



SCOPE OF ACCREDITATION TO ISO/IEC 17025-2005

JAPAN QUALITY ASSURANCE ORGANIZATION  
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CALIBRATION

Valid To: March 31, 2020

Certificate Number: 1400.04

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory at the location listed above as well as the one satellite laboratory location listed below to perform the following calibrations<sup>1</sup>:

I. Chemical Quantities

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
pH Indicator <sup>3,4</sup> –  Instrumental Error Linearity Repeatability	(0 to 14) pH units (0 to 14) pH units (0 to 14) pH units	0.0080 pH units 0.016 pH units 0.013 pH units	DC voltage
pH Detector <sup>3,4</sup> –  Instrumental Error Linearity Repeatability	4 pH units, 9 pH units 4 pH units, 7 pH units, 9 pH units 4 pH units, 7 pH units 9 pH units	0.40 mV/pH units 1.1 mV 1.0 mV 2.0 mV	Standard solutions

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
pH Meter <sup>3,4</sup> –  Instrumental Error	4 pH units (3p) 7 pH units (3p) 9 pH units (3p) 4 pH units, 9 pH units (2p) 7 pH units (2p) 4 pH units, 7 pH units, 9 pH units (1p)	0.011 pH units 0.012 pH units 0.031 pH units 0.024 pH units 0.014 pH units 0.18 pH units	Standard solutions
CO <sub>2</sub> Meter	0 parts in 10 <sup>6</sup> 2000 parts in 10 <sup>6</sup> 5000 parts in 10 <sup>6</sup>  200, 400, 600, 800, 1000 parts in 10 <sup>6</sup>  1200, 1400, 1600, 1800 parts in 10 <sup>6</sup>  500, 1500, 2500, 3000, 3500, 4000, 4500 parts in 10 <sup>6</sup>	40 parts in 10 <sup>6</sup> 60 parts in 10 <sup>6</sup> 80 parts in 10 <sup>6</sup>  50 parts in 10 <sup>6</sup>  60 parts in 10 <sup>6</sup>  110 parts in 10 <sup>6</sup>	Standard gas: CO <sub>2</sub> in N <sub>2</sub>  Standard gas and gas divider
Electrical Conductivity Meters	14.7 mS/m 141 mS/m 1280 mS/m  14.7 mS/m 141 mS/m 1280 mS/m	3.2 % 2.0 % 1.9 %  4.6 % 2.6 % 2.4 %	Standard electrical conductivity solutions  Calibrated electrical conductivity meters

II. Mechanical

Parameter/Equipment	Range	CMC <sup>2,5</sup> (±)	Comments
Graduated Cylinders, Internal and External	5 ml ≤ 20 ml ≤ 25 ml ≤ 50 ml ≤ 100 ml ≤ 200 ml ≤ 300 ml ≤ 500 ml ≤ 1000 ml ≤ 2000 ml	0.030 ml 0.066 ml 0.078 ml 0.14 ml 0.25 ml 0.51 ml 0.75 ml 1.6 ml 3.0 ml 6.0 ml	Mass method
Flasks –  Internal	10 ml ≤ 25 ml ≤ 50 ml ≤ 100 ml ≤ 200 ml ≤ 500 ml ≤ 1000 ml ≤ 2000 ml ≤ 3000 ml ≤ 5000 ml ≤ 10 000 ml	0.016 ml 0.020 ml 0.030 ml 0.050 ml 0.070 ml 0.13 ml 0.20 ml 0.30 ml 0.70 ml 1.0 ml 2.0 ml	Mass method
External	10 ml ≤ 25 ml ≤ 50 ml ≤ 100 ml ≤ 200 ml ≤ 500 ml ≤ 1000 ml ≤ 2000 ml ≤ 3000 ml ≤ 5000 ml ≤ 10 000 ml	0.030 ml 0.030 ml 0.040 ml 0.070 ml 0.090 ml 0.15 ml 0.30 ml 0.40 ml 0.80 ml 1.3 ml 2.5 ml	

