



Standards Council of Canada
Conseil canadien des normes

Program for Accreditation of Laboratories – Canada
Programme d'accréditation des laboratoires – Canada

CERTIFICATE OF ACCREDITATION

Transcat Canada - Burlington
916 Gateway, Burlington, ON L7L 5K7

having been assessed by the National Research Council of Canada (NRC), under the authority of the Standards Council of Canada (SCC), and found to conform with the requirements of ISO/IEC 17025:2017 and conditions established by SCC, and the NRC Calibration Laboratory Assessment Service (CLAS), and having demonstrated the capability of calibrating measurement instruments and standards and providing verified traceability to the national measurement standards of Canada, in specified fields and specified uncertainty limits, is hereby recognized as an

ACCREDITED CALIBRATION LABORATORY
For specific measurement capabilities which are hereby CERTIFIED
by CLAS



as listed in the Directory of the Canadian Calibration Network maintained by NRC and approved by SCC. The national measurement standards of Canada are realized, maintained and disseminated by NRC under the authority of the *National Research Council Act* and the *Weights and Measurements Act*. Bilateral agreements recognizing the equivalence of national measurement standards exist between NRC and other national metrology institutes. Copies of these agreements are available from NRC.



Chief Metrologist (NRC) / Métrologue en chef (CNRC)

The validity of this certificate, including the date of last re-accreditation and its expiry can be confirmed by the accompanying Scope of Accreditation document in the Directory of Accredited Laboratories on the SCC website at www.scc.ca.

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



National Research
Council Canada

Conseil national
de recherches Canada

Calibration Laboratory Assessment Service
Service d'évaluation de laboratoires d'étalonnage

CERTIFICAT D'ACCRÉDITATION

ayant fait l'objet d'une évaluation par le Conseil national de recherches du Canada (CNRC), sous l'autorité du Conseil canadien des normes (CCN) et ayant été trouvé conforme aux exigences d'ISO/IEC 17025:2017, ainsi qu'aux conditions établies par le CCN et le Service d'évaluation de laboratoires d'étalonnage (CLAS) du CNRC, et ayant prouvé ses compétences en matière d'étalonnage des instruments de mesure et des étalons, et de raccordement aux étalons nationaux du Canada, dans des domaines précis et des limites établies d'incertitude, est de ce fait reconnu comme étant un

LABORATOIRE D'ÉTALONNAGE ACCRÉDITÉ
CERTIFIÉ par le CLAS pour des capacités précises de mesurage

indiquées dans le Répertoire du réseau canadien d'étalonnage établi par le CNRC et approuvé par le CCN. Les étalons nationaux du Canada sont établis, maintenus et émis par le CNRC en vertu de la *Loi sur le Conseil national de recherches* et de la *Loi sur les poids et mesures*. Il existe entre le CNRC et d'autres instituts nationaux de métrologie des accords bilatéraux qui reconnaissent l'équivalence des étalons nationaux de mesure. Le CNRC tient à la disposition du public des exemplaires de ces accords.

Accredited laboratory number: / Numéro de laboratoire accrédité : 22
SCC file number: / Dossier du CCN n° : 15006
NRC CLAS Certificate No. / Numéro du certificat CNRC CLAS : 2000-03
Initial accreditation date: / Date de la première accréditation : 1985-10-08

Vice-President – Accreditation Services / Vice-président – Services d'accréditation

Issued on: / Délivré le : 2020-06-15

Pour vérifier la validité du présent certificat, y compris la date de la dernière réaccréditation et la date d'expiration du certificat, consulter la portée d'accréditation qui se trouve dans le répertoire des laboratoires accrédités dans le site Web du CCN au www.ccn.ca.

Ce laboratoire est accrédité conformément à la Norme internationale reconnue ISO/IEC 17025:2017. Cette accréditation démontre la compétence technique d'un organisme pour une portée définie et l'exploitation d'un système de management de la qualité de laboratoire (cf. communiqué conjoint ISO-ILAC-IAF date de avril 2017).



9900 Cote-de-Liesse, Montreal, QC H8T 1A1 • Phone: 514.631.6653 • Fax: 514.631.6122 • Transcat.ca

January 18, 2021

Dear Valued Customer,

We are pleased to provide this letter of clarification in reference to the information on our current ISO 17025 certificates of accreditation.

Our laboratories have been audited and assessed by the National Research Council of Canada (NRC) through its Calibration Laboratory Assessment Service (CLAS). Based on the successful completion of our audits, we are confirmed as accredited by the Standards Council of Canada (SCC) who provides our ISO 17025 certificates of accreditation. These frameable paper certificates are formally issued by the Standards Council of Canada and indicate our SCC laboratory number, our CLAS certificate number, the date of our initial accreditation and the date on which the paper certificate was printed.

For the period of validity of our **current scope of accreditation**, including the **date on which the scope was issued and the expiry date**, these are published on the SCC website at scc.ca.

For the list of our full measurement capabilities, our detailed scope of accreditation is outlined on the NRC website at nrc.canada.ca in the directory of accredited calibration laboratories.

If you have any questions, please do not hesitate to contact our Quality Manager, David Llorens via email at david.llorens@transcat.ca or via telephone at 1-800-828-1470 extension 7232.

We appreciate being your trusted calibration partner, and we thank you for your business!

Yours very truly,

A handwritten signature in blue ink that reads "Ingrid M. Ulrich". The signature is fluid and cursive.

Ingrid M. Ulrich, CA, CPA, MBA
Vice-President, Operations & Administration
Transcat Canada Inc.



TESTING AND CALIBRATION LABORATORY ACCREDITATION PROGRAM (LAP)

Scope of Accreditation

Accredited Laboratory No. 22

Legal Name of Accredited Laboratory: Transcat Canada - Burlington

Contact Name: Sean Hastings

Address: 916 Gateway, Burlington, ON L7L 5K7

Telephone: 905 632 5869

Fax: 905 632 3741

Website: www.transcat.ca

Email: sean.hastings@transcat.ca

SCC File Number:	15006
Provider:	NRC-CLAS
Provider File Number:	434
Accreditation Standards:	ISO/IEC 17025:2017
Clients Served:	All interested parties On-site calibration services are available for Type III calibration capabilities and for certain Type II capabilities.
Field of Calibration:	Dimensional Electrical Force Hardness Pressure Time and frequency
Program Specialty Area:	Calibration
Initial Accreditation:	1985-10-08
Most Recent Accreditation:	2020-06-15
Accreditation Valid to:	2023-10-08

Remarque: La présente portée d'accréditation existe également en français, sous la forme d'un document distinct.
Note: This scope of accreditation is also available in French as a separately issued document.



