



SCOPE OF ACCREDITATION TO ISO/IEC 17025:2005

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CALIBRATION

Valid To: December 31, 2019

Certificate Number: 3884.01

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

I. Acoustical

Parameter/Equipment	Range	CMC ² (±)	Comments
Sound Level Meter ³ Sound Pressure Level @ 1000 Hz	94 dB 114 dB	0.2 dB 0.2 dB	Piston Phone Tecpel 336 IEC60942

II. Chemical Quantities

Parameter/Equipment	Range	CMC ² (±)	Comments
pH Meter ³	1.67 pH 4.01 pH 7.01 pH 10.01 pH 11.72 pH	0.024 pH 0.017 pH 0.017 pH 0.025 pH 0.024 pH	Standard solution
Conductivity Meter ³	84 µS/cm 1413 µS/cm 12880 µS/cm	0.84 µS/cm 4.2 µS/cm 100 µS/cm	Standard solution
Refractometer ³	10 % Brix 20 % Brix 30 % Brix 50 % Brix 60 % Brix	0.12 % Brix 0.12 % Brix 0.12 % Brix 0.12 % Brix 0.12 % Brix	Sucrose standard solution (CRM) OIML R142:2008(E)

Parameter/Equipment	Range	CMC ² (±)	Comments
Refractive Index ³	1.34782 nD 1.36384 nD 1.38115 nD 1.42009 nD 1.44193 nD	0.000 22 nD 0.000 22 nD 0.000 22 nD 0.000 22 nD 0.000 22 nD	Sucrose standard solution (CRM) OIML R142:2008(E)
Gas Detector / Analyzer ³ – Oxygen in Nitrogen; O ² Methane in Air; CH ₄	2 cmol/mol 18 cmol/mol 21 cmol/mol 2.5 cmol/mol 50 % LEL	0.059 cmol/mol 0.12 cmol/mol 0.13 cmol/mol 0.084 cmol/mol 1.7 % LEL	Certified gas reference material (CRM) In-House Method
UV/Vis Spectrophotometer ³ – Photometric Accuracy @ 235, 257, 313, 350, 440, 465, 546.1, 590 and 635 nm Wavelength Accuracy Holmium Filter: Nominal Didymium Filter: Nominal	(0.0 to 0.6) Abs > 0.6 Abs 241 nm 279 nm 287 nm 334 nm 361 nm 418 nm 453 nm 460 nm 536 nm 634 nm 585 nm 684 nm 741 nm 748 nm 807 nm	0.005 Abs 0.006 Abs 0.11 nm 0.11 nm 0.11 nm 0.11 nm 0.11 nm 0.11 nm 0.11 nm 0.11 nm 0.11 nm 0.11 nm 0.11 nm 0.11 nm 0.11 nm 0.11 nm	ASTM E 275-08 and ASTM E 925-09 ASTM E 275-08 and ASTM E 925-09

III. Dimensional

Parameter/Equipment	Range	CMC ² (±)	Comments
Calipers ³ (Analog, Digital) – External, Internal, Step Height, Depth	(0 to 200) mm (>200 to 600) mm	5.8 µm 7.2 µm	Gage blocks and caliper checker

Parameter/Equipment	Range	CMC ² (±)	Comments
External Micrometer ³ (Digital, Analog)	Up to 25 mm (>25 to 125) mm	0.62 μm 1.2 μm	Gage blocks and optical parallels
Dial Thickness Gage ³ (Digital, Analog)	Up to 10 mm	1.2 μm	Gage blocks
Dial Gage ³ (Digital, Analog)	Up to 50 mm	2.0 μm	Dial gage tester and gage blocks
Dial Gage Tester	Up to 10 mm (>10 to 50) mm	0.31 μm 0.37 μm	Gage blocks
Dial Test Indicator ³ (Digital, Analog)	Up to 1 mm	2.0 μm	Dial gage tester and gage blocks
Bore Gage ³ (Digital, Analog)	Up to 50 mm	2.0 μm	Dial gage tester and gage blocks
Glass Scales	Up to 300 mm	4.6 μm	Vision measuring machine
Height Gage ³ (Digital, Analog)	Up to 150 mm (>150 to 600) mm	5.9 μm 7.6 μm	Gage blocks, caliper checker & granite surface plate
Universal Length Measuring Machine (ULM) ³	Up to 10 mm (10 to 25) mm (25 to 50) mm (50 to 75) mm (75 to 100) mm (100 to 200) mm (200 to 300) mm (300 to 400) mm (400 to 500) mm (500 to 600) mm	0.13 μm 0.17 μm 0.20 μm 0.29 μm 0.34 μm 0.76 μm 1.0 μm 1.3 μm 1.4 μm 1.7 μm	Gage blocks
Measuring Microscope, Vision Measuring Machine, Profile Projector ³	X (or Y or Z) Axis Up to 300 mm	3.3 μm	Glass scale and gage blocks
Plain Plug/Pin Gage	(0.1 to 100) mm (>100 to 250) mm	0.6 μm 2.0 μm	ULM and gage blocks

