Schedule of Accreditation

issued by

United Kingdom Accreditation Service

2 Pine Trees, Chertsey Lane, Staines-upon-Thames, TW18 3HR, UK

0208
Accredited to
ISO/IEC 17025:2017

Scotia Instrumentation Ltd

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Calibration performed at the above address only

DETAIL OF ACCREDITATION

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks
PRESSURE			Methods consistent with EURAMET CG3 and CG17.
<u>Gas Pressure (Gauge)</u>			
Calibration of pressure indicating instruments and gauges	-100 kPa to +3.5 kPa 3.5 kPa to 10 kPa 10 kPa to 100 kPa 100 kPa to 700 kPa 700 kPa to 900 kPa 900 kPa to 12 MPa	0.012 % 0.008 0 % 0.006 5 % 0.007 0 % 0.009 5 % 0.008 0 %	The calibration of Instruments with an electrical output may be undertaken.
Pressure equivalent calibration of dead weight testers including ball/nozzle type instruments	3.5 kPa to 10 kPa 10 kPa to 100 kPa 100 kPa to 700 kPa 700 kPa to 900 kPa 900 kPa to 12 MPa	0.008 0 % 0.006 5 % 0.007 0 % 0.009 5 % 0.008 0 %	
<u>Gas Pressure (Absolute)</u>			
Calibration of pressure indicating instruments and gauges	10 kPa to 80 kPa 80 kPa to 115 kPa 115 kPa to 800 kPa 800 kPa to 1.1 MPa 1.1 MPa to 12.1 MPa	0.040 % + 10 Pa 0.020 % + 0.80 Pa 0.007 0 % + 30 Pa 0.009 5 % + 30 Pa 0.008 0 % + 30 Pa	
<u>Hydraulic Pressure (Gauge)</u>			
Calibration of pressure indicating instruments and gauges	600 kPa to 6 MPa 6 MPa to 120 MPa	0.008 6 % + 40 Pa 0.013% + 40 Pa	
Pressure equivalent calibration of Dead Weight Testers	600 kPa to 6 MPa 6 MPa to 120 MPa	0.009 0 % + 40 Pa 0.013% + 40 Pa	
<u>Gas Pressure (Differential)</u>			
Calibration of pressure indicating instruments and gauges	0.25 kPa to 420 kPa (line pressures 1.2 MPa to 2.1 MPa) 0.25 kPa to 420 kPa (line pressures 2.1 MPa to 20 MPa)	0.60 ppm of line pressure, + 0.007 5 % of differential pressure + 11 Pa 0.60 ppm of line pressure, + 0.006 0 % of differential pressure + 11 Pa	Differential pressure cells may be calibrated using the digital communication protocol.

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks
TEMPERATURE			Calibration performed within Liquid Baths
Liquid-in-glass thermometers	-30 °C to +250 °C	0.070 °C	Liquid-in-glass thermometers can be examined for compliance with the published specification marked on them if requested.
Resistance thermometers	-30 °C to +250 °C	0.045 °C	
Electronic thermometers with sensors	-30 °C to +250 °C	0.040 °C plus: Analogue- Half scale division Digital- One least significant digit	
Temperature indicators and recorders, with temperature sensor(s)	-10 °C to +40 °C -20 °C to +80 °C	1.1 °C 2.2 °C	Analogue type chart recorders
Block calibrators	-30 °C to +250 °C	0.75 °C	
ELECTRICAL MEASUREMENTS			
DC Resistance	10 Ω 100 Ω 1 kΩ 10 kΩ 100 kΩ 1 MΩ 10 MΩ 100 MΩ 1 GΩ	50 ppm 17 ppm 17 ppm 17 ppm 17 ppm 50 ppm 85 ppm 200 ppm 630 kΩ	These are source values available for the calibration of measuring equipment.
	0 Ω to 20 Ω 20 Ω to 200 Ω 200 Ω to 2 kΩ 2 kΩ to 20 kΩ 20 kΩ to 200 kΩ 200 kΩ to 2 MΩ 2 MΩ to 20 MΩ 20 MΩ to 200 MΩ 200 MΩ to 2 GΩ	50 ppm + 40 μΩ 17 ppm + 100 μΩ 17 ppm + 1.0 mΩ 17 ppm + 10 mΩ 17 ppm + 100 mΩ 50 ppm + 2.0 Ω 85 ppm + 100 Ω 200 ppm + 10 kΩ 370 ppm + 100 kΩ	Measurement of the output of sources using a digital multimeter and generation, for application to measuring devices, using a multi-function calibrator.
DC Voltage	0 mV to 200 mV 200 mV to 2 V 2 V to 20 V 20 V to 200 V 200 V to 1 kV	11 ppm + 1.0 μV 8.0 ppm + 1.5 μV 5.0 ppm + 3.5 μV 7.0 ppm + 50 μV 9.0 ppm + 500 μV	
DC Current	0 μA to 200 μA 200 μA to 2 mA 2 mA to 20 mA 20 mA to 200 mA 200 mA to 2 A 2 A to 10 A	150 ppm + 2.0 nA 60 ppm + 10 nA 60 ppm + 100 nA 60 ppm + 1.0 μA 150 ppm + 20 μA 350 ppm + 100 μA	