CALIBRATION OF MEASURING AND TEST EQUIPMENT

For calibration measurement capability, please refer to the Canadian Calibration Network web page at the National Research Council of Canada. This laboratory is accredited by the Standards Council of Canada as part of the Calibration Laboratory Assessment Service (CLAS) program and is listed at nrc.canada.ca.

This document forms part of the Certificate of Accreditation issued by the Standards Council of Canada (SCC). The original version is available in the Directory of Accredited Laboratories on the SCC website at www.scc.ca.

Elias Rafoul
Vice-President, Accreditation Services
Publication on: 2020-06-17

CLAS Certificate Number 2000-03

From: National Research Council Canada

Company name	Transcat Canada - Burlington
Company address	916 Gateway Burlington, Ontario Canada L7L 5K7
Contact	Sean Hastings Tel: 905-632-5869 Toll Free: 1-800-897-0067 Fax: 905-632-3741 Email: Sean.Hastings@transcat.ca Website: www.Transcat.ca
Clients served	• All interested parties • On-site calibration services are available for Type III calibration capabilities and those Type II capabilities specifically indicated in the remarks column.
Fields of calibration	• <u>Dimensional</u> • <u>Hardness</u> • <u>Force</u> • <u>Pressure</u> • <u>Electrical</u> • <u>Time and Frequency</u>
SCC accreditation (ISO/IEC 17025)	• Accredited Laboratory N° 22 • First issued 1985-0-08 • Issue 9.0e 2020-06-15

i This scope of calibration capabilities is published by the CLAS program of the National Research Council of Canada (NRC) in close co-operation with the laboratory accreditation program of the Standards Council of Canada (SCC), Canada's accreditation body for calibration and testing laboratories. The SCC accredits the capability of the named laboratory for being able to perform the listed calibrations at the given Calibration Measurement Capability (see Supplementary **note C** and **note D**) with traceability to the International System of Units (SI) or to standards acceptable to the CLAS program.

Dimensional

Measured Quantity & Range or Instrument	Calibration Measurement Capability expressed as an Uncertainty (±) (See <u>supplementary notes</u>)	Type	Remarks
Gauge Block, length: Steel, Rectangular and Square			
Inch, up to 4 inches	± (0.5 + 1.85L) μinch or ± 2.5 μinch, whichever greater (Note: L in inches)	I	GGG-G-15C, ASME B89.1.9. Limited to calibrations performed by comparison with individual inch-sized steel gauge blocks covering the range from 0.05 inch through 20 inches (or mm equivalent) where the reference standards have been calibrated and traceable to the International System of Units (SI).
Inch, 5 to 20 inches	± (1.5 + 1.3L) μinch (Note: L in inches)		
Metric, up to 100 mm	± (0.013 + 0.002L) μm or ± 0.064 μm, whichever greater (Note: L in mm)		
Metric, 125 to 500 mm	± (0.16 + 0.001L) μm (Note: L in mm)		
Variation in length of gauge blocks (parallelism):	± 1 μinch or ± 0.025 μm		
Optical Flatness			
Measurement of optical flatness of gauge blocks and 4 inch diameter optical flats	± 3 μinch	II	Limited to the measurement of optical flatness of gauge blocks and 4 inch diameter optical flats by the use of a reference optical flat and monochromatic light source.
Ring gauge cylindrical, diameter:			
Inch, up to 12 inches	± (10 + 5.2L) μin (Note: L in inches)	I	ASME B89.1.6M. Laboratory primary gauge blocks are used as reference standards for plain ring measurement. Single gauge blocks wrung with "end caps" are

Measured Quantity & Range or Instrument	Calibration Measurement Capability expressed as an Uncertainty (±) (See <u>supplementary notes</u>)	Type	used as reference length standards; uncertainties are based on a one to one size relationship between the device under measurement and the gauge block reference standard.
			Remarks
Metric, up to 305 mm	± (0.25 + 0.0052L) μm (Note: L in mm)		
Plug gauge cylindrical, diameter:			
Inch, up to 12 inches	± (5 + 5.2L) μin (Note: L in inches)	I	ASME B89.1.5. Laboratory primary gauge blocks are used as reference standards for plug gauge measurement. Uncertainties are based on a one to one size relationship between the device under measurement and the gauge block reference standard.
Metric, up to 305 mm	± (0.12 + 0.0052L) μm (Note: L in mm)		
Thread wire, diameter:			
Inch, up to 1 inch	± 10 μin	I	ASME B89.1.17.
Metric, up to 25 mm	± 0.25 μm		
Caliper: Outside			
Inch, up to 12 inches	± 310 μin	II III	Federal Standard GGG-C-111
Inch, over 12 to 24 inches	± 450 μin		
Inch, over 24 to 40 inches	± 640 μin		
Metric, up to 300 mm	± 8 μm		
Metric, from 300 to 600 mm	± 12 μm		
Metric, from 600 to 1000 mm	± 16 μm		
Caliper: Inside			
Inch, up to 12 inches	± 310 μin	II III	Federal Standard GGG-C-111
Metric, up to 300 mm	± 8 μm		
Caliper: Depth			

Measured Quantity & Range or Instrument	Calibration Measurement Capability expressed as an Uncertainty (±) (See <u>supplementary notes</u>)	Type	Remarks
Inch, up to 12 inches	± 330 μin	II	Federal Standard GGG-C-111
Metric, up to 300 mm	± 9 μm	III	
Dial and Test Indicators:			
Inch, 0.001 inch resolution	± 140 μin	II	ASME B89.1.10M
Inch, 0.0001 inch resolution	± 48 μin	III	
Inch, 0.00002 inch resolution	± 16 μin		
Metric, 0.02 mm resolution	± 4 μm		
Metric, 0.002 mm resolution	± 1.2 μm		
Metric, 0.0005 mm resolution	± 0.4 μm		
Micrometers: Outside			
Inch, up to 6 in	± (34 + 3.1L) μin (Note: L in inches)	II	Federal Specification GGG-C-105, ASME B89.1.13
Over 6 to 36 in	± (50 + 7L) μin (Note: L in inches)	III	
Metric, up to 150 mm	± (0.86 + 0.0031L) μm (Note: L in mm)		
Over 150 to 900 mm	± (1.27 + 0.007L) μm (Note: L in mm)		
Micrometers: Inside			
Inch, head travel of 1 in	± 60 μin	II	Federal Specification GGG-C-105, ASME B89.1.13
		III	