Parameter/Equipment	Range	CMC ² (±)	Comments
Plain Ring Gage	(0.5 to 100) mm (>100 to 250) mm	1.3 µm 2.6 µm	ULM and master ring gages
Thread Measuring Wire	(0.1 to 50) mm	0.56 µm	ULM and gage blocks
Thread Ring Gage	M3 to M100 (3 to 100) mm	1.8 µm	ULM and master ring gages
Thread plug gage	M1 to M100 (1 to 100) mm	1.6 µm	ULM, gage blocks and 3-wire set
Steel Ruler	Up to 2000 mm	0.02 mm	Steel tape calibrator
Steel Tape / Textile Tape	Up to 10 m (10 to 20) m (20 to 30) m (30 to 40) m (40 to 50) m	0.09 mm 0.17 mm 0.26 mm 0.34 mm 0.43 mm	Steel tape calibrator
Optical Flat	Up to 60 mm	0.027 µm	Flatness calibrator
Optical Parallel	(12.00 to 25.37) mm	0.32 µm	ULM and gage blocks
Gage Blocks and Long Gage Blocks	Up to 10 mm (>10 to 20) mm (>20 to 50) mm (>50 to 70) mm (>70 to 100) mm (>100 to 200) mm (>200 to 300) mm (>300 to 400) mm (>400 to 500) mm (>500 to 600) mm	0.21 µm 0.23 µm 0.32 µm 0.35 µm 0.46 µm 0.93 µm 1.3 µm 1.7 µm 2.1 µm 2.2 µm	ULM, gage block and long gage block
Micrometer Head –			
Linear	Up to 10 mm (>10 to 50) mm	0.31 µm 0.37 µm	ULM and gage blocks
Measuring Face Flatness	Up to 3 µm	0.05 µm	Optical flat

Parameter/Equipment	Range	CMC ² (±)	Comments
Inside Micrometer	Up to 25 mm (>25 to 50) mm (>50 to 75) mm (>75 to 100) mm (>100 to 125) mm (>125 to 150) mm (>150 to 175) mm (>175 to 200) mm (>200 to 225) mm (>225 to 250) mm (>250 to 300) mm (>300 to 400) mm (>400 to 500) mm (>500 to 600) mm	0.39 μm 0.43 μm 0.5 μm 0.55 μm 0.62 μm 0.69 μm 0.79 μm 0.97 μm 1.1 μm 1.2 μm 1.3 μm 1.7 μm 1.9 μm 2.6 μm	Universal length measuring machine, Gage blocks and long gage blocks
Depth Micrometer ³	Up to 50 mm (>50 to 75) mm (>75 to 100) mm (>100 to 125) mm (>125 to 150) mm (>150 to 200) mm (>200 to 400) mm (>400 to 600) mm	1.2 μm 1.3 μm 1.4 μm 1.6 μm 1.7 μm 1.8 μm 1.9 μm 2.4 μm	Gage blocks and long gage blocks
Micrometer Setting Rod	Up to 50 mm (>50 to 75) mm (>75 to 100) mm (>100 to 125) mm (>125 to 150) mm (>150 to 175) mm (>175 to 200) mm (>200 to 225) mm (>225 to 250) mm (>250 to 300) mm (>300 to 400) mm (>400 to 500) mm (>500 to 600) mm	0.43 μm 0.5 μm 0.55 μm 0.58 μm 0.71 μm 0.88 μm 0.97 μm 1.1 μm 1.2 μm 1.3 μm 1.6 μm 1.8 μm 2.6 μm	Universal length measuring machine, Gage blocks and long gage blocks
CMM – Linear Measurement Only: X (or Y or Z) Axis	Up to 10 mm (>10 to 20) mm (>20 to 50) mm (>50 to 100) mm (>100 to 200) mm (>200 to 400) mm (>400 to 600) mm (>600 to 1000) mm	0.15 μm 0.17 μm 0.25 μm 0.43 μm 0.92 μm 1.7 μm 2.5 μm 4.2 μm	Gage blocks and long gage blocks

