CERTIFICATE OF ACCREDITATION

The ANSI National Accreditation Board

Hereby attests that

Forth Calibration & Service Co., Ltd.
305/47 Soi Ramintra 123, Ramintra Road
Minburi, Minburi, Bangkok, Thailand 10510

Fulfills the requirements of

ISO/IEC 17025:2017

In the fields of

CALIBRATION, DIMENSIONAL MEASUREMENT, AND TESTING

This certificate is valid only when accompanied by a current scope of accreditation document.
The current scope of accreditation can be verified at www.anab.org.

Jason Stine, Vice President

Expiry Date: 01 December 2027
Certificate Number: AC-3041

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017. 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).

SCOPE OF ACCREDITATION TO ISO/IEC 17025:2017

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CALIBRATION, DIMENSIONAL MEASUREMENT, AND TESTING

ISO/IEC 17025 Accreditation Granted: **31 December 2025**

Certificate Number: **AC-3041** Certificate Expiry Date: **01 December 2027**

Acoustics and Vibration

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
[1] Sound Level Meter	94 dB 104 dB 114 dB	0.2 dB 0.2 dB 0.2 dB	CEI/IEC 61672-1,2,3; Sound Level Calibrator

Chemical Quantities

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
[1] pH Meter	4 pH 7 pH 10 pH	0.033 pH 0.039 pH 0.083 pH	ASTM D1293; pH Buffer Solution with Temperature Thermometer
[1] Conductivity Meter	84 µS/cm 147 µS/cm 1.414 mS/cm 12.8 mS/cm	0.84 µS/cm 1.4 µS/cm 31 µS/cm 0.31 mS/cm	ASTM D1125; Potassium Chloride Solution with Temperature Thermometer
[1] Refractometer	5 %Brix 10 %Brix 20 %Brix 30 %Brix 50 %Brix	0.032 %Brix 0.032 %Brix 0.06 %Brix 0.073 % Brix 0.11 %Brix	OIMLR142; Sucrose Standard Solution with Temperature Thermometer

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Chemical Quantities

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
[1] Total Dissolved Solids	1 000 mg/l	4 mg/l	FCS-CP-52; Comparison with TDS Standard Solution with Temperature Thermometer
[1] Salinity Meter	50 g/l 100 g/l	0.27 g/l 0.59 g/l	FCS-CP-53; Comparison with Salinity Standard Solution with Temperature Thermometer

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
[1] Source Electrical Simulation of Thermocouple Indicating Devices (Without Cold Junction Compensation)	Type K (-50 to 1 000) °C Type T (-50 to 1 000) °C Type J (-50 to 1 000) °C	0.96 °C 0.72 °C 0.9 °C	EURAMET cg11; Martel MC-1200
[1] Source Simulation of RTD Indicating Devices	PT385 (100 Ω) (-50 to 300) °C	0.058 °C	EURAMET cg11; Martel MC-1200
[1] Source DC Voltage	Up to 200mV 200 mV to 2 V (2 to 20) V (20 to 200) V (200 to 1 000) V	58 µV/V + 7.5 µV 58 µV/V + 71 µV 58 µV/V + 0.67 mV 58 µV/V + 6.8 mV 58 µV/V + 63 mV	FCS-CP-32; Comparison with Transmille 9050A
[1] Source DC Current	20 µA to 200 µA (0.2 to 2) mA (2 to 20) mA (20 to 200) mA 200 mA to 2 A (2 A to 10) A	0.14 mA/A + 24 nA 0.12 mA/A + 0.58 µA 0.12 mA/A + 1.1 µA 0.14 mA/A + 11 µA 0.58 mA/A + 0.59 mA 0.6 mA/A + 1.19 mA	FCS-CP-33; Comparison with Transmille 9050A