Parameter/Equipment	Range	CMC <sup>2.5</sup> (±)	Comments
Volumetric Pipette – External	1 ml ≤ 2 ml ≤ 5 ml ≤ 10 ml ≤ 20 ml ≤ 50 ml ≤ 100 ml ≤ 200 ml	0.0060 ml 0.0090 ml 0.016 ml 0.023 ml 0.025 ml 0.030 ml 0.040 ml 0.070 ml	Mass method
Graduated Pipette	1 ml ≤ 2 ml ≤ 5 ml ≤ 10 ml ≤ 25 ml ≤ 50 ml	0.0070 ml 0.010 ml 0.020 ml 0.025 ml 0.050 ml 0.10 ml	Mass method
Buret – External	5 ml ≤ 10 ml ≤ 25 ml ≤ 50 ml ≤ 100 ml	0.010 ml 0.020 ml 0.030 ml 0.040 ml 0.060 ml	Mass method

Parameter/Range	Frequency	CMC <sup>2, 5</sup> (±)	Comments
Vibration Meter –			
Acceleration Up to 500 m/s <sup>2</sup>	(5 to < 10) Hz (0.01 to 2) kHz	5.0 % 3.0 %	Secondary vibration calibration system
Velocity Up to 100 mm/s	(5 to < 10) Hz (0.01 to 2) kHz	4.0 % 3.0 %	
Displacement Up to 10 mm	(5 to < 10) Hz (10 to 160) Hz	4.0 % 3.0 %	
Vibration Exciter with Accelerometer <sup>3, 4</sup> –			
Acceleration Up to 500 m/s <sup>2</sup>	(5 to < 10) Hz (0.01 to 5) kHz	5.0 % 4.0 %	Vibration meter, accelerometer and counter
Velocity Up to 100 mm/s	(5 to < 10) Hz (10 to 80) Hz (> 80 to 160) Hz (> 0.16 to 1) kHz (> 1 to 3) kHz	6.0 % 4.0 % 5.0 % 7.0 % 12 %	
Displacement Up to 10 mm	(5 to 40) Hz (> 40 to 100) Hz (> 100 to 160) Hz (> 160 to 315) Hz	4.0 % 5.0 % 10 % 17 %	
Frequency	(5 to < 10) Hz (10 to < 20) Hz (20 to < 30) Hz (0.03 to 5) kHz	0.12 % 0.06 % 0.03 % 0.02 %	

SATELLITE FACILITY

JAPAN QUALITY ASSURANCE ORGANIZATION  
 Shikatsu Branch Testing Department  
 53-1 Yamaura  
 Yakushiji, Kitanagoya-shi, Aichi, Japan 481-0005

I. Dimensional

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Gage Block	(≥ 0.5 to 100) mm (> 100 to 150) mm (> 150 to 200) mm (> 200 to 250) mm (> 250 to 300) mm (> 300 to 400) mm (> 400 to 500) mm	0.070 μm 0.090 μm 0.11 μm 0.13 μm 0.15 μm 0.19 μm 0.23 μm	By mechanical comparison
Step Gage	≤ 200 mm (> 200 to 500) mm (> 500 to 700) mm (> 700 to 1000) mm	1.0 μm 1.6 μm 2.5 μm 3.2 μm	Gage blocks, surface plate indicators
Standard Bar	≤ 300 mm (> 300 to 500) mm (> 500 to 800) mm (> 800 to 1000) mm	1.0 μm 1.5 μm 2.5 μm 3.0 μm	Comparison to gage blocks
Ring Gage	(≥ 1 to 100) mm (> 100 to 200) mm	0.8 μm 2.0 μm	IDM Master ring gage, ULM