Parameter/Equipment	Range	CMC ² (±)	Comments
Thickness Plate, Standard Coating Thickness, Standard Foil	Up to 5 mm	0.25 µm	ULM and gage blocks
Coating Thickness Gage ³	Up to 263 µm (>263 to 500) µm (>500 to 988) µm (>988 to 1523) µm	3.3 µm 3.6 µm 4.6 µm 6 µm	Standard thickness plate, standard foil clothing
Ultrasonic Thickness Gage ³	Up to 50 mm (>50 to 100) mm (>100 to 200) mm (>200 to 400) mm	0.2 µm 0.3 µm 0.6 µm 1 µm	Gage blocks
Precision Level-Inclinometer-Level Gage ³	Up to 1 mm/m	2.7 µm/m	Gage blocks and sine bar
Grind Gage	Up to 100 µm	0.18 µm	ULM and gage blocks
Bevel Protractor	Up to 360 °	0°, 0', 0.83"	Vision measuring machine
Feeler Gage	Up to 5 mm	0.21 µm	ULM and gage blocks
Radius Gage	Up to 180°	3.5 µm	Vision measuring machine
Spheres & Precision Balls – Diameter	Up to 100 mm	0.48 µm	Vision measuring machine
Test Sieve	Up to 300 mm	4.1 µm	Vision measuring machine
Jig Fixture	Up to 300 mm	4.6 µm	Vision measuring machine

IV. Electrical – DC/Low Frequency

Parameter/Equipment	Range	CMC ² (±)	Comments
DC Voltage – Generate ³	Up to 202 mV 202 mV to 2.02 V (2.02 to 20.2) V (20.2 to 202) V (202 to 1025) V	15 µV 96 µV 0.86 mV 9.7 mV 52 mV	Transmille 3041
DC Voltage – Measure ³	Up to 100 mV 100 mV to 1 V (1 to 10) V (10 to 100) V (100 to 1000) V	13 µV 0.06 mV 3.4 mV 8.2 mV 84 mV	Fluke 8846A
DC Voltage, High Voltage – Measure ³	(1 to 30) kV (30 to 50) kV (50 to 70) kV (70 to 100) kV	0.02 kV 0.03 kV 0.05 kV 0.07 kV	HV Probe HVL-100 with Precision HV Meter Vitrek 4700
DC Cutoff Current – Generate ³	0.5 mA 1 mA 2 mA 5 mA 10 mA 20 mA 50 mA 100 mA	0.01 mA 0.02 mA 0.03 mA 0.06 mA 0.13 mA 0.26 mA 0.64 mA 1.3 mA	Kikusui Curr. Calibrator For W. Tester TOS 1200
DC Current – Generate ³	Up to 202 µA 202 µA to 2.02 mA (2.02 to 20.2) mA (20.2 to 202) mA 202 mA to 2.02 A 2.02 mA to 20 A	77 nA 0.29 µA 1.9 µA 22 µA 0.42 mA 10 mA	Transmille 3041
DC Current, Clamp – Generate ³	Up to 60 A (60 to 300) A (300 to 1500) A	0.57 A 2.9 A 11 A	Transmille 3041 with turn coil EA 002

Parameter/Equipment	Range	CMC ² (±)	Comments
DC Current – Measure ³	Up to 100 μ A 100 μ A to 1 mA (1 to 10) mA (10 to 100) mA (100 to 400) mA 400 mA to 1 A (1 to 3) A (3 to 10) A	0.087 μ A 0.65 μ A 8.1 μ A 0.06 mA 0.27 mA 0.83 mA 4.3 mA 19 mA	Fluke 8846A
DC Power – Generate ³	Up to 200 W (200 to 500) W 500 W to 1 kW (1 to 10) kW (10 to 20) kW	0.42 W 1.1 W 2.3 W 57 W 0.11 kW	Transmille 3041
Resistance – Generate ³	Up to 10 Ω (10 to 100) Ω 100 Ω to 1 k Ω (1 to 10) k Ω (10 to 100) k Ω 100 k Ω to 1 M Ω (1 to 10) M Ω (10 to 100) M Ω 100 M Ω to 1 G Ω	7.3 m Ω 13 m Ω 0.1 Ω 1.0 Ω 9.6 Ω 0.19 k Ω 5.4 k Ω 0.65 M Ω 16 M Ω	Transmille 3041
Resistance – Measure ³	Up to 10 Ω (10 to 100) Ω 100 Ω to 1 k Ω (1 to 10) k Ω (10 to 100) k Ω 100 k Ω to 1 M Ω (1 to 10) M Ω (10 to 100) M Ω 100 M Ω to 1 G Ω	9.5 m Ω 0.03 Ω 0.21 Ω 2.1 Ω 0.02 k Ω 0.25 k Ω 8.4 k Ω 1.1 M Ω 23 M Ω	Fluke 8846A
Electrical Simulation of RTD ³ – Pt 385, 100 Ω	-220 $^{\circ}$ C to 850 $^{\circ}$ C	0.33 $^{\circ}$ C	SIKA MC-50