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks
DC Current (continued)			
Generation only	10 A to 1000 A	0.060 % + 100 mA	For the calibration of current clamps and similar devices, using multi-turn coil technique.
AC Voltage	2 mV to 20 mV		Measurement of the output of sources using a digital multimeter and generation, for application to measuring devices, using a multi-function calibrator.
	10 Hz to 30 Hz	350 ppm + 5.5 µV	
	30 Hz to 1 kHz	350 ppm + 5.5 µV	
	1 kHz to 10 kHz	350 ppm + 5.5 µV	
	10 kHz to 100 kHz	800 ppm + 5.5 µV	
	20 mV to 200 mV		
	30 Hz to 1 kHz	200 ppm + 5.5 µV	
	1 kHz to 10 kHz	200 ppm + 5.5 µV	
	10 kHz to 100 kHz	500 ppm + 5.5 µV	
	200 mV to 2 V		
	10 Hz to 300 Hz	120 ppm + 5.5 µV	
	300 Hz to 1 kHz	80 ppm + 5.5 µV	
	1 kHz to 10 kHz	50 ppm + 5.5 µV	
	10 kHz to 30 kHz	80 ppm + 5.5 µV	
	30 kHz to 100 kHz	220 ppm + 10 µV	
	2 V to 20 V		
	10 Hz to 300 Hz	120 ppm + 50 µV	
	300 Hz to 1 kHz	60 ppm + 50 µV	
	1 kHz to 10 kHz	75 ppm + 50 µV	
	10 kHz to 30 kHz	90 ppm + 50 µV	
	30 kHz to 100 kHz	500 ppm + 100 µV	
	20 V to 200 V		
	10 Hz to 300 Hz	120 ppm + 2.5 mV	
	300 Hz to 1 kHz	60 ppm + 1.0 mV	
	1 kHz to 10 kHz	75 ppm + 1.0 mV	
	10 kHz to 30 kHz	90 ppm + 2.0 mV	
	30 kHz to 100 kHz	500 ppm + 2.5 mV	
	200 V to 1 kV		
	40 Hz to 1 kHz	180 ppm + 20 mV	
	1 kHz to 10 kHz	180 ppm + 20 mV	
	10 kHz to 30 kHz	300 ppm + 25 mV	
AC Current	10 µA to 200 µA		
	10 Hz to 1 kHz	300 ppm + 15 nA	
	1 kHz to 5 kHz	0.16% + 20 nA	
	200 µA to 2 mA		
	10 Hz to 1 kHz	200 ppm + 0.15 µA	
	1 kHz to 5 kHz	350 ppm + 0.15 µA	
	2 mA to 20 mA		
	10 Hz to 1 kHz	200 ppm + 1.5 µA	
	1 kHz to 5 kHz	350 ppm + 1.5 µA	

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks
AC Current (continued)	20 mA to 200 mA *10 Hz to 1 kHz* *1 kHz to 5 kHz* 200 mA to 2 A *10 Hz to 1 kHz* *1 kHz to 5 kHz* 2 A to 10 A *40 Hz to 100 Hz* *100 Hz to 1 kHz* 10 A to 820 A *50 Hz*	 250 ppm + 15 μA 350 ppm + 15 μA 500 ppm + 110 μA 700 ppm + 150 μA 800 ppm 0.15 % 0.080 % + 100 mA	Measurement of the output of sources using a digital multimeter and generation, for application to measuring devices, using a multi-function calibrator. For the calibration of current clamps and similar devices, using multi-turn coil technique.
Frequency	1.0 Hz to 2.4 GHz	2.4 in 10^9	Using GPS receiver and frequency counter.
Optical Tachometry	60 rpm to 60,000 rpm	2.6 rpm	Optical simulation.
Oscilloscope Calibration			
Vertical deflection	1 mV to 320 mV 320 mV to 3.2 V 3.2 V to 32 V 32 V to 320 V 320 V to 1 kV	0.18 % + 4.2 μV 0.15 % + 42 μV 0.15 % + 420 μV 0.15 % + 4.5 mV 0.15 % + 20 mV	Using oscilloscope calibrator.
Horizontal deflection Time markers	10 ns to 100 μs 100 μs to 5 s	6.1 ns 10 ppm + 6.1 μs	Using oscilloscope calibrator.
Temperature indicators and simulators, calibration by electrical simulation			
Base and Noble metal thermocouples	-250 °C to -200 °C -200 °C to 0 °C 0 °C to 1372 °C -250 °C to -200 °C -200 °C to 0 °C 0 °C to 1372 °C	1.8 °C 0.64 °C 0.34 °C 1.8 °C 0.60 °C 0.27 °C	Including cold junction compensation Excluding cold junction compensation