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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
[1] DC Current Clamp-On Ammeters	2 mA to 20 mA 20 mA to 200 mA (0.2 to 2) A (2 to 20) A (20 to 100) A (100 to 1 000) A	0.93 µA/A + 1.6 µA 0.11 mA/A + 16 µA 0.49 mA/A + 1.3 mA 0.41 mA/A + 13 mA 5.9 mA/A + 0.14 A 5.9 mA/A + 0.14 A	FCS-CP-44; Comparison with Transmille 9050A with 2901A Coil
[1] Source AC Voltage	(0.2 to 200) mV (10 to 44) Hz 45 Hz to 1.999 kHz (2 to 20) kHz (0.2 to 2) V (10 to 44) Hz 45 Hz to 1.999 kHz (2 to 19.999) kHz (20 to 100) kHz 330 mV 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 (2 to 20) V (10 to 44) Hz 45 Hz to 1.999 kHz (2 to 19.999) kHz (20 to 100) kHz (20 to 200) V 40 Hz to 1.999 kHz (2 to 20) kHz (200 to 1 000) V 40 Hz to 1.999 kHz (2 to 20) kHz	 0.81 mV/V + 52 µV 0.41 mV/V + 29 µV 1.2 mV/V + 0.22 mV 0.74 mV/V + 0.7 mV 0.81 mV/V + 0.47 mV 0.7 mV/V + 0.45 mV 2.3 mV/V + 3.5 mV 1.7 mV/V + 145 µV 0.35 mV/V + 36 µV 0.93 mV/V + 36 µV 1.6 mV/V + 0.17 mV 2.8 mV/V + 0.99 mV 5.8 mV/V + 1.91 mV 0.7 mV/V + 3.3 mV 0.41 mV/V + 2.6 mV 0.81 mV/V + 4.5 mV 3.5 mV/V + 35 mV 0.52 mV/V + 26 mV 1 mV/V + 45 mV 0.52 mV/V + 0.15 mV 1 mV/V + 0.34 mV	FCS-CP-30; Comparison with Transmille 9050A
[1] Source AC Current	(20 to 200) µA (10 to 44) Hz 45 Hz to 1.999 kHz (2 to 10) kHz 0.2 mA to 2 mA (10 to 44) Hz 45 Hz to 1.999 kHz (2 to 10) kHz	 2.1 mA/A + 0.92 µA 0.8 mA/A + 0.35 µA 1.2 mA/A + 0.58 µA 1 mA/A + 0.73 µA 0.8 mA/A + 0.52 µA 1.2 mA/A + 0.84 µA	FCS-CP-31; Comparison with Transmille 9050A

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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
[1] Source AC Current	(2 to 20) mA (10 to 44) Hz 45 Hz to 1.999 kHz (2 to 10) kHz (20 to 200) mA (10 to 44) Hz 45 Hz to 1.999 kHz (2 to 10) kHz 200 mA to 2 A (10 to 44) Hz 45 Hz to 2 kHz (2 to 10 A) (10 to 45 Hz) (45 to 199.9 Hz) 200 Hz to 1 kHz	 1 mA/A + 4.6 µA 0.81 mA/A + 3.5 µA 1.2 mA/A + 6.9 µA 1 mA/A + 46 µA 0.81 mA/A + 35 µA 2.3 mA/A + 0.14 mA 1.2 mA/A + 0.52 mA 1 mA/A + 0.46 mA 2.3 mA/A + 10 mA 1.7 mA/A + 6.9 mA 2.3 mA/A + 9.2 mA	FCS-CP-31; Comparison with Transmille 9050A
[1] Source AC Current Clamp-On Ammeters	45 Hz to 1.999 kHz (2 to 20) mA 45 Hz to 1.999 kHz (0.2 to 2) A 45 Hz to 200 Hz (2 to 20) A 45 Hz to 1.999 kHz (20 to 100) A 45 Hz to 200 Hz (100 to 1 000) A	 0.82 mA/A + 1.4 A 1.1 mA/A + 1.4 A 1.8 mA/A + 1.4 A 6.6 mA/A + 1.4 A 12 mA/A + 1.4 A	FCS-CP-45; Comparison with Transmille 9050A with 2901A Coil
[1] Source Resistance	4-wire (0 to 0.22) Ω (0.22 to 10) Ω (10 to 100) Ω 100 Ω to 1 kΩ (1 to 10) kΩ (10 to 100) kΩ 2-wire 100 kΩ to 1 MΩ (1 to 10) MΩ (10 to 110) MΩ	 24 mΩ 31 mΩ 67 mΩ 0.13 Ω 1.3 Ω 13 Ω 0.18 kΩ 7.5 kΩ 0.13 MΩ	FCS-CP-048; Comparison with Transmille 9050A
[1] Source AC Power (45 to 400) Hz, PF = 1	(45 to 400) Hz (4 to 4 000) W (45 to 400) Hz (4 to 20) kW	 1.9 mW/W + 0.18 W 0.6 W	FCS-CP-34; Comparison with Transmille 9050A