Parameter/Range	Frequency	CMC ² (±)	Comments
Electrical Simulation of Thermocouples ³ –			
Type J	-210 °C to 0 °C >0 °C to 1200 °C	0.4 °C 0.43 °C	SIKA MC-50
Type K	-250 °C to 0 °C >0 °C to 1372 °C	0.74 °C 0.39 °C	
Type R	-50 °C to 120 °C >0 °C to 1768 °C	0.99 °C 1.0 °C	
Type S	-50 °C to 120 °C 900 °C to 1750 °C	1.22 °C 1.00 °C	
Type T	-250 °C to 0 °C >0 °C to 400 °C	0.69 °C 0.53 °C	
AC Voltage (3-Phase) – Generate ³			
Up to 110 V (110 to 380) V	(45 to 65) Hz	0.03 V 0.04 V	Energy meter calibrator
AC Voltage, High Voltage – Measure ³			
(1 to 10) kV (10 to 30) kV (30 to 50) kV (50 to 70) kV	(0 to 400) Hz (0 to 400) Hz (0 to 400) Hz (0 to 400) Hz	0.02 kV 0.04 kV 0.1 kV 0.14 kV	HV Probe HVL-100 with Precision HV meter Vitrek 4700
AC Cutoff Current – Generate ³			
0.5 mA 1 mA 2 mA 5 mA 10 mA 20 mA 50 mA 100 mA	(45 to 65) Hz	0.01 mA 0.01 mA 0.03 mA 0.06 mA 0.12 mA 0.25 mA 0.62 mA 1.3 mA	Kikusui Curr calibrator for W. Tester TOS 1200

Parameter/Range	Frequency	CMC ² (±)	Comments
AC Voltage – Generate ³			
(20 to 202) mV	(40 to 44) Hz (45 to 999) Hz (1 to 19.999) kHz (20 to 99.999) kHz (100 to 500) kHz	0.67 mV 0.13 mV 0.29 mV 1.0 mV 2.6 mV	Transmille 3041
202 mV to 2.02 V	(40 to 44) Hz (45 to 999) Hz (1 to 19.999) kHz (20 to 99.999) kHz (100 to 500) kHz	6.5 mV 1.1 mV 2.2 mV 10 mV 20 mV	
(2.02 to 20.2) V	(40 to 44) Hz (45 to 999) Hz (1 to 19.999) kHz (20 to 100) kHz	64 mV 11 mV 19 mV 0.11 V	
(20.2 to 202) V	(40 to 44) Hz (45 to 999) Hz (1 to 20) kHz	0.16 V 0.11 V 0.29 V	
(202 to <1020) V	(40 to 44) Hz (45 to 999) Hz (1 to 10) kHz	0.98 V 0.62 V 2.6 V	
AC Voltage – Measure ³			
Up to 100 mV	10 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz	0.14 mV 0.21 mV 0.79 mV 5.2 mV	Fluke 8846A
100 mV to 1 V	10 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz	1.0 mV 2.0 mV 7.9 mV 52 mV	
(1 to 10) V	10 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz	11 mV 20 mV 17 mV 0.47 V	
(10 to 100) V	10 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz	0.44 V 0.20 V 0.79 V 5.2 V	
100 V to 1 kV	10 Hz to 1 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz	1.1 V 1.9 V 7.7 V 51 V	



Parameter/Range	Frequency	CMC ² (±)	Comments
AC Current – Measure ³			
(25 to 100) µA	10 Hz to 5 kHz (5 to 10) kHz	0.48 µA 1.3 µA	Fluke 8846A
100 µA to 1 mA	10 Hz to 5 kHz (5 to 10) kHz	2.2 µA 5.4 µA	
(1 to 10) mA	10 Hz to 5 kHz (5 to 10) kHz	28 µA 54 µA	
(10 to 100) mA	10 Hz to 5 kHz (5 to 10) kHz	0.21 mA 0.54 mA	
(100 to 400) mA	10 Hz to 5 kHz (5 to 10) kHz	1.2 mA 4.2 mA	
400 mA to 1 A	10 Hz to 5 kHz (5 to 10) kHz	2.2 mA 12 mA	
(1 to 3) A	10 Hz to 5 kHz (5 to 10) kHz	8.5 mA 37 mA	
(3 to 10) A	10 Hz to 5 kHz (5 to 10) kHz	0.03 A 0.12 A	
AC Current – Generate ³			
(20 to 202) µA	(40 to 44) Hz (45 to 999) Hz (1 to 10) kHz	0.96 µA 0.58 µA 4.0 µA	Transmille 3041
202 µA to 2.02 mA	(40 to 44) Hz (45 to 999) Hz (1 to 10) kHz	6.4 µA 2.0 µA 21 µA	
(2.02 to 20.2) mA	(40 to 44) Hz (45 to 999) Hz (1 to 10) kHz	64 µA 20 µA 0.14 mA	
(20.2 to 202) mA	(40 to 44) Hz (45 to 999) Hz (1 to 10) kHz	0.64 mA 0.20 mA 1.4 mA	
202 mA to 2.02 A	(40 to 44) Hz (45 to 999) Hz (1 to 5) kHz	6.6 mA 2.8 mA 18 mA	
(2.02 to 20) A	(40 to 44) Hz (45 to 99) Hz 100 Hz to 2 kHz	54 mA 20 mA 0.09 A	