END

Appendix - Calibration and Measurement Capabilities

Introduction

The definitive statement of the accreditation status of a calibration laboratory is the Accreditation Certificate and the associated Schedule of Accreditation. This Schedule of Accreditation is a critical document, as it defines the measurement capabilities, ranges and boundaries of the calibration activities for which the organisation holds accreditation.

Calibration and Measurement Capabilities (CMCs)

The capabilities provided by accredited calibration laboratories are described by the Calibration and Measurement Capability (CMC), which expresses the lowest uncertainty of measurement that can be achieved during a calibration. If a particular device under calibration itself contributes significantly to the uncertainty (for example, if it has limited resolution or exhibits significant non-repeatability) then the uncertainty quoted on a calibration certificate will be increased to account for such factors. The CIPM-ILAC definition of the CMC is as follows:

A CMC is a calibration and measurement capability available to customers under normal conditions:
(a) as published in the BIPM key comparison database (KCDB) of the CIPM MRA; or
(b) as described in the laboratory's scope of accreditation granted by a signatory to the ILAC Arrangement.

The CMC is normally used to describe the uncertainty that appears in an accredited calibration laboratory's schedule of accreditation and is the uncertainty for which the laboratory has been accredited using the procedure that was the subject of assessment. The CMC is calculated according to the procedures given in M3003 and is normally stated as an expanded uncertainty at a coverage probability of 95 %, which usually requires the use of a coverage factor of $k = 2$. An accredited laboratory is not permitted to quote an uncertainty that is smaller than the published CMC in certificates issued under its accreditation.

The CMC may be described using various methods in the Schedule of Accreditation:

As a single value that is valid throughout the range.
As an explicit function of the measurand or of a parameter (see below).
As a range of values. The range is stated such that the customer can make a reasonable estimate of the likely uncertainty at any point within the range.
As a matrix or table where the CMCs depend on the values of the measurand and a further quantity.
In graphical form, providing there is sufficient resolution on each axis to obtain at least two significant figures for the CMC.

Expression of CMCs - symbols and units

In general, only units of the SI and those units recognised for use with the SI are used to express the values of quantities and of the associated CMCs. Nevertheless, other commonly used units may be used where considered appropriate for the intended audience. For example, the term "ppm" (part per million) is frequently used by manufacturers of test and measurement equipment to specify the performance of their products. Terms like this may be used in Schedules of Accreditation where they are in common use and understood by the users of such equipment, providing their use does not introduce any ambiguity in the capability that is being described.

When the CMC is expressed as an explicit function of the measurand or of a parameter, this often comprises a relative term (e.g., percentage) and an absolute term, i.e. one expressed in the same units as those of the measurand. This form of expression is used to describe the capability that can be achieved over a range of values. Some examples are shown below. It should be noted that these expressions are *not* mathematical formulae but are instead written in a commonly used shorthand for expressing uncertainties - therefore, for purposes of clarity, an indication of how they are to be interpreted is also provided below.

DC voltage, 100 mV to 1 V: 0.0025 % + 5.0 µV

Over the range 100 mV to 1 V, the CMC is 0.0025 %·V + 5.0 µV, where V is the measured voltage.

Hydraulic pressure, 0.5 MPa to 140 MPa: 0.0036 % + 0.12 ppm/MPa + 4.0 Pa

Over the range 0.5 MPa to 140 MPa, the CMC is $0.0036\ \%\cdot p + (0.12\cdot 10^{-6}\cdot p\cdot 10^{-6}) + 4.0$ Pa, where p is the measured pressure in Pa.

It should be noted that the percentage symbol (%) simply represents the number 0.01. In cases where the CMC is stated only as a percentage, this is to be interpreted as meaning percentage of the measured value or indication.

Thus, for example, a CMC of 1.5 % means $1.5 \cdot 0.01 \cdot i$, where i is the instrument indication.