Measured Quantity & Range or Instrument	Calibration Measurement Capability expressed as an Uncertainty (±) (See <u>supplementary notes</u>)	Type	Remarks
Inch, up to 36 in	± (40 + 6L) μin (Note: L in inches)		
Metric, head travel of 25.4 mm	± 1.5 μm		
Metric, up to 900 mm	± (1.0 + 0.006L) μm (Note: L in mm)		
Micrometer head - Spindle displacement:			
up to 1 inch	± 10 μinch	II	
up to 25.4 mm	± 0.26 μm		
Optical comparator:			
lens magnification	< 0.1 %	III	
horizontal encoder with digital readout	± 100 μin		
vertical encoder with digital readout	± 100 μin		
angle	± 2.2 minutes of arc		
Micrometer setting standards:			
Inch, up to 36 inches	± (30 + 4L) μin (Note: L in inches)	II	Federal Specification GGG-C-105, ASME B89.1.13
over 36 up to 80 inches	± (200 + 5L) μin (Note: L in inches)		
Metric, up to 900 mm	± (0.8 + 0.004L) μm (Note: L in mm)		

Measured Quantity & Range or Instrument	Calibration Measurement Capability expressed as an Uncertainty (±) (See <u>supplementary notes</u>)	Type	Remarks
over 900 up to 2000 mm	± (5 + 0.005L) μm (Note: L in mm)		
Rules, measuring			
Inch, length up to 48 inches	± (30 + 8L) μin (Note: L in inches)	II	Federal Specification GGG-R-791H
Metric, length up to 1000 mm	± (0.8 + 0.008L) μm (Note: L in mm)		
Surface Plate Flatness			
up to 20 foot diagonal	± (43+2D) μinch, where, D is the length of the diagonal in inches.	III	Federal Specification GGG-P-463 (using a HP 5529A Laser Interferometer)
Thread plug gauge and thread setting plug gauge, 60 degree: Pitch diameter (measured over thread wires)			
Inch, up to 1.5 inches	± 100 μin	II	ANSI/ASME B1.2, ANSI/ASME B1.6 In normal commercial gauging practice, the pitch diameter of a thread plug gauge is determined by measuring the diameter over thread wires inserted in the thread groove on opposite sides of the axis. The preferred term for this measurement is 'thread groove diameter'. Other names for this measurement are 'simple effective diameter' and 'simple pitch diameter'.
over 1.5 up to 6 inches	± 200 μin		
over 6 up to 12 inches	± 300 μin		
Metric, up to 35 mm	± 2.5 μm		
over 35 up to 150 mm	± 5.1 μm		
over 150 up to 300 mm	± 7.6 μm		
Thread plug gauge and thread setting plug gauge, 60 degree: Major diameter			
Inch, up to 12 inches	± (10 + 6L) μin (Note: L in inches)	II	ANSI/ASME B1.2, ANSI/ASME B1.6

Measured Quantity & Range or Instrument	Calibration Measurement Capability expressed as an Uncertainty (±) (See <u>supplementary notes</u>)	Type	Remarks
Metric, to 300 mm	± (0.25 + 0.006L) μm (Note: L in 'millimetres')		
Thread ring gauge, solid, 60 degree parallel: Pitch diameter (measured over balls)			
Inch, up to 5.5 inches	± 90 μin	II	ANSI/ASME B1.2, ANSI/ASME B1.6 In normal commercial gauging practice, the pitch diameter of a thread plug gauge is determined by measuring the diameter over thread wires inserted in the thread groove on opposite sides of the axis. The preferred term for this measurement is 'thread groove diameter'. Other names for this measurement are 'simple effective diameter' and 'simple pitch diameter'.
Metric, up to 139 mm	± 2.3 μm		
Thread ring gauge, adjustable, 60 degree parallel:			
- Set to thread setting plug - Inch, up to 12 inches - Metric, up to 305 mm	The adjustable thread ring gauge is set to the functional diameter of the thread setting plug.	II	ANSI/ASME B1.2, ANSI/ASME B1.6
Height gauges			
Inch, up to 22 inches	600 μin	II	Comparison against a reference bar.
Inch, 22 inches to 50 inches	700 μin		
Metric, up to 560 mm	15 μm		
Metric 560 mm to 1270 mm	18 μm		

Force

Measured Quantity & Range or Instrument	Calibration Measurement Capability expressed as an Uncertainty (±) (See <u>supplementary notes</u>)	Type	Remarks
Torque transducers: Clockwise and counter clockwise			
50 lb•in to 250 lb•ft	± 0.25 % of reading	II	Federal Specification GGG-W-686
65 N•m to 339 N•m	± 0.25 % of reading		
Torque wrenches & screwdrivers: Clockwise and counter clockwise			
4.5 oz•in to 600 lb•ft	± 0.5 % of reading	II III	Federal Specification GGG-W-686
0.032 N•m to 813 N•m	± 0.5 % of reading		

Pressure

Pressure, Gauges, Controllers, & Transducers

Measured Quantity & Range or Instrument	Calibration Measurement Capability expressed as an Uncertainty (±) (See <u>supplementary notes</u>)	Type	Remarks
Gauge, Pneumatic			
Pressure Range (-17, 0.5, 1.0, 10.0, 15.0 30.0, 100.0, 50.0, 250.0, 500,0, 750,0 1,500) psig	± 0.01 % of Full Scale for each range	II & III	Mensor APC 600 Multiple-Range Pressure Controller
Pressure Range -100 to 10,000 kPa	± 0.01 % of Full Scale for each range		
0 to 4,500 psig	± 0.01 % of Full Scale	II & III	Mensor 2106-4.5k Pressure Gauge
0 to 31,000 kPa	± 0.01 % of Full Scale		
Gauge, Hydraulic			
100 to 16,000 psig	± 0.025 % of Reading	I	Budenberg 580HXA Pressure Balance
0 to 4,500 psig	± 0.01 % of Full Scale	I & II	Mensor 2106-4.5k Pressure Gauge