Parameter/Equipment	Range	CMC ² (±)	Comments
Oscilloscopes ³ – (cont)			
Vertical Deflection	5 mV	52 μV	
Accuracy 1 MΩ Load	10 mV	58 μV	
Square Wave Signal	20 mV	72 μV	
< 10 kHz	50 mV	120 μV	
	100 mV	190 μV	
	200 mV	350 μV	
	500 mV	11 mV	
	1 V	29 mV	
	2 V	56 mV	
	5 V	89 mV	
	10 V	110 mV	
Horizontal Cursor Accuracy (Time Base)	5 s to 2 ns	5.8 ms/s	

V. Electrical/RF Microwave

Parameter/Equipment	Range	CMC ² (±)	Comments
RF Tuned Power ³ – Generate (+13 to -139.9) dB	(0.1 to 1) MHz 1 MHz to 1 GHz (1 to 3) GHz (3 to 6) GHz	3.5 dBm 1.2 dBm 1.8 dBm 2.4 dBm	Agilent 8665B
Amplitude Modulation ³ – Generate Carrier: (0.01 to 100) MHz Rate: 50 Hz to 1 kHz	(5 to 90) %	4.8 % of Reading	Agilent 8665B
Frequency Modulation ³ – Generate Rate: 400 Hz rate Max. Dev. (1 to 300) kHz	100 MHz to 1 GHz	1.5 % of Reading	Agilent 8665B

VI. Fluid Quantities

Parameter/Equipment	Range	CMC ² (±)	Comments
Air Velocity	Up to 10 m/s (>10 to 25) m/s	0.82 m/s 1.8 m/s	Wind tunnel with anemometer
Burettes	5 ml 10 ml 25 ml 50 ml 100 ml	0.0042 ml 0.0043 ml 0.0068 ml 0.011 ml 0.019 ml	Analytical balance and standard weight; ASTM E542-01, ISO 8655-6:2003(E)
Pipettes	(1 to 5) ml 10 ml 15 ml 25 ml 50 ml 100 ml	0.0033 ml 0.0043 ml 0.0064 ml 0.0068 ml 0.010 ml 0.017 ml	Analytical balance and standard weight; ASTM E542-01, ISO 8655-6:2003(E)
Micro pipette	(10 to 100) µl (> 100 to 200) µl (> 200 to 1000) µl (> 1 to 2) ml (> 2 to 5) ml (> 5 to 10) ml	0.12 µl 0.12 µl 0.17 µl 0.26 µl 1.2 µl 1.2 µl	Analytical balance and standard weight; ASTM E542-01, ISO 8655-6:2003(E)
Volumetric flask	5 ml 10 ml 25 ml 50 ml 100 ml 200 ml 250 ml 500 ml 1000 ml 2000 ml	0.0062 ml 0.0063 ml 0.0089 ml 0.014 ml 0.020 ml 0.030 ml 0.037 ml 0.065 ml 0.14 ml 0.26 ml	Analytical balance and standard weight; ASTM E542-01, ISO 8655-6:2003(E)
Cylinder & Beaker	5 ml 10 ml 25 ml 50 ml 100 ml 250 ml 500 ml 1000 ml 2000 ml	0.021 ml 0.027 ml 0.049 ml 0.056 ml 0.063 ml 0.073 ml 0.085 ml 0.14 ml 0.26 ml	Analytical balance and standard weight; ASTM E542-01, ISO 8655-6:2003(E)

Parameter/Equipment	Range	CMC ² (±)	Comments
Viscometer ³	100 mPa/s 500 mPa/s 5000 mPa/s 10 000 mPa/s	0.43 mPa/s 2.3 mPa/s 22 mPa/s 46 mPa/s	Viscosity certified standard (CRM); ASTM D445-06, ASTM D7042-16e2