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Rules and Tape – Measure			
Rule	≤ 1m (> 1 to 5) m	11 μm 11L μm	Master scales, laser and micrometer.  In the statement of best uncertainty, <i>L</i> is the numerical value of the nominal length of the device measured in meters.
Rule (End Gage)	≤ 3 m	0.070 mm	
Steel Tape Measure	≤ 5 m (> 5 to 100) m	0.10 mm 0.020L mm	
Textile Tape Measure	≤ 5 m (> 5 to 100) m	0.30 mm 0.060L mm	
Convex Rule	≤ 5.5 m (> 5.5 to 10.5) m (> 10.5 to 15) m	0.30 mm 0.40 mm 0.50 mm	
Tape Measure for Diameter Measurement	≤ 1500 mm	0.040 mm	Note: Range is the diameter indicated on the tape
Plug and Pin Gage	(≥ 1 to 100) mm	0.90 μm	Gage blocks, ULM, master pins and laser scan
Caliper	≤ 200 mm (> 200 to 300) mm (> 300 to 600) mm (> 600 to 1000) mm	0.030 mm 0.040 mm 0.050 mm 0.070 mm	Gage blocks, step gages

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Micrometer	≤ 25 mm (> 25 to 50) mm (> 50 to 150) mm (> 150 to 200) mm (> 200 to 300) mm (> 300 to 400) mm (> 400 to 500) mm	0.6 μm 2.0 μm 3.0 μm 4.0 μm 5.0 μm 6.0 μm 7.0 μm	Gage blocks
Dial Gage	≤ 5 mm (> 5 to 20) mm (> 20 to 50) mm (> 50 to 100) mm	1.0 μm 1.3 μm 1.8 μm 2.1 μm	Dial gage calibrator, inspection machine for indicator
Electrical Comparator	≤ 5 mm	0.16 μm	Gage blocks, inspection machine for indicator
Digital Measuring Instrument	≤ 100 mm	0.90 μm	Gage blocks, inspection machine for indicator
Screw Plug Gage  Pitch Diameter Major Diameter	≤ 30 mm	3.1 μm 1.0 μm	ULM Three wires for screw thread measuring
Precision Surface Plate <sup>3,4</sup> (Flatness Only)	Diagonal Length: ≤ 430 mm (> 430 to 1810) mm (> 1810 to 2830) mm	1.5 μm 3.0 μm 3.2 μm	Electronic level



II. Electrical – DC/Low Frequency

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Electrical Simulation of Temperature Indicators –			
Thermocouples			
Type R			
(Internal Reference Junction)	(-50 to < -40) °C	1.1 °C	Digital multimeter, ice point
	(-40 to < -20) °C	1.0 °C	
	(-20 to < -10) °C	0.90 °C	
	(-10 to < 20) °C	0.80 °C	
	(20 to < 60) °C	0.70 °C	
	(60 to < 200) °C	0.60 °C	
	(200 to 1768) °C	0.50 °C	
(External Reference Junction)	(-50 to < -40) °C	0.90 °C	
	(-40 to < -30) °C	0.80 °C	
	(-30 to < -10) °C	0.70 °C	
	(-10 to < 30) °C	0.60 °C	
	(30 to < 200) °C	0.50 °C	
	(200 to 1768) °C	0.40 °C	
Type K			
(Internal Reference Junction)	(-270 to < -260) °C	11 °C	Digital multimeter, ice point
	(-260 to < -250) °C	3.3 °C	
	(-250 to < -240) °C	1.9 °C	
	(-240 to < -230) °C	1.3 °C	
	(-230 to < -220) °C	1.0 °C	
	(-220 to < -210) °C	0.80 °C	
	(-210 to < -200) °C	0.70 °C	
	(-200 to < -180) °C	0.60 °C	
	(-180 to < -150) °C	0.50 °C	
	(-150 to < -100) °C	0.40 °C	
	(-100 to 1372) °C	0.30 °C	
(External Reference Junction)	(-270 to < -260) °C	3.7 °C	
	(-260 to < -250) °C	1.1 °C	
	(-250 to < -240) °C	0.70 °C	
	(-240 to < -230) °C	0.50 °C	
	(-230 to < -220) °C	0.40 °C	
	(-220 to < -170) °C	0.30 °C	
	(-170 to 1372) °C	0.20 °C	