Measured Quantity & Range or Instrument	Calibration Measurement Capability expressed as an Uncertainty ($\pm$) (See <u>supplementary notes</u>)	Type	Remarks
0 to 31,000 kPa	± 0.01 % of Full Scale		
Absolute, Pneumatic			
Pressure Ranges (0.5, 1.0, 10.0, 15.0, 30.0, 50.0, 100, 250.0, 500.0, 750.0, 1,500) psia	± 0.01 % of Full Scale for each range	II & III	Mensor APC 600 Multiple-Range Pressure Controller
Pressure Range 0 to 70,000 kPa	± 0.01 % of Full Scale for each range	II & III	Mensor APC 600 Pressure Controller Barometric Reference
Barometric Range 758 to 1172 hPa	± 0.01 % of Reading		

Hardness

Measured Quantity & Range or Instrument	Calibration Measurement Capability expressed as an Uncertainty (±) (See <u>supplementary notes</u>)	Type	Remarks
Indirect verification of Rockwell Hardness Testers:			
HRA, HRBW, HRC, HREW	Governed by the uncertainty of the standardized test block used to perform the indirect verification	II & III	ASTM E18 Standardized Test Blocks per ASTM E18.
Indirect verification of Rockwell Superficial Hardness Testers:			
HR15N, HR15TW, HR15YW	Governed by the uncertainty of the standardized test block used to perform the indirect verification	II & III	ASTM E18 Standardized Test Blocks per ASTM E18 .
HR30N, HR30TW			
HR45N, HR45TW			
Indirect verification of Brinell Hardness Testers:			
HBW	Governed by the uncertainty of the standardized test block used to perform the indirect verification	II & III	ASTM E10 Standardized Test Blocks per ASTM E10 .
Indirect verification of Vickers Micro Indentation Hardness Testers:			

Measured Quantity & Range or Instrument	Calibration Measurement Capability expressed as an Uncertainty ($\pm$) (See <u>supplementary notes</u>)	Type	Remarks
HV	Governed by the uncertainty of the standardized test block used to perform the indirect verification	II & III	ASTM E384 Standardized Test Blocks per ASTM E384.
Indirect verification of Knoop Micro Indentation Hardness Testers:			
HK	Governed by the uncertainty of the standardized test block used to perform the indirect verification	II & III	ASTM E384 Standardized Test Blocks per ASTM E384.

Time and Frequency

Measured Quantity & Range or Instrument	Calibration Measurement Capability expressed as an Uncertainty ($\pm$) (See <u>supplementary notes</u>)	Type	Remarks
Frequency			
10 MHz	1 part in 10^{-10}	II	For the calibration of the normalized frequency offset averaged over 24 hours of stable frequency sources and measuring devices using a frequency standard and GPS system
0.01 Hz to 2 MHz	2.5 ppm + 5 μ Hz		For the calibration of frequency measuring devices using a multifunction calibrator. On-site calibration available

Electrical

Measured Quantity & Range or Instrument	Calibration Measurement Capability expressed as an Uncertainty ($\pm$) (See <u>supplementary notes</u>)	Type	Remarks
Voltage, DC			
0 mV to 220 mV	7.5 $\mu\text{V/V}$ + 0.4 μV	II	Generate using a multifunction calibrator. For the calibration of voltage measuring devices. On-site calibration available.
220 mV to 2.2 V	5 $\mu\text{V/V}$ + 0.7 μV		
2.2 V to 11 V	3.5 $\mu\text{V/V}$ + 2.5 μV		
11 V to 22 V	3.5 $\mu\text{V/V}$ + 4 μV		
22 V to 220 V	5 $\mu\text{V/V}$ + 40 μV		
220 V to 1100 V	6.5 $\mu\text{V/V}$ + 400 μV		
0 V to 100 mV	5.5 ppm + 0.3 μV	II	Measure using a digital multimeter. For the calibration of dc voltage generating devices. On-site calibration available.
100 mV to 1 V	4.5 ppm + 0.3 μV		
1V to 10 V	4.5 ppm + 0.5 μV		
10 V to 100 V	6.5 ppm + 30 μV		
100 V to 1000 V	18 ppm + 100 μV		
1 kV to 100 kV	0.1 %	II	Measure using a high voltage divider and digital multimeter. For the calibration of dc voltage generating devices. On-site calibration available.
Current, DC			
0 A to 220 μA	40 $\mu\text{A/A}$ + 6 nA	II	Generate using a multifunction calibrator. For the calibration of dc current measuring devices. On-site calibration available.
220 μA to 2.2 mA	35 $\mu\text{A/A}$ + 7 nA		
2.2 mA to 22 mA	35 $\mu\text{A/A}$ + 40 nA		
22 mA to 220 mA	45 $\mu\text{A/A}$ + 0.7 μA		
220 mA to 2.2 A	80 $\mu\text{A/A}$ + 12 μA		
2.2 A to 11 A	360 $\mu\text{A/A}$ + 480 μA		
11 A to 20 A	0.1 % + 750 μA		

0 to 100 nA	30 $\mu\text{A}/\text{A} + 0.04$ nA	II	Measure using a digital multimeter. For the calibration of dc current generating devices. On-site calibration available.
100 nA to 1 μA	20 $\mu\text{A}/\text{A} + 0.04$ nA		
1 μA to 10 μA	20 $\mu\text{A}/\text{A} + 0.1$ nA		
10 μA to 100 μA	20 $\mu\text{A}/\text{A} + 0.8$ nA		
100 μA to 1 mA	20 $\mu\text{A}/\text{A} + 5$ nA		
1 mA to 10 mA	20 $\mu\text{A}/\text{A} + 50$ nA		
10 mA to 100 mA	35 $\mu\text{A}/\text{A} + 500$ nA		
100 mA to 1 A	110 $\mu\text{A}/\text{A} + 10$ μA		
10 A to 100 A	100 ppm		Measure using dc shunts and a digital multimeter. For the calibration of dc current generating devices.