VII. Mechanical

Parameter/Equipment	Range	CMC ² (±)	Comments
Centrifuge ³	Up to 999 RPM (1000 to 9999) RPM (10 000 to 15 000) RPM	0.60 RPM 5.8 RPM 8.7 RPM	Digital tachometer
Digital Tachometer ³ – Photo Type	(1 to 999.9) RPM (1000 to 9999) RPM (10 000 to 99 999) RPM	0.1 RPM 0.95 RPM 5.8 RPM	GE Druck TRX-II with LED
Mechanical Tachometers (Contact)	(1 to 999.9) RPM (1 000 to 9 999) RPM (10 000 to 99 999) RPM	0.1 RPM 0.95 RPM 5.8 RPM	GE Druck TRX-II
Balances and Scales ³ (Digital, Analog)	Up to 50 g (50 to 100) g (100 to 200) g (200 to 500) g 500 g to 1 kg (1 to 2) kg (2 to 10) kg (10 to 20) kg (20 to 100) kg (100 to 200) kg (200 to 500) kg (500 to 1000) kg (1000 to 1750) kg	0.12 mg 0.23 mg 0.41 mg 1.4 mg 2.3 mg 4.2 mg 0.02 g 0.04 g 7.0 g 13 g 30 g 59 g 60 g	Standard weight Class E2, F1 and M1
Force Gage / Tension Gage ³ (Digital, Analog)	Up to 50 g (50 to 100) g (100 to 200) g (200 to 500) g 500 g to 1 kg (1 to 2) kg (2 to 10) kg (10 to 20) kg (20 to 100) kg (100 to 200) kg	0.12 mg 0.23 mg 0.41 mg 1.5 mg 2.3 mg 4.2 mg 0.02 g 0.04 g 8.7 g 14 g	Standard weight Class F1, M1 and standard load cell

Parameter/Equipment	Range	CMC ² (±)	Comments
Mass (Standard Weight)	50 mg 100 mg 200 mg 500 mg 1 g 2 g 5 g 10 g 20 g 50 g 100 g 200 g 500 g 1000 g 2000 g 5 kg 10 kg 20 kg	0.017 mg 0.025 mg 0.024 mg 0.031 mg 0.034 mg 0.041 mg 0.053 mg 0.071 mg 0.080 mg 0.13 mg 0.21 mg 0.37 mg 1.6 mg 3.4 mg 5.2 mg 12 mg 21 mg 39 mg	Standard weight Class E1, F1 and electronic balance
Torque, Hand Tools ³	(0.5 to 1500) N·m	1.4 % of Reading	Torque tester calibrator
Torque Tester ³	(0.5 to 10) N·m (>10 to 1500) N·m	0.24 % of Reading 0.26 % of Reading	Calibration arms and weight Torque transfer wrench/ static torque measuring device
Indirect Verification of Rockwell Hardness Testers ³	HRA: Low Medium High HRB: Low Medium High HRC: Low Medium High	0.4 HRA 0.4 HRA 0.4 HRA 0.42 HRB 0.4 HRB 0.4 HRB 0.4 HRC 0.4 HRC 0.4 HRC	Indirect verification per ASTM E18

Parameter/Equipment	Range	CMC ² (±)	Comments
Indirect Verification of Microindentation Hardness Testing Machine ³ – HV 1 (1 kgf): Knoop/Vickers HV 5 (5 kgf): Vickers HV 10 (10 kgf): Vickers	(100 to 240) HV (>240 to 600) HV >600 HV (100 to 240) HV (>240 to 600) HV >600 HV (100 to 240) HV (>240 to 600) HV >600 HV	2.1 HV1 15 HV1 33 HV1 2.1 HV5 11 HV5 20 HV5 1.4 HV10 11 HV10 19 HV10	Indirect verification per ASTM E384
Indirect Verification of Brinell Hardness Testers ³ at Test Conditions – HBW 10/3000/15	(200 to 399) HBW (400 to 600) HBW	4.0 HBW 8.0 HBW	Indirect verification per ASTM E10 and E110
Durometers ³ – Types A, B, C, D, O, DO, OO and M Indentor Extension Length Indentor Display Spring Calibration – Force	(0 to 90) durometer units Up to 5 kg	5.2 µm 0.7 durometer units 0.26 g	ASTM D2240 Vision measuring machine Gage blocks Electronic balance and load cell