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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
[1] Measure DC High Voltage	(1 000 to 2 000) V (2 000 to 3 000) V (3 000 to 4 000) V (4 000 to 5 000) V (5 000 to 6 000) V (6 000 to 7 000) V (7 000 to 8 000) V (8 000 to 9 000) V (9 000 to 10 000) V	16 V 22 V 27 V 33 V 39 V 45 V 51 V 56 V 62 V	FCS-CP-35; Comparison with Kikusui 149-10A
[1] Measure AC High Voltage (50 to 60) Hz	(1 to 2) kV (2 to 3) kV (3 to 4) kV (4 to 5) kV (5 to 6) kV (6 to 6.6) kV	30 V 42 V 54 V 65 V 78 V 85 V	FCS-CP-36; Comparison with Kikusui 149-10A
[1] Measure DC Voltage	Up to 100mV 100 mV to 1 V (1 to 10) V (10 to 100) V (100 to 1 000) V	58 µV/V + 5 µV 47 µV/V + 9 µV 41 µV/V + 6 µV 53 µV/V + 0.7 mV 53 µV/V + 20 mV	FCS-CP-37; Comparison with Keysight 34461A
[1] Measure DC Current	Up to 100 µA 0.1 mA to 1 mA (1 to 10) mA (10 to 100) mA 100 mA to 1 A (1 to 3) A (3 to 10) A	0.58 mA/A + 29 nA 0.58 mA/A + 0.07 µA 0.58 mA/A + 2.4 µA 0.58 mA/A + 6 µA 1.2 mA/A + 0.12 mA 2.3 mA/A + 0.7 mA 1.4 mA/A + 2 mA	FCS-CP-39; Comparison with Keysight 34461A
[1] Measure AC Voltage	(10 to 100) mV 10 Hz to 20 kHz (0.1 to 1) V 10 Hz to 20 kHz (1 to 10) V 10 Hz to 20 kHz (10 to 100) V 10 Hz to 20 kHz (100 to 750) V 10 Hz to 20 kHz	0.7 mV/V + 35 µV 0.7 mV/V + 0.35 mV 0.7 mV/V + 3.5 mV 0.7 mV/V + 35 mV 0.7 mV/V + 0.35 V	FCS-CP-38; Comparison with Keysight 34461A

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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
[1] Measure AC Current	(10 to 100) µA 5 Hz to 10 kHz (0.1 to 1) mA 5 Hz to 10 kHz (1 to 10) mA 5 Hz to 10 kHz (10 to 100) mA 5 Hz to 10 kHz (0.1 to 1) A 5 Hz to 10 kHz (1 to 3) A 5 Hz to 10 kHz (3 to 10) A 5 Hz to 10 kHz	1 mA/A + 0.46 µA 0.8 mA/A + 0.35 µA 1.2 mA/A + 0.58 µA 1.2 mA/A + 0.58 µA 1 mA/A + 0.73 µA 0.8 mA/A + 0.52 µA 1.2 mA/A + 0.84 µA	FCS-CP-40; Comparison with Keysight 34461A
[1] Measure Resistance (4-wire)	Up 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 110) MΩ	0.12 mΩ/Ω + 4.3 mΩ 0.12 mΩ/Ω + 12 mΩ 0.12 mΩ/Ω + 0.12 Ω 0.12 mΩ/Ω + 1.2 Ω 0.12 mΩ/Ω + 12 Ω 0.47 mΩ/Ω + 0.12 kΩ 9.3 mΩ/Ω + 12 kΩ	FCS-CP-41; Comparison with Keysight 34461A
[1] Measuring Instrument Insulation Resistance	250 V 10 MΩ 500 V 1 GΩ 1 000 V 10 GΩ 5 000 V 100 MΩ	 83 kΩ 7.9 MΩ 0.2 GΩ 0.77 MΩ	FCS-CP-69; Direct Measurement Technique with Standard Resistance Box
[1] Source Capacitance	(0.1 to 1) nF (1 to 10) nF (10 to 100) nF (0.1 to 1) µF (1 to 10) µF (10 to 100) µF	6 mF/F + 6 pF 5 mF/F + 14 pF 5 mF/F + 0.14 nF 5 mF/F + 1.4 nF 5 mF/F + 14 nF 5 mF/F + 14 µF	FCS-CP-46; Comparison with Transmille 9050A
Measure Magnetic Rod (Magnetism)	Up to 12 000 G	1.2 G	FCS-CP-059; Direct Measurement using Tesla Meter

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Length – Dimensional Metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
[1] Caliper	Up to 150 mm (> 150 to 200) mm (> 200 to 300) mm (> 300 to 400) mm	9.1 µm 9.8 µm 12 µm 14 µm	JIS B 7507 Gauge Block Set
[1] Caliper	(> 400 to 500) mm (> 500 to 600) mm (> 600 to 700) mm (> 700 to 800) mm (> 800 to 900) mm (> 900 to 1 000) mm	16 µm 18 µm 21 µm 23 µm 26 µm 28 µm	JIS B 7507; Gauge Block Set
[1] Depth Gauge	Up to 150 mm (> 150 to 200) mm (> 200 to 300) mm (> 300 to 400) mm (> 400 to 500) mm (> 500 to 600) mm (> 600 to 700) mm (> 700 to 800) mm (> 800 to 900) mm (> 900 to 1 000) mm	9.1 µm 9.8 µm 12 µm 14 µm 16 µm 18 µm 21 µm 23 µm 26 µm 28 µm	JIS B 7518; Gauge Block Set
[1] 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 275) mm (> 275 to 300) mm (> 300 to 325) mm (> 325 to 350) mm (> 350 to 375) mm (> 375 to 400) mm (> 400 to 425) mm (> 425 to 450) mm	0.8 µm 1 µm 1.3 µm 1.6 µm 1.9 µm 2.3 µm 2.6 µm 2.9 µm 3.3 µm 3.5 µm 4 µm 4.2 µm 4.5 µm 4.9 µm 5.2 µm 5.6 µm 5.9 µm	JIS B 7502; Gauge Block Set