Resistance

0 Ω to 10.9999 Ω	0.0040 % + 0.001 Ω	II	Generate using a multifunction calibrator. For the calibration of resistance measuring devices. On-site calibration available
11 Ω to 32.999 Ω	0.0030 % + 0.0015 Ω		
33 Ω to 109.9999 Ω	0.0028 % + 0.0014 Ω		
110 Ω to 1.099999 k Ω	0.0028 % + 0.002 Ω		
1.1 k Ω to 3.29999 k Ω	0.0028 % + 0.02 Ω		
3.3 k Ω to 10.99999 k Ω	0.0028 % + 0.02 Ω		
11 k Ω to 109.9999 k Ω	0.0028 % + 0.2 Ω		

110 k Ω to 1.099999 M Ω	0.0032 % + 2 Ω		
1.1 M Ω to 3.29999 M Ω	0.0060 % + 30 Ω		
3.3 M Ω to 10.99999 M Ω	0.0130 % + 50 Ω		
11 M Ω to 32.99999 M Ω	0.025 % + 2.5 k Ω		
33 M Ω to 109.9999 M Ω	0.05 % + 3 k Ω		
110 M Ω to 329.9999 M Ω	0.3 % + 100 k Ω		
330 M Ω to 1100 M Ω	1.5 % + 500 k Ω		
1 m Ω to 100 M Ω	10 ppm to 100 ppm	II	Source: For the calibration of resistance measuring devices. On-site calibration available.
1 M Ω to 100 G Ω	100 ppm to 1000 ppm	II	For the calibration of insulation resistance measurement instruments using fixed resistors.
1 m Ω to 10 Ω	0.0015 % + 50 $\mu\Omega$	II	Measure using a digital multimeter. For the calibration of resistors. On-site calibration available
10 Ω to 100 Ω	0.0012 % + 0.5 m Ω		
100 Ω to 1 k Ω	0.001 % + 0.5 m Ω		
1 k Ω to 10 k Ω	0.001 % + 5 m Ω		
10 k Ω to 100 k Ω	0.001 % + 50 m Ω		
100 k Ω to 1 M Ω	0.0015 % + 2 Ω		
1 M Ω to 10 M Ω	0.005 % + 100 Ω		
10 M Ω to 100 M Ω	0.05 % + 1 k Ω		

100 MΩ to 1 G Ω	0.5 % + 10 kΩ
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Measured Quantity & Range or Instrument	Frequency	Calibration Measurement Capability expressed as an Uncertainty (±) (See <u>supplementary notes</u>)	Type	Remarks
Voltage, AC				
220 μV to 1100 V	10 Hz to 1 MHz	49 ppm to 8 %	II	Generate using a multifunction calibrator. For the calibration of AC current measuring devices. See <u>Annex A</u> for detailed capabilities. On-site calibration available.
1 mV to 700 V	1 Hz to 8 MHz	0.007 % to 1.5 %		Measure. For the calibration of voltage sources using a digital multimeter. See <u>Annex C</u> for detailed capabilities. On-site calibration available.
1 kV to 60 kV	60 Hz	0.5 %		Measure using a high voltage divider and digital multimeter. For the calibration of ac voltage generating devices. On-site calibration available.
Current, AC				
29 μA to 2.2 A	10 Hz to 10 kHz	7 % to 136 ppm	II	Generate using a multifunction calibrator. For the calibration of sinewave current measurement devices. See <u>Annex B</u> for details. On-site calibration available.
3 A to 20 A	45 Hz to 5 kHz	0.08 % to 3 %		
10 μA to 1 A	10 Hz to 100 kHz	0.03 % to 1 %		Measure using a digital multimeter. For the calibration of sinewave current generating devices. See <u>Annex D</u> for details. On-site calibration available.

Oscilloscope

Measured Quantity & Range or Instrument	Frequency	Calibration Measurement Capability expressed as an Uncertainty (±) (See <u>supplementary notes</u>)	Type	Remarks
Amplitude DC				
1.0 mV to 130 V (1 MΩ)	DC	0.05 % of output + 40 μV	II	Source using a multifunction calibrator. For the calibration of oscilloscopes. On-site calibration available
1.0 mV to 6.6 V (50 Ω)	DC	0.25 % of output + 40 μV		
Square wave				
1.0 mV to 130 V p-p (1 MΩ)	10 Hz to 10 kHz	0.25 % of output + 40 μV	II	Source using a multifunction calibrator. For the calibration of oscilloscopes. On-site calibration available
1.0 mV to 6.6 p-p V (50 Ω)	10 Hz to 10 kHz	0.25 % of output + 40 μV		
Flatness. Levelled Sine Wave				
5 mV to 5.5 V relative to 50 kHz	50 kHz to 100 MHz	1.5 % + 100 μV	II	Source using a multifunction calibrator. For the calibration of oscilloscopes. On-site calibration available
	100 MHz to 300 MHz	2 % + 100 μV		
	300 MHz to 600 MHz	4 % + 100 μV		
	600 MHz to 1.1 GHz	5 % + 100 μV		
Time Marker				
1 ns to 20 ms 50 ms to 5 s		(25 + 1000T) ppm (Note: T in seconds)	II	Source using a multifunction calibrator. For the calibration of oscilloscopes. On-site calibration available
Rise Time	1 kHz to 2 MHz	300 ps		
	2 MHz to 10 MHz	350 ps		

Measured Quantity & Range or Instrument	Frequency	Calibration Measurement Capability expressed as an Uncertainty ($\pm$) (See <u>supplementary notes</u>)	Type	Remarks
Input Resistance				
40 Ω to 60 Ω		0.1 %	II	Source using a multifunction calibrator. For the calibration of oscilloscopes. On-site calibration available
500 K Ω to 1.5 M Ω		0.1 %		
Input Capacitance				
5 pF to 50 pF (1 M Ω)		5 % + 0.5 pF	II	Source using a multifunction calibrator. For the calibration of oscilloscopes. On-site calibration available