Parameter/Equipment	Range	CMC ² (±)	Comments
Universal Testing Machine ³ , Load Cell and Force Sensor Compression and Tension	Up to 1 kN (>1 to 2) kN (>2 to 3) kN (>3 to 4) kN (>4 to 5) kN (>5 to 6) kN (>6 to 7) kN (>7 to 8) kN (>8 to 9) kN (>9 to 10) kN (>10 to 50) kN (>50 to 100) kN (>100 to 200) kN (>200 to 300) kN (>300 to 400) kN (>400 to 500) kN	0.63 N 1.3 N 1.9 N 2.5 N 3.1 N 3.7 N 4.4 N 5.0 N 5.6 N 6.2 N 50 N 75 N 0.13 kN 0.20 kN 0.26 kN 0.32 kN	Standard load cell ASTM E4, ISO 7500-1, ISO 5893
Pressure Measuring Instruments ³ (Analog, Digital)			
Pneumatic	Up to 2 bar Up to 1 bar Up to 20 bar	1.3 mbar 0.1 mbar 1.9 mbar	GE Druck DPI 104 GE Druck PACE 1000 GE Druck PACE 1000
Water	Up to 700 bar Up to 700 bar	0.43 bar 0.07 bar	GE Druck DPI 104 GE Druck PACE 1000
Hydraulic	Up to 1500 bar	5.1 bar	SIKA D.2
Transmitter	(4 to 20) mA	0.007 mA	SIKA MC-50
Vacuum Measuring Instruments ³ (Analog, Digital)			
Transmitter	Up to -0.95 bar Up to -0.95 bar (4 to 20) mA	1.3 mbar 0.1 mbar 0.007 mA	GE Druck DPI 104 GE Druck PACE 1000 SIKA MC-50



VIII. Optical Quantities

Parameter/Equipment	Range	CMC ² (±)	Comments
Light (Light Meters) – Measure			
Illuminance	Up to 4000 Lux	2.0 % of Reading	Standard light meter
Irradiance ($\mu\text{W}/\text{cm}^2 * \text{nm}$)	(300 to 400) nm (400 to 930) nm (930 to 1100) nm	2.9 % of Reading 2.2 % of Reading 1.6 % of Reading	Gamma Scientific RS-10 with RS 70-1
Radiance ($\mu\text{W}/\text{cm}^2 * \text{nm}$)	(300 to 400) nm (400 to 930) nm (930 to 1100) nm	2.9 % of Reading 2.2 % of Reading 1.6 % of Reading	
Illuminance	677.1 lm/m ²	1.0 % of Reading	
Luminance	850 cd/m ²	1.2 % of Reading	
Color temperature	2855 °K	8.7 °K	
CIE Color 1931 (x)	0.4483	0.0016 % of Reading	
CIE Color 1931 (y)	0.4089	0.0008 % of Reading	
Spectral Irradiance – Measure			
UV Ultra Violet Radiometers	Up to 200 mW/cm ²	2.2 % of Reading	Gamma Scientific S470 with optimized sensor head
Solar Radiometers	(250 to 400) nm (400 to 930) nm (930 to 1200) nm	3.2 % of Reading 2.3 % of Reading 2.2 % of Reading	
Optical Power Meter	Up to 20 mW	2.2 % of Reading	Gamma Scientific S470 with optimized sensor head
Laser Power Meter	Up to 100 W	2.8 % of Reading	Gamma Scientific S470 with optimized sensor head

IX. Thermodynamic Quantities

Parameter/Equipment	Range	CMC ² (±)	Comments
Thermometer ³ – Dial Liquid in Glass	-30 °C to 200 °C 200 °C to 600 °C -30 °C to 200 °C	0.3 °C 1.4 °C 0.08 °C	Fluke 1521 with standard IPRT
Liquid Bath ³ – Oil / Water COD Reactor	(-40 to 200) °C (200 to 250) °C (25 to 250) °C	0.13 °C 0.18 °C 0.17 °C	Agilent 34970A with RTD sensor
Temperature Block ³ and Liquid Bath Calibrator ³	-80 °C to 600 °C 600 °C to 1200 °C	0.14 °C 3.8 °C	Fluke 1521 with Standard IPRT and standard type S
Autoclave ³	110 °C to 135 °C	0.53 °C	Agilent 34970A with RTD sensor
Furnace ³	200 °C to 1200 °C	3.8 °C	Agilent 34970A with TC sensor
Temperature Mapping of Storage Areas ³	-30 °C to 60 °C	0.49 °C	Dataloggers
Temperature Chamber Systems ³ , Calibration & Profiling	-80 °C to -40 °C -40 °C to 50 °C 50 °C to 250 °C	0.41 °C 0.31 °C 0.44 °C	Agilent 34970A with RTD sensor
Humidity Chamber Systems ³ , Calibration & Profiling	(20 to 95) % R.H.	3.4 % R.H.	Agilent 34970A with humidity sensor
Infrared Temperature ³	-35 °C to 255 °C	1.7 °C	Back body calibrator
Thermo-hygrometer ³ – Temperature Relative Humidity	-30 °C to 60 °C (20 to 95) % R.H.	0.42 °C 2.4 % R.H.	Almemo 2590 with temperature & humidity chamber