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Length – Dimensional Metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
[1] Micrometer	(> 450 to 475) mm (> 475 to 500) mm (> 500 to 525) mm (> 525 to 550) mm (> 550 to 575) mm (> 575 to 600) mm	6.6 µm 7 µm 7.3 µm 7.6 µm 8 µm 8.3 µm	JIS B 7502; Gauge Block Set
[1] Depth 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 275) mm (> 275 to 300) mm	0.8 µm 1 µm 1.3 µm 1.6 µm 1.9 µm 2.2 µm 2.5 µm 2.8 µm 3.1 µm 3.5 µm 3.8 µm 4.1 µm	JIS B 7544; Gauge Block Set
[1] Disk Micrometer	Up to 25 mm (> 25 to 50) mm (> 50 to 75) mm (> 75 to 100) mm	0.8 µm 1 µm 1.3 µm 1.6 µm	JIS B 7502; Gauge Block Set
[1] 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 275) mm (> 275 to 300) mm	0.8 µm 1 µm 1.3 µm 1.6 µm 1.9 µm 2.2 µm 2.5 µm 2.8 µm 3.1 µm 3.5 µm 3.8 µm 4.1 µm	JIS B 7502; Gauge Block Set
[1] Dial Gauge Thickness Gauge	Up to 10 mm (> 10 to 20) mm (> 20 to 30) mm (> 30 to 50) mm	0.55 µm 0.6 µm 0.67 µm 0.87 µm	FCS-CP-08; Comparison with Gauge Block Set

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Length – Dimensional Metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
[1] Digital Linear Gauge	Up 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	0.5 µm 0.52 µm 0.56 µm 0.6 µm 1.1 µm 1.4 µm 1.8 µm 2.3 µm	JIS B 7503; Comparison with Gauge Block Set
[1] Caliper Gauge (Internal and External)	Up to 25 mm (> 25 to 50) mm (> 50 to 75) mm (> 75 to 100) mm (> 100 to 125) mm (> 125 to 150) mm	5.8 µm 5.9 µm 5.9 µm 6 µm 6.1 µm 6.2 µm	JIS B 7507; Comparison with Gauge Block Set
[1] Height Gauge	Up to 150 mm (> 150 to 200) mm (> 200 to 300) mm (> 300 to 600) mm (> 600 to 700) mm (> 700 to 800) mm (> 800 to 900) mm (> 900 to 1 000) mm	7.1 µm 8 µm 10 µm 18 µm 20 µm 23 µm 25 µm 28 µm	JIS B 7517; Gauge Block Set
Steel Rules	Up to 200 mm (> 200 to 300) mm (> 300 to 600) mm (> 600 to 1 000) mm (> 1 000 to 2 000) mm	97 µm 0.11 mm 0.12 mm 0.13 mm 0.17 mm	JIS B 7516; Measuring tolerance of Length only by Comparison with Line Scale Standard, Visual Measuring Machine.
Radius Gauge	(> 0.5 to 20) mm (> 20 to 100) mm	5 µm 5.2 µm	FCS-CP-25; Comparison with Video microscope, Visual Measuring Machine
Pitch Gauge	(> 0.1 to 10) mm	1.7 µm	FCS-CP-23; Comparison with Video Microscope, Visual Measuring Machine