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Electrical Simulation of Temperature Indicators (cont) –			
Thermocouples			
Type E			
(Internal	(-270 to < -260) °C	7.2 °C	Digital multimeter, ice point
Reference	(-260 to < -250) °C	2.2 °C	
Junction)	(-250 to < -240) °C	1.4 °C	
	(-240 to < -230) °C	1.0 °C	
	(-230 to < -220) °C	0.80 °C	
	(-220 to < -210) °C	0.70 °C	
	(-210 to < -190) °C	0.60 °C	
	(-190 to < -160) °C	0.50 °C	
	(-160 to < -90) °C	0.40 °C	
	(-90 to < 200) °C	0.30 °C	
	(200 to 1000) °C	0.20 °C	
(External	(-270 to < -260) °C	1.7 °C	
Reference	(-260 to < -250) °C	0.50 °C	
Junction)	(-250 to < -240) °C	0.40 °C	
	(-240 to < -210) °C	0.30 °C	
	(-210 to 1000) °C	0.20 °C	
Type J			
(Internal	(-210 to < -190) °C	0.60 °C	Digital multimeter, ice point
Reference	(-190 to < -170) °C	0.50 °C	
Junction)	(-170 to < -100) °C	0.40 °C	
	(-100 to 1200) °C	0.30 °C	
(External	(-210 to < -200) °C	0.30 °C	
Reference	(-200 to 1200) °C	0.20 °C	
Junction)			

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Electrical Simulation of Temperature Indicators (cont) –			
Thermocouples Type T			
(Internal Reference Junction)	(-270 to < -260) °C	7.6 °C	Digital multimeter, ice point
	(-260 to < -250) °C	2.3 °C	
	(-250 to < -240) °C	1.4 °C	
	(-240 to < -230) °C	1.1 °C	
	(-230 to < -220) °C	0.90 °C	
	(-220 to < -210) °C	0.80 °C	
	(-210 to < -190) °C	0.70 °C	
	(-190 to < -180) °C	0.60 °C	
	(-180 to < -140) °C	0.50 °C	
	(-140 to < -80) °C	0.40 °C	
	(-80 to < 200) °C	0.30 °C	
	(200 to 400) °C	0.20 °C	
(External Reference Junction)	(-270 to < -260) °C	2.6 °C	
	(-260 to < -250) °C	0.80 °C	
	(-250 to < -240) °C	0.50 °C	
	(-240 to < -230) °C	0.40 °C	
	(-230 to < -200) °C	0.30 °C	
	(-200 to 400) °C	0.20 °C	

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Electrical Simulation of Temperature Indicators (cont) –			
Thermocouples Type N			
(Internal Reference Junction)	(-270 to < -260) °C	16 °C	Digital multimeter, ice point
	(-260 to < -250) °C	3.7 °C	
	(-250 to < -240) °C	2.1 °C	
	(-240 to < -230) °C	1.6 °C	
	(-230 to < -220) °C	1.2 °C	
	(-220 to < -210) °C	1.0 °C	
	(-210 to < -200) °C	0.90 °C	
	(-200 to < -190) °C	0.80 °C	
	(-190 to < -180) °C	0.70 °C	
	(-180 to < -160) °C	0.60 °C	
	(-160 to < -130) °C	0.50 °C	
	(-130 to < -60) °C	0.40 °C	
	(-60 to 1300) °C	0.30 °C	
(External Reference Junction)	(-270 to < -260) °C	7.6 °C	
	(-260 to < -250) °C	1.9 °C	
	(-250 to < -240) °C	1.1 °C	
	(-240 to < -230) °C	0.70 °C	
	(-230 to < -220) °C	0.60 °C	
	(-220 to < -210) °C	0.50 °C	
	(-210 to < -170) °C	0.40 °C	
	(-170 to < -110) °C	0.30 °C	
	(-110 to 1300) °C	0.20 °C	
Resistance Temperature Devices	(-200 to -100) °C	0.020 °C	Decade resistor
	(> -100 to 0) °C	0.021 °C	
	(> 0 to 100) °C	0.045 °C	
	(> 100 to 260) °C	0.050 °C	
	(> 260 to 390) °C	0.055 °C	
	(> 390 to 640) °C	0.060 °C	
	(> 640 to 850) °C	0.065 °C	

