Schedule of Accreditation
issued by
United Kingdom Accreditation Service
2 Pine Trees, Chertsey Lane, Staines-upon-Thames, TW18 3HR, UK

0175 **Accredited to ISO/IEC 17025:2017**	**Isothermal Technology Ltd** **Issue No:** 057 **Issue date:** 01 July 2020	
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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
TEMPERATURE			Unless otherwise stated calibration by comparison with reference instruments
Platinum resistance thermometers			
Calibration by comparisons	- 80 °C to - 40 °C - 40 °C to + 50 °C 50 °C to 156 °C 156 °C to 300 °C 300 °C to 420 °C 420 °C to 660 °C	7.0 mK 4.0 mK 5.0 mK 6.5 mK 20 mK 35 mK	In a fluid bath or a fixed point cell bath
Calibration at fixed points			Uncertainty in the determination of W(t_{90}) used to calculate ITS-90 coefficients
See Note 1 BP Nitrogen (see note 4) BP Nitrogen (see note 5) TP Argon TP Mercury TP Water (See Note 3) MP Gallium FP Indium FP Tin FP Zinc FP Aluminium FP Silver	 - 195.798 °C - 195.798 °C - 189.3442 °C - 38.8344 °C 0.01 °C 29.7646 °C 156.5985 °C 231.928 °C 419.527 °C 660.323 °C 961.78 °C	 2.0 mK 0.60 mK 0.50 mK 0.24 mK 0.070 mK 0.15 mK 1.0 mK 1.0 mK 1.2 mK 2.0 mK 7.0 mK	Note: TP = Triple Point FP = Freezing Point MP = Melting Point BP = Boiling Point Note 1: Suitable only for HT/SPRTs with high stability. Includes extrapolation to zero power and immersion checks.
See Note 2 BP Nitrogen TP Argon TP Mercury TP Water (See Note 3) MP Gallium FP Indium FP Tin FP Zinc FP Aluminium FP Silver	 - 195.798 °C - 189.3442 °C - 38.8344 °C 0.01 °C 29.7646 °C 156.5985 °C 231.928 °C 419.527 °C 660.323 °C 961.78 °C	 5 mK 2.0 mK 2.0 mK 1.0 mK 1.0 mK 2.0 mK 3.0 mK 3.5 mK 6.0 mK 40 mK	Note 2: Suitable for most SPRTs using nominal current. Note 3: Determination of R(0.01°C) Note 4: measured in a comparator Note 5: measured at TP Argon and extrapolated according to Euromet Technical Guide 1

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks
TEMPERATURE (cont'd) Fixed point cells See Note 6			
TP Argon TP Mercury TP Water MP Gallium FP Indium FP Tin FP Zinc FP Aluminium FP Silver	- 189.3442 °C - 38.8344 °C 0.01 °C 29.7646 °C 156.5985 °C 231.928 °C 419.527 °C 660.323 °C 961.78 °C	0.80 mK 0.20 mK 0.070 mK 0.070 mK 0.65 mK 0.60 mK 0.90 mK 1.1 mK 2.0 mK	Note: TP = Triple Point FP = Freezing Point MP = Melting Point BP = Boiling Point Note 6: . Suitable for optimal realisations. Includes 3 melts, 3 freezes, 2 intercomparisons.
See Note 7 TP Mercury TP Water MP Gallium FP Indium FP Tin FP Zinc FP Aluminium FP Silver	 - 38.8344 °C 0.01 °C 29.7646 °C 156.5985 °C 231.928 °C 419.527 °C 660.323 °C 961.78 °C	 1.0 mK 0.50 mK 1.0 mK 2.0 mK 2.0 mK 2.0 mK 6.0 mK 15 mK	Note 7: Also appropriate for slim cells. Includes 1 melt, 1 freeze, 1 intercomparison sequence using a monitor SPRT.
Metal block calibrators and portable liquid baths	0 °C - 80 °C to 0 °C 0 °C to 156 °C 156 °C to 300 °C 300 °C to 420 °C 420 °C to 660 °C 660 °C to 1100 °C 1100 °C to 1300 °C	10 mK 25 mK 20 mK 35 mK 50 mK 65 mK 1.0 °C 3.0 °C	Suitable for zero reference baths
Thermocouples			Thermocouples without a cold junction will have increased uncertainty
Platinum thermocouples			
Calibration by comparisons	- 50 °C to 0 °C 0 °C to 50 °C 50 °C to 660 °C 660 °C to 1100 °C 1100 °C to 1300 °C	0.50 °C 0.45 °C 0.40 °C 0.70 °C 1.7 °C	In a fluid bath or a fixed point cell bath In a furnace
Other thermocouples	- 196 °C - 80 °C to 0 °C 0 °C to 50 °C 50 °C to 300 °C 300 °C to 420 °C 420 °C to 660 °C 660 °C to 1100 °C 1100 °C to 1300 °C	0.30 °C 0.25 °C 0.10 °C 0.25 °C 0.30 °C 0.40 °C 0.80 °C 2.2 °C	In liquid Nitrogen In a fluid bath or a fixed point cell bath In a furnace
Compensating and extension cables	- 25 °C to + 200 °C	1.0 °C	In a liquid bath

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (*k* = 2)	Remarks
ELECTRICAL			Unless otherwise stated calibration by comparison with reference instruments
DC VOLTAGE			
Specific Values	± 10 mV ± 20 mV ± 50 mV ± 100 mV ± 250 mV ± 500 mV ± 1 V ± 2 V	0.22 µV 0.25 µV 0.35 µV 0.50 µV 1.0 µV 1.4 µV 4.0 µV 5.5 µV	
Other values	0 mV to 140 mV 140 mV to 1.4 V	12 ppm + 0.60 µV 12 ppm + 1.3 µV	
DC RESISTANCE Measurement	0.1 Ω to 1 kΩ 1 kΩ to 100 kΩ	0.30 ppm 12 ppm	Resistors suitable for oil immersion can be measured over the range 20 °C to 23 °C
Specific Values	1 Ω 5 Ω 10 Ω 25 Ω 100 Ω 400 Ω	0.080 ppm 0.080 ppm 0.075 ppm 0.072 ppm 0.072 ppm 0.10 ppm	
AC RESISTANCE	*At 75 Hz:* 0.1 Ω to 400 Ω 400 Ω to 1 kΩ	2.0 ppm 2.2 ppm	The uncertainties can only be realised for resistors with suitable AC characteristics
DC RESISTANCE RATIO			
Resistance ratio	0.16 to 6.27	30 ppb	DC ratio bridge calibration using RBC 100A
TEMPERATURE SIMULATION			
Temperature indicators and simulators, calibration by electrical simulation, for the following sensor types:			
Base metal thermocouple	- 200 °C to + 1600 °C	0.31 °C	including cold junction compensation
Noble metal thermocouple	- 200 °C to + 1760 °C	0.40 °C	including cold junction compensation
Resistance sensors (Pt100)	- 200 °C to + 800 °C	0.002 °C	

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.

<u>DC voltage, 100 mV to 1 V</u>: 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.

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

Over the range 0.5 MPa to 140 MPa, the CMC is 0.0036 %·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 · 0.01 · i, where i is the instrument indication.