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Length – Dimensional Metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
[1] Ultrasonic Thickness Gages	Up to 20 mm (> 20 to 25) mm (> 25 to 50) mm (> 50 to 75) mm (> 75 to 100) mm	0.65 µm 0.68 µm 0.9 µm 1.2 µm 1.5 µm	FCS-CP-029; Comparison with Standard Gauge Block/Gauge Block Set
[1] Coating Thickness Gauge	(12 to 500) µm 700 µm 1 000 µm	0.44 µm 0.45 µm 0.46 µm	FCS-CP-028; Comparison with Standard Film/Film Thickness Standard
Stage Micrometers / Scale Lupe	Up to 100 mm	5.2 µm	JIS B 7541; Visual Measuring Machine
[1] Shims/Feeler Gages	(0.05 to 3) mm	0.2 µm	FCS-CP-010; High Precision Digital Micrometer
Test Sieves	(0.05 to 50) mm	5.7 µm	ASTM E11-04; Visual Measuring Machine
[1] Measuring Microscopes	X Axis, Y Axis Up to 50 mm (> 50 to 100) mm (> 100 to 150) mm (> 150 to 200) mm (> 200 to 250) mm (> 250 to 300) mm	 1.2 µm 1.3 µm 1.7 µm 2 µm 2.3 µm 2.7 µm	JIS B 7153; Standard Scale
[1] Profile Projector	X Axis, Y Axis Up to 50 mm (> 50 to 100) mm (> 100 to 150) mm (> 150 to 200) mm (> 200 to 250) mm (> 250 to 300) mm	 1.2 µm 1.3 µm 1.7 µm 2 µm 2.3 µm 2.7 µm	JIS B 7184; Standard Scale
[1] Can Seam Micrometer	Up to 13 mm	0.74 µm	JIS B 7502; Gauge Blocks
Protractors	(0.1 to 360)°	0.012°	BS-1685: 1951; Visual Measuring Machine
[1] Roughness Testers	0.40 µm Ra 3.19 µm Ra	72 nm 73 nm	JIS B 0659; Comparison with Precision Roundness Specimen, Roughness Standard
[1] Dial Gauge	Up to 50 mm	2.7 µm	JIS B 7503; Calibration Tester

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Length – Dimensional Metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
[1] Dial Test Indicator	Up to 1 mm (> 1 to 2) mm	2.6 µm 2.6 µm	JIS B 7533; Calibration Tester
[1] Plain Plug Gauge, Pin Gauge	(0.1 to 3) mm (> 3 to 5) mm (> 5 to 10) mm (> 10 to 15) mm (> 15 to 20) mm (> 20 to 25) mm	0.43 µm 0.44 µm 0.47 µm 0.49 µm 0.53 µm 0.62 µm	FCS-CP-11; High Precision Micrometer
Precision Level Slope/Length	(0 to 0.24) mm/m	2.2 µm/m	JIS B 7510; Digital Dial Indicator, Angle Generator
Steel Tape, Textile Tape	Up to 300 mm (300 to 500) mm (500 to 900) mm (900 to 1 200) mm (1 200 to 1 500) mm (1 500 to 2 000) mm (2 000 to 3 000) mm (3 000 to 5 000) mm (5 000 to 10 000) mm (10 000 to 20 000) mm (20 000 to 30 000) mm (30 000 to 40 000) mm (40 000 to 50 000) mm	0.11 mm 0.12 mm 0.13 mm 0.15 mm 0.17 mm 0.19 mm 0.24 mm 0.34 mm 0.58 mm 1.1 mm 1.6 mm 2.1 mm 2.6 mm	JIS B 7512; Measuring tolerance of Length only by Comparison with Line Scale Standard.
[1] Holtest / Bore Gauge	(1 to 20) mm (> 20 to 50) mm (> 50 to 70) mm (> 70 to 80) mm (> 80 to 100) mm (> 100 to 200) mm (> 200 to 300) mm (> 300 to 400) mm	0.4 µm 0.81 µm 1.1 µm 1.3 µm 1.6 µm 3.1 µm 4.6 µm 6.1 µm	JIS B 7515; Dial Gauge Tester, Ring Gauges
Taper Gauge	Up to 60 mm	1.4 µm	FCS-CP 51; Comparison with Line Scale Standard, Visual Measuring Machine

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Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
[2] Universal Testing Machine (Tension and Compression)	(0.1 to 1) kN (1 to 10) kN (10 to 100) kN	0.44 % of reading 0.44 % of reading 0.28 % of reading	ISO 7500-1; Force Transducer
[1] Force Gauge & Push Pull	(1 to 100) N (0.1 to 1) kN (1 to 10) kN	0.44 % of reading 0.44 % of reading 0.28 % of reading	ISO 7500-1; Force Transducer, Weight Set
[1] Scales and Balances, Load Cell (0.000 1 g resolution) (0.000 1 g resolution) (0.001 g resolution) (0.01 g resolution) (0.01 g resolution) (0.01 g resolution) (0.1 g resolution) (0.1 g resolution) (0.1 g resolution) (1 g resolution) (1 g resolution) (0.001 kg resolution) (0.01 kg resolution) (0.01 kg resolution) (0.1 kg resolution) (0.1 kg resolution) (0.1 kg resolution)	 (0 to 50) g (0 to 200) g (0 to 500) g (0 to 1) kg (0 to 2) kg (0 to 3) kg (0 to 5) kg (0 to 6) kg (0 to 10) kg (0 to 20) kg (0 to 30) kg (0 to 50) kg (0 to 60) kg (0 to 150) kg (0 to 300) kg (0 to 600) kg (0 to 1 000) kg	 82 µg 0.22 mg 0.85 mg 2.9 mg 3.4 mg 6.1 mg 7.1 mg 9.8 mg 20 mg 30 mg 0.13 g 0.22 g 0.25 g 0.63 g 1.3 g 2.5 g 4.2 g	UKAS Lab 14; Standard Weight Set
[1] Scales and Balances (0.0001 g resolution) (0.0001 g resolution) (0.001 g resolution) (0.01 g resolution) (0.01 g resolution) (0.01 g resolution) (0.1 g resolution) (0.1 g resolution) (0.1 g resolution) (1 g resolution) (1 g resolution)	 (0 to 50) g (0 to 200) g (0 to 500) g (0 to 1) kg (0 to 2) kg (0 to 3) kg (0 to 5) kg (0 to 6) kg (0 to 10) kg (0 to 20) kg (0 to 30) kg	 0.62 mg 0.7 mg 1.6 mg 3.3 mg 4.5 mg 7.5 mg 11 mg 13 mg 24 mg 41 mg 0.16 g	Guidelines on the Calibration of Non-Automatic Weighing Instruments: Euramet CG 18; Standard Weight Set