III. Mechanical

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Scales and Balances <sup>3,4</sup> Electronic Type	(>60 to 500) kg	73 µg/g	Comparison with Class E2, F1, F2, M1 and M2 weights.
	(>2 to 60) kg	2.4 µg/g	
	(1 to 2) kg	0.86 µg/g	
	(>500 to <1) kg	0.96 µg/g	
	500 g	0.98 µg/g	
	(>200 to <500) g	1.1 µg/g	
	200 g	0.93 µg/g	
	(>100 to <200) g	1.5 µg/g	
	100 g	1.2 µg/g	
	(>50 to <100) g	1.8 µg/g	
	50 g	1.3 µg/g	
	(>20 to <50) g	2.5 µg/g	
	20 g	2.2 µg/g	
	(>10 to <20) g	5.2 µg/g	
	10 g	3.2 µg/g	
	(>5 to <10) g	7.7 µg/g	
	5 g	5.1 µg/g	
	(>2 to <5) g	13 µg/g	
	2 g	10 µg/g	
	(>1 to <2) g	28 µg/g	
	1 g	17 µg/g	
	(>500 to <1) g	43 µg/g	
	500 mg	32 µg/g	
	(>200 to <500) mg	61 µg/g	
	200 mg	51 µg/g	
	(>100 to <200) mg	0.14 mg/g	
	100 mg	80 µg/g	
	(>50 to <100) mg	0.20 mg/g	
	50 mg	0.13mg/g	
	(>20 to <50) mg	0.32 mg/g	
	20 mg	0.26 mg/g	
	(>10 to <20) mg	0.83 mg/g	
10 mg	0.44 mg/g		
9 mg	1.2 mg/g		
8 mg	1.4 mg/g		
7 mg	1.1 mg/g		
6 mg	1.2 mg/g		
5 mg	0.72 mg/g		
4 mg	1.8 mg/g		
3 mg	2.4 mg/g		
2 mg	1.8 mg/g		
1 mg	3.6 mg/g		

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Scales & Balances <sup>3,4</sup> Mechanical Type	(>60 to 500) kg	0.16 mg/g	Comparison with Class E2, F1, F2, M1 and M2 weights.
	60 kg	0.21 mg/g	
	(>6 to <60) kg	0.13 mg/g	
	6 kg	0.21 mg/g	
	(5 to <6) kg	0.10 mg/g	
	(1 to <5) kg	2.3 µg/g	
	(>500 to <1) kg	4.5 µg/g	
	500 g	5.0 µg/g	
	(>200 to <500) g	6.6 µg/g	
	200 g	1.5 µg/g	
	(>100 to <200) g	2.0 µg/g	
	100 g	2.5 µg/g	
	(>50 to <100) g	4.4 µg/g	
	50 g	7.0 µg/g	
	(>20 to <50) g	11 µg/g	
	20 g	2.2 µg/g	
	(>10 to <20) g	5.2 µg/g	
	10 g	3.3 µg/g	
	(>5 to <10) g	7.8 µg/g	
	5 g	5.1 µg/g	
	(>2 to <5) g	13 µg/g	
	2 g	10 µg/g	
	(>1 to <2) g	28 µg/g	
	1 g	17 µg/g	
	(>500 to <1) g	43 µg/g	
	500 mg	32 µg/g	
	(>200 to <500) mg	61 µg/g	
	200 mg	51 µg/g	
	(>100 to <200) mg	0.14 mg/g	
	100 mg	81 µg/g	
	(>50 to <100) mg	0.20 mg/g	
	50 mg	0.13 mg/g	
	(>20 to <50) mg	0.32 mg/g	
20 mg	0.27 mg/g		
(>10 to <20) mg	0.83 mg/g		
10 mg	0.46 mg/g		
9 mg	1.2 mg/g		
8 mg	1.4 mg/g		
7 mg	1.1 mg/g		
6 mg	1.3 mg/g		
5 mg	0.76 mg/g		
4 mg	1.9 mg/g		
3 mg	2.5 mg/g		
2 mg	1.9 mg/g		
1 mg	3.8 mg/g		

