temperature – Measure ³	(-196 to 420) °C	0.06 °C	Fluke 1524 w/5615-12 Probe
Temperature – Measuring Equipment ³	(-45 to 140) °C	0.18 °C	Fluke 9170
	(-15 to 350) °C	0.15 °C	Fluke 9009 w/ Ext Probe
Infrared Thermometry – Measuring Equipment ³	Up to 100 °C	1 °C	Fluke 4181
	Up to 200 °C	1.2 °C	
	Up to 350 °C	1.7 °C	
	Up to 500 °C	2.3 °C	

VI. Time & Frequency

Parameter/Equipment	Range	CMC ² (±)	Comments
Timers & Stopwatches ³	(1 to 3600) s	0.2 s	Monarch PLT 200
Frequency – Measuring Equipment ³	0.01 Hz to 2 MHz	3.1 ppm + 5 µHz	Fluke 5522A

¹ This laboratory offers commercial calibration and field calibration services, where noted.

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

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

⁴ 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.

⁵ In the statement of CMC, L is the numerical value of the nominal length of the device measured in inches; R is the numerical value of the resolution of the device, DL is the diagonal length of the device in inches.

⁶ In the statement of CMC, percentages are percent of reading, unless otherwise indicated.

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

⁸ This scope meets A2LA's P112 Flexible Scope Policy.



Accredited Laboratory

A2LA has accredited

CROSS TECHNOLOGIES, INC DBA CROSS (FORMERLY J.A. KING)

Lexington, SC

for technical competence in the field of

Calibration

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017 *General requirements for the competence of testing and calibration laboratories*. This laboratory also meets R205 – Specific Requirements: Calibration Laboratory Accreditation Program. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated April 2017).



Presented this 1st day of December 2020.

A blue ink signature of a person, likely the Vice President mentioned in the text below.

Vice President, Accreditation Services
For the Accreditation Council
Certificate Number 1741.12
Valid to September 30, 2022
Revised May 11, 2021

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