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Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
[1] Scales and Balances (0.001 kg resolution) (0.01 kg resolution) (0.01 kg resolution) (0.1 kg resolution) (0.1 kg resolution) (0.1 kg resolution)	 (0 to 50) kg (0 to 60) kg (0 to 150) kg (0 to 300) kg (0 to 600) kg (0 to 1 000) kg	 0.23 g 0.27 g 0.64 g 1.3 g 2.5 g 4.2 g	Guidelines on the Calibration of Non-Automatic Weighing Instruments: Euramet CG 18; Standard Weight Set
[1,3] Moisture Analyzer/Balance Mass	Up to 20 g (20 to 50) g (50 to 100) g (100 to 200) g	72 µg 82 µg 0.12 mg 0.22 mg	Standard Weight Set and UKAS lab 14 utilized in the calibration of the weighing system.
Volumetric Glassware, Burette, Volumetric Pipette, Measuring Pipette, Volumetric Flask, Graduated Cylinder, Beaker, Piston Burette, Dilutor Dispenser	(100 to 1 000) µl (1 to 10) ml (10 to 200) ml (200 to 500) ml (500 to 1 000) ml (1 000 to 2 000) ml	0.55 µl 3.1 µl 60 µl 0.15 ml 0.3 ml 0.6 ml	Electronic Balance; ASTM E542-01 utilized as the method in the calibration of these devices with temperature thermometer.
Piston Operated Volumetric Apparatus Single channel piston Pipette, Multichannel Piston Pipette, Positive-Displacement Pipette, Piston Burette	(100 to 1 000) µl (1 to 10) ml (10 to 200) ml (200 to 500) ml (500 to 1 000) ml (1 000 to 2 000) ml	0.55 µl 3.1 µl 60 µl 0.15 ml 0.3 ml 0.6 ml	Electronic Balance; ISO 8655-6 utilized as the method in the calibration of these devices with temperature thermometer.
[1] Durometers (Spring Force Only) Types A, B, E, O, C, D, DO, M, and FO	Up to 44.5 N	89 mN	Partial Direct Verification per ASTM D 2240 using Force Transducer.
[2] Rockwell Hardness Testing Machine	25 HRC 45 HRC 60 HRC	0.53 HRC 0.37 HRC 0.35 HRC	ISO 6508-2; Indirect Verification using Test Blocks
[2] Vickers Hardness Testers	200 HV 500 HV 750 HV	4.8 HV 5.7 HV 5.8 HV	ISO 6507-2; Indirect Verification using Test Blocks
[2] Brinell Hardness Testers	400 HBW 500 HBW	6.2 HBW 8.0 HBW	ISO 6506-2; Indirect Verification using Test Blocks