Measured Quantity & Range or Instrument	Frequency	Calibration Measurement Capability expressed as an Uncertainty ($\pm$) (See <u>supplementary notes</u>)	Type	Remarks
Capacitance				
0.19 nF to 1.1 nF	10 Hz to 10 kHz	0.5 % + 0.01 nF	II	Source synthesized capacitance using a multiproduct calibrator. For the calibration of capacitance measuring devices. On-site calibration available.
1.1 nF to 3.3 nF	10 Hz to 3 kHz	0.5 % + 0.01 nF		
3.3 nF to 11 nF	10 Hz to 1 kHz	0.25 % + 0.01 nF		
11 nF to 110 nF	10 Hz to 1 kHz	0.25 % + 0.1 nF		
110 nF to 330 nF	10 Hz to 1 kHz	0.25 % + 0.3 nF		
0.33 μ F to 1.1 μ F	10 Hz to 600 Hz	0.25 % + 1 nF		

Measured Quantity & Range or Instrument	Frequency	Calibration Measurement Capability expressed as an Uncertainty ($\pm$) (See <u>supplementary notes</u>)	Type	Remarks
1.1 μ F to 3.3 μ F	10 Hz to 300 Hz	0.25 % + 3 nF		
3.3 μ F to 11 μ F	10 Hz to 150 Hz	0.25 % + 10 nF		
11 μ F to 33 μ F	10 Hz to 120 Hz	0.40 % + 30 nF		
33 μ F to 110 μ F	10 Hz to 80 Hz	0.45 % + 100 nF		
110 μ F to 330 μ F	DC to 50 Hz	0.45 % + 300 nF		
0.33 mF to 1.1 mF	DC to 20 Hz	0.45 % + 1 μ F		
1.1 mF to 3.3 mF	DC to 6 Hz	0.45 % + 3 μ F		
3.3 mF to 11 mF	DC to 2 Hz	0.45 % + 10 μ F		
11 mF to 33 mF	DC to 0.6 Hz	0.75 % + 30 μ F		
33 mF to 110 mF	DC to 0.2 Hz	1.1 % + 100 μ F		

Current clamp calibration

Measured Quantity & Range or Instrument	Frequency	Calibration Measurement Capability expressed as an Uncertainty ($\pm$) (See <u>supplementary notes</u>)	Type	Remarks
Effective DC current output				

Measured Quantity & Range or Instrument	Frequency	Calibration Measurement Capability expressed as an Uncertainty (±) (See <u>supplementary notes</u>)	Type	Remarks
10 to 16.5 A Turns		0.5 % + 20 mA	II	Source using a multifunction calibrator and a 50 turn coil. For the calibration of clamp meters.
16.5 to 150 A Turns		0.5 % + 140 mA		
150 to 1025 A Turns		0.5 % + 500 mA		
Effective AC current output				
20 to 150 A Turns	65 to 440 Hz	0.8 %	II	Source using a multifunction calibrator and a 50 turn coil. For the calibration of clamp meters.
150 to 1000 A Turns	65 to 440 Hz	0.8 %		

Power

Measured Quantity & Range or Instrument	Frequency	Calibration Measurement Capability expressed as an Uncertainty ($\pm$) (See <u>supplementary notes</u>)	Remarks
Power, DC			
0.33 mA to 330 mA			
11 μ W to 1.1 mW	DC	0.024 %	Fluke 5520A or equivalent standard. Source. For the calibration of measurement devices using multifunction calibrators. On-site calibration available.
1.1 mW to 110 mW	DC	0.027 %	
0.11 W to 110 W	DC	0.024 %	
110 W to 330 W	DC	0.018 %	
0.33 A to 3 A			
11 W to 110 mW	DC	0.044 %	Fluke 5520A or equivalent standard. Source. For the calibration of measurement devices using multifunction

Measured Quantity & Range or Instrument	Frequency	Calibration Measurement Capability expressed as an Uncertainty (±) (See <u>supplementary notes</u>)	Remarks
0.11 W to 990 W	DC	0.053 %	calibrators. On-site calibration available.
1 W to 3 kW	DC	0.0096 %	
3 A to 20.5 A			
0.099 W to 0.99 W	DC	0.088 %	Fluke 5520A or equivalent standard. Source. For the calibration of measurement devices using multifunction calibrators. On-site calibration available.
0.99 W to 6.8 kW	DC	0.07 %	
6.8 kW to 20.5 kW	DC	0.04 %	
Power, AC			
3.3 mA to 9 mA			
0.11 mW to 3 mW	10 Hz to 65 Hz	0.13 %	Fluke 5520A or equivalent standard. Source. For the calibration of measurement devices using multifunction calibrators. (PF = 1). See Note 1. On-site calibration available.
3 mW to 9 W	10 Hz to 65 Hz	0.077 %	
9 mA to 33 mA			
0.3 mW to 10 mW	10 Hz to 65 Hz	0.089 %	Fluke 5520A or equivalent standard. Source. For the calibration of measurement devices using multifunction calibrators. (PF = 1). See Note 1. On-site calibration available.
10 mW to 33 W	10 Hz to 65 Hz	0.077 %	
33 mA to 90 mA			
1 mW to 30 mW	10 Hz to 65 Hz	0.071 %	Fluke 5520A or equivalent standard. Source. For the calibration of measurement devices using multifunction calibrators. (PF = 1). See Note 1. On-site calibration available.
30 mW to 90 W	10 Hz to 65 Hz	0.057 %	
90 mA to 330 mA			
3.0 mW to 100 mW	10 Hz to 65 Hz	0.089 %	Fluke 5520A or equivalent standard. Source. For the calibration of measurement devices using multifunction