Parameter/Equipment	Range	CMC <sup>2, 6</sup> (±)	Comments
Force-Measuring Device  Proving Ring, Standardizing Box, Load Cell, Push-Pull Gauge, etc.	Compression 0.1 N to 3 MN  Tension 0.1 N to 300 kN	0.030 %  0.030 %	Calibration method per JIS B 7728 (ISO 376) or JIS B 7721 or JIS B 7602 or ASTM E74 weights, force calibration machine
Pressure Balances –  Air Pressure    Oil Pressure	Gauge Pressure: (8 to 5000) kPa  Absolute Pressure: (8 to 350) kPa  Gauge Pressure: (0.1 to 1) MPa (>1 to 100) MPa	Larger of 0.0045 % or 1.4 Pa  Larger of 0.0055 % or 6.6 Pa  1.0 kPa Larger of 0.0065 % or 0.65 kPa	Pressure balances
Liquid Column Manometer	Gauge Pressure: (2 to 20) kPa  Gauge Pressure: (> 20 to 220) kPa	0.010 kPa  0.10 kPa	Pressure controller

Parameter/Equipment	Range	CMC <sup>2,6</sup> (±)	Comments
Pressure Gauge –  Air Pressure	Gauge Pressure: (8 to 100) kPa (> 100 to 500) kPa (> 500 to 5000) kPa	0.0040 kPa 0.0040 % 0.0060 %	Pressure balances
	Absolute Pressure: (8 to 100) kPa (> 100 to 350) kPa	0.0050 kPa 0.0050 %	
	Gauge Pressure: (-100 to 0) kPa (> 0 to 100) kPa (> 100 to 500) kPa (> 500 to 700) kPa (> 700 to 5000) kPa	0.016 kPa 0.014 kPa 0.014 % 0.022 % 0.018 %	Pressure controller
	Absolute Pressure: (8 to 100) kPa (> 100 to 350) kPa (> 350 to 500) kPa (> 500 to 700) kPa (> 700 to 5100) kPa	0.015 kPa 0.015 % 0.014 % 0.023 % 0.018 %	



Parameter/Equipment	Range	CMC <sup>2, 5</sup> (±)	Comments
Pressure Gauge (cont)			
— Air Pressure	Gauge Pressure: (-20 to < -15) kPa (-15 to < -10) kPa (-10 to < -7.5) kPa (-7.5 to < -1) kPa (-1 to 1) kPa (> 1 to 7.5) kPa (> 7.5 to 10) kPa (> 10 to 15) kPa (> 15 to 20) kPa  Differential Pressure: (-20 to < -15) kPa (-15 to < -10) kPa (-10 to < -7.5) kPa (-7.5 to < -1) kPa (-1 to 1) kPa (> 1 to 7.5) kPa (> 7.5 to 10) kPa (> 10 to 15) kPa (> 15 to 20) kPa  Absolute Pressure: (75 to 115) kPa	1.8 Pa 1.5 Pa 1.2 Pa 0.75 Pa 0.55 Pa 0.75 Pa 1.2 Pa 1.5 Pa 1.8 Pa  1.8 Pa 1.5 Pa 1.2 Pa 0.75 Pa 0.50 Pa 0.75 Pa 1.2 Pa 1.5 Pa 1.8 Pa  0.050 kPa	Low pressure controller        [Line pressure: 100 kPa ± 5kPa (absolute pressure)]  Digital pressure gauge
Oil Pressure	Gauge Pressure: (0.1 to 1) MPa (1 to 100) MPa  Absolute Pressure: (0.2 to 1.1) MPa (1.1 to 100.1) MPa  Gauge Pressure: (0 to 100) MPa	1.0 kPa Larger of 0.0080 % or 0.80 kPa  1.0 kPa Larger of 0.0081 % or 0.80 kPa  0.20 MPa	Pressure balances      Digital pressure gauge