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Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
[1] Hand Torque Tool, Torque Wrench, Torque Driver, Electronic Torque Tool	(1 to 10) N·m (10 to 50) N·m (50 to 200) N·m (200 to 500) N·m	0.73 % of reading 0.51 % of reading 0.68 % of reading 0.83 % of reading	ISO 6789; Torque Transducer, Indicator
Torque Meter	Up to 20 N·m	0.14 % of reading	FCS-CP-062; Direct Measurement using Master Weights, 500 mm Calibration Arm
[1] Pressure Gauge (Pneumatic &Hydraulic), Digital Pressure Gauge, Pressure Transducer, Differential Pressure Gauge, Pressure Transmitter, Manometer, Pressure Switch	(0 to 10) kPa (0 to 100) kPa (0 to 2000) kPa (0 to 70 000) kPa	19 Pa 0.15 kPa 4.2 kPa 16 kPa	DKD R 6-1; Pressure Calibrator
[1] Vacuum Gauge	(-90 to 0) kPa	0.13 kPa	DKD R 6-1; Pressure Calibrator
[1] Anemometer	(0 to 20) m/s	0.58 m/s	FCS-CP-42; Comparison with Standard Anemometer in Wind Tunnel
[1] Flow Velocity	(0.3 to 2.5) m/s	1.2 % of reading + 0.003 5 m/s	FCS-CP-47; Comparison with Standard Ultrasonic Flowmeter
[1] Flow Rate	(20 to 182) m^3/h	0.3 % of reading + 0.01 m^3/h	FCS-CP-47; Comparison with Standard Ultrasonic Flowmeter
[1] Rotational Viscometer Dynamic Viscosity	100 mPa·s (cP) 500 mPa·s (cP) 1 000 mPa·s (cP) 6 000 mPa·s (cP) 16 000 mPa·s (cP) 30 000 mPa·s (cP) 70 000 mPa·s (cP)	0.35 % of reading 0.35 % of reading 0.43 % of reading 0.43 % of reading 0.49 % of reading 0.49 % of reading 0.49 % of reading	FCS-CP-43; Viscosity Reference Standard

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Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
[1] Rotational Viscometer Kinematic Viscosity	100 mm²/s (cSt) 500 mm²/s (cSt) 1 000 mm²/s (cSt) 6 000 mm²/s (cSt) 16 000 mPa·s (cP) 30 000 mPa·s (cP) 70 000 mPa·s (cP)	0.35 % of reading 0.35 % of reading 0.43 % of reading 0.43 % of reading 0.49 % of reading 0.49 % of reading 0.49 % of reading	FCS-CP-43; Viscosity Reference Standard
[1] Viscosity Cups Ford Cups (#s 1, 2, 3, 4, 5) Shell Cups (#s 1, 2, 2½, 3, 3½, 4, 5, 6) Zahn Cups (#s 1, 2, 3, 4, 5)	100 mm²/s (cSt) 500 mm²/s (cSt) 1 000 mm²/s (cSt)	0.12 s 0.12 s 0.12 s	ASTM D 1200, ASTM D 4212; Viscosity Reference Standard, Stopwatch
[1] Mass Determination	(0.5 to 1) kg (1 to 2) kg (2 to 5) kg (5 to 10) kg (10 to 20) kg	8.2 mg 8.2 mg 60 mg 70 mg 80 mg	OIML R111-1; Standard Weight Set, Electronic Balance

Photometry and Radiometry

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Light Meter	(0 to 500) lux (500 to 5 000) lux	2.6 % of reading 2.2 % of reading	FCS-CP-70; Comparison with Standard Light Meter

Thermodynamic

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
[1] Moisture Analyzer/Balance Temperature	(100 to 200) °C	0.33 °C	Comparison with Temperature Datalogger with Probe

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Thermodynamic

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
[1] Air Temperature Controlled chamber			G20 TLAS; Agilent 34970A Datalogger
Hot Air Oven	50 °C	0.69 °C	with RTD Probe
	(> 50 to 100) °C	0.65 °C	
	(> 100 to 250) °C	0.75 °C	with Type T Thermocouple
	(250 to 400) °C	3.1 °C	with Type K Thermocouple
Incubator	(10 to 50) °C	0.3 °C	with RTD Probe
Refrigerator	(0 to 10) °C	0.28 °C	with RTD Probe
Freezer	(-25 to 0) °C	0.28 °C	with RTD Probe
Autoclave	(115 to 125) °C	0.65 °C	with Type T Thermocouple
[1] Dial Thermometer	(-25 to 200) °C	0.2 °C	FCS-CP-21; Comparison with Standard Temperature, Dry Block Calibrator
	(200 to 500) °C	0.33 °C	
[1] Digital Thermometer with Sensor Types			
K, J, E, T, N, R, S	(-25 to 150) °C	0.24 °C	FCS-CP-19; Comparison with Standard Temperature, Dry Block Calibrator
	(200 to 300) °C	0.4 °C	
	(300 to 400) °C	0.42 °C	
	(400 to 500) °C	0.45 °C	
[1] Digital Thermometer with Sensor			
Type RTD	(-25 to 200) °C	0.2 °C	FCS-CP-14; Comparison with Standard Temperature, Dry Block Calibrator
	(200 to 500) °C	0.33 °C	
[1] Liquid in Glass Thermometers	(200 to 300) °C	0.44 °C	FCS-CP-27; Comparison with Standard Temperature Probe
	(300 to 500) °C	0.45 °C 0.47 °C	
[1] Liquid Bath	(25 to 50) °C	0.2 °C	Comparison with Standard Temperature Probe, Agilent 34970A Datalogger per ASTM E715.
	(50 to 100) °C	0.25 °C	