Measured Quantity & Range or Instrument	Frequency	Calibration Measurement Capability expressed as an Uncertainty (±) (See <u>supplementary notes</u>)	Remarks
100 mW to 300 W	10 Hz to 65 Hz	0.078 %	calibrators. (PF = 1). See Note 1. On-site calibration available.
0.33 A to 0.9 A			
11 mW to 300 mW	10 Hz to 65 Hz	0.071 %	Fluke 5520A or equivalent standard. Source. For the calibration of measurement devices using multifunction calibrators. (PF = 1). See Note 1. On-site calibration available.
300 mW to 900 W	10 Hz to 65 Hz	0.081 %	
0.9 A to 2.2 A			
30 mW to 720 mW	10 Hz to 65 Hz	0.089 %	Fluke 5520A or equivalent standard. Source. For the calibration of measurement devices using multifunction calibrators. (PF = 1). See Note 1. On-site calibration available.
720 mW to 2 kW	10 Hz to 65 Hz	0.079 %	
2.2 A to 4.5 A			
80 mW to 1.4 W	10 Hz to 65 Hz	0.088 %	Fluke 5520A or equivalent standard. Source. For the calibration of measurement devices using multifunction calibrators. (PF = 1). See Note 1. On-site calibration available.
1.4 W to 4.5 kW	10 Hz to 65 Hz	0.18 %	
4.5 A to 20.5 A			
150 mW to 6.7 W	10 Hz to 65 Hz	0.17 %	Fluke 5520A or equivalent standard. Source. For the calibration of measurement devices using multifunction calibrators. (PF = 1). See Note 1. On-site calibration available.
6.7 W to 20 kW	10 Hz to 65 Hz	0.17 %	
Phase			
0 ° to 179.99 °	10 Hz to 65 Hz	0.11 °	Fluke 5520A or equivalent standard. Source. For the calibration of measurement devices using multifunction calibrators. On-site calibration available.
	65 Hz to 500 Hz	0.20 °	

Measured Quantity & Range or Instrument	Frequency	Calibration Measurement Capability expressed as an Uncertainty ($\pm$) (See <u>supplementary notes</u>)	Remarks
	500 Hz to 1 kHz	0.39 °	
	1 kHz to 5 kHz	1.9 °	
	5 kHz to 10 kHz	3.9 °	
	10 kHz to 30 kHz	7.8 °	

Electrical Calibration of Temperature Indicators and Simulators

Measured Quantity & Range or Instrument	Calibration and Measurement Capability expressed as an Uncertainty ($\pm$) (See <u>supplementary notes</u>)	Type of Service	Remarks
Electrical calibration of temperature indicators and simulators			
Thermocouple simulation			
Type B			
600 to 800°C	0.44°C	II	Source. For the calibration of temperature indicators and process calibrators by electrical simulation of temperature. On-site calibration available.
800 to 1000°C	0.34°C		
1000 to 1550°C	0.30°C		
1550 to 1820°C	0.33°C		
Type E			
-250 to -100°C	0.50°C	II	Source. For the calibration of temperature indicators and process calibrators by electrical simulation of

Measured Quantity & Range or Instrument	Calibration and Measurement Capability expressed as an Uncertainty (±) (See <u>supplementary notes</u>)	Type of Service	Remarks
-100 to -25°C	0.16°C		temperature. On-site calibration available.
-25 to 350°C	0.14°C		
350 to 650°C	0.16°C		
650 to 1000°C	0.21°C		
Type J			
-210 to -100°C	0.27°C	II	Source. For the calibration of temperature indicators and process calibrators by electrical simulation of temperature. On-site calibration available.
-100 to -30°C	0.16°C		
-30 to 150°C	0.14°C		
150 to 760°C	0.17°C		
760 to 1200°C	0.23°C		
Type K			
-200 to -100°C	0.33°C	II	Source. For the calibration of temperature indicators and process calibrators by electrical simulation of temperature. On-site calibration available.
-100 to -25°C	0.18°C		
-25 to 120°C	0.16°C		
120 to 1000°C	0.26°C		
1000 to 1372°C	0.40°C		
Type N			
-200 to -100°C	0.40°C	II	Source. For the calibration of temperature indicators and process calibrators by electrical simulation of temperature. On-site calibration available.
-100 to -25°C	0.22°C		
-25 to 120°C	0.19°C		
120 to 410°C	0.18°C		
410 to 1300°C	0.27°C		
Type R			
0 to 250°C	0.57°C	II	Source. For the calibration of temperature indicators and process calibrators by electrical simulation of

Measured Quantity & Range or Instrument	Calibration and Measurement Capability expressed as an Uncertainty ($\pm$) (See <u>supplementary notes</u>)	Type of Service	Remarks
250 to 400°C	0.35°C		temperature. On-site calibration available.
400 to 1000°C	0.33°C		
1000 to 1767°C	0.40°C		
Type S			
0 to 250°C	0.47°C	II	Source. For the calibration of temperature indicators and process calibrators by electrical simulation of temperature. On-site calibration available.
250 to 1000°C	0.36°C		
1000 to 1400°C	0.37°C		
1400 to 1767°C	0.46°C		
Type T			
-250 to -150°C	0.63°C	II	Source. For the calibration of temperature indicators and process calibrators by electrical simulation of temperature. On-site calibration available.
-150 to 0°C	0.24°C		
0 to 120°C	0.16°C		
120 to 400°C	0.14°C		
RTD simulation			
-200°C to 630°C	0.04°C to 0.23°C	II	Source. For the calibration of temperature indicators and process calibrators by electrical simulation of temperature. On-site calibration available.

Note 1: The uncertainties shown are for the most favorable conditions. There is an increase in uncertainty that corresponds to the laboratory's AC voltage and current uncertainties at different frequencies other than the ones shown. Power factors (PF) other than the one shown contribute to the power uncertainty. PF is related to the cosine of phase. Therefore, uncertainties track the laboratory's phase uncertainty closely at PF near one but are magnified heavily as PF approaches zero. The lab may also report reactive power, apparent power, and power factor under this accreditation. If needed, contact laboratory for more information regarding uncertainties at frequency and power factor combinations other than the ones shown.

Annex A

Uncertainty, $\pm \{ (\% \text{ of reading}) + \text{residual} \}$, of AC voltage measurement for the calibration of digital multimeters and voltage measuring devices