Parameter/Equipment	Range	CMC <sup>2, 5</sup> (±)	Comments
Torque Measuring Devices – Torque Transducer Torque Meter	2 N·m to 10 kN·m	0.040 %	Torque calibration machine
Torque Measuring Devices <sup>3, 4</sup> – Torque Wrench Tester Torque Tester, Torque Checker, Torque Gauge, etc.	40 mN·m to 1 kN·m 20 mN·m to 100 N·m	0.20 % 0.20 %	Reference torque meter Lever-Mass-System (moment-arm and weights)
Torque Tools <sup>3, 4</sup> – Torque Wrench, Torque Screwdriver, Torque Gauge	200 mN·m to 500 N·m	0.40 %	Torque wrench tester, torque tester

#### IV. Thermodynamic

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Thermometers – Digital	(-100 to < -80) °C (-80 to < 0) °C (0 to 250) °C (> 250 to 420) °C (> 420 to 500) °C (> 500 to 600) °C (> 600 to 960) °C (> 960 to 1100) °C (> 1100 to 1200) °C	0.055 °C 0.020 °C 0.015 °C 0.030 °C 0.065 °C 0.14 °C 0.30 °C 0.80 °C 1.9 °C	Standard platinum resistance thermometer, standard platinum resistance thermometers for high temperature; thermocouple type R/S, freezing point, baths, furnace;  Accredited calibrations are only offered for complete systems including the sensor and indicator

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Platinum Resistance Thermometer Sensors –			Standard platinum resistance thermometer, water triple point cell, baths.
(4-wire)	(-100 to < -80) °C (-80 to < 0) °C (0 to 100) °C (> 100 to 250) °C (> 250 to 420) °C (> 420 to 500) °C	0.053 °C 0.016 °C 0.012 °C 0.014 °C 0.039 °C 0.067 °C	(4-wire) Calibration resistance ratio: R(t)/R(0.01) or R(t)/R(0) Calibration value: R(t)
(3-wire)	(-100 to < -80) °C (-80 to < 0) °C 0 °C (> 0 to 250) °C (> 250 to 420) °C (> 420 to 500) °C	0.055 °C 0.025 °C 0.020 °C 0.025 °C 0.045 °C 0.067 °C	(3-wire) Calibration value: R(t) Note: R(t): resistance value in calibration temperature R(0.01): resistance value in triple point of water R(0): resistance value in freezing point

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Thermocouple Sensor –			
Type E	(-100 to < 0) °C (0 to 250) °C (> 250 to 900) °C	0.30 °C 0.20 °C 0.30 °C	Indicating thermometers, thermocouple type R/S, freezing point, baths, furnace, voltage standard and voltmeter;  Standard platinum resistance thermometers for high temperature
Type J	(-100 to < 0) °C (0 to 250) °C (> 250 to 800) °C	0.30 °C 0.20 °C 0.30 °C	
Type K	(-100 to < 0) °C (0 to 250) °C (>250to 960) °C (> 960 to 1100) °C (> 1100 to 1200) °C	0.30 °C 0.20 °C 0.30 °C 0.80 °C 1.9 °C	
Type N	(-100 to < 0) °C (0 to 250) °C (> 250 to 960) °C (> 960 to 1100) °C (> 1100 to 1200) °C	0.30 °C 0.20 °C 0.30 °C 0.80 °C 1.9 °C	
Type R	(-60 to < -40) °C (-40 to < 0) °C (0 to 960) °C (> 960 to 1100) °C (> 1100 to 1200) °C	0.90 °C 0.70 °C 0.50 °C 0.80 °C 1.9 °C	
Type S	(-60 to < -40) °C (-40 to < 0) °C (0 to 960) °C (> 960 to 1100) °C (> 1100 to 1200) °C	0.70 °C 0.60 °C 0.50 °C 0.90 °C 1.9 °C	
Type T	(-100 to < 0) °C (0 to 250) °C (> 250 to 400) °C	0.30 °C 0.20 °C 0.30 °C	