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Thermodynamic

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
[1] Furnace	(300 to 600) °C (600 to 900) °C (900 to 1200) °C	0.7 °C 4.7 °C 5.1 °C	FCS-CP-56; Comparison with Type S Thermocouple Probe, Temperature Indicator
[1] Infrared Thermometers	(30 to 150) °C (150 to 200) °C (200 to 300) °C	2.5 °C 2.8 °C 2.9 °C	FCS-CP-054; Comparison Method with Black Body (flat plate), RTD with Temperature Indicator; λ = (8 to 14) µm, ε = 0.95
Thermo-hygrometer, Thermo-hygrograph, Temperature/Humidity Meter Temperature Humidity	(15 to 40) °C (20 to 30) %RH (30 to 70) %RH (70 to 90) %RH	0.55 °C 2 %RH 2.1 %RH 2.2 %RH	FCS-CP-67; Comparison with Standard Temperature/Humidity Meter, Temperature/Humidity Chamber

Time and Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
[1] Source Frequency	100 mV to 10 V 10 Hz to 100 Hz 100 Hz to 1 kHz 1 kHz to 10 kHz	 0.25 mHz/Hz + 0.6 Hz 0.12 mHz/Hz + 6 Hz 0.12 mHz/Hz + 0.6 Hz	FCS-CP-050; Comparison with Multiproduct Calibrator
[1] Measurement Frequency	100 mV to 10 V 3 Hz to 10 Hz 10 Hz to 100 Hz 100 Hz to 1 kHz 1 kHz to 300 kHz	 1.2 mHz/Hz + 0.6 mHz 0.35 mHz/Hz + 0.6 mHz 0.12 mHz/Hz + 6 mHz 0.12 mHz/Hz + 0.6 Hz	FCS-CP-49; Measurement with Reference Multimeter
[1] Timers, Stopwatches	(1 to 1 800) s	12 ms	FSC-CP-061; Comparison to Seiko W073-4000 Stopwatch

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Time and Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
[1] Non-contact Tachometers	(0 to 1 000) rpm (1 000 to 90 000) rpm	0.058 rpm 0.58 rpm	FCS-CP-68 In-house Method by Direct Measurement; Multifunction Calibrator

DIMENSIONAL MEASUREMENT

1 Dimensional

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Dimensional Measurement – 1D Length	(> 0 to 25) mm	0.9 µm	FCS-CP-063; Direct Measurement with High Precision Micrometer
	(0 to 25) mm (> 25 to 200) mm	2.6 µm 4 µm	FCS-CP-064; Direct Measurement with Visual Measuring Machine
	(> 0 to 1 000) mm	0.12 mm	FCS-CP-064; Direct Measurement with Linear Scale Calibrator

2 Dimensional

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Dimensional Measurement – 2D Length	X-axis, Y-axis (> 0 to 20) mm (> 20 to 100) mm (> 100 to 200) mm	 2 µm 2.6 µm 4 µm	FCS-CP-057; Direct Measurement with Visual Measuring Machine
Angle Measurement	(0.1 to 360)°	0.015°	FCS-CP-058; Direct Measurement with Visual Measuring Machine

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TESTING

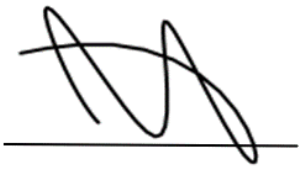
Mechanical

Specific Tests and/or Properties Measured	Specification, Standard, Method, or Test Technique	Items, Materials or Product Tested	Key Equipment or Technology
[4] Metal Detectors	Internal Procedure FCS-CP-060	Indirect Diameter Measurement of Metal Objects	Ferrous (Fe), Non-Ferrous (NFe), SUS (316) Certified Samples

Calibration and Measurement Capability (CMC) is expressed in terms of the measurement parameter, measurement range, expanded uncertainty of measurement and reference standard, method, and/or equipment. The expanded uncertainty of measurement is expressed as the standard uncertainty of the measurement multiplied by a coverage factor of 2 (k=2), corresponding to a confidence level of approximately 95%.

Notes:

1. On-site calibration service is available for this parameter, since on-site conditions are typically more variable than those in the laboratory, larger measurement uncertainties are expected on-site than what is reported on the accredited scope.
2. Onsite Calibration only.
3. The CMC for scales and balances is highly dependent upon the resolution of the unit under test. The CMC presented here does not include the resolution of the unit under test. The resolution will be included in the reported measurement uncertainty at the time of calibration.
4. These devices produce Qualitative Measurements and not Quantitative Measurements (Pass/Fail measurand). There is Measurement Uncertainty associated with the diameter of the Metal Samples. Contact the laboratory for those calculations.



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