Voltage, AC	Frequency							
	10 Hz to 20 Hz	20 Hz to 40 Hz	40 Hz to 20 kHz	20 kHz to 50 kHz	50 kHz to 100 kHz	100 kHz to 300 kHz	300 kHz to 500 kHz	500 kHz to 1 MHz
220 μ V to 2.2 mV	0.0240 % + 4 μ V	0.009 % + 4 μ V	0.008 % + 4 μ V	0.020 % + 5 μ V	0.050 % + 5 μ V	0.11 % + 10 μ V	0.14 % + 20 μ V	0.27 % + 20 μ V
2.2 mV to 22 mV	0.024 % + 4 μ V	0.009 % + 4 μ V	0.008 % + 4 μ V	0.020 % + 4 μ V	0.05 % + 5 μ V	0.11 % + 10 μ V	0.14 % + 20 μ V	0.27 % + 20 μ V
22 mV to 220 mV	0.024 % + 12 μ V	0.009 % + 7 μ V	0.008 % + 7 μ V	0.02 % + 7 μ V	0.046 % + 17 μ V	0.09 % + 20 μ V	0.14 % + 25 μ V	0.27 % + 45 μ V
220 mV to 2.2 V	0.024 % + 40 μ V	0.009 % + 15 μ V	0.0045 % + 8 μ V	0.0075 % + 10 μ V	0.011 % + 30 μ V	0.042 % + 80 μ V	0.10 % + 200 μ V	0.17 % + 300 μ V
2.2 V to 22 V	0.024 % + 400 μ V	0.009 % + 150 μ V	0.0045 % + 50 μ V	0.0075 % + 100 μ V	0.010 % + 200 μ V	0.0275 % + 600 μ V	0.10 % + 2000 μ V	0.15 % + 3200 μ V
22 V to 220 V	0.024 % + 4 mV	0.009 % + 1.5 mV	0.0052 % + 0.6 mV	0.008 % + 1 mV	0.015 % + 2.5 mV	0.09 % + 16 mV	0.44 % + 40 mV	0.8 % + 80 mV

Voltage, AC	Frequency	
	15 Hz to 50 Hz	50 Hz to 1 kHz
220 V to 1100 V	0.03 % + 16 mV	0.007 % + 3.5 mV

Annex B

Best Uncertainty, $\pm \{ (\% \text{ of measured AC current}) + \text{residual} \}$, of AC current measurement for the calibration of current generating devices

Current, AC	Frequency				
	10 Hz to 20 Hz	20 Hz to 40 Hz	40 Hz to 1 kHz	1 kHz to 5 kHz	5 kHz to 10 kHz
1 nA to 220 μ A	0.025 % + 16 nA	0.016 % + 10 nA	0.012 % + 8 nA	0.028 % + 12 nA	1.1 % + 65 nA
220 μ A to 2.2 mA	0.025 % + 40 nA	0.016 % + 35 nA	0.012 % + 35 nA	0.02 % + 110 nA	1.1 % + 650 nA
2.2 mA to 22 mA	0.025 % + 400 nA	0.016 % + 350 nA	0.012 % + 350 nA	0.02 % + 550 nA	1.1 % + 5000 nA
22 mA to 220 mA	0.025 + 4 μ A	0.016 % + 3.5 μ A	0.012 % + 2.5 μ A	0.02 % + 3.5 μ A	1.1 % + 10 μ A
220 mA to 2.2 A	N/A	N/A	0.065 % + 35 μ A	0.075 % + 80 μ A	8.5 % + 160 μ A

Annex C

Calibration Measurement Capability for the Calibration of Sinewave Voltage Generating Devices, expressed as $\pm \{ (\% \text{ of reading}) + \text{residual in } \mu\text{V} \}$

Voltage, ac	Frequency					
	1 Hz to 40 Hz	40 Hz to 1 kHz	1 kHz to 20 kHz	20 kHz to 50 kHz	50 kHz to 100 kHz	100 kHz to 300 kHz
1 mV to 10 mV	0.03 + 3	0.02 + 1.1	0.03 + 1.1	0.1 + 1.1	0.5 + 1.1	4 + 2
10 mV to 100 mV	0.007 + 4	0.007 + 2	0.014 + 2	0.03 + 2	0.08 + 2	0.3 + 10
100 mV to 1 V	0.007 + 40	0.007 + 20	0.014 + 20	0.03 + 20	0.08 + 20	0.3 + 100
1 V to 10 V	0.007 + 400	0.007 + 200	0.014 + 200	0.03 + 200	0.08 + 200	0.3 + 1000
10 V to 100 V	0.02 + 4000	0.02 + 2000	0.02 + 2000	0.035 + 2000	0.12 + 2000	0.4 + 10000
100 V to 700 V	0.04 + 40000	0.04 + 20000	0.06 + 20000	0.12 + 20000	0.3 + 20000	

Voltage, ac	Frequency				
	300 kHz to 1 MHz	1 MHz to 2 MHz	2 MHz to 4 MHz	4 MHz to 8 MHz	8 MHz to 10 MHz
1 mV to 10 mV	1.2 + 5	7 + 7	7 + 7	20 + 8	
10 mV to 100 mV	1 + 10	1.5 + 10	4 + 70	4 + 80	15 + 100
100 mV to 1 V	1 + 100	1.5 + 100	4 + 700	4 + 800	15 + 1000
1 V to 10 V	1 + 1000	1.5 + 1000	4 + 7000	4 + 8000	15 + 10000
10 V to 100 V	1.5 + 10000				

Annex D

Calibration Measurement Capability for the Calibration of Sinewave Current Generating Devices, expressed as $\pm \{ (\% \text{ of reading}) + \text{residual in } \mu\text{A} \}$

Voltage, ac	Frequency						
	10 Hz to 20 Hz	20 Hz to 45 Hz	45 Hz to 100 Hz	100 Hz to 5 kHz	5 kHz to 20 kHz	20 kHz to 50 kHz	50 kHz to 100 kHz
10 μA to 100 μA	0.4 + 0.03	0.15 + 0.03	0.06 + 0.03	0.06 + 0.03			
100 μA to 1 mA	0.4 + 0.2	0.15 + 0.2	0.06 + 0.2	0.03 + 0.2	0.06 + 0.2	0.4 + 0.4	0.55 + 1.5

Voltage, ac	Frequency						
	10 Hz to 20 Hz	20 Hz to 45 Hz	45 Hz to 100 Hz	100 Hz to 5 kHz	5 kHz to 20 kHz	20 kHz to 50 kHz	50 kHz to 100 kHz
1 mA to 10 mA	0.4 + 2	0.15 + 2	0.06 + 2	0.03 + 2	0.06 + 2	0.4 + 4	0.55 + 15
10 mA to 100 mA	0.4 + 20	0.15 + 20	0.06 + 20	0.03 + 20	0.06 + 20	0.4 + 40	0.55 + 150
100 mA to 1 A	0.4 + 200	0.16 + 200	0.08 + 200	0.1 + 200	0.3 + 200	1 + 400	

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