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Temperature Calibration Instrument <sup>3,4</sup> – Measure Only (Metrology Wells)	(-100 to < -80) °C (-80 to < -50) °C (-50 to < -40) °C (-40 to 100) °C (> 100 to 250) °C (> 250 to 300) °C (> 300 to 400) °C (> 400 to 500) °C (> 500 to 600) °C (> 600 to 700) °C	0.09 °C 0.07 °C 0.040 °C 0.030 °C 0.050 °C 0.060 °C 0.070 °C 0.090 °C 0.12 °C 0.15 °C	Standard platinum resistance thermometer, indicating resistance thermometer, standard thermocouple, voltage standard and voltmeter
Non-Contact Type Thermometer (Radiation Thermometer, Infrared Thermograph, et. al.)	(-50 to < 0) °C (0 to < 35) °C (35 to 100) °C (> 100 to 200) °C (> 200 to 350) °C (> 350 to 500) °C (> 500 to 600) °C (> 600 to 700) °C (> 700 to 800) °C (> 800 to 900) °C (> 900 to 1000) °C	1.2 °C ε = 0.997 0.60 °C ε = 0.997 0.60 °C ε = 0.95 0.90 °C ε = 0.95 1.3 °C ε = 0.95 1.4 °C ε = 0.95 1.8 °C ε = 0.997 2.0 °C ε = 0.997 2.1 °C ε = 0.997 2.2 °C ε = 0.997 2.3 °C ε = 0.997	Blackbody, tammann tube (Cavity) and reference PRT;  ε = Emissivity

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Infrared Calibrator	(-50 to < 0) °C 0 °C (> 0 to 50) °C (> 50 to 100) °C (> 100 to 200) °C (> 200 to 250) °C (> 250 to 300) °C (> 300 to 350) °C (> 350 to 400) °C (> 400 to 500) °C (> 500 to 600) °C (> 600 to 700) °C (> 700 to 800) °C (> 800 to 900) °C (> 900 to 1000) °C	1.5 °C $\epsilon = 0.997$ 0.60 °C $\epsilon = 1.000$ 0.70 °C $\epsilon = 1.000$ 0.70 °C $\epsilon = 1.000$ 1.3 °C $\epsilon = 1.000$ 1.4 °C $\epsilon = 1.000$ 1.5 °C $\epsilon = 1.000$ 1.6 °C $\epsilon = 1.000$ 1.7 °C $\epsilon = 1.000$ 1.7 °C $\epsilon = 1.000$ 1.9 °C $\epsilon = 1.000$ 2.0 °C $\epsilon = 1.000$ 2.1 °C $\epsilon = 1.000$ 2.1 °C $\epsilon = 1.000$ 2.2 °C $\epsilon = 1.000$	Radiation thermometer  $\epsilon =$ Emissivity
Contact Thermometry <sup>3,4</sup> (Surface Plates)	(30 to 100) °C (> 100 to 200) °C (> 200 to 500) °C	0.60 °C 0.70 °C 0.80 °C	Contact thermometer
Hygrometer	(25 to 30) % RH (> 30 to 50) % RH (> 50 to 80) % RH (> 80 to 95) % RH	0.7 % RH 1.0 % RH 1.5 % RH 1.8 % RH	Optical dew point meter

<sup>1</sup> This laboratory offers commercial calibration service.

<sup>2</sup> Calibration and Measurement Capability (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. 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.

<sup>3</sup> 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.

<sup>4</sup> The CMC stated for calibrations performed in the laboratory is applicable for the calibrations performed in the field.

<sup>5</sup> In the statement of CMC, % is the uncertainty percentage of the relative value of the reading.

<sup>6</sup> This accreditation covers calibrations performed at all laboratory locations listed in this scope of accreditation.

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## Accredited Laboratory

A2LA has accredited

# JAPAN QUALITY ASSURANCE ORGANIZATION

*Aichi, JAPAN*

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 23<sup>rd</sup> day of May 2018.

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

President and CEO  
For the Accreditation Council  
Certificate Number 1400.04  
Valid to March 31, 2020  
Revised on June 29, 2018

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