Parameter/Equipment	Range	CMC ² (±)	Comments
Temperature Sensor ³ – Thermocouples –			
Type J	-80 °C to 200 °C 200 °C to 300 °C 300 °C to 600 °C 600 °C to 1200 °C	0.44 °C 0.46 °C 0.47 °C 3.9 °C	Fluke 1521 with standard IPRT (NOTE: Agilent 34970A with S type of thermocouple is used above 600 °C)
Type K	-80 °C to 100 °C 100 °C to 200 °C 200 °C to 300 °C 300 °C to 600 °C 600 °C to 1200 °C	0.75 °C 0.40 °C 0.42 °C 0.43 °C 3.9 °C	
Type R	0 °C to 600 °C 600 °C to 1200 °C	1.1 °C 4.0 °C	
Type S	0 °C to 600 °C 600 °C to 1200 °C	1.1 °C 4.0 °C	
Type T	-80 °C to 100 °C 100 °C to 200 °C 200 °C to 300 °C 300 °C to 400 °C	0.70 °C 0.54 °C 0.55 °C 0.56 °C	
RTDs:	-80 °C to -30 °C -30 °C to 200 °C 200 °C to 600 °C	0.34 °C 0.35 °C 0.38 °C	
PRTs:	-80 °C to -30 °C -30 °C to 200 °C 200 °C to 600 °C	0.34 °C 0.35 °C 0.38 °C	



Parameter/Equipment	Range	CMC ² (±)	Comments
Temperature Indicator with Sensor ³ –			
Thermocouple	-80 °C to -30 °C -30 °C to 100 °C 100 °C to 200 °C 200 °C to 300 °C 300 °C to 400 °C 400 °C to 500 °C 500 °C to 600 °C 600 °C to 700 °C 700 °C to 900 °C 900 °C to 1200 °C	0.19 °C 0.24 °C 0.47 °C 0.70 °C 0.93 °C 1.2 °C 1.4 °C 3.5 °C 3.8 °C 3.9 °C	Fluke 1521 with standard IPRT Agilent 34970A with S type of thermocouple
RTDs	-80 °C to -30 °C -30 °C to 200 °C 200 °C to 600 °C	0.05 °C 0.08 °C 0.14 °C	Fluke 1521 with standard IPRT
PRTs	-80 °C to -30 °C -30 °C to 200 °C 200 °C to 600 °C	0.05 °C 0.08 °C 0.14 °C	Fluke 1521 with standard IPRT
Transmitter	(4 to 20) mA	0.007 mA	SIKA MC-50

X. Time & Frequency

Parameter/Equipment	Range	CMC ² (±)	Comments
Frequency – Measuring Equipment ³	Up to 100 Hz 100 Hz to 1 kHz (1 to 10) kHz (10 to 100) kHz 100 kHz to 1 MHz (1 to 10) MHz (10 to 20) MHz (20 to 100) MHz 100 MHz to 1 GHz (1 to 6) GHz	0.58 mHz 5.8 mHz 0.06 Hz 0.58 Hz 5.8 Hz 4.4 Hz 8.7 Hz 0.04 kHz 0.43 kHz 2.6 kHz	HP 3325B Agilent 8665B
Frequency – Measure ³	Up to 1 MHz (1 to 100) MHz (100 to 225) MHz	0.14 mHz 6.7 mHz 12 mHz	HP 53131A
Totalizing Counter ³	(5 to 99 999) count	1.5 count	GE Druck TRX-II

Parameter/Equipment	Range	CMC ² (±)	Comments
Stop Watch Quartz Crystal ³	32 768 Hz (nominal)	0.76 ms/s	HP 53131A

¹ This laboratory offers commercial and field calibration service.

² Calibration and Measurement Capability Uncertainty (CMC) is the smallest uncertainty of measurement that a laboratory can achieve within its scope of accreditation when performing more or less routine calibrations of nearly ideal measurement standards or nearly ideal measuring equipment. Calibration and Measurement Capabilities 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 Adjustable thread rings are set to applicable specifications using calibrated master set plug gages.



Accredited Laboratory

A2LA has accredited

INCTECH METROLOGICAL CENTER CO.,LTD.

Bangkok, THAILAND

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 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 9th day of February 2018.

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

President and CEO
For the Accreditation Council
Certificate Number 3884.01
Valid to December 31